TIMBER BRIDGES

Bridge 707, Lake Bridge, Sussex County.
Photograph from Delaware Department of Transportation photographic archives.
TIMBER BRIDGES

There were twelve timber bridges included among the historic highway bridges considered significant in Delaware. While poorly represented in northern Delaware, the majority of bridges surveyed in southern Delaware were timber bridges. Included in the list of significant timber bridges were examples of several types. There are two extant covered bridges; a number of small, single span timber beam bridges; a very long, multiple-span example of a simple timber beam bridge; and three exceptional examples of a unique composite design, a timber-concrete slab bridge.

Bridge historian Henry G. Tyrell wrote in his 1911 book entitled History of Bridge Engineering that the majority of bridges built prior to 1860 in the United States were built of timber. Other nineteenth and twentieth century engineers, presenting histories of bridge building, including Theodore Cooper and Robert Fletcher described the evolution of the type.

In 1889, prominent bridge engineer Theodore Cooper summarized bridge history in the United States, in an article published in the Transactions of the American Society of Civil Engineers, he wrote:

The earliest bridges where single timbers were not sufficient to stretch from bank to bank, were short spans supported on piles...Where the conditions would not allow of structures of this character, arch spans were usually adopted.

Fletcher and Snow described multiple span versions of these early bridges in an 1852 American Society of Civil Engineers Transactions article:

And, in "The Evolution of American Bridges", Llewellyn N. Edwards described an early example of this type of bridge, Sewall's 1761 Bridge in York, Maine. Illustrated below, this elemental structure is

Early example of multi-span timber bridge. Sewall's Bridge, York River, Maine, 1761.
clearly similar to Delaware’s extant multiple-span example of the simple timber beam bridge (Bridge 708).

As the need for longer spans and heavier loads increased, new types were developed and executed by master craftsmen. Cooper continued, praising the builders of early American covered bridges:

The bridging of small streams was a part of the pioneers’ labor. The crossing of the larger rivers developed specially gifted men, like Timothy Palmer, Theodore Burr, Lewis Wernwag, and others less well known, who built timber bridges that are looked upon as wonderful structures, even to the present day.

The record of historic timber bridges in Delaware, both extant bridges and those illustrated in historic photographs, stands as an interesting illustration of the history of the type. Recorded examples include the earliest type, the simple beam on pile bents; beams on masonry abutments; simple timber trusses on masonry abutments; and a number of covered wooden truss bridges. Extant examples illustrate the continued popularity of the earliest and simplest type, and the adaptability of the material for creative twentieth century applications, such as the unique composite timber-concrete structures built in southern Delaware in the 1930s.

Delaware Department of Transportation photographic archives for New Castle County illustrate the existence of approximately 130 timber bridges in that county in the 1920s. There are no similar records for Kent and Sussex County. Most of the timber bridges illustrated were simple, single spans. Some were constructed on masonry substructure, some were constructed on timber pile bents or abutments; some illustrate elaborate iron railings. In addition to the simple beam structures, there were wood truss bridges and a number of covered bridges. Several of the types are illustrated below. Examples of covered bridges will be illustrated in the following pages.

**EARLY TIMBER BRIDGES OF NEW CASTLE COUNTY**

- Multiple span timber bridge on timber pile bents. North Delaware City Road, New Castle County. Photo from 1921. No longer standing.
- Timber bridge with lattice rail. Between Blackbird and Walker, New Castle County. Photo from 1921. No longer standing.
- Timber bridge spanning masonry abutments. Near Delaney, New Castle County. Photo from 1921. No longer standing.
- Double lattice wood through truss span. Wooddale, New Castle County. No longer standing.
Records indicate that there were over thirty-five covered bridges in Delaware. Newspaper photographs dating in the 1930s illustrated that at least one Burr truss and one Howe truss were built in Delaware. Yorklyn Bridge, a Town Lattice (no longer extant), is illustrated below. By 1937, there were five remaining covered bridges: Smith's Bridge across the Brandywine; Yeatman's Bridge across White Clay Creek; and three across the Red Clay Creek. Two of the covered bridges built to cross Red Clay Creek are still standing, the Wooddale (137) and Ashland Bridges (118). These bridges are Town trusses, patented by Ithiel Town of New Haven, Connecticut in 1820. Town, an architect, designed his truss for ease of construction by a good carpenter. He advertised and marketed it for roadways and later, for railroad use. His patent is shown opposite.

