

4580 MEMORIAL DRIVE,  
ST. JOHNSBURY, VT 05819  
P 802-748-5898  
RES@MYFAIRPOINT.NET



**RUGGLES ENGINEERING SERVICES INC.**

**MIDDLESEX  
BRF 024-1(37)**

TEMPORARY BRIDGE  
CRITICAL DESIGN CALCULATIONS  
Revised - July 22, 2015

Previously designed for  
**MIDDLESEX  
BRF 024-1(32)**  
APRIL 1, 2009

AND USED FOR:  
CORNWALL BRS0172 (6)  
HINESBURG STP 0199(2)  
JOHNSON BRF 030-2(26)

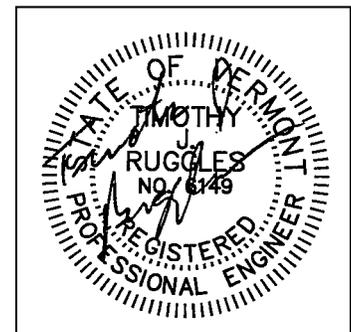
THIS TEMPORARY BRIDGE IS THE MIDDLE (80') SPAN OF A THREE SPAN STRUCTURE THAT HAS BEEN SUCCESSFULLY USED ON THE ABOVE PROJECTS. THE CALCULATIONS ENCLOSED HAVE BEEN MODIFIED TO REFLECT THE PROPOSED USE ON THIS PROJECT.

PREPARED FOR:

A.L. ST. ONGE CONTRACTOR, INC.  
P.O. BOX 65  
MONTGOMERY, VT 05470

ANALYSIS SHEETS  
PLAN SHEETS (SEPARATE)  
STANDARD SHEET

1-5/5  
1-3/3  
G-16





## Analysis Sheet

Date: 7/22/15

By: \_\_\_\_\_

Project: MIDDLESEX BRIDGE 024-1(37) Sheet 1 of 5

TEMPORARY BRIDGE

CRITICAL DESIGN CALCULATIONS FOR TWO-WAY  
TEMPORARY BRIDGE, GIVEN:

1) SPAN IS 80'; USED W36x245 GIRDERS (5)  
-  $S_x = 895 \text{ IN}^3$

2) DECK IS 27' PRECAST CONCRETE  
8" THICK; NO PAVEMENT ON DECK.

3) BRIDGE TO BE 24', RAIL TO RAIL

4) BEAMS TO BE 5' O.C.

1) CALCULATE LOADS AND CHECK BEAMS:

A) DEAD LOADS (ALL PER GIRDER) PER FOOT

$$\text{- DECK: } 27' \times 1' \times 0.67' \times 150 \text{ lb/ft}^3 \div 5 = 0.54 \text{ K/FT}$$

$$\text{- BEAMS: } 245 \text{ lb/ft} \times 1.1 \text{ (DIAPHRAGMS)} = 0.27 \text{ K/FT}$$

$$\text{- GUARDRAIL: } 2 \times 200 \text{ lb/ft} \div 5 = 0.08 \text{ K/FT}$$

$$\text{TOTAL D.L.} = 0.89 \text{ K/FT}$$

$$\text{SO } M_{DL} = \frac{wL^2}{8} = \frac{0.89 \times (80)^2}{8} = 712 \text{ K-FT}$$

### Analysis Sheet

Date: 7/22/15

By: \_\_\_\_\_

Project: MIDDLESEX BRIDGE 024-1(37)

Sheet 2 of 5

TEMPORARY BRIDGE

B) LIVE LOADS:

$$\text{LANE LOAD} = \overset{\text{HS-20}}{1164.9} \times 1.25 = \overset{\text{HS-25}}{1456.1} \text{ K/FT/LANE}$$

(AASHTO APP. A)

$$\text{WHEEL LOAD} = \frac{1}{2} \text{ LANE LOAD} = 728.1 \text{ K/FT}$$

$$\text{CALCULATE } I = \frac{50}{L+125} = \frac{50}{80+125} = 0.24$$

$$\text{USE D.F.} \approx 1.0$$

$$M_{LL} = 728.1 \times 1.24 \times 1.0 = 902.8 \text{ K-FT}$$

(I) (D.F.)

C)  $M_{\text{TOTAL}} = 712 \text{ K-FT} + 903 \text{ K-FT} = 1615 \text{ K-FT}$

D)  $S_x (\text{REQD}) = \frac{M_{\text{MAX}}}{f_b} = \frac{1615 \text{ K-FT} \times 12 \text{ "/FT}}{24 \text{ K/IN}^2}$

$$= 807.5 \text{ IN}^3/\text{FT}$$

E) W 36x245 HAS  $S_x = 895 \text{ IN}^3/\text{FT} > 807.5 \text{ IN}^3/\text{FT}$  : OK

2) CALCULATE END REACTIONS:

$$LL = \text{LANE END REACTION} = \overset{\text{HS-20}}{63.6} \times 1.25 \times 2 \text{ LANES} = 159 \text{ K}$$

(AASHTO APP. A)

$$DL = 0.89 \text{ K/FT} \times 80' \times 5 \text{ BEAMS} \div 2 = 178 \text{ K}$$

(LD/FT OF BEAM)

$$\text{TOTAL END REACTION} = 337 \text{ K}$$

(EACH END)

### Analysis Sheet

Date: 07/22/15

By: \_\_\_\_\_

Project: MIDDLESEX BRIDGE 24-1 (37)

Sheet 3 of 5

TEMPORARY BRIDGE

3) CHECK ABUTMENT END LOAD CONDITIONS:

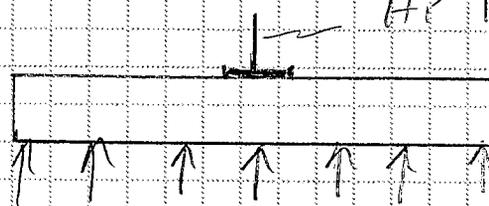
- LOAD ON ABUTMENT ENDS = 337 K
- USE A 5' X 27' PRECAST DECK SECTION UNDER THE GIRDERS (SEE SECTION 4)

- TOTAL AREA = 5' X 27' = 135 SQ. FT.

- LOAD =  $\frac{337}{135} = 2.5 \text{ K/FE}^2$

- USE STRUCTURAL FILL UNDER PRECAST SO 2.5 K/FE<sup>2</sup> IS REASONABLE.

