## HAER Level II Documentation

# Clark's Mills Bridge

## Towns of Greenwich and Easton, Washington County, New York. (BIN 3-30363-0/ PIN 1755.32)

## NYS OPRHP 15PR04768 (HAA #4906-61)

*Sponsored By:*
**Washington County**

*Funded By:*
**NYS DOT, Region 1 & The Federal Highway Administration**

*Prepared By:*
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**October 2017**

Clark's Mills Bridge
Towns of Greenwich and Easton
Washington County
New York

HAER No. NY-

# OUTLINE FORM REPORT

Historic American Engineering Record
National Park Service
Department of the Interior
Washington, D. C. 20240

HISTORIC AMERICAN ENGINEERING RECORD

CLARK'S MILLS BRIDGE
(BIN 3-30363-0)

HAER No. NY-

**Location:** Clark's Mills Bridge carries County Route 113 over the Battenkill. It is located in the towns of Easton and Greenwich in Washington County, New York.

USGS Quadrangle: Glens Falls, NY
UTM Coordinates: Zone 18N 616485 Easting, 4774664 Northing (NAD 83 datum)

**Owner:** Washington County, New York

**Significance:** The Clark's Mills Bridge is an early example of the use of the Melan patent to construct a composite steel and concrete arched bridge. The bridge was built in 1915-16, and has been determined to be eligible for listing on the National Register.

## PART I. HISTORICAL INFORMATION

### A. Physical History:

**1. Date of erection:**
The bridge was constructed in 1915-16.

**2. Architect:**
The designer/engineer of the bridge was William Mueser. A brief biography of Meuser, who designed or supervised the construction of approximately 2,800 reinforced concrete bridges, has been published.

> Mueser was born in Germany in 1872 and emigrated to the United States in 1893. Between 1895 and 1900 he was associated with the Melan Arch Construction Company, initially as a designer and eventually as an owner of the company. He is credited with designing and supervising the construction of the first reinforced concrete arch bridge built in the United States, in Rock Rapids, Iowa in 1894. Mueser also designed the first reinforced concrete arch bridges built in New York, New Jersey, Pennsylvania, and the District of Columbia. In 1900 he formed the Concrete-Steel Engineering Company in partnership with Edwin Thacher. Thacher, like Mueser, specialized in reinforced concrete engineering and held

a number of concrete arch and reinforcing system patents. After 1912 when Thacher retired from the firm and from active practice, Mueser became the sole owner of the Concrete-Steel Engineering Company. One of his most notable bridges is the Galveston Causeway, Texas. Mueser continued to manage the firm until 1933 when he dissolved the company and entered the employment of the Federal Civil Works Administration as a Regional Director. Before his death on August 4, 1950, Meuser obtained 50 patents pertaining to reinforced concrete construction including the "diamond" reinforcement bar still in use today. He was a member of both the American Society of Civil Engineers and the American Society of Materials Testing (Bridgehunter 2017).

3. **Original and subsequent owners, occupants, uses:**
The original owners of the bridge were the Towns of Easton and Greenwich. At an unknown date ownership was transferred to Washington County. It was designed and has always been used for carrying vehicular traffic.

4. **Builder, Contractor, suppliers:**
N. R. Porterfield, New York, NY.

5. **Original plans and construction:**
A set of six original drawings exists, and are stored in the flat files of the Senior Engineer at the Washington County Department of Public Works, Fort Edward, NY.

6. **Alterations and additions:**
The bridge has been altered by the removal of electric lamp standards, which were formerly located at each end of the bridge. No photographs of this feature of the bridge have been located.

## B. Historical Context:

### History of the Site

A nineteenth century treatise on water power provides background information on the site previous to the construction of the present span.

> The first water privilege met in ascending the stream [from the Hudson] is but a short distance above the mouth, at a place locally known as Clark’s Mills. The river there runs between banks and over a bed of black slate rock, is about 250 feet wide, shallow, and contains rapids with moderate fall for 800 or 1,000 feet below the dam. The privilege is owned by Hiram Clark, and is utilized on the north bank in

> the manufacture of sashes, doors, and blinds, a saw-mill and plaster-mill also being run in connection with the other works. A log dam, 9 feet high, runs across to a ledge on the south bank. The fall obtained as the mills is 10 feet. There is at times a little scarcity of water, but it is due to the very leaky condition of the dam, and even in its present condition the proprietor counts upon 100 horse-power in the very lowest stage of the river. Once in three or four years some hindrance is experienced for perhaps a week, due to backwater from the Hudson. In the spring break-up gorges form at the head of the pond, and when they go out cause a very heavy run of ice (Trowbridge 1885: 40).

A span had been constructed at Clark's Mills and two other locations on the Battenkill by the early 20th century. The Clark's Mills Bridge and two others were condemned by the New York State Highway Department, who required their repair or replacement, in about 1914. In December 1914, a public meeting, presenting the reports of Engineer Brainard, "who was employed by the town [of Cambridge?] to examine the four bridges [a fourth bridge was included at this point, but appears to have been dropped out of consideration at a later date], and of Engineer Hermans of the highway department, who inspected them later on and on whose report three of the bridges have been condemned….The Clark's Mills bridge [County Superintendent Richards opined, was]…in very bad shape and not worth repairing." Assessments of the other bridges were presented, with one of them—the village bridge—being thought worth saving. The report of this meeting, quoted in part above, continues with an account of the presentation of William Mueser who made a presentation at "the theatre", the location of which was not specified. Mueser was described as

> an engineer representing the Concrete-Steel Engineering company, [who] gave a talk on concrete bridges, illustrated with a large number of stereopticon views of bridges built from his company's plans. A number of citizens were present in addition to the members of the town boards.
>
> Mr. Mueser stated that his company is not in the contracting business and does not build any bridges. It does design bridges and furnish plans and inspection for their erection. He contrasted concrete with steel construction, saying that about thirty years is the life of a steel bridge, while a concrete bridge is stronger at the end of thirty years than when first built. His views showed a large number of concrete bridges, some of them large structures, in the Middle West that went through the floods of a couple of years ago, while steel bridges alongside of them were swept away.
>
> Mr. Mueser continued his talk after the meeting reconvened at the town office. He showed drawings and designs for bridges to replace those under consideration. He also gave figures of the probable cost of such bridges, stating that the figures were outside estimates and included all the costs connected with the building and taking care of traffic while the bridge is under construction, as well as the engineering and all other expenses.
>
> For the Clark's Mills bridge the plans called for a bridge with three spans, each eight-five feet long, two piers and two abutments, all on rock foundation. The

> bridge would have a twenty-foot roadway, and Mr. Meuser placed the cost at $24,000. Mr. Richards states that he believed that a bridge according to the specifications could be built for less money, and he thought the cost would not exceed $20,000. This bridge, Mr. Richards said, would cost about twenty per cent more than a steel bridge, and he considered it would be worth more than the difference….
>
> Mr. Richards said that he considered Mr. Mueser's estimates of the cost of the bridges more than liberal but the latter stated that he preferred them to be high rather than low, and expressed the opinion that …officials often erred on the side of making estimates too low. The taxpayers, he said, would be better pleased to have a balance left to be turned into the general funds rather than to have a demand made for more money to finish the job.
>
> Mr. Mueser also pointed out that a concrete bridge, besides being a permanent structure, has the advantage that it is built almost entirely by home labor and home materials, while the money that is spent for a steel bridge nearly all goes to some steel mill in a distant city.
>
> The question was asked if the cost of these bridges would not be reduced by making them sixteen instead of twenty feet wide. Mr. Mueser said it would be, but he did not recommend it. The reduction in cost would not be in proportion to the size of the bridge, and he believed the width should be made ample (Greenwich Journal 1914).

It is clear from the above that initial plans for the bridges were already extant by late 1914. By February of 1915, proposals for the replacement of the three bridges agreed upon were laid before the Washington County Board of Supervisors, with an estimate of $37,000 construction cost for all three, specifying that they be concrete bridges (Washington County 1915:75-76). A more thorough case was laid out for the replacement of the bridges later on that year, when the estimate for their construction was raised to $41,000. Provisions for raising the necessary funds by bond were established at a meeting of the County Supervisors:

> …it appears that all three said bridge are old and through use and wear have become unsafe for public use and travel and that the same have been condemned by the State Highway Commission of the State of New York, and that by an order of the Honorable Henry V. Borst, Justice of the Supreme Court of the State of New York, entered in Washington County Clerk's office on the 10th day of July, 1915, it has been directed that the three aforesaid concrete steel-arch bridges should be built across the Battenkill between the Town of Greenwich and Easton and that the cost thereof should be borne equally by the two said towns; and that the electors of the Town of Easton at the regular biennial town meeting held therein at the time of general election on the 2nd day of November, 1915, have authorized the raising by tax of not to exceed $20,500 and the issuance of bonds therefor in order to pay said town's share of the cost of the construction of said bridges; and that it further appears by the application of the town board of said town that the estimated cost

> and expense of the construction of said bridges as shown by the price at which the contract was let is $41,000, one-half of which must be borne by the said town of Easton; and that said town should be authorized to borrow the sum of $20,500 upon the credit of such town and issue its bonds…(Washington County 1915: 126).

