A Guide to the Research and Documentation of Historic Bridges in Texas

By Lila Knight, Knight & Associates
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By Lila Knight

Knight & Associates

PO Box 1990

Kyle, Texas 78640
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Historic Bridges are an important, but often over-looked, resource in the history of our communities. The Historical Studies Branch, Department of Environmental Affairs Division, of the Texas Department of Transportation undertook a survey of historic bridges throughout Texas completed in 1994. As a result of this inventory, many of the state’s most important bridges became listed in the National Register of Historic Places in 1996 for their state-wide importance. But many bridges could also qualify for the National Register of Historic Places at the local level of importance. The purpose of this guide is to provide information on the available research resources for the nomination by local groups or individuals of historic bridges to the National Register of Historic Places on a local level of significance.

The most common application of the National Register criteria to a locally important bridge will be under Criterion A in the area of “community planning and development” for their association with historical events that have contributed to the overall history of an area. Historic Bridges do not exist in isolation as they are integral and distinctive features of transportation corridors in both rural and urban landscapes. They are but one part of the built environment concerning transportation. But the role of bridges in the development of roadways and railways are only one obvious link with a larger historic context for a community. More importantly, this historic context can shed light on the overall development of a particular area or community with respect to its political, cultural, agricultural, economic, and physical development.

When conducting research on bridges, a number of issues should be addressed to provide the required documentation for historic designation on either the state level (Official State Historical Marker from the Texas Historical Commission) or at the federal level (the National Register of Historic Places, administered by the National Park Service through the Texas Historical Commission). This research guide provides a list of questions that should be investigated during the course of research on individual bridges. Other helpful information is included: a brief history of roads and bridges in Texas; illustrations to the most common bridge types; a guide to the most common research resources that should be consulted; a list of bridges in Texas listed in the National Register of Historic Places; and a glossary.
Brief History of Roads and Bridges in Texas
Brief History of Roads and Bridges in Texas

While the earliest roads, and bridges, served stagecoach and mail routes, they became increasingly important for the development of regional economies. The type of bridge built for a particular crossing depended on a myriad of factors, such as soil and topographical conditions; the length of the span; the availability of materials and the skills of local labor; the price and accessibility of pre-manufactured metal structural materials; and the political and economic forces of a region. Because of the variety of these factors, the history of bridges involves a great deal of overlapping of the types of bridges used at any point in time.

The dominance of railroads in the transportation of goods played a prominent role in the development of bridge technology as they required strong, durable structures that could withstand the weight of heavy rail cars. The development of the metal truss by the railroads revolutionized bridge building. Moreover, as a result of the primacy of railroads, roads served as crucial shipping avenues to railroad depots, as well as routes between farms or ranches and local agricultural markets. The bridging of streams and rivers became essential for the transportation of goods to markets. The 1876 Texas Constitution stipulated that counties would be responsible for all road and bridge improvements. But counties were often unable to afford the cost of building permanent, durable bridges until the Texas Legislature passed a number of bills in the 1870s that allowed counties to levy road taxes and issue limited bonds for the construction of roads and bridges. The construction of metal truss bridges, however, remained limited as the cost of shipping heavy metal components prohibited the use of iron and steel bridges by most Texas counties.

The last two decades of the 19th century finally witnessed the construction of permanent bridges. The rapid population growth in the state from 1880 to 1900 demanded the construction of additional roads and bridges. It was not until the late 1800s, however, when railroad lines finally provided linkages across most of the state, that counties began erecting bridges capable of sustaining adequate loads. The financing of these
bridges was finally adequately addressed during this period. In 1885, a constitutional amendment allowed counties to levy ad valorem property taxes to fund road and bridge projects. By 1887, the Texas Legislature permitted counties to issue bonds (for up to 20 years) specifically for the purpose of erecting bridges. In 1893, the bonding period was increased from 20 to 40 years, stimulating a building boom in bridge construction as it allowed counties to construct multiple bridges with the issuance of one bond. As a result, hundreds of metal truss bridges were erected across the state, particularly in rural areas.

Some of the earliest American bridges were small-scale stone arch bridges, covered bridges, and timber truss bridges. Few, if any, of these bridge types survive in Texas today. But the metal truss bridge developed from the timber truss bridge first used during the late 18th century. First utilized by the railroad companies, the metal truss bridge became popular even in more isolated parts of the country along rural roads. Providing a lightweight, durable, and easily erected bridge, these bridges could be broken down and moved to other locations allowing greater flexibility in their use. This bridge type was composed of two trusses, one on either side of the roadway, with both upper and lower chords providing tensile and compression support. Both diagonal and vertical members connected the two chords. Multiple segments, or panels, could be utilized to lengthen the truss, dependent upon the width of the river to be spanned. The structural arrangement of these components characterized the type of truss. By the late 19th century, the metal truss bridge was the most popular type used in Texas.

The name of each type of truss refers to its designer or engineer. The Howe truss, developed by William Howe, combines diagonal wooden compression members and vertical iron tension members. Commonly used by the railroads due to their inexpensive construction, they required a large amount of lumber and were not appropriate for large areas of the state.
Patented in 1844 by Thomas and Caleb Pratt, this type of metal truss bridge first became popular with the railroad companies. This bridge type consisted of parallel upper and lower chords joined by vertical and diagonal posts. Unlike the Howe Truss, the Pratt Truss used vertical members in compression and diagonal members in tensions. Among the variations of this type of truss are the Lenticular; the bowstring; the Parker; and the camelback. The Pratt truss became the most popular type of bridge system by the late 1880s. Available in a variety of shapes and sizes, it was easy to erect and provided for a strong, durable bridge. It was used primarily for short to intermediate span lengths (30 to 50 feet). The Pratt Truss bridge became the most popular type of bridge system in Texas between 1895 and 1910.

Squire Whipple patented the first "bowstring arch" truss in 1841. With a semicircular shape similar to a bow, it consisted of a curved top chord compression member held together by a bottom chord tension member. The vertical tension members hang from the top chord and support the floor beams. Although inexpensive and lightweight, the Whipple truss bridge could withstand a large load. Because of these characteristics, the Whipple truss became popular for rural highway crossings.
In 1847 Whipple patented a stronger version of the Pratt truss. This type of truss is also commonly known as a "double-intersection Pratt" because the diagonal tension members cross two panels rather than one. The Whipple truss became popular with the railroads as because of its strength and rigidity. This type of truss was less common than the Pratt truss for roads, but was utilized where the span was longer than what could be accommodated by the Pratt truss.

English engineer James C. Warren patented a bridge design in 1848. The Warren metal truss bridge resembles a "W" in shape and is characterized by rigid diagonals combining both tension and compression forces. The Warren truss did not become a popular type of span until field riveting became common in the late 19th century. Its simple configuration and lightweight members eventually led to its use superceding that of the Pratt Truss for short spans (30 to 90 feet). By adding polygonal top chords, the span could be increased to 125 feet or more.

Bridges were further categorized by the location of the roadway on the bridge. If the truss structure is below the road, it is known as a deck truss. A roadway located along the bottom chords of the bridge, which are connected with lateral bracing, is called a through truss. A pony truss is essentially a through truss with no overhead lateral bracing.