4) CHECK PRECAST DECK PANEL FOR USE AS ABUTMENT:



HP 12 TO DISTRIBUTE LOADS  
5' WIDE X 12" THICK

$w = 2.5 \text{ K/FE}$

SEE SHEET 4  
FOR FOOTING

NEED TO PROVIDE NEW FOOTINGS THAT ARE 5' X 27' X 12" THICK W/ # 7 @ 12" O.C. ON BOTTOM

TOP - # 5 @ 12" O.C. E.W.

- SEE SHEET 5 -



SIMPLE DESIGN OF CONCRETE SLAB WITH THE FOLLOWING ASSUMPTIONS:  
DESIGN IS FOR A 12" WIDE SECTION OF SLAB  
SLAB IS UNIFORMLY LOADED FOR THE ENTIRE WIDTH

Date: 7/21/2015

Given Information:

Uniform Load w (k/ft)	Length L (ft)	Slab Thickness (in)	Steel cover (in)	Bar size	Bar Dia. (in)	Concrete design strength f <sub>c</sub> (psi)	Rebar allowable load f <sub>s</sub> (psi)
2.5	5	12	3	7	0.875	3,000	24,000

Formulas used:

$$A_s = M_T / (f_s * j * d) \quad j = 1 - (k/3) \quad k = n / (n+r) \quad r = f_s / f_c \quad f_c = 0.45 * f'_c$$

$$n = E_s / E_c \quad E_s = 29,000,000 \quad E_c = 57,000 * f'_c^{.5}$$

Calculate:

WT<sub>ft</sub> = 150 lb/ft      Weight per foot of slab

M<sub>DL</sub> = 0.47 k-ft      Dead Load Moment

M<sub>LL</sub> = 7.81 k-ft      Live Load Moment

M<sub>T</sub> = 8.28 k-ft = 99360 lb-in      (to make units work)

d = 8.56 in

n = 9.289

f<sub>c</sub> = 1350 lb/in<sup>2</sup>

r = 17.778

k = 0.343

j = 0.886

A<sub>s(req'd)</sub> = 0.55 in<sup>2</sup>

# bars req'd/ft. = 0.91 (minimum required to provide A<sub>s(req'd)</sub>)

Required spacing = 13 1/4 inches (maximum spacing allowed)

Use:

# bars = 1

Actual Spacing = 12 inches

A<sub>s(provided)</sub> = 0.60 O.K.

M<sub>T(allowable)</sub> = 109435 lb-in  
9.12 k-ft

Shrinkage and temperature steel percentage required (.0018bh)

Distribution steel A<sub>s(req'd)</sub> = 0.26 in<sup>2</sup>

Use: Bar size 5 Bar Dia. (in) 0.625

# bars/ft = 1

Actual Spacing = 12 inches

A<sub>s(provided)</sub> = 0.31 O.K.