The act to authorize the issuing of bonds for bridge construction was passed at a meeting on 18 November 1915 (Washington County 1915: 77).

**Reinforced concrete bridges**

At the time the Clark's Mills Bridge was built, the use of steel reinforced concrete technology for constructing spans was still in its infancy. An industry publication from the period touted the benefits of the use of this structural system, the process of erection, and some of the structural limitations that were taken into consideration in the design of these bridges.

> The use of concrete and reinforced concrete arches for highway spans has increased enormously within the last few years and they will probably eventually supplant other types in a very large percentage of all spans between 30 and 160 feet in length. Within generous limits they may have any required dimensions and lend themselves very readily to a wide range of architectural and artistic treatment and embellishment at a moderate increase over the minimum cost. The concrete may be made monumental in character and consistent with high class surroundings so as to have features in keeping with the suburbs and landscapes.
>
> They almost invariably possess a large excess of strength without materially increasing the minimum cost of construction. They are very durable and require little or no maintenance. They are not, however, articles of manufacture, cannot be fabricated in factories, purchased complete, or shipped from place to place, but should always be designed specifically for each given site by competent engineers and built by experienced contractors. They require larger piers and more secure foundations than are indispensable for steel bridges, and cannot be as quickly erected and opened for travel. They cannot be shifted from place to place, and cannot readily be reconstructed. They require considerable height between water level and the top of the floor and are not adapted for supporting a through road-way.
>
> Construction. The construction of the sub-structure generally requires derricks or their equivalent, and a complete concrete storage, mixing and distributing plant. For work below the water level, sheet piling, cribs, cofferdams and pumping equipment are often required. Operations are generally simple and can be executed by any organization and equipment for ordinary engineering construction and foundation work.
>
> The same plant that is installed for the substructure is usually suitable for a large part of the construction of the superstructure of concrete or reinforced concrete arch spans. As for the sub-structure, the concrete may be distributed by

> service tracks on the new structure, or on an adjacent old one, or on falsework trestles alongside, by derricks or by cables. The arch forms require support on strong and rigid centers and these may either be made with pile and trestle falsework or with movable trussed centers, generally built of steel for spans in excess of 40 feet.
>
> The arch rings are usually built in successive sections corresponding to the voussoirs of masonry arches, and the form work is comparable with the work of any other heavy concrete construction. There is abundant field for ingenuities and economies in design and handling the concrete plants. Competent specialists are available for designing structures and the construction plans and the equipment can be purchased from experienced manufactures that specialize in its production and can furnish it more cheaply and satisfactorily than the owner can otherwise provide it.
>
> Concrete arch bridges invariably have either solid fill or concrete floors, the latter sometimes being carried wholly or in part by steel floor beams encased in concrete. Sometimes concrete arch bridges are provided with reinforced concrete floors carried by steel beams and girders (Public Works 1921: 352-53).

The above text is particularly apposite, given the fact that it was illustrated with images that included the Clark's Mills Bridge as an example.

**Melan Arch Bridges**

The Melan system of constructing composite steel-reinforced concrete arch bridges was first tested in July 1892 by Pittel & Brausewetter, manufacturers, in Austria. The Melan system was found in later comparative assessments to have a "much greater capacity than either the Monier or concrete arches of the same span" and it was determined that "this arch is eminently adapted for heavily loads floors or bridges of small spans" (Hill 1895: 172). Joseph Melan, then professor at the Imperial and Royal Technical High School at Brünn, in Moravia (today's Brno in Czechia), was the inventor of this structural system, and received Letters Patent from Austria-Hungary on 23 October 1892. The invention was identified as a design for a "Vault for ceilings, bridges, etc." in a United States patent application filed on 17 May 1893 by Melan, who received a patent on 12 September 1893 (patent number 505,054) for his structural innovation. In his patent application, Melan claimed

> a novel construction in fire-proof arches for bridges, viaducts, the ceiling of vaults and the like, the objects being to provide an arch that possesses equal or greater strength than the ones in general use but which will be considerably light; to provide an arch having sufficient resistance to support an unequally distributed load without injury, and to provide an arch that can easily be constructed and that will be inexpensive.

Melan went on to describe his system, and the process of construction. The design incorporated

> longitudinal girders or beams between which the arches are made....the ribs of the arch curved to conform to the intrados of the arch and…made of rolled I or T iron, riveted iron plates, or the like, that is to say these ribs are made of metallic beams that are stiff transversely. For long spans I have found riveted iron plates most advantageous. The said ribs are located at intervals between the beams or girders and it will be noted that if the ends thereof are fitted nicely a stilt and rigid connection will be made between the ribs and beams or girders, but to insure such rigid connection I prefer to employ wedge plates that are forced in between the beveled ends of the ribs and the beams or girders, and which serve to hold the ribs rigidly in place in an obvious manner. It is manifest that I can bolt or rivet the ribs and girders if found convenient. After this frame work is constructed the centering is then constructed below the ribs and a filling of rammed concrete or the like is built that covers the sides of the ribs and extends between the same. The upwardly projecting portions of beams or girders are then covered with a coating of rammed concrete, and then a layer of rubble or other light filling material is placed upon the concrete filling, and upon this layer or filling all the pavement or flooring can be built.
>
> It will be seen from the foregoing description that the arch or vault can be easily and quickly built with the minimum of labor, as I obviate bolting or riveting, which is a decided improvement as it reduced the cost of construction. And then, further, it makes a lighter vault or arch capable of withstanding great strains. Moreover, the strains to which the concrete vault is subjected are reduced, and notably when the load is unequally distributed upon two adjoining panels, for in this case the strain is borne for the most part by the ribs, thereby increasing the bearing strength of the vault (Melan 1893).

**Building the Bridge**

Clark's Mills Bridge was one of three bridges in Washington County for which bids went out in August 1915. The bridges were described as "3 concrete steel arch bridges…One at Greenwich, 1 span 120 ft., width 27 ft.; one at Middle Falls, two spans 33 ft. and 1 span 82 ½ ft., width 22 ft.; and the other at Clarks Mills, 3 spans, 86 ft., width 22 ft." (Engineering Record 1915a: 55). Bids from N. R. Porterfield of 17 Battery Place, New York, were accepted for all three bridges, for a total cost of $41,000. The plans and supervision were furnished by the "Concrete Steel [sic] Eng. Co., Park Row Bldg., New York." (Engineering Record 1915b: 109).

The Concrete-Steel Engineering Co. were a consulting engineering company, and successors to the Melan Arch Construction Company. They held the patents for the construction of Melan type bridges, and patents by Thacher, Von Emperger, Mueser and others (Concrete-Steel n. d.).

The design of the bridge made use of the patents the firm held, its design specified as having "Three Melan rib 86-foot arch spans, 20-foot roadway, no sidewalks." Its cost in 1916 was reported as $17,000 (Public Works 1921: 352).

Work was reported to be "progressing" in November 1915, and that it was "expected that the structure will be completed by spring" of the following year (News 1915: 7). Difficulties attended the construction of the span, which was referred to as "the Riverside bridge" in a report of the New York State Commissioner of Highways. It was the "largest bridge built by [that is, under the supervision of] a town superintendent" in 1916. Foundation work proved to be difficult "as it was necessary to carry the excavation to rock (Duffey 1917: 259). The bridge was opened for use on 25 July 1916 (Our Century 1999:4). It was described as "299 feet long and 20 feet wide" in the report of Orson C. Richards, County Superintendent of Highways, at the 6 December 1916 meeting of the County Board of Supervisors. Richards further noted that construction of the bridge had "been supervised by these experts [i.e., staff of the Concrete Steel Engineering Company] during construction" [Washington County 1916: 111].

## PART II. ARCHITECTURAL INFORMATION

### A. General statement:

1. **Architectural Character:**
   The Clark's Mills Bridge incorporates neoclassical detailing showing the influence of the Arts & Crafts movement in its reductive and stylized forms. This is particularly evident in the design of its parapet wall.

2. **Condition of fabric:**
   Significant deterioration of the surfaces of various components of the bridge has occurred, including spalling and undercutting as the result of erosion at the base of the piers and abutments. Loss of some components including coping light standards has occurred.

### B. Description of Exterior:

1. **Overall dimensions:**
   The roadbed, measuring from curb to curb is approximately19'-6" wide. Construction document called for the outside width of the bridge to be 22 feet, with a 20'-6" wide arch. The bridge is approximately 290 feet in length. Piers measure 11'-0" in width at their base, and 6'-6" wide at the springing of the arches.

