COLUMBIA COUNTY, NEW YORK

RICHARD A. BRADY, P.E. - COMMISSIONER OF PUBLIC WORKS

INSPECTION AND REPORT OF THE

SHAW BRIDGE

ON

VAN WYCK LANE

OVER

CLAVERACK CREEK

CLAVERACK, COLUMBIA COUNTY, NEW YORK

MAY 1980

PREPARED BY:

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BRIDGE REPORT

SHAW'S BRIDGE

The Shaw's bridge is a two span, approximately 160 ft. long Tied Arch Truss structure spanning the Claverack Creek in Claverack, Columbia County, New York.

This bridge was built by J.D. Hutchinson Company, of Troy, New York, and appears to be the last remaining bridge of this type. This structure has been included in the National Register of Historic Sites.

Each truss is comprised of 9 panels. The three end panels are approximately 9.17' in length, the next adjacent panel is approximately 8.25' in length and center panel measures approximately 8.5'. The center to center of truss dimension is 13.7'. Total length of each Truss is approximately 80 ft. with a 10.33' single lane roadway.

The structure is oriented in a North-South direction. The spans and panel numbers are measured from the North towards the South.

The bridge was originally constructed in the late 1800's. The top chord is made up of unique cast metal sections. Each section, in plan view, has a trapezoidal configuration with three trapezoidal voids cast into them. In section, the castings have a channel like shape. The truss lower chord consists of 1½" diameter rods in a loop shape. The loops are placed around uniquely shaped lower chord pins. The truss verticals are 1½" diameter rods for U_4L_4 and U_5L_5. The remaining verticals are 1 5/8" diameter rods.

The floor system is made up of 9" Rolled Wrought Iron Floorbeams, 4" x 8" Timber Stringers spaced at 18" centers and 3" x 8" Timber Plank Deck.

The bridge is presently posted for 4 Tons. The truss members were found to be in generally good condition. Span No. 1 (East Truss) has a misalignment of the top chord at U_5. Span No. 1 (West Truss) has a bent vertical U_6L_6 and also a misalignment of the top chord at U_5. Span No. 2 (East Truss) has bent members U_3L_3 and U_3L_4 also broken members U_4L_3 (broken at L_3) and U_6L_5 (broken at U_6). Span No. 2 (West Truss) has no visible deficiencies.

The deck timbers and timber stringers were examined and showed no significant deterioration.

The structure was analyzed as a Tied Arch with the hangers supporting the floor system. The upper chord acting as an arch was found capable of supporting the dead load of the structure with no overstress. Under a 4 Ton truck the arch is subject to both axial forces and bending. The construction of the arch is such that the arch cannot resist significant bending. Therefore the vertical and diagonal rods are required to aid in resisting bending under live load.

RECOMMENDATIONS

1. Re-align top chord members at joints where required and clamp top chord to maintain proper alignment.

2. Maintain the 4 Ton posting.

3. Replace or Repair broken diagonals and verticals.

4. A complete inspection of the entire structure should be done on a semi-annually basis.

CALCULATIONS

A. G. Lichtenstein & Associates, Inc.
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(201) 837-4300

JOB 696 SHAWS BRIDGE
SHEET NO. ____ OF ____
CALCULATED BY TJC DATE 3/30
CHECKED BY ____ DATE ____
SCALE ____

RESULTS OF ANALYSIS:

THE STRUCTURE WAS ANALYZED AS A TIED ARCH WITH HANGERS SUPPORTING THE FLOOR SYSTEM. THE UPPER CHORD ACTING AS AN ARCH WAS FOUND CAPABLE OF SUPPORTING THE DEAD LOAD OF THE STRUCTURE WITH NO OVERSTRESSES. UNDER A 4 TON TRUCK THE ARCH IS SUBJECT TO BOTH AXIAL FORCES AND BENDING. THE CONSTRUCTION OF THE ARCH IS SUCH THAT THE ARCH CAN NOT RESIST SIGNIFICANT BENDING. THEREFORE THE VERTICAL AND DIAGONAL RODS ARE REQUIRED TO AID IN RESISTING BENDING UNDER LIVE LOAD.

RECOMMENDATIONS:

1. RE-ALIGN TOP CHORD MEMBERS AT JOINTS WHERE REQ'D & CLAMP TOP CHORD TO MAINTAIN THE PROPER ALIGNMENT.
2. REPLACE OR REPAIR BROKEN DIAGONALS AND HANGERS.
3. INSPECTION FOR TOP CHORD MIS-ALIGNMENT & DAMAGE OR DISTRESS TO THE DIAGONALS & HANGERS SHOULD BE MADE AGAIN ANNUALLY

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JOB 696 SHAWS BRIDGE
SHEET NO 1 OF
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SHAWS BRIDGE - BOW STRING ARCH TRUSS

DEAD LOAD

Plank $2\frac{1}{2}$" + Say 11'
$\frac{2\frac{1}{2}}{12} \times 11' \times 55$ PCF = 126 #/l

Stringers $8 \times \frac{3\frac{3}{4} \times 7\frac{1}{4}}{144} \times 55$ PCF = 83 #/l

Rail Post. $2 \times \frac{6" \times 7\frac{1}{2}"}{144} \times \frac{2.5'}{11.5'} \times 55$ PCF = 8 #/l

Guide Rail Say 15 #/LF 15 #/l

Floorbeam. I 9 x 28# $28^{\#} \times \frac{14.75'}{5.85'}$ (AVG SPACING) 46 #/l

278 #/l

TRUSS for CHORD

$A = 6 \times \frac{11}{16} = 4.125$
$2\frac{5}{16} \times \frac{3}{4} = 1.734$
$\frac{3}{4} \times \frac{1}{2} = .375$
6.234"

$6.23 \times 2 = 12.47$ □" $\times \frac{490^{\#}}{144} = 42.4$ #/l

ADD for Lateral Diagonals Say 50# Total

Bot Chords 4 - 1¼" ϕ Rods 4.91 □" $\times \frac{490}{144} = 16.7$ #/l
Verticles Say 8 - 8' Avg. x 1⅝" ϕ Rods $\times \frac{490}{144} = \frac{593^{\#}}{80'} = 7.4$ #/l
Diagonals Say 14 - 11.5' Avg. - 1" ϕ Rods $= \frac{490}{144} = \frac{430^{\#}}{80} = 5.4$ #/l

Truss $50 + 16.7 + 7.4 + 5.4 = 80$ #/l

80 #/l + $\frac{278^{\#}/l}{2} = 219$ #/l Say 220 #/LF

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JOB 0.16 SHAW'S ISMOSE
SHEET NO 2 OF
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ASSUME ARCH IS PARABOLIC AND DL IS UNIFORM LOAD THEN MOMENT = 0 AND

$H = \frac{WL^2}{8h}$ H = THRUST h = RISE OF ARCH L = SPAN

h = 109.5" + 6.5" = 116" (SEE FIELD NOTES)
= 9.67'