### Analysis Sheet

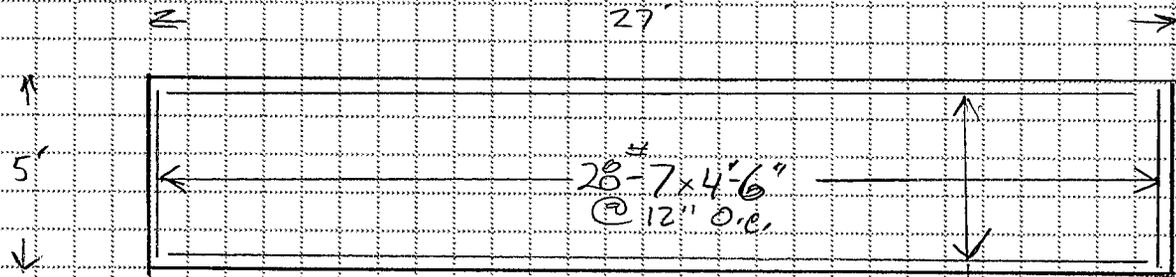
Date: 07/22/15

By: \_\_\_\_\_

Project: MIDDLESEX BRIDGE 024-1(37)  
TEMPORARY BRIDGE

Sheet 5 of 5

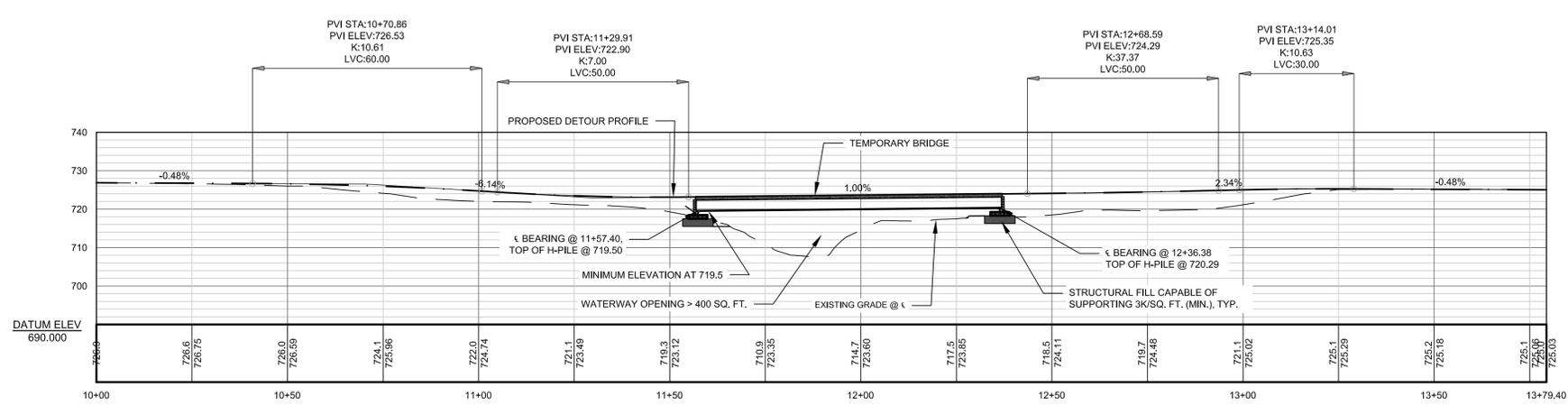
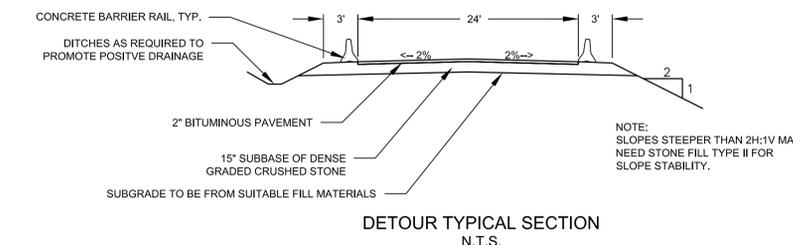
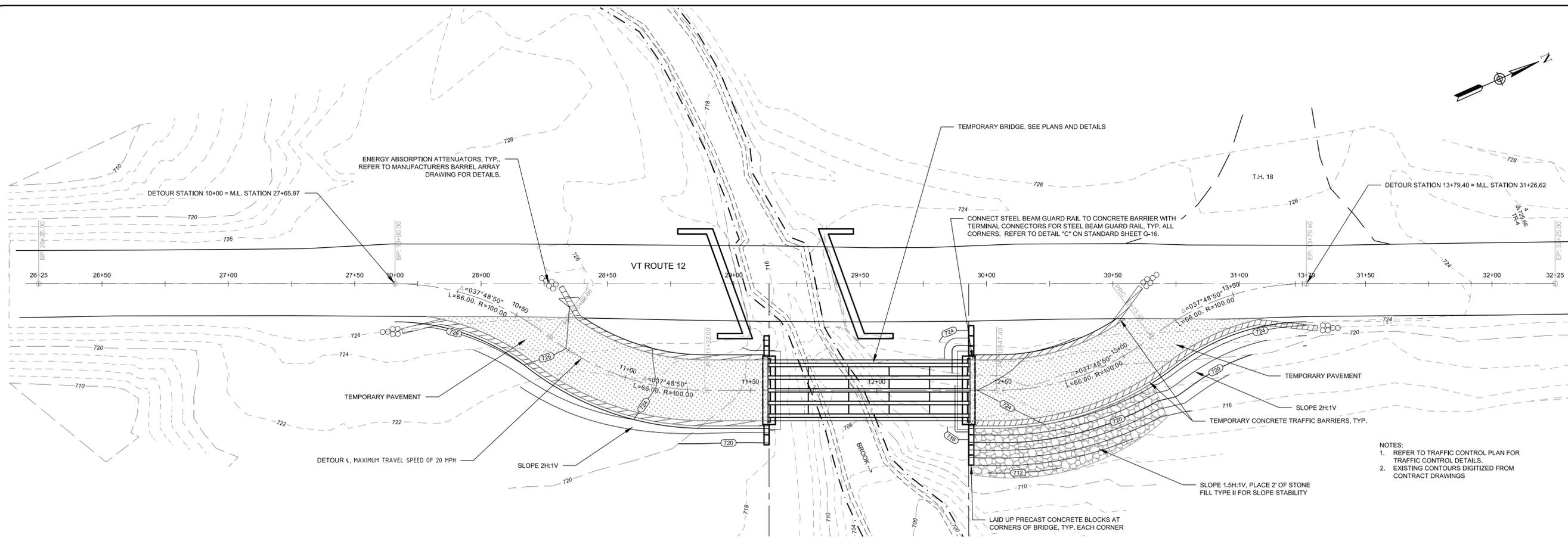
#### A) CONT'D. - FOOTING DESIGN



SLAB TO BE 12" THICK  
CONCRETE = CLASS B  
REBAR = GRADE 60 - BLACK BAR  
REBAR TO BE 3" CLEAR

6'5" x 26'6"

C:\Users\Tim\Documents\RES Projects\2015\15030 - A.L. St. Onge - Middlesex BRF 024-1(37)\St. Onge - Middlesex  
 (detour.dwg=07/27/15)



Vermont Agency of Transportation  
**RECEIVED**  
 St Onge - Middlesex BRF 024-1(37)-TEMP-BRIDGE-Approved.pdf

CK'D BY FDB OK'D BY HIS

July 27, 2015

RESUBMIT No Approved  
 BY Carolyn Carlson DATE 07/28/15

**RUGGLES**  
 ENGINEERING SERVICES, INC.  
 480 MEMORIAL DRIVE ST. JOHNSBURY, VT 05819  
 Civil Engineering, Site Development  
 Septic System Design, Soils Analysis  
 802-748-5898  
 JOB No. 15030

PREPARED FOR: **A.L. ST. ONGE CONTRACTORS, INC.**  
 P.O. BOX 65 MONTGOMERY, VT 05470

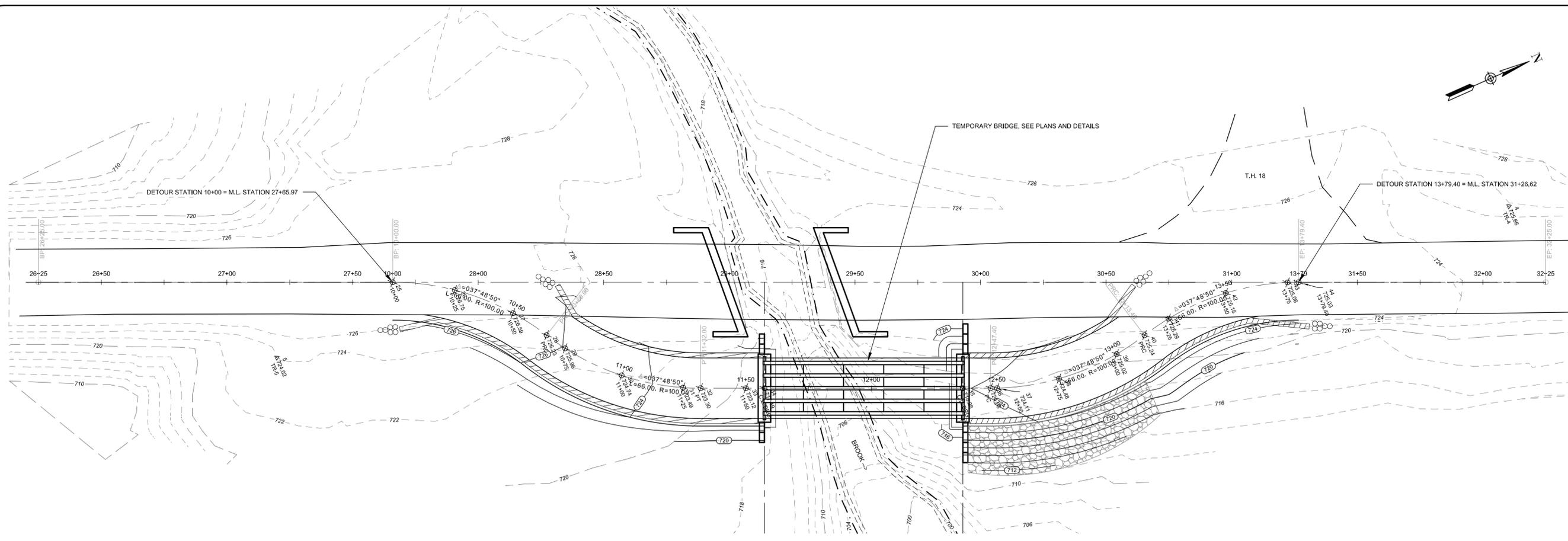
DETOUR PLAN AND PROFILE  
 MIDDLESEX BRF 024-1(37)

