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RUGGLES ENGINEERING SERVICES INC.

HYDE PARK
STP CULV(26

TEMPORARY BRIDGE
CRITICAL DESIGN CALCULATIONS
April 18, 2014

Previously performed for

MIDDLESEX
BRF 0241 (32)
APRIL 1, 2009

PREPARED FOR:

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

ANALYSIS SHEETS	1-6/6
PLAN SHEETS (SEPARATE)	1-3/3
STANDARD SHEET	G-16

Timothy J. Ruggles PE

Digitally signed by Timothy J. Ruggles PE
DN: cn=Timothy J. Ruggles PE, o=Ruggles Engineering Services, ou, email=RES@myfairpoint.net, c=US
Date: 2014.04.18 09:05:10 -04'00'

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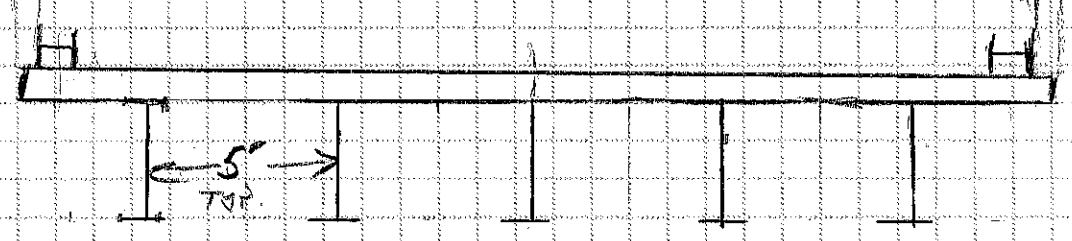
RUGGLES ENGINEERING SERVICES INC.

Analysis Sheet

Date: 04/01/09
By: TJR
Project: A.L. ST. ONGE - MIDDLESEX - TEMP. BRIDGE Sheet 1 of 6

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

1) END SPANS @ 70', USED W 33X 201 GIRDERS (5)
   - $S_x = 684 \text{ in}^3$
2) MIDDLE SPAN @ 80', USED W 36X 245 GIRDERS (5)
   - $S_x = 895 \text{ in}^3$
3) DECK TO BE 27' PRECAST CONCRETE, 8" THICK + 3" PAVEMENT - USE 0.83' THICK (PREVIOUSLY DESIGNED AND BUILT)
4) BRIDGE TO BE 24' RAIL TO RAIL
5) PIERS TO BE PILE BENTS, FROM HP 14X73



BEAMS @ 5' O.C.

ANALYZE BEAMS FOR WORTCASE, ONE WHEEL LOAD DIRECTLY OVER ON BEAM

DEAD LOAD DISTRIBUTED OVER 5 BEAMS

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Analysis Sheet

Date: 04/01/09
By: T.R
Project: A.L ST. ONGE – MIDDLESEX TEMP. BRIDGE Sheet 2 of 6

1) END SPANS: (70' LONG)

A) DEAD LOADS (ALL PER GIRDER)

- DECK: 27' × 1' × .83' × 150 lb/ft³ ÷ 5 = 0.67 K/FT
- BEAMS 201 lb/FT × 1.1 (DIAPHRAMS ETC = 0.22 K/FT
- GUARD RAIL 2 × 200 lb/FT ÷ 5 = 0.08 K/FT

TOTAL DL = 0.97 K/FT

So $M_{DC} = \frac{wl^2}{8} = \frac{(0.97) \times (70)^2}{8} = 594$ K-FT.

B) LIVE LOAD

4928

(AASHTO APP A) LANE LOAD = 985.6 (HS-20) × 1.25 TO HS25 = 1232 K-FT

So 1/2 LANE LOAD ON GIRDER = 616 K-FT

$I = \frac{50}{L+125} = \frac{50}{70+125} = 0.26$

DIST FACTOR $= \frac{S}{5.5} = \frac{5}{5.5} = 0.91$ = (D.F)

So $M_{LL} = 616 \times 1.26 \times 0.91 = 706.3$ K-FT
(I) (DF)

C) $M_{TOTAL} = \underset{M_{DC}}{594.0} + \underset{M_{LL}}{706.3} = 1300.3$ K-FT

D) $S_{x(REQD)} = \frac{M_{MAX}}{F_b} = \frac{1300.3 \times 12 \text{ IN/FT}}{24 \text{ K/IN}^2} = 650.1 \text{ IN}^3$

E) S_x W 33×201 = 684 IN³ > 650.1 IN³ ∴ O.K.