$H = \frac{220\#/' (80')^2}{8 (9.67)} = 18.2^k$

$V = 220\#/' \frac{(80')}{2} = 8.8^k$ $\sqrt{(18.2)^2 + (8.8)^2} = 20.2^k$

STRESS AT ENDS OF ARCH

$\frac{20.2^k}{12.47 D^2} = 1.62$ KSI

AT CROWN OF ARCH

$\frac{18.2^k}{12.47} = 1.46$ KSI

TENSION ON RODS $A = 4.91 D^2$

$\frac{18.2^k}{4.91} = 3.71$ KSI

FOR LIVE LOAD ASSUME 2-HINGED ARCH
NEGLECT ELONGATION OF TIE BARS

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JOB 676 — PHELPS BRIDGE
SHEET NO. 3 OF
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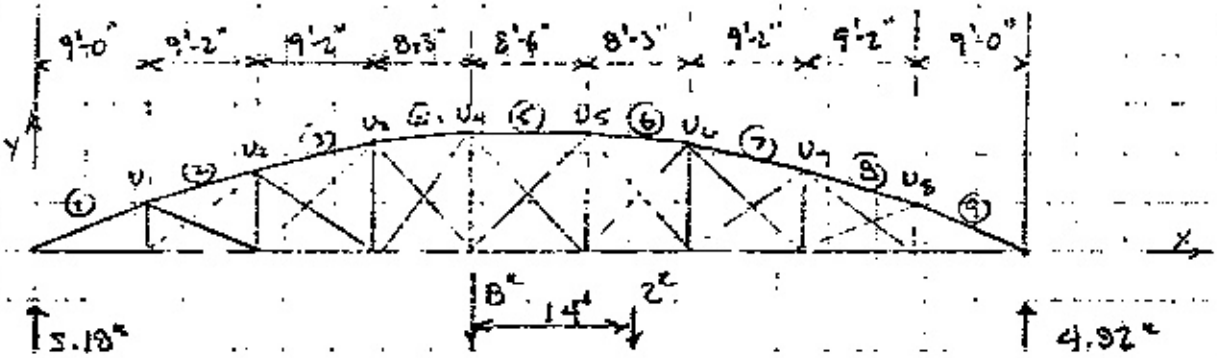
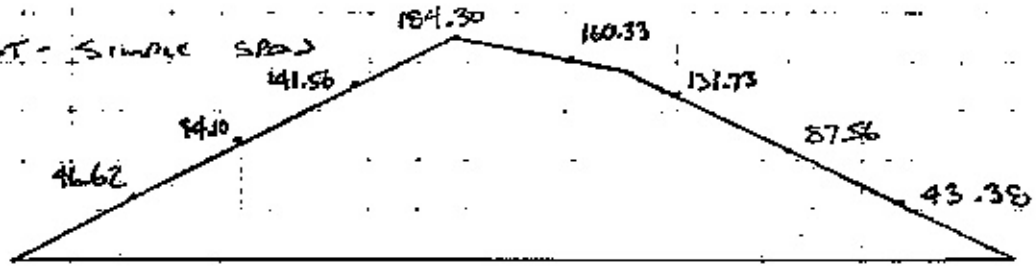
SCALE

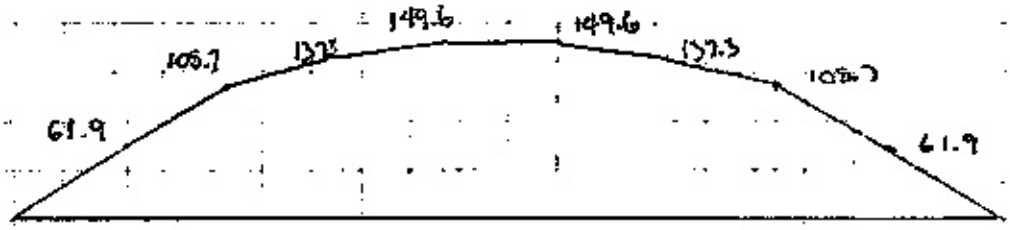
LIVE LOAD - H10 TRUCK 8 TON AXLE & 2 TON AXLE



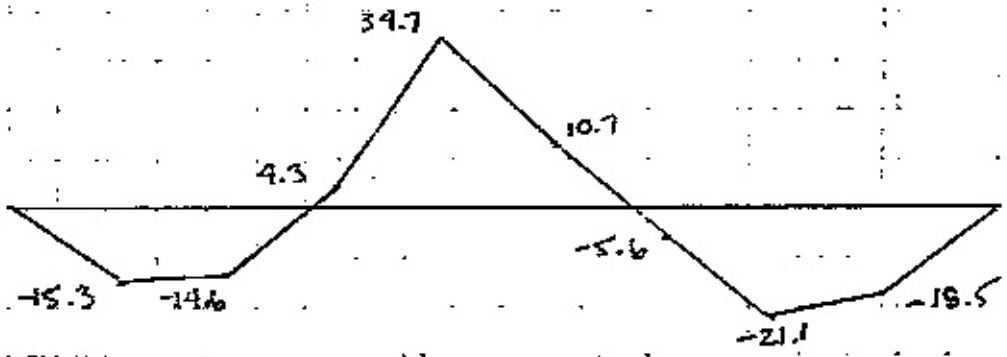
ASSUMED MOMENT - SIMPLE SPAN



CORRECTION MOMENT - SEE FOLLOWING PAGE



FINAL MOMENT = ASSUMED MOMENT MINUS CORRECTED MOMENT



M @ U4

$34.7^{k'} = 5.18^{k}(35.54') - H(9.81')$

$H = 149.4 / 9.81 = 15.2^{k}$

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COLUMN ANALOGY

MOMENT OF INERTIA OF ARCH IS CONSTANT ∴ Δ OF EACH SEGMENT IS EQUAL TO THE LENGTH OF THE SEGMENT

Y = VERTICAL DISTANCE TO CENTROID OF SEGMENT

M_o = ASSUMED MOMENT (SEE PREVIOUS PAGE) @ CENTER OF SEGMENT

SEG	Δ	Y	YΔ	$Y^2\Delta$	M_o	$M_o\Delta$	$YM_o\Delta$
HINGE	∞	0	0	0	0	0	0
1	9.87	2.03	20.1	41	23.3	230.	467
2	9.66	5.59	54.0	302	70.4	680	3802
3	9.36	8.06	75.4	608	111.8	1103	8892
4	8.29	9.41	78.0	734	162.9	1351	12705
5	8.50	9.82	83.4	818	172.3	1465	14391
6	8.29	9.41	78.0	734	146.0	1210	11390
7	9.36	8.06	75.4	608	109.6	1026	8268
8	9.66	5.59	54.0	302	65.5	633	3540
9	9.87	2.03	20.1	41	21.7	214	434
HINGE	∞	0	0	0	0	0	0
				4188			63869

CORRECTION MOMENT = $\frac{Mc}{I} = \frac{63869}{4188}(y) = 15.25(y)$

PANEL POINT	ASSUMED M_o	Y	CORRECTION M_1	FINAL MOMENT $M_o - M_1$
U_1	46.6	4.06	61.9	-15.3
U_2	94.1	7.13	108.7	-14.6
U_3	141.6	9.00	137.3	4.3
U_4	184.3	9.81	149.6	34.7
U_5	160.3	9.81	149.6	10.7
U_6	131.7	9.00	137.3	-5.6
U_7	87.6	7.13	108.7	-21.1
U_8	43.4	4.06	61.9	-18.1

TENSION IN RODS

LL 15.2K / 4.91 in² = 3.1 KSI DL+LL = 6.8 KSI OK

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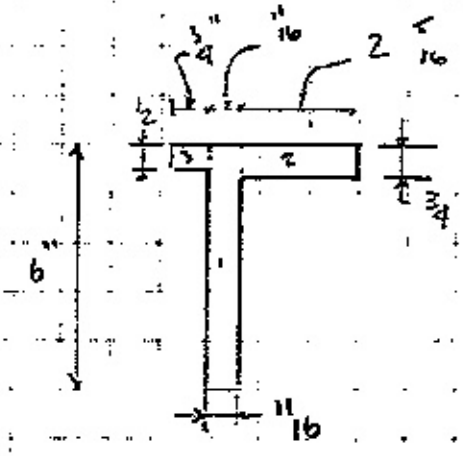

	A	Y	AY	AY²	I_o
1	4.127	3"	12.375	37.125	12.375
2	1.734	5.625	9.756	54.877	–
3	.375	5.95	2.156	12.398	–
	6.236		24.29	104.30	12.38