Wrought iron was first employed in bridge trusses in the 1840s, replacing the more brittle cast iron. Its use continued and became the most common material for bridges by 1870. With the increase in steel production after the Civil War, steel became available at a lower cost, becoming increasingly popular as steel mills began producing structural shapes in the strong, durable material. Both wrought iron and steel members were used in bridges during the last decade of the 19th century. By the beginning of the
20th century, however, steel replaced wrought iron as the preferred material for truss bridges. Pin connections were the primary method for connecting the structural components of bridges by the 1860s. This type of connection allowed trusses to be manufactured and shipped in small pieces. But it was also prone to wear and tear around the connections and produced considerable vibrations. Field riveting replaced pinning by 1920 after development of portable pneumatic riveting systems.

These early bridges were constructed without any standards or state regulations. Most counties did not hire engineers to assess a particular bridge site for soil conditions or load carrying capacity, and bid specifications often consisted of merely one sentence. Bridges were most commonly placed at right angles to the stream of rivers and creeks to minimize the possibility of damage from flooding. The preferred bridge site included high banks and a narrow streambed to minimize the length of bridge spans. It was not uncommon for floods to destroy the timber approaches to a bridge, often floods would knock the truss spans off the piers and into the streambed.

Most bridges were purchased from out-of-state companies who employed local agents to bid on bridge contracts with Texas counties. Most of the bridge fabrication shops were located in the Northeast and Midwest, and these bridge companies could provide the components of a bridge within a few weeks. The bridge components were shipped via the railroads and, in addition to the trusses, would include bridge members and connection pieces (pins, eyebars, and bolts). Texas bridge companies began to operate only after the 1900s. But rather than fabricating the components of bridges, the majority of these companies purchased steel trusses from out-of-state companies and merely sold them in Texas under their own name. Among the larger bridge companies were the American Bridge Company of New York, the Chicago Bridge and Iron Company, the George E. King Bridge Company of Des Moines, and the Kansas City Bridge and Iron Company.
The Alamo Construction Company is typical of this type of early Texas bridge company. Located in San Antonio, the firm was primarily a construction company, but served as agents for various out-of-state bridge companies. The Alamo Construction Company began providing metal truss bridges to Texas counties between 1914 and 1918. Among the engineers known to have been employed by the Alamo Construction Company are G. H. Bradford and H. L. Miles. C. G. Sheely served as president of the company until the late 1920s. Other major bridge companies in Texas included the Texas Bridge Company of Dallas, the El Paso Bridge Company, Alamo Iron Works of San Antonio, and the Mosher Steel and Machinery Company of Dallas.

Austin Brothers, Contractors, of Dallas was the only major bridge fabricator in Texas. George L. Austin and his brother, Frank, opened a fabrication plant for bridge components in 1910. Previously, George Austin served as an agent for the George E. King Bridge Company of Des Moines, Iowa. Austin used his contacts from serving as an agent to establish a thriving bridge business in the state. The Austin Brothers firm supplied Warren pony trusses as well as Pratt and Warren polygonal chord pony trusses. By developing a book of standard plans and stocking a large variety of steel products, the Austin Brothers company could provide bridges at a lower cost and in a more timely fashion. By World War I, the company had become the largest bridge builder in Texas. The firm was sold to Charles R. Moore, one of their agents, in 1918 who changed the name to the Austin Bridge Company. The company expanded its operations to oil pipelines, railroad bridges and other steel products after the Texas Highway Department began building concrete and steel bridges in the mid-1930s. More than 200 of the company's bridges are still in existence on Texas roads.

Even in the early years of the 20th century, most county roads were still comprised entirely of dirt roads that detoured around property lines and natural barriers, and did not commonly connect with the roads of adjacent counties. The efforts to improve roads at the turn-of-the-century sprang from a variety of factors, including the growing political influence of rural Americans in the establishments of the Grange; the need to bring produce in from farmlands to markets as quickly and cheaply as possible; the creation and expansion of rural mail service; and the influence of the Good Roads Movement. Local governments became compelled to improve and extend existing roads and highways.
The National Grange movement in 1913 promoted the improvement of local roads, emphasizing the importance to consumers as well as to producers of agriculture, to lessen the cost of transportation. Good roads also reportedly had a positive impact upon the land values of farms. The emphasis of the federal government on rural roads is reflected in the establishment of an Office of Public Roads within the Department of Agriculture, rather than the creation of a new agency. Closely connected with the growing political influence of farmers is the advent of Rural Free Delivery (RFD) which greatly increased the number of improved roads. Between 1897 and 1908 it is estimated that 100 streams and rivers were bridged in Texas to qualify for RFD services.

The Good Roads movement became a national phenomenon that grew out of the popularity of the bicycle which required smooth roads. The development of the automobile not only replaced the popularity of the bicycle, but it rapidly became an essential mode of transportation. Between 1900 and 1910 motor vehicle registrations in the United States grew a phenomenal 5,500%. By 1910, over 14,000 vehicles were registered in Texas, prompting the establishment of the Texas Good Roads Association in 1911 that lobbied for better roads and a statewide road system. During World War I, shipping by truck became common due to the need to use railroads for supplies and munitions which took precedence over consumer goods. Trucks loaded with goods, however, caused extensive damage to existing roads. As a result, the need for adequate roads and bridges became even more essential.

The Texas Legislature passed a number of acts during the first decade of the 20th century that broadened local funding options for road and bridge improvements. Several bills were introduced to create a centralized state highway agency, but most legislators opposed
Designation as a state highway did not immediately improve travel conditions as early efforts often faced funding shortfalls. A centralized road agency preferring local control. Numerous bills were also introduced at the federal level to fund road and bridge construction. But the federal funding of roads was stalled by the failure to resolve the problem of local versus federal responsibility. Passage of federal legislation to provide funding for the construction of roads and bridges was finally approved in 1916. Signed into law by President Woodrow Wilson, the Federal Aid Road Act (also known as the "Good Roads Bill") authorized $85 million over a five-year period. But the Federal Aid Road Act of 1916 required each state to establish an agency specifically for the distribution of federal funds for the construction of post roads. As a result, the Texas State Highway Department was formed in 1917. Texas received $291,000 in the first allocation. The new state agency distributed state and federal moneys to counties, established standards for the construction of highways and bridges, and designated a state highway system following existing county roads. Counties, however, maintained primary jurisdiction over roads, initiating applications for state and federal funds.

Although funding was still inadequate, the work of the State Highway Department continued to improve the quality of the construction of bridges during the 1920s. George Grover Wickline served as the first bridge engineer at the Texas State Highway Department from 1918 through 1943. During his tenure, the Texas State Highway Department developed standard designs and specifications for all types of bridges based on federal standards. Although local bridges were not required to use these designs, county engineers often utilized the standard plans in their design and layout of local bridges. By 1918, the state required all bridges receiving federal funds to be designed to carry a minimum of 15 tons, improving the capacity of many local bridges. As a result, the practice of hiring independent bridge companies who provided fabricated trusses gave way to the professional bridge engineer.
Concrete bridges became increasingly popular in the early decades of the 20th century due to their strength and economy. Constructed of reinforced concrete, this type of bridge eventually supplanted the metal truss bridge in popularity. Concrete is strong in compression and, when reinforced with steel bars, provides tensile strength as well. Early reinforced-concrete bridges were stone arch bridges, often referred to as closed spandrel bridges. These bridges often featured masonry piers and abutments.

Concrete bridges reduced maintenance costs and used locally available materials. In addition, these bridges could be built by unskilled laborers, thus reducing construction costs.

During the 1920s, the popularity of the automobile mushroomed as people began travelling for pleasure. But navigating the complicated system of roads was difficult at best. Trail Associations were founded to provide narrative directions, and later maps, to guide travelers. Many of the routes were given names, such as the Bankhead Highway and the Old Spanish Trail. Eventually, the American Association of State Highway Offices (AASHO) developed a system of numbering the major routes. North to south U.S. highways were assigned odd numbers, beginning on the east coast and proceeding west. East to west U.S. highways were assigned even numbers. The numbering of these roadways began at the northern border of the United States and increased along the southern boundary with Mexico. This first interstate system was adopted voluntarily by all the states in 1926.