REVISIONS		Date	Address
No.	Description	07/22/15	
1	MINOR NOTE REVISIONS		

Designed: T.R.  
 Drawn: -  
 Checked: -  
 DATE: 07/13/15

**DTR 1**  
 Sheet of

C:\Users\Tim\Documents\RES Projects\2015\15030 - A.L. St. Ouge - Middlesex BRF 024-1(37)\St. Ouge - Middlesex  
 (detour.dwg=2015/07/13)



DETOUR LAYOUT PLAN  
 1" = 20'

Point #	Raw Description	Elevation	Northing	Easting
3	TR-3	728.39	660343.699	1619763.487
4	TR-4	725.66	661038.506	1620017.348
5	TR-5	724.02	660565.676	1619873.812
25	10+00		660619.921	1619865.135
26	10+25	726.75	660641.291	1619877.984
27	10+50	726.59	660658.817	1619895.720
28	PRC	726.25	660667.501	1619909.137
29	10+75	725.96	660672.123	1619916.857
30	11+00	724.74	660688.366	1619935.776
31	11+25	723.49	660708.785	1619950.088
32	PT	723.30	660715.081	1619953.139
33	11+50	723.12	660731.545	1619960.420
34	C.L. BRG	717.49	660738.313	1619963.413
35	C.L. BRG	718.28	660810.547	1619995.356
36	PC	724.08	660820.625	1619999.812

Point #	Raw Description	Elevation	Northing	Easting
37	12+50	724.11	660823.015	1620000.832
38	12+75	724.48	660847.077	1620007.372
39	13+00	725.02	660872.009	1620007.755
40	PRC	725.24	660885.191	1620005.402
41	13+25	725.29	660896.585	1620003.263
42	13+50	725.18	660921.520	1620003.197
43	13+75	725.06	660945.696	1620009.303
44	13+79.40	725.03	660949.756	1620010.992

Vermont Agency of Transportation  
**RECEIVED**  
St Ouge - Middlesex BRF 024-1(37)-TEMP-BRIDGE-Approved.pdf

CK'D BY FDB OK'D BY HIS

July 27, 2015

RESUBMIT No Approved             
 BY Carolyn Carlson DATE 07/28/15

**RUGGLES**  
 ENGINEERING SERVICES, INC.  
 4860 MEMORIAL DRIVE ST. JOHNSBURY, VT 05819  
 Civil Engineering, Site Development  
 Septic System Design-Soils Analysis  
 JOB No. 15030

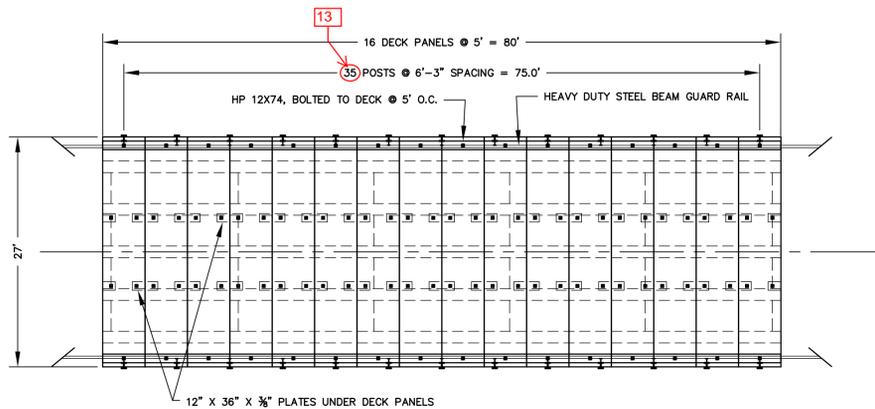
PREPARED FOR: **A.L. ST. OUGE CONTRACTORS, INC.**  
 P.O. BOX 65 MONTGOMERY, VT 05470  
 Address

DETOUR LAYOUT PLAN  
 MIDDLESEX BRF 024-1(37)

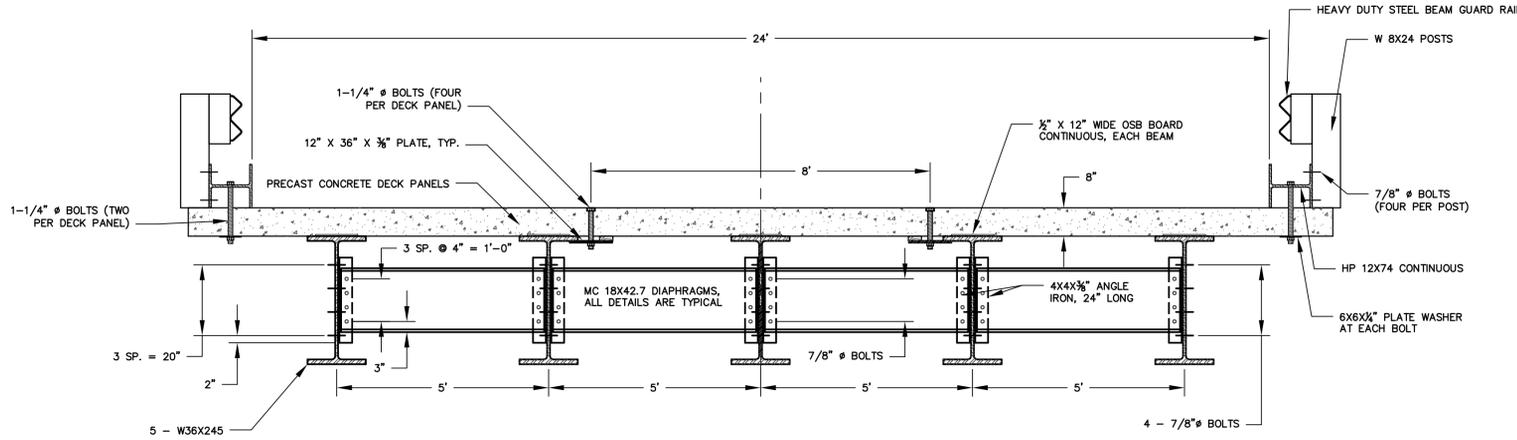
REVISIONS		Date		
No.	Description			
1	MINOR NOTE REVISIONS	07/22/15		