$\bar{y} = \frac{24.29}{6.236} = 3.895"$

$I = 104.30 + 12.38 - 6.236(3.895)^2$
$= 21.98 \text{ in}^4$

FOR BOTH SECTIONS

$S_{TOP} = 2 \times \frac{21.98}{2.105} = 20.9 \text{ in}^3$ $S_{BOT} = 2 \times \frac{21.98}{3.895} = 11.3 \text{ in}^3$

SPEED LIMIT 10 MPH LOAD LIMIT 4 TONS

Say ONLY 10% IMPACT @ P.P. U4

$\frac{4}{10} \times 34.7^K \times 1.1 = 15.3^K$

$f_{TOP} = \frac{15.3 \times 12}{20.9} = 8.78 \text{ KSI COMP}$

$f_{BOT} = \frac{15.3 \times 12}{11.3} = 16.25 \text{ KSI TENSION}$

AXIAL LOAD @ U4 $\frac{4}{10} \times \frac{15.2^K}{12.47 \square"} \times 1.1 = 5.4 \text{ KSI COMP}$

TOTAL STRESSES (+) = COMP (–) TENSION

DL + LL AXIAL + LL BENDING

$f_{TOP} = 1.46 + 0.54 + 8.78 = 10.78 \text{ KSI COMP}$

$f_{BOT} = 1.46 + 0.54 - 16.25 = -14.25 \text{ KSI TENSION}$

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JOB
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STRINGER TIMBER $3\frac{3}{4}" \times 7\frac{1}{4}"$

Max Span 9'-2"

D.L $3\frac{3}{4} \times 7\frac{1}{4} \times \frac{55\ pcf}{144} =$ $10\ \#/l$

Plank $\frac{2\frac{1}{2}"}{12} \times 1.5' \times 55\ pcf$ $17\ \#/l$ } $27\ \#/l$

$M_{DL} = 27\ \#/l\ (9.17')^2/8 = 280\ \#\text{-ft}$

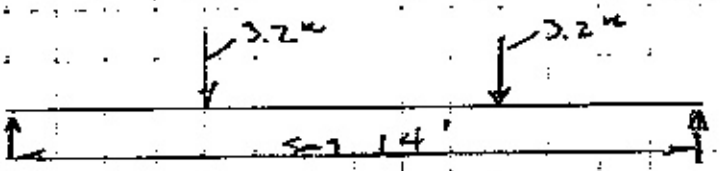
LL H4 Timber NO IMPACT DIST = Span 1.0

$M_{LL} = \frac{3.2^k\ (9.17)}{4} = 7.3\ k\text{-ft}$

Section Modulus $= \frac{3.75\ (7.25)^2}{6} = 32.9\ in^3$

$f = \frac{M}{S} = \frac{(7.3 + .3)}{32.9} = .231\ ksi = 231\ \#/D"$ OK

Floor Beam



From Field Notes
$4'8" \times 9"$ I
$t_w = \frac{1}{2}"$

DL $10\ \#/l \times 9.17' \times \frac{1}{1.5'} = 61\ \#/l$

$\frac{2\frac{1}{2}"}{12} \times 9.17' \times 55\ \#$ $= 105\ \#/l$

Floor Beam $20\ \#/l$

$194\ \#/l$

From old Beam Book
9" = 28# W.I. Beam
S = 22.5

$M_{DL} = \frac{.194\ (14)^2}{8} = 4.75^{k'}$

Min I = 30%

$M = 1.3 \times 3.2^k\ (4') = 16.64^{k'}$

$M_{DL+LL} = 4.75 + 16.64 = 21.4^{k'}$

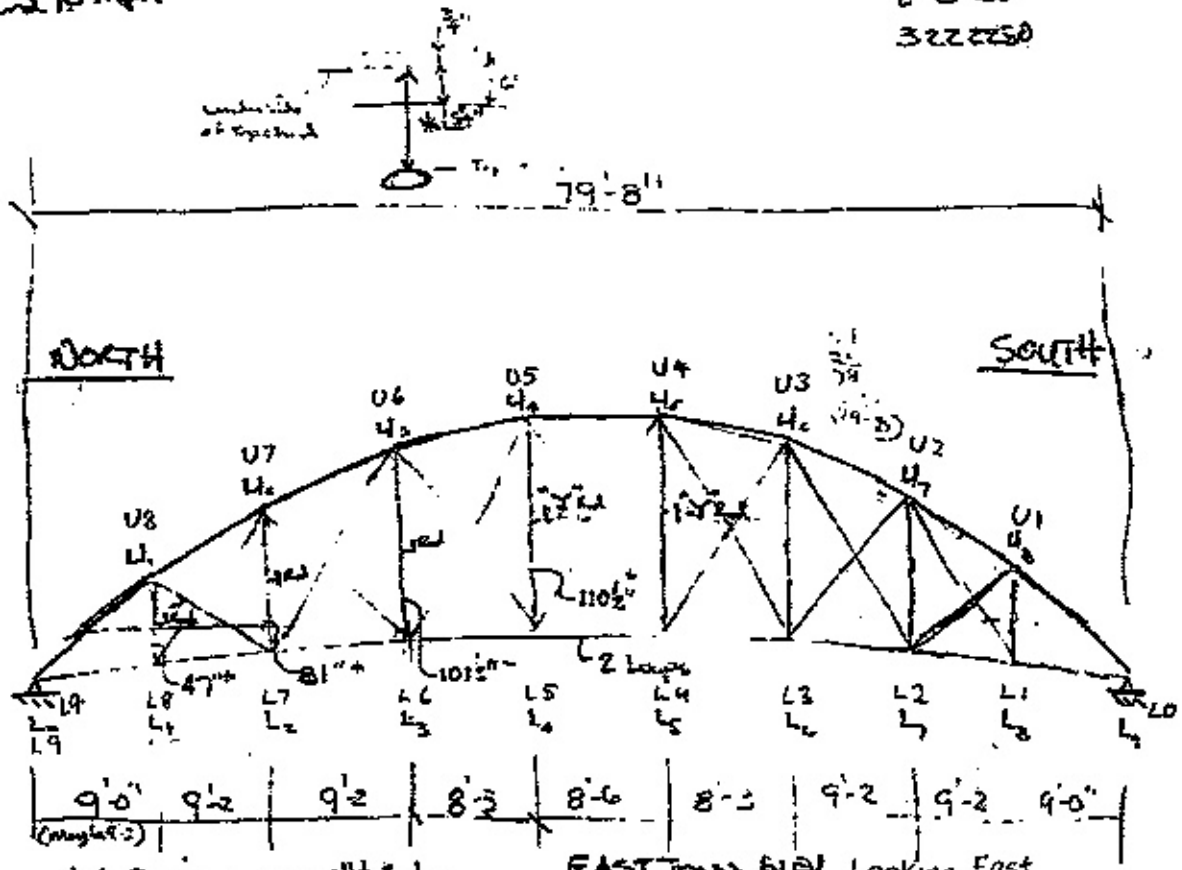
$f = \frac{21.4 \times 12}{22.5} = 11.4\ ksi$ OK

FIELD NOTES

696

Posted 4 Tons
and 10 mph

Shaws Bridge
2-8-80
322250



All Diagonals are 1"ϕ Rods. EAST Truss Shown Looking East

U8-L8 → U6L6 U3-L3 → U1-L1

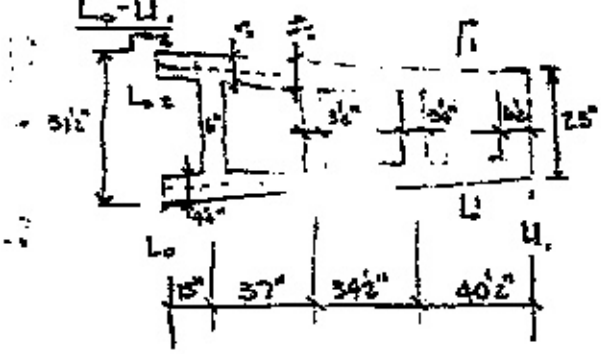
Verticals - $U_1L_1 \rightarrow U_3L_3$ & $U_4L_4 \rightarrow U_6L_6$ are all 1⅝" ϕ Rods