**2. Foundations:**
The bridge abutments and intermediary piers are all founded directly on bedrock. The method of attachment is unknown.

**3. Side walls:**
Precast concrete parapet walls with panels on inside and outside faces inset 2" (typ.), 3'-4 ½" high above a 2 ½" projecting base, and with a beveled cap measuring 1 ¼" high. The panels were fabricated from multiple pours of concrete, each approximately 7" or 8" in thickness. The beveled cap was poured using a finer aggregate, perhaps to permit a more refined finish on the top surface of the parapet walls.

**4. Structural system:**
Steel reinforced poured concrete arches constructed using the Melan system.

**C. Site:**

**1. Historic landscape design:**

The bridge is located on a rural site, and spans a ravine created by the Battenkill. To the north are the remains of the hamlet known as Clark's Mills. Immediately west of the south end of the bridge is a mill site, currently occupied by Hollingsworth & Vose.

## PART III. SOURCES OF INFORMATION

**A. Architectural drawings:**
The original drawings, dated July 1915, are by the Concrete-Steel Engineering Co., of New York City. They are reproduced here in the Supplemental Material portion of this documentation, and are on file at the Washington County Department of Public Works, Fort Edward, NY.

**B. Early Views:**
Two early views, both of which were published in professional journals, have been located. They are reproduced in the Supplemental Material portion of this documentation.

**C. Bibliography:**

Bridgehunter
2017 https://bridgehunter.com/category/builder/william-mueser/ accessed 28 August 2017.

Concrete-Steel
n. d. *Concrete-Steel Arch Bridges*. Concrete-Steel Engineering Company, New York, NY. [c. 1900]

Duffey, Edwin
1917 *State of New York. Report of the State Commissioner of Highways* [for the year 1916]. Albany: J. B. Lyon Company.

Engineering Record
1915a "Bridges," *Engineering Record* 72:5 (7 August 1915).
1915b "Bridges," *Engineering Record* 72: 11 (11 September 1915).

Greenwich Journal
1914 "Concrete Bridges for Greenwich, Easton and Jackson," *Washington County Post* [Salem, NY], n. d., reprinted from the *Greenwich Journal* of 23 December.

Hill, George
1895 "Fire-Proof Floor Arches," *The Brickbuilder* 4:8 (August 1895), 170-172.

Melan, Joseph
1893 US Patent 505054. Available online at https://www.google.com/patents/US505054.

News
1915 "News of Schuylerville," *The Saratogian*, 18 November 1915, 7.

Our Century
1999 "Our Century, A Journal of Local Twentieth Century History Gleaned From the Pages of the Greenwich Journal and Salem Press," *Greenwich Journal and Salem Press*, 4 March 1999, 4.

Public Works
1921 "Short-Span Highway Bridges," *Public Works* 50: 17 (23 April 1921), 352-53.

Trowbridge, W. P.
1885 *Statistics of Power and Machinery Employed in Manufactures: Reports on the Water-power of the United States, pt. 1*. Washington, DC: Government Printing Office.

Washington County
1915 Proceedings of the Board of Supervisors of Washington County [N. p.: The County, 1915].
1916 Proceedings of the Board of Supervisors of Washington County [N. p.: The County, 1916].

**D. Likely Sources Not Yet Investigated:**

There are no known potential sources for additional information about the bridge.