The Depression halted most road-building and bridge construction by counties. The passage of the 1932 State Assumption Highway Bond Law abolished the requirements of a county to contribute financially to a state highway, except for the purchase of right-of-way. Federal relief legislation did provide states with some avenues for funding bridges and roads.

The National Industrial Recovery Act of 1933.
The Hayden-Cartwright Act of 1934 provided emergency funding for the repair or reconstruction of highways and bridges on the federal aid system which were damaged or destroyed by natural disasters. With the implementation of the Emergency Relief Appropriation Act of 1935, the federal government granted Texas nearly $12 million for road and bridge construction and an additional $11 million for railroad grade crossings. Provisions of this federal act required that at least 90% of the laborers be selected from public relief rolls and that hand labor methods be utilized as much as possible. The Public Works Administration also provided funding for the construction of roads and bridges.

Material shortages and war priorities delayed most highway and bridge construction during the World War II era. After World War II, metal trusses became obsolete except for very long spans, such as the Pecos River Bridge (1957) and the Corpus Christi High Bridge (1959). Continuous girder and I-beam bridges of concrete or steel became the most widely accepted bridge type after the Federal Aid Highway Act of 1944 set new standards for bridge construction.

With the election of President Eisenhower in 1953, the interstate system of highways became a priority. Impressed by the advantages of the Autobahn observed during World War II, Eisenhower made the establishment of a similar system a top priority in the United States. Originally conceived for national defense, this roadway also improved safety, developed
new construction techniques and standards for roads and bridges, increased speeds for travel, and developed standardized designs and signage. Begun in 1956, the Interstate System transformed the country and our expectations for roads.
Guide to Conducting Research on Texas Bridges
Step 1
Is the Bridge Listed in the
National Register of Historic Places?

The National Register of Historic Places is the nation's honor roll of historic properties. The requirements for listing in the National Register of Historic Places are:

1. A property must be 50 years of age or older.
2. It must have significance or importance.
3. It must retain a sufficient level of integrity, or historic materials, from its original appearance.

A bridge may be listed for its importance to the local history of an area. It need not be important on a state-wide or national basis.

Check to see if the bridge is already listed in the National Register of Historic Places. This information is available on-line in the "Texas Historic Sites Atlas" (www.atlas.thc.state.tx.us). A list of Texas bridges in the National Register of Historic Places may be found in the appendix of this publication. This list is current to 2001.

If you would like to pursue listing the bridge in the National Register of Historic Places, contact the Division of History, National Register (512) 463-6013, at the Texas Historical Commission for additional information and guidance. The required form for listing a property in the National Register of Historic Places is available from the Texas Historical Commission, History Program Division. It is also available on-line at ADD WEBSITE FOR NPS

The National Park Service publishes guides for listing a property in the National Register of Historic Places. You should obtain National Register Bulletin 16A, How to Complete the National Register Registration Form and National Register Bulletin 15, How to Apply the National Register Criteria for Evaluation. These are available free of charge from the Texas Historical Commission or you may obtain them online at ADD WEBSITE FOR NPS

It will be helpful to obtain copies of the National Register nominations for other bridges, particularly those that are a similar type to your bridge. National Register nominations for bridges are is available on-line in the "Texas Historic Sites Atlas" (www.atlas.thc.state.tx.us).
Contact the Historic Bridge Foundation in Austin, a non-profit organization devoted to the preservation of bridges. Contact Kitty Henderson, executive director, at (512) 407-8898. You may also wish to visit their web site at www.historicbridgefoundation.com.

It is also important to contact the TXDOT Area Engineer's Office in your region to obtain information from their files on your particular bridge.

As you conduct your research, keep in mind why the property is important to your community. This will help you in gathering the important information for documenting its importance. It will help in recognizing what type of information is needed to document its importance. The following discusses the National Register rules for listing a property. Additional information is provided in "Step Five: Why and How is this Bridge Important?"

There are four possible criteria for determining the significance of a property for listing in the National Register of Historic Places:

**Criterion A**
- Association with events that have made a significant contribution to the broad patterns of our history.

**Criterion B**
- Association with the lives of persons significant in our past.

**Criterion C**
- Embodiment of the distinctive characteristics of a type, period, or method of construction or that represents the work of a master.

**Criterion D**
- Its potential to yield information important in prehistory or history. This area is generally used for archeological sites.

Most bridges are important for their association with historical events that have contributed to the overall history of an area (Criterion A). Under certain conditions, however, a local bridge might also be eligible for consideration for its unique design and construction representing technological advances in bridge construction or design (Criterion C). It is difficult to document that a local bridge plays an important historical role in the overall history of the design and engineering of bridges. Typically a bridge was constructed by a large bridge company that erected bridges all over the state. Or it may have been part of a larger transportation system built by the Department of Transportation, the state agency responsible for bridge construction across the state. Historic documentation to support Criterion C requires a great deal of comparison with similar bridges in your area to prove its importance in the advancement of bridge design and construction.
In addition, you must determine the "area of significance" for a property. Most bridges will be significant in one or more of the following areas:

**Transportation**
The process and technology of conveying passengers or materials. This is the most commonly used area of significance for a bridge.

**Community planning and development**
The design or development of the physical structure of communities, such as a system of roads and bridges.

**Agriculture**
The process and technology of cultivating soil, producing crops, and raising livestock and plants. Many rural bridges are important for providing transportation of agricultural goods to market.

**Commerce**
The business of trading goods, services, and commodities. If a bridge is critical to the development of the commerce in an area, it could be important in this area.

**Politics/Government**
The enactment and administration of laws by which a political jurisdiction is governed and activities related to the political process. A bridge that is important in the construction and improvement of transportation for an area as deemed by a political process could qualify in this area.

**Research Resources**

- National Register Bulletin 16A, How to Complete the National Register Registration Form and National Register Bulletin 15, How to Apply the National Register Criteria for Evaluation.
- For information on bridges: www.historicbridgefoundation.com
- "Texas Historic Sites Atlas" (www.atlas.thc.state.tx.us) for a list of Texas bridges in the National Register of Historic and bridges with Official State Historical Markers, as well as the information submitted for the particular designation.
- The National Register Program in the History Program Division at the Texas Historical Commission. (512) 463-6013.
- Contact the TXDOT Area Engineer's Office in your region to obtain information on a particular bridge.
Step 2
What is the Date of Construction?

The date of construction for a bridge is essential to understand its initial placement within a wider historic context. It is the first clue to determining which steps to take next. If local sources do not reveal the date of a bridge, one should consult the Texas Department of Transportation's "Historic Bridge Inventory." While some bridges are only given approximate dates in this inventory, this is very useful in locating sources with more specific information. On many bridges a "bridge plate," or a plaque commemorating its construction, will be found on the bridge itself.

More specific dates often can be located within the minutes of the County Commissioners Court, located in the County Clerk's office. An index is provided for these records which will aid in searching for information on a specific bridge. The County Clerk's office will often contain older maps of the county. A series of dated maps will help you establish a general date for the construction of a bridge. Keep in mind that bridges are closely connected to the roadway system. If a map does not specifically indicate a bridge, any road that traverses a creek or river would require a bridge or a low water crossing.

Research Resources

• Look for a bridge plate which often contains this information.

