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 SUCCESFULLY 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

Timothy Ruggles, P.E.

Digitally signed by Timothy Ruggles, P.E.
DN: cn=Timothy Ruggles, P.E., o=Ruggles Engineering Services, ou, email=RES@myfairpoint.net, c=US
Date: 2015.07.22 15:52:13 -04'00'

ANALYSIS SHEETS	1-5/5
PLAN SHEETS (SEPARATE)	1-3/3
STANDARD SHEET	G-16

STATE OF VERMONT
TIMOTHY J. RUGGLES
NO. 6149
REGISTERED PROFESSIONAL ENGINEER

4580 MEMORIAL DRIVE,
ST. JOHNSBURY, VT 05819
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RUGGLES ENGINEERING SERVICES INC.

Analysis Sheet

Date: 7/22/15
By:
Project: MIDDLESEX BRF 024-1(37) 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

- DECK: $27' \times 1' \times 0.67' \times 150 \text{ lb/ft}^3 \div 5 = 0.54 \text{ K/FT}$
- BEAMS: $245 \text{ lb/ft} \times 1.1$ (DIAPHRAGMS) $= 0.27 \text{ K/FT}$
- GUARDRAIL: $2 \times 200 \text{ lb/ft} \div 5 = 0.08 \text{ K/FT}$

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

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

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RUGGLES ENGINEERING SERVICES INC.

Analysis Sheet

Date: 7/22/15
By:
Project: MIDDLESEX BRF 024-1 (37) Sheet 2 of 5
TEMPORARY BRIDGE

B) LIVE LOADS:

LANE LOAD = 1164.9 (HS-20) x 1.25 (HS-25) = 1456.1 K/FT / LANE
(AASHTO APP. A)

WHEEL LOAD = 1/2 LANE LOAD = 728.1 K/FT

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

USE D.F. = 1.0

$M_{LL} = 728.1 \times 1.24 \times 1.0 = 902.8$ K-FT
(I) (D.F.)

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

D) $S_{x\,(REQ'D)} = \frac{M_{max}}{F_b} = \frac{1615\ K\text{-}FT \times 12''/FT}{24\ K/IN^2}$

= 807.5 IN³/FT

E) W 36x245 HAS S_x = 895 IN³/FT > 807.5 IN³/FT ∴ OK✓

2) CALCULATE END REACTIONS:

LL = LANE END REACTION = 63.6 (HS-20) x 1.25 (HS-25) x 2 LANES = 159K
(AASHTO APP. A)

DL = 0.89 K/FT (LD/FT OF BEAM) x 80' x 5 BEAMS ÷ 2 = 178K

TOTAL END REACTION = 337K
(EACH END)

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Analysis Sheet

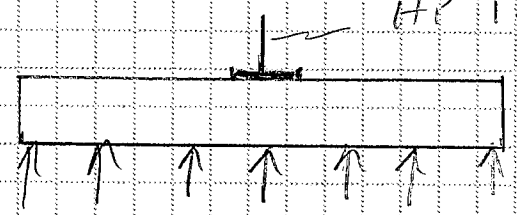
Date: 07/22/15
By:
Project: MIDDLESEX BRF 024-1 (37) TEMPORARY BRIDGE

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 K/FT^2
- USE STRUCTURAL FILL UNDER PRECAST SO 2.5 K/FT^2 IS REASONABLE.

4) CHECK PRECAST DECK PANEL FOR USE AS ABUTMENT:

HP 12 TO DISTRIBUTE LOADS



5' WIDE x 12" THICK

w = 2.5 K/ft

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" OC. E.W.

— SEE SHEET 5 —

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RUGGLES ENGINEERING SERVICES INC.