Designed: T.R.  
 Drawn: -  
 Checked: -  
 DATE: 07/13/15

**DTR 2**  
 Sheet of

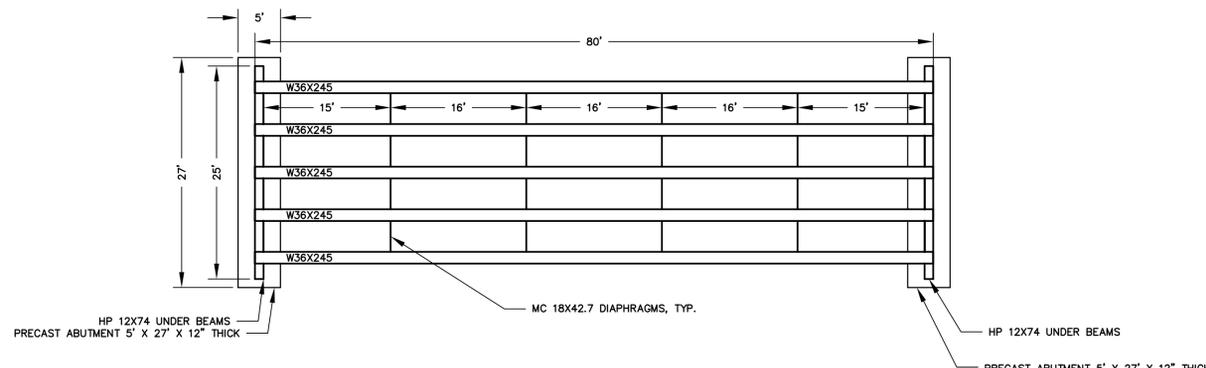


BRIDGE DECK PLAN  
1" = 10'

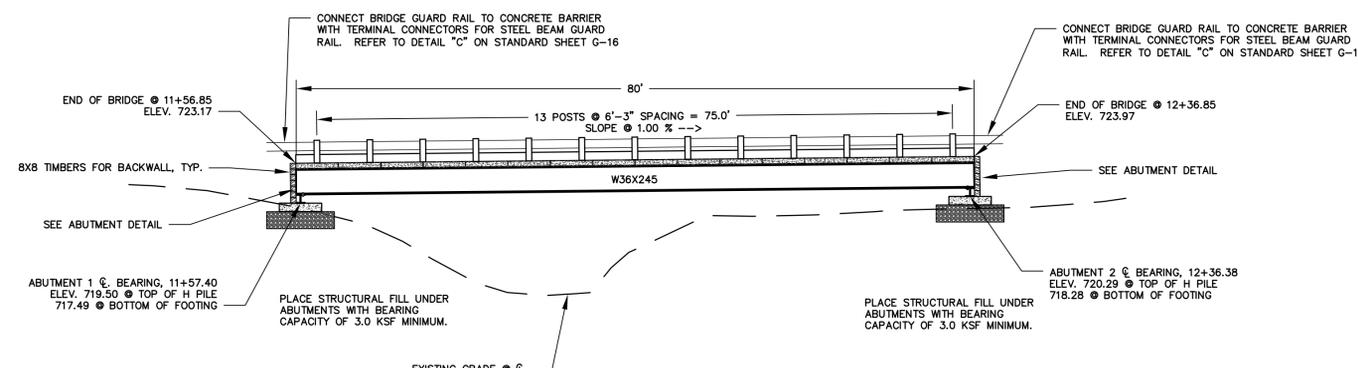


TYPICAL BRIDGE SECTION  
1" = 2'