**E. Supplemental Material: Historic Images and Original Drawings**

**Reproduced on the following pages.**

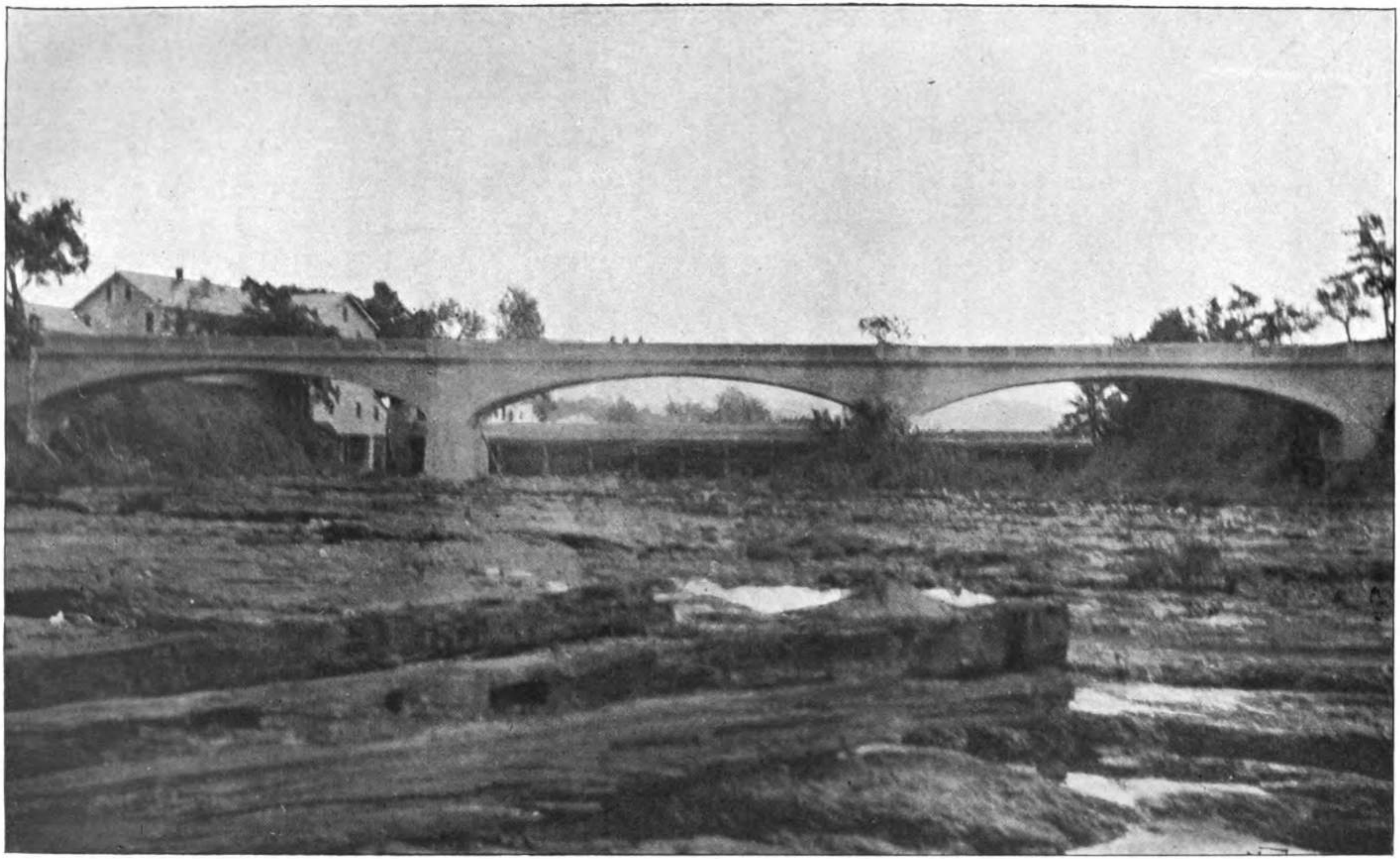


*Figure 1.* View looking east. *State Commissioner of Highways (1917: 251).*

*Figure 2.* View looking east. *(Public Works 1921).*

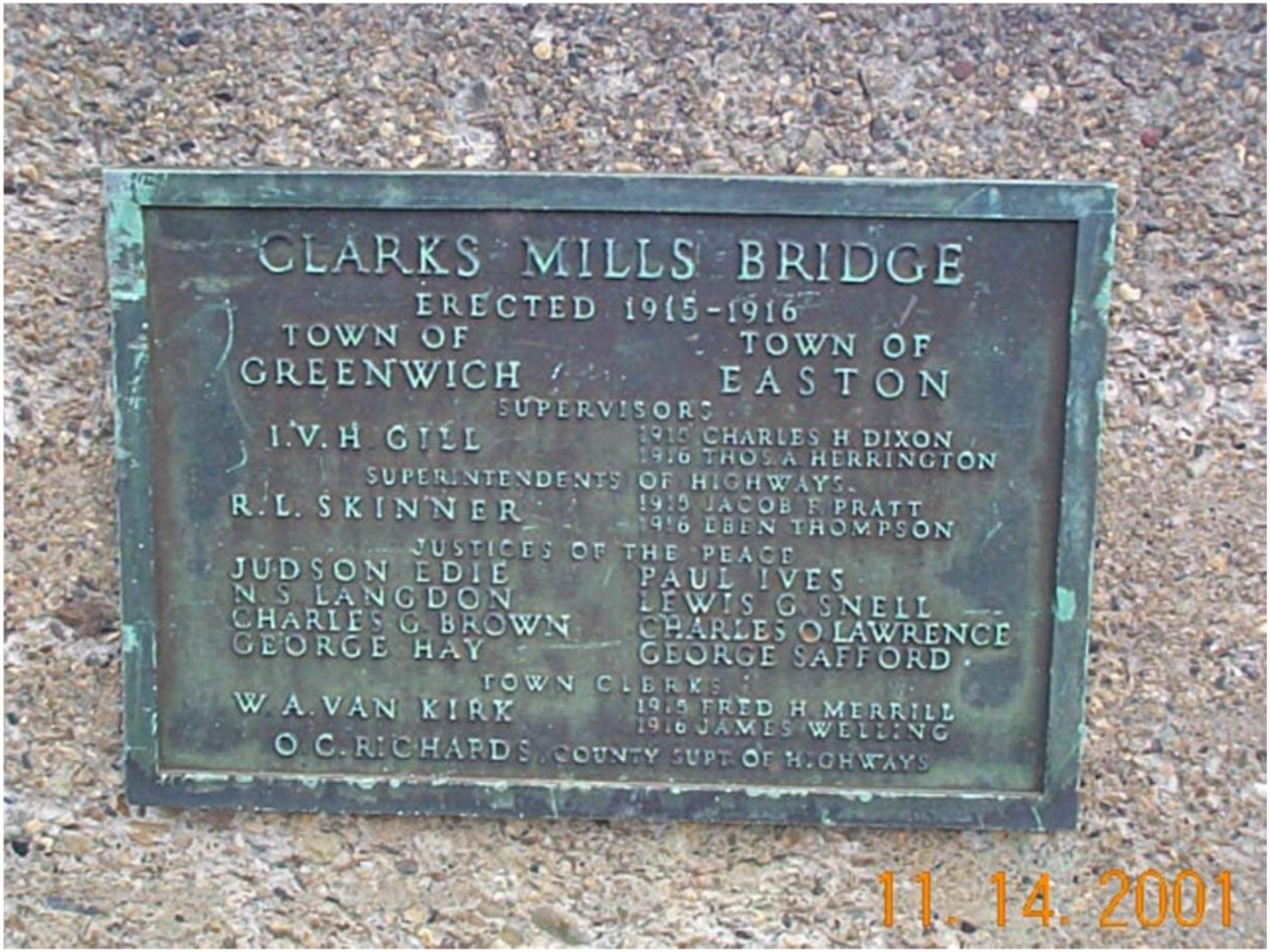



*Figure 3.* Bridge plaque. Photograph included in 2001 inspection report.

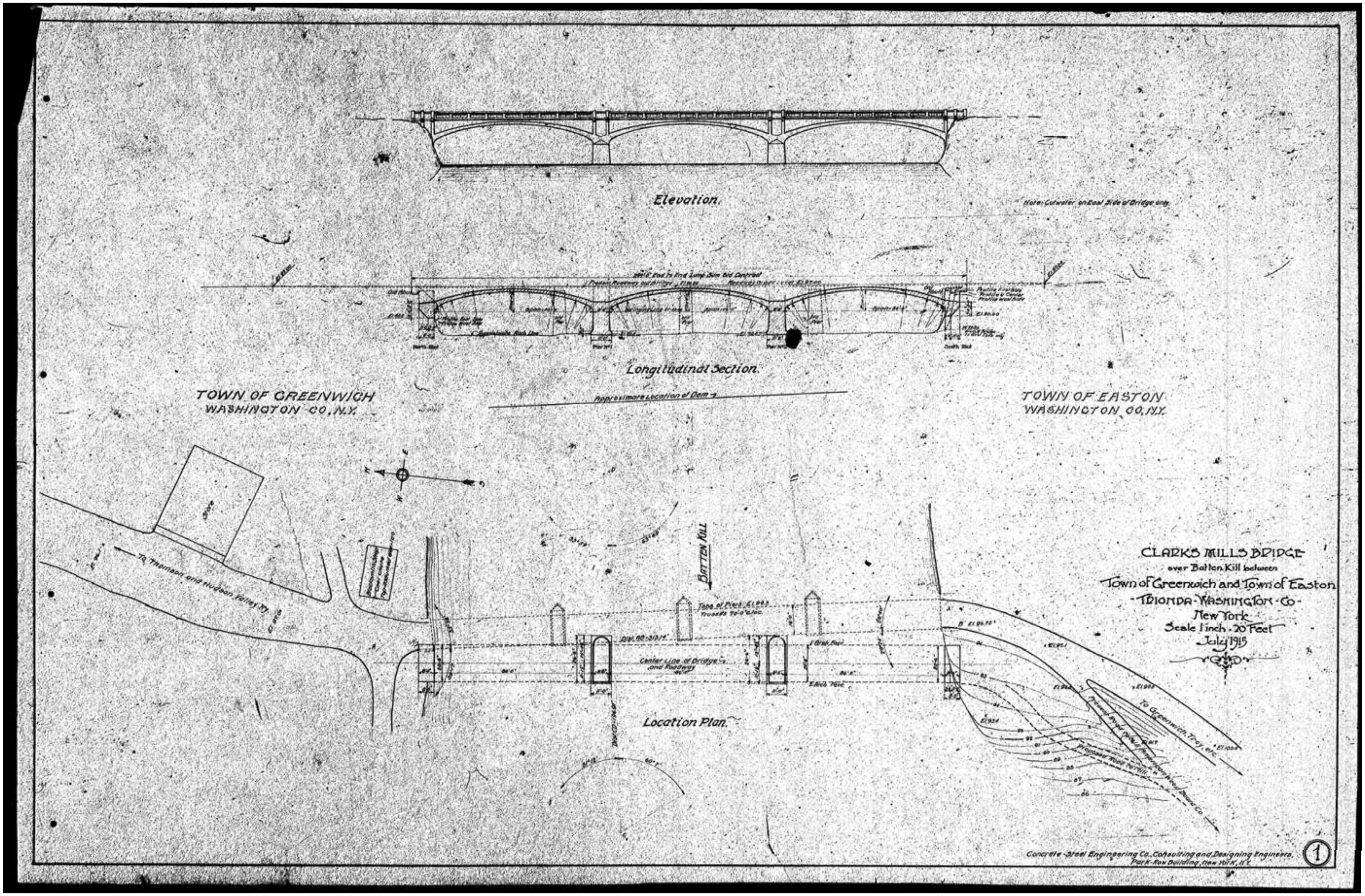



*Figure 4.* Sheet 1 of the construction documents (Washington County Department of Public Works).