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'_c (psi)	Rebar allowable load f_s (psi)
2.5	5	12	3	7	0.875	3,000	24,000

Formulas used:

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

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

Calculate:

$WT_{/ft}$=	150	lb/ft	Weight per foot of slab
M_{DL}=	0.47	k-ft	Dead Load Moment
M_{LL}=	7.81	k-ft	Live Load Moment
M_T=	8.28	k-ft =	99360 lb-in (to make units work)
d =	8.56	in	
n=	9.289		
f_c =	1350	lb/in^2	
r =	17.778		
k =	0.343		
j =	0.886		
$A_{s(req'd)}$ =	**0.55**	in^2	

bars req'd/ft. = 0.91 (minimum required to provide $A_{s(req'd)}$)
Required spacing = 13 1/4 inches (maximum spacing allowed)

Use:
bars = 1
Actual Spacing = 12 inches
$A_{s(provided)}$ = **0.60** O.K.

$M_{T(allowable)}$= 109435 lb-in
9.12 k-ft

Shrinkage and temperature steel percentage required (.0018bh)
Distribution steel As(req'd) = 0.26 in^2

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

bars/ft = 1
Actual Spacing = 12 inches
$A_{s(provided)}$ = **0.31** O.K.

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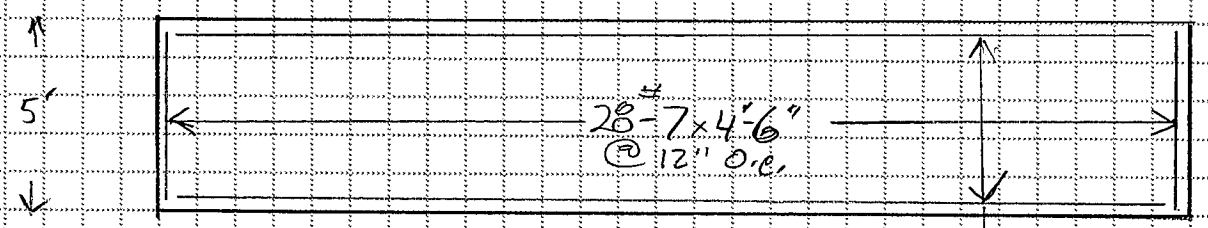
RUGGLES ENGINEERING SERVICES INC.

Analysis Sheet

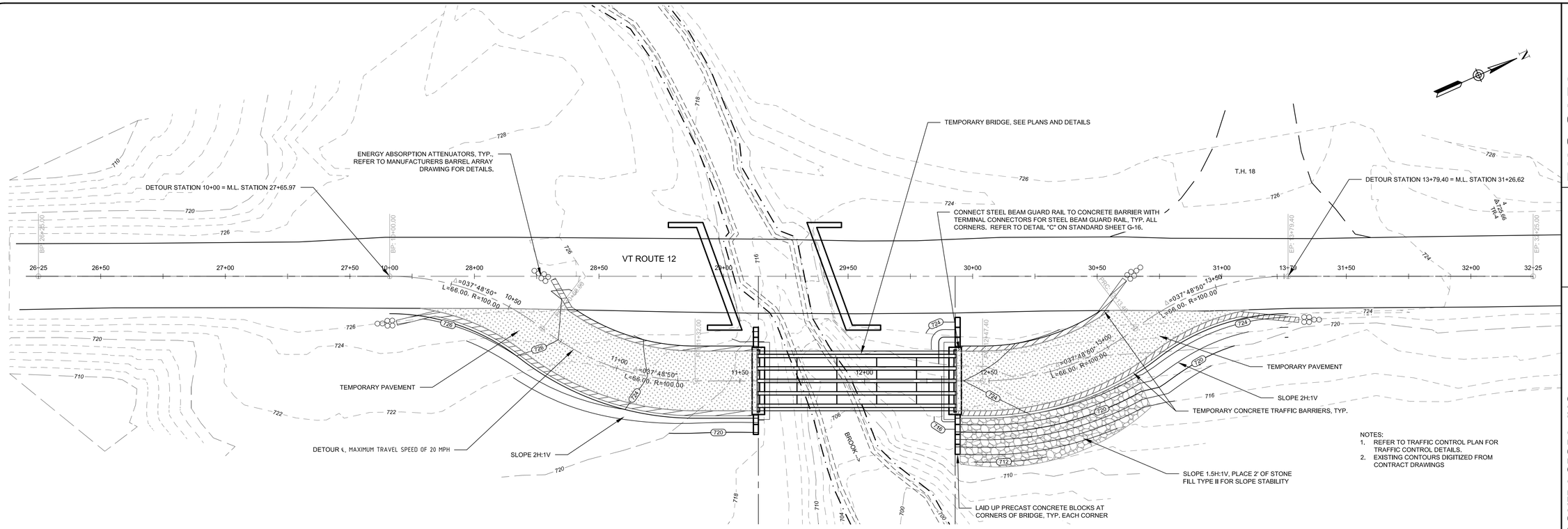
Date: 07/22/15
By:
Project: MIDDLESEX BRF 024-1(37) TEMPORARY BRIDGE