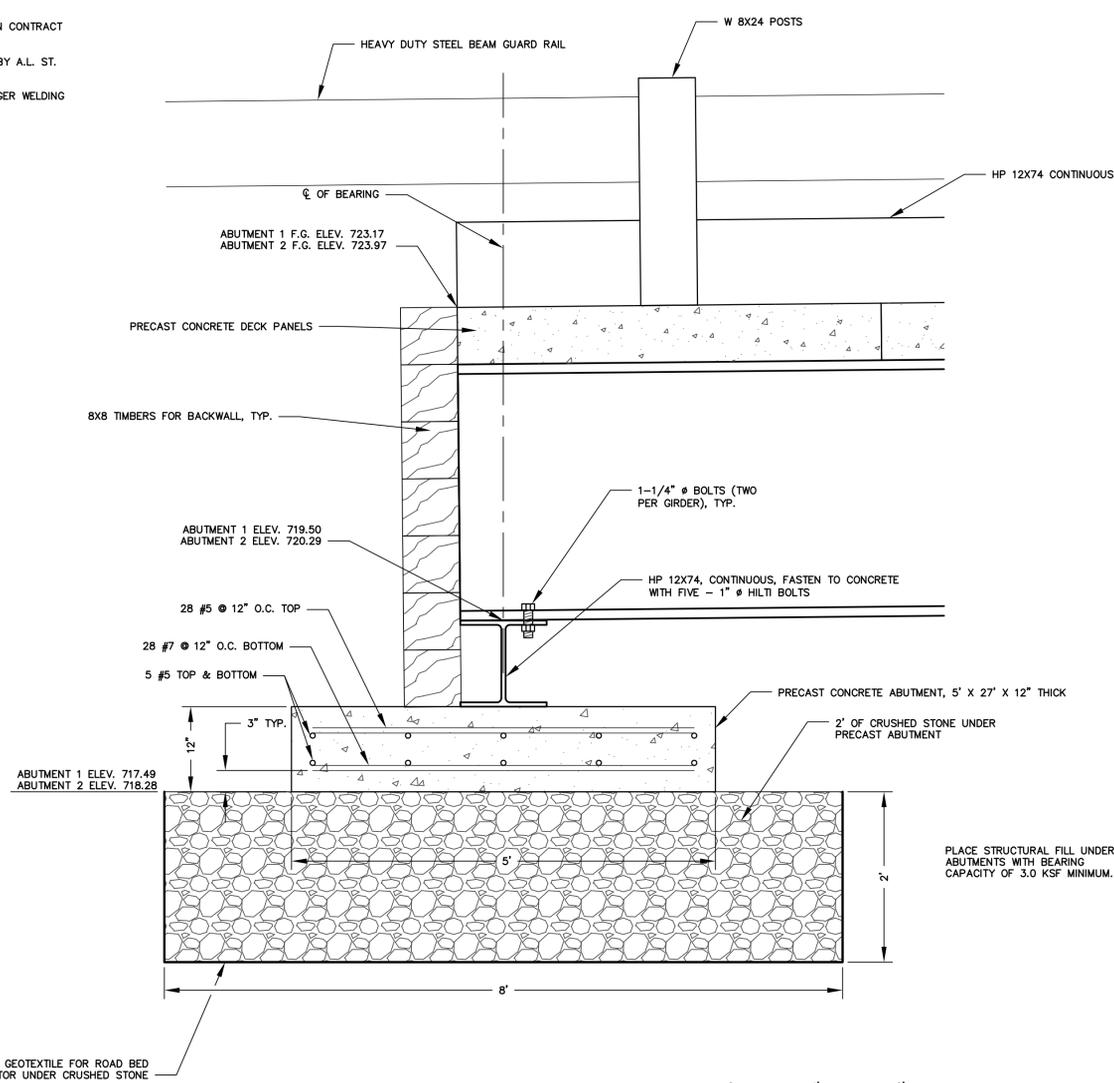
- NOTES:
1. ALL BEAMS ARE TO BE IN GOOD CONDITION WITH A MINIMUM YIELD STRENGTH OF 36 KSI.
  2. STEEL FOR BRACING SHALL BE NEW OR IN LIKE NEW CONDITION AND ASTM A36 OR STRONGER.
  3. BOLTS AND NUTS FOR CONNECTIONS SHALL BE H.S. A-325 WITH ALL HOLES DRILLED. ALL BOLTED CONNECTIONS TO HAVE A FLAT WASHER ON EACH END.
  4. CONCRETE FOR PRECAST PANELS SHALL BE CLASS A.
  5. REINFORCING STEEL SHALL BE GRADE 60.
  6. BRIDGE IS DESIGNED FOR TWO-WAY TRAFFIC, HS-25 LOADING. DESIGN BASED ON CONTRACT DOCUMENTS AND TEMPORARY STRUCTURE CONSIDERATIONS.
  7. PRECAST DECK PANELS TO HAVE A 8" NOMINAL DEPTH. PREVIOUSLY DESIGNED BY A.L. ST. ONGE FOR HS-25 LOADING.
  8. ALL WELDING TO BE PERFORMED BY QUALIFIED WELDERS USING E70XX OR STRONGER WELDING ELECTRODE.



BRIDGE FRAMING PLAN  
1" = 10'



BRIDGE ELEVATION  
1" = 10'



DETAIL @ ABUTMENTS  
1" = 1'

Vermont Agency of Transportation  
**RECEIVED**  
CK'D BY FDB OK'D BY HIS  
July 27, 2015  
RESUBMIT No Approved AsNoted  
BY Carolyn Carlson DATE 07/28/15

**RUGGLES ENGINEERING SERVICES, INC.**  
4860 MEXICAL DRIVE, ST. JOHNSBURY, VT 05470  
Civil Engineering, Site Development  
Septic System Design, Soils Analysis  
802-748-8888  
JOB No. 15030

PREPARED FOR: **A.L. ST. ONGE CONTRACTORS, INC.**  
P.O. BOX 65 MONTGOMERY, VT 05470  
Address  
**TEMPORARY BRIDGE PLAN AND DETAILS**  
MIDDLESEX BRG 024-1(37)

REVISIONS	No.	Description	Date
	1	REVISED FOOTING	07/22/15

Designed: T.R.  
Drawn: -  
Checked: -  
DATE: 07/13/15

BR 1  
Sheet of

C:\Users\Tim\Documents\RES Projects\2015\15030 - A.L. St. Onge - Middlesex BRG 024-1(37)\Middlesex-Bridge.dwg  
Plot on: 07/28/15 10:41:43 AM