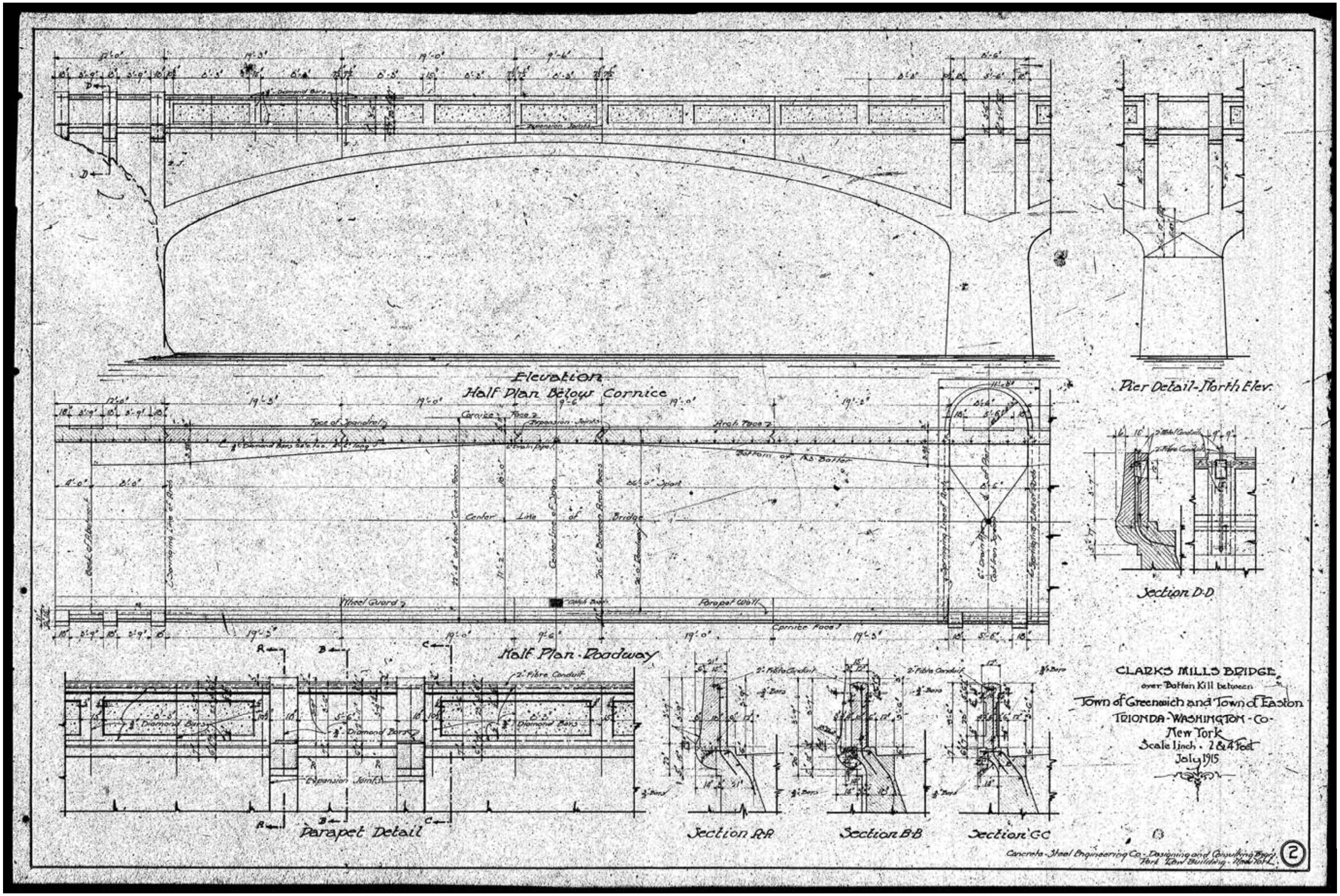



*Figure 5.* Sheet 2 of the construction documents (Washington County Department of Public Works).

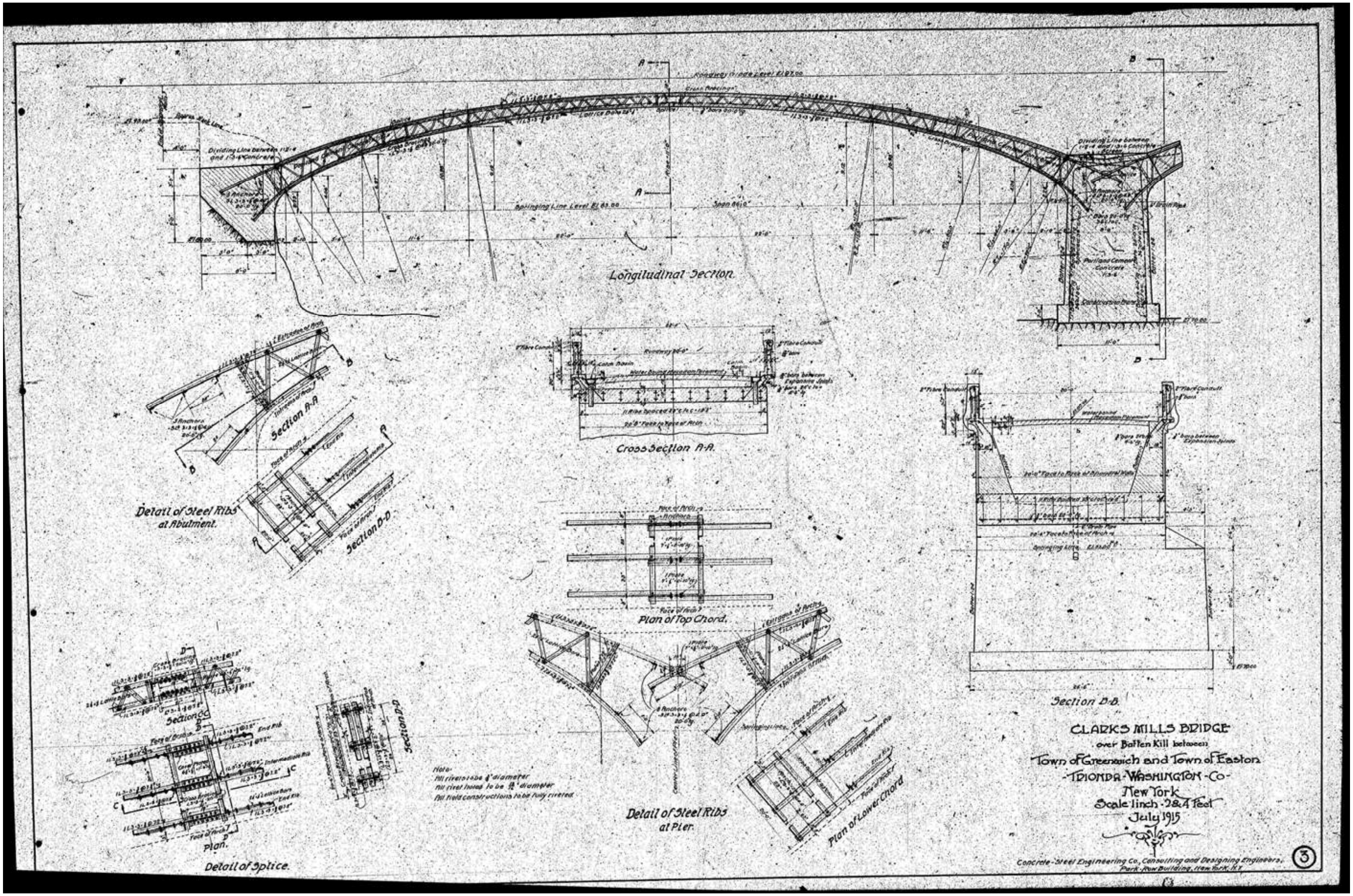



*Figure 6.* Sheet 3 of the construction documents (Washington County Department of Public Works).

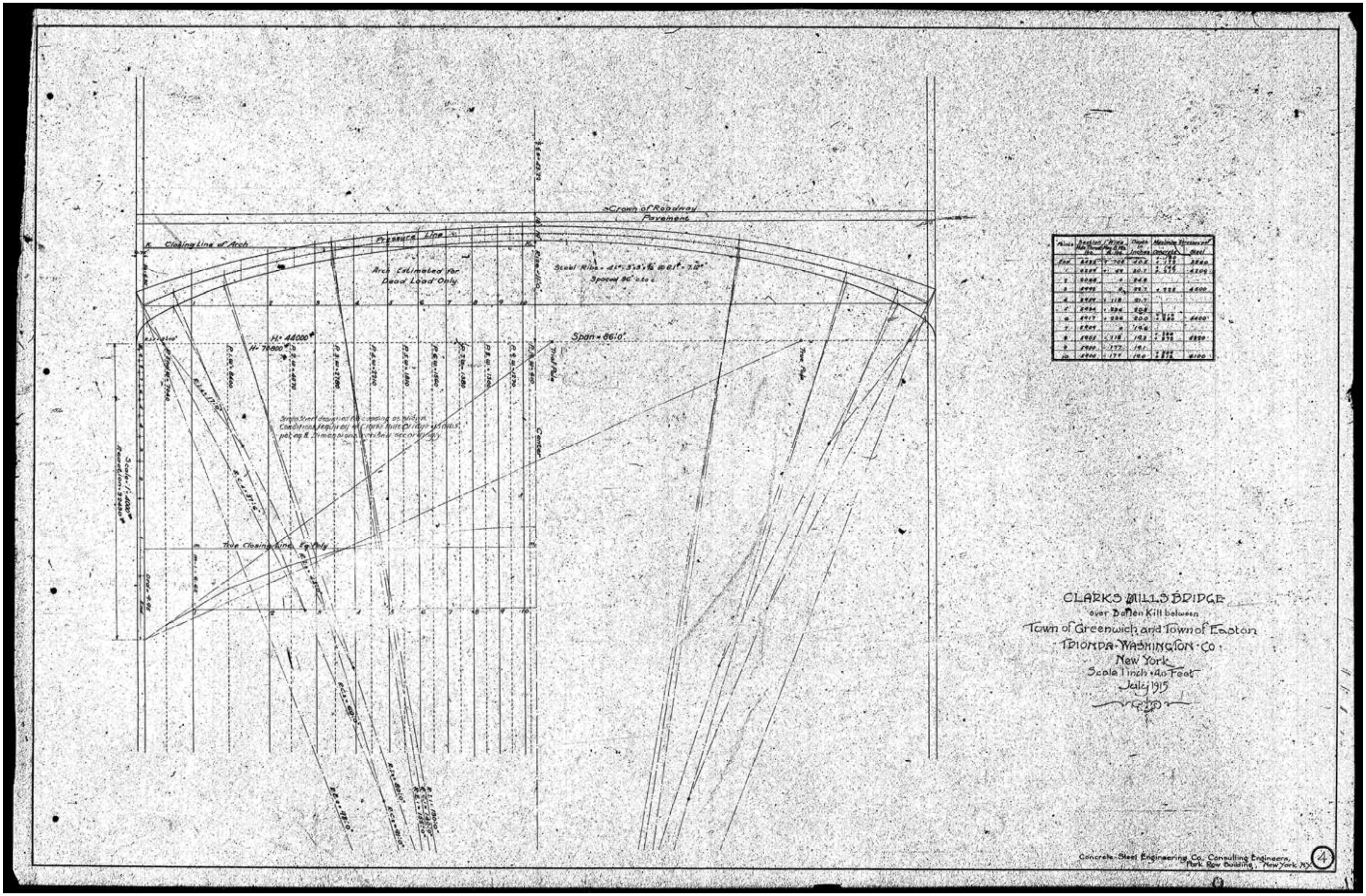



*Figure 7.* Sheet 4 of the construction documents (Washington County Department of Public Works).