• Contact the Texas Department of Transportation, Environmental Affairs Division, Historic Resources (512-416-2628).

• Consult the index to the minutes of the County Commissioners Court Minutes at the local county courthouse.

• Review old county and city maps for clues as to when a bridge is first in existence.
Step 3
What Type of Bridge Is It?
(Physical Description of the Bridge)

Many types of bridge construction are typical of a particular period. In addition to giving a narrative description of a bridge, this information is important in determining whether a bridge retains its historic integrity.

What river or stream does the bridge cross? What roadway is the bridge located on? What is the setting of the bridge?

What is the type of construction used? If it is a metal truss bridge, what kind of truss is used? Describe the details of the truss. Is it constructed of concrete? If so, what specific kind of concrete construction is utilized?

Was the bridge constructed from the "ground up" in its current location, or were stock building materials utilized that were shipped and assembled on site?

What is the length of the bridge? How many spans are contained within the bridge? If it is a truss bridge, how many panels are within each truss?

What is the substructure of the bridge? Is it supported by concrete or masonry piers?

Are there any important decorative features?

The Department of Transportation holds a great deal of technical information about bridges, including brief descriptive information for each bridge in the "Historic Bridge Inventory" and plans for bridges constructed after 1917 with state assistance. General information on identifying the types of bridges is also contained within this guide. In addition, a guide to identifying the different types of bridges is available on the web site of the Historic Bridge Foundation (www.historicbridgefoundation.com).

The description of the bridge is placed within Section 7 of the form used for listing a bridge in the National Register of Historic Places. An example of a summary of the "description" is given below. This summary paragraph should be followed by a more extensive description of the bridge. It should also contain any information about changes in the bridge. This section establishes that the bridge retains enough of its "historic integrity" to qualify for listing in the National Register of Historic Places. See additional information in "Step Six: Historic Integrity."
"The Mulberry Creek Bridge, located on the Old Praha Road, is a single span, bed­
stead, pin-connected Pratt truss bridge. Each truss consists of four panels for a total
length of 60 feet. The truss has vertical rather than inclined end posts, as is usually
employed in the Pratt truss. The end posts, as well as the upper chords, are made of
latticed 4" channels. The main trusses are spaced 12 feet apart and are pin connected.
The deck is made of wood, and guard rails consisting of angle iron flanges with lattice­
work webs run the entire length of each truss. The structure is supported on each end
by concrete piers."
(from the National Register of Historic Places nomination for the Mulberry Creek
Bridge in Fayette County; listed in 1975)

Research Resources

• Contact the Texas Department of Transportation, Environmental Affairs Division,
Historic Resources (512-416-2628)

• A number of secondary research resources exist for bridges (see attached glossary
and bibliography)

• The historic context for metal truss bridges (available from the Texas Historical
Commission or online at the agency's web site, www.atlas.thc.state.tx.us) may provide
valuable information on a particular type of bridge.

• A guide to identifying the different types of bridges is available on the web site of
the Historic Bridge Foundation (www.historicbridgefoundation.com).
Step 4

Why was the Bridge Constructed?
(Function of the Bridge)

The function of a bridge is essential to understanding the importance and original purpose of a bridge, or why it was built in the first place. This will provide you with some of the information you will need to describe why a bridge was important (Step 5). Among the questions that are important in considering why a bridge was built are:

- What specific roadway does the bridge serve?
- What river or creek does the bridge cross?
- Does it provide access to a particular community, a cemetery, a route for the movement of agricultural products, or a particular site (such as a school or cemetery)? Compare this information with similar bridges.
- What was the cost of the bridge?
- Who was the bridge engineer?
- What company constructed the bridge?
- What is the history of the particular bridge company?

Is the bridge company or contractor important in the history of bridge construction locally or on a state-wide level? Did they build any other bridges in the area? Was the bridge built by the Texas State Highway Department?

Research Resources

- Maps will indicate the specific roads and waterways connected with the bridge. You may want to consult older maps dating from the period of construction, as the names and numbers of roadways commonly change over time.

- Consult the County Commissioners Minutes for this particular bridge which may supply this information.

- Bridge dedications were sometimes covered in local newspapers. Consult these local resources from around the period of its construction. The Center for the Study of
American History at The University of Texas at Austin contains a great many Texas newspapers on microfilm.

- For comparative information on other bridges, consult the National Register of Historic Places files available at the Texas Historical Commission, (available from the Texas Historical Commission or their web site, www.atlas.thc.state.tx.us) or at the web site for the National Register of Historic Places

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Step 5
Why and How is this Bridge Important? (Historic Context)

It is important to discover how a particular bridge fits within the overall history of a place. Once you have determined why this road was built (step 4), it will give you clues as to why it was important at the particular time to construct this road or bridge. All bridges are associated with roads, but perhaps this particular road is important for a specific reason. It is also important to establish if there were any individuals associated with the construction of the bridge who are important to its history.

Was it part of a roadway system constructed with special funds, such as a depression era Work Progress Administration project or a bond issue within the county?

Was the bridge and road part of a boom development period in the county's or city's period?

If it is connected a particular community with other areas of the county, what was special or important about this community? Did the bridge significantly improve access and passage through a particular community? Did this allow the development of agriculture or settlement?

Is it associated with a larger event, such as the development of the Rural Free Delivery Program of the Post Office?

Were other bridges and roads being built at the same time? Did this bridge play a critical role in the development of a regional transportation network?

Was the bridge necessary for the establishment and development of the public school system (or even its later consolidation of numerous small schools)?

Was there a particular bridge construction company associated with the bridge?

Who were the county commissioners/city officials who were in office at the time of funding? Did any of them make other significant contributions to the history of the county/city?

Many bridges were constructed by a particular bridge company. Did they also build other bridges in the area? How does this bridge compare with their other designs for bridges?
Once you have studied the overall history of your community, analyze the research material you have compiled. Are there outstanding points of interest that you have collected such as: the first bridge of this type in the area; a key element in an overall transportation plan for the area; an important connection between two points in an area; an association with a person of outstanding importance; an association with an important community; or an association with an important event in the community?

This information is placed within Section 8 of the form for listing in the National Register of Historic Places. An example of a summary of the "statement of significance" is given below. The summary paragraph in a National Register nomination provides the essential documentation necessary to demonstrate this importance. It is the history of the bridge.

"Built in 1895 across the Paluxy River on the present US 377, the Bluff Dale Bridge provided a primary crossing for the people of Erath county en route to Fort Worth. Founded in the 1870s, Bluff Dale's population increased with the establishment of the Fort Worth and Rio Grande Railroad line in 1889. The growing community felt an acute need for an all-weather road crossing the Paluxy River in order to transport agricultural goods to market. The Bluff Dale bridge was the community's first permanent bridge. This bridge is significant under Criterion A for its association with the history of transportation in the area."

(from the National Register nomination for the Bluff Dale Suspension Bridge in Erath County; listed in 1977)

**Research Resources**

- Contact individuals in the area that may have knowledge of the history of the bridge. Perhaps county officials (do not forget retired officials) or older members of the community will remember the construction of a particular bridge in their area.
• Local histories of counties/cities for information on the history of roads and any individual's achievements. The catalog for the Center for the Study of American History at The University of Texas at Austin is available on-line at www.utcat.edu.

• Consult the index to the minutes of the County Commissioners Court Minutes at the local courthouse.

• The historic context for metal truss bridges (available from the Texas Historical Commission or their web site, www.thc.state.tx.us) may provide valuable information on this particular type of bridge.

• The Handbook of Texas contains histories of each of the counties and cities, as well as information on individual creeks and rivers.