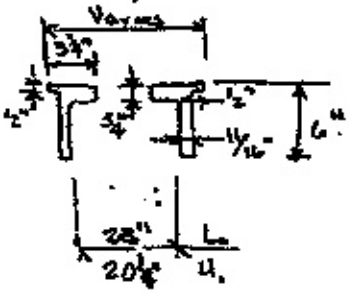
U5-L5 U9-L9

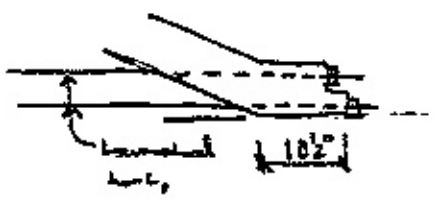
Verticals U_9L_9 & U_5L_5 are 1½" ϕ Rods

Bottom Chord are 1¼" ϕ Rods (Loops)

Top Chord
L9-U8
L_0-U_1

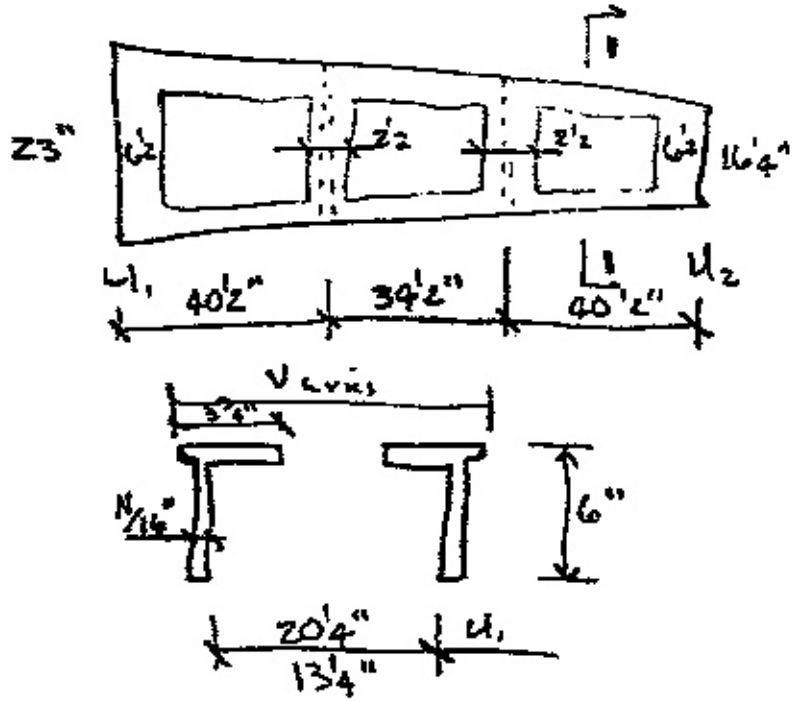






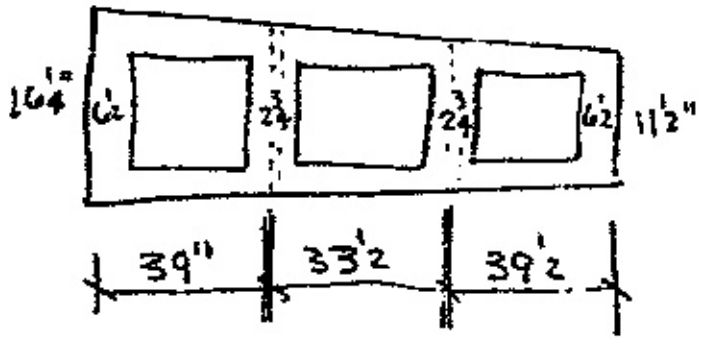
U8 - U7

$U_1 - U_2$



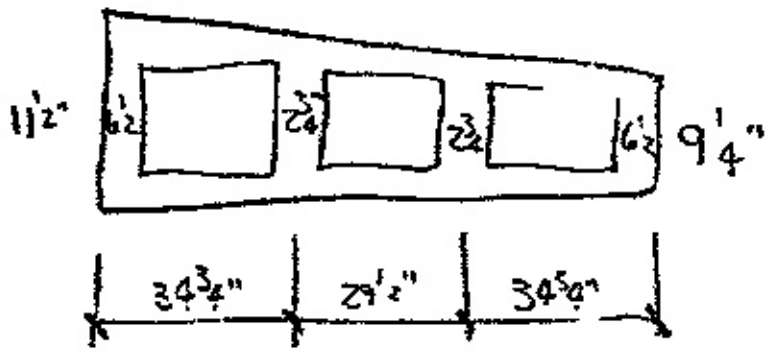
U7 - U6

$U_2 - U_3$



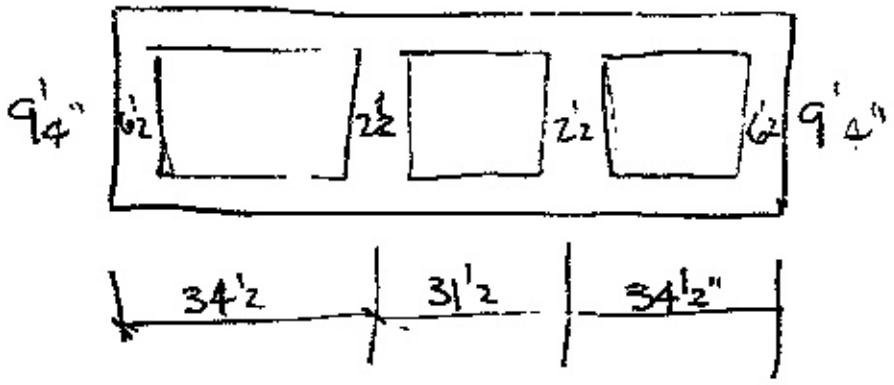
U6 - U5

$U_3 - U_6$



U5 - U4

U4 - U5

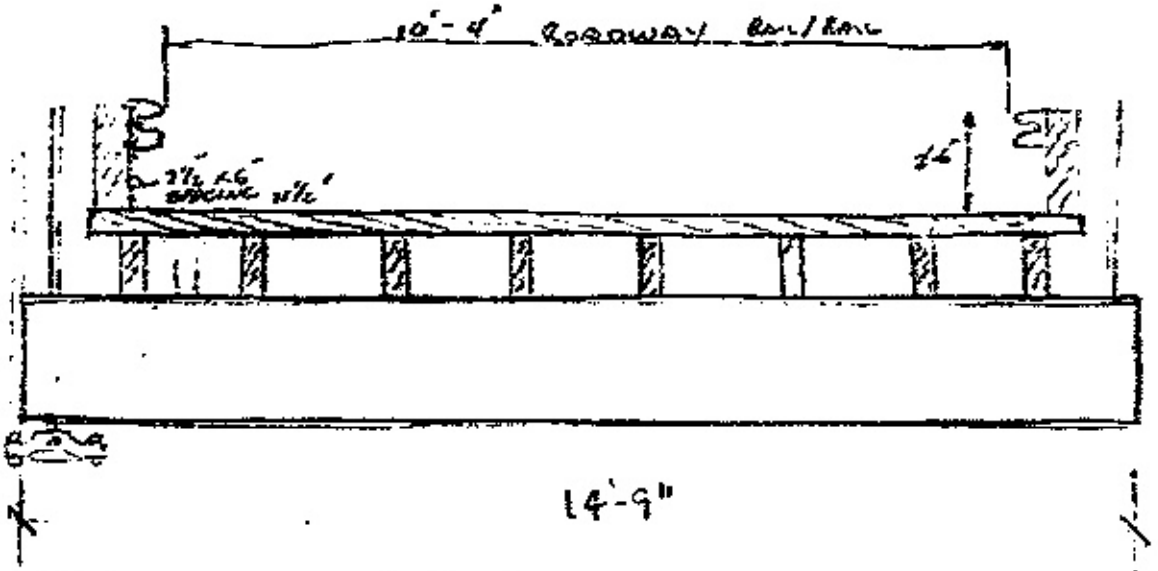


33222250

2/8/80 Built by T. D. HUTCHINSON

TROY N.Y 1870

TYP. SECTION

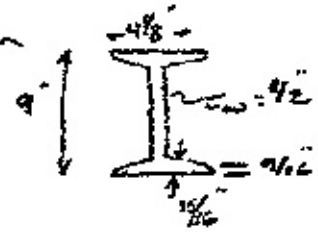


STRINGER SPACING : 1'-6" c/c

TIMBER STRINGERS : ACTUAL 3¾" x 7¼"

TIMBER PLANK DECK : ACTUAL 2½ x 7½
(VERT) (HORIZ)

FLOOR BEAM

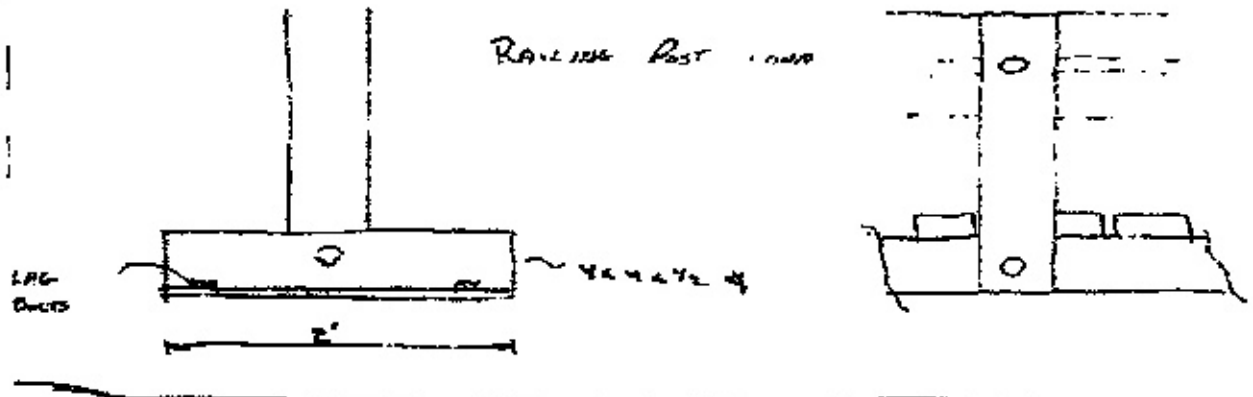


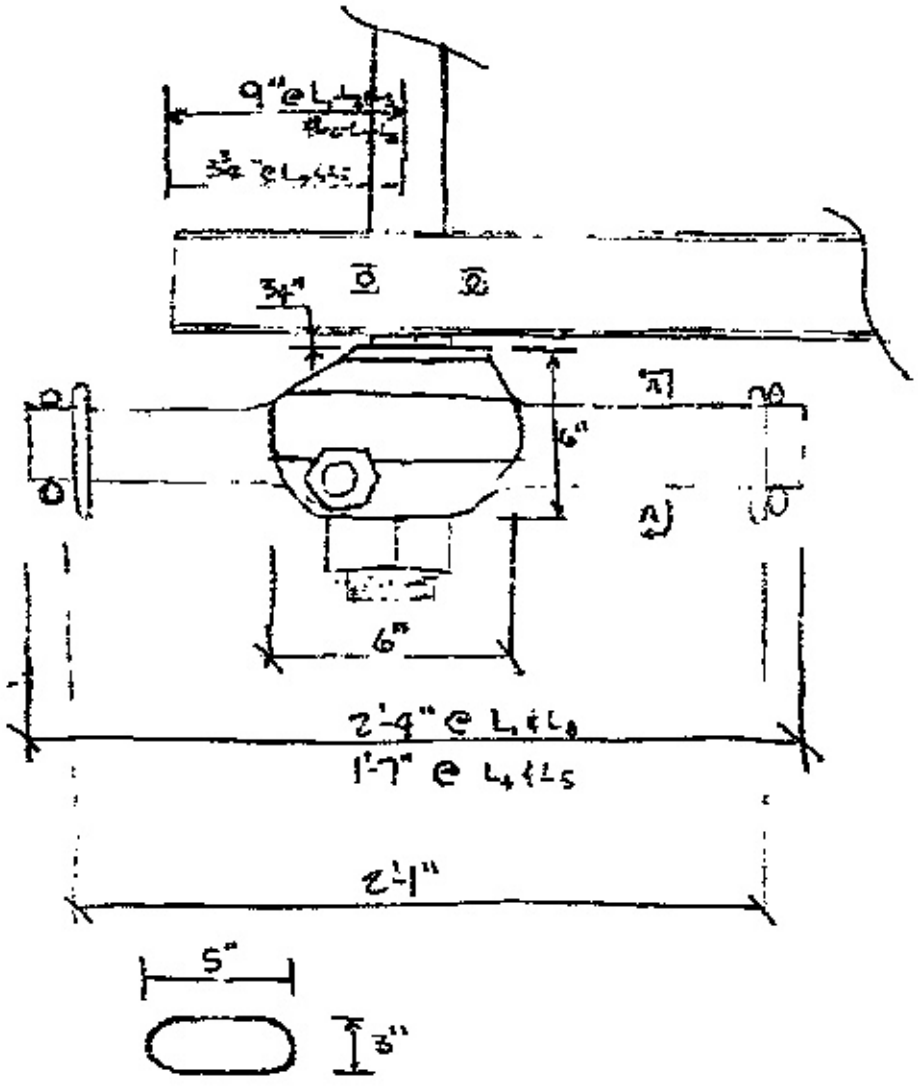
14'-9" Long

DECK OUT/OUT : 12'

c/c TRUSSES : 13'-2"

332250
2/8/80





Section A-A

Photos

