Tuttle Bridge (Golden Hill Road Bridge)
Spanning the Housatonic River on Golden Hill Road
Lee
Berkshire County
Massachusetts

HAER No. MA-105

HAER
MASS,
2-LEE,
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PHOTOGRAPHS
WRITTEN HISTORICAL AND DESCRIPTIVE DATA

Historic American Engineering Record
National Park Service
Department of the Interior
Washington, DC 20013-7127

HAER
MASS.
2-LEE,
1-

HISTORIC AMERICAN ENGINEERING RECORD

TUTTLE BRIDGE
(GOLDEN HILL ROAD BRIDGE/SHEA'S CROSSING)
HAER No. MA-105

Location:	Spanning the Housatonic River on Golden Hill Road, Lee, Berkshire County, Massachusetts UTM: East Lee, Mass., Quad. 18/448100/4687760
Date of Construction:	1885
Structural Type:	Wrought-iron lenticular pony truss bridge
Fabricator/ Builder:	Berlin Iron Bridge Company, East Berlin, Connecticut
Engineer:	Unknown; design based on 1885 patent by William O. Douglas
Owner:	Town of Lee, Massachusetts
Use:	Rural vehicular and pedestrian bridge
Significance:	The Tuttle Bridge is an excellent, virtually unaltered, example of William O. Douglas's 1885 patent, which he claimed improved upon his earlier (1878) patent for a lenticular truss bridge. The Tuttle Bridge incorporates the features of Douglas's second patent, including floor-line tension chords and strut braces. The bridge was fabricated and erected by one of New England's most prolific iron bridge builders, the Berlin Iron Bridge Company. Between 1878 and 1895 the company erected well over 600 lenticular trusses in New England and Upstate New York. The Tuttle Bridge is one of approximately fifty lenticular truss bridges to survive nationally, and one of only ten known surviving lenticular truss bridges in Massachusetts (eight of which are under Massachusetts Department of Public Works purview.)
Project Information:	Documentation of the Tuttle Bridge is part of the Massachusetts Historic Bridge Recording Project, conducted during the summer of 1990 under the co-sponsorship of HABS/HAER and the Massachusetts Department of Public Works, in cooperation with the Massachusetts Historical Commission. Patrick Harshbarger, HAER Historian, August 1990

Description

The Tuttle Bridge spans the Housatonic River at Golden Hill Road about one mile northeast of downtown Lee, Massachusetts, in the Berkshire Mountains. The bridge sits in a marshy bottomland just upstream from a large paper mill. To the east, Golden Hill Road crosses the bottomland, and a railroad spur parallels the river. The road rises steeply to the top of a small hill west of the bridge.

The Tuttle Bridge is a single-span lenticular pony truss. Parabolic upper and lower chords characterize the lenticular form. Because of their distinctive shape, such bridges ate often referred to as "pumpkinseed bridges." The Tuttle Bridge is a five-panel pony truss, measuring 80'-0" long and 16'-10" wide. The distance from the bottom chord to the river is approximately 5'. The depth of the structure varies from 5'-0" at the portal ends, to 7'-0" at centerspan. Each truss panel measures 16'-2" in length, with the exception of the eastern end panel, which measures 16'-0". This slight difference may be due to distortion in the bridge and not to design.

The segmental upper chord is riveted and bolted together at each panel point. Each segment is comprised of wrought-iron plates and angles riveted together into the shape of an inverted trough, 16"x8", with lattice on the underside. The lower chord is comprised of a pair of wrought-iron, 1"x3" eyebars. The lower chord segments are pinned together at each panel point. The vertical endposts are manufactured in a fashion similar to the upper chord. They are built-up in the shape of an inverted trough, 16"x8", with lattice on the underside. The bases of the endposts rest directly upon the stone abutments. The assembly of the upper chord and post is held together by a cast-iron cap, and a pin to which the lower chord's eyebars are connected.

The vertical web members are paired, 2½" wrought-iron angles joined by lattice. The main diagonals are paired, 1¼" diameter wrought-iron rods with turnbuckles. The counters are single, 1¼" diameter wrought-iron rods. A "tension floor-line chord," in the form of a wrought-iron rod, runs the length of the truss, and is bolted to the footing of each endpost and to the floor beams. The floor-line rod is 1¼" in diameter and has adjustable turnbuckles near the second and fourth panel points. The rod has been severely twisted, probably from the force of flooding.[1]

The I-shaped floor beams taper, their deepest point at the center of the bridge and their shallowest at the exterior edges. The floor beams hang from the lower chord panel points by means of U-shaped rods passing over the connecting pins. The lower lateral rods bolt to the floor beams. The stringers are modern, steel I-beams, which run the length of the bridge. The roadway is Irving open steel grid decking.