• Name plates found on the bridge itself.

• Local histories of counties/cities for information on an individual's achievements. The catalog for the Center for the Study of American History at The University of Texas at Austin is available on-line at www.utcat.edu.

• For information on individual engineers, contact the Texas Department of Transportation or the files at the State Board of Registration for Professional Engineers.

• Histories of important bridge companies (see attached bibliography).
Step 6
Does the Bridge Retain Its Historic Integrity?

Historic integrity is the ability of a property to convey its significance. In addition to being important, a bridge must be able to demonstrate this significance in its current appearance. In order to determine if a bridge retains a sufficient level of integrity for listing in the National Register of Historic Places, it is important to understand a bridge's physical features (from its description stated in Section 7 of the National Register form) and how these features relate to its significance (from the history of the bridge given in Section 8 of the National Register form) A basic integrity test for a property is whether a historical contemporary would recognize a property as it exists today.

The National Register of Historic Places utilizes "seven aspects of integrity" to determine if a property retains a sufficient level of integrity for listing in the Register of Historic Places. A bridge must retain a majority of these aspects in order to qualify for listing.

Seven Aspects of Integrity

1. Location: Location is the place where the historic property was constructed. Location is important to understand why the bridge was erected. the actual location, combined with its setting, is important in giving a bridge its sense of place.

   Is the bridge in its original location, or has it been relocated?

2. Setting: Setting is the physical environment surrounding the bridge. Setting refers to the character of the place where the bridge is located. It involves how a property is situated in the landscape and its relationship to the surrounding features, such as roads, rivers and open space.

   Has the approach to the bridge been changed? Is the bridge still used to transport people or vehicles across a waterway?

   What has changed about the immediate surroundings or setting of the bridge? Are there now developments where once there was just a rural landscape? In an urban setting, how have the roadways and circulation patterns changed?
3. Design: Design refers to the combination of elements that create the form, plan, space, and structure of a property. With reference to a bridge, design applies to its particularly technology and function, including the arrangement of the components.

Does it still have the features and elements that are characteristic of this particular type of bridge?

Has the bridge retained its original design? Is the superstructure in its original condition, including its original connection system and configuration of members?

Have any important components or features been removed? Have any important supports or piers been replaced?

Does it still have the same type of structural system? Or has it been altered due to safety considerations? The structural system should continue to function. For example, a truss that no longer functions to support a bridge has lost its integrity of design. The replacement of the decking and guard rails for safety reasons, however, is very common. It is not essential in the overall design.

Is the approach to the bridge the same as in the past, or has it been widened?

Do you perceive any structural changes to the bridge such as new abutments, a new decking, or changes in the bridge railing?

4. Materials: Materials are the actual elements that were used in the construction of a bridge. The choice of materials reveals the availability of particular types of materials and their technologies.

Has the bridge retained its original materials? Are there any modern materials used to replace those made of wrought iron or steel? If it was constructed of concrete, to what extent has it been patched with new materials?

Have some materials been replaced during repair and maintenance? How extensive are these repairs? Are any new materials compatible with those used in the original erection?
5. Workmanship: Workmanship is the physical evidence of the craftsmanship of a particular period. It can apply to the property as a whole (the overall aesthetics of a bridge type) or to its individual components. It can reflect either common traditions and characteristics or innovative techniques.

What was the method of construction? Was it pin-connected or riveted-and-bolted?

Does the bridge have any ornamental detailing such as decorative railing, a name plate over the entrance, or decorative embellishment on any of the metalwork?

6. Feeling: This is a property's expression of the aesthetic or historic sense of a particular period of time. It is a very subjective judgement, but can be determined by analyzing the presence of physical features that, taken together, convey the bridge's historic character.

7. Association: This is the direct link between an important historic event and a historic bridge. A property retains association if it is the place where the event or activity occurred.

Is there still a roadway that crosses the bridge? Bridges with no roads leading to them will appear disconnected and out of place.

Has the river or stream been diverted or otherwise radically changed?

The following is an example of a description of historic integrity for a bridge. This information is included as part of Section 7 on the National Register form.

"Aside from the introduction of modern guardrailing, the Bunton Branch Bridge displays a high degree of integrity. There are no apparent alterations to its original design and, with the exception of small areas of concrete patching, the bridge has retained the majority of its 1915 materials. Changes to the roadway, in the form of application of asphalt over the original gravel surface, have somewhat modified the historic character of the road. This changes, as well as the presence of the IH-35 to the east, has also impacted the historic setting of the road corridor. Despite these changes, however, the
Bunton Branch Bridge retains its integrity of design, materials, workmanship, location, setting, feeling and association.
(from the National Register nomination for the Bunton Branch Bridge in Hays County; listed in 2001)

Research Resources:

- For historic photographs, ask various individuals in the county courthouse. Historic photographs are sometimes deposited with the county clerks office or may be included in county records or reports on area roads and bridges. You can often find them framed and hanging in various offices as well, where they may not be visible to the public. Compare the existing bridge with historic photographs of the bridge.

- Make on-site observations.

- As this assessment requires a great deal of technical information, contact the office of the area engineer of the Texas Department of Transportation. You may also want to contact the Bridge Division of the Texas Department of Transportation in Austin (512-416-2183)
Major Types of Metal Trusses
Metal Truss Bridge Type

The diagram illustrates the components of a metal truss bridge. Each part is labeled as follows:

- **Portal Strut**
- **Vertical**
- **Top Chord**
- **Top Lateral Bracing**
- **Rearway Deck**
- **Bearing Seat**
- **Floor Beam**
- **Lower Chord**
- **Stringer**
- **Diagonal**
- **Bottom Lateral Bracing**
- **Pier**
- **Abutment**
- **Portal Bracing**
- **Pin**
- **Inclined End Post**
- **Upper Chord**
- **Eye Bars**
- **Hip Vertical**
- **Lattice Bracing**

Two connection types are shown:

- **Pinned Connection**
- **Riveted Connection**
Construction Types:  
Relationship of Roadway to Truss

Through Truss  
Roadway is located along the bottom chords of the truss. Chords are connected with lateral bracing.

Pony Truss  Pratt Half-Hip  
Roadway is located along the bottom chords of the truss. Chords are connected with lateral bracing.
Construction Types:
Relationship of Roadway to Truss

Deck Truss
Truss is located below the roadway.

Highway 281 Bridge in Marble Falls, Burnet County, Texas. Built in 1937.

Elevation

Transverse Section
The Different Types of the Pratt Truss

**Pratt**
1844-20th Century.
Span of 25-150 feet.
Diagonals in tension, verticals in compression (except for hip verticals adjacent to inclined end posts).

Piano Bridge, spanning the East Navidad River near Schulenburg, Fayette County, Texas. Built in 1885.

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**Pratt Half-Hip**
Late 19th, early 20th century.
Span of 30-150 feet.
A Pratt with inclined end posts that do not horizontally extend the length of a full panel.

East Sweden Bridge near Brady, McCulloch County, Texas. Built circa 1900.
The Different Types of the Pratt Truss

**Parker**
Mid-late 19th-20th century.
Span of 40-200 feet.
A Pratt with a polygonal top chord.

Roy Inks Bridge spanning the Llano River, Llano, Llano County, Texas. Built circa 1935.