4) CONT'D. - FOOTING DESIGN



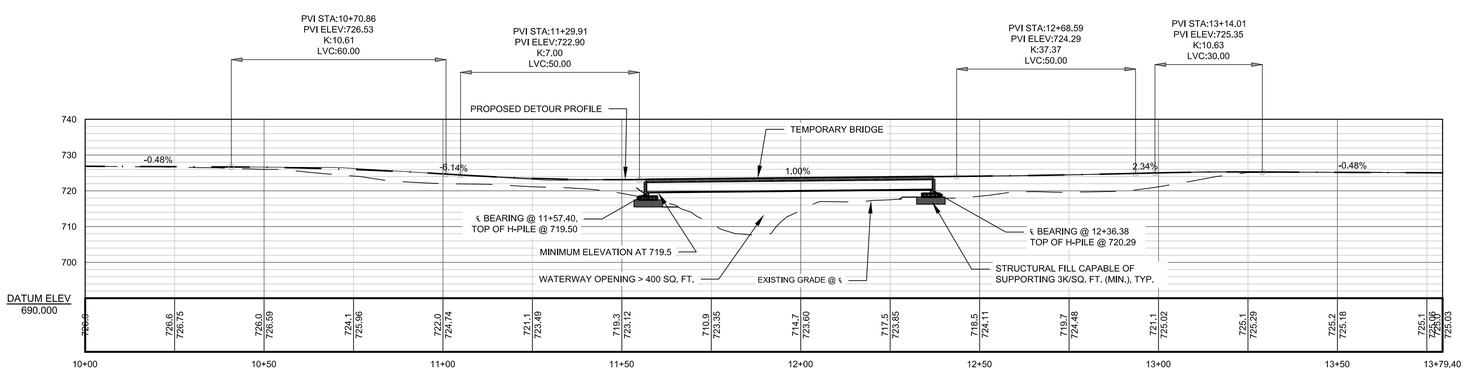
6-#5 x 26'-6"

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

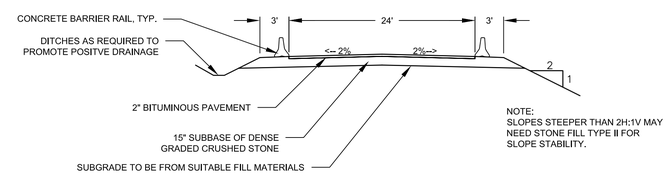


NOTES:
1. REFER TO TRAFFIC CONTROL PLAN FOR TRAFFIC CONTROL DETAILS.
2. EXISTING CONTOURS DIGITIZED FROM CONTRACT DRAWINGS

DETOUR LAYOUT PLAN
1" = 20'



DETOUR PROFILE
1" = 20'



NOTE:
SLOPES STEEPER THAN 2H:1V MAY NEED STONE FILL TYPE II FOR SLOPE STABILITY.

DETOUR TYPICAL SECTION
N.T.S.