Lenticular Bridges

A number of amateur and professional historians have written about the history of lenticular bridges. The lenticulars' association with a single manufacturer (the Berlin Iron Bridge Company), their predominance in a relatively small geographic region (New England and Upstate New York), and their aesthetically-pleasing form, have made the lenticular truss a popular subject among bridge enthusiasts. Between 1878 and 1895 the Berlin Iron Bridge Company built well over 600 lenticular bridges in the Northeast. The Tuttle Bridge is one of approximately fifty lenticular bridges known to survive nationally, and one of only ten known surviving lenticular bridges in Massachusetts (eight of which are under Massachusetts Department of Public Works purview).[2] Built in 1885, it is a rare example of a structural type that once predominated among the iron truss bridges of Western Massachusetts.[3]

Lenticular trusses came in a variety of sizes and configurations. They ranged from 20' to over 200' in length, and could be designed as either pony, through, half-through, or deck trusses, although through and pony trusses were by far the most common.

When the Corrugated Metal Company, the forerunner of the Berlin Iron Bridge Company, began building trusses in the late 1870s, the lenticular form had been known for a number of years. Lenticular trusses had been built in 1840 in France, in 1857 in Germany, and in 1859 in England. Patents for bridges of the lenticular-truss type had been granted in the United States to Edwin Stanley in 1851, and to Horace Hervey and Robert Osborne in 1855.[4]

Considering these earlier structures and patents, historians have considered it somewhat odd that the United States Patent Office granted William O. Douglas a patent for lenticular trusses in 1878. Douglas was a West Point graduate and a disabled veteran of the Civil War. He had spent some time in the Reconstruction government of Texas and moved back to his hometown, Binghamton, New York, to open a hardware business, which failed in 1877. Shortly thereafter, Douglas took out a patent on a lenticular truss and entered into business with the new owner of the Corrugated Metal Company of East Berlin, Connecticut. It is not known where Douglas received the inspiration for his patent, although he may have been exposed to its principles in engineering classes at the military academy. Bridge historian Victor Darnell believes that Douglas developed his ideas without any knowledge of European usage or earlier American patents.[5]

Berlin Iron Bridge Company

The Corrugated Metal Company had descended from a series of firms that had specialized in tinner's tools and machines, and corrugated iron for buildings. When an entrepreneur named S.C. Wilcox took over the firm in 1877, it was on the verge of bankruptcy. Wilcox reorganized the company, obtained the rights to Douglas's bridge patent, and began building lenticular trusses. In 1883, Wilcox renamed the enterprise the Berlin Iron Bridge Company.[6]

In the late-nineteenth century, dozens of engineers and companies experimented with a wide variety of bridge designs. Most of the new trusses proved economically unfeasible, or lacked strength and durability. The success of the Berlin Iron Bridge Company was unusual and relied upon a combination of marketing savvy, engineering skill, and luck. The firm specialized in highway bridges and salesmen aggressively pursued contracts with nearby towns that were just beginning to replace older wooden bridges with iron spans. With lower transportation and erection costs, the company could underbid many of its competitors from Boston, New York, and

Philadelphia. Guided by Wilcox's entrepreneurial skill, the Berlin Iron Bridge Company designed its product, marketing technique, and price to appeal to the selectmen and bridge committees in charge of purchasing bridges for New England towns.[7]

In the 1870s, a new iron truss bridge of substantial length cost little more than a new wooden bridge. When it came time to replace an older bridge that had been washed away in a flood or had simply worn out, a town's citizens often chose to buy an iron truss rather than to continue the tradition of hiring local craftsmen to erect a wooden trestle or covered bridge.

Tuttle Bridge

A wooden bridge may have spanned the Housatonic River at the site of the Tuttle Bridge as early as the 1790s. A 1796 map appears to show a bridge near the present location, but changes in the course of the river and the lack of local landmarks make it difficult to verify that this was the Tuttle Bridge. The earliest written report of the Tuttle Bridge is in the 1863 edition of the Reports of the Town of Lee. In that year, the selectmen commented that the abutment needed repairing. In 1866 the town paid T.D. Thatcher, a local millwright, to rebuild the bridge at a cost of $1,000. The Tuttle Bridge provided local farmers a convenient crossing of the Housatonic River to the main road between Lee and Pittsfield.[8]

The newspapers often reviewed the conditions of the local roads and bridges prior to town meetings. The Valley Gleaner, Lee's newspaper, reported on April 1, 1885, "The Tuttle bridge is not a very stable affair and it is probable the town will see fit to make some appropriation therefor [sic]." Twenty years was an average lifespan for an uncovered wooden bridge, and it is probable that the 1866 bridge had worn out.

The following week at Lee's town meeting, Wellington Smith, a prominent citizen and owner of the Smith Mill's Paper Company, located downstream from the Tuttle Bridge, made the motion to raise $2,000 to erect a "first class iron bridge." The town meeting passed the motion, and the selectmen received the authority to enter into a contract with the bridge manufacturer they felt most fit to complete the work. On April 22, 1885, only two weeks after the town meeting, this notice to bridge builders appeared in the Valley Gleaner:

> Proposals will be received by the selectmen of the town of Lee at their rooms in Lee, Mass., on the first day of May next, at 2 o'clock p.m. for the building of a bridge of about 87 feet span and 14 feet width across the Housatonic River in said town. Further information will be given at that time.

