Stark Covered Bridge
Stark, New Hampshire

Historic Structure Report

Stark Covered Bridge and Stark Union Church (2012)

Prepared for

H.E. Bergeron Engineers, Inc.
2605 White Mountain Highway
North Conway, NH 03860

by:

Historic Documentation Company, Inc.
490 Water Street,
Portsmouth, Rhode Island 02871

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CONTENTS

1.0 INTRODUCTION

1.1 Historic Structure Report Overview

Stark Covered Bridge is a two span wood Paddleford Truss covered bridge located in Stark village center in the Town of Stark. (see Figures 1 and 2). It carries Northside Road over the Upper Ammonoosuc River and remains in service, posted at 10 tons. The bridge is listed on the NHDOT municipal bridge redlist due to its deteriorated condition.

In 2009 the Town of Stark and NHDOT prepared and submitted and application to the Federal Highway Administration (FHWA) for a *National Historic Covered Bridge Preservation Project (NHCBPP)* grant for the rehabilitation of Stark Covered Bridge. The following project purpose and need is adapted from that application. Upon receiving notice of grant approval the Town requested qualifications from engineering firms to design the rehabilitation repairs and improvements. The firm of H.E. Bergeron of Conway, NH was selected by the town in 2011. HEB contracted with Historic Documentation Company, Inc. (HDC) to prepare this report to assist the information needs of the Section 106 permitting process.

The purpose of this report is to provide the information on the history and physical condition of the bridge necessary to make informed decisions regarding the rehabilitation of the structure. The report identifies the character defining features of the historic bridge, the rehabilitation treatments they require, and the effects of those treatments on the historical integrity of those features. The report compiles or summarizes the other historical, inspection and engineering studies and reports pertaining to the Stark Covered Bridge conducted to date. The report was prepared by Richard M. Casella, Architectural and Engineering Historian with Historic Documentation Company, Inc.

1.2 Bridge Rehabilitation Project Overview

Structural Condition of Bridge

Overall, Stark Covered Bridge is in poor condition and in need of a complete rehabilitation. According to the NHDOT Bridge Inspection Report of 10 September 2010 , Stark Covered Bridge is classified in the FHWA National Bridge Inventory as Structurally Deficient with a Sufficiency Rating of 22.2 percent and as such is listed on the NHDOT Municipal Redlist.[1] Without immediate maintenance of the structural support elements (steel girders and timber stringers) they will continue to deteriorate resulting in a downgrade of the live load posting and eventual closing of the bridge.

The full rehabilitation will need to include a new wood shake roof, new interior bridge decking and sidewalk decking, repairs to steel and timber stringers, new bearing devices, reconstruction of abutment bridge seats, repairs to the north abutment stone breastwall and northwest wingwall.

[1] Federal Sufficiency Rating (FSR)measures the ability of the bridge to remain in service using a formula of weighted variables: including the structural condition of the bridge (55%); serviceability and obsolescence factors (30%) that include traffic volumes, number of lanes, road widths, clearances; and the importance of the bridge for national security and public use (15%).

Further improvements will include new lighting and installation of fire detection and fire prevention measures to meet funding grant requirements. A more detailed description of the proposed rehabilitation is contained in Section 3 below, and contained in the inspection report entitled *Engineering Study of the Northside Road Bridge #115/091 over the Upper Ammonoosuc River, Located in Stark, New Hampshire, June, 2012,* prepared by H.E. Bergeron Engineers, Inc (HEB) for the Town of Stark.

Transportation Importance [2]

Stark Covered Bridge is an important transportation link for the Town of Stark. Since the Upper Ammonoosuc River divides the Town, the bridge connects the north side (North Road to the NW of the River) and south side (NH Route 110 to the SE of the River) of the Town in the heart of the Village. If this bridge were closed, a 4½-mile detour would be imposed on travelers, police, and emergency services, adding significant emergency response time.

Cultural and Economic Importance

The site of the Stark Covered Bridge is a popular location for photographers, artists and covered bridge enthusiasts. The truly picturesque setting, with the bridge in the background of a typical 19th century New England Village Center, is one of the most photographed locations in the State. Pictures of the Stark Covered Bridge have appeared in books, travel magazines, newspapers, calendars, puzzles, and on collectables and mementos, clearly demonstrating its importance to the State of New Hampshire as a whole and specifically to the community. For these reasons, the Stark Covered Bridge contributes significantly to the local economy. The covered bridge enthusiasts, tourists, artists, and photographers that make the Town of Stark and the bridge a destination, also purchase goods and services during their visits, which adds to and supports the local economy.

Project Goal

The project goal is to rehabilitate the bridge and maintain the current 10-ton load capacity so that it can continue to serve the transportation needs of the local community. This project will also enable the Stark Covered Bridge to continue as a significant and well-known historic attraction for the enjoyment and benefit of tourists, residents, local businesses, and the community as a whole.

[2] Taken from the *National Historic Covered Bridge Preservation Project (NHCBPP) Grant Application for Stark Covered Bridge, 2009.*

2.0 HISTORICAL & DESCRIPTIVE INFORMATION

2.1 Chronological History of Events Associated with Bridge

The town of Stark was originally part of the territory named Percy, granted in 1774 by Governor John Wentworth to Jacob Walden and others. In 1787 twenty-six persons had agreed to settle in a town to be established and Caleb Smith and Jacob Treadwell agreed to build a saw and gristmill there. The town of Percy was incorporated in 1795 and grew from a population of 140 in 1800, to 284 in 1830. In 1832 the name of the town was changed from Piercy to Stark, in honor of General John Stark (1728-1822), the revolutionary war hero from Londonderry New Hampshire.[3]

The town is bisected east to west by the Upper Ammonoosuc River and most settlement and development occurred along the watercourse and streams feeding it, as shown on the 1861 Walling map of the town (see Figure 1). The completion of the Atlantic and St. Lawrence Railroad in 1853 through Stark along the north side of the Ammonoosuc River was immediately followed by further development of the town.

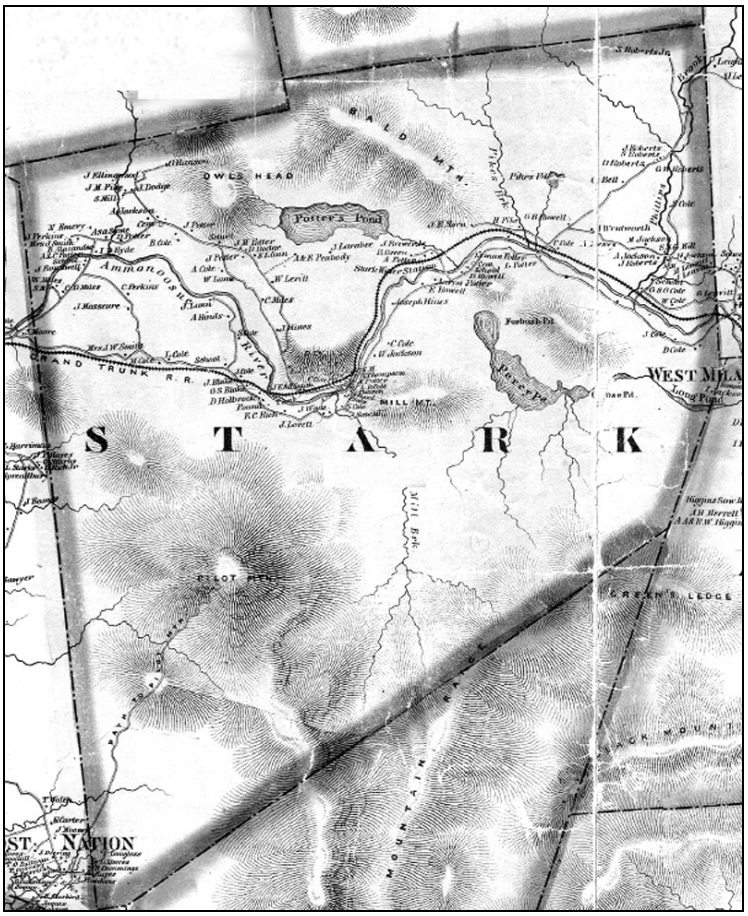


Figure 1: Walling, H.F. "Map of Coos County, New Hampshire" New York: Smith, Mason & Co., 1861.

[3] For additional information see: New Hampshire Division of Historical Resources Area Form "SK - Stark Town Project Area. "Prepared by Lynne E. Monroe, et. al., January 1998.

The Union Church in Stark, which stands at the south entrance to Stark Covered Bridge, was built in 1853 (see Figure 2). Population grew from 48 in 1790, to 418 in 1850, to 464 in 1870, and to 690 in 1880. Timber products were the primary commodity and by 1887 there were two mills producing large quantities of dimension lumber: "Dole & Stewart operated with steam and waterpower at Stark station producing dimension lumber, laths, shingles, clap-boards and pickets to the amount of 7,000,000 feet annually; Milan Steam Mills (F.A. Pitcher) [produced] dimension lumber, laths, clap-boards and pickets, 5,000,000 feet per annum."[4]

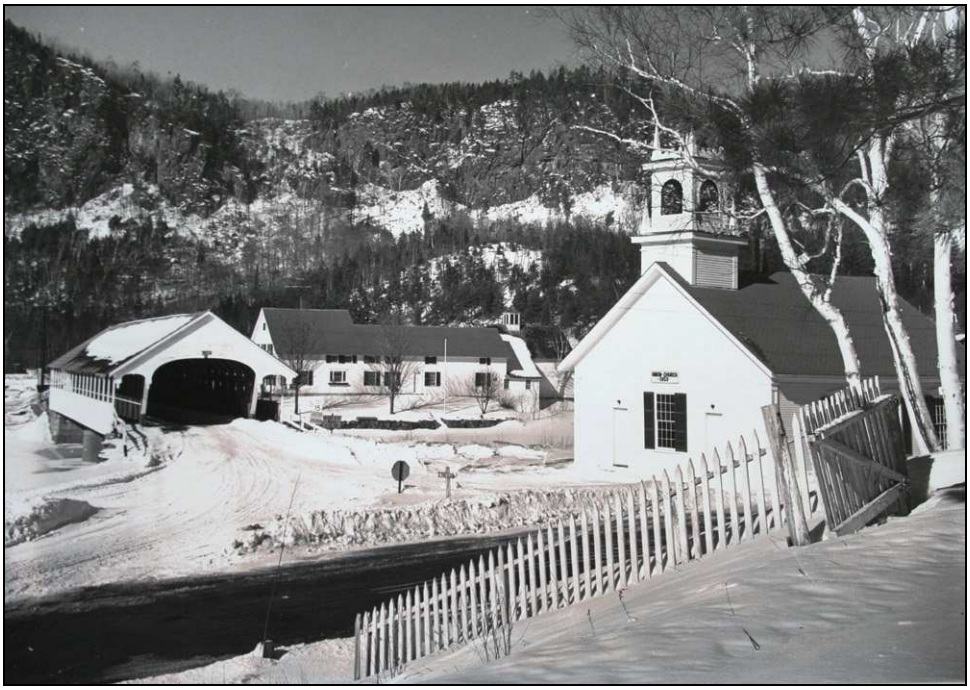


Figure 2: Stark Union Church and Stark Covered Bridge (undated, Stark Town Hall photo collection)

The date and location of the first bridge over the Ammonoosuc could not be determined but according to the 1888 History of Coos County one evidently existed in 1846 at the time the town hall was erected:

> "At the annual meeting in 1846 it was voted to build a town-house "near the bridge on the south road, near Clifford Cole Jrs;" the site to be selected by a committee of nine - one from each highway district - Daniel Rowell, Solomon Cole, John Massuere, Abiathar Pike, Ezra Hinds, Weeden Cole, Moses Jackson, John Roberts, and Joshua Lunn, and $300 voted for the purpose. The neat and commodious town hall on its pleasant situation was the outgrowth of this movement. " [5]

According to the National Register Nomination Form prepared in 1979, the first bridge was "a floating bridge positioned a short distance eastward (upriver)." [6]

[4] Drew, Georgia M. *History of Coos County, New Hampshire*, Syracuse NY: W.A. Fergusson & Co., 1888. p. 562.
[5] Ibid.
[6] Deborah Joyce. "Stark Covered Bridge National Register Form. August 1979. On file at New Hampshire Division of Historical Resources, Concord. Joyce does not cite references for her information.

Mrs. Raymond Stuart provided the following history in an article entitled "Stark Covered Bridge," published in July 1947 issue of *New Hampshire Highways Magazine*.[7]

> The first bridge across the Ammonoosuc River in Stark was situated above the church. In 1857 this was replaced with a new covered edifice, in the spot where the bridge now stands. Captain Richardson of Groveton, a veteran bridge-builder with bridges in Groveton and Guildhall to his credit, was chosen to superintend the operation. He built the bridge much as we see it now, but with a center pier, which later proved to be impractical.
>
> In the spring of 1895 ice and logs jammed against the pier, lifted the structure from its foundation, and deposited it in Darwin Cole's field, many feet downstream. Mr. Levi Abbott, one of Stark's oldest living residents, with a crew of five men, returned the bridge to its site. This was done in a unique manner. As the timbers were virtually unharmed, the entire structure was sawed into sections, loaded onto wagons and hauled back.
>
> The work of rebuilding was done under the leadership of Mr. Osgood, from Colebrook. One great change was made at this time when the center pier was omitted and arches, extending from one side of the bridge to the other, used for support. At this time an immense boulder on the upper side was blasted out and the stone used to extend the abutments. The work was done mostly by local boys and men; among these was Mr. Will Emery, now active and able at 81 years of age. Until recently, the painstaking labor of those people paid well in service, but time and weather has taken its toll and extensive repairs or replacement has become necessary.

The National Register Nomination version provides additional details:

> The bridge was originally built as a 2-span Paddleford truss; but in 1890 (1895, according to one reference) a spring freshet tore away the center pier and carried the bridge downstream, where it is said to have been saved by being snagged in debris. The stone abutments were reconstructed and the bridge was hauled back and set in place again. At that time laminated arches were introduced to eliminate the need of the center pier, which was considered a source of danger during floods.

The Stark Annual Town Report for 1895 shows that the Town paid $1979.33 for "Cost of bridge and abutements at Stark Village."[8] This information confirms parts of the above accounts that in 1895 the bridge was washed off its abutments, dragged back and reassembled. The repair cost was the largest expenditure of the year, exceeding the entire school budget of $1579.68, and amounting to nearly 25 percent of the total town budget. As one would expect, the bridge was one of, if not the, most important asset of the town.

The Town Reports do not show any specific expenditure for the bridge again until 1919 when the following payments, totalizing $298.51, were listed under the heading "Stark Bridge":

[7] Mrs. Raymond Stuart, "Stark Covered Bridge." New Hampshire Highways Magazine [Published by N.H. Good Roads Association, Inc. Concord]. July 1947, p. 6. Note: The original *New Hampshire Highways* was published by the New Hampshire Highway Department from 1922 until 1932 when it was cut from the budget. In 1946, the N.H. Good Roads Association assumed republication of the magazine, in close cooperation with the State Highway Department.

[8] *Annual Report of the Town Officers to the Citizens of Stark, N.H. For the year ending February 15, 1896.* Lancaster, N.H.: Printed at the Office of the Coos County Democrat, 1897, p.2. [Hereafter cited as Stark Annual Report]. The New Hampshire State Library holding of Stark Annual Town Reports begins with the 1895 report.

L.P. Abbott	$5.48
Mathew Smith	150.00
L.P. Abbott	40.11
Mathew Smith	102.92

The 1919 work was apparently a lead-up to much more extensive repairs that were done in 1920 as shown below in a clip from the Annual Report for that year:

STARK BRIDGE

Nails and spikes:		
G. W. Kimball	$22.82	
Newell Brothers	13.01	
Lumber:		
L. C. Baldwin	$5.73	
Paul R. Cole	290.70	
S. R. Veazie	8.44	
Matthew Smith	2.24	
Rods and bolts:		
Groveton Paper Co., Inc.	$63.48	
Sawing shingles:		
L. P. Abbott	$165.86	
Labor:		
Gilbert Rogers	$249.00	
Willis Abbott	144.00	
S. R. Veazie	70.00	
Matthew Smith	8.50	
		$1,043.78

The next entry in the Town Reports for "Stark Bridge" is for 1929 when the following expenditures were recorded:

S.R Veazie, planking Stark bridge		$5.25
Walter Perkins, planking Stark bridge		5.25
Groveton Paper Co., lumber, Stark bridge	177.40	
Paul Cole, trucking, Stark bridge		22.50

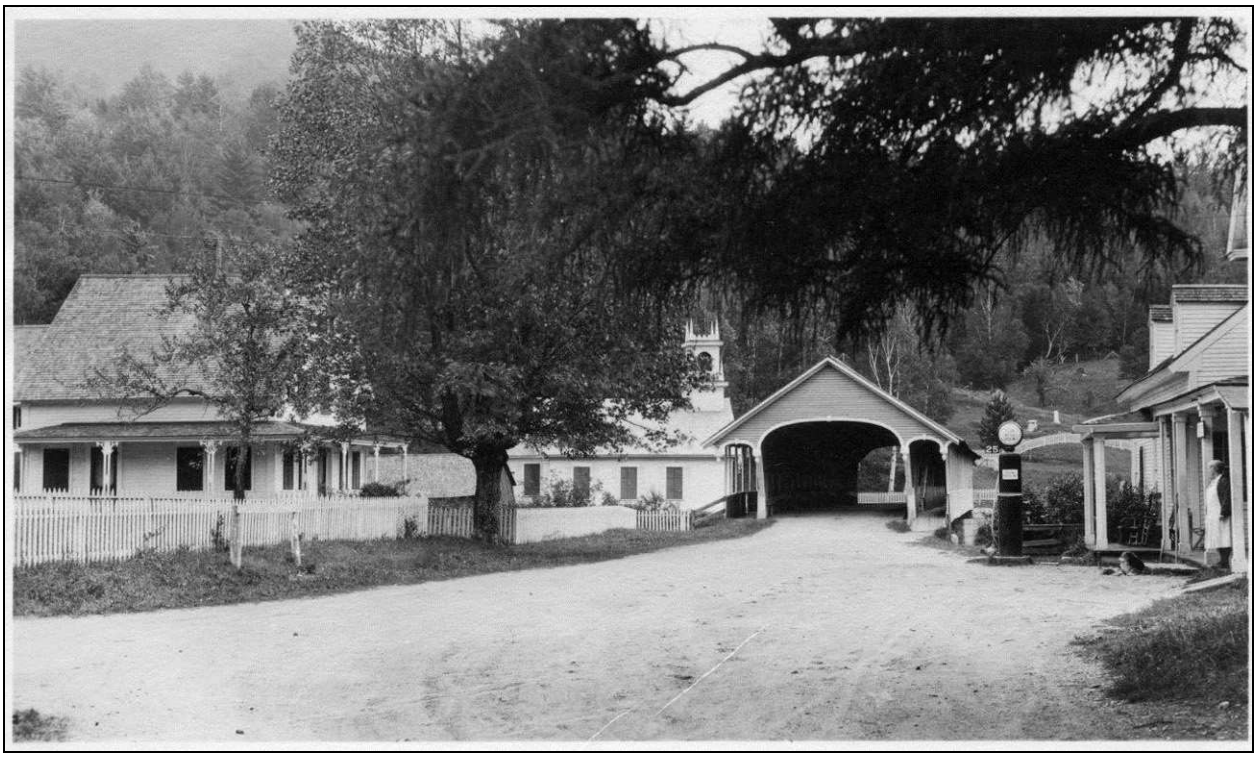


Figure 3: Early 20th century view (ca. 1925) of north end of Stark bridge (Source: Collection of the National Society for the Preservation of Covered Bridges).

Figure 4: Early 20th century view (ca. 1925) of west elevation of Stark Bridge before bridge began sagging in the 1930s.Note missing siding boards. (Source: Collection of the National Society for the Preservation of Covered Bridges).

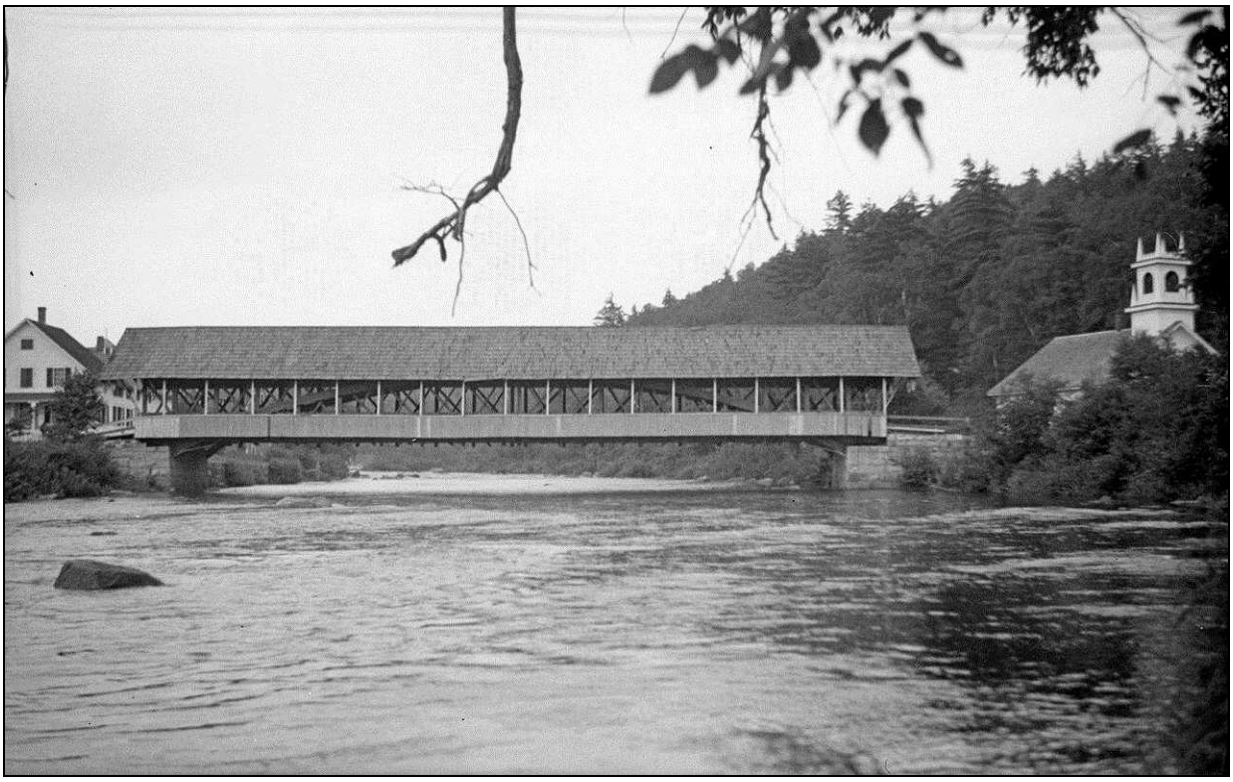


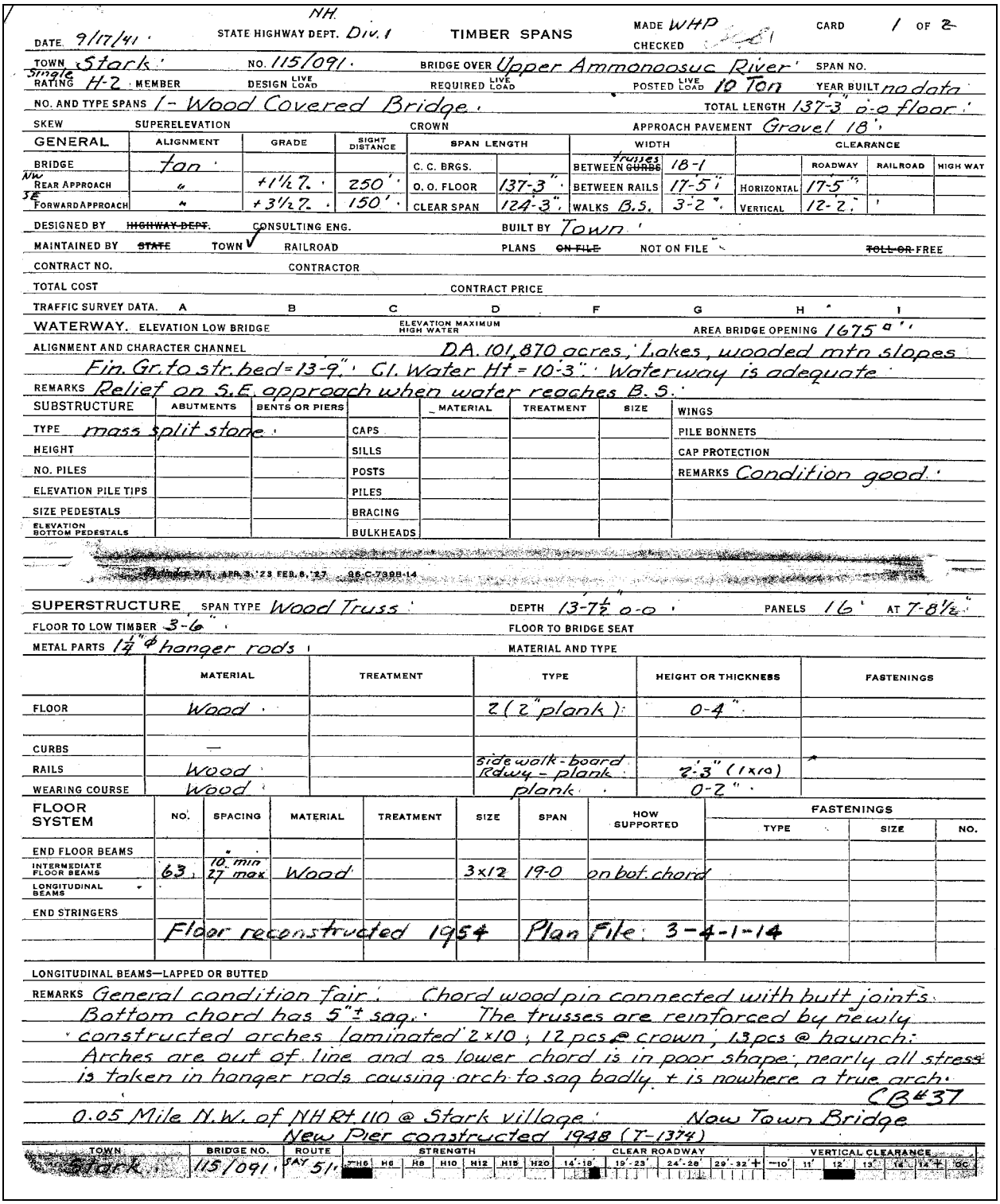
Figure 5: Early 20th century view (undated) of west elevation of Stark bridge. Note replacement of missing siding boards seen in Figure 4 above. (Source: Collection of the National Society for the Preservation of Covered Bridges).