RUGGLES ENGINEERING SERVICES, INC.
4580 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.
Address P.O. BOX 65 MONTGOMERY, VT 05470

DETOUR PLAN AND PROFILE
MIDDLESEX BRF O24-1(37)

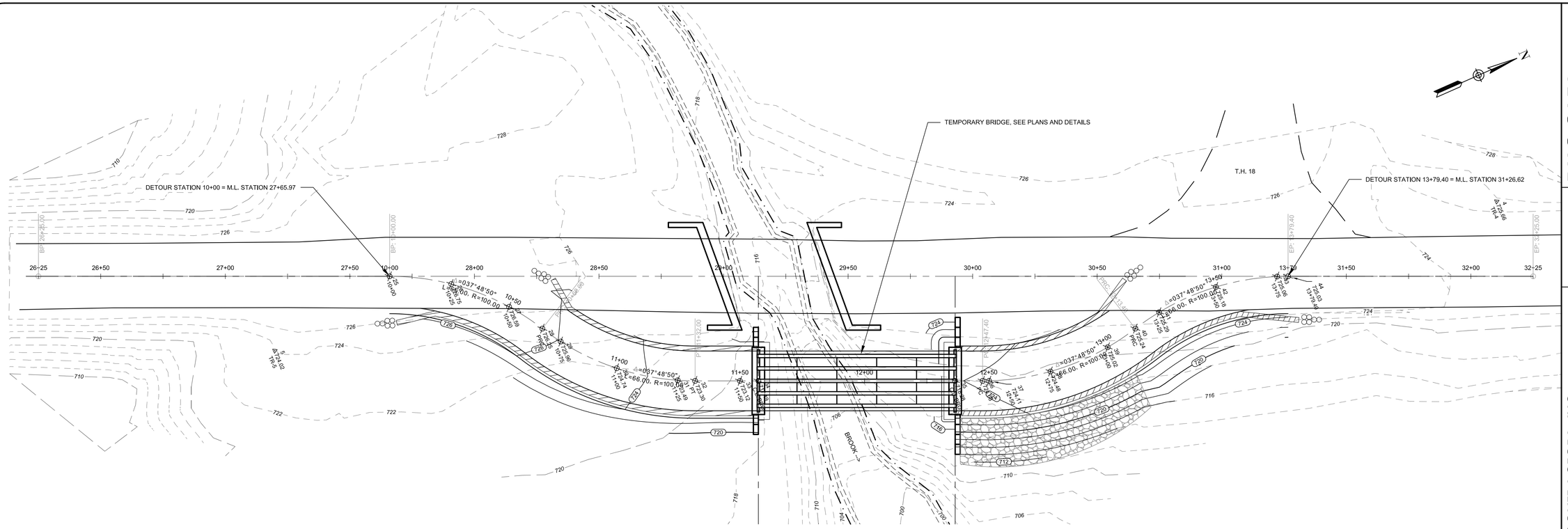
REVISIONS

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

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

DTR 1

Sheet of



DETOUR LAYOUT PLAN
1" = 20'
0 20' 40'

Point Table				
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 Table				
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

RUGGLES
ENGINEERING SERVICES, INC.
4580 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.
Address P.O. BOX 65 MONTGOMERY, VT 05470

DETOUR LAYOUT PLAN
MIDDLESEX BRF 024-1(37)