On May 1, 1885, a number of bridge builders gathered in the town offices to pitch their proposals to the town selectmen. On May 13 the newspaper announced that the selectmen had elected to give the contract to the Berlin company for $943, the lowest bid received.

Construction began at once. The town hired a contractor to remove the old bridge, and the abutments needed only minor repairs. A local stone mason, Patrick Shea, received $24 for his labor. Shortly thereafter, a construction team arrived from Berlin by railroad with the bridge. (According to Victor Darnell, the company had up to thirty erection crews that traveled the countryside during the spring, summer and fall laying the falsework and assembling the lenticular trusses. A medium-size span, such as the Tuttle Bridge, could be erected within a few weeks.) On July 7, 1885, the new bridge opened for travel after less than two months of work. The Valley Gleaner reported, "[The Tuttle Bridge] is a very handsome and substantial structure and will prove a good investment for the town." The total cost was $1,166.01, including the expense of lumber for the falsework and bridge deck.[9]

An unusual feature of the Tuttle Bridge was the "tension floor-line chord" that ran from the footing of each end post to the end post on the opposite bank. The Berlin Iron Bridge Company probably had begun adding the floor-line chord to some of its bridges in 1884. Douglas applied for a patent for the floor-line chord in October of that year, stating that it resisted the effect of the wind or other forces acting laterally against the bridge.(See appendix.) The lateral system which the "tension floor-line chord" was designed to replace used stiff, heavy struts, capable of resisting compression as well as tension, between the ends of the floor beams. The "tension floor-line chord," designed only to resist tension, could be a single, slender rod, thereby reducing the amount (and cost) of material.[10]

The Tuttle Bridge is the only one of five remaining lenticular pony trusses in the Massachusetts Department of Public Works database that incorporates the "tension floor-line chord." Victor Darnell is skeptical that the chord served much of a structural purpose, and claims that when Douglas combined the floor-line chord with the inclined strut, such as in the Blackinton Bridge at North Adams (HAER No. MA-109), he may have actually reduced the truss's lateral stiffness. Darnell estimates that only about one-third of the Berlin Iron Bridge Company's trusses built after 1885 made use of Douglas's second patent.[11]

Conclusion

By the mid-1890s most of New England's wooden bridges had been replaced, and the Berlin company's business had dwindled. The builder phased out the lenticular design in favor of more heavily-constructed Warren trusses. Although the firm hired salesmen in the Midwest, the cost of transportation probably prevented the firm from effectively competing against other bridge manufacturers. Eventually, the company shifted its emphasis to metal-frame factory and mill buildings, evidently a more profitable venture. In 1900, the Berlin Iron Bridge Company, along with twenty-five other regional bridge companies, merged with the American Bridge Company.[12]

The age of the automobile marked the beginning of the end for the lenticular trusses. Not only did the Berlin Company stop manufacturing them, but many towns found that their lenticular bridges proved inadequate to the increased volume of heavier and faster vehicles. Berlin had built few lenticular trusses wider than 16', and fast-moving cars needed wider clearances. A number of these narrow bridges met their end when an auto or truck rammed the endpost. Throughout the twentieth century, steel and concrete bridges replaced the beautiful lenticular trusses.[13]

The Tuttle Bridge was a rare survivor of the automobile age. In the 1940s, a developer built a colony of low-cost ranch houses to the east of the bridge, significantly increasing the number of automobiles crossing the bridge. Occasional floods have threatened the span, but amazingly little damage has occurred. In 1970, the Massachusetts Department of Public Works replaced the bridge's stringers with steel I-beams and laid an open steel grid deck.[14] Today, the bridge shows signs of wear, the endpost caps have cracked, and now the posts themselves incline outward.

UNITED STATES PATENT OFFICE.

WILLIAM O. DOUGLAS, OF BINGHAMTON, NEW YORK.

BRIDGE.

SPECIFICATION forming part of Letters Patent No. 315,259, dated April 7, 1885.

Application filed October 18, 1884. (No model.)

To all whom it may concern:

Be it known that I, WILLIAM O. DOUGLAS, a citizen of the United States, residing at Binghamton, in the county of Broome and State of New York, have invented certain new and useful Improvements in Bridges, of which the following is a description.

A very important factor in bridge construction is the means employed to resist the effect of the wind or other force acting laterally on a truss. This is especially true in long spans where the conditions are such that the distance between the trusses of a bridge is limited. In the case of a parabolic truss this wind-truss is a very important factor in the construction of a bridge, requiring in long spans with narrow roadway a large amount of material because the chords or flanges of the wind-truss have been heretofore designed to resist both compression and tension, the leeward chord being in tension and the windward chord being in compression alternating upon the chords in character or kind of strain according to the direction of the wind or other force applied laterally.