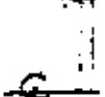
1 & 2 Bridge From Begin
3 - U_2
4 - L_2
5 - L_4
6 - U_4
7 - Misalignment @ East Truss U_5
8 - " @ West " U_5
9 - Batt Vertical L_6-U_6 (West Truss)
10 - West Truss Pin No. 1 Bearing

Span 1

11 - Batt Vertical U_3L_3 - East Truss - Span # 2
12 - L_3 Pin - Note Broken Diagonal L_3-U_4
13 - U_6 Broken Diag. U_6-L_5
14 - South Approach
15 - Bridge From South
16 - North Approach
17 - South Deck Jt.
18 - Typ. Underside Config.
19 - Pier (South) Face (Needs Repointing
20 & 21 South Abut - Repointing Needed
22 - Batt Members Span # 2 East Truss
23 - South Abutment
24 - North Abut - Needs Repointing
25 - Pier (North) Side - Needs Repointing
26 - Typ. Pin Config
27 - FLBM Attached to Pin
28 - North Deck Jt.
29 - Upstream (East)
30 - Downstream (West)
31 - Typ. Hanger Rod "Y" for U_4-L_4 & U_5-L_5
32 - Typ. Deck Condition
33 - Guide Rail Attachment
34 - Top Chord @ Panel Point