**Camelback**
Late 19th, early 20th century.
Span of 100-300 feet.
A Parker with a polygonal top chord of exactly five slopes.
*(a variation has subdivided panels)*

Bryant Station Camelback Bridge on County Road 275 at the Little River, in the vicinity of Bucholts, Milam County, Texas. Built in 1909.
The Different Types of the Pratt Truss

**Pennsylvania**
(Petit)
1875-early 20th century.
Span of 250-600 feet.
a. A Parker with sub-struts.
b. A Parker with sub-ties.

![San Marcos River Bridge on County Road 465 at the San Marcos River, near Gonzales, Gonzales County, Texas. Built in 1902.](image1)

**Lenticular**
(Parabolic)
1878-early 20th century.
Span of 150-400 feet.
A Pratt with both top and bottom chords parabolically curved over their entire length.

![Bryant Station Camelback Bridge on County Road 275 at the Little River, in the vicinity of Bucholts, Milam County, Texas. Built in 1909.](image2)
Bowstring Arch Truss

Bowstring Arch Truss
1840- late 19th century.
Span of 70-175 feet.
A tied arch with the diagonals serving as bracing and the verticals supporting the deck.

Bowstring Bridge on County Road 301 at the Leon River, near Hamilton, Hamilton County, Texas. Built in 1884, Moved.
The Different Types of the Warren Truss

Warren
1848-20th century.
Span of 50-400 feet. Triangular in outline, the diagonals carry both compressive and tensile forces. A “true” Warren truss has equilateral triangles.

Warren
(with verticals)
Mid 19th-20th century.
Span of 50-400 feet. Diagonals carry both compressive and tensile forces. Verticals serve as bracing for triangular web system.
Major Types of Concrete Bridges
Concrete Bridge Types

Open Spandrel Arch

Scott Avenue Bridge at the Wichita River, Wichita Falls, Wichita County, Texas. Built in 1927.

Closed Spandrel Arch

Roosevelt Bridge at Mission Parkway at the San Antonio River, San Antonio, Bexar County, Texas. Built in 1915.
Concrete Bridge Types

Concrete Girder
(T-Beam)

Oakes Street Bridge at the North Concho River, San Angelo, Tom Green County, Texas. Built in 1930.

Transverse Section

Elevation

Concrete Slab

Palo Pinto Snider Bridge, Palo Pinto County, Texas. Built in 1940.

Transverse Section

Elevation
General Works


Banks, Ralph K. *A History of the Bridge Division*. Austin: Texas Department of Transportation.


**Sources for Major Bridge Companies**


**Local Sources**

Index to County Commissioners Minutes (Office of the County Clerk)
County Commissioners Minutes (Office of the County Clerk)
Published sources on the history of your county or city
Contact your local County Historical Commission Chairman (contact your county judge's office as the commission is appointed by the County Commissioners Court)
Web Sites

Texas Historical Commission
512-463-6100
www.thc.state.tx.us (under "Atlas of Historic Places" from main menu)
The Texas Historical Commission is the "official" state agency for historic preservation. In addition to administering the county historical commissions program, they are the official repository for National Register nominations from Texas. Both the History Programs (512-463-5853) and the Division of Architecture (512-6094) may contain information on historic bridges. The library at the Texas Historical Commission contains copies of all National Register of Historic Places nominations, as well as the files for the State Marker Program.

Center for the Study of American History, The University of Texas at Austin
Architecture Library, The University of Texas at Austin
www.utcat.edu
The Center for the Study of American History (formerly the Barker Texas History Center) is an important resource for the history of our state. It is a repository for numerous books and various cities and counties, as well as historical photographs, maps, newspapers and magazines. It is an essential resource to contact for historic research. The Architecture Library and the Engineering Library contain general books on the design and construction of bridges. The catalog for the holdings of these two libraries is available on-line at the above web site.

Historic Bridge Foundation
(512-407-8898)
www.historicbridgefoundation.com
Established in Austin in 1998, this non-profit foundation provides educational programs and offers consultation with public officials on alternatives to demolition of historic bridges. They welcome inquiries on historic bridges and can provide information on potential sources of funding for the restoration of bridges.

Digital Bridges
www.bridges.lib.lehigh.edu
This web site provides information on books, technical information and bridge catalogs from the 19th century bridges. It also contains a good glossary, although it is very technical in nature.
Texas Escapes
www.texasescapes.com
This web site contains some information on 19th century bridges, many with illustrations. Although your specific bridge may not be listed here, it is useful for comparing it with other bridges from around the state. From the main menu, connect with "Texas Images - Bridges."

National Bridge Inventory
www.nationalbridgeinventory.com
This website contains statistics of bridges within each state on over 600,000 public roads in the United States. While it does not contain information on specific bridges at this time, it does provide statistical information for bridges within each state.
List of Bridges Currently Listed in the
National Register of Historic Places

Bastrop County
Colorado River Bridge at SR 150, Bastrop (1990)

Iron Bridge over Piney Creek, Bastrop (1978)

Bee
Medio Creek Bridge at CR 241, Normanna (1988)

Bell
Missouri, Kansas & Texas Railroad across the Leon River at Taylor's Valley Road, Belton (1990)

State Highway 53 over the Leon River at FM 817, Belton (1996)

Bexar
Espada Aqueduct, Espada road near US 281 South, San Antonio (NHL, 1966)

Collingsworth

Colorado
State Highway 3 Bridge at the Colorado River, US 90 near junction with Loop 329, Columbus (1996)

Dallas
Houston Street Viaduct, Houston Street between Arlington and Lancaster, Dallas (1984)

De Witt

Erath
Bluff Dale Suspension Bridge, Berry's Creek Road, Bluff Dale, (1977)

Fanin
State Highway 78 Bridge at the Red River, OK 78 at Texas State Line, near Ravenna (1996)
Fayette
State Highway 71 Bridge at the Colorado River, near junction with FM 609, La Grange (1996)

Galveston
Galveston Causeway, Galveston Bay from Virginia Point to Galveston, Galveston (1976)

Harris

Hays
Bunton Branch Bridge, CR 210 near intersection of Bunton Overpass and Interstate 35, Kyle (2001)

Jasper
US 190 Bridge at the Neches River, US 190 at the Jasper and Tyler county line, near Jasper (1996)

Kaufman
State Highway 34 Bridge at the Trinity River, Texas 34 at the Ellis and Kaufman County line, near Rosser (1996)

Kimble
State Highway 27 Bridge at Johnson Fork, Interstate 10 near the junction with FM 2169, near Junction (1996)

State Highway 27 Bridge at the South Llano River, Loop 481 near the junction with 6th Street, Junction (1996)

Knox
State Highway 16 Bridge at the Brazos River, Texas 6 near the junction with US 82, near Benjamin (1996)

Lamar
State Highway 5 Bridge at High Creek, FM 1509 near the junction with FM 38, near Brookston (1996)

State Highway Bridge 5 at Big Pine Creek, FM 1510 near the junction with FM 38, near Brookston (1996)

Lampasas
US 190 Bridge over the Colorado River, US 190 at the Lampasas and San Saba County
line, near Lometa (1996)

Liberty
State Highway 3 Bridge at the Trinity River, US 190 near the junction with FM 2684, Liberty (1996)

Mason
State Highway 9 Bridge at the Llano River, US 87 south of TX 29, near Mason (1996)

McLennan
Waco Suspension Bridge over the Brazos River, Bridge Street, Waco (1970)
Washington Avenue Bridge over the Brazos River, Washington Avenue, Waco (1998)

Mills
Regency Suspension Bridge, south of Regency at the Colorado River, near Regency (1976)

Newton
Burr's Ferry Bridge, TX 63 at the Louisiana State Line, near Burkeville (1998)