My invention is designed to improve this condition of things in parabolic truss-bridges to the end of cheapening the cost of the bridge both in the amount of material and cost of construction and increasing its efficiency by providing a means by which both flanges of the wind-truss shall be always in tension, which is done by providing the brace A to resist the pull of the chords B in a parabolic truss.

Figure I represents an outline diagram in elevation of a parabolic truss. Fig. II represents an outline diagram of a floor-plan of the same. Fig. III represents an enlarged view of the end panel and part of the second panel of the truss shown in Fig. I, in which D represents the top chord of the supporting-truss; E, the bottom chord; C, the end post; F, the first web-post; G, the first web-tie; H, the suspender; B, the tension floor-line chord, and A the end brace-strut, all hereinafter described, and in different figures represented by the same letters.

Referring to Fig. III, A is the diagonal strut, extending from the first panel-point of lower chord to a pin near base of end post, to which same pin the tension floor-line chord B attaches. The strut A might extend from base of end post to second panel of lower chord, to first or second panel of upper chord, or to any convenient point in the supporting-truss in such a manner as to make a stiff fixed member to resist the pull arising from the tension floor-line chord B; but it is preferred as represented. In short spans less than about seventy-five feet the brace or strut A may be omitted, the tension floor-line chord being secured at the end post by a bolt in the masonry.

Fig. IV represents a detail side and sectional elevation of the first panel-point of the lower chord, showing lower chord, E, first web-post F, web-tie G, suspender H, and the diagonal strut-brace A, all connected at panel-point by pin I.

Fig. V represents a detail side and sectional view of base of end post, C, resting on a nest of rollers and connected with the diagonal strut-brace A and the tension floor-line chord B by means of a pin passing through the three pieces R.

Fig. IV represents a brace between the end posts to keep them from drawing together under the tension of sway-rods J.

Figs. VI and VII represent the connection of tension floor-line chord B with floor-beam K and sway-rod J. In Fig. VIII the same connection is shown for a bridge askew with the abutments. In all of the above figures the connections are by means of pins; but I do not confine myself to the use of pins alone in the connections; but my invention would be the same if the connections were made by rivets or otherwise. The forms of the different parts as represented are those generally used in the parabolic truss; but these forms may be changed to suit the different conditions or different details of construction.

In a separate application of even date herewith I have shown, described, and claimed the tie-rod B in connection with the rods J and floor-beams K, forming a lower lateral wind-truss; and I therefore make no broad claim to that feature in this case.

What I claim as my invention is—

The combination of a tension floor-line chord, B, with a strut-brace, A, or its described equivalent in a parabolic truss-bridge, whereby a point in the end post is fixed so rigidly as to resist the pull of the chords B, making both flanges of the wind-truss always in tension, substantially as illustrated and described.

WILLIAM O. DOUGLAS.

Witnesses:

F. J. BAYLESS,

CHAS. D. MATTHEWS.

(No Model.)

4 Sheets—Sheet 1.

W. O. DOUGLAS.

BRIDGE.

No. 315,259. Patented Apr. 7, 1885.