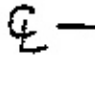
Deflections from String line to ℄ Pin

Span 1

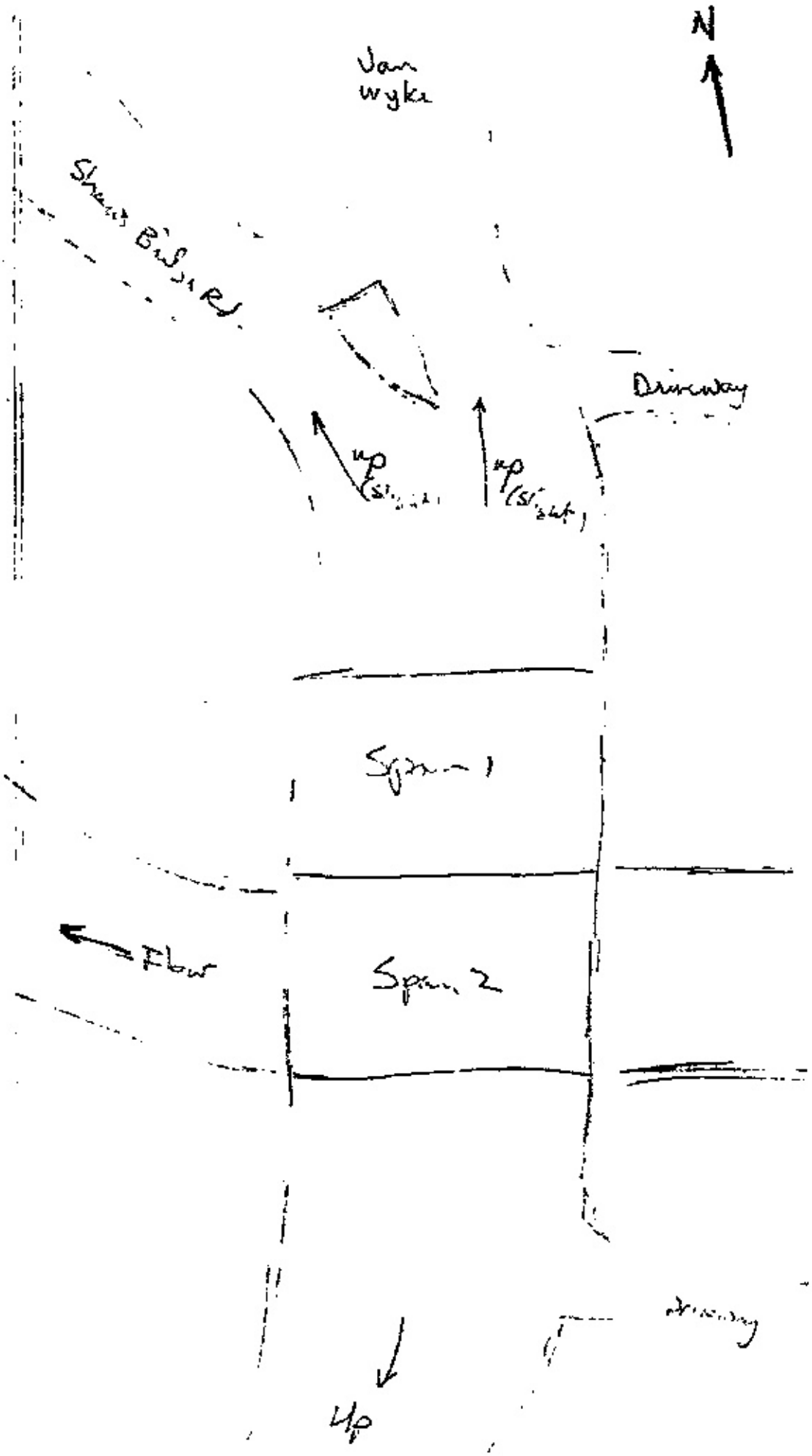


L_1 - $\frac{3}{8}$"
L_2 - 3"
L_3 - 5"
L_4 - $6\frac{3}{4}$
L_5 - 7
L_6 - 7
L_7 - $5\frac{1}{4}$
L_8 - $2\frac{1}{2}$

Span 2



L_1 - $1\frac{3}{4}$
L_2 - 5
L_3 - $6\frac{1}{2}$
L_4 - $7\frac{1}{2}$
L_5 - 7
L_6 - $6\frac{1}{2}$
L_7 - 4
L_8 - $1\frac{3}{4}$


N
Jan
wyke
Driveway
Span 1
Span 2
Flow
Up

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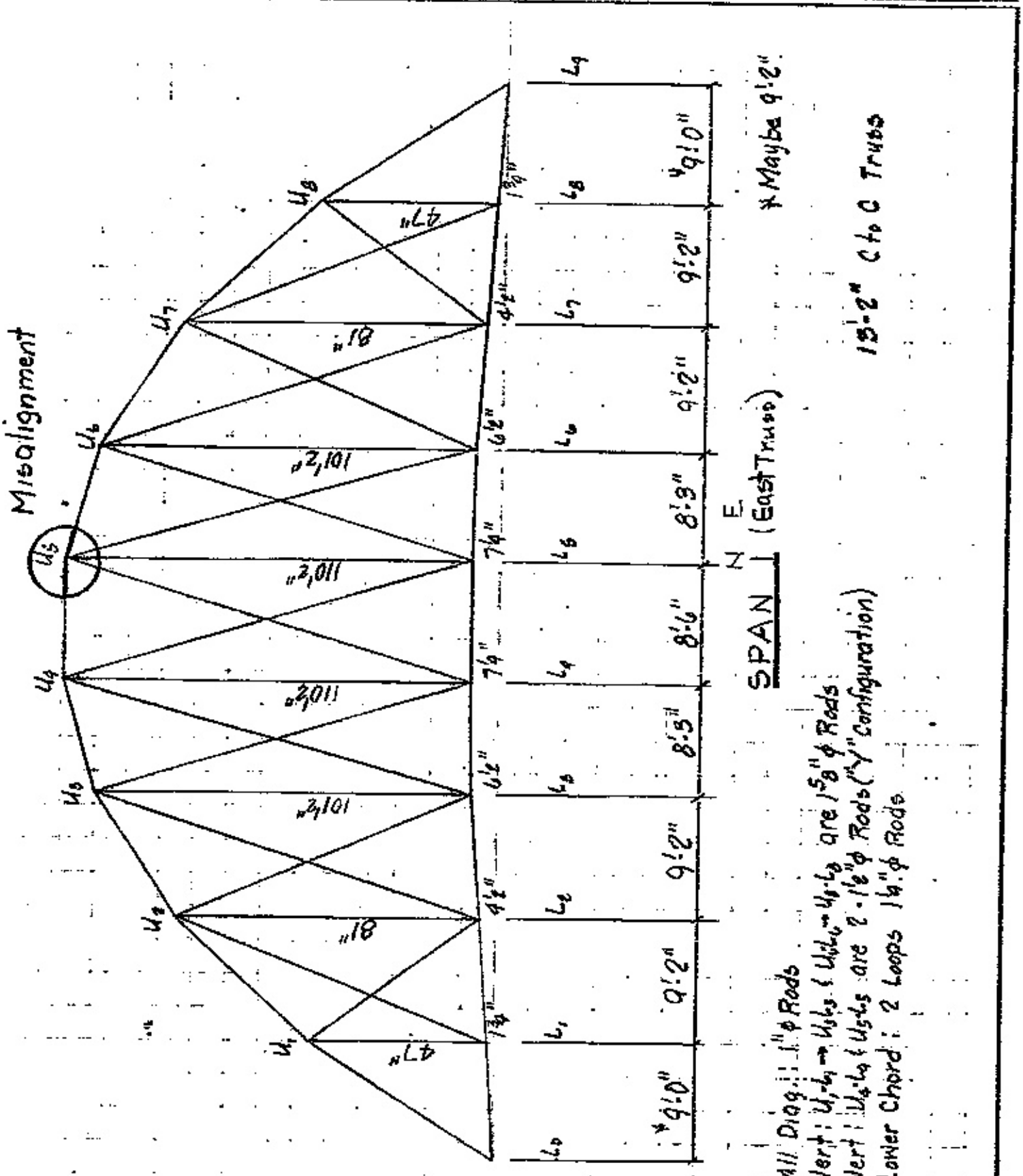
JOB "696 - Shaws Bridge