According to the National Register Form, "The bridge remained intact until 1938, when the arches were repaired; but they subsequently began to sag, and in 1946 a temporary center pier of wood was introduced." The Town Reports do not contain any specific reference to these repairs, however they may have been done under the Road Agent account that does not often specify what project the various payments of labor and materials are for.

On 17 September 1941 the New Hampshire Highway Department inspected Stark Covered Bridge in the course of the Department's first statewide inspection and inventory of bridges. A bridge inventory card was prepared that included a data sheet, field sketch and three photo (see Figures 6-10). The added arch is visible in the photos. The condition of the bridge was noted on the card as follows:

> General condition fair. Chord wood pin connected with butt joints. Bottom chord has 5"± sag. The trusses are reinforced by newly constructed arches; laminated 2x10, 12 pcs @ crown; 13 pcs @ haunch. Arches are out of line and as lower chord is in poor shape, nearly all stress is taken in hanger rods causing arch to sag badly + is nowhere a true arch.

The note made on the card, "recently constructed arches" seems to coincide with the statement made in the National Register Form, noted above, that the arches were rebuilt in 1938. Perhaps they were so extensively rebuilt or replaced that they appeared as entirely new and recent construction, and the inspector was unaware that previous arches existed.



NH

DATE 9/17/41 · STATE HIGHWAY DEPT. Div. 1 · TIMBER SPANS · MADE WHP · CHECKED · CARD 1 OF 2

TOWN Stark · NO. 115/091 · BRIDGE OVER Upper Ammonoosuc River · SPAN NO.

Single RATING H-2 · MEMBER · DESIGN LIVE LOAD · REQUIRED LIVE LOAD · POSTED LIVE LOAD 10 Ton · YEAR BUILT no data

NO. AND TYPE SPANS 1 - Wood Covered Bridge. · TOTAL LENGTH 137-3" o-o floor

SKEW · SUPERELEVATION · CROWN · APPROACH PAVEMENT Gravel 18'

GENERAL	ALIGNMENT	GRADE	SIGHT DISTANCE	SPAN LENGTH		WIDTH		CLEARANCE			
				C. C. BRGS.		BETWEEN ~~GURBS~~ Trusses	18-1		ROADWAY	RAILROAD	HIGH WAT
BRIDGE	fan			O. O. FLOOR	137-3"	BETWEEN RAILS	17-5"	HORIZONTAL	17-5"		
NW REAR APPROACH	"	+1½%	250'	CLEAR SPAN	124-3"	WALKS B.S.	3-2"	VERTICAL	12-2"		
SE FORWARD APPROACH	"	+3½%	150'								

DESIGNED BY ~~HIGHWAY DEPT.~~ · CONSULTING ENG. · BUILT BY Town

MAINTAINED BY ~~STATE~~ TOWN ✓ · RAILROAD · PLANS ~~ON FILE~~ · NOT ON FILE · ~~TOLL OR~~ FREE

CONTRACT NO. · CONTRACTOR

TOTAL COST · CONTRACT PRICE

TRAFFIC SURVEY DATA. A · B · C · D · F · G · H · I

WATERWAY. ELEVATION LOW BRIDGE · ELEVATION MAXIMUM HIGH WATER · AREA BRIDGE OPENING 1675 sq ft

ALIGNMENT AND CHARACTER CHANNEL DA. 101,870 acres, Lakes, wooded mtn slopes

Fin. Gr. to str. bed = 13-9". Cl. Water Ht = 10-3". Waterway is adequate

REMARKS Relief on S.E. approach when water reaches B.S.

SUBSTRUCTURE	ABUTMENTS	BENTS OR PIERS		MATERIAL	TREATMENT	SIZE	
TYPE	mass split stone		CAPS				WINGS
HEIGHT			SILLS				PILE BONNETS
NO. PILES			POSTS				CAP PROTECTION
ELEVATION PILE TIPS			PILES				REMARKS Condition good.
SIZE PEDESTALS			BRACING				
ELEVATION BOTTOM PEDESTALS			BULKHEADS				

Bridge PAT. APR 3, '23 FEB 6, '27 86-C-7998-14

SUPERSTRUCTURE · SPAN TYPE Wood Truss · DEPTH 13-7½ o-o · PANELS 16 · AT 7-8½"

FLOOR TO LOW TIMBER 3-6" · FLOOR TO BRIDGE SEAT

METAL PARTS 1¼" ϕ hanger rods · MATERIAL AND TYPE

	MATERIAL	TREATMENT	TYPE	HEIGHT OR THICKNESS	FASTENINGS
FLOOR	Wood		2 (2" plank)	0-4"	
CURBS	—				
RAILS	Wood		side walk - board Rdwy - plank	2-3" (1x10)	
WEARING COURSE	Wood		plank	0-2"	

FLOOR SYSTEM	NO.	SPACING	MATERIAL	TREATMENT	SIZE	SPAN	HOW SUPPORTED	FASTENINGS TYPE	SIZE	NO.
END FLOOR BEAMS										
INTERMEDIATE FLOOR BEAMS	63	10" min 27" max	Wood		3x12	19-0	on bot. chord			
LONGITUDINAL BEAMS										
END STRINGERS										
	Floor reconstructed 1954					Plan File: 3-4-1-14				

LONGITUDINAL BEAMS—LAPPED OR BUTTED

REMARKS General condition fair. Chord wood pin connected with butt joints. Bottom chord has 5" ± sag. The trusses are reinforced by newly constructed arches laminated 2x10; 12 pcs @ crown, 13 pcs @ haunch. Arches are out of line and as lower chord is in poor shape; nearly all stress is taken in hanger rods causing arch to sag badly. + is nowhere a true arch.

CB #37

0.05 Mile N.W. of NH Rt 110 @ Stark village. Now Town Bridge

New Pier constructed 1948 (T-1374)

TOWN	BRIDGE NO.	ROUTE	STRENGTH							CLEAR ROADWAY				VERTICAL CLEARANCE					
			H6	H8	H10	H12	H15	H20		14'-18'	19'-23'	24'-28'	29'-32'+	10'	11'	12'	13'	14'	14'+
Stark	115/091	SAY 51																	

Figure 6: Bridge Inventory Card, data sheet, dated 9/17/41.

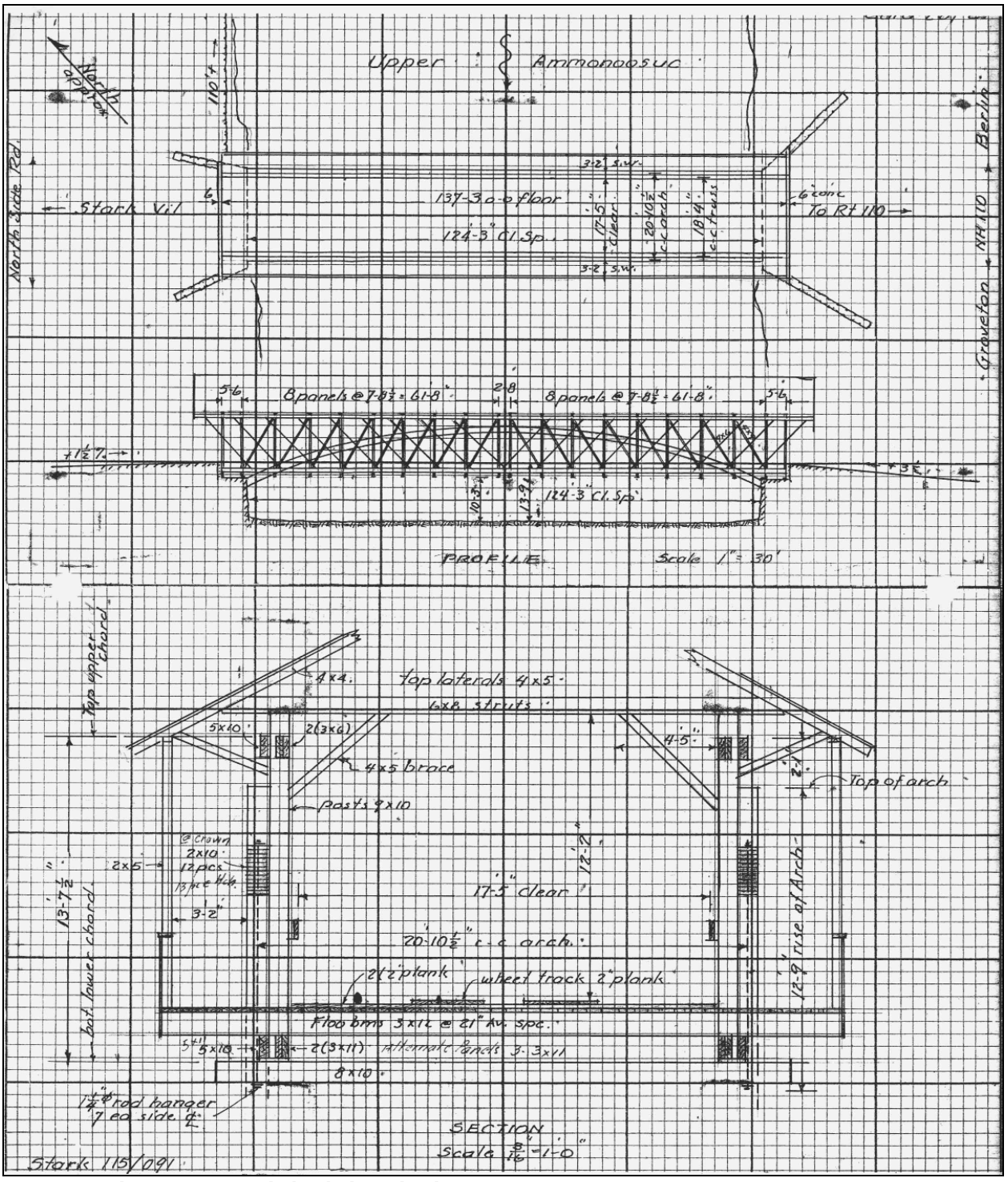


Figure 7: Bridge Inventory Card, sketch sheet, dated 9/17/41.

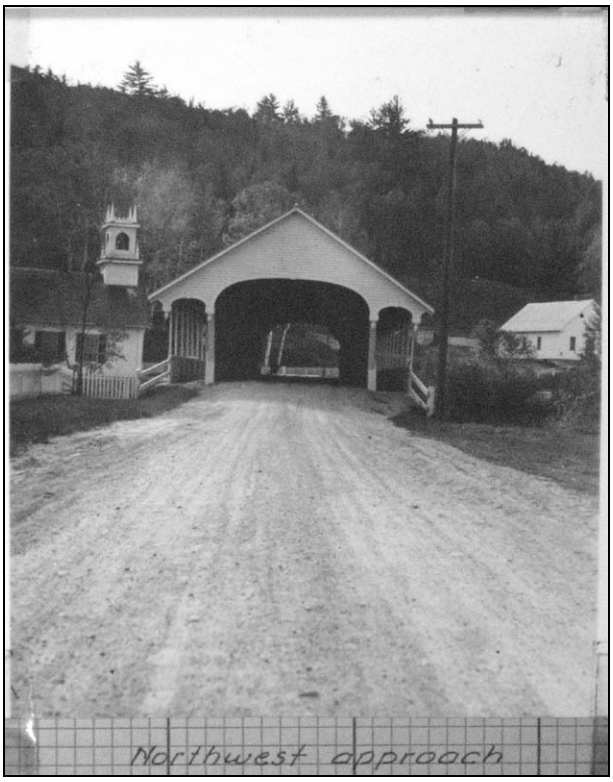


Figure 8: Bridge Inventory Card Photo, 1941.

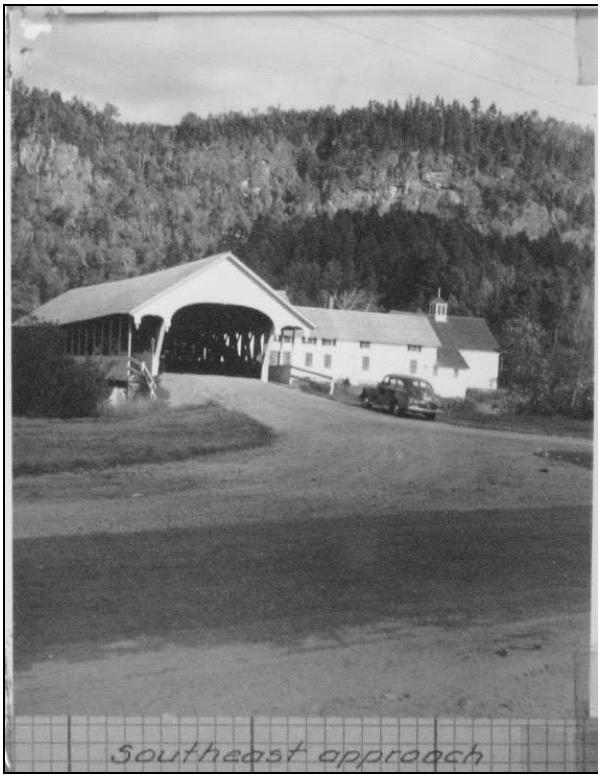


Figure 9: Bridge Inventory Card Photo, 1941.

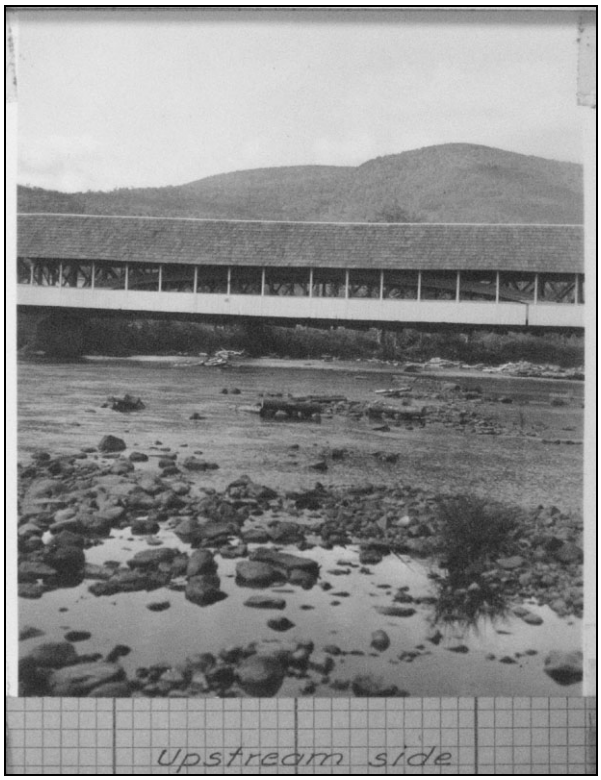


Figure 10: Bridge Inventory Card Photo, 1941.

In 1945 the town voted on the warrant question "to raise the sum of $1800, the probable cost of building a concrete pier under the existing Covered Wooden Bridge in Stark." The warrant was defeated and the following year the question put before the voters was simply "To see what action the Town will take in regards to the Covered Bridge in Stark Village and raise money for same." [9]

The outcome of the question is not contained in the town reports, but apparently Senator Cummings of District 2 was asked by the town to submit a joint resolution to the Legislature ordering the state Highway Department to repair the bridge, due to its historical and recreational value to the state. The resolution, reproduced below, was passed.

SENATE JOINT RESOLUTION, NO. 9

Introduced by Senator Cummings of District No. 2

(Referred to the Committee on Public Improvements)

STATE OF NEW HAMPSHIRE

SENATE

In the year of our Lord
One thousand nine hundred and forty-seven

JOINT RESOLUTION

Relative to Repairs to a Covered Bridge in the Town of Stark.

Whereas, there is at present an old covered bridge on a Class V road near the church in the town of Stark; and

Whereas, said bridge is of historic value and an asset to the state from a recreational standpoint, now therefore

Resolved by the Senate and House of Representatives in General Court convened:

That the state highway department is authorized to expend from funds of the department such sum as represents fifty-five per cent of the cost of repairs to the before mentioned bridge, provided that the total cost of said repairs shall not exceed the sum of eleven thousand dollars, and provided further that the town of Stark shall appropriate sufficient money to cover forty-five per cent of the said costs.

In August 1948, New Hampshire Highway Department Bridge Division engineer Lester W. Holt, prepared plans for the reinforced concrete pier to be placed under the bridge at mid-span. Plans were approved by Harold E. Langley, State Bridge Engineer, on January 14, 1949. The project was designated "Stark Legislative Special" No. T-1374 and the original plans for the pier are on file at NHDOT, Plan File Number 2-11-2-13 (see Appendix A). The concrete pier, which remains in service

[9] Stark Annual Report for the year(s) ending December 31, 1945, p. 9, and 1946, p. 4.

today in unaltered condition, was constructed in 1948 according to a note added to the bridge card: "New Pier Constructed, 1948." Among the "General Notes" on the plan is the requirement that "The bridge shall be jacked up to provide 3" of camber at C.L. [center line] of pier." The effect of the jacking can be seen in the deformation of the arch in some of the before and after photos below.

Figure 11: Photo dated August 28, 1948, just prior to construction of the center concrete pier (Source: Collection of the National Society for the Preservation of Covered Bridges).

Figure 12: Photo dated August 28, 1948, prior to construction of pier. Note sag in bridge seen in the roadway guardrail. (Source: Collection of the National Society for the Preservation of Covered Bridges).

Figure 13: Photo dated August 28, 1948, prior to construction of pier. Note deformed arch. (Source: Collection of the National Society for the Preservation of Covered Bridges).

Figure 14: Photo of south end of bridge, 1938. Note missing sidewalk posts and railing on upstream side. (Source: Collection of the National Society for the Preservation of Covered Bridges).

Figure 15: Photo of downstream side of bridge, circa 1950. New pier supporting bridge visible under removed siding. (Source: Collection of the National Society for the Preservation of Covered Bridges).

Figure 16: Photo of upstream side of bridge, circa 1950. New pier supporting bridge visible under removed siding. (Source: Collection of the National Society for the Preservation of Covered Bridges).

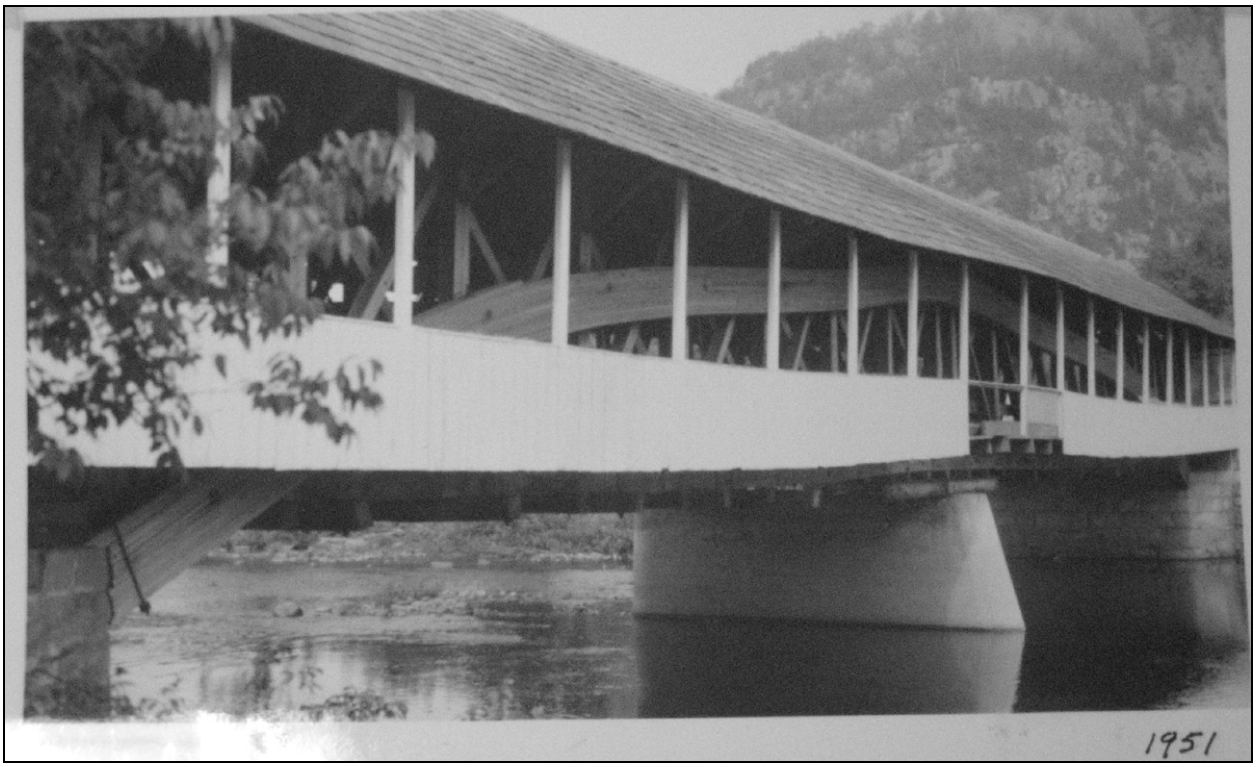


Figure 17: NHHD Bridge Inventory Card photo dated 1951 showing new pier built in 1948 and wood arch, lifted and slightly less deformed than seen in Figure 13.

Figure 18: Photo of arch and sidewalk, circa 1950. (Source: Collection of the National Society for the Preservation of Covered Bridges).

In 1951, Harold E. Langley, Bridge Engineer for the New Hampshire Highway Department, discussed several covered bridges in which he was involved, including the Stark Covered Bridge, in a talk before the Society for the Preservation of Covered Bridges.[10] In his presentation, Langley "discussed the causes for bridge deterioration, the means to remedy it, and the numerous problems involved when old bridges are subjected to modem heavy traffic." [11]

Langley made general several points relevant to all covered bridges which are reproduced in full below for the insight they provide on the engineer's perspective of covered bridge problems at that time.

- Covered bridges are [often] neglected by the towns until they get into such a state of disrepair that communities are no longer able to afford to put them in shape… they call for help from the state, and the state engineer inspects them and very often he finds it necessary to condemn bridges that could easily be saved if given earlier attention…
- The weak point in most of the old covered bridges is the floor system. This often deteriorates because the side covering of the bridge is neglected, allowing rain to pelt through on to the floor. In almost any old bridge, there is an inch or more of accumulated dust and dirt. When this is dampened by rain, decay sets in.
- The engineer sometimes finds floors weakened because the towns, in repairing, have turned the floor beams over instead of replacing them. In looking for trouble, he examines the floor and bottom chord first, and especially the condition of the sills, which may carry decay to the chord.
- Occasionally trouble is found in the "trunnels", or wooden pegs, that hold the parts of a bridge together. Dry rot may appear in the center of the pin. In replacing these, a new type of steel ring, known as a Teco Connector, is sometimes used. This is so constructed that the holes do not grow longer and larger, as with a simple steel pin once tried out for the purpose, and the stresses and strains of moving traffic are less liable to do injury to the members.