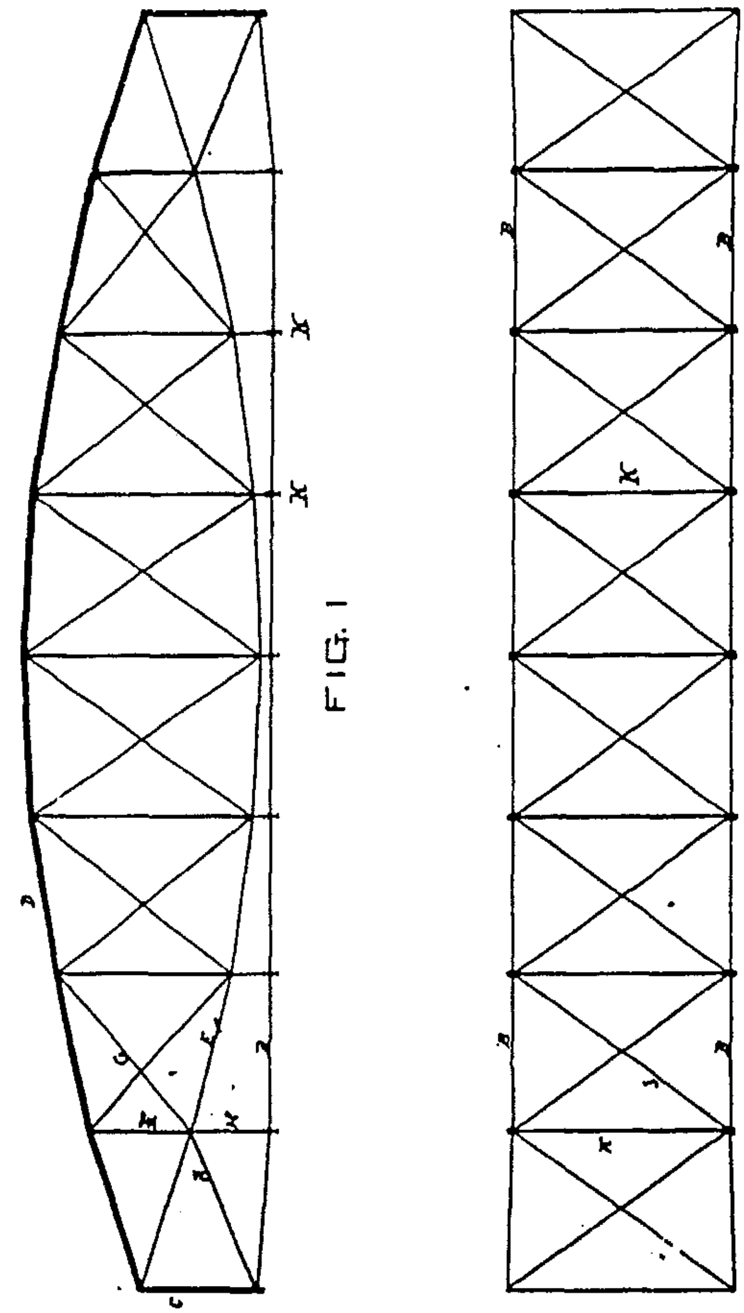


FIG. I

FIG. II

WITNESSES:

Edw. W. Byrn

Harrison R. Brown

INVENTOR:

Wm. O. Douglas

BY Munn & Co

ATTORNEYS.

(No Model.)

4 Sheets—Sheet 2.

W. O. DOUGLAS.

BRIDGE.

No. 315,259. Patented Apr. 7, 1885.