Town Lattice wooden covered bridge.
Yorklyn, New Castle County.
No longer standing.
The extant covered bridges are located in New Castle County, but very few of the simple span timber bridges illustrated in the archives remain in that county. However, the majority of bridges surveyed on secondary roads in southern Delaware are simple timber bridges, mostly single spans, consisting of timber stringers on pile bents with wood decks and railings. Their structural configuration is simple and represents the continued use of one of the most primitive types of early bridges, which found widespread application over a long period. Most of these bridges surveyed in Delaware date to the 1930s, although some are attributed earlier dates by the Department. Historic photographs illustrate that the type was built widely prior to the 1920s. It continued to be built in the 1940s as these bridges represent a specific engineering response to conditions characteristic of the region: they present a low-cost solution to the need for short spans crossing the numerous small waterways of southern Delaware.

The structural simplicity of the type, the use of readily available materials, and the speed of erection also made it an ideal choice for use as a replacement bridge in emergency situations, such as after the disastrous floods of September 1935 when approximately 100 bridges were destroyed in Delaware. The 1937 annual report of the State Highway Department noted that a total of 52 creosoted timber bridges were built during the year on the secondary system to replace inadequate or functionally obsolete structures.

During that period, Delaware Department of Transportation engineers also experimented with a new application for timber bridges in a composite design, resulting in the construction of three timber beam-concrete slab bridges in southern Delaware. The first of these structures, the Mill Creek Bridge (Bridge 9A) was considered "a new and very economical design". The State Highway Department declared in its 1936 Annual Report, ".. its serviceability will be watched with interest by the Department's engineers". The Department constructed two more of this design, each with more elaborate ornamentation, and they continue to carry traffic today (Bridges 445 and 707). Bridge 707 is shown below in a photograph from the 1938 Annual Report.

Examples of Delaware's historic timber bridges are arranged into groups by technological differences and presented in the following pages. A complete list of the timber bridges can be found in Appendix 1.

Bridge 707, Lake Bridge, as it appeared in the 1938 Annual Report.
State Bridge Number 118

Ashland Covered Bridge
Wooddale Drive over Red Clay Creek
Ashland, New Castle County, Delaware
1850-1880/1982

State Highway Bridge 118 is a covered timber bridge measuring 51'-9" long. It carries one lane of vehicular traffic on a 14'-6" deck. The bridge originally consisted of a Town Lattice truss constructed with oak timbers connected together with hardwood tapered dowels ("trunnels"). The abutments were constructed of semi-coursed rubble; flared uncoursed rubble wing walls are topped with sloped concrete capstones. The portals of the bridge are ornamented by pilasters with flared capitals reminiscent of classical columns. The bridge underwent a major alteration in 1982, when rolled steel I-beams were installed under the deck to support the bridge structurally. Excerpts from drawings made at that time are included on the following page.

Delaware Department of Transportation records state that Bridge 118 was built perhaps as early as the mid-nineteenth century and is one of only two remaining covered bridges in the State. Ithiel Town of New Haven, Connecticut, successfully patented this lattice truss in 1820, meeting with widespread adoption over the next thirty years. From New England to Virginia to as far west as Ohio, the timber bridges were used for both highway and railway spans. The Ashland Bridge is thought to have been built by the same craftsmen that constructed its twin, the Wooddale Covered Bridge some two miles away. Both structures were listed on the National Register in 1973.
State Bridge Number 137

Wooddale Covered Bridge
Road 263A over Red Clay Creek
Mt. Cuba, New Castle County, Delaware
1850-1880/1969

State Highway Bridge 137 is a covered timber bridge spanning 53'-6" long. It carries one lane of vehicular traffic on a 13'-0" wide deck. The bridge originally consisted of a Town lattice truss, comprised with oak timber, connected together with hardwood tapered dowels ("trunnels"). The abutments were constructed of semi-coursed rubble with a smooth finish on the exposed face. Flared wing walls are topped with granite capstone. Drawings from a 1939 repair are reproduced on the following page. A major 1969 alteration added rolled steel I-beams under the deck, which support the bridge structurally. The bridge is 10'-0" above water level.

Delaware Department of Transportation record drawings, made in 1939, document the configuration and construction details of this structure. These drawings, excerpts of which are presented on the following page, depict a Town Lattice truss on rubble masonry abutments with flared stone wing walls, having a 53'-6" clear span, 67'-0" overall length, and 15'-9" width. The truss is constructed of 2"x8" diagonals; plates and sills are built up from 3"x10" timbers. Floor beams of 6"x12" timbers with 4"x6" cross bracing support 4"x8" stringers carrying 8"x3" plank decking. Drawings note "Liveload 3 tons (not 13)". Delaware Department of Transportation records also include drawings dated July 23, 1981, detailing alterations which add wood members to the floor framing system; the 1981 drawings also show that a steel I-beam subframe had been constructed by that date, to relieve the load on the wooden truss.