The following sections of the article pertain to Langley's comments on Stark Covered Bridge:

> The speaker told an amusing tale about the bridge at Stark, where he was called more than ten years ago. This is now a one-span structure. At that time it was of such peculiar construction, with numbers of apparently useless parts, that he began to wonder what had happened to it. After making inquiries, he learned from an elderly man that the bridge was originally of two spans. During a flood, the center pier had washed out and the bridge had floated downstream. The town had then hired a carpenter to take it apart and move it back. This he did, but, not wishing to build a new pier, he reconstructed the bridge as a one-span affair, adding the superfluous parts according to his own fancy.
>
> The bridge, of course, had a sag in the bottom chord. It was estimated that a pier could be built and the bridge made over for $11,000. The needed legislation was not voted until two years later. Meanwhile costs had begun to rise. Nevertheless, the work was begun. The engineers ran into trouble before the pier was finished, as a supposedly solid bed of gravel in the river proved to have shifting sands beneath. By the time, the pier was built, more than half the money had been expended, and an extra appropriation of $2500 had to be raised to $8000 in the end.

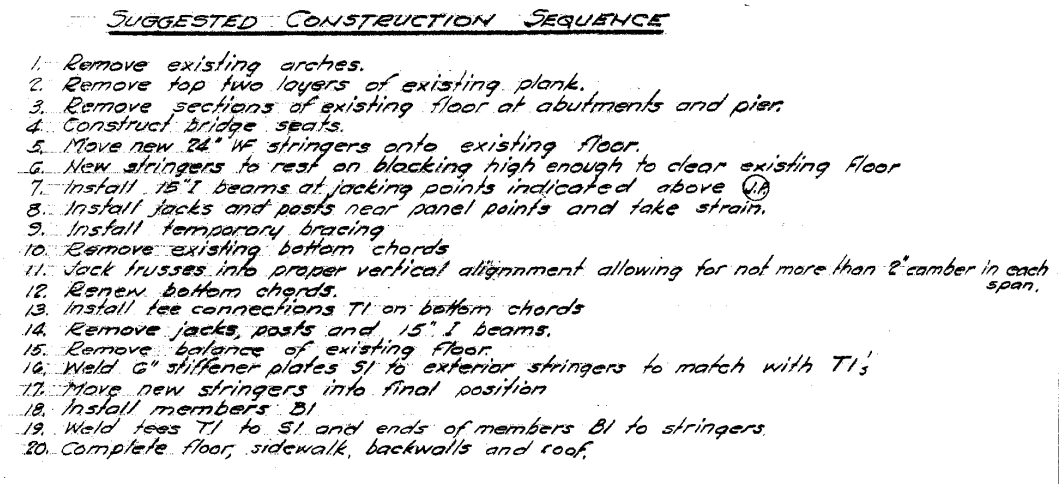
[10] "Talk by H.E. Langley, March 27, 1951." Society for the Preservation of Covered Bridges, Bulletin No. 7; [Xerox copy of article with no date or publisher]. On file at NHDHR, Concord.
[11] Ibid.

In 1952 the town voted in favor of Warrant Article 17 pertaining to Stark Bridge:

> To raise the sum of 4,650 to complete the reconstruction of Stark Covered Bridge in the following manner: Four lines of steel beams placed inside the existing wood trusses and supporting a treated wood floor to provide a safe live load capacity of fifteen tons. The lower chord would be fastened to the exterior steel stringers to provide lateral stability and the roof would also be repaired. The total cost of this work and also the cost of the pier already completed would amount to $24,000. The town's share would be 40% or $9600 and the state's share 60% or $14,400. Under the legislative act, the town's share was $4,950. The additional cost to the town would be $4,650. If the town will provide this amount together with the unexpended balance of $2,700 or a total of $7,350, the state will contribute the balance. " (1952 Stark Annual Report). [Note: The $7,350 was appropriated and paid to the state in 1954 (AR 1954 p. 17).

In 1953, with the approval from the town to share the cost of repairs now in hand, the New Hampshire Highway Department prepared two sheets of repairs drawings (Plan File No. 3-4-1-14; see Appendix A. The repairs were designed by Harold E. Langley on November 15, 1953 and drawn by Robert J. Prowse on January 20, 1954. Langley and Prowse were probably the two most accomplished engineers in the department at the time (Langley served as the state Bridge Engineer 1942 to 1961; Prowse served as state Bridge Engineer from 1968 to 1969) and it is not apparent why the two took responsibility for the project other than they simply wanted to.

The structural engineering design aspect of the work was relatively straightforward, consisting of constructing a simple steel I-beam stringer span inside of the existing wood trusses to carry the live traffic loads. The execution of the work, however, which was to be undertaken by the NHHD bridge construction and maintenance force, did require some clever thinking. The detailed "suggested construction sequence" that was included on the plans, reproduced below, identifies the major elements of the work and gives an appreciation of the complexity of the project.



SUGGESTED CONSTRUCTION SEQUENCE

1. Remove existing arches.
2. Remove top two layers of existing plank.
3. Remove sections of existing floor at abutments and pier.
4. Construct bridge seats.
5. Move new 24" WF stringers onto existing floor.
6. New stringers to rest on blocking high enough to clear existing floor
7. Install 15"I beams at jacking points indicated above (J.P.)
8. Install jacks and posts near panel points and take strain.
9. Install temporary bracing
10. Remove existing bottom chords
11. Jack trusses into proper vertical alignment allowing for not more than 2"camber in each span.
12. Renew bottom chords.
13. Install tee connections T1 on bottom chords
14. Remove jacks, posts and 15" I beams.
15. Remove balance of existing floor.
16. Weld 6" stiffener plates S1 to exterior stringers to match with T1's
17. Move new stringers into final position
18. Install members B1
19. Weld tees T1 to S1 and ends of members B1 to stringers.
20. Complete floor, sidewalk, backwalls and roof.

Most if not all of the work and materials from the 1954 Langley-Prowse rehab of the Stark bridge survive today. More detailed information on the specific elements of the work is provided in the sections below.

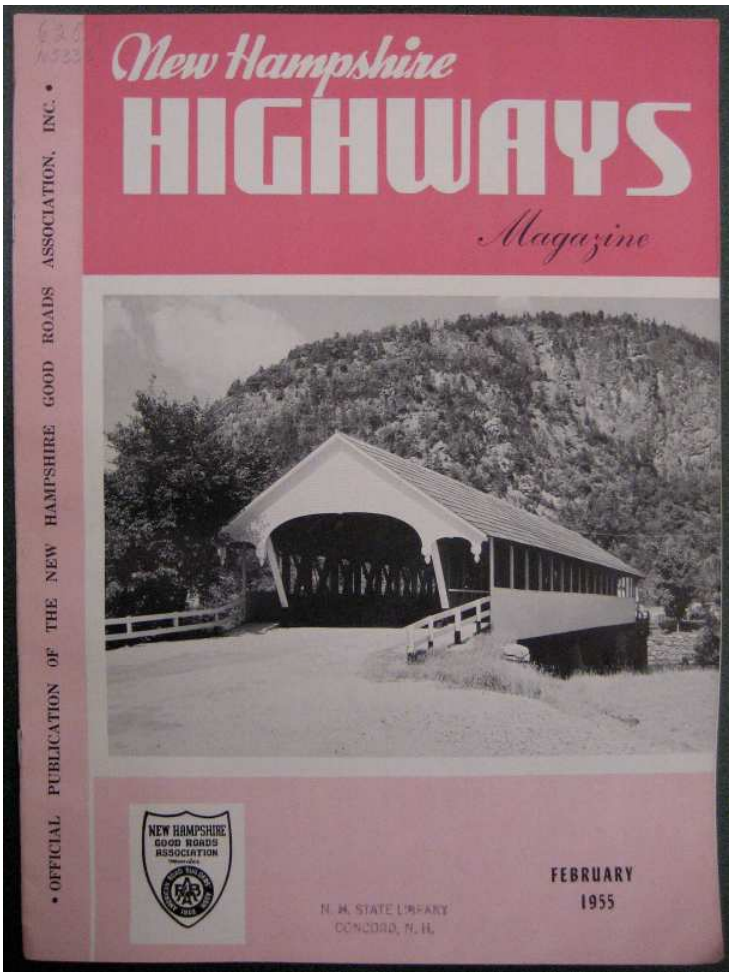


Figure 19: Stark Bridge on cover of *New Hampshire Highways Magazine*.

In 1955 the bridge appeared on the cover of the February issue of New Hampshire Highways (see Figure 19) with the following note on page 2: "Stark covered bridge has undergone an engineering operation. Strengthened by concealed steel beams, it will remain with us as an example of a page from the past and a priceless scenic attraction."

In the Town Report for 1961, it was noted that Albert LaPointe was paid $100.06 for "Painting Stark Bridge". No further details on that work was obtained.

In the late 1970s Deborah Joyce, Town of Stark Selectwoman, took up the cause to recognize and protect Stark Covered bridge by having it listed in the National Register of Historic Places. Seeking funds to hire a professional consultant to prepare a NR nomination form met with resistance by the Town as serving no useful purpose. Taxpayers were generally opposed to spending even minor sums for repairs to the structure.

Selectwoman Joyce then undertook the task herself of preparing the National Register Nomination Form for the Stark Covered Bridge and in August 1979 submitted the completed form to the state Historic Preservation Office. On 14 October 1980, the State Historic Preservation Officer George Gilman found the bridge to be eligible under state-level significance, and on 1 December 1980 it was

listed in the National Register.[12]

In February 1981, right on the heels of her successful National Register listing of the bridge, Selectwoman Joyce applied to the Historic Preservation Office "for two Consultant Service Grants, for the engineering/feasibility studies, for rehabilitation of the Stark Covered Bridge and the Crystal Bridge, both in Stark, New Hampshire." [13] Joyce had also taken a liking to the Crystal Bridge, a 1909 steel truss bridge located upriver from the Stark Covered Bridge that was in need of repair.

The Town was granted two 500-dollar Consultant Service Grants, but ultimately used only one to hire Milton S. Graton who agreed to evaluate and provide rehabilitation recommendations on both bridges for the $500.

In 1981 the town voted and approved the withdrawal of $7,500 from the Capital Reserve Fund, and the $3,000 from the Revenue Sharing Fund for a total of $10,500 to be used for the replacement of the roof of the bridge and other repairs (AR 1981, p. 16). The total cost of the roof was 34,723. (1982 Stark AR.) Details of the repair work conducted as a result of Graton's recommendations are provided in an article in the Fall 1982 *Covered Bridges Bulletin,* reproduced entirely below:

> "There's a new look about the 120-year-old bridge in Stark, (N.H. Covered Bridge No. 37; WG No. 29-04-05) … but unless you look closely you won't be able to spot the newness. That's one of the aims of contractor Robert (Bob) Kidder who's been carrying out the restoration work on the bridge this summer for the town of Stark. Kidder, who's a native of the area, expresses a special fondness for the scenic bridge. He describes his work as "using modern tool, but doing the job the way the old timers did it." The construction crew has replaced all the roof rafters (with beams twice as heavy) and replaced a third of the structural cross members on the top of the bridge. Each piece of the post and beam construction has been carefully removed and numbered for proper replacement with new spruce timbers. Made-to-fit hardwood pins have been used to hold beams in place in the original manner. The new roof consists of native white cedar, each shingle cut individually. In midsummer the bridge had the look of destruction to some visitors, Kidder says. But the job, including leveling of the sidewalks, was due to be finished before snowfall. This was the first major repair on the upper structure of the bridge, according to Kidder. The state Municipal Highway Division will work on the substructure of the bridge next year. Funding of the work has been provided by the Highway Division ($40,000) and the town (110,000).[14]

The nature of the work planned to be done in 1983 as mentioned in the last sentence of the article above, has not been determined and it is not apparent that more work was in fact done.

[12] The National Register form is located in the NHDHR Town of Stark files, "Stark Covered Bridge."
[13] NHDHR Town of Stark files, "Stark Covered Bridge," contain various letter correspondences between the town, NHSHPO and Milton S. Graton regarding the inspection of the two bridges.
[14] Anonymous. "Stark, COOS County, New Hampshire 29-04-05." *Covered Bridges Bulletin*, Fall 1982, n.p.

2.2 **Bridge Description** (From National Register Nomination Form, prepared 1979)

At present, the Stark Covered Bridge is a single lane, two span wooden Paddleford-type wooden covered truss bridge. It rests on flared abutments of rectangular split granite blocks set in mortar; the central pier is constructed of reinforced concrete with smoothly finished downward-sloping sides and integral rounded ends; the eastern (upstream) side of the pier has a greater flare, to deflect flood-borne debris. The open (unenclosed) upper portion of the truss consists of 18 panels of single-component crossed diagonals secured to crossed-diagonal lateral ceiling bracing by angled knee braces Vertical panel posts arc single units, except over the center pier where they are doubled. Top chords are laminated; bottom chords, floor construction, and lower lateral bracing are concealed by the floor and sidewalk decking of wood plank laid crosswise between the trusses. A heavy timber curb protects the lower edge of the truss from traffic and supports the sidewalk flooring. The two sidewalks are attached, to the exterior sides of the trusses, beneath the flared eaves of the gabled portals, and are supported by vertical wooden posts lighter than the truss uprights. The lower portion of the sidewalks is enclosed by an exterior 'wainscot" of flush-boarded planking. A handrail of two horizontal planks, attached to round wooden posts along the top of the abutment wingwalls, links each sidewalk to the roadway shoulders.

The projected, flared gable portals of the Stark Covered Bridge, though typical of the configuration favored by mid-19th century New Hampshire bridge builders, are particularly graceful examples of their type. The medium-pitch roof encompasses three semi-elliptical openings: two smaller sidewalk entrances flanking a large central archway over the roadway. Each is delineated by a plain wooden casing centered with a wooden keystone; the adjoining ellipses spring from shared plain wooden impost blocks from which acorn-shaped turned wooden drops are pendant. A segmental ellipse links the outer imposts and the projected eaves, which have plain enclosed "box" soffits, a plain wooden fascia band, and a plain unmolded wooden frieze. The roof is covered with wooden shingles laid on purlins without sheathing. The entire portal unit is extended approximately a 2/3 bay distance beyond the truss ends, through use of a diagonal wooden strut projected from the first panel upright on each side of the truss. The overall effect—particularly when the bridge is viewed obliquely from either end—is almost ethereal, belying the massive proportions of the truss work and the 3ength of the span.

The graceful design and picturesque setting of the mid-19th century Stark Covered bridge make it one of New Hampshire's best-known covered bridges—the subject of innumerable calendars, Christmas cards, paintings, and illustrations; a favored stop on the Canadian National Railroad annual North Country foliage tours; the scene of "Covered Bridge Dances" for local fundraising projects; and, illuminated at Christmas, a traditional focal point for holiday celebrations. Indeed, the Stark bridge owes its existence to artists and covered bridge buffs, who convinced the state legislature to appropriate funds to preserve the structure is a bridge "of historic value and an asset to the state" (Senate Joint Resolution //9, 1947) although the town had voted to replace it with a steel span. Following standard state practice, the Stark Covered Bridge has been modified structurally over the years (see 7, Description) in response to flood damage and increasing traffic loadings, but it retains its architectural character and historical significance while illustrating the evolution of wooden covered bridge engineering and preservation technology.

The Stark Covered Bridge is also important as an example of the Paddleford truss type - an unpatented regional variant of the Long truss - originated by Peter Paddleford of Littleton, New

Hampshire; other examples are located in nearby Groveton and Lancaster, New Hampshire, as well as in Carroll County, New Hampshire and Oxford County, Maine. It is noteworthy that almost all of the Paddleford truss bridges were later—like the Stark Bridge—strengthened with added Burr-type arches, suggesting an inherent (but not irremediable) flaw in the truss design. At Stark, the ultimate substitution of steel stringers and a new center pier—replacing a poorly-built successor to a flood-damaged support—made it possible to recapture the original Paddleford truss configuration, by removing the arches. However, even the use of concrete and carefully-concealed steel stringers has not entirely alleviated the dangers of overloading, the Stark Covered Bridge is the only crossing of the Upper Ammonoosuc for approximately four miles downstream and two miles upstream, and has historically been an important transportation link between communities on the north and south sides of the river. With the increasing importance of wood harvesting in the area, the bridge has been subjected to substantial truck and heavy equipment traffic; during 1979 the portals were damaged by large trucks loaded with logs, is prompted two different responses in the town: one, that the bridge was an extraordinary local and state resource which should be preserved intact; the other, that the bridge was an impediment to local economic activity and should be replaced, or the roof and superstructure removed, to eliminate the need for large trucks to detour around it. At present, the bridge has been repaired; but National Register designation is considered essential to insure its continued existence.