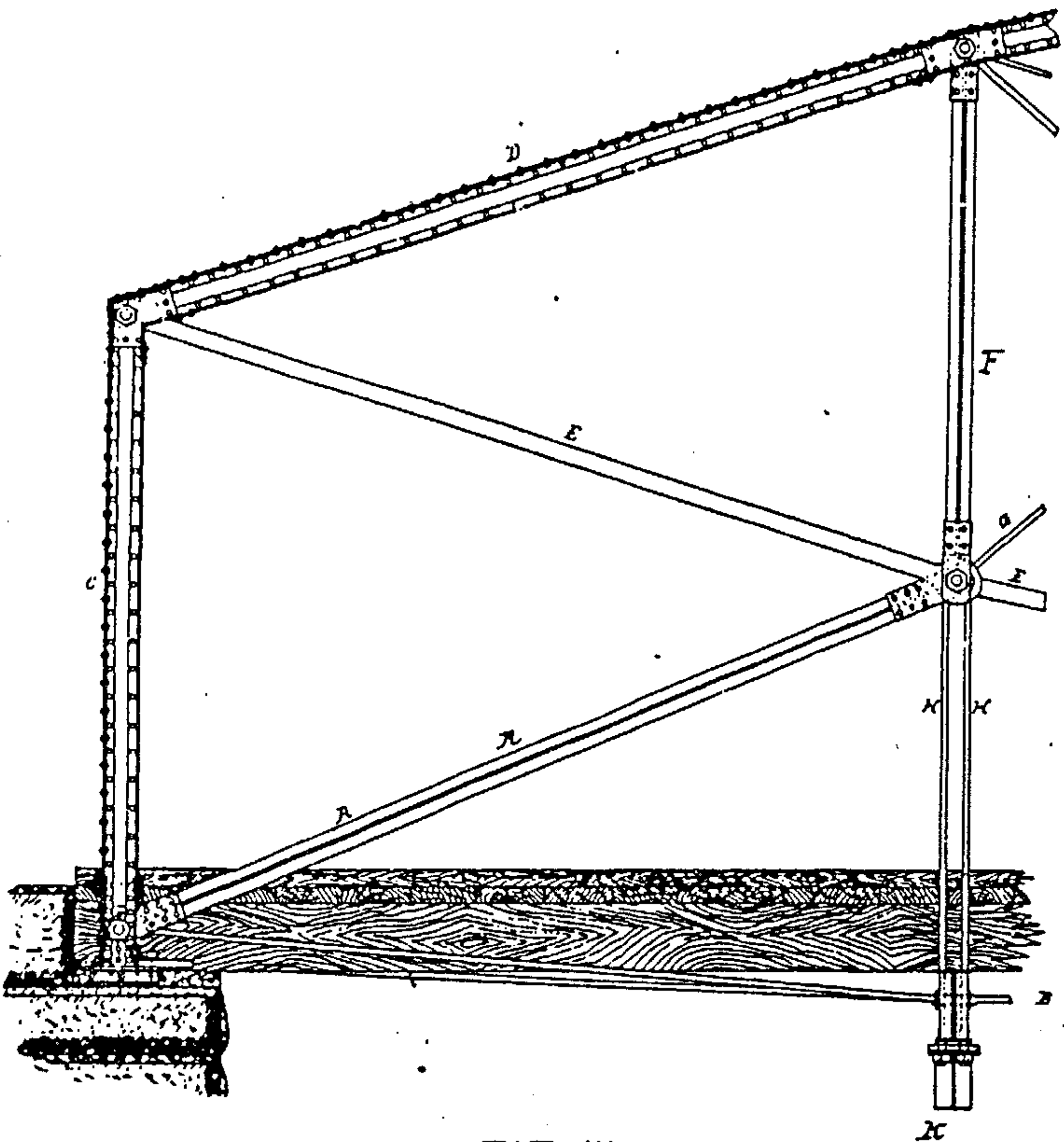


FIG. III

WITNESSES:

Edw. W. Byrn.
Harrison B. Brown

INVENTOR:

Wm. O. Douglas
BY Munn & Co
ATTORNEYS.

(No Model.) 4 Sheets—Sheet 3.

W. O. DOUGLAS.

BRIDGE.

No. 315,259. Patented Apr. 7, 1885.