Bridge 137 was built perhaps as early as the mid-nineteenth century and is one of only two remaining covered bridges in the State. The Wooddale Bridge is thought to have been built by the same craftsmen that constructed its twin, the Ashland Covered Bridge some two miles away. Both structures were listed on the National Register of Historic Places in 1973.
Diagram of covered bridge truss types.

Elevation, plan and section from 1939 record drawings of Bridge 137.
State Highway Bridge 123A is a 13'-10" single span timber beam bridge with a timber superstructure and substructure. Beams, 4"x12" in section, support the deck composed of 4"x10" planks that have been paved over. There is a simple wood railing composed of 4"x6" posts and 2"x6" rails. The superstructure is supported by timber bents, each comprising seven piles 12" in diameter which support a 10"x12" header. The straight wing walls are constructed of 4"x10" planks. The bridge is 21'-8" wide and carries two lanes of traffic.

Delaware Department of Transportation records state that Bridge 123A was built in 1933 under State Highway Department contract 297, as part of a project to construct a slag road between Thompsonville and Sour Apple Tree, a distance of 5.9 miles. This project involved the construction of the present bridge and the provision of 24 pipe culverts to improve drainage on the road, which was reported covered with standing water wherever the road went through a wooded section. The road construction contract was executed with the Wilson Contracting Company of Wilmington, Delaware, for a bid price of $16,740, of which an estimated $740 applied to the construction of the bridge. Bridge 123A replaced a previous timber structure at the same site. Original drawings, dated February 1933, are on file at the Delaware Department of Transportation. Notes on the drawings specify the use of creosoted timber piles and lumber; acceptable materials included southern yellow pine, Douglas fir, southern cypress, and oak. The wood was treated with Grade 1 creosote oil under the full cell process. Like other small timber bridges of this period, Bridge 123A was designed for a 15 ton truck load, without impact. Handwritten notes on the drawings indicate that materials were supplied by the Century Wood Preserving Company of Newport, Delaware. Excerpts from the drawings are presented on the following page.
The majority of bridges surveyed on secondary roads in southern Delaware are simple timber bridges, mostly single spans, consisting of timber stringers on pile bents with wood decks and railings. Their structural configuration is simple and represents the continued use of one of the most primitive types of early bridges. State Bridge No. 123A is a typical southern Delaware timber bridge which appears to retain much of its original fabric; it was built as part of a project to improve the rural transportation network in Kent County. The nature of the timber bridge presumes frequent replacement of members as wear and deterioration take their toll, timber decking and railings are especially vulnerable. As long as the bridge retains the majority of its original superstructure and substructure, it was considered to retain sufficient integrity to be significant as a representative example of the type.

Elevation, plan and section from original 1933 drawings for Bridge 123A.
STATE BRIDGE NUMBER 708

Route 24 over Love Creek
Marshtown, Sussex County, Delaware 1939

Delaware State Bridge 708 is a 21 span timber bridge, 400'-0" long. The spans are equally spaced 18'-9" apart. The bridge was built along a vertical curve. It is composed of 8" x 14" timber beams spaced 1'-6" apart. A 6" deep concrete deck has been placed atop the bridge's timber frame and deck. The superstructure rests on timber bents comprising 12" x 12" beams on piles 12"-15" in diameter and has straight timber wing walls. The bents are braced diagonally. There is a timber pedestrian walkway, 4'-0" wide, cantilevered on the west elevation. The walkway has a timber outside rail 3'-0" in height. The bridge is 33'-0" wide and carries two lanes of traffic and a 4'-0" sidewalk on one side. The vehicular railing measures 3'-6" high and consists of timber posts, a 2" x 6" top rail and a metal intermediate rail.

The Delaware Department of Transportation's records state that Bridge 708 was built in 1939 and underwent alterations or repairs in 1983. Original drawings dated 1938-1939 note this bridge replaced a 1933 "creosote structure" at this site. Portions of the 1939 drawings appear on the following page. As originally constructed it consisted of simple timber spans comprising stringers on bents. The timber deck was covered by a thin bituminous concrete wearing surface. The contract was awarded on June 16, 1939, to Spear-Jones and Company, Inc., of Dover, Delaware, for $24,814.90. Studies for various lengths were made for this replacement bridge; alternatives included a 172' bridge, a 210' bridge costing $31,000 and a 400' bridge. A.G. Livingston, Highway Department Bridge Engineer wrote to W.W. Mack, Chief Engineer that the 400' length was chosen due to the soft ground at the site and the desirability of a concrete wearing surface.