2.3 Measured Drawings of Existing Conditions

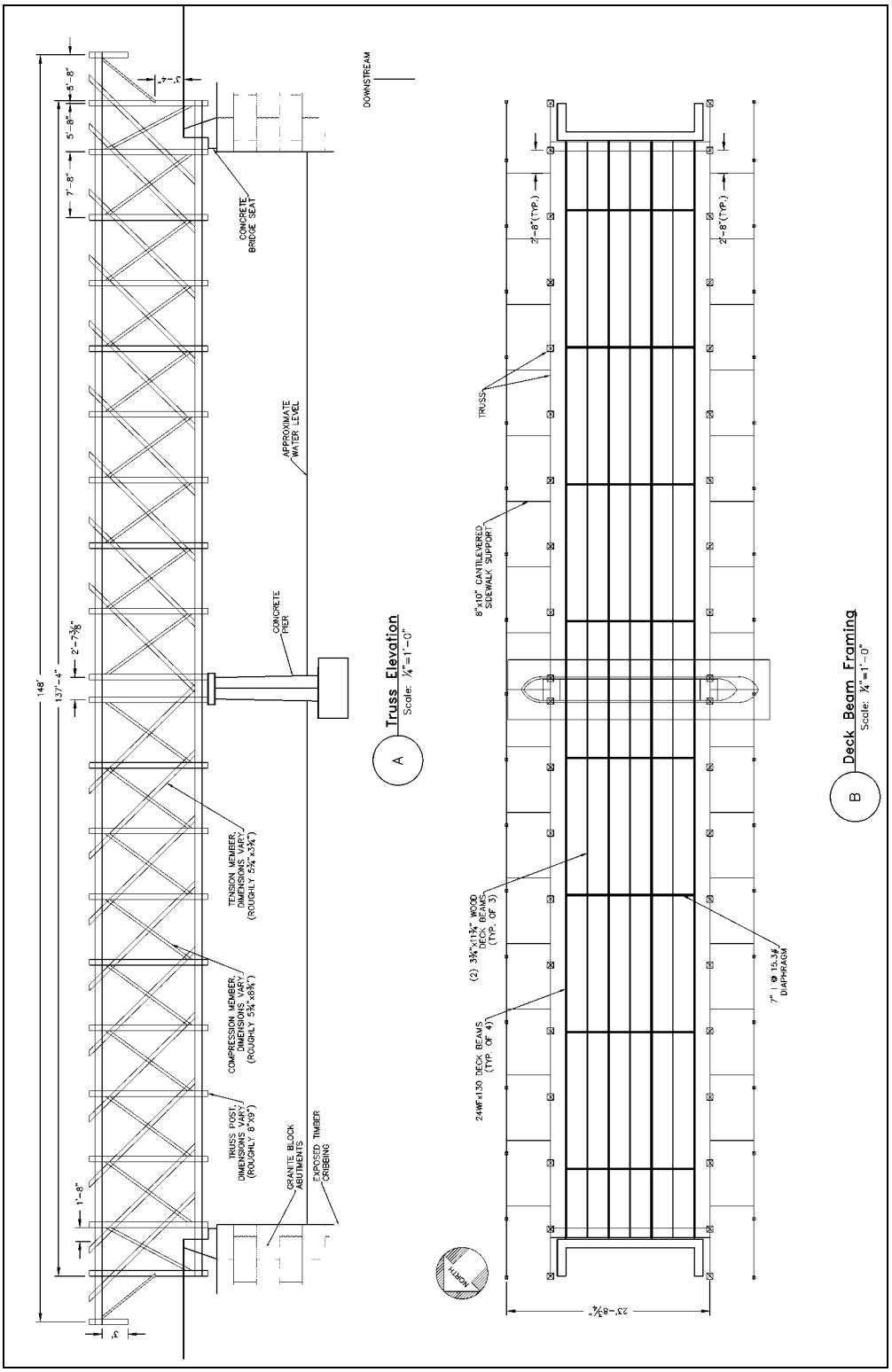


Figure 20: Current Conditions Drawing from HEB Engineering Study 2012, Sheet 1

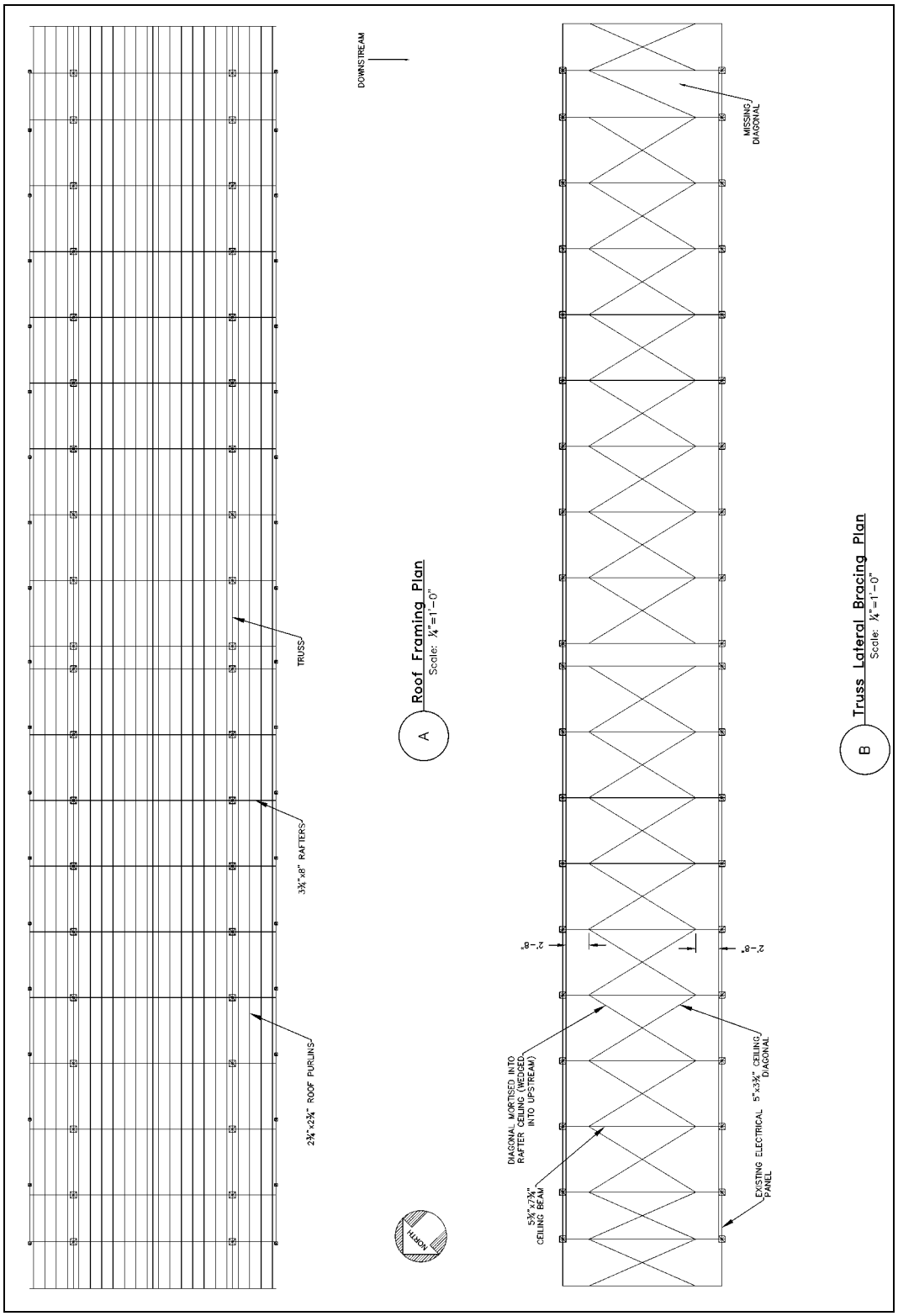


Figure 21: Current Conditions Drawing from HEB Engineering Study 2012, Sheet 2

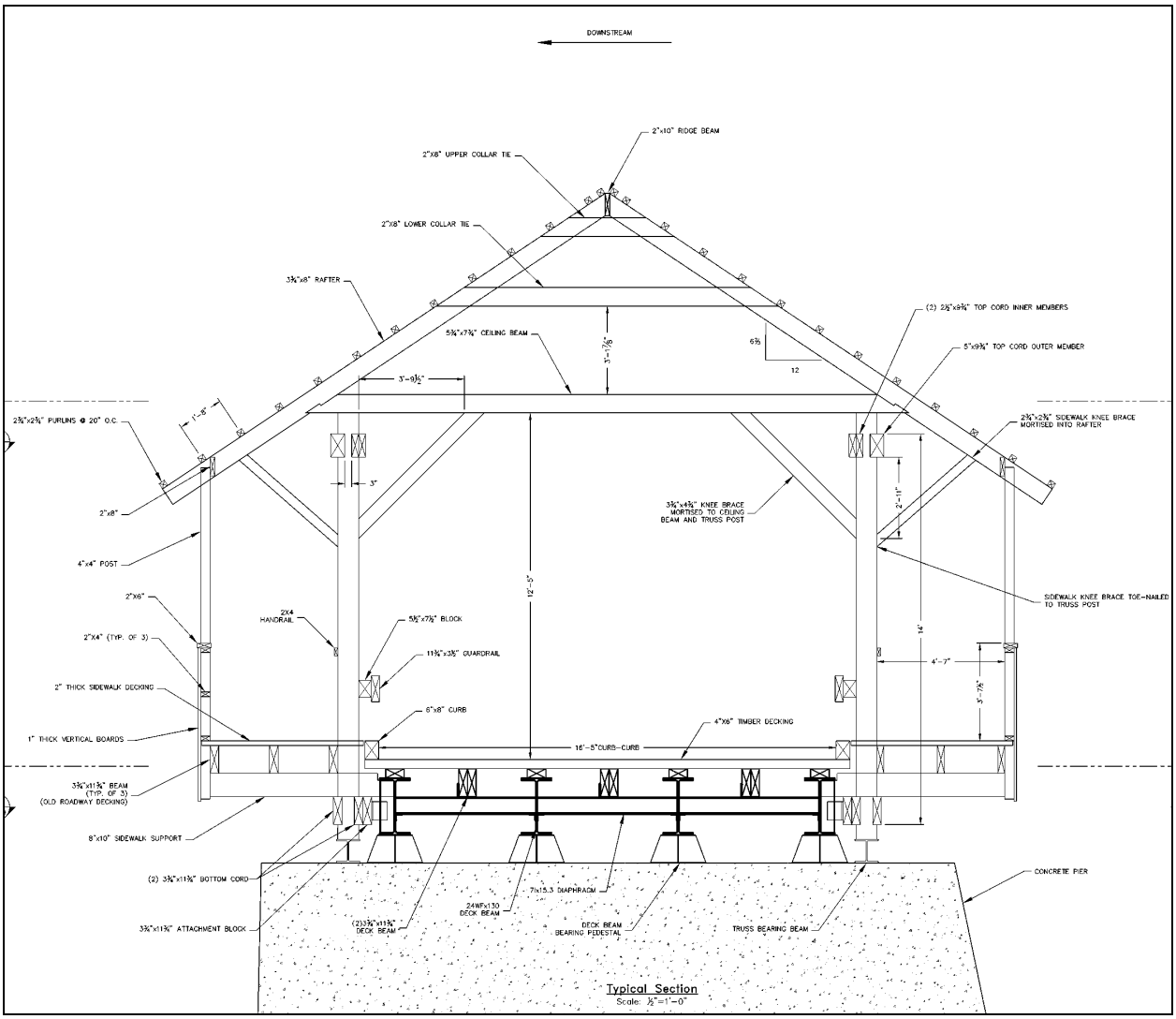


Figure 22: Current Conditions Drawing from HEB Engineering Study 2012, Sheet 3

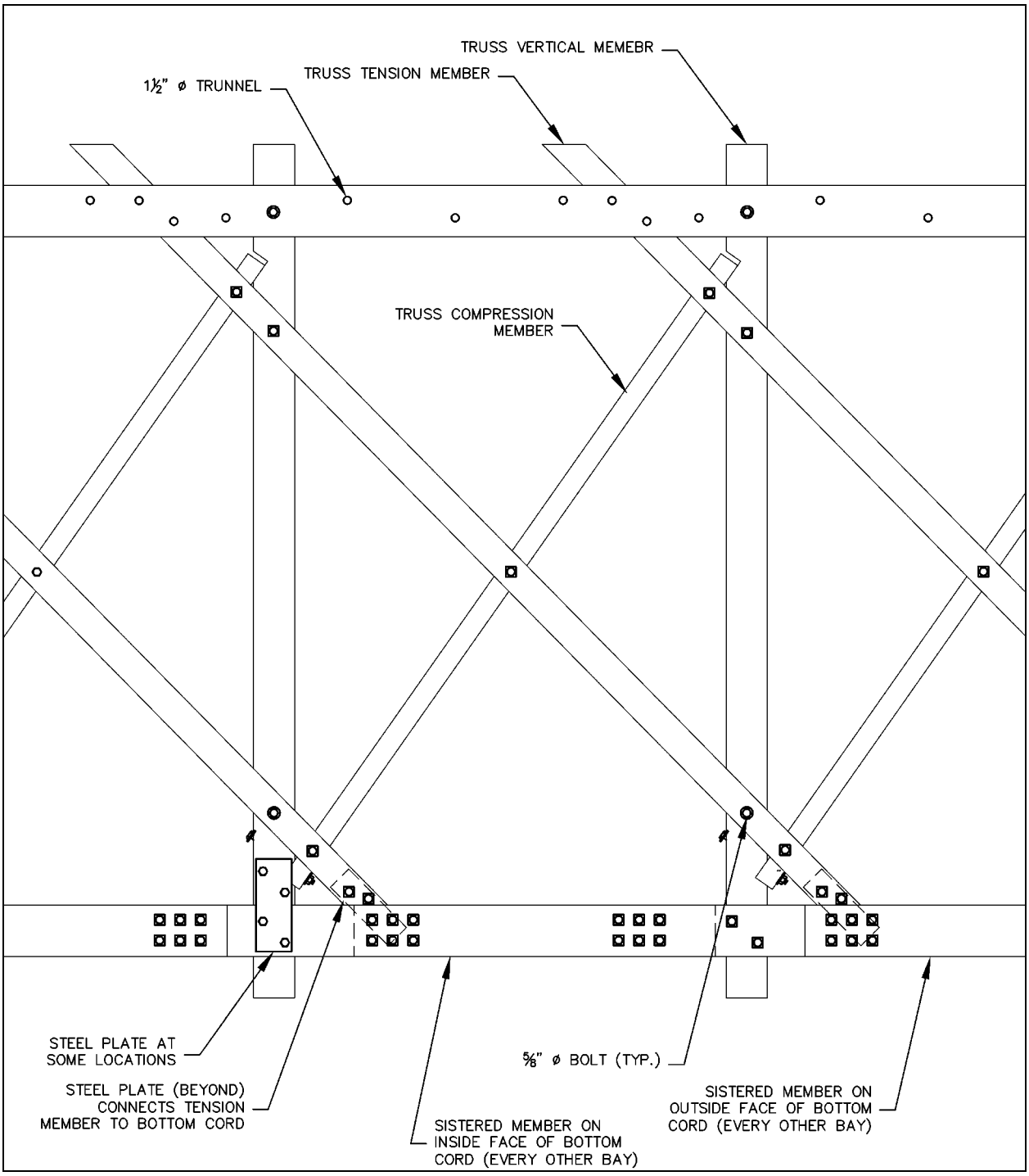


Figure 23: Current Conditions Drawing from HEB Engineering Study 2012, Sheet 3, Inset.

3.0 PROPOSED REHABILITATION & EFFECTS

3.1 Description of Proposed Work

The following listing of proposed work items is taken from the *National Historic Covered Bridge Preservation Project Application*, cited above. The work elements described are subject to modification pending the findings of the Engineering Study and the Preliminary and Final Rehabilitation Designs to be prepared by H.E. Bergeron Engineers, Inc.

A. Remove and replace the existing wood shake roof
B. Remove, replace, or strengthen deteriorated bridge members, including:
- Replace roof rafters, as needed
- Replace truss verticals, as needed
- Replace worn and rutted deck planks
- Replace worn and decayed sidewalk deck planks (east sidewalk, entire length)
- Replace worn and decayed sidewalk deck planks (west sidewalk, 20% area)
- Replace and/or repair splits and decay of timber deck stringers (10% of total)
- Replace and/or repair splits and decay of timber sidewalk stringers (10% of total)

C. Provide temporary support during member replacement and jacking of bridge trusses to restore camber
D. Vertical realignment of both trusses including shimming of the truss members
E. Remove dirt and debris from all areas of the bridge
F. Address settlement at north abutment and wingwalls
G. Repair concrete seats at the pier and abutments
H. Replace bridge bearings under steel stringers
I. Strip and repaint steel stringers
J. Apply water repellant to all exposed concrete surfaces
K. Install a fire protection system
L. Remove and repave 50’ of the approaches to the bridge
M. Install adequate lighting in bridge and enclosed sidewalks
N. Install new approach guardrail
O. Repair and repaint siding as needed

3.2 Assessment of Project Effects

All proposed work is being undertaken with the intent to meet the provisions of the *Secretary of the Interior's Standards for the Treatment of Historic Properties- Rehabilitation* (Secretary's Standards) and the requirements of the FHWA Covered Bridge Preservation Program Grant. Additional guidance for consideration of historically acceptable treatments for covered bridges was obtained from the *Draft Guidelines for the Treatment and Rehabilitation of Historic Covered Bridges* (Covered Bridge Guidelines), however, they are not yet adopted as official federal standards and do not supersede the Secretary's Standards in the Section 106 review process.

Character defining features are those features that contribute to the historical significance of the bridge. They must retain physical integrity of original design and materials to be contributing features. Opinions differ regarding when a feature is damaged or deteriorated to the point that it cannot be *reasonably repaired* in accordance with the Secretary's Standards. Features that everyone agrees

cannot be reasonably repaired can be considered to have lost their *integrity of materials and design* and therefore may be subject to alternative treatments. The Covered Bridge Guidelines recommend that after stabilization and protection of the bridge from ongoing deterioration or damage, the next levels of *Rehabilitation Practice* are *Repairing* followed by *Replacing*. According to the Guidelines:

> Repairing should be done "with the least degree of intervention possible such as patching-in, piecing in, splicing, consolidating, or otherwise reinforcing or supplementing those features according to recognized preservation methods. Repairing also includes the limited replacement in-kind or with compatible substitute material of extensively deteriorated or missing parts or features."
>
> "Following repair in hierarchy, Rehabilitation guidance is provided for replacing and entire character defining feature with new material because the level of deterioration or damage of materials precludes repair, for example, exterior siding, interior truss members, or a complete floor system or roof. If the essential form and detailing are still evident so that the physical evidence can be used to reestablish the feature as an integral part of the rehabilitation, then its replacement is appropriate."

The Guidelines do not specify the exact actions to be taken; the bridge owner, the project engineers and the funding and permitting agencies involved are responsible for defining the steps taken in each historic bridge rehabilitation project. Each step should be considered and adjusted to best solve the unique problems of each bridge and achieve the overall project goals.

Bridge structural systems function as complete assemblies dependent on the individual integrity and service life of each individual member. Whenever possible, repairs to individual members should be in the manner that insures the longest service while replicating the original design and purpose of the member. For members that were originally spliced, such as a long chord or arch made up of multiple boards spliced together, splicing-in new members are appropriate. If an original member was designed to be cut from a single piece of wood, such as a post or diagonal, then a whole replacement member may be the most appropriate. Splicing or sistering onto an original member may also be appropriate if it avoids possible damage to other members by dismantling, or is the most cost effective repair method.

3.3 Character Defining Features of Stark Bridge

The primary character defining features of covered timber truss bridges is generally agreed upon by bridge historians to be the components of the truss frame itself, plus any other special features that contribute to the definition of the bridge type, or distinguish the bridge, such as siding, roofing and other architectural embellishments. Also recognized by the Secretary's Standards, are "changes to a property that have acquired historic significance in their own right." Typical examples for covered bridges may include laminated arches or supplemental beams added under or beside the trusses to increase the load capacity of the bridge. The addition of piers or bents to reduce the span length and increase capacity or support deteriorated or sagging structures are also common alterations.

In the case of the Stark Covered Bridge, arches were added in 1895, and then removed in 1954 when the work of adding a concrete pier (1948) and steel stringers was completed. The 1954 work resulted in the complete replacement of the original sidewalk assembly, deck beams, flooring and lower chord members. In 1981 the entire roof system was replaced, including rafters, purlins and shingles, as well

as several cross beams and lateral braces that tie the trusses together over the roadway. The 1981 repairs are not yet fifty years of age and are therefore not considered character-defining features. The 1948 and 1954 modifications are over 50 years old and therefore need to be evaluated as to whether they contribute to the National Register eligibility of the bridge.

Whether the 1954 repairs contribute or detract from the significance of the bridge was not addressed in the 1979 NR nomination of the bridge. The nomination states that the "substitution of steel stringers and a new center pier—replacing a poorly-built successor to a flood-damaged support—made it possible to recapture the original Paddleford truss configuration, by removing the arches." Although the removal of the arches and reinstallation of the center pier did return the bridge to a configuration more closely resembling its original design, it did not actually restore the structural function of the trusses to that of a Paddleford truss. The combination of the 1895 reconstruction, the addition and then subtraction of the arches, and the thru-bolting of most connections, has completely altered the structural behavior of the trusses.

The design of the center pier, steel I-beam stringer span and accompanying deck and sidewalk assemblies, was straightforward and did not introduce exceptional or innovative materials or engineering practice. The design met the need for low cost by utilizing as much salvaged material that could be recycled from the bridge itself and from the state highway department supplies (NHHD routinely salvaged and saved bridge components for reuse).

The design of the sidewalk – on cantilevered beams notched and hooked under the I-beam stringers, proved to be a poor design, evidenced by the many beams that split at the notches causing the current sag in the walkway. The overall design of the repairs did not provide for the protection of the lower truss components from water and dirt accumulation that leads to rot; the result being the extensive rot now seen in those elements.

The overall design concept of removing the live traffic loads from the trusses was, however, an arguably successful measure in preserving them from further over-stressing and structural failure. The primary considerations in preserving a historic resource is first to retain the overall appearance of the resource, as a feature of a historic landscape or district, and secondly, to retain the individual historically-important components of the resource, including those that may be out of general view. The 1954 rehab can be considered important and successful for preserving the bridge as a whole, but less successful for removing original fabric, features and function.

The actual execution of the 1954 rehab work, accomplished by the NHHD bridge construction and maintenance force, required clever thinking. The "suggested construction sequence" that was included on the plans (reproduced in the historical section above), identifies the major elements of the work and gives an appreciation of the complexity of projects undertaken by the state at that time.

4.0 BRIDGE FEATURE REHABILITATION TREATMENT FORMS

4.1 STRINGERS	
Date of Feature: 1954	**Source:** NHDOT plans and records

Description: [see drawings and photos below]

In 1954 the New Hampshire Highway Department repaired the bridge by building a 2-span, I-beam stringer deck bridge underneath the covered bridge to carry the live traffic loads. The steel stringers consist of four 24" WF 130# I-beams that rest on concrete bridge seats cast on the stone abutments, and steel pedestal seats on the concrete pier built in 1948 as an emergency center support under the sagging bridge. The truss carries the dead load of the covered bridge plus the live wind, snow and sidewalk loads. Between the each of the primary steel I-beam stringers are intermediate stringers consisting of two 3 ¾"x11 ¾" wooden beams 16' long, sistered together and carried on 8" steel I-beam diaphragms spaced 16' apart. The intermediate stringers are of the same salvaged and recycled floor planks used for the lower chord members.

Significance:

The comprehensive 1954 repairs to the structure were designed by Harold E. Langley and Robert J. Prowse and executed by NHHD forces. Langley and Prowse were significant to the history of the NHHD. The repairs do not represent the best work by Langley and Prowse, or the best covered bridge repair practice by today's standards, or possess notable engineering characteristics. The 1954 repairs as a whole are notable as an early effort by the state to preserve its historic covered bridges in service through a cost-effective alternative design.

Condition: (information from HEB 2012 Engineering Study)

The two interior steel stringers show severe deterioration and rusting of the top and bottom flanges with an estimated average section loss of 25%. The two exterior steel girders appear in good condition with estimated average section loss on the flanges less than 5%. The steel pedestal bearings and steel diaphragms are in poor condition with heavy rusting and section loss.

Proposed Treatment:

Retain, clean and epoxy paint the two exterior steel stringers; replace the two interior stringers. Replace steel diaphragms. Remove intermediate wood stringers and install wood glue-laminated transverse deck beams resting on steel stringers.

Project Need:

Rehab and replacement of the steel stringers is required to meet federal design load specifications. The work will allow for several of the wood truss diagonal members to be returned to their original positions restoring the truss to its original two-span Paddleford configuration and the proper distribution of loads. The work will allow installation of transverse floor beams (originals removed in 1954) closely replicating original configuration, providing proper distribution of truss and sidewalk loads.

Impacts:

The work does not impact original historic features of the bridge. The repair and replacement in-kind of the I-beam stringers, the primary components of the 1954 rehab that allowed for the overall preservation of the bridge, is consistent with Secretary of the Interior's Standards for Rehabilitation (SOI Standards). The removal of secondary elements of the 1954 rehab including the sidewalk cantilever system and intermediate wood stringers replaces incompatible features with features matching original design is constant with SOI Standards.

Alternative Treatments Considered:

Two alternatives were considered: complete replacement of the steel stringers with new stringers which was determined impractical due to cost; replacement of steel stringers with wood arch system which was determined impractical due to the resulting reduced load capacity of the bridge.

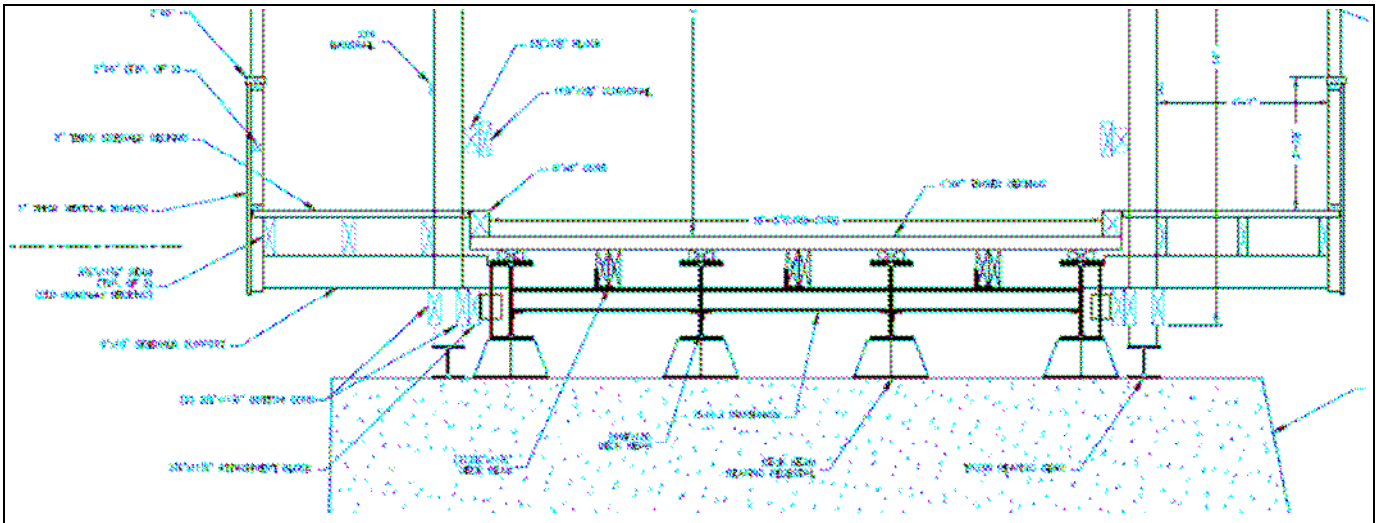


FIGURE: 4.1-1: Stringers, existing conditions (source: HEB 2012a)

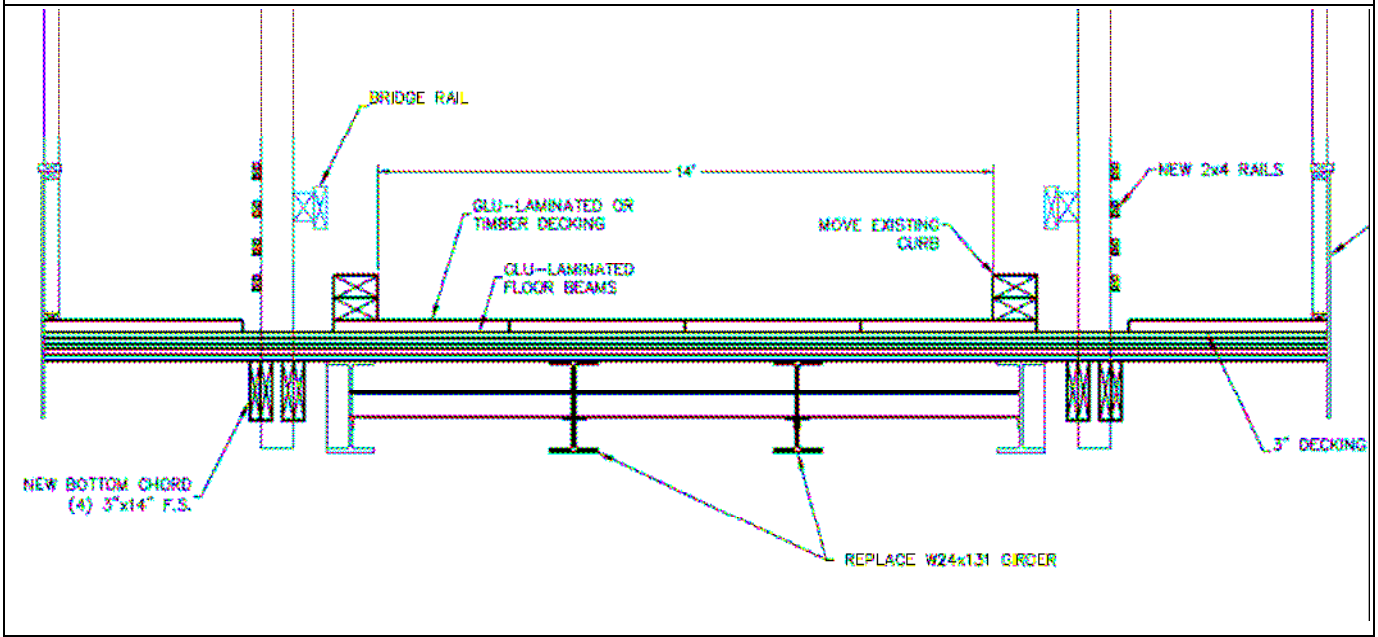


FIGURE: 4.1-2: Stringers, proposed rehab (source: HEB 2012b)

FIGURE: 4.1-3: I-beam stringers, diaphragms and intermediate stringers.

4.2 TRUSS UPPER CHORD	
Date of Feature: 1853, 1895	**Source:** Historical information, visual evidence

Description: [see drawings and photos below].

The top chord consists of three rectangular sawn timbers joined together with wood trunnels and iron or steel bolts The members fit into 2-1/2" deep notches on the inside on outside of the posts; the remaining material of the post creates a 3" space between the inner and outer members. The single exterior member measures 5" x 9-¾". The two interior members are 2-½" x 9-¾".

Significance:

The truss upper chords are a character-defining feature of the bridge. There is no reason to assume that the majority of the chord members are not original to the bridge. The reconstruction of the bridge in 1895 may have resulted in the replacement of some members but none were positively identified.

Condition: (information from HEB 2012 Engineering Study)

Due to their location above areas of the truss subject to repeated wetting, the upper chords are in good condition with very little rot or insect damage observed.

Proposed Treatment:

No treatment is proposed other than refastening to posts and diagonals in the course of repairs to those members.