**RECEIVED**

St Onge - Middlesex BR 024-1(37)-TEMP-BRIDGE-Approved.pdf

CK'D BY FDB

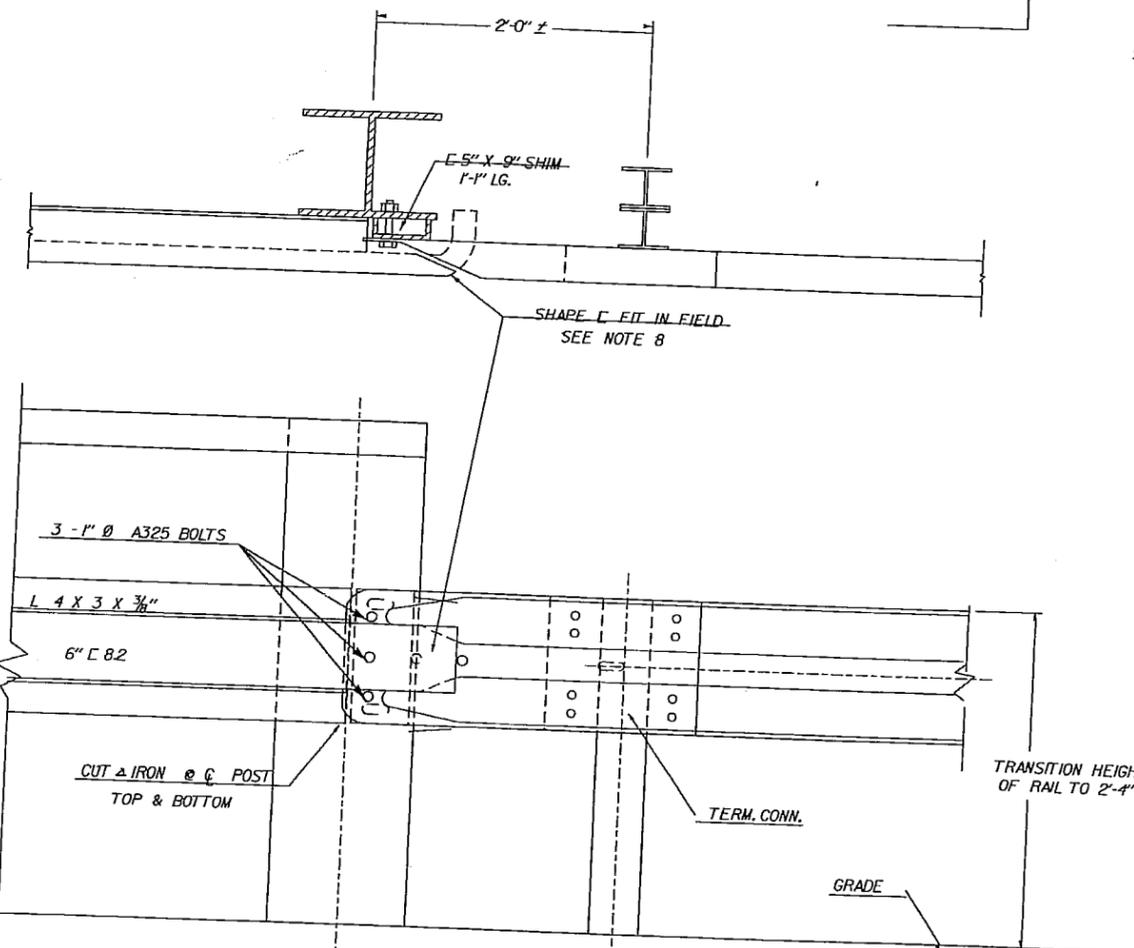
OK'D BY HIS

July 27, 2015

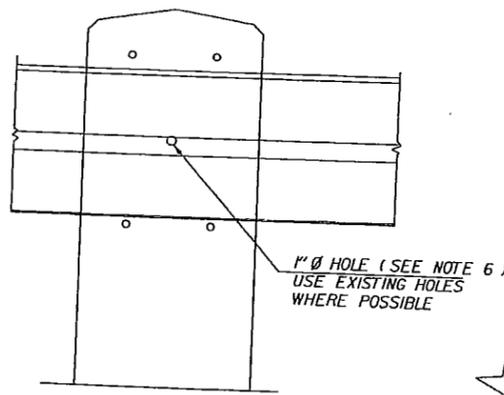
RESUBMIT No  
BY Carolyn Carlson

Approved

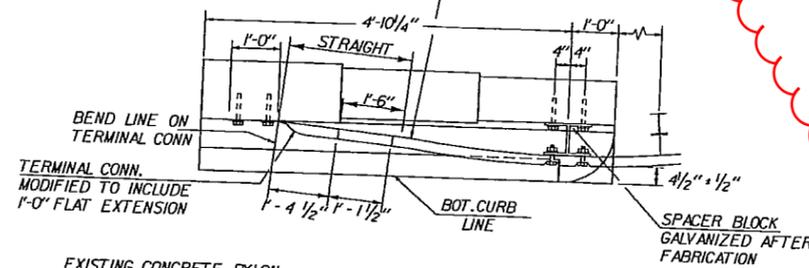
DATE 07/28/15



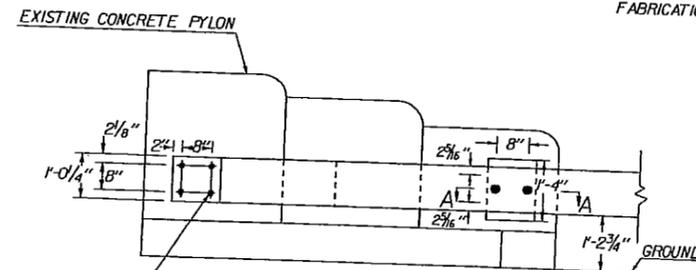
DETAIL "D"  
TERMINAL CONNECTION TO  
STEEL TRUSS RAIL  
SCALE: 1/2" = 1'-0"



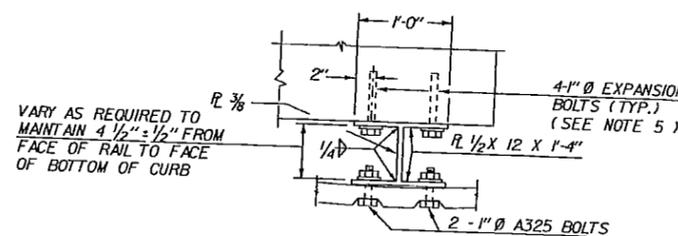
DETAIL "B"  
STEEL BEAM INSTALLATION  
ON CONCRETE POST  
SCALE: 1/2" = 1'-0"