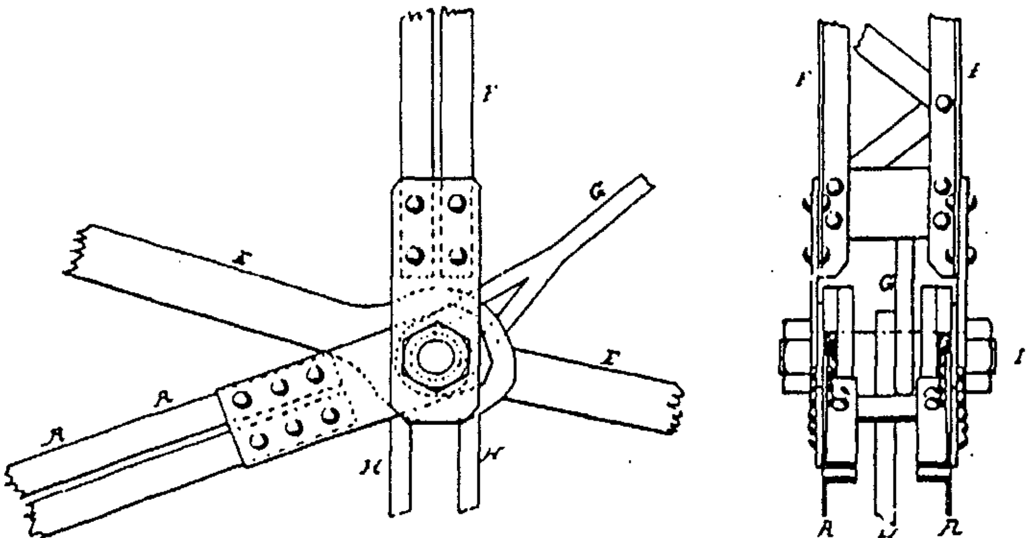


FIG. IV

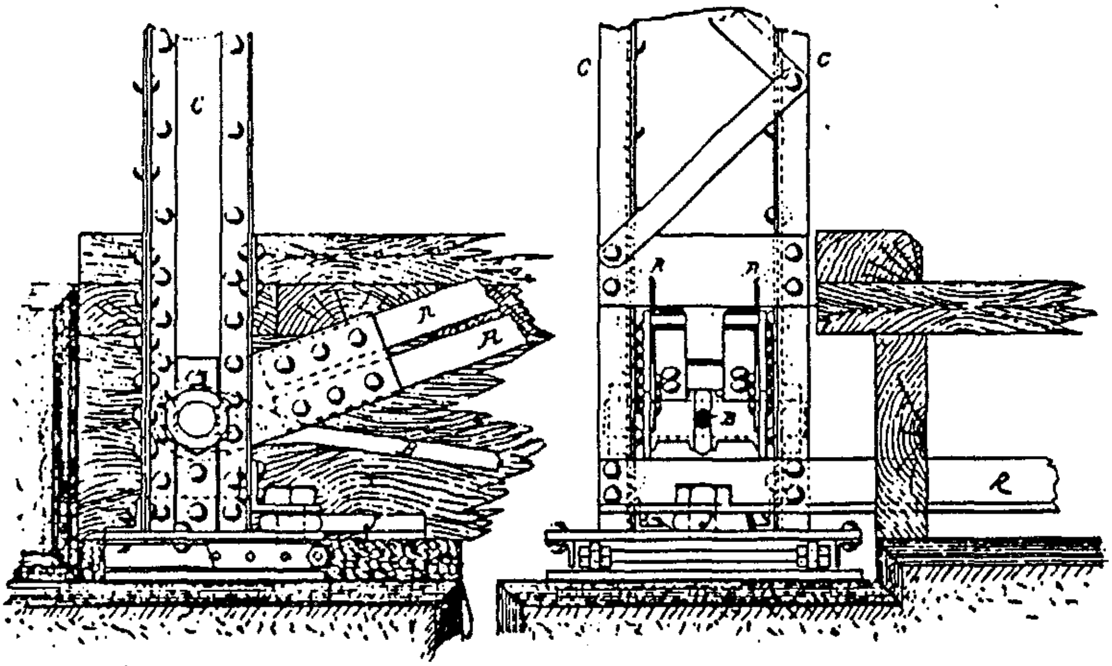


FIG. V

WITNESSES:

Edw. W. Byrn

Harrison B. Brown

INVENTOR:

Wm. O. Douglas

BY Munn & Co

ATTORNEYS.

(No Model.) 4 Sheets—Sheet 4.

W. O. DOUGLAS.
BRIDGE.

No. 315,259. Patented Apr. 7, 1885.