REVISIONS

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

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

DTR 2

Sheet of

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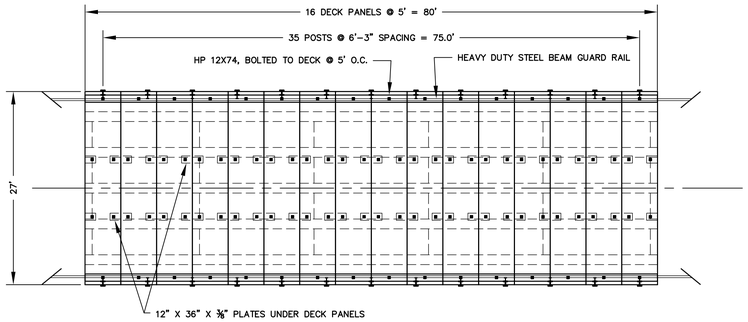
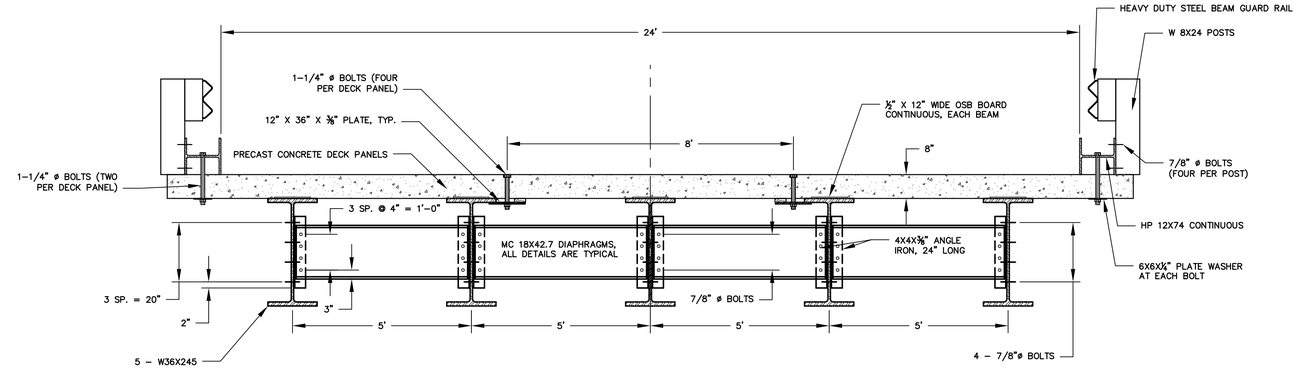


BRIDGE DECK PLAN
1" = 10'

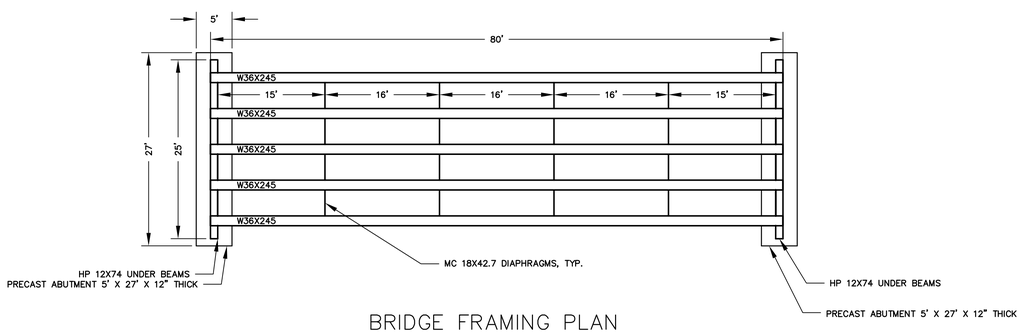


TYPICAL BRIDGE SECTION
1" = 2'

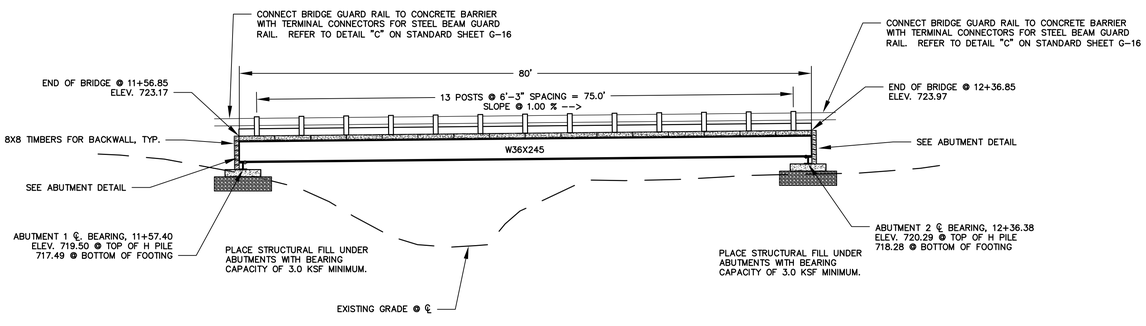
0 2' 4'

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.