The Love Creek Bridge was noted in the 1939 Highway Department Annual Report as one of the year's highlights in Sussex County. A photograph from the 1939 Annual Report is shown on the first page of this section. Part of a major
improvement to a highway carrying "very heavy traffic of pleasure-bound motorists, bound for Rehoboth and Oak Orchard during the summer months, ... the building of Love Creek Bridge and its approaches has eliminated one of the danger spots on this road. The alignment on this section has been eased and the bridge widened."

State Bridge No. 708 is an exceptionally long, multiple span example of a simple timber bridge. The individual spans are representative of the type, and the bridge's history illustrates the economy of the type even as a multiple-span structure. Comprising 21 spans, it measures 400 feet long; most timber girder bridges in southern Delaware consist of only one span, usually less than 20 feet long. Bridge 708 is significant as an unusual variation of a common type, and for its association with the development of the road network in Sussex County during this period, when efforts were directed toward facilitating travel to the growing seaside resorts.
STATE BRIDGE NUMBER 9A

Route 6 over Mill Creek
Smyrna, Kent County, Delaware
1936

State Highway Bridge 9A (Mill Creek Bridge) is a 100'-0" composite concrete and timber bridge. A five span timber and concrete slab superstructure is combined with a substructure of timber bents and timber abutments. Each span measures 20'-0". The parapet consists of concrete posts and rails. The bridge is 23'-6" wide and carries two lanes of traffic. The substructure has been reinforced with steel I-beams, and the flared wing walls are made of steel sheeting. The timber bents have been augmented with steel bents and the underside of the slab appears satisfactory but is difficult to see well.

Delaware Department of Transportation records state that Bridge 9A was built in 1936. Spear-Jones and Company, Inc., of Dover, Delaware, were the contractors, for a bid price of $6,820. The bridge was highlighted in the State Highway Department's annual report for 1936 as an example of "unusual construction" involving a "new and very economical design . . . its serviceability will be watched with interest by the Department's engineers." Two photographs of Bridge 9A from the 1936 Annual Report are presented on the following page. It was noted that the Vines Creek Bridge in Sussex County (Bridge 445), which was also placed under contract in 1936, was a similar design, and both replaced "narrow, obsolescent structures."

Original drawings, dated June 1935, detail the bridge's configuration. Drawing notes indicate that Bridge 9A replaced a pony truss bridge at this site. The typical section for this bridge shows a composite structure, incorporating timber and concrete. Drawing notes indicate special provisions for material placement to form a "composite beam" using 2'X8" laminated timber with "shear developers and uplift spikes" and covered with approximately 5 inches of concrete. The bridge was designed for a 15 ton truck, with 30% impact, live load. The drawing notes specified that southern yellow pine, douglas fir, oak, and southern cypress were acceptable materials, treated with 14 pounds of grade no. 1 creosote oil under the full cell process. Added notes on the drawings document the construction process. Excerpts from the drawings are
presented on the following page. In 1970, under contract 70-05-001, it was repaired with steel reinforcement to the substructure.

This composite structure, comprising a multiple-span timber substructure and concrete slab superstructure, has considerable technological significance, and exemplifies the receptiveness to innovation which characterized the bridge engineers of the State Highway Department during this period. This new type of structure offered the advantage of utilizing economical materials, and Department engineers were quick to test its merits. It is significant as one of only three composite timber/concrete bridges surveyed in Delaware.

*Bridge 9A as it appeared in the 1936 Annual Report showing deck before and after placing concrete.*
Elevation and section of original 1935 drawings for Bridge 9A.
STATE BRIDGE NUMBER 445

Omar Bridge
Road 54 over Vines Creek
Frankford, Sussex County, Delaware
1937

State Highway Bridge Number 445, Omar Bridge, is a three span combination timber and concrete bridge. Each span measures 20'-0", for an overall length of 60'-0". It carries two lanes of traffic, with a deck width of 26'-0". The superstructure rests on timber bents, comprising a 12" x 12" beam supported by six creosoted 12"-diameter pilings set on six-foot centers with cross bracing. The timber wing walls are straight, with perpendicular extensions on the southwest and northeast. The deck is a composite slab structure comprising timber and concrete. The bridge has a concrete parapet featuring large stepped blocks at the portals and above the piers, spanned by arched balustrades. The parapet incorporates a curb and fascia; a series of perforations at the level of the roadway provide for drainage.