Palo Pinto

Parker
State Highway 89 Bridge at the Brazos River, Interstate 20 near the junction with FM 113, near Millsap (1996)

Shackelford
Hubbard Creek Bridge, FM 601 near the junction with TX 6, near Albany, (1996)
State Highway 23 Bridge at the Clear Fork of the Brazos River, US 283 near the Throckmorton County Line, near Albany (1996)

Starr
Roma-San Pedro International Bridge, near Hidalgo Street and Bravo Alley, Roma (1984)

Tom Green
Lone Wolf Crossing Bridge, Avenue K extension, San Angelo (1988)

Travis
Lamar Boulevard Bridge, Lamar Boulevard at the Colorado River, Austin (1994)
Montopolis Bridge, US 183 over the Colorado River, Austin (1996)

Uvalde
State Highway 3 Bridge, US 90 over the Nueces River (1996)

Walker
Riverside Swinging Bridge, near Riverside (1979)

Wharton
Texas and New Orleans Railroad Bridge, near Old US 59 over the Colorado River,
Wharton (1993)

Wichita
Beaver Creek Bridge, FM 2326, Electra (1996)
Glossary of Terms
Glossary of Terms

Terms for Describing the Features of a Bridge:

Abutment
The part of the substructure of a bridge that supports the ends of a single span, or the extreme ends of a multi-span structure. An abutment also supports the approach embankment and carries the load from the deck.

Beam
A linear structural member designed to span from one support to another. A rigid and horizontal structural element.

Bent
A substructure unit made up of two or more columns/column-like members connected at their top-most ends by a cap, strut, or other member holding them in place.

Bracing
A system of secondary members that maintain the geometric configuration of primary members.

Cast iron
Relatively pure iron, smelted from iron ore, containing 1.8% to 4.5% free carbon and cast to a particular shape. It is a brittle alloy that has been melted and can be made into any shape.

Chord
The upper or lower part of a truss, usually horizontal, that resists compression or tension.

Column
A vertical, structural element strong in compression.

Component
A general term reserved to describe a bridge deck, superstructure, or substructure. Subcomponents, such as floor beams, are called "elements."

Cross bracing
Transverse bracings between two main longitudinal members

Cross girders
Girders supported by bearings which supply transverse support for longitudinal beams or girders.

Deck
The roadway surface of a bridge.

Decking
A term specifically applied to bridges with wooden floors and it is used to designate the floor only. It does not include the members serving to support the flooring.

Design load
The force for which a structure is designed.

Diagonal
A structural member of a truss or bracing system that runs obliquely across a panel.

Diaphragm
A member placed within a member or superstructure system to distribute stresses and improve strength and rigidity.

End post
The end compression member of a truss, wither vertical or inclined in position and extending from top chord to bottom chord.

End span
A span adjacent to an abutment.

Girder
A large beam that acts as a primary support, receiving loads from floor beams and stringers. It usually receives loads from floor beams and stringers.

Lateral bracing
The bracing assemblage engaging a member perpendicular to the plane of the member. Its function is to resist lateral movement.

Longitudinal bracing
Bracing that runs lengthwise with a bridge and provides resistance against longitudinal movement and deformation of transverse members.

Lower chord
The bottom horizontal member of a truss.

Member
An individual angle, beam, or plate intended to become an integral part of an assem-
bled frame or structure.

Panel
That portion of a truss between adjacent posts or struts in Pratt truss bridges. It is also called a "bay."

Pier
A vertical supporting structure like a pillar. The part of a bridge substructure that supports the ends of the spans of a multi-span superstructure at intermediate locations between the abutments.

Rib
Curved structural member supporting a curved shape or panel.

Secondary member
A member that is carried by other members and does not resist traffic loads.

Slab
A flat beam, usually of reinforced concrete, which supports a load.

Span
The distance a bridge extends between two supports.

Structural member
An individual piece, like a beam or strut, which is an integral part of a structure.

Substructure
The abutments, piers, bents and footings that alone or in combination support the superstructure of the bridge.

Superstructure
The portion of a bridge that receives traffic loads, in turn transferring those loads and its own load to the substructure. The superstructure may consist of girders, slabs, or other types of construction.

Truss
A bridge support whose framework is composed of members forming a triangle or system of triangles that support both the weight of the bridge (dead load) and the traffic (live) loads. The tension and compression members are arranged to transmit loads from intermediate points to the ends.

Transverse bracing
The bracing assemblage engaging the columns of bents and towers in planes trans-
verse to the bridge alignment that resists the transverse forces tending to produce lateral movement and deformation of the columns.

Web members
The intermediate members of a truss, not including the end posts. They are usually vertical or inclined.

Common Engineering Terms:

Axle load
The load borne by one axle of a vehicle.

Compression
A type of stress involving pressing together. It tends to shorten a member. (the opposite of tension).

Compression members
Generally, stiff, heavy members that withstand pressures that tend to push them together. These members may be made of timber, iron, steel or concrete.

Cyclic stress
The variation in stress at a point from initial dead load value to the maximum additional live load value, and hence back to dead load value with the passage of a live load.

Dead load
A static load due to the weight of a structure alone.

Distributed load
A load uniformly applied along the length of an element or component of a bridge.

Live load
A dynamic load, such as vehicular traffic, that is applied to a structure suddenly. Vibration and movement affect its intensity.

Load
Weight distribution through a structure.

Moving load
A live load which is moving, such as vehicular traffic.
Tension
A type of stress tending to elongate a body. It tends to lengthen a member. (the opposite of compression).

Tension members
Members of a bridge that resist forces tending to pull them apart; usually made of iron or steel due to superior tensile strength.

Terms for Describing the Condition of a Bridge:

Appraisal rating
A judgement of the condition of a bridge component in comparison to current standards.

Bridge deficiency
A defect in the bridge component or member that makes the bridge less capable or less desirable for us.

Brittle
Characteristic of a material that fails without warning. Brittle materials do not stretch or shorten before failing.

Condition rating
A rating of a bridge component condition in comparison to its original, as-built condition.

Corrosion
The general disintegration of surface metal through oxidation.

Delamination
Subsurface separation of concrete into layers.

Efflorescence
A white deposit on concrete or brick caused by the crystallization of soluble salts brought to the surface by moisture in the masonry or concrete.

Fatigue
The tendency of a member to fail at a lower stress when subjected to cyclical loading than when subjected to static loading.
Fracture critical member
A member in tension or with a tension element whose failure would probably cause a portion of the entire bridge to collapse.

Hairline cracks
Very small cracks that form in the surface of concrete due to tension caused by loading.

NBIS
National Bridge Inspection Standards. First established in 1971 to set bridge inspection frequency, standards and procedures for inspection, and report formats.

Scaling
The gradual deterioration of a concrete surface due to the failure of the cement paste caused by chemical attack or freeze and thaw cycles.

Alignment
The relative horizontal and vertical positioning with the approaches or roadways.

Anchor bolt
A shaft-like piece of metal commonly threaded and fitted with a nut and washer at one end only. It is used to secure the components of a bridge to the substructure.

Approach slab
A reinforced concrete slab placed on the approach embankment adjacent to and usually resting upon the abutment back wall. The function is to carry the weight of a load directly to the abutment thus preventing any roadway misalignment due to embankment settlement.

Aqueduct
A bridge or channel for conveying water, usually over long distances.

Arch
A curved structure in compression.

Arch bridge
A curved structure that converts the downward force of its own weight, and the weight of the bridge, into an outward force along its sides and base.

Bank
Sloped sides of a waterway channel or approach roadway.

Bascule bridge
A bridge over a waterway with a section that rotates from a horizontal to a vertical position to allow passage of boats under the bridge.