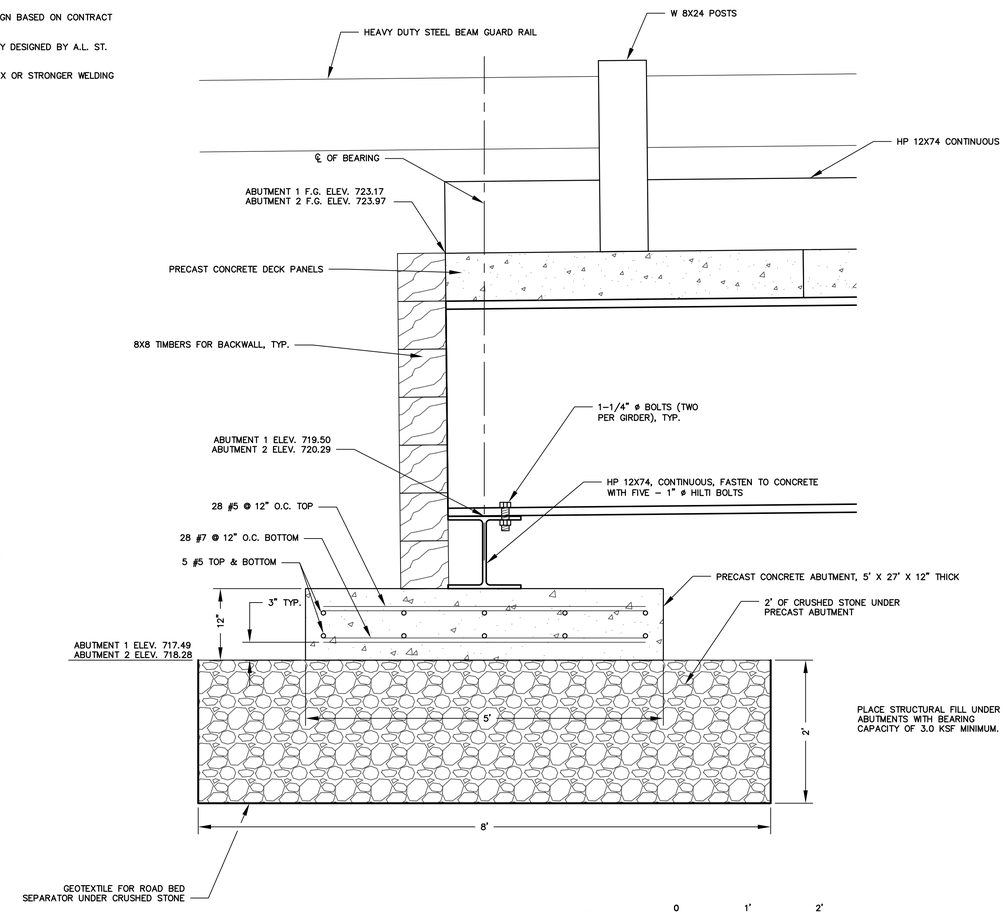


BRIDGE FRAMING PLAN
1" = 10'



BRIDGE ELEVATION
1" = 10'

0 10' 20'



DETAIL @ ABUTMENTS
1" = 1'

0 1' 2'

RUGGLES ENGINEERING SERVICES, INC.
4580 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.**
Address P.O. BOX 65 MONTGOMERY, VT 05470

TEMPORARY BRIDGE PLAN AND DETAILS
MIDDLESEX BRF 024-1(37)

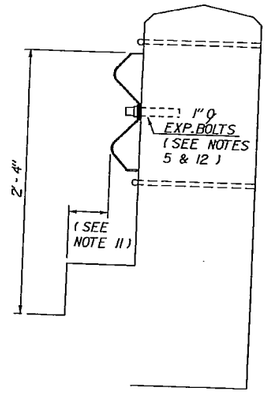
REVISIONS

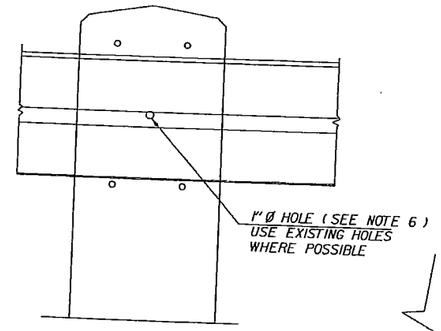
No.	Description	Date
1	REVISED FOOTING	07/22/15
-	-	-
-	-	-
-	-	-