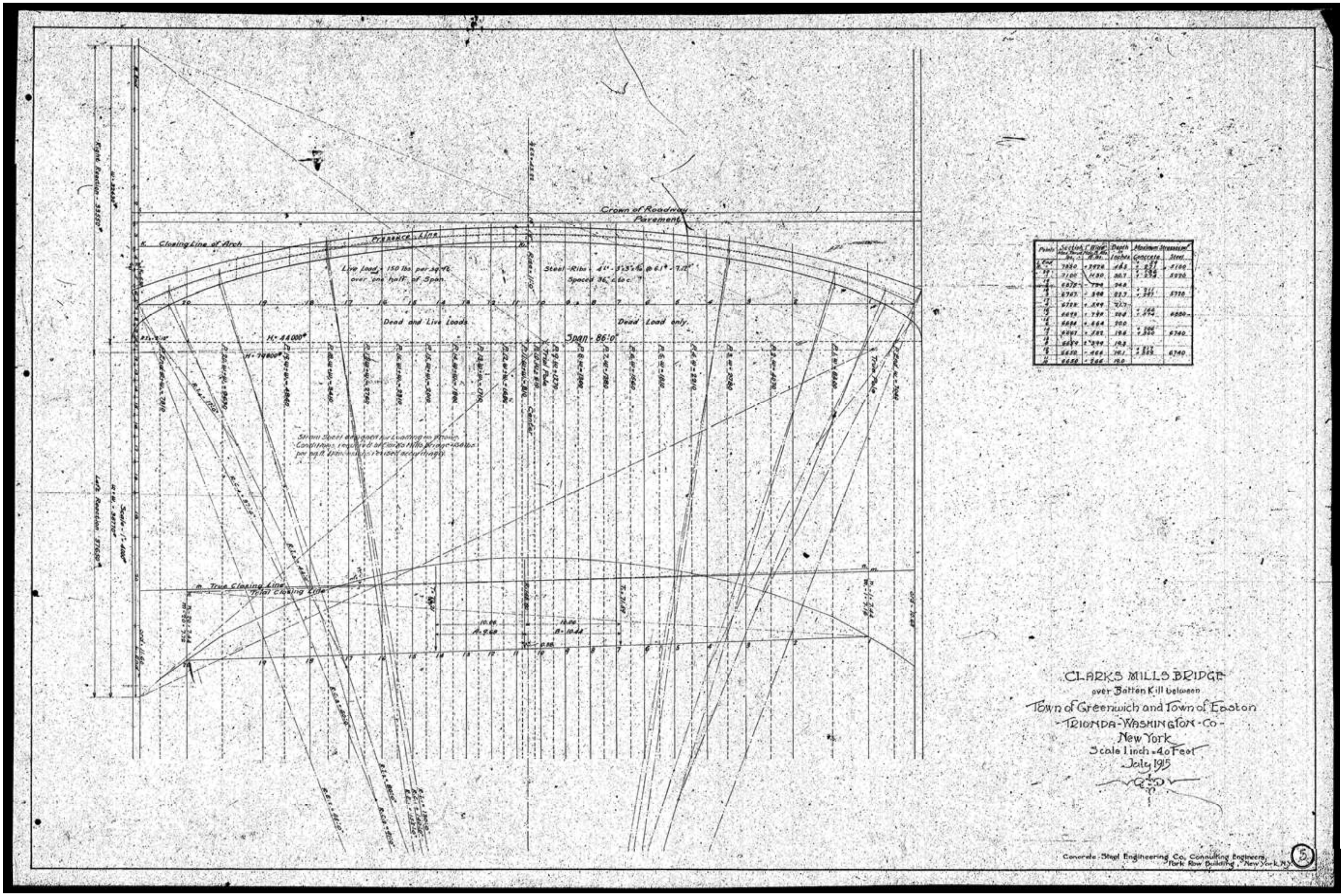



*Figure 8.* Sheet 5 of the construction documents (Washington County Department of Public Works).

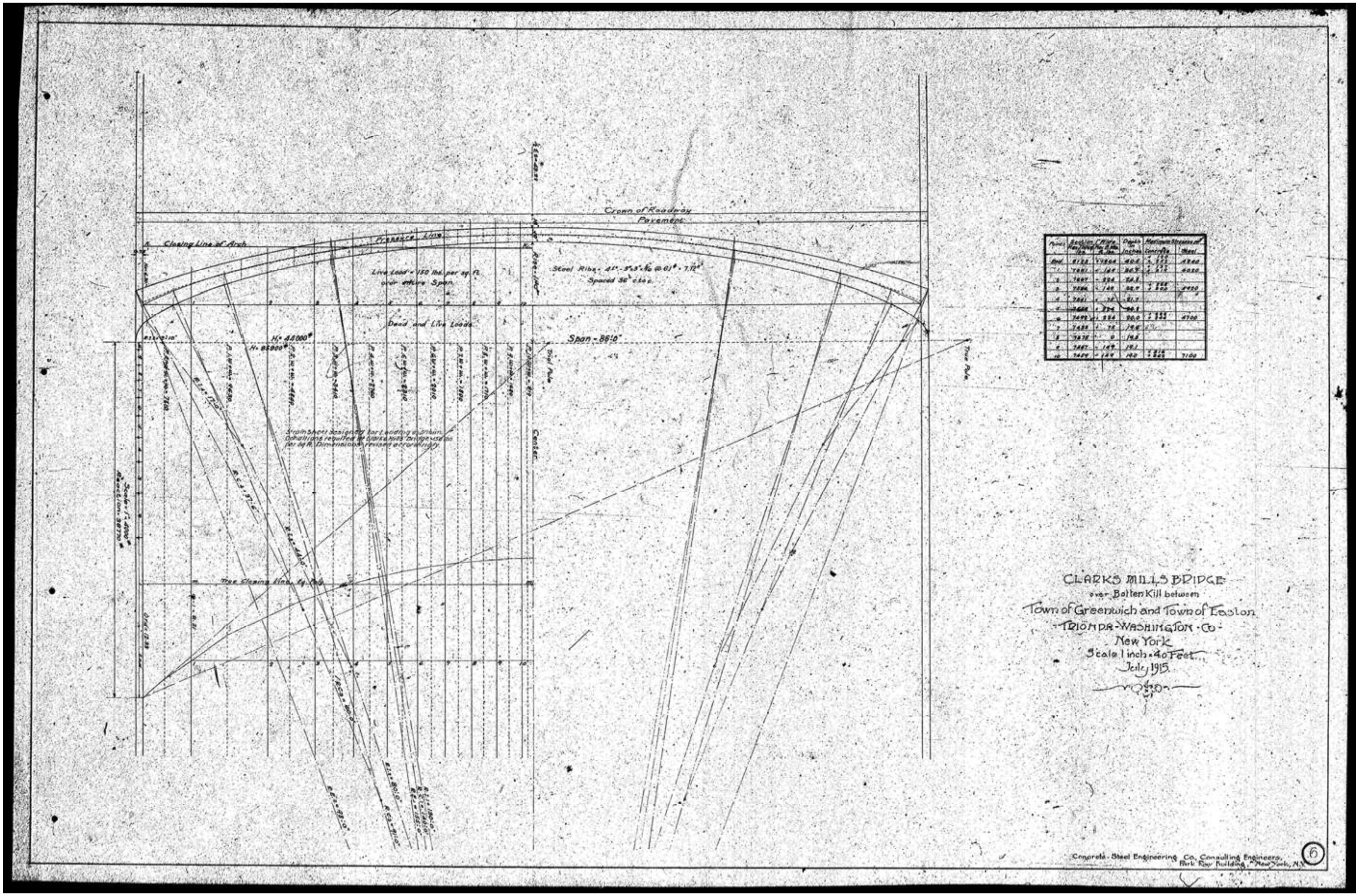
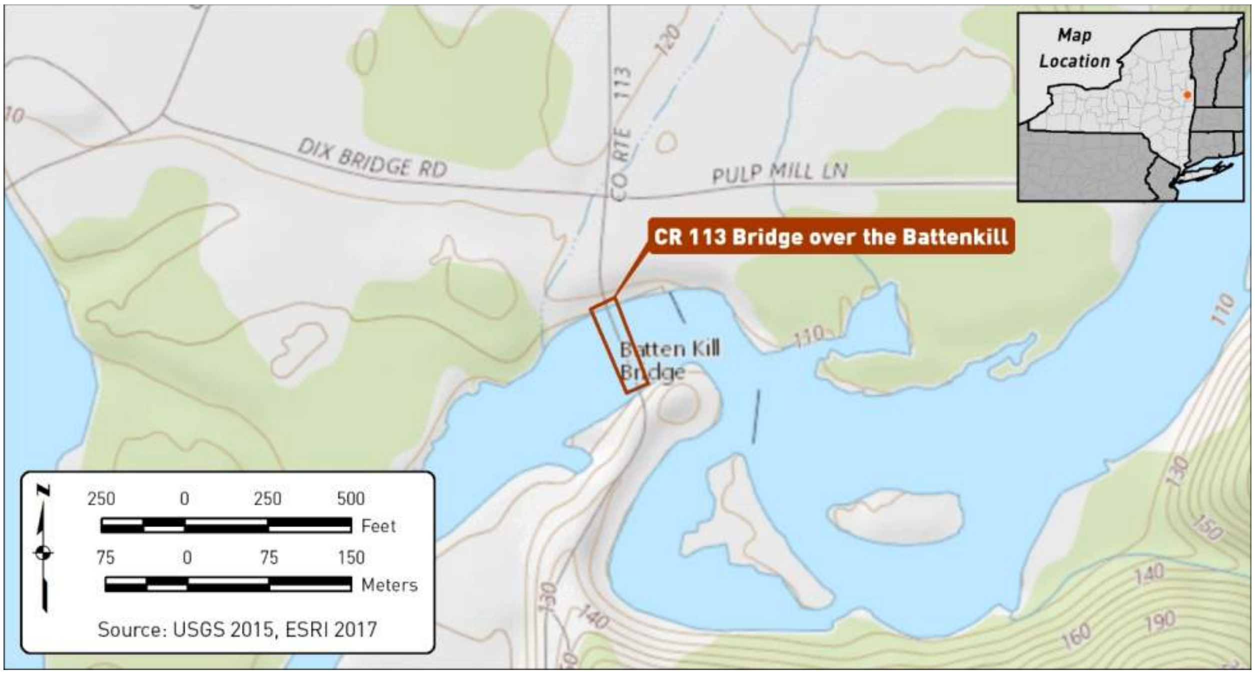