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Analysis Sheet

Date: 04/01/09
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Project:

2) MIDDLE SPAN: (80' LONG)

A) DEAD LOADS (ALL PER GIRDER (SAME AS ENDS)

- DECK 0.67 K/FT
- BEAMS 0.22 K/FT
- GUARDRAIL 0.08 K/FT

TOTAL 0.97 K/FT

SO $M_{DL} = \frac{0.97 \times (80)^2}{8} = 776$ K-FT

B) LIVE LOAD:

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

SO 1/2 LANE LOAD = 728.1 K-FT

USE I = 0.26 ; DF = 0.91

SO $M_{LL} = 728.1 \times 1.26 \times 0.91 = 834.8$

C) $M_{TOTAL} = \underset{M_{DL}}{776} + \underset{M_{LL}}{834.8} = 1610.8$ K-FT

D) $S_{x\,REQ'D} = \frac{M_{max}}{F_b} = \frac{1610.8 \text{ K-FT} \times 12 \text{ IN/FT}}{24 \text{ K/IN}^2} = 805.4 \text{ IN}^3$

E) W 36×201 $S_x = 895 \text{ IN}^3 > 805.4 \text{ IN}^3$ ∴ OK

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Analysis Sheet

Date: 04/01/09
By: T.R
Project:

3) CALCULATE END REACTIONS:

A) END SPANS: 70'

AASHTO APP A - REACTION = 62.4 X 1.25/LANE X 2 LANE = 156 K

D.L. = 0.971 K/FT X 70' X 5 BEAMS / 2 = 170 K

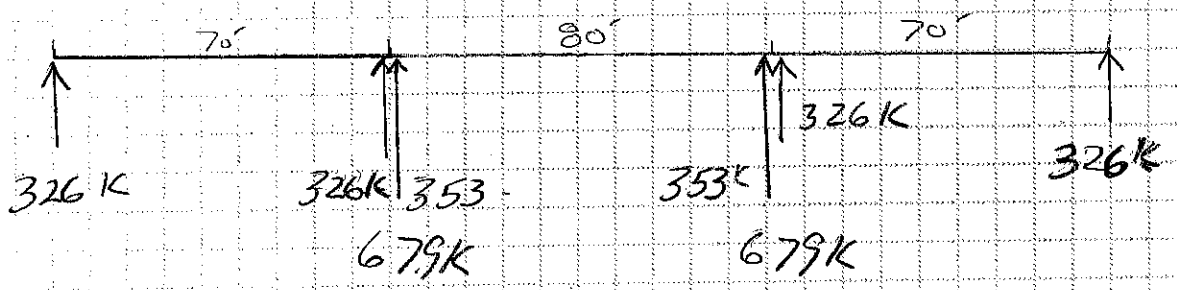
326 K EACH END

B) MID SPAN = 80'