Project Need:

Refastening is required to restore structural integrity to the truss.

Impacts:

The work will have no impact on historic features of the bridge.

Alternative Treatments Considered:

None

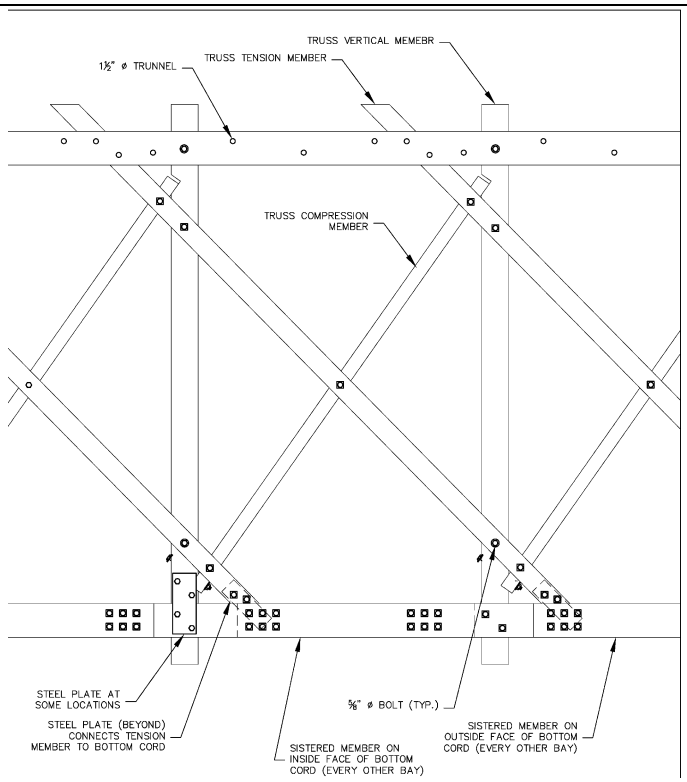


FIGURE: 4.2-1: Truss elevation, showing upper chord (source: HEB 2012)

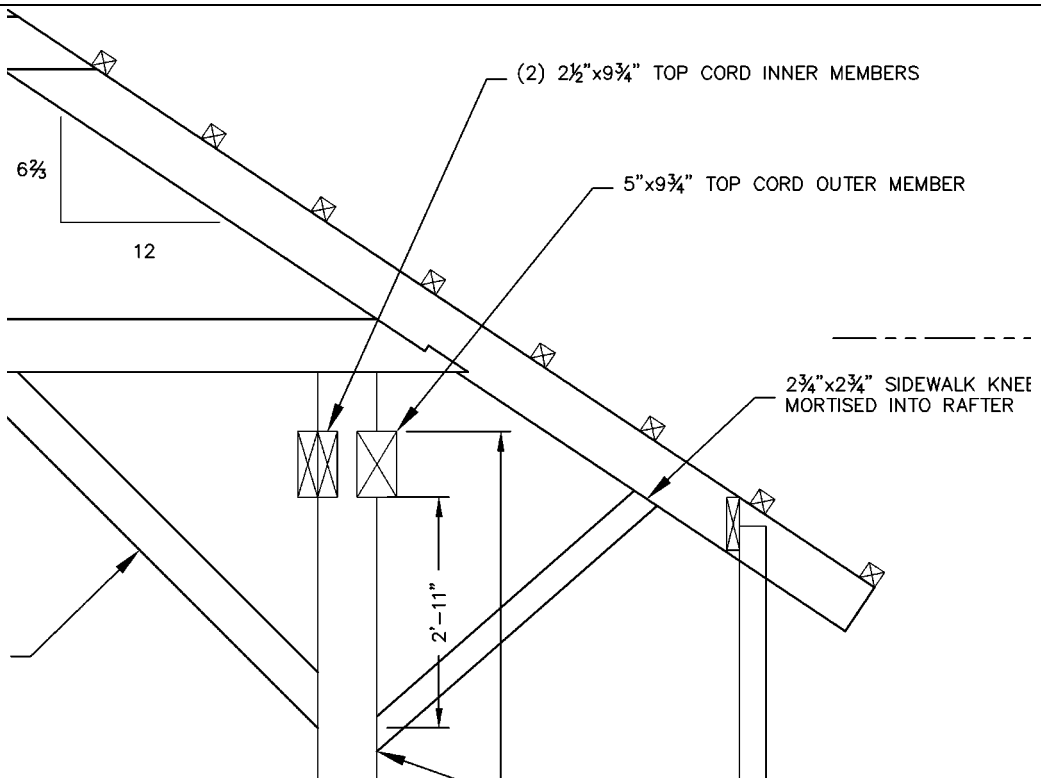


FIGURE: 4.2-2: Upper chord, section (source: HEB 2012)

FIGURE: 4.2-3: Upper chord connection to posts showing wood trunions and thru-bolts.

FIGURE: 4.2-4: Upper chord connection to diagonal counter brace.

FIGURE: 4.2-5: Upper chord showing spacer block at pegged splice connection.

FIGURE: 4.2-6: Upper chord at mid-span showing bolted steel plate splice connection.

4.3 TRUSS LOWER CHORD	
Date of Feature: 1954	**Source:** NHDOT plans and records

Description: [see drawings and photos below]

Lower chords consist of two, 3¾" x 11¾" timbers separated by 3" blocking to allow attachment to either side of the posts and diagonal truss members. The lower chords were installed in the 1954 rehab of the bridge and are evidently recycled deck planks salvaged from another bridge. They are pressure-treated with creosote, with one flat side showing the typical regularly spaced incision cuts made in the treatment process to increase penetration of the creosote. The opposite side of the planks are coated with sand and gravel asphalt pavement, with some showing a yellow paint stripe, obviously lane striping. The chord members are thru-bolted to the truss members. Splices are butted and sistered with short sections of the same planks applied inside, outside and between the chords, and thru-bolted. Midway between the post connections there is thru-bolted blocking between and on the inside of the chords to add support under the cantilevered sidewalk beams that rest on the chords.

Significance:

As previously noted, the comprehensive 1954 repairs to the structure were designed by Harold E. Langley and Robert J. Prowse and executed by NHHD forces and represent a notable early effort by the state to preserve its historic covered bridges in service through a cost-effective alternative design. The lower chord members however are not a contributing feature of the rehab since they are incompatible with the original design in size, material and method of attachment.

Condition:

The lower chords are in fair to good condition due to being treated against rot and coated with asphalt.

Proposed Treatment:

All lower chords will be replaced with new wood members compatible with existing original truss components.

Project Need:

The lower chords are primary structural members of the truss that carry the live and dead loads. The lower chord members and their thru-bolt connections are of insufficient strength and do not possess the required structural integrity to carry the required loads.

Impacts:

The existing chord members are not original to the bridge and are incompatible with the original design because they were salvaged deck timbers of different size, surfaced with asphalt pavement.

Alternative Treatments Considered:

None. There are no other repair alternatives that meet the Secretary of the Interior's Standards for Rehabilitation.

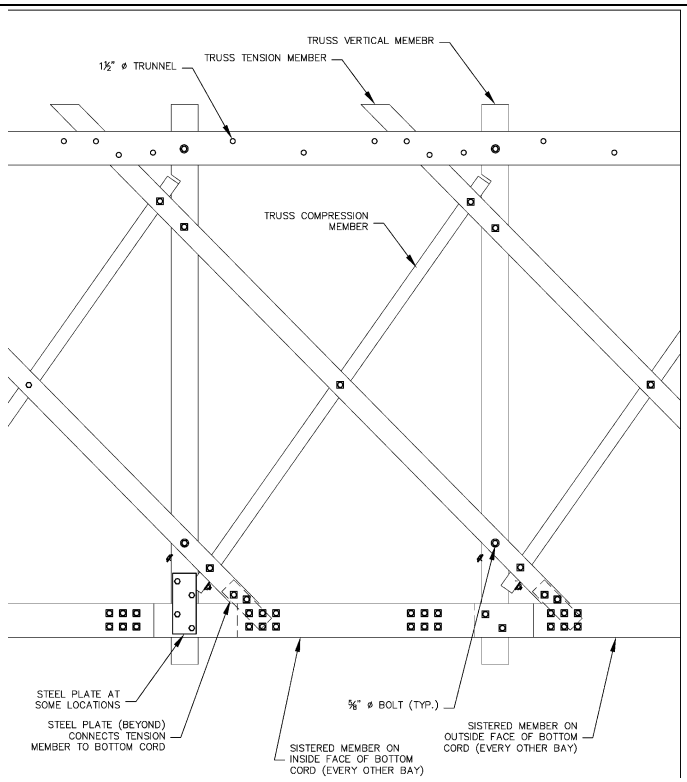


FIGURE: 4.3-1: Lower chord, elevation (source: HEB 2012)

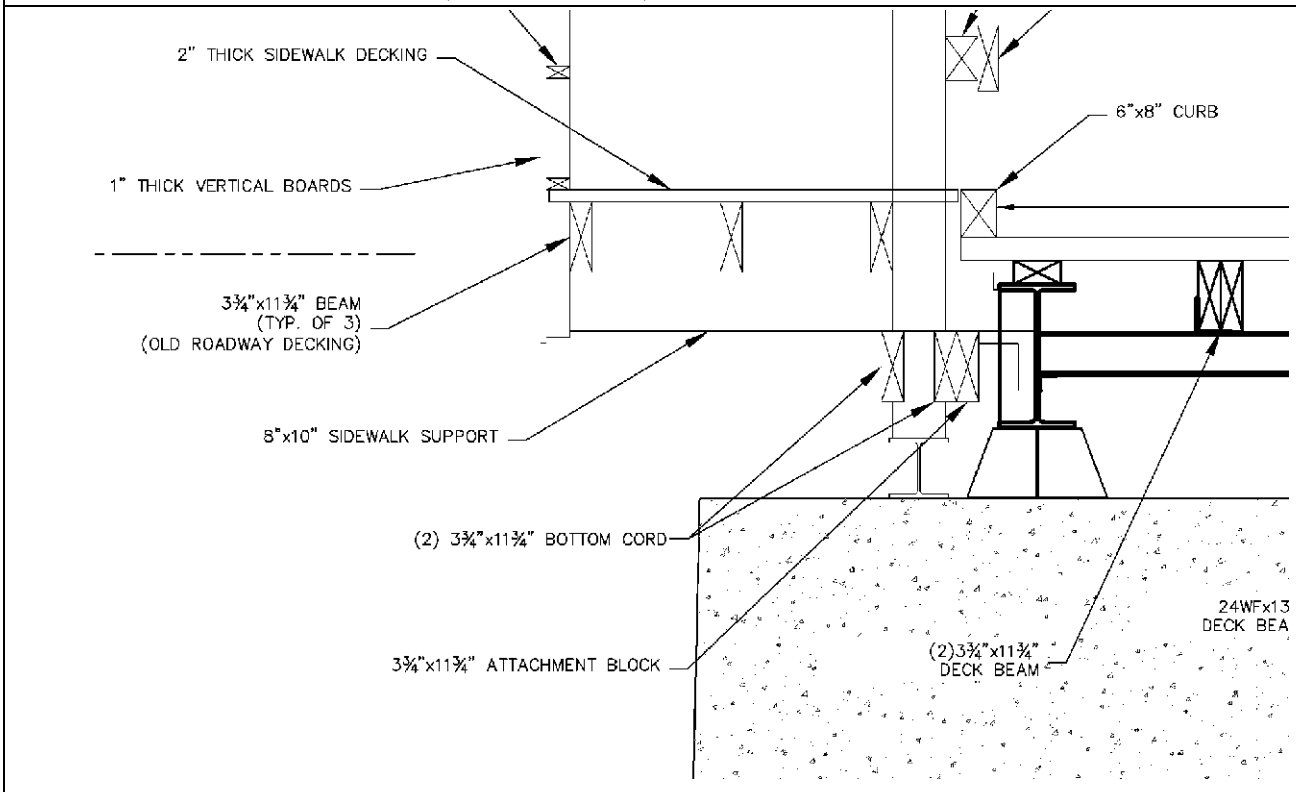


FIGURE: 4.3-2: Lower chord, section (source: HEB 2012)

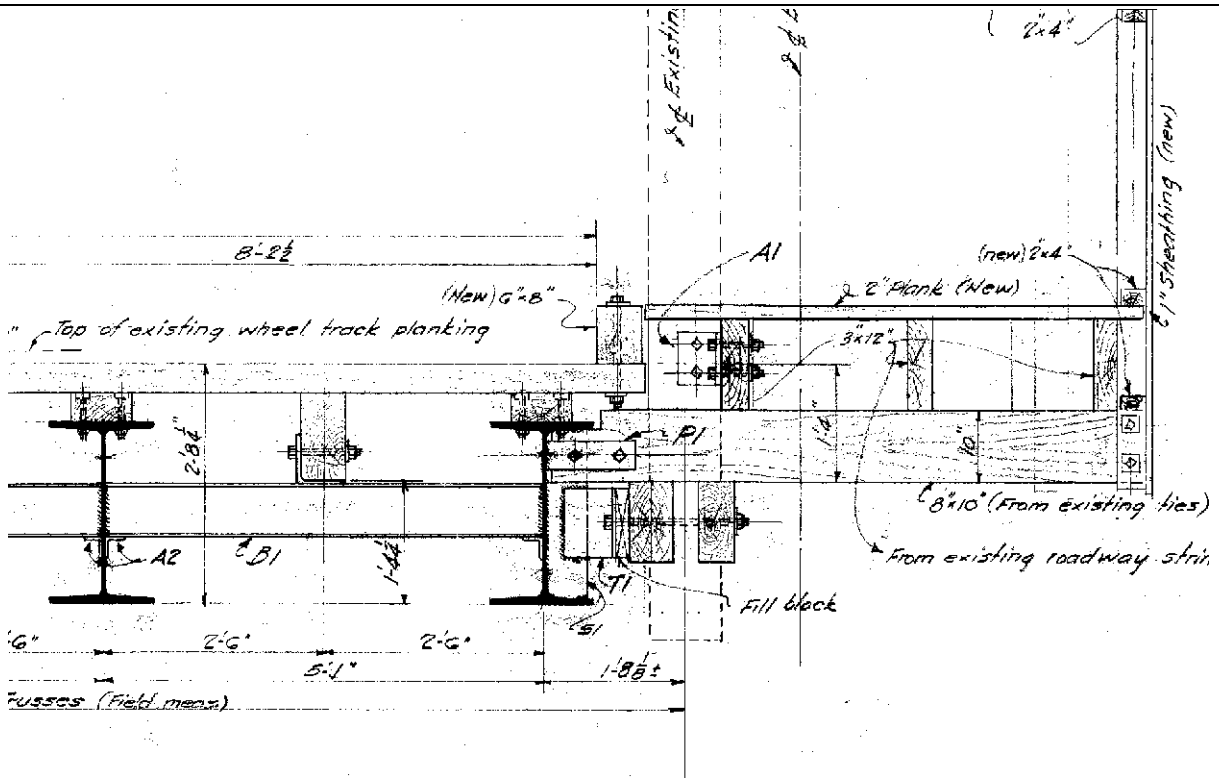


FIGURE: 4.3-3: Original design for lower chord from 1954 Repair Drawing does not show the use of the recycled deck planks.

FIGURE: 4.3-4: Lower chord members bolted to posts and diagonals. The same salvaged deck members are also used for intermediate floor stringers between the I-beam stringers; two are visible in upper half of photo.

FIGURE: 4.3-5: Lower chord members. Note splice blocks, asphalt road surface coating, yellow line stripe at center of photo.

4.4 TRUSS VERTICALS (POSTS)	
Date of Feature: 1853	**Source:** Historical information, visual evidence

Description: [see drawings and photos below]

The vertical truss members (posts) are spaced approximately 7'-8" o.c. and vary in size from 8" x 8" to 10" x 10". They are approximately 15'-4" long, extending beyond the top and bottom chords by about 8". The posts have notches top and bottom, about 2-1/2" deep, into which the chord members fit. The chord-post connection was originally pegged and many pegs remain in place, but the connections have since been reinforced with thru-bolts. The diagonal members, knee braces and cross beams are also joined to the posts with mortised joints, pegged and/or thru-bolted.

Significance:

The vertical posts of the truss are a character-defining feature of the bridge. The majority of the verticals appear to be original to the bridge. Several posts have evidently either been moved from their original locations or replaced probably when the bridge was reconstructed in 1895. The splice repairs are typical to wood bridges and do not significantly diminish the integrity of the structure as a whole.

Condition: (information from HEB 2012 Engineering Study)

Rot and insect damage was observed in most of these members at and below the deck elevation. Thirteen of the forty posts have been spliced below the deck elevation using half lapped connections and bolts. In two locations the bottom tails of the vertical posts have been broken off within the bottom chord. In four other locations, the bottom tails have been cut flush with the bottom chord.

Proposed Treatment:

Repair an estimated 14 posts per truss by splicing new timber sections on the lower end of the posts; replace an estimated 8 posts per truss.

Project Need:

Restoration of the structural integrity of the posts is necessary to enable the truss to carry the live and dead loads being placed on it.

Impacts:

The work impacts original historic features of the bridge. The repair and replacement of the timber post members will be done in-kind, replicating the materials, design and workmanship of the original members, consistent with Secretary of the Interior's Standards for Rehabilitation (SOI Standards).

Alternative Treatments Considered:

Rehabilitation of the vertical members in accordance with SOI Standards is the only treatment considered.

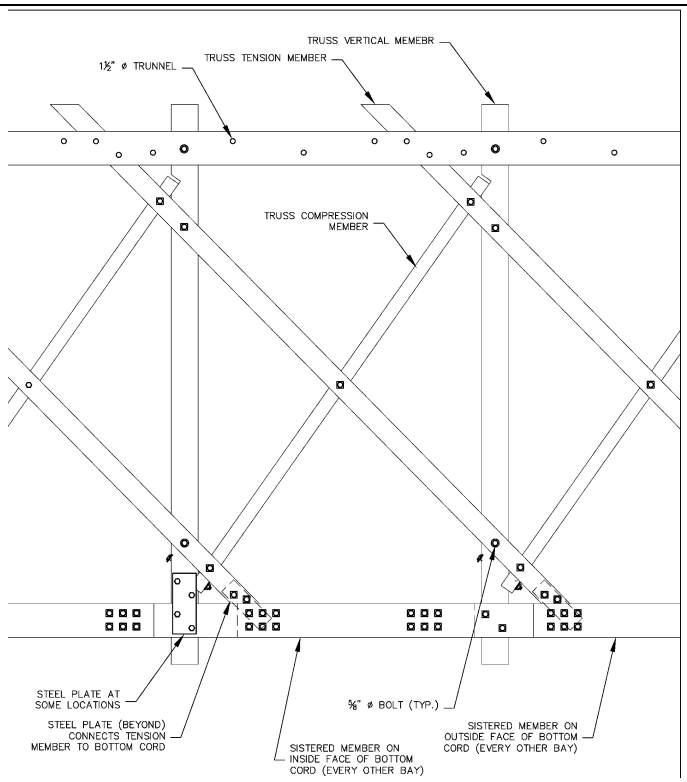


FIGURE: 4.4-1: Vertical truss members, existing conditions detail (source: HEB 2012)

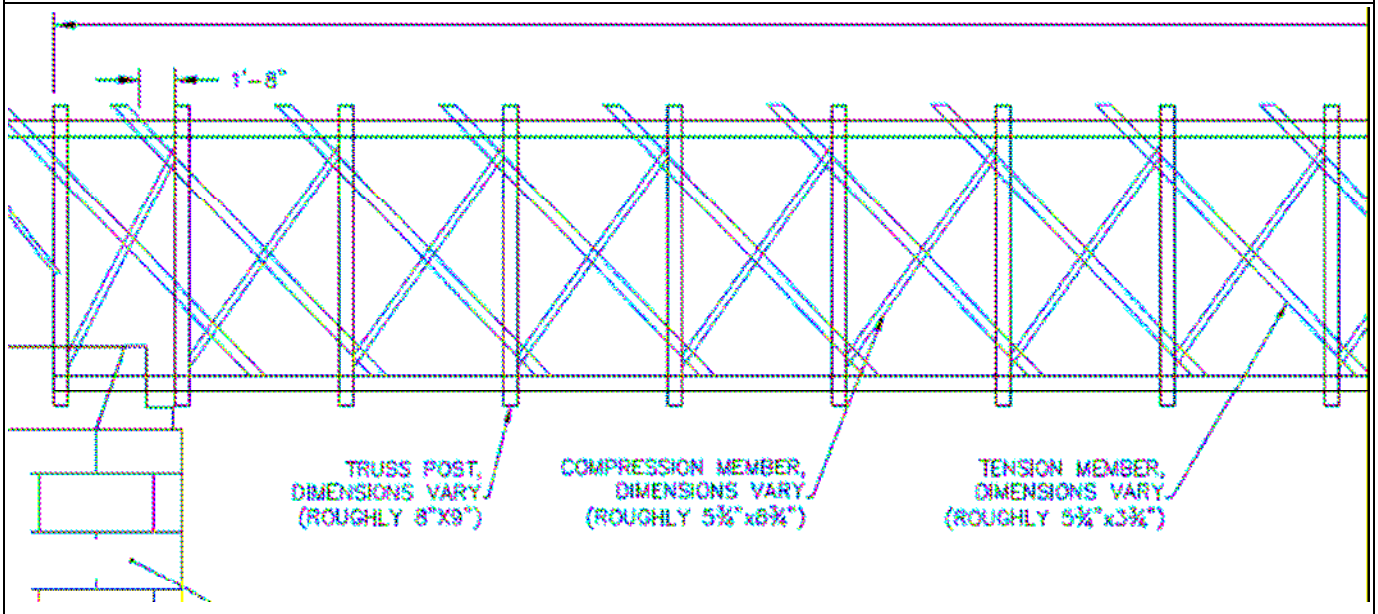


FIGURE: 4.4-2: Vertical truss members, existing conditions (source: HEB 2012)

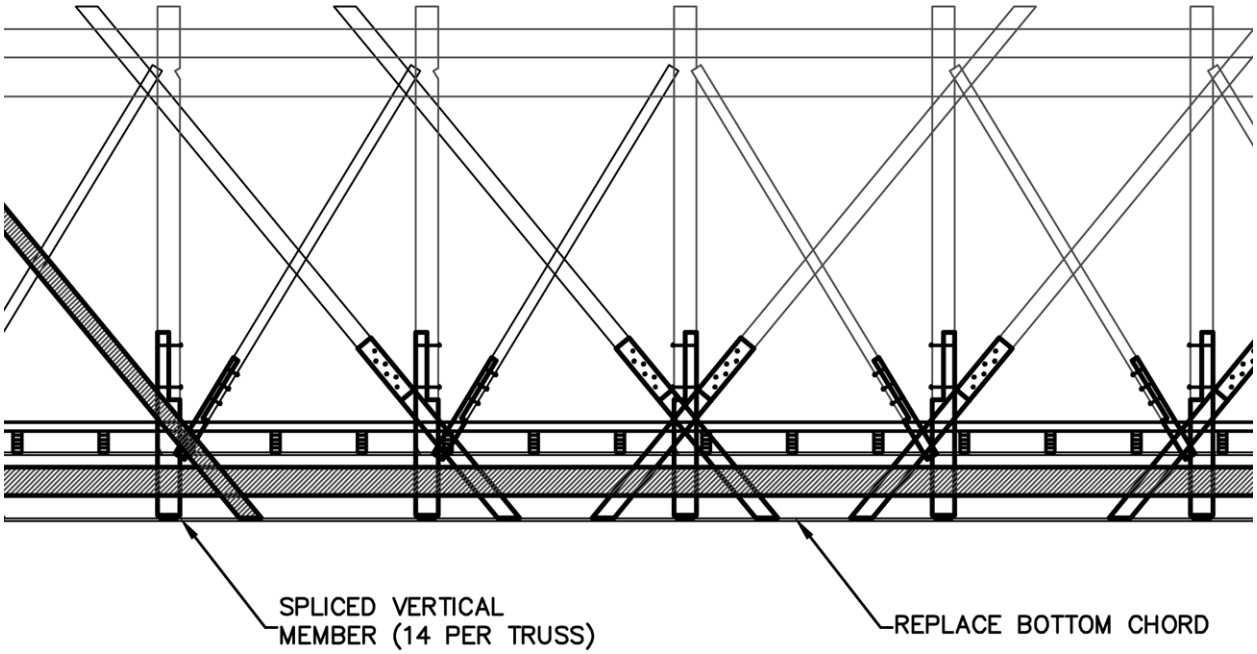


FIGURE: 4.4-3: Proposed repairs to vertical truss members (source: HEB 2012)

FIGURE: 4.4-4: Overall view of verticals (posts).