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

BR 1
Sheet of

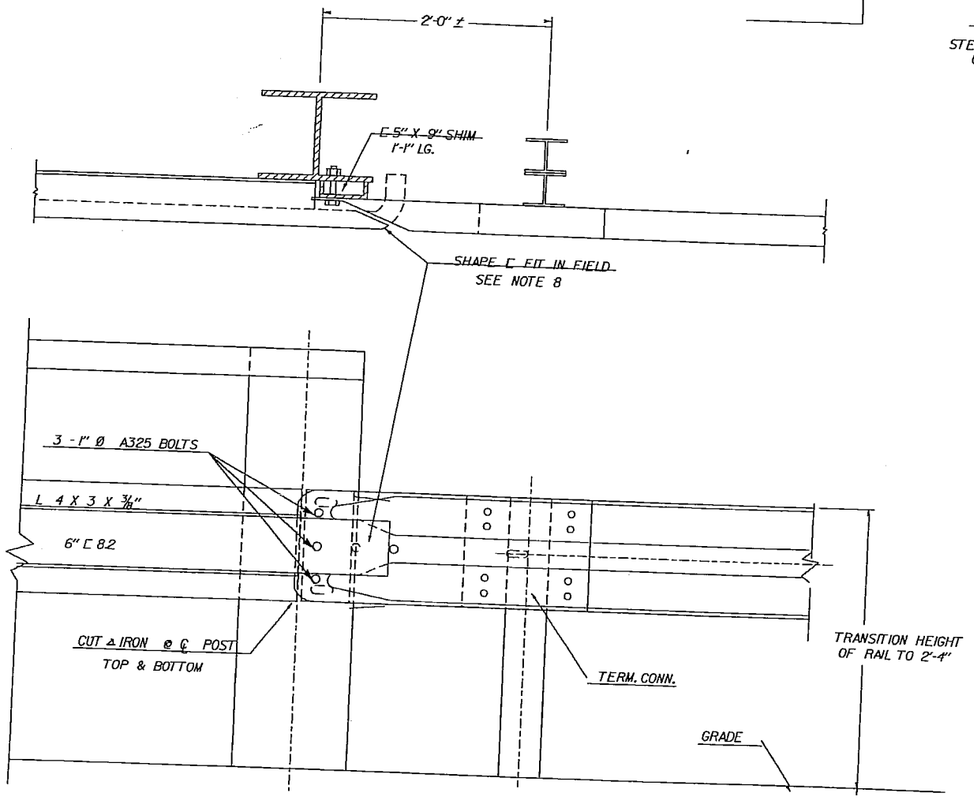
C:\Users\Tim\Documents\RES Projects\2015\15030 - A.L. St. Onge - Middlesex BRF 024-1(37)\Middlesex-Bridge
Plans-80 - sep-Mon - 2015/07/13





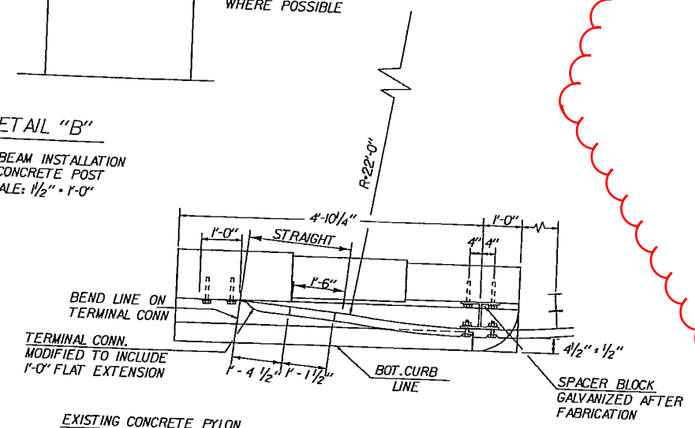
DETAIL "B"