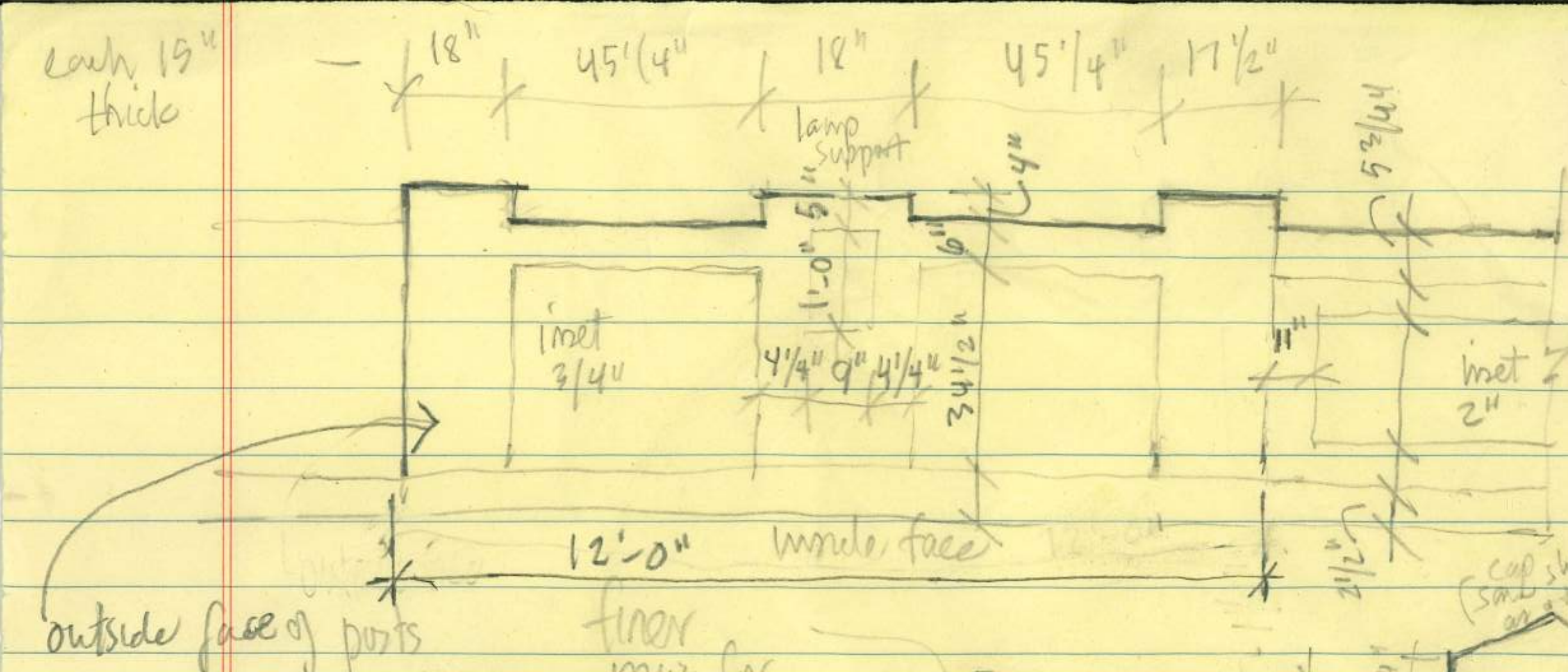

*Figure 9.* Sheet 6 of the construction documents (Washington County Department of Public Works).