Base plate
A rectangular slab of steel connected to a column, bearing or other member to transmit and distribute its load to the superstructure.

Battered pile
A pile driven in an inclined position to resist horizontal forces as well as vertical forces.

Beam bridge
A simple type of bridge composed of horizontal beams supported by vertical posts. A continuous span beam bridge is one in which beam bridges are linked to another. Some of the longest bridges in the world are this type of bridge.

Bowstring truss
A general term applied to a truss of any type having a polygonal arrangement of its top chord members conforming to the arrangement required for a parabolic truss.

Box beam
A hollow structural beam with a square, rectangular, or trapezoidal cross-section.

Box culvert
A culvert in a rectangular or square form.

Brush curb
A narrow curb, nine inches or less in width, which prevents a vehicle from brushing against the railing.

Caisson
A rectangular or cylindrical chamber for keeping water or soft ground from flowing into an excavation. Used during the construction of a bridge's piers or abutments.

Cantilever
A projecting structure supported only at one end, like a shelf bracket or a diving board.
Cast-in place
Constructing a concrete component by pouring the concrete within a formwork.

Closed spandrel arch
A stone or reinforced concrete arch span having spandrel walls to retain the spandrel fill or to support (entirely or partially) the floor system when the spandrel is not filled.

Continuous beam
A general term applied to a beam which spans uninterrupted over one or more intermediate supports.

Continuous truss
A truss having its chord and web members arranged to continue uninterrupted over one or more intermediate points of support.

Covered bridge
A term applied to a wooden bridge having its roadway protected by a roof and enclosed sides.

Culvert
A drainage structure beneath an embankment.

Deck bridge
A bridge in which all the supporting members are beneath the roadway.

Double intersection
The style of truss where the diagonals cross the posts at the middle of their length.

Embankment
A bank of earth constructed above the natural ground surface to carry a road or to prevent water from passing beyond desirable limits.

Fascia girder
An exposed outermost girder of a span sometimes decorated.

Field riveting
Reveting done in the field during construction. It is the poorest and most expensive kind of riveting.

Footing
The enlarged lower portion of a substructure which distributes the load either to the earth or to supporting piles. The most common form of footing is a concrete slab.
Girder bridge
A bridge type in which the deck is supported by longitudinal structural members, or girders. The superstructure consists of two or more girders supporting a separate floor system.

Girder span
A span in which the major longitudinal supporting members are girders.

Hanger
A tension members serving to suspend an attached member.

Hip joint
The juncture of the inclined end post with the end top chord member of a truss. Also known as the hip truss.

Howe truss
A truss of the parallel chord type with a web system composed of verticals (tension) rods at the panel points with an X-pattern of diagonals.

Iron
One of the cheapest and most commonly used metals.

King post truss
Two triangular panels with a common center vertical. It is the simplest of the triangular system trusses.

K-truss
A truss having a web system wherein the diagonal members intersect the vertical members at or near the mid-height. The assembly in each panel for the letter "K."

Lattice truss
A truss having its web members included. Also refers to a truss having two or more web systems composed entirely of diagonal members at any interval and crossing each other with reference to vertical members.

Lenticular truss
A truss having parabolic top and bottom chords curved in opposite directions with their ends meeting at a common joint. Also referred to as a fish belly truss.

Masonry
A building material including stone, clay brick or concrete.

Masonry plate
A steel plate attached to the substructure to support a superstructure bearing and to distribute the load to the masonry beam.

**Name plate**
A plate of iron placed in a conspicuous position on a bridge, containing such information as the maker of the bridge and its date of construction.

**Open spandrel arch**
A bridge which has open spaces between the deck and the arch, allowing one to look through the bridge.

**Paddleboard**
Striped, paddle-shaped signs or boards, placed on the roadside in front of a narrow bridge to warn of narrow roadway width.

**Parabolic truss**
A polygonal truss having its top chord and end post vertices coincident with the arc of a parabola. Its bottom chord is straight and its web system is either triangular or quadrangular. Also known as a parabolic arched truss.

**Pin**
A cylindrical bar used to connect components.

**Pin-connected truss**
A type of early truss construction in which the truss members were connected by iron or steel pins, or bolts.

**Pin joint**
A joint in a truss where the members are assembled upon a cylindrical pin.

**Pony truss**
A low through truss that has no enclosing overhead members or lateral bracing joining the top chords of the individual trusses.

**Portal**
The entrance to a bridge, especially through a truss or through arch. The bridge plaque is often located at the top of the portal.

**Post**
A member resisting compressive stresses. It is located vertical to the bottom chord of a truss and is common to two truss panels.

**Pratt truss**
A truss with parallel chords and a web system composed of vertical posts with diagonal ties inclined outward and upward from the bottom chord panel points towards the ends of the truss. Also known as a "N" truss.

Reinforced concrete
Concrete with embedded steel reinforcing bars that bond to the concrete and add tensile strength to its inherent compressive strength.

Rivet
A metal fastener made with a rounded pre-formed head at one end and installed hot into a pre-drilled hole. The other end is hammered into a similar shaped head, thereby clamping the adjoining parts together.

Scupper
An opening in the floor portion of a bridge to provide means for water drainage.

Simple span
The span of a bridge or element which begins at one support and ends at an adjacent support.

Single intersection truss
A style of truss in which the diagonals do not cross the posts.

Slab bridge
A type of bridge, usually short, in which the deck and its support are integral. The superstructure is composed of a reinforced concrete slab constructed either as a single unit or as a series of narrow slabs placed parallel with the roadway.

Steel
An alloy of iron, carbon and various other elements and metals. It is a hard, strong and malleable material.

Stiffener
A small member attached to another member to transfer stress and to prevent buckling.

Stiffening truss
A truss incorporated in a suspension bridge to distribute the traffic loads uniformly among the suspenders.

Stringer
A longitudinal beam supporting the bridge deck.

Suspension bridge
A bridge type with the roadway suspended from high towers, using a combination of cables, chains, or eyebars.

Sway anchorage
Diagonal bracing located at the top of a through truss, perpendicular to the truss itself and usually in a vertical plane. It resists horizontal forces.

Swing span bridge
A movable bridge in which the entire span rotates to permit passage of marine traffic.

Through truss
A bridge with overhead bracing. A truss in which the deck is nearly at the bottom of the superstructure, with traffic passing between the trusses.

Tie
A member carrying tension

Tie rod
A rod-like member in a frame functioning to transmit tensile stress. Also known as a tie bar.

Trestle
A bridge structure consisting of spans supported upon frame bents.

Truss bridge
A bridge having a pair of trusses for a superstructure.

Viaduct
A series of spans carried on piers at short intervals.

Vierendeel truss
A Pratt truss without diagonal members and with rigid joints between top and bottom chords and the verticals.

Voussoir arch
An arrangement of wedge shaped stones forming an arch.

Warren truss
A triangular truss consisting of sloping members between the top and bottom chords and no verticals. The members form the letter "W."

Weep hole
A hole in a concrete retaining wall to provide drainage of water.
Welded bridge structure
A structure whose metal elements are connected by welds.

Whipple truss
A truss with vertical posts and diagonal ties spanning two panels. Also referred to as a double quadrangular truss, a Linville Truss, and a double system Pratt truss.

Wingwall
The retaining wall extension of an abutment intended to restrain and hold in place the side slope material of an approach roadway embankment.

Wrought iron
Cast iron which has been mechanically worked to remove slag and undissolved carbon. It is an iron alloy that is less brittle than cast iron.