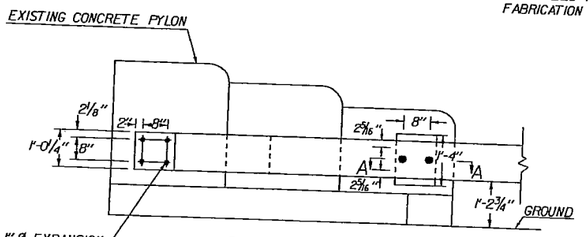
STEEL BEAM INSTALLATION
ON CONCRETE POST
SCALE: 1½" = 1'-0"



DETAIL "D"

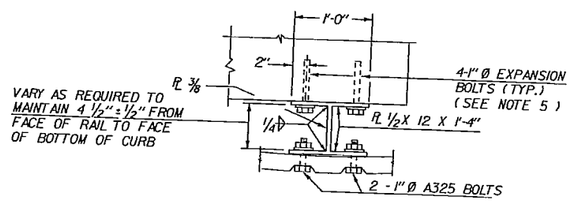
TERMINAL CONNECTION TO
STEEL TRUSS RAIL
SCALE: 1½" = 1'-0"





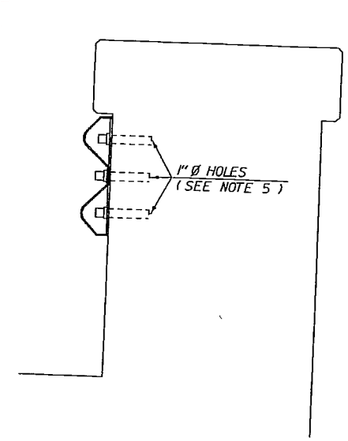
DETAIL "A"

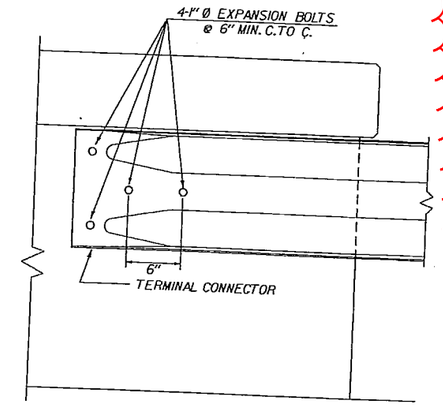
BLOCKED-OUT STEEL BEAM CONNECTION
ON CONCRETE PYLON WITH CURB
SCALE: ½" = 1'-0"



SECTION A-A

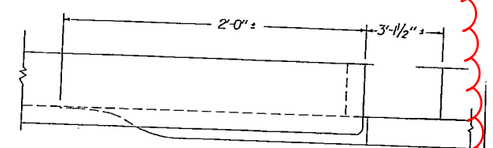
SPACER BLOCK DETAIL
SCALE: 1" = 1'-0"





DETAIL "C"

TERMINAL CONNECTION
TO SOLID RAIL
SCALE: 1½" = 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-111. 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' - 1½" 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 4½" ± ½" CURB TO RAIL OFFSET.
12. THE POST MAY BE DRILLED THROUGH AND THE RAIL FASTENED WITH ONE ⅝" Ø GALVANIZED BOLT. A 6" SQUARE GALVANIZED WASHER (1¼" THICK) SHALL BE INSTALLED ON THE BACK SIDE OF THE POST.

REVISIONS AND CORRECTIONS

9, 1977 - ORIGINAL APPROVAL DATE
, 1978 - CONSTRUCTION DETAILS REVISED
6, 1980 - TITLE BLOCK REVISED
1994 - REISSUED, WITHOUT CHANGE, UNDER NEW SIGNATURES.

APPROVED

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

Gordon R. MacArthur P.E.
DIRECTOR OF ENGINEERING

John M. Murphy, PE
DESIGN ENGINEER

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

VERMONT AGENCY OF TRANSPORTATION

STANDARD
G-16