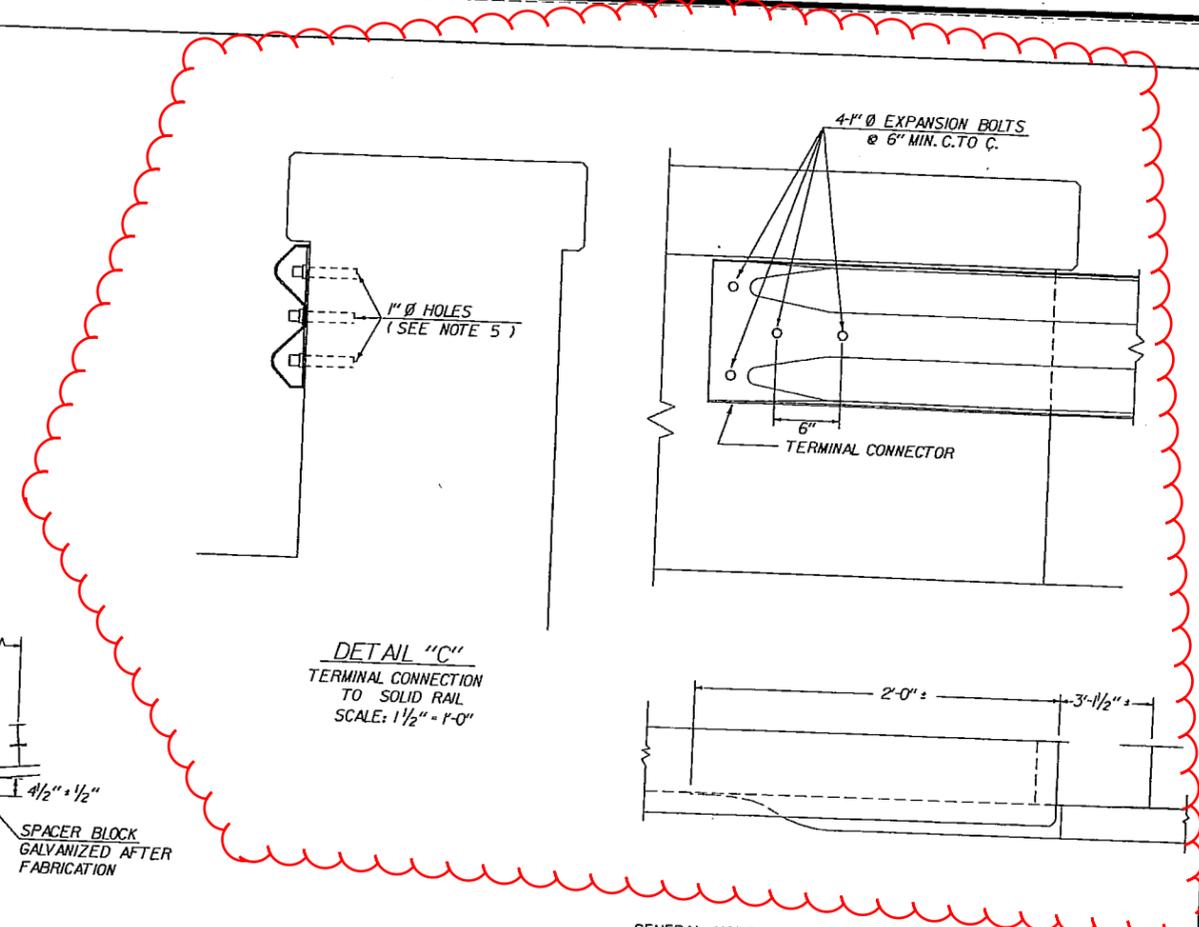
DETAIL "C"  
TERMINAL CONNECTION  
TO SOLID RAIL  
SCALE: 1/2" = 1'-0"



DETAIL "A"  
BLOCKED-OUT STEEL BEAM CONNECTION  
ON CONCRETE PYLON WITH CURB  
SCALE: 1/2" = 1'-0"



SECTION A-A  
SPACER BLOCK DETAIL  
SCALE: 1" = 1'-0"



- GENERAL NOTES
1. AT LEAST 2 PANELS (25') OF RAIL AT APPROACH TO BRIDGE SHALL BE HEAVY DUTY STEEL BEAM. SEE STANDARD G-1 FOR ADDITIONAL DETAILS.
  2. ALL METAL PARTS SHALL BE GALVANIZED IN ACCORDANCE WITH AASHTO M-III. ALL FIELD ALTERATIONS TO GALVANIZED MEMBERS SHALL BE PAINTED WITH 2 COATS OF ZINC RICH PAINT (SECTION 708.07).
  3. TERMINAL CONNECTORS SHALL BE STANDARD HM-TF-13/RE-8.
  4. EXPANSION BOLTS SHALL BE STAINLESS STEEL, ASTM A582 TYPE 303, 1"Ø BY 9 INCHES IN LENGTH WITH A MINIMUM THREAD LENGTH OF 2 INCHES. EXPANSION WEDGES SHALL BE ASTM A276 TYPE 304. NUTS AND WASHERS SHALL BE TYPE 18-8 STAINLESS STEEL.
  5. EXPANSION BOLTS SHALL HAVE 7" MIN. DEPTH OF EMBEDMENT INTO EXISTING CONCRETE AND SHALL BE CAPABLE OF ULTIMATE TENSILE STRENGTH = 18,000 LBS MIN. DETAILS SHALL BE SUBMITTED FOR APPROVAL PRIOR TO INSTALLATION.
  6. STEEL BEAM RAILING TO BE INSTALLED ON EXISTING CONCRETE POSTS SHALL BE DRILLED TO FIT IN THE FIELD.
  7. POST SPACING TO BE 3' - 1/2" AT EACH CORNER OF ALL BRIDGES FOR ONE PANAL (12.5'), UNLESS OTHERWISE NOTED. NORMAL LINE POST SPACING TO BE 6' - 3".
  8. WHEN CONNECTING NEW BEAM RAIL TO EXISTING STEEL RAIL ON TRUSS BRIDGES, ANY EXISTING BRIDGE RAIL CUT SHALL BE CLEANED AND PAINTED IN ACCORDANCE WITH SECTION 513.
  9. EXISTING BRIDGE RAILING SHALL NOT BE REMOVED UNTIL THE NEW BRIDGE RAILING AND ALL NECESSARY ACCESSORIES ARE ON THE PROJECT.
  10. ONLY ONE SIDE OF EACH BRIDGE SHALL BE WORKED ON AT A TIME.
  11. WHEN THE CURB TO RAIL OFFSET EXCEEDS 8", USE A SPACER BLOCK AS SHOWN IN SECTION A-A. MAINTAIN 4 1/2" ± 1/2" CURB TO RAIL OFFSET.
  12. THE POST MAY BE DRILLED THROUGH AND THE RAIL FASTENED WITH ONE 5/8" Ø GALVANIZED BOLT. A 6" SQUARE GALVANIZED WASHER (1/4" THICK) SHALL BE INSTALLED ON THE BACK SIDE OF THE POST.

REVISIONS AND CORRECTIONS

9, 1977 - ORIGINAL APPROVAL DATE

1978 - CONSTRUCTION DETAILS REVISED

5, 1980 - TITLE BLOCK REVISED

1994 - REISSUED, WITHOUT CHANGE, UNDER NEW SIGNATURES.

APPROVED

APPROVED FOR THIS PROJECT  
AND/OR DESIGN IMPLEMENTATION,  
FHWA FINAL APPROVAL PENDING.

*Stephen D. MacArthur, P.E.*  
DIRECTOR OF ENGINEERING

*John D. Mungler, PE*  
DESIGN ENGINEER

STEEL BEAM GUARD RAIL ATTACHMENTS  
TO EXISTING BRIDGE  
TERMINAL CONNECTOR FOR STEEL BEAM GUARD RAIL



STANDARD  
G-16