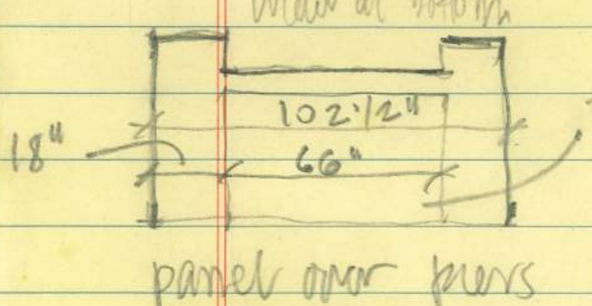
**F. Location Map**

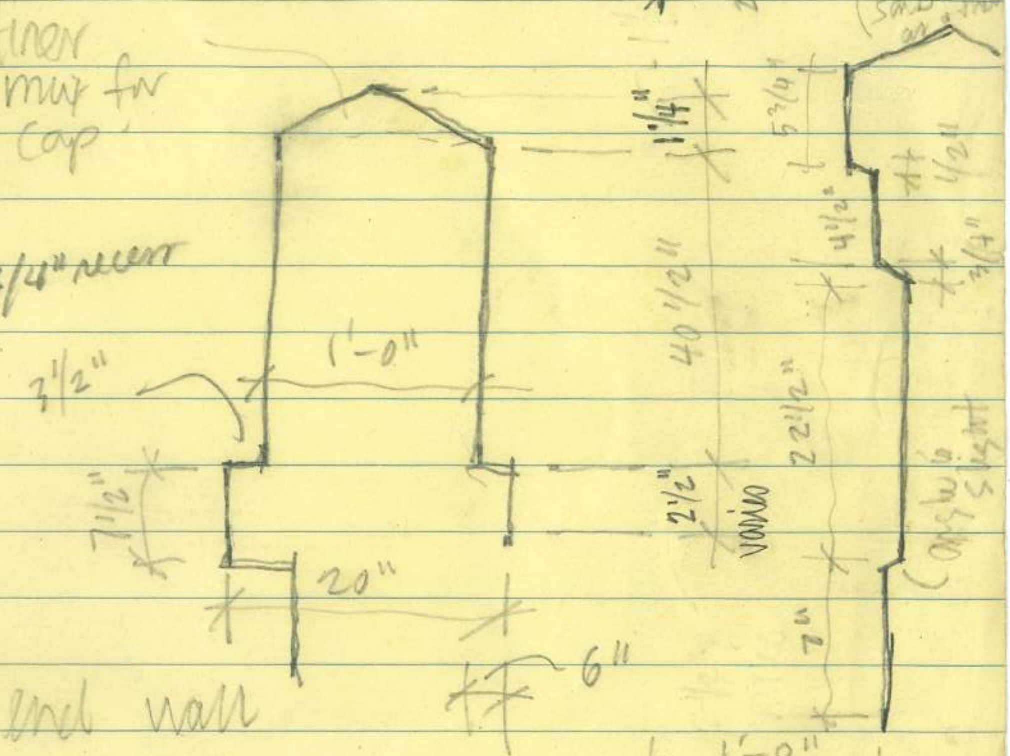


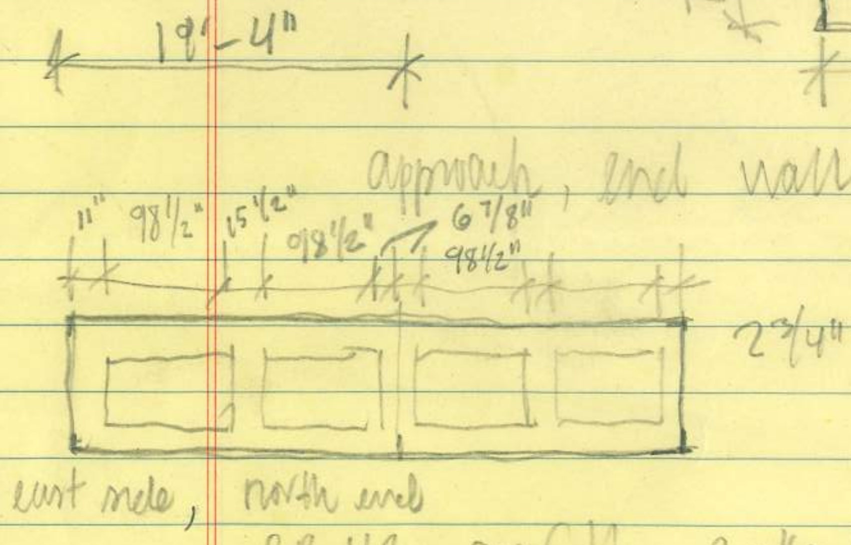

**G. Field Notes (2017)**

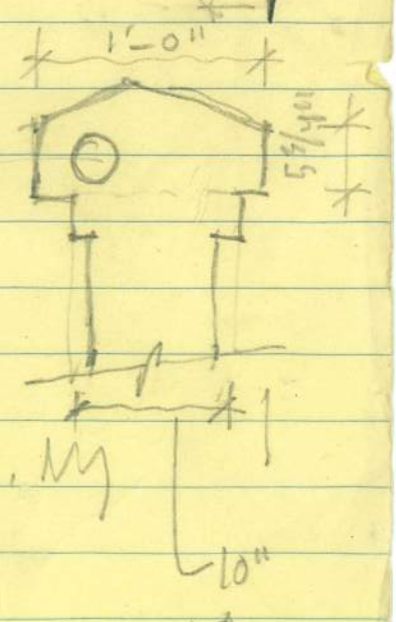
**Reproduced on the following two pages.**



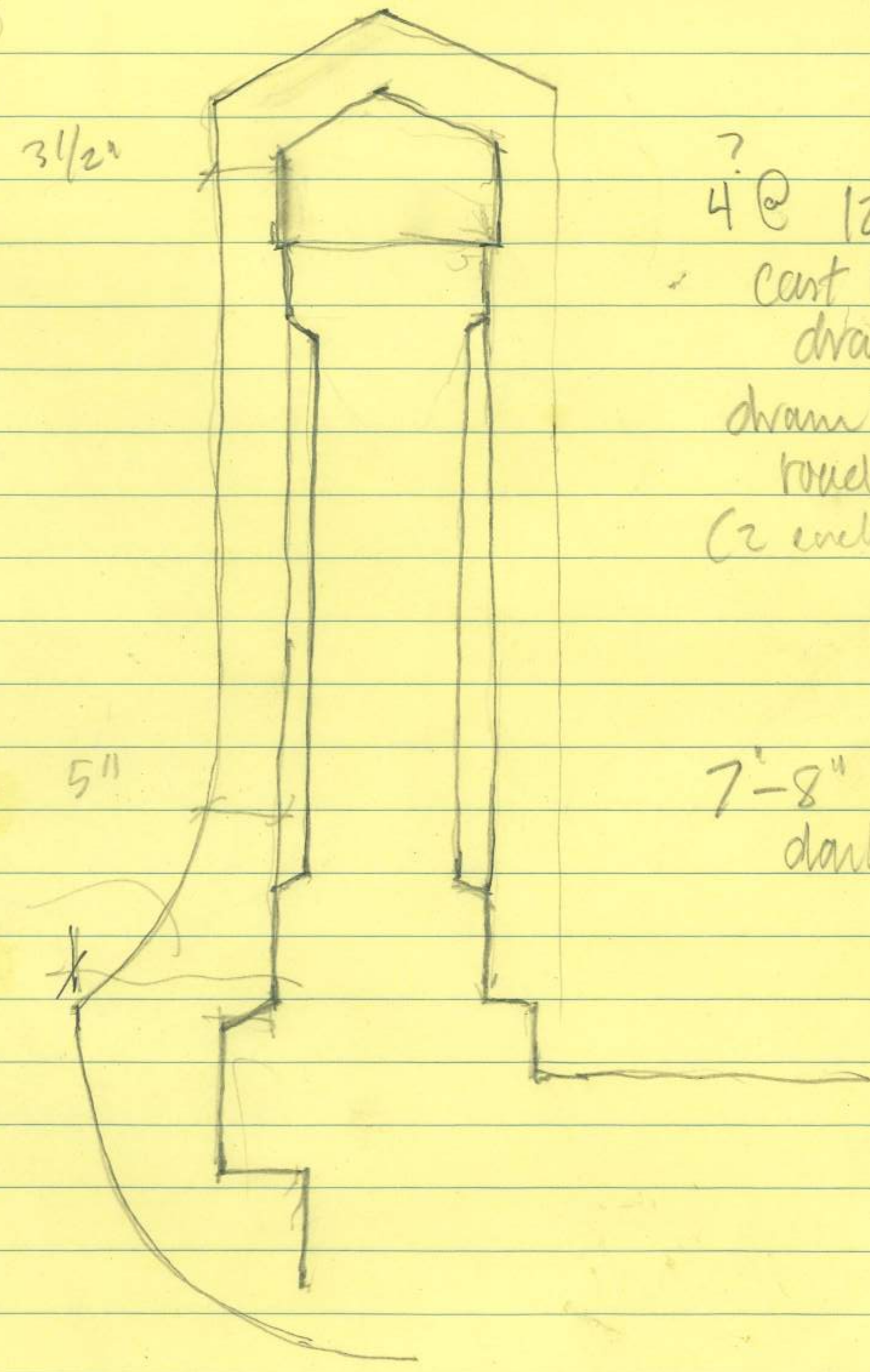




CR 113 over the Battenkill
Easton & Greenwich, Washington Co. NY
8 AUGUST 2017
W. Wheeler

roadbed width – inside face major (18") post to inside post = 20'-0 3/4"

19'-5 1/2"
curb to curb




4 @ 12" x 8"
cast iron drains
drain the roadbed
(2 each side)

7'-8" thick
daily pours

Bridge plaques (2) on W side of east ~~two~~ rail, have been removed.

W. Wheeler

8 AUGUST 2017

**PART IV. PROJECT INFORMATION**

This report was assembled by Walter Richard Wheeler. Mr. Wheeler wrote all sections of the documentation. Field notes and measurements were taken on 8 August 2017 by Mr. Wheeler. HAER photography was taken by Stephen Penson Ross on 8 August 2017.

HISTORIC AMERICAN BUILDINGS SURVEY

CLARK’S MILLS BRIDGE
HAER No. NY-

INDEX TO PHOTOGRAPHS

Photographer: Stephen Penson Ross 8 August 2017

1. Bridge approach, looking south-southeast

2. Bridge approach, looking north

3. East façade of bridge, looking west

4. West façade of bridge, looking east-northeast

5. North pier, looking east-northeast, with scale stick

6. General view, looking north

7. General view from river bed, looking south-southwest

8. North abutment and arch, showing steel arch partially exposed, looking northeast

9. Parapet wall and north approach, looking southwest, with scale stick

10. Pier, looking southeast, with scale stick

Bridge approach, looking south-southeast

Bridge approach, looking north


SPEED LIMIT
40

East façade of bridge, looking west


NOTICE
KEEP OFF
DAM

West façade of bridge, looking east-northeast

North pier, looking east-northeast, with scale stick

General view, looking north

General view from river bed, looking south-southwest

North abutment and arch, showing steel arch partially exposed,
looking northeast

Parapet wall and north approach, looking southwest, with scale stick

Pier, looking southeast, with scale stick