FIGURE: 4.4-5: Vertical connection to upper chord showing multiple thru-bolts.

FIGURE: 4.4-6: Verticals showing typical connection to diagonals, cross beams and bracing.

FIGURE: 4.4-7: Verticals at center of bridge moved from original location

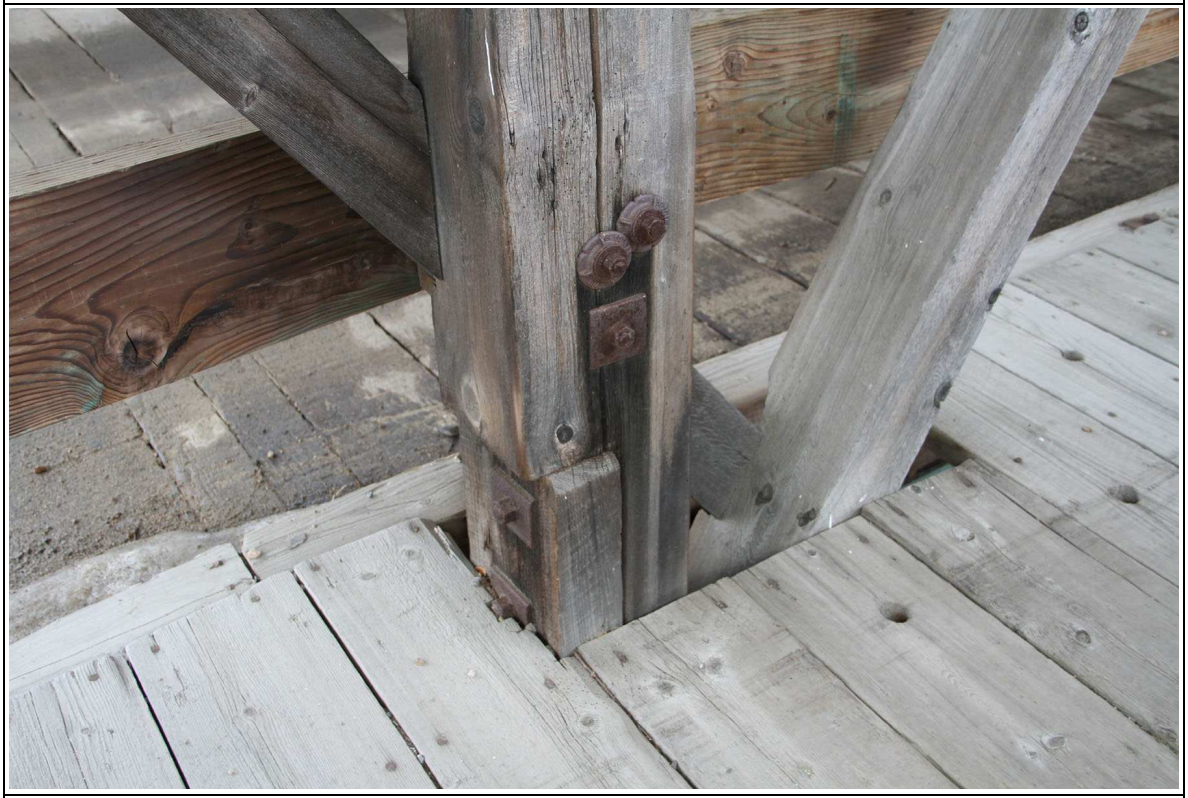


FIGURE: 4.4-8: Vertical with splice at bottom

4.5 TRUSS DIAGONAL BRACES

Date of Feature: 1853, 1895 | **Source:** Historical information, visual evidence

Description: [see drawings and photos below]

The Paddleford truss design uses primary diagonal members in compression the counter braces in tension; on the Stark bridge there is one diagonal of each type between the posts, in opposite directions, forming an X-brace. The main diagonals (compression members) are of two sizes: 5-¾" x 8-¾" at the ends of the bridge and 3-¾" x 8-¾" at the middle of the bridge. It is not known if this difference is the original design or the result of reconstruction. The upper and lower ends are fit into notches in the vertical posts approximately 6" above the bottom chord and below the top chord. Originally designed to be tightened with wedges, the connections are now thru-bolted.

The counter-braces (tension members) are approximately 4" x 6" and extend past the posts to attach to the top and bottom chords. The brace is mortised and pegged between the top chord members; the bottom of the brace is thru-bolted. The braces are mortised and bolted to the face of the post and to the main diagonals where they cross.

Significance:

The diagonals are a character-defining feature of the bridge. Like the posts, most diagonals appear to be original to the bridge. Some have evidently been moved from their original locations or replaced, probably when the bridge was reconstructed in 1895. The replacements and splice repairs are typical to wood bridges and do not significantly diminish the integrity of the structure as a whole.

Condition: (information from HEB 2012 Engineering Study)

Due to the many alterations to the bridge and the sagging of the trusses due to deterioration and loose joints, many of the diagonals currently are not functioning in their intended structural capacity. Most diagonals show signs of rot or insect damage at the lower portion of the member.

Several of the main diagonal joints have opened up, indicating that the members are no longer acting in compression. Spacer blocks have been added to some of the open joints in an attempt to put a bearing load on the member. Many of the main diagonals have unused notches, notches that have been widened, and unused holes suggesting they have been moved from their original locations; three appear to have been replaced and one has been spliced. The counter braces are in similar condition, with numerous additional holes and notches; one has been spliced.

Proposed Treatment:

Restore trusses to original two-span configuration; relocate several diagonal members in their original locations; splice or replace members in-kind to achieve structural integrity. Repair estimate per truss: 14 counter braces require splices; 10 main diagonals require splices; 8 main diagonals require replacement; 8 main diagonals require repositioning.

Project Need:

Restoration of the structural integrity of the truss is necessary to enable it to carry the live and dead loads being placed on it.

Impacts:

The work impacts original historic features of the bridge. The repair and/or replacement of the timber members will be done in-kind, replicating the materials, design and workmanship of the original members, consistent with Secretary of the Interior's Standards for Rehabilitation (SOI Standards).

The restoration of the trusses to the original two-span configuration removes incompatible repairs that have compromised the overall structural integrity of the bridge, and is constant with SOI Standards.

Alternative Treatments Considered:

Rehabilitation of the truss members in accordance with SOI Standards is the only treatment considered.

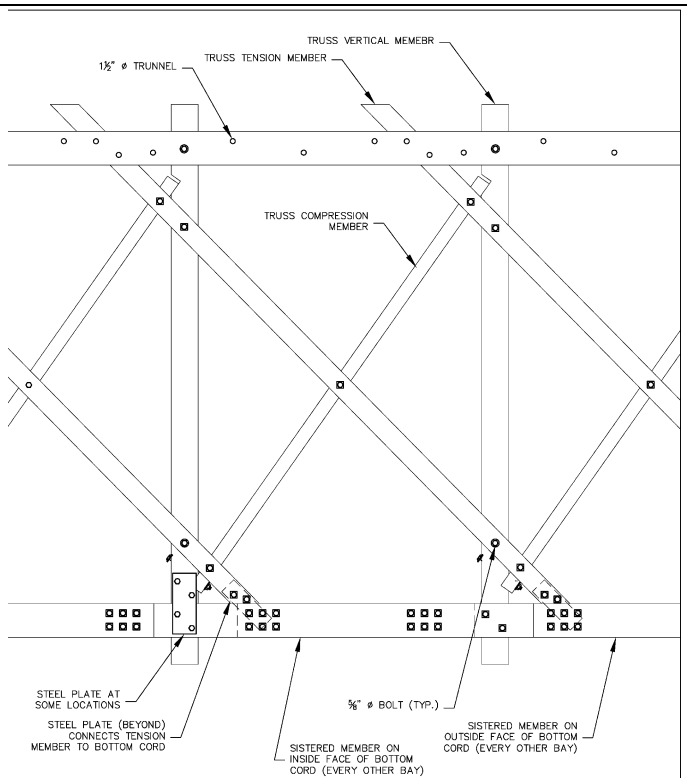


FIGURE: 4.5-1: Diagonal truss members, existing conditions (source: HEB 2012)

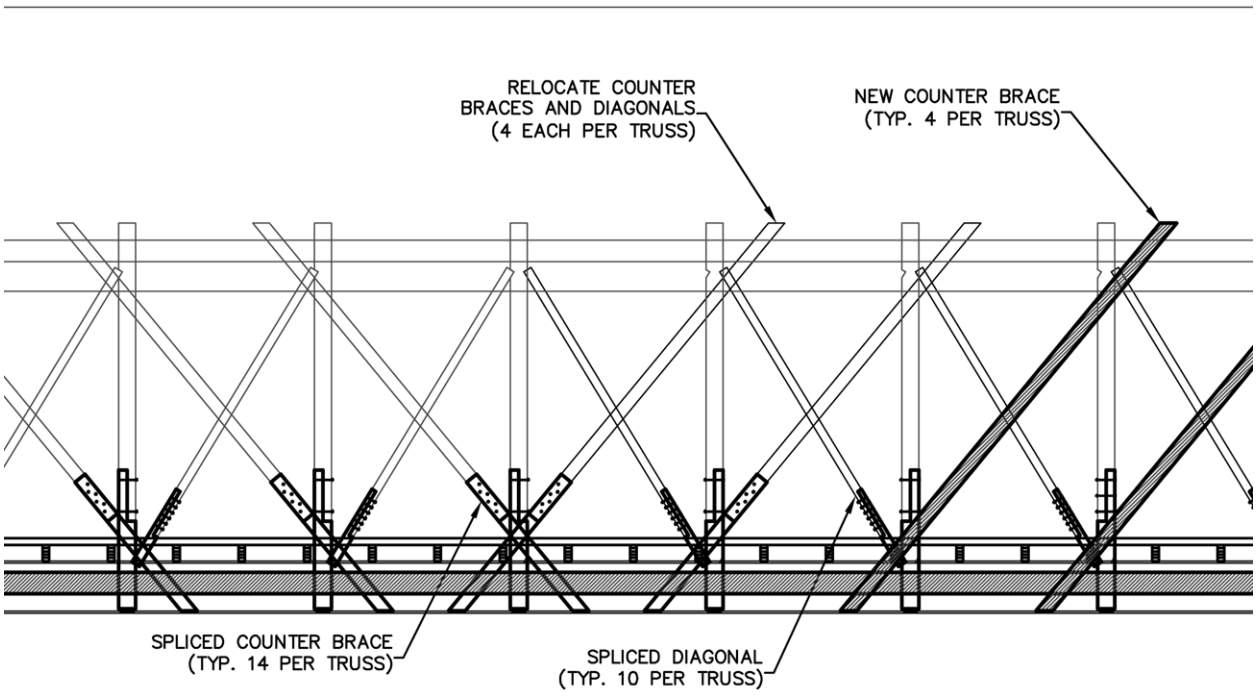


FIGURE: 4.5-2: Diagonal truss members, proposed repairs (source: HEB 2012)

FIGURE: 4.5-3: Overall view of diagonals

FIGURE: 4.5-4: Loose diagonal with spacer block inserted in open joint.

FIGURE: 4.5-5: Example of many diagonals that are bolted instead of pegged due to being misplaced and/or misaligned during previous reconstructions.

FIGURE: 4.5-6: Diagonal connections at bottom chord; compression member shown in notch and bolted to the post above chord; tension member extends between chord members and bolted to them.

4.6 UPPER TIE BEAMS & BRACES	
Date of Feature: 1853, 1895, 1981	**Source:** Historical information, visual evidence

Description: [see drawings and photos below]

Cross beams, also known as tie beams or struts, join the two trusses together at the top of each post, and run perpendicular over the roadway. These timber members measure 5-3/4" x 7-3/4" and are joined with mortised and pegged connections to the posts rafters and knee braces. The height of the cross beams establishes the 12'-5" vertical clearance over the road. In 1981 the entire bridge roofing system was replaced including rafters, ridge board, purlins and roof shingles. The work was done by local contractor Robert (Bob) Kidder and described in an article in Covered *Bridges Bulletin*. The work, "replaced a third of the structural cross members on the top of the bridge. Each piece of the post and beam construction has been carefully removed and numbered for proper replacement with new spruce timbers. Made-to-fit hardwood pins have been used to hold beams in place in the original manner." (*Covered Bridges Bulletin*, Fall 1982). The detailed Engineering Inspection (HEB 2012) observed numerous cross beams at the south end of the bridge that appeared to be the 1981 replacements.

Diagonal lateral braces measure 3-3/4" x 5" and brace the cross beams in an X pattern, with two braces between each bay (truss panel). They connect to the cross ties about 3.5' from the posts, just inside the knee brace connection, with mortise and tenon joints. The joints are wedged to compress and tighten the braces.

Knee braces measure 3-3/4" x 4-3/4" and connect to the cross beams to the posts. They connect to the cross beams about 4' from the posts, thereby limiting the full vertical clearance over the road to about an 8' wide path down the centerline. Impact by vehicles has broke two knee braced and damaged several others.

Significance:

The cross beams, diagonal lateral bracing and knee braces are original character-defining features of the bridge and retain material and design integrity. (The 1981 repairs were done in-kind and meet SOI Standards).

Condition: (data from HEB 2012 Engineering Study)

The cross beams, diagonal lateral bracing and knee braces are generally in good condition. One diagonal bracing member is missing. Two knee braces are broken.

Proposed Treatment:

Replace missing diagonal lateral bracing member, and two broke knee braces in-kind. Rehabilitate and tighten joint connections as required.

Project Need:

Proposed work is required to meet structural design requirements.

Impacts:

The work does not impact historic features of the bridge.

Alternative Treatments Considered:

No alternatives considered.

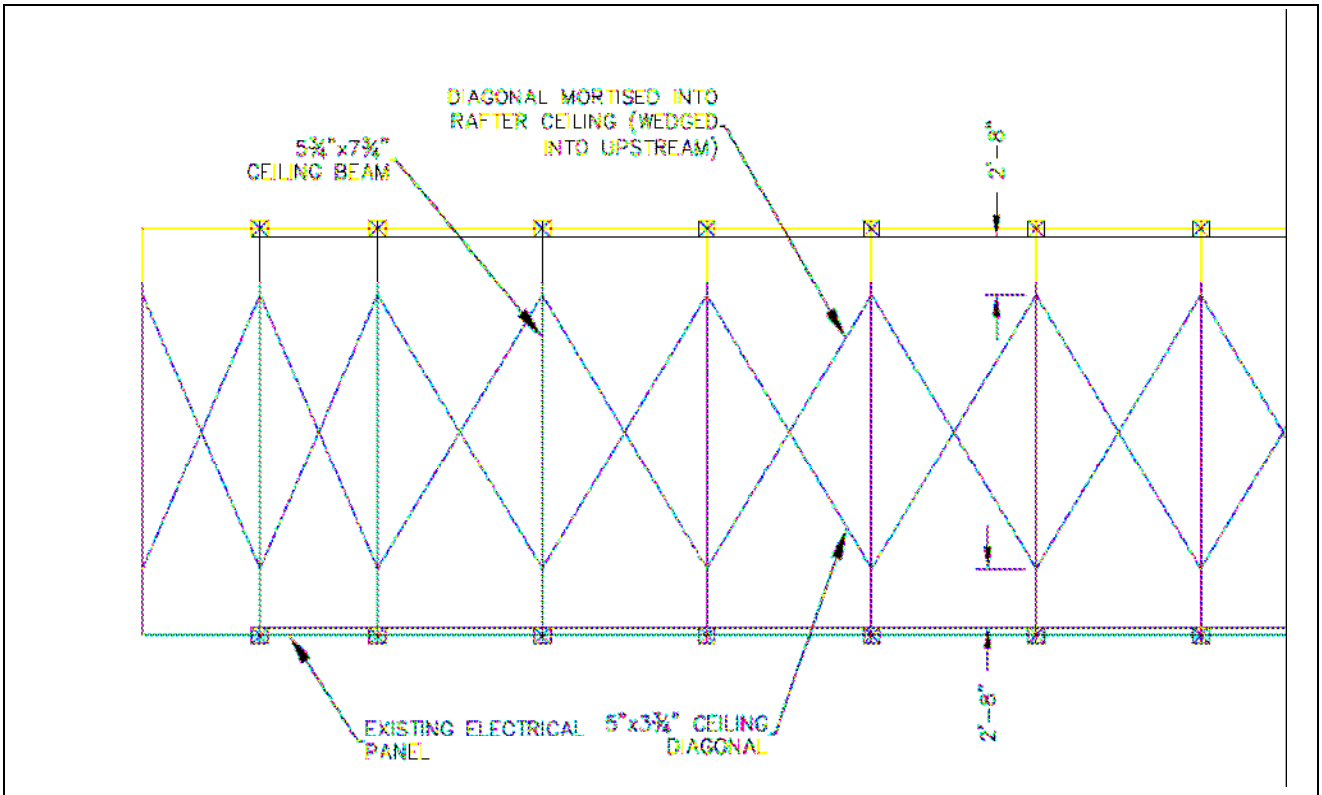


FIGURE: 4.6-1: Upper cross (tie) beams and diagonal lateral bracing, plan of existing conditions (source: HEB 2012)

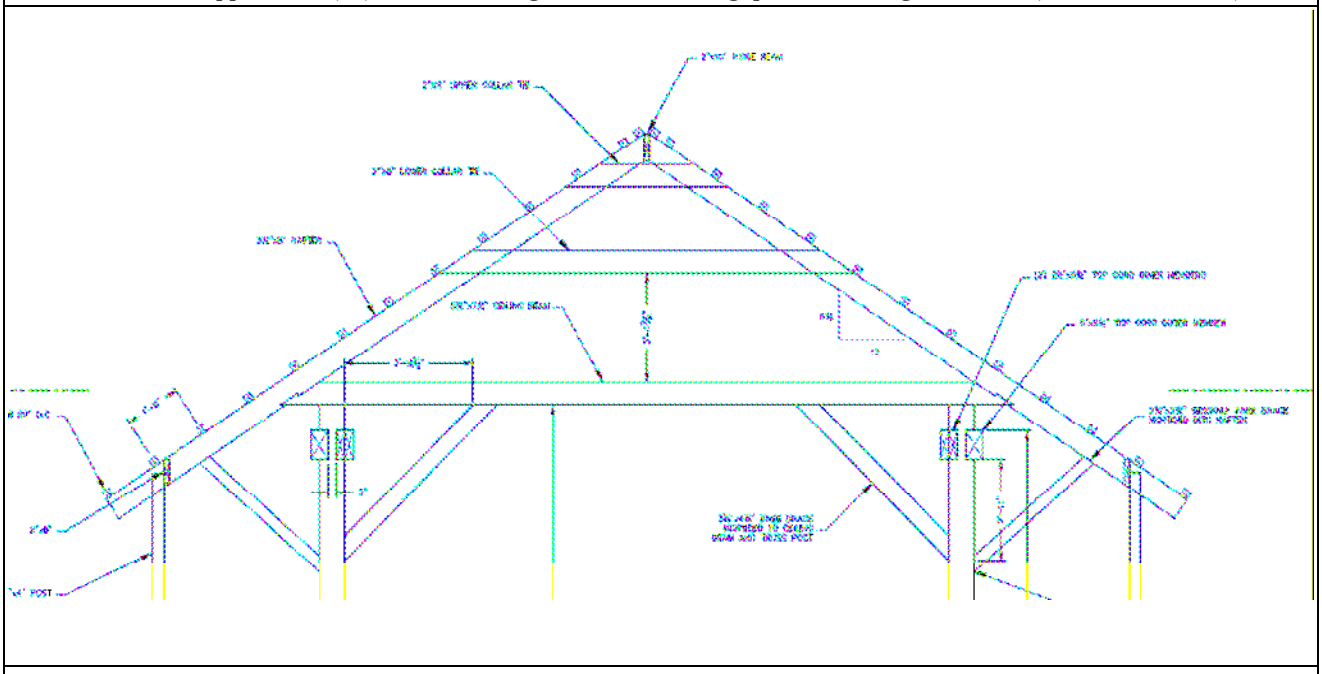


FIGURE: 4.6-2: Upper cross (tie) beams and knee braces, section of existing conditions (source: HEB 2012)

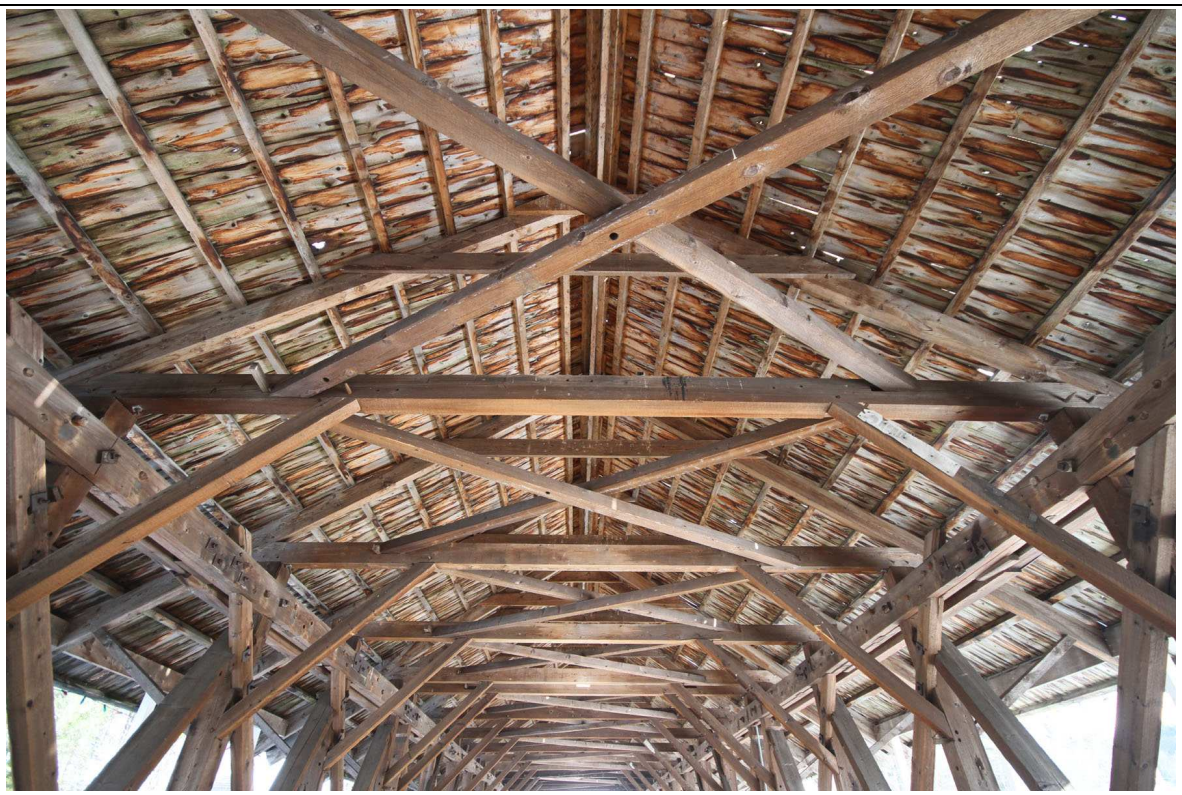


FIGURE: 4.6-3: Upper cross (tie) beams and knee braces, overall view.

FIGURE: 4.6-4: Upper cross (tie) beams and knee braces showing connection details.

4.7	ROOF SYSTEM – RAFTERS, RIDGE BOARD, PURLINS, ROOF SHINGLES
Date of Feature: 1981	**Source:** *Covered Bridges Bulletin,* Fall 1982

Description: [see drawings and photos below]

In 1981 the entire bridge roofing system was replaced including rafters, ridge board, purlins and roof shingles. The work was done by local contractor Robert (Bob) Kidder and described in an article in Covered *Bridges Bulletin*. The roof rafters were replaced with "with beams twice as heavy" using "new spruce timbers." "The new roof consists of native white cedar, each shingle cut individually."

Rafters consist of 3-¾" x 8" timbers, sloped at a 6.67/12 pitch, with 2" x 8" collar ties. Purlins are 2-¾" square members spaced 20" on centers. Roof shingles are ½" thick wooden shakes, and are presumably the same hand split native white cedars shakes noted above.

Significance:

The 1981 repairs are not yet 50 years of age and do not contribute to the historical significance of the bridge.

Condition: (information from HEB 2012 Engineering Study)

The shake roofing is in poor condition with widespread leakage and numerous holes and cracking visible. The purlins have widespread water staining do not appear structural inadequate. Rafters and collar ties appear in good condition.