Delaware Department of Transportation records indicate that Bridge Number 445 was built in 1937 under State Highway Department contract 543 (Federal Aid Project 173B), replacing a previous structure at this site. Bids were received March 16, 1938, and the contract was awarded to the Old Line Construction Company of Chestertown, Maryland, for $16,851. As with other large timber pile structures of the period in the region, problems developed in constructing the substructure: adequate bearing could not be obtained with 24' piles, as designed, so piles averaging 45' in length were substituted, and details of abutment bent design were revised. The increase in pile length was partially responsible for a cost overrun of $1,733.67. The structure was completed on September 24, 1938. Original drawings document the construction methods, including placement of concrete reinforcement and construction of the composite floor system, which is very similar to that of Bridge 9A. Details from original drawings showing this floor system are presented on the following page along with other excerpts.

This composite structure, comprising a three span composite timber-concrete bridge, is unusual in Sussex County and has considerable technological significance. It is similar to the Mill Creek Bridge of 1936 in Smyrna, Kent County (Bridge 9A); specifications for the Omar Bridge conform to those for the Mill Creek Bridge in many respects. Bridge 445 is considered significant as one of only three composite timber-concrete structures surveyed in Delaware.
Details illustrating construction of unusual timber-concrete composite deck system.

Elevation and details from original 1937 drawings for Bridge 445.
STATE BRIDGE NUMBER 707

Road 50 over Silver Lake
Rehoboth Beach, Sussex County,
Delaware
1938

Delaware State Highway Bridge 707, "Lake Bridge", is a thirteen span combination timber and concrete bridge 260'-2" long. The spans are equally spaced at 20'-0". The deck is a "composite slab structure and the parapet is concrete. The parapet is decorated with rectangular shaped arched pointed openings between columns. These columns are spaced 6'-4" apart. A concrete fascia, with a broad segmental arch curve, also ornaments the bridge. The fascia is 1'-8" wide at the crown of the arch and 4'-0" above the water level. The concrete deck, parapet and fascia are supported by timber members. The substructure is timber with timber bents comprising 12" x 12" beams on pilings, and U-shaped timber wing walls. The bridge's timber bents are laterally braced with horizontal struts. Two joints and double piers support the structure at the fourth and ninth pier. The bridge is 30'-8" wide and carries two lanes of traffic and two sidewalks. There are four decorative lamps on the bridge's west elevation.

The records of the Delaware Department of Transportation state that Bridge 707 was built in 1938 under contract 532. Original drawings indicate that this bridge replaced a 1928 timber bridge. The drawings show construction details of the composite system: laminated wood flooring using "uplift spikes" and "shear developers" to be incorporated in a concrete roadway surface. Drawing notes indicate that "a similar bridge was constructed East of Smyrna" (Bridge 9A; Bridge 445 is also similar.) Portions of the original drawings are presented on the following page. The bridge was designed to carry a 15 ton truck with impact. The construction of Bridge 707 was a component of Federal Aid Project 113 which involved the construction of a new road between Rehoboth and Bethany Beach, a distance of 12.65 miles. Project 113B provided for the construction of the Silver Lake Bridge. The project was plagued by slow delivery of materials, and encountered a brief setback when a heavy windstorm blew the contractor's pile driver into the lake. Nevertheless, the bridge was completed and opened to traffic on April 8, 1939.
This composite structure, comprising a multiple-span timber substructure and composite timber-concrete slab superstructure, has considerable technological significance. In addition, its relatively high degree of architectural elaboration may reflect the increasing economic importance of Delaware's seashore resorts in the late 1930s. The project of which the bridge construction was a part was intended to facilitate travel to and from the growing resorts of Rehoboth and Bethany Beach. The Federal Aid Program project statement also predicted that the route would "be greatly increased in importance by the location of a permanent inlet to Indian River which is now being considered by the U.S. Engineers, and this Bridge becomes necessary to adequately take care of the increased traffic." Upon completion of the project, the inspection report noted "there are real possibilities of growth in population along the project, particularly as to summer residents. The growth in population, will depend largely on the increase in popularity that beach life holds for the general public."

Elevation and balustrade details from original 1937 drawings for Bridge 707.