SHEET NO. ____ OF ____

CALCULATED BY M.M. DATE 2-25-80

CHECKED BY ____ DATE ____

SCALE ____



F9

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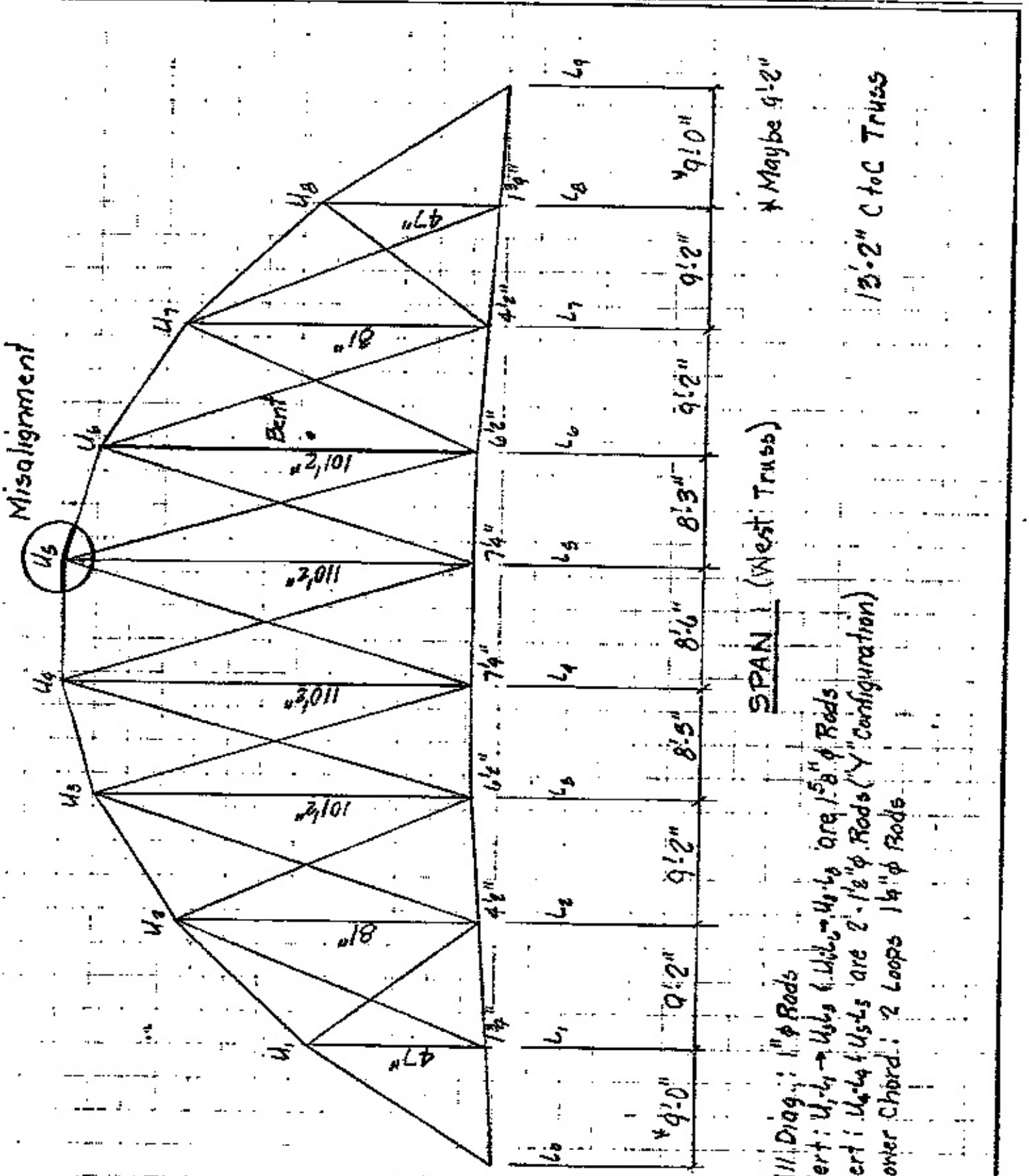
JOB "696 - Shans Bridge

SHEET NO _____ OF _____

CALCULATED BY M.M. DATE 2-25-80

CHECKED BY _____ DATE _____

SCALE _____



F10

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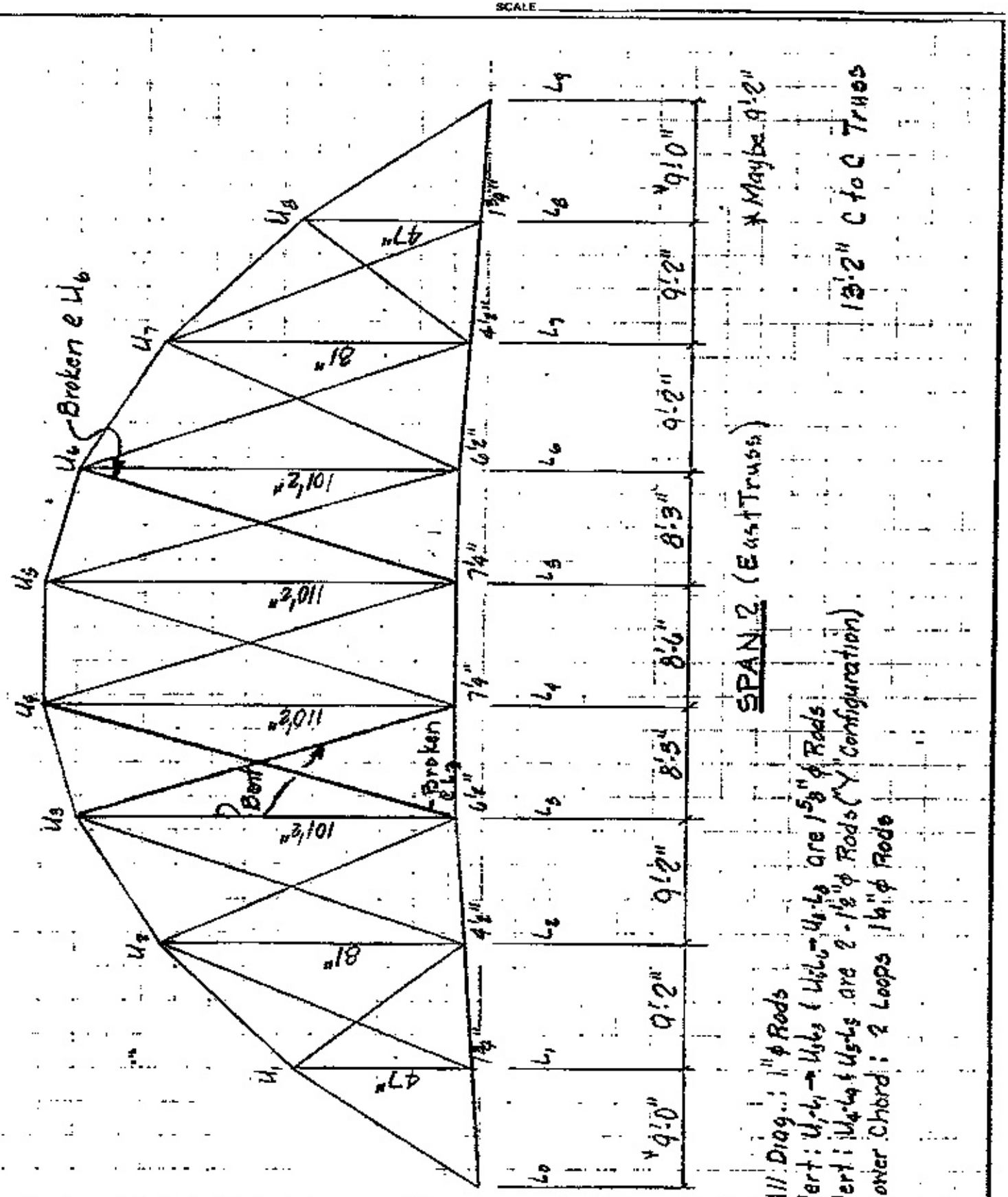
JOB # 696 - Shaws Bridge