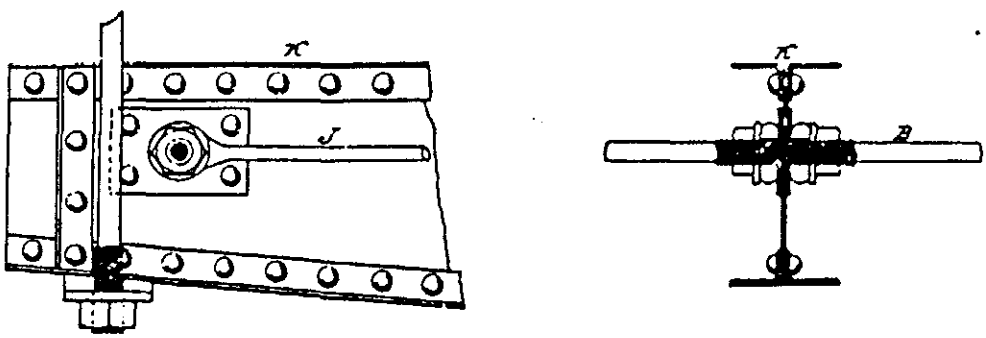


FIG VI

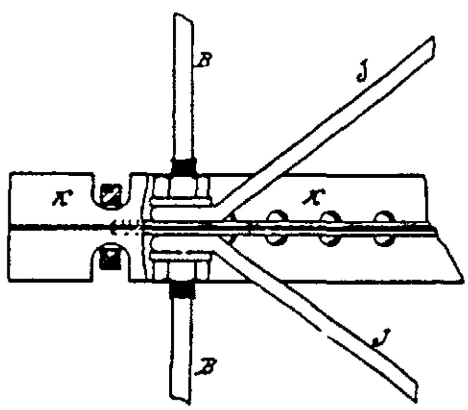


FIG VII

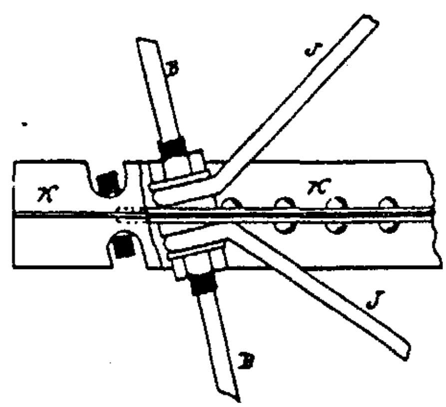
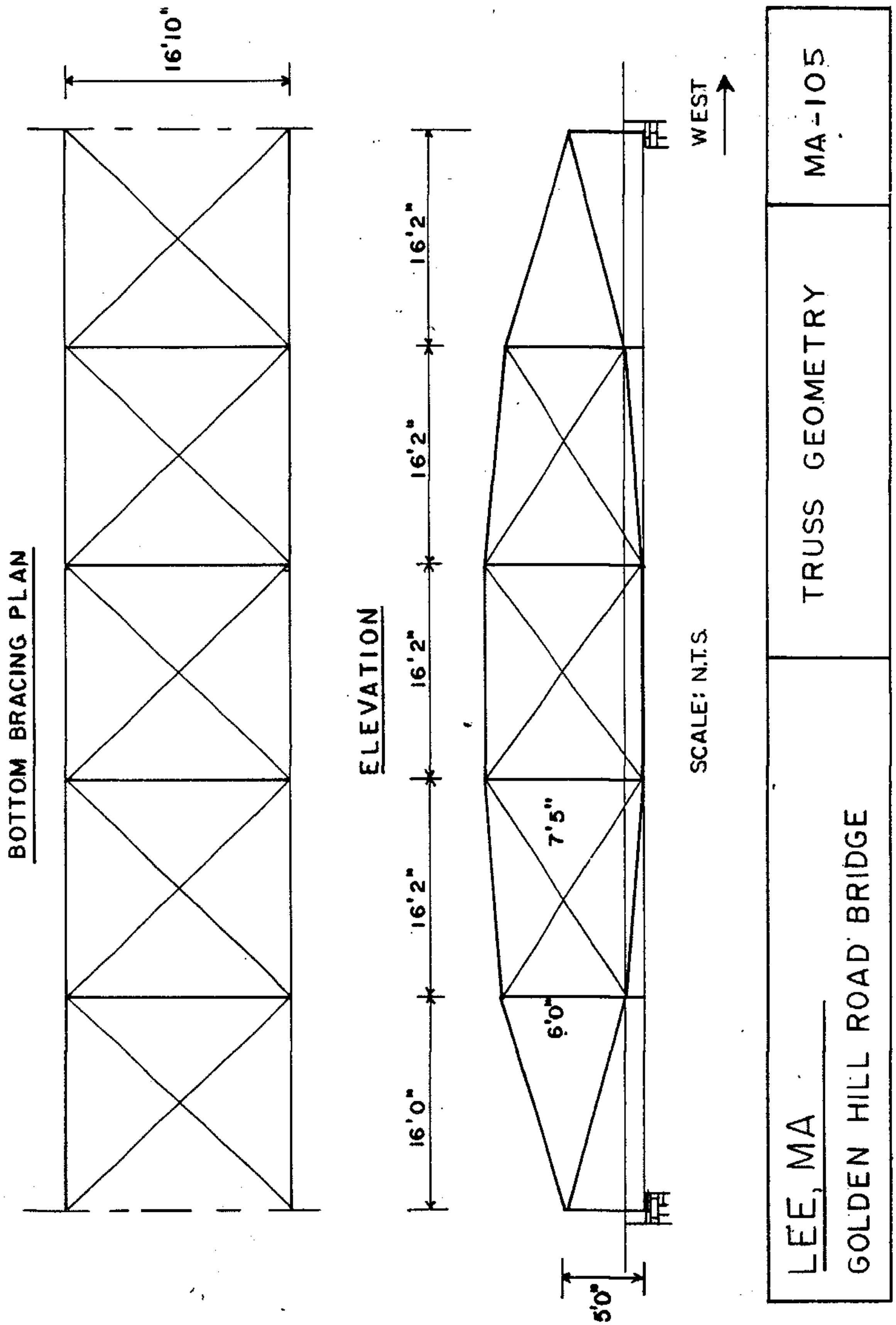


FIG VIII

WITNESSES:
Edw. W. Byrn.
Harrison B Brown

INVENTOR:
Wm O. Douglas
BY Munn & Co
ATTORNEYS.


BOTTOM BRACING PLAN
16'10"
ELEVATION
16'2"
16'2"
16'2"
16'2"
16'0"
7'5"
6'0"
5'0"
WEST
SCALE: N.T.S.
MA-105
TRUSS GEOMETRY
LEE, MA
GOLDEN HILL ROAD BRIDGE

ENDNOTES

1. In his patent, William Douglas refers to this feature as a "tension floor-line chord," and to the combination of floor-line chord, floor beams, and lower lateral rods as a "wind truss."

2. See: Victor Darnell, "Lenticular Bridges from East Berlin, Connecticut," The Journal of the Society for Industrial Archeology, vol. 5, no. 1, 1979, pp. 19-32; and Bernard Drew, Spanning Berkshire Waterways (Great Barrington, Massachusetts: Attic Revivals Press, 1990).

3. The 1990 Massachusetts Historic Bridge Recording Project documented three other lenticular truss bridges: Bardwell's Ferry Bridge at Conway/Shelburne (HAER No. MA-98), Blackinton Bridge at North Adams (HAER No. MA-109), and Aiken Street Bridge at Lowell (HAER No. MA-106).

4. Darnell, p. 19.

5. Ibid, pp. 19 and 27.

6. Ibid, p. 24.

7. Carl W. Condit, American Building Art: The Nineteenth Century (New York, 1960); Darnell, pp. 20-24; and Drew, pp. 17-21.

8. Records of the Town of Lee From Its Incorporation to 1801 (Lee, Massachusetts: Press of The Valley Gleaner, 1900); and Reports of the Town of Lee 1863-64 and 1866-67.

9. Reports of the Town of Lee, 1885-86; and, The Valley Gleaner, 8 July 1885.

10. Darnell, p. 20.

11. Ibid.

12. J.A.L. Waddell, Bridge Engineering (New York: John Wiley & Sons, 1916), p. 474; Darnell, p. 27; and, Drew, pp. 20-21.

13. Drew, pp. 19-20.

14. Florence Consolati, See All the People or, Life in Lee (Lee, Massachusetts, 1978), p. 256.

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