Proposed Treatment:

Reinforce existing rafters by sistering 2x8 timbers to each side of rafter. Apply wood plank sheathing boards and new cedar shake roof. Reinforce roof structure with 4x4 bracing.

Project Need:

Reinforcement of rafters, sheathing and bracing is required to meet structural design requirements.

Impacts:

The work does not impact historic features of the bridge.

Alternative Treatments Considered:

Alternative sheet metal roof was considered due to the advantage of lessening dead load compared with wood roof, but dismissed as historically incompatible.

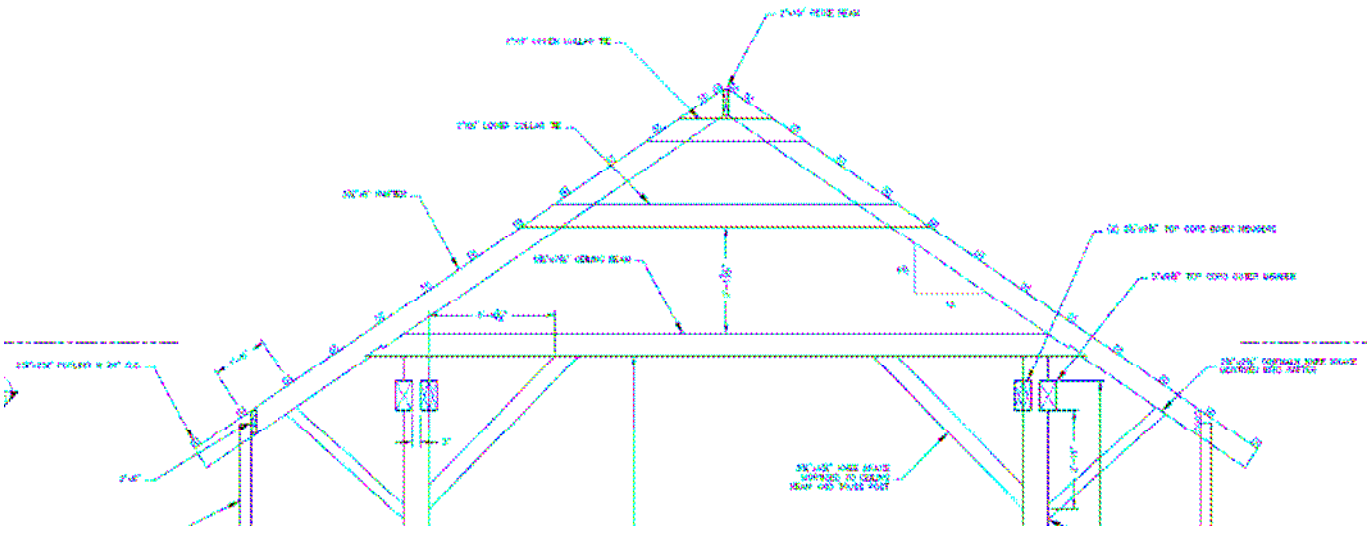


FIGURE: 4.7-1: Existing roof system conditions (source: HEB 2012)

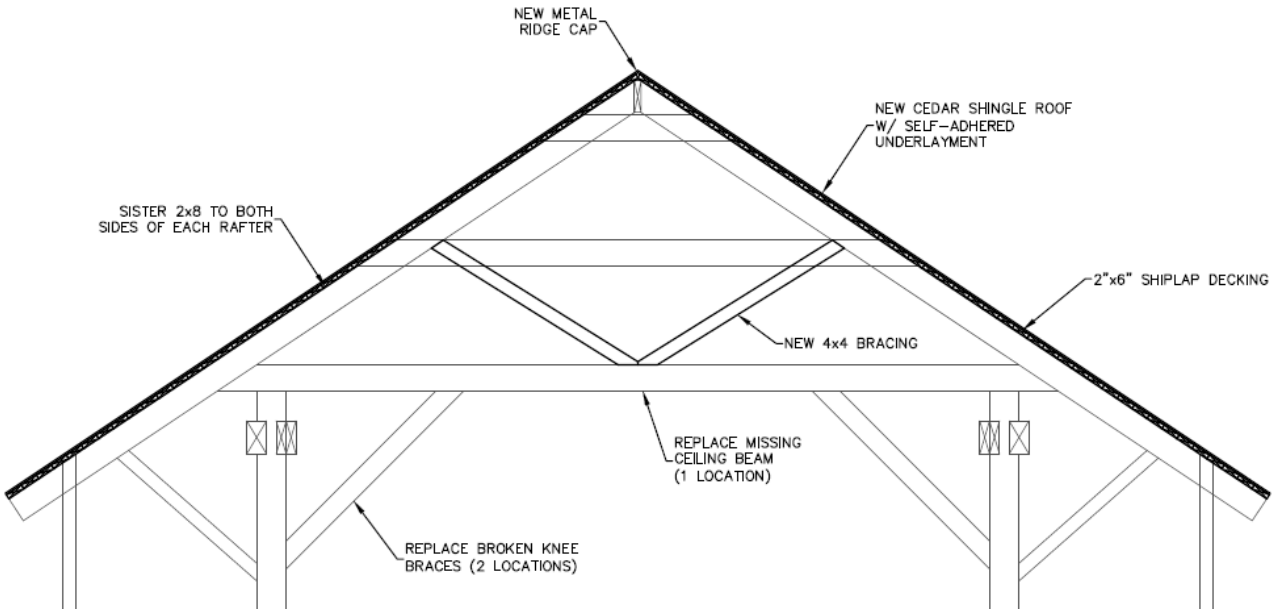


FIGURE: 4.7-2: Proposed repairs to roof system (source: HEB 2012)

FIGURE: 4.7-3: Overall view of roof system.

FIGURE: 4.7-4: Detail of underside of roof showing holes and gaps in shingles.

FIGURE: 4.7-5: Present wood shake roofing, installed 1981 and in poor condition.

4.8 FLOORING	
Date of Feature: 1954	**Source:** NHDOT plans and records

Description: [see photo below]

In 1954 the New Hampshire Highway Department repaired the bridge by building a 2-span, I-beam stringer deck bridge underneath the covered bridge to carry the live traffic loads. At that time the decking was replaced with wood planks 3-½" x 12", laid perpendicular to traffic bearing on the I-beam stringers (on wood nailer blocks) and directly on the intermediate stringers. Timber curbing, 6" x 8", creates a 16'-5" wide travel lane.

Significance:

As noted above, the comprehensive 1954 repairs to the structure were designed by H. E. Langley and R. J. Prowse and built by NHHD forces. They represent an early and notable effort by the state to preserve its historic covered bridges in service through a cost-effective alternative design.

Condition:

The deck planks show significant cracking and loss of section due to tire abrasion that has created unsafe wheel ruts. The curbing is in good condition.

Proposed Treatment:

Replace all decking. Reuse and reposition curbing.

Project Need:

The decking does not meet service life design specifications; wheel ruts present a safety hazard; repositioning curbing eliminates inadequate overhead clearance due to truss knee braces.

Impacts:

The work does not impact original historic features of the bridge. The repair and replacement in-kind of the floor decking is consistent with Secretary of the Interior's Standards for Rehabilitation (SOI Standards). The repositioning of the curbing eliminates the possibility of further impact damage to the historic knee braces and is a necessary and insignificant alteration of the original design.

Alternative Treatments Considered:

Alternative treatment option include glue-laminated flooring which provides superior service life and live load distribution thereby providing less stress on the historic truss assemble over time.

FIGURE: 4.8-1: Bridge floor.

4.9 SIDEWALK ASSEMBLY

Date of Feature: 1954 | **Source:** NHDOT plans and records

Description: [see drawings and photos below]

The existing sidewalk assembly, consisting of the cantilevered support beams, stringers, plank decking, posts, railings and siding, all date from the 1954 reconstruction of the bridge, previously described. The continuous transverse floorbeams that would have originally cantilevered out beyond the truss to carry the sidewalks were replaced with short cantilevered 8" x 10" timbers that are notched to fit under the top flanges of the outside I-beam stringers. They bear on reinforced sections of the lower chord (see lower chord description) and carry three longitudinal stringers, 3¾" x 11¾", and 2" thick decking. Robert Kidder, who repaired the bridge in 1981, told HEB Engineers that the sidewalk decking was constructed from material salvaged from the old timber arches that were removed in 1954. The stringers are the same salvaged 3"x12" deck creosote-treated and asphalt coated bridge deck planks used for the lower chords and intermediate stringers, previously described.

The 1954 repair drawings show that the existing sidewalk railing assembly, 4x4 posts, 2x6 handrail and 1" x 6" vertical siding boards, were all new materials installed at that time.

Significance:

As previously noted, the comprehensive 1954 repairs to the structure were designed by Harold E. Langley and Robert J. Prowse and executed by NHHD forces and represent a notable early effort by the state to preserve its historic covered bridges in service through a cost-effective alternative design.

Condition:

Many of the sidewalk floorbeams have longitudinal stress cracks beginning at the notches under the I-beam. These splits have caused the outboard end of the sidewalks to sag, giving the walk and uncomfortable and unsafe slope toward the river. The decking is worn and weathered, with isolated rot and numerous holes in members.

The siding is generally in fair to poor condition with warping, weathering and isolated rot. The white exterior paint has failed and is peeling and flaking off. The rails and posts are in fair condition, showing weathering and isolated rot particularly at the deck level.

Proposed Treatment:

The entire sidewalk assembly will be reconstructed in-kind with the new stringers bearing on new wood floor beams continuous across the width of the bridge as originally designed.

Project Need:

Reconstruction of the sidewalk assembly is required to meet federal design specifications. The work will allow for the removal of creosote and lead paint environmental hazards. The installation of continuous transverse floor beams (originals removed in 1954) will replicate the original configuration, providing proper distribution of sidewalk loads onto the trusses.

Impacts:

The work does not impact original historic features of the bridge. The repair and replacement in-kind of the I-beam stringers, the primary components of the 1954 rehab that allowed for the overall preservation of the bridge, is consistent with Secretary of the Interior's Standards for Rehabilitation (SOI Standards). The removal of secondary elements of the 1954 rehab including the cantilevered sidewalk assembly, replaces incompatible features with features matching original design is constant with SOI Standards.

Alternative Treatments Considered:

Alternative designs are not considered.

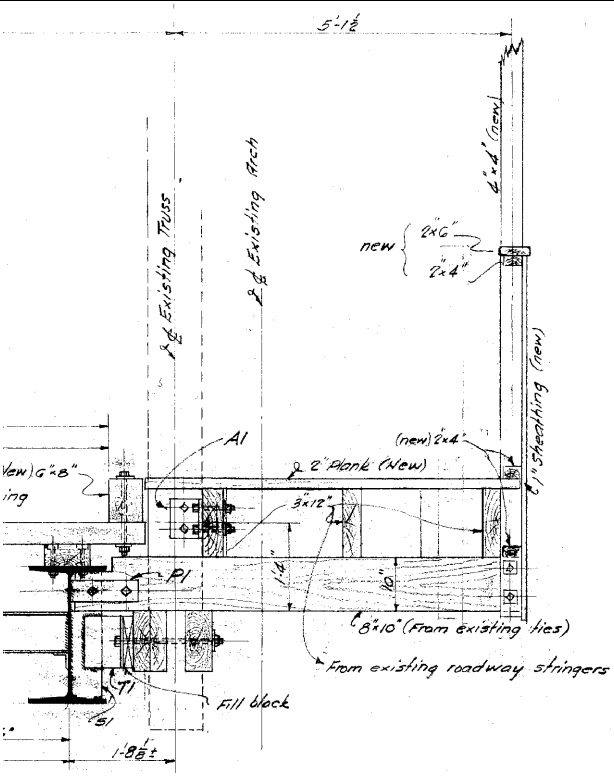


FIGURE: 4.9-1: Sidewalk assembly, existing conditions, from 1954 repair plans. (source: NHDOT)

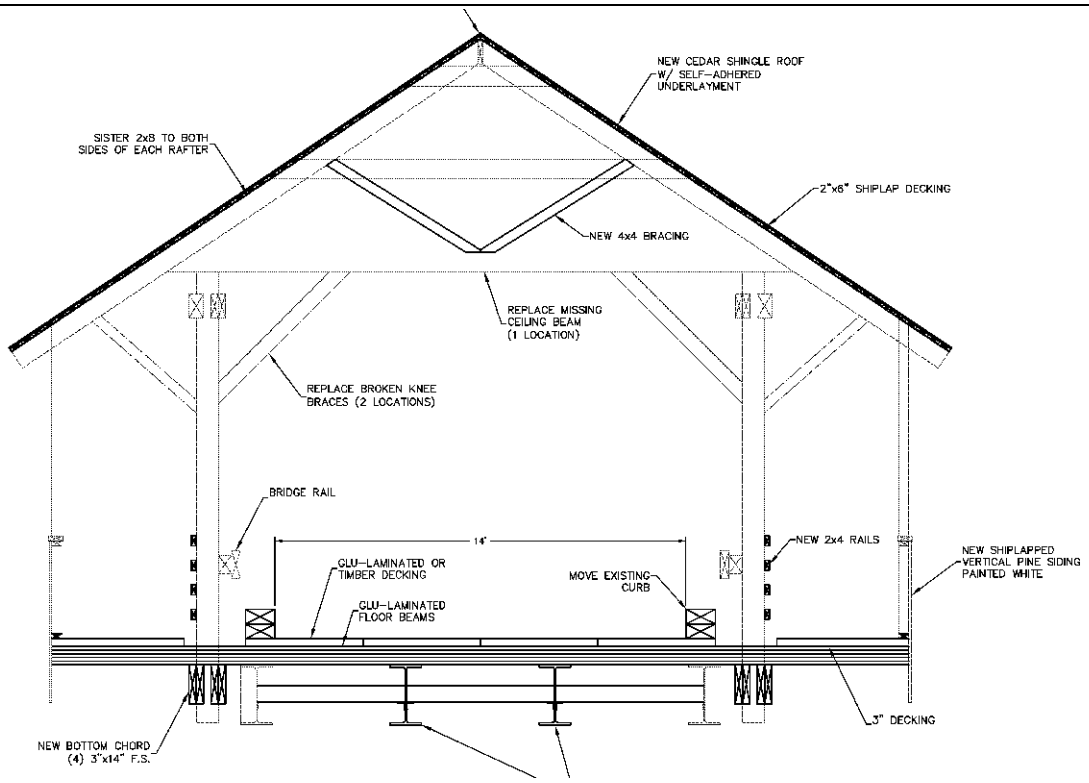


FIGURE: 4.9-2: Proposed sidewalk reconstruction (source: HEB 2012)

FIGURE: 4.9-3: Underside of sidewalk showing cantilevered floor beams and stringers.

FIGURE: 4.9-4: Interior view of sidewalk.

FIGURE: 4.9-5: Vertical wood siding railing on sidewalk.

4.10 ABUTMENTS

Date of Feature: 1853 with later repairs

Source: Historical information, visual evidence

Description: [see drawings and photos below]

The split and cut granite abutments are believed to date in whole or in part to the original construction of the bridge in 1853. The blocks are laid in even 12" courses and measure between 2 and 4 feet in length on average. The abutments are roughly 30' wide and 12' tall overall with wing wall that return into the embankment. The granite blocks were probably laid in a bed of mortar, but the joints have been repointed on several occasions and original mortar is not evident. According to the National Register nomination, the abutments were rebuilt in 1895 but that work is not clearly identifiable. The work probably involved repairs to the wings where different stone was introduced as shown in the photos below. Also at that time the top course of stonework was modified with recesses or notches to accept the ends of the wood arches added then. According to the HEB Engineering Study, "wooden cribbing was observed under the granite blocks at the north end of the bridge where the soil at the toe of the abutment has washed away."

Significance:

The cut granite abutments are an original and character-defining feature of the bridge. Subsequent repairs and extensions to the wingwalls have been done in a haphazard way, with poor application of repointing mortar, and use of random fieldstone that does not match to the original workmanship.

Condition: (information from HEB 2012 Engineering Study)

The facewalls of both abutments show isolated cracking and minor deterioration of mortar joints. The north abutment has a pronounced diagonal crack that has opened along vertical and horizontal joints with resultant loss of mortar. The north abutment upstream wingwall shows significant settling with associated cracking and deterioration of the mortar joints. The south abutment and wing-walls are in good condition with minor cracking and deterioration of the mortar joints. Portions of the joints have been re-pointed.

Proposed Treatment:

Mortar joints will be re-pointed to minimize future erosion behind the abutments and wing-walls. Materials and workmanship will replicate original work. To prevent scour and undermining of the abutments, mats of partially grouted riprap will be placed on the streambed in front and around the toe of the abutments.

Project Need:

Restoration of the structural integrity of the abutments is required to meet design specifications. Prevention of scour and erosion is necessary to insure structural stability.

Impacts:

The work impacts original historic features of the bridge. The repointing of the abutment joints will be done in-kind, replicating the materials, design and workmanship of the original masonry as practical and consistent with Secretary of the Interior's Standards for Rehabilitation (SOI Standards). The proposed scour mats introduce a new feature but are the least intrusive alternative and will capture sediment and become invisible over time.

Alternative Treatments Considered:

Two scour prevention alternatives were considered: placing concrete scour walls at the base of the granite walls, and installing conventional riprap. Both options are more intrusive to the historic character of the resource than the chosen method.

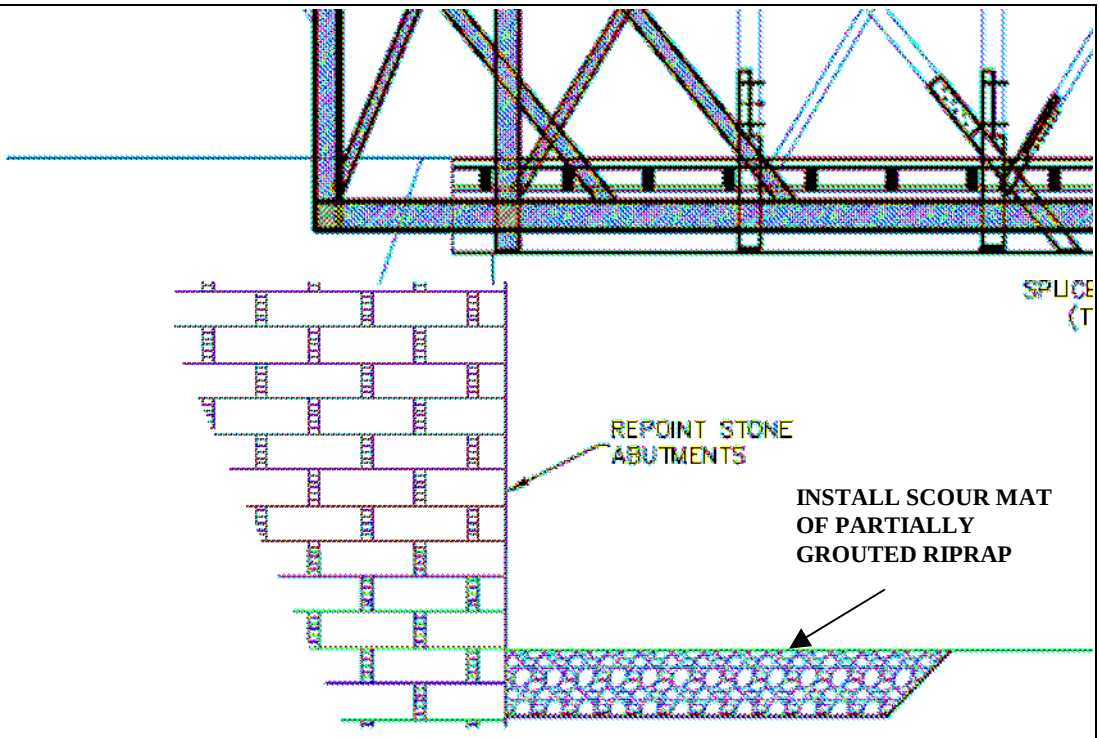


FIGURE: 4.10-1: Proposed rehab of stone abutments (source: HEB 2012).

FIGURE: 4.10-2: North abutment, upstream corner.

FIGURE: 4.10-3: North abutment, face showing opened joints at upstream corner.

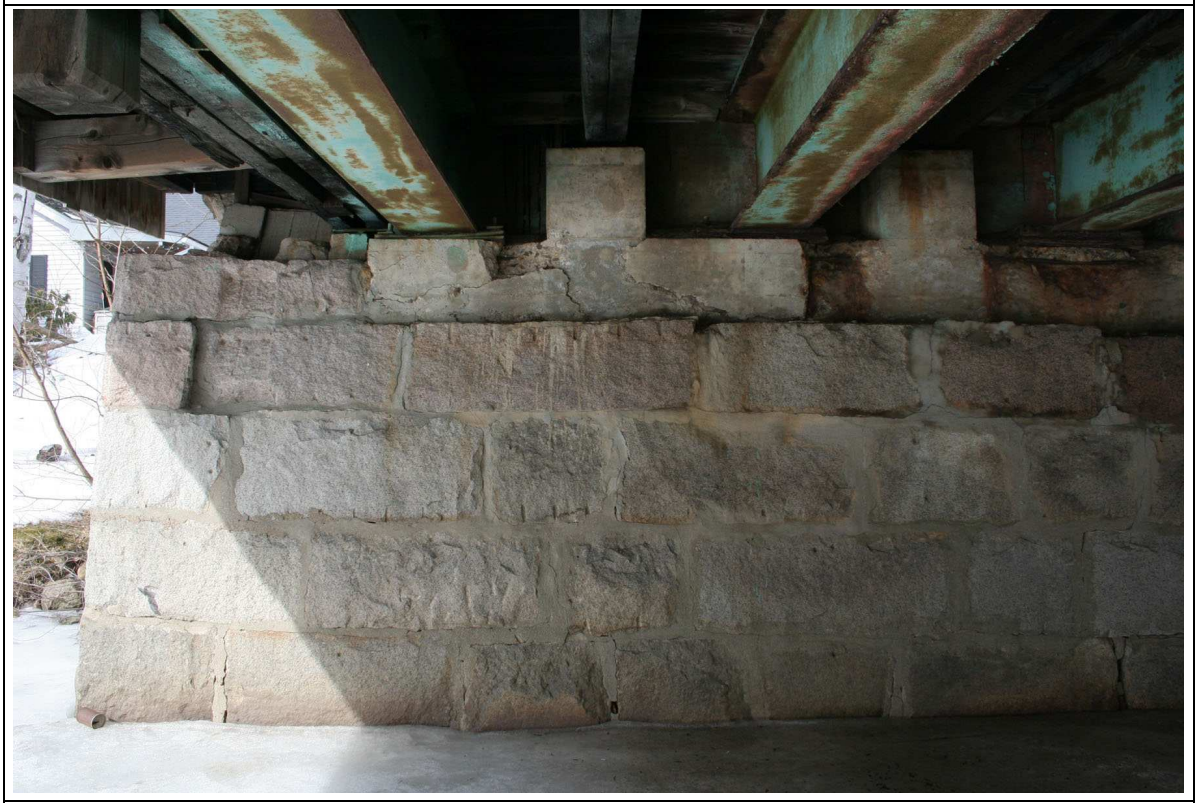


FIGURE: 4.10-4: North abutment, face and downstream corner.

FIGURE: 4.10-5: North abutment, downstream corner and wingwall, showing settlement and fieldstone repairs.

FIGURE: 4.10-6: Detail of north abutment, downstream wingwall.

FIGURE: 4.2.1-5: South abutment, face and upstream corner

FIGURE: 4.2.1-6: South abutment, face and downstream corner

4.11 PIER, BEARINGS & SEATS	
Date of Feature: 1948, 1954	**Source:** NHDOT plans and records

Description: [see drawings and photos below]

The 1948 emergency repair of the bridge by the New Hampshire Highway Department constructed a new concrete pier under the sagging single span truss, creating a 2-span continuous truss structure. The second phase of the repairs were completed in 1954 and involved constructing elevated bearing seats to carry a new deck stringer system. See drawings and photos below that accompany descriptions.

The concrete pier measures approximately 3' wide by 26' long by 12' high. The upstream face is battered and rounded to a point to break and deflect ice and debris. In 1954 steel pedestal bearings (called pier shoes on the plans) consisting of two sections of 12" WF beams welded together, were added to the pier to elevate and carry the new steel and wood stringer system; on the abutments concrete bridge seats were cast for the same purpose, with simple steel plate bearings carrying the stringers. The concrete seats have an integral backwall with an alternating dropped seats of either 24" or 12" to accommodate the corresponding depth of the steel and wood stringers.