AASHTO APP. A - REACTION = 63.6 X 1.25/LANE X 2 LANE = 159 K

D.L. = 0.97 K/FT X 80' X 5 BEAMS / 2 = 194 K

353 K EACH END.



SO PILE BENTS MUST SUPPORT 679 K

ABUTMENTS MUST SUPPORT 326 K

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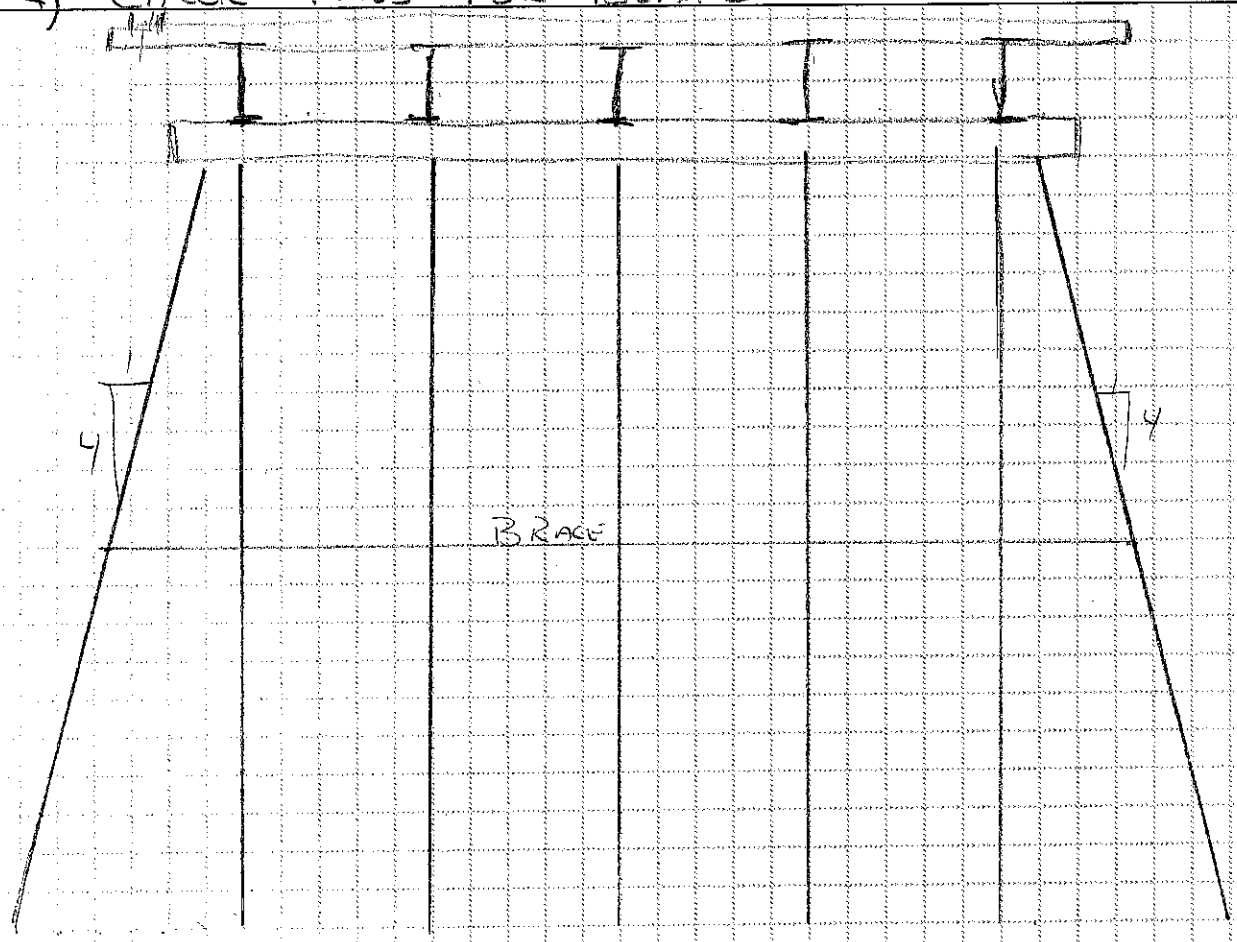
RUGGLES ENGINEERING SERVICES INC.

Analysis Sheet

Date: 04/01/09
By: T.R
Project:

4) CHECK PILES FOR BENTS



PLACE PILES DIRECTLY BELOW GIRDERS
SAY LOAD IS DISTRIBUTED OVER 5 PILES

∴ $LOAD_{/PILE}$ = 679 K/5 = 135.8 K - SAY 150 K

SAY EACH COLUMN ≈ 25' LONG SO

USE $K = 1.2$ $r = 3.49$ $A_c = 21.4\ in^2$ $C_c = 126.1$
$\ell = 300''$
$K\ell/r = 103.2$ $F_a = \dfrac{[1-(K\ell/r)^2/2C_c^2]F_y}{FS}$ (103.2, 126.1, 36 K, FS 1.91)

$F_a = 12.54\ K/in^2$

SO ALLOWABLE LOAD = 21.4 x 12.54 = 268.3 K > 150 K ∴ OK

04/01/09
T.R

5/A/6

Column Load Calculator

Steel Member: HP14x73

As	21.4	Area of steel column
L	25	Length of member in feet
l	300	Length of member in inches
K	1.2	Effective Length factor
r	3.49	Least radius of gyration
Cc	126.1	For A36 Steel
Fy	36000	Yield Stress, psi
Kl/r	103.2	Slenderness Ratio
$(Kl/r)^2$	10650.24	
$(Kl/r)^3$	1099104.768	
F.S.	1.91	Factor of Safety
Fa	12536	Axial Compression stress (psi)