SHEET NO _____ OF _____

CALCULATED BY M.M. DATE 2-25-80

CHECKED BY _____ DATE _____

SCALE _____



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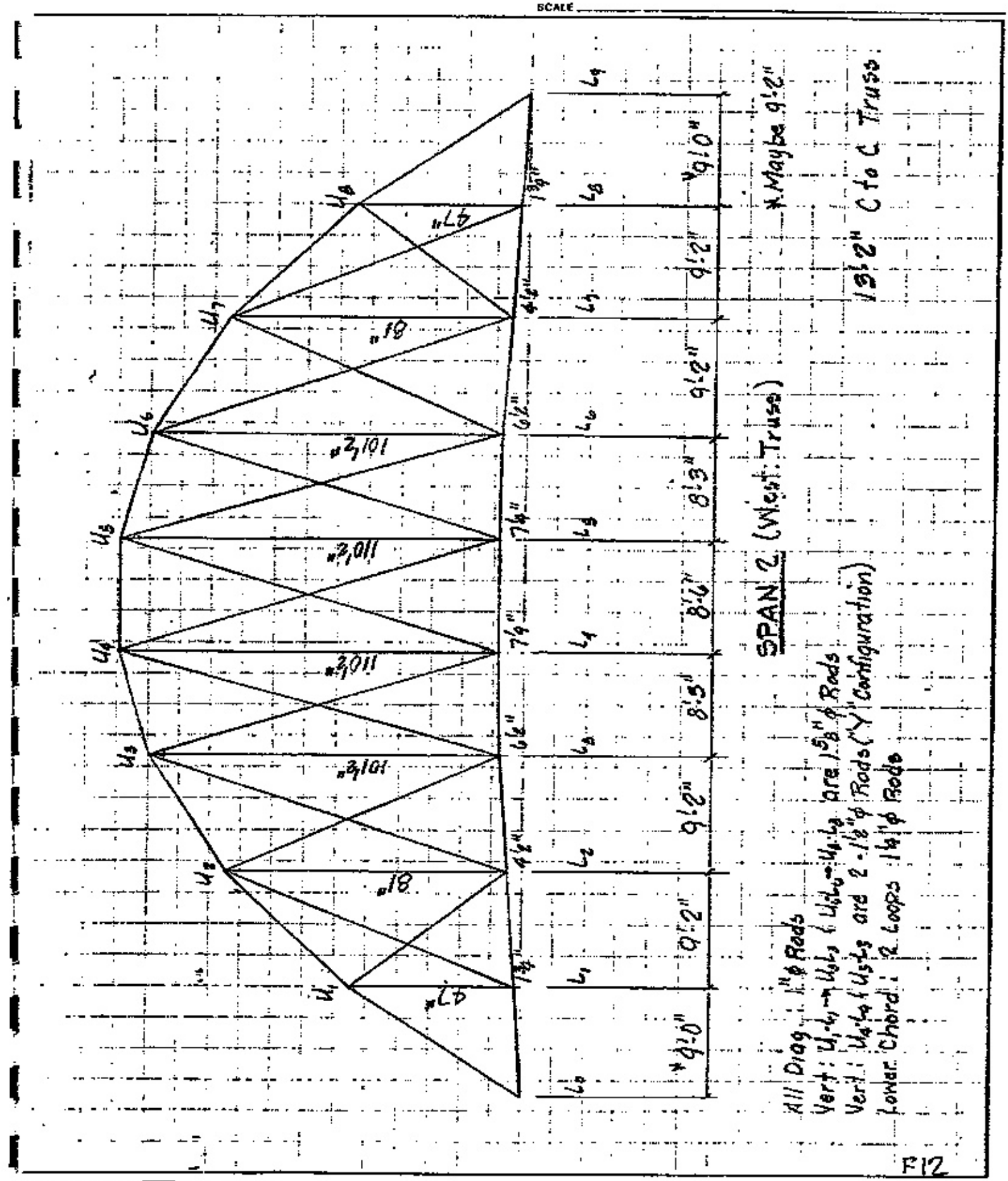
JOB 0410 - Orans Bridge

SHEET NO. _____ OF _____

CALCULATED BY M.M. DATE 2-25-80

CHECKED BY _____ DATE _____

SCALE _____



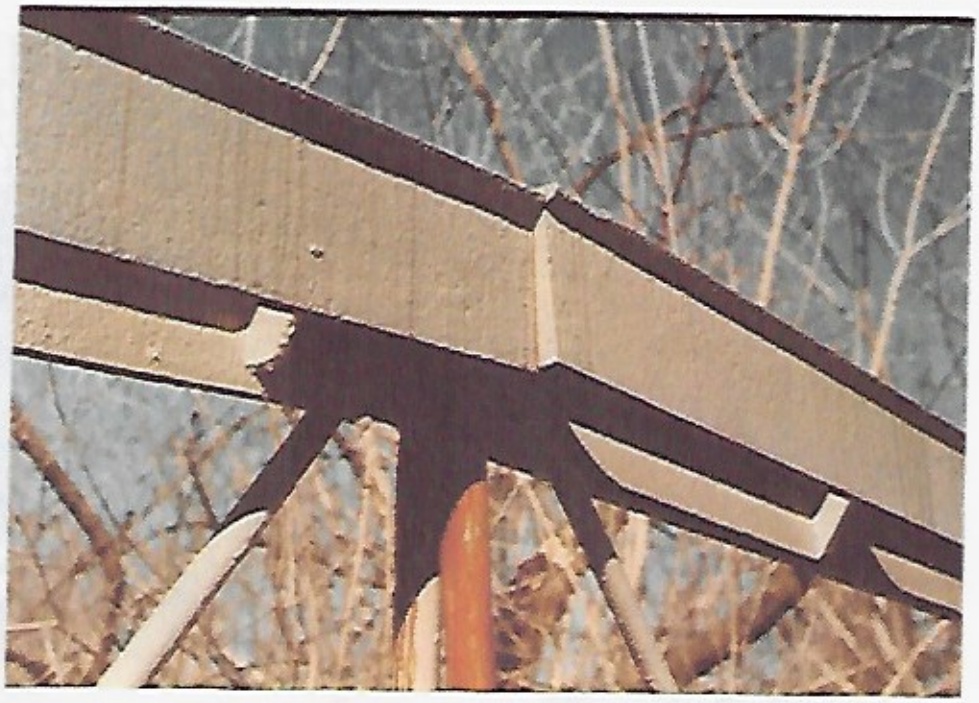
F12

PHOTOGRAPHS

BRIDGE FROM NORTH

MISALIGNED TOP CHORD

(East Truss U_5 Span #1)



MISALIGNED TOP CHORD
(West Truss U_5 Span #1)

BENT MEMBERS
(East Truss Span #2)

BROKEN DIAGONAL

(East Truss Span #2 L_3–U_4)

Broken at L_3

BROKEN DIAGONAL

(East Truss Span #2 L_5–U_6)

Broken at U_6