Significance:

As noted above, the comprehensive 1954 repairs to the structure were designed by Harold E. Langley and Robert J. Prowse and executed by NHHD forces and represent a notable early effort by the state to preserve its historic covered bridges in service through a cost-effective alternative design.

Condition: (data from HEB 2012 Engineering Study)

The pier is generally in fair condition with spalling and exposed rebar in some places and erosion at the water line. The concrete bridge seats are severely cracked and spalled. Large sections of concrete under the steel stringers have broken away, exposing heavily rusted reinforcing bars. The steel pedestal bearings on the pier are in poor condition with severe rusting and section loss.

Proposed Treatment:

Encase pier with 3 or 4" layer of reinforced concrete; repair or replace pedestal bearings on pier; repair or replace concrete bearing seats on abutments.

Project Need:

The deteriorated condition of the pier, bearings and seats must be corrected to meet structural design specifications.

Impacts:

The work does not impact original historic features of the bridge. The repair and/or replacement of the pier, bearings and seats - features that do not contribute to the significance of the 1954 rehab - will be done in-kind to the extent feasible and in a manner consistent with Secretary of the Interior's Standards for Rehabilitation (SOI Standards).

Alternative Treatments Considered:

The proposed treatment is the only practical repair option and is consistent with the SOI Standards and therefore alternative treatments were not considered.

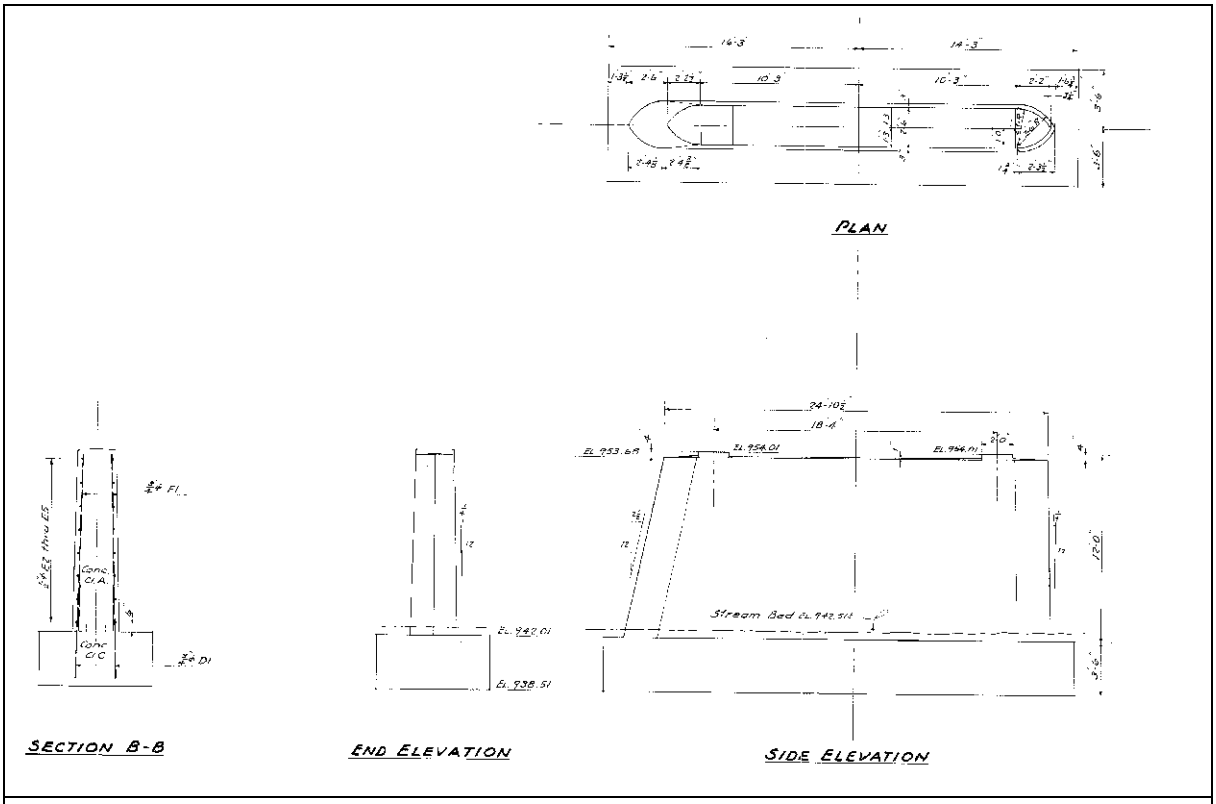


FIGURE: 4.11-1: Plan of emergency concrete pier constructed in 1948 (from NHHD Plan No. 2-11-2-13, dated Aug. 1948).

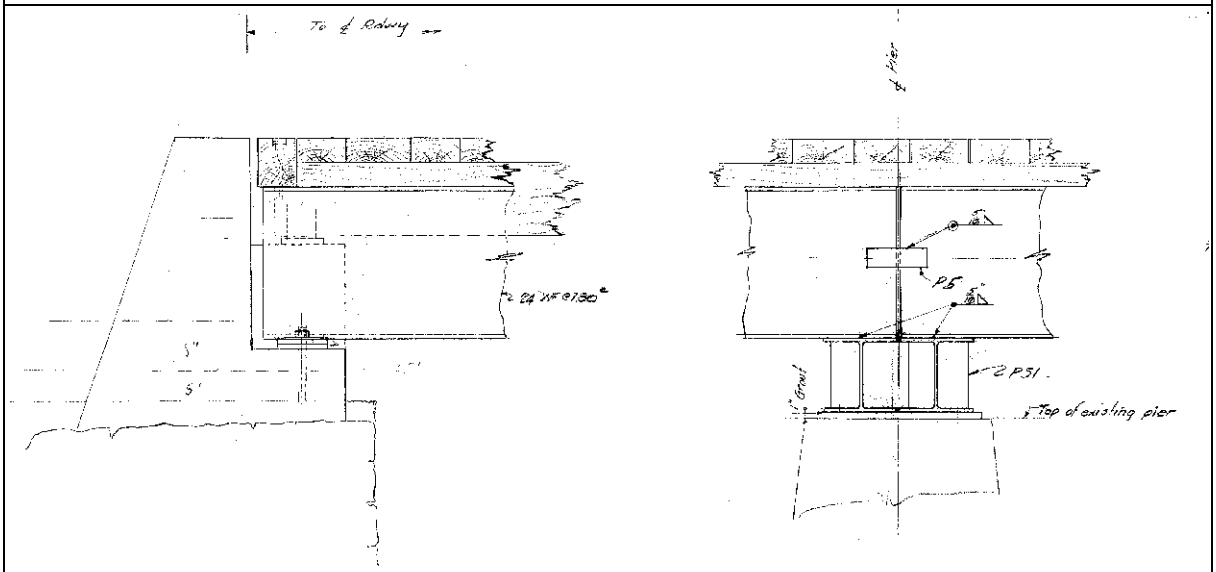


FIGURE: 4.11-2: Plan of concrete seats and steel plate bearings added to stone abutments, and of steel pedestal bearings added to pier in 1954 rehab (from NHDPW Plan No. 3-4-1-14, dated 1/22/54).

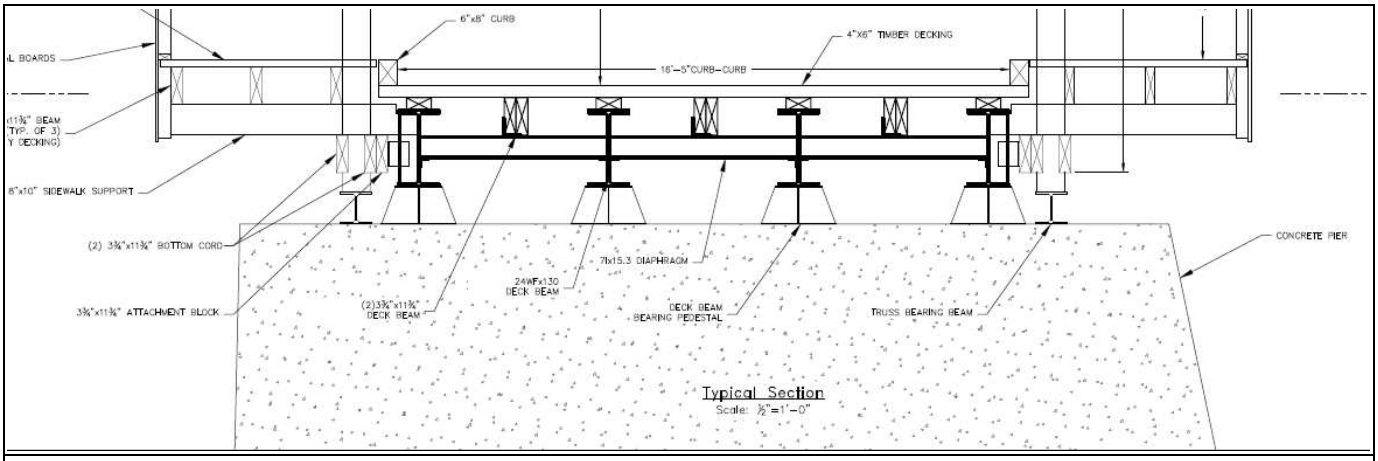


FIGURE: 4.11-3: Section thru concrete pier showing existing conditions. (Source: HEB 2012).

FIGURE: 4.11-4: View of pier and pedestal bearings.

FIGURE: 4.11-5: Elevation view of pier and bearings.

FIGURE: 4.11-6: Concrete bearing seats and steel plate bearings, 1954 rehab, on original stone abutment.

4.12 PORTALS	
Date of Feature: 1853, with later repairs	**Source:** Historical information, visual evidence

Description: [see photos below]
The openings, or portals, at each of the bridge are identical and consist of a wood -framed, clapboard-sided gable endwall, shaped around a wide arched opening over the roadway, flanked by two small arched openings over the sidewalks. The arches are elliptical, with decorative drop pendants at each of the four arch spring points. The endwall framing (rafters, collar ties and bracing) project out from the truss endpost about 6 feet, supported by the extended top chord of the truss. The project top chord is braced with a diagonal timber strut notched into the endpost. The gable rakes project about 12" and are boxed with flat board trim.

Significance:
The portals are a distinctive and important character defining features of the bridge. Some of the portal materials may be original to the bridge although this could not be confirmed by inspection. Historic photos indicate that the design has been in place since the early 20th century; if materials have been replaced it they have been done so in-kind.

Condition:
The portal components are in good condition with the exception of peeling paint and several loose and cracked clapboards.

Proposed Treatment:
The portals will be stripped of paint, loose boards glued and refastened, and repainted.

Project Need:
The portals require the proposed maintenance to prevent further deterioration and extend service life.

Impacts:
The work impacts historic character-defining feature of the bridge. The proposed maintenance will be done in-kind and consistent with Secretary of the Interior's Standards for Rehabilitation (SOI Standards)

Alternative Treatments Considered:
None.

FIGURE: 4.12-1: South portal.

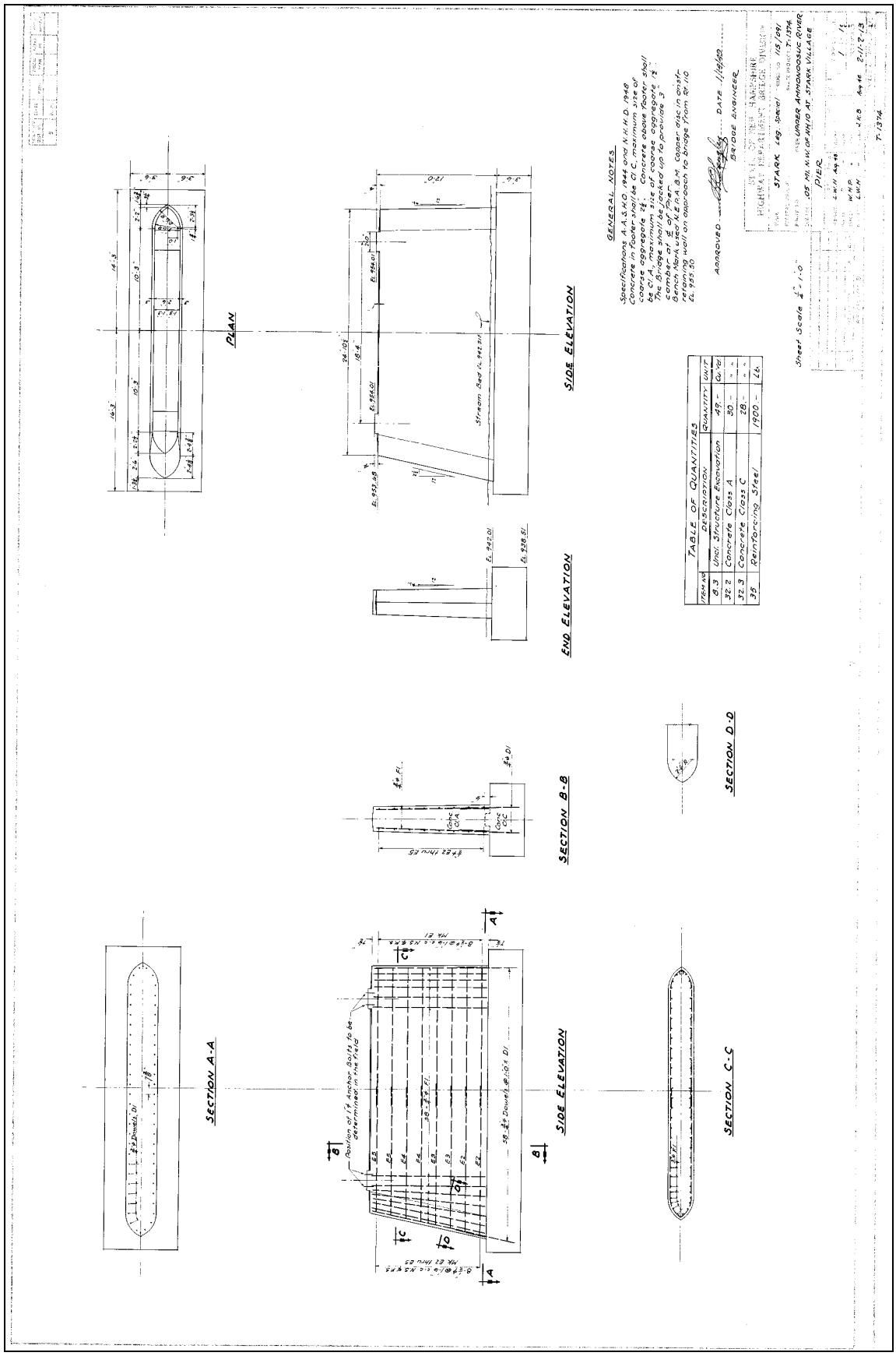
FIGURE: 4.1-2: North portal.

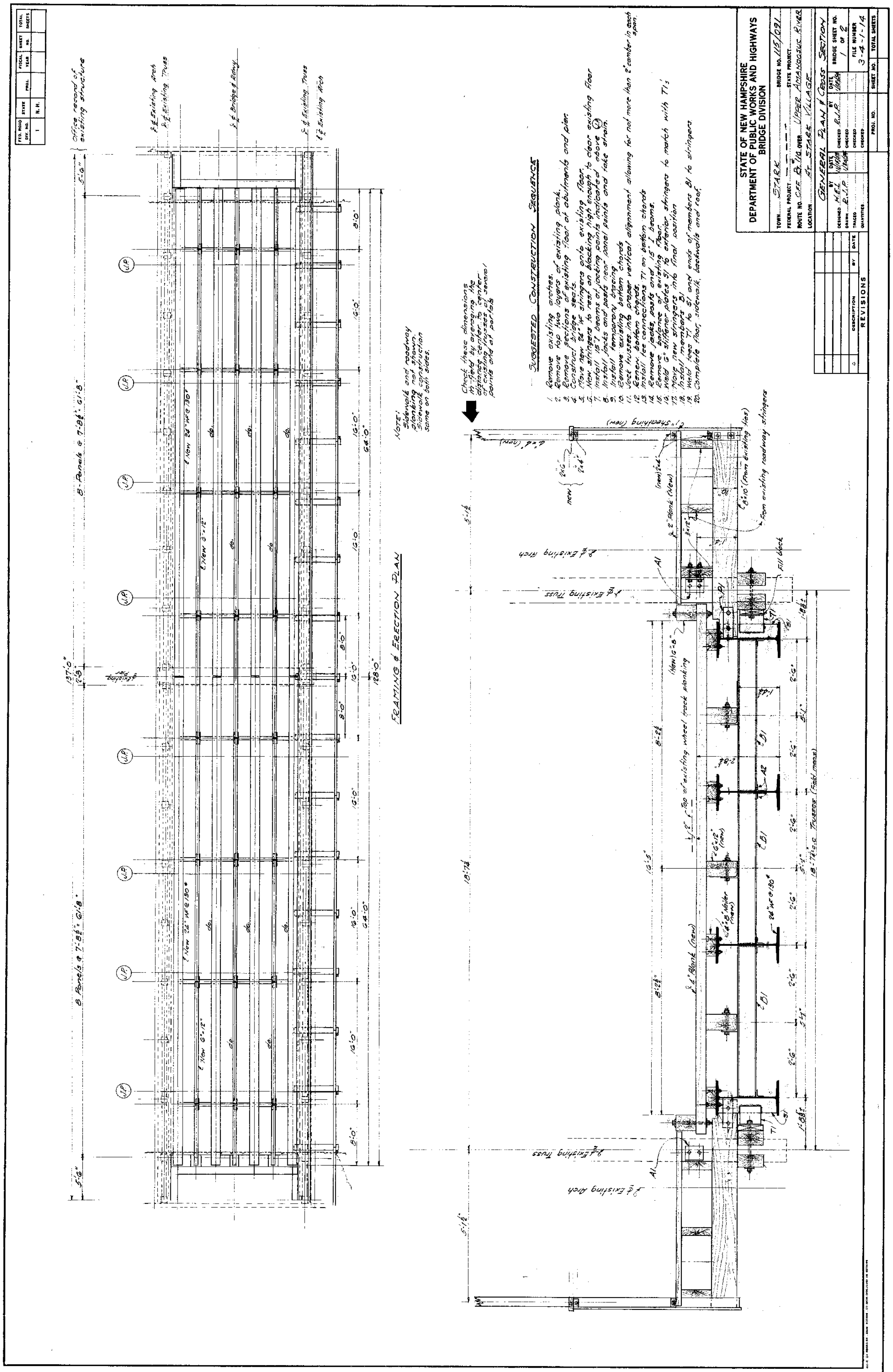
FIGURE: 4.12-3: Detail of projected portal wall.

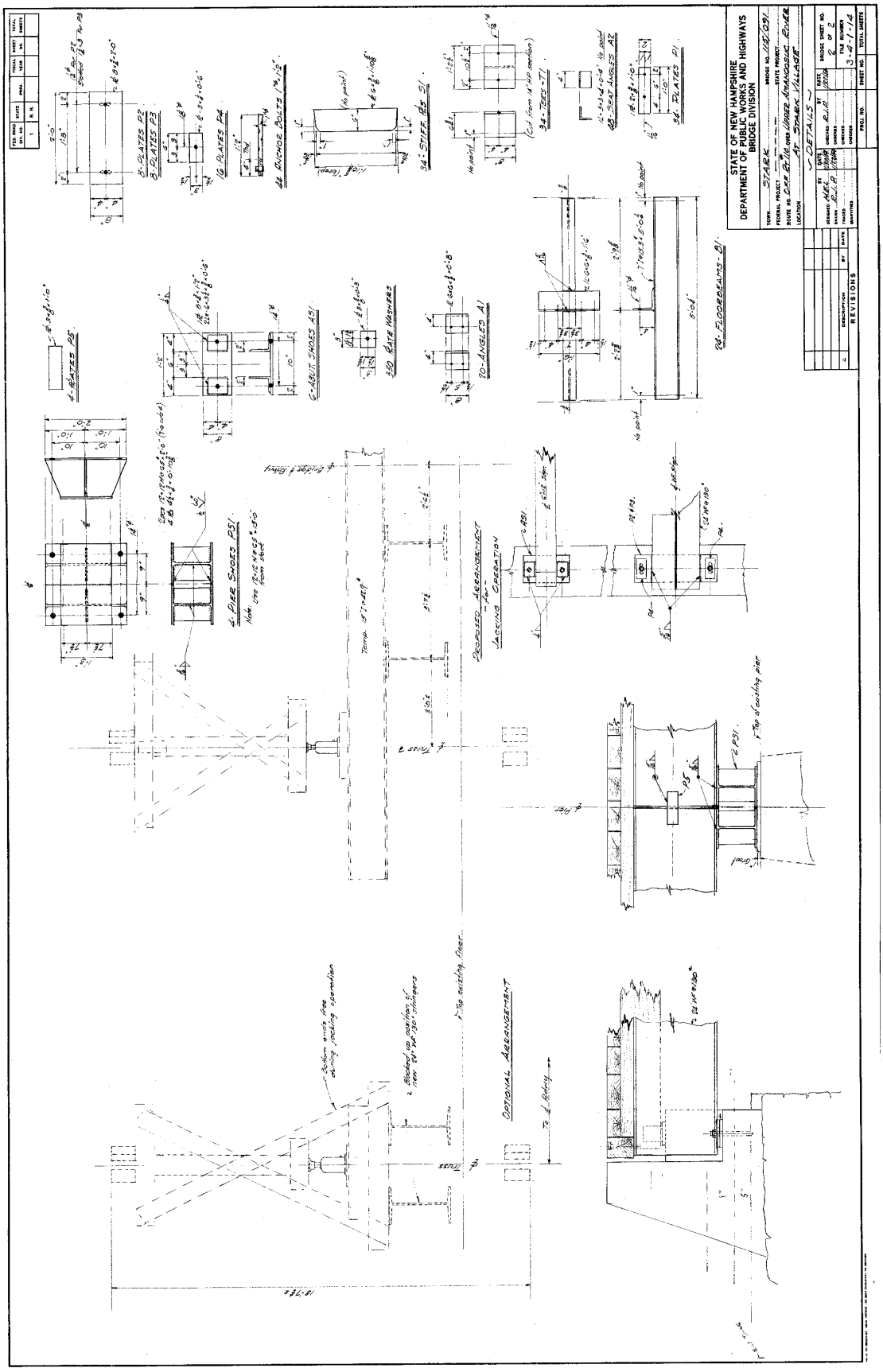
FIGURE: 4.12-4: Detail of portal eaves and siding.

APPENDIX A

Drawings – Pier Construction, NH Highway Department 1948 [1 sheet];
Drawings – Bridge Reconstruction, NH Dept. of Public Works & Highways, 1953 [2 sheets]


PLAN
SIDE ELEVATION
END ELEVATION
SECTION A-A
SECTION B-B
SECTION C-C
SECTION D-D
SIDE ELEVATION
GENERAL NOTES
TABLE OF QUANTITIES
STARK Lag. Steel
OVER AMMONOOSUC RIVER
PIER


STATE OF NEW HAMPSHIRE
DEPARTMENT OF PUBLIC WORKS AND HIGHWAYS
BRIDGE DIVISION
FRAMING & ERECTION PLAN
SUGGESTED CONSTRUCTION SEQUENCE
REVISIONS


STATE OF NEW HAMPSHIRE
DEPARTMENT OF PUBLIC WORKS AND HIGHWAYS
BRIDGE DIVISION
STARK
BRIDGE NO. 118/059
STATE PROJECT
FEDERAL PROJECT
ROUTE NO. Dist. 2, No. 118 OVER AMMONOOSUC RIVER
LOCATION AT STARK VILLAGE
DETAILS
REVISIONS
DESCRIPTION
BY
DATE
DESIGNED
DRAWN
TRACED
CHECKED
QUANTITIES
CHECKED
FED. ROAD DIV. NO.
STATE
FISCAL YEAR
PROJ.
SHEET NO.
TOTAL SHEETS
BRIDGE SHEET NO.
FILE NUMBER
SHEET NO.
TOTAL SHEETS
8 - PLATES P2
8 - PLATES P3
16 - PLATES P4
44 ANCHOR BOLTS 3/4" x 12"
34 - STIFF. PLS. S1
34 - TEES T1
48 - SEAT ANGLES A2
36 - PLATES P1
4 - ABUTS P5
6 - ABUT. SHOES A5
330 GATE WASHERS
20 - ANGLES A1
28 - FLOORBEAMS B1
4 - PIER SHOES P5
PROPOSED ARRANGEMENT
FOR
LIFTING OPERATION
OPTIONAL ARRANGEMENT
To existing pier
To existing pier
To existing pier