Allowable Load	268270	pounds
Allowable Load	268.3	kips

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Analysis Sheet

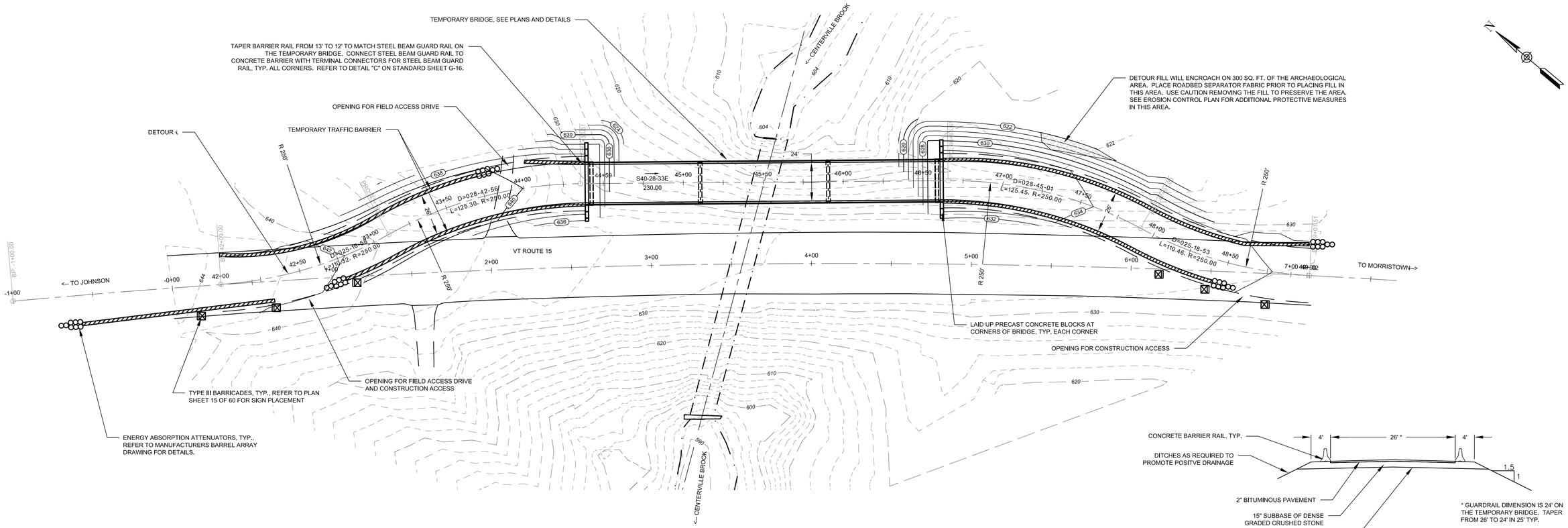
Date: 04/01/09
By: T.R
Project:

5) CHECK ABUTMENT END LOAD CONDITIONS

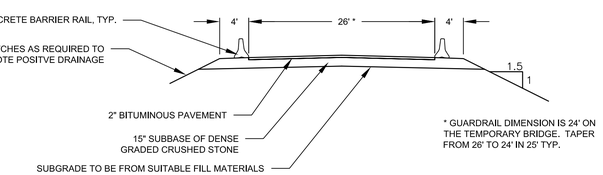
- LOAD ON ABUTMENT ENDS = 326 K
- USE A 5' x 27' x 8" THICK PRECAST DECK SECTION UNDER THE GIRDERS
- TOTAL AREA = 5 x 27 = 135 SQ FT
- LOAD = $\frac{326\,K}{135\,FT^2}$ = 2.4 K/FT² SAY 2.5 K/FT²
- USING STRUCTURAL FILL, SO 2.5 K/FT² IS REASONABLE FOR TEMPORARY USE.
- USE 2.5 K/FT² SURCHARGE LOAD WHEN DESIGNING SHEETING FOR ABUTMENTS.

6) NOTE:
PRECAST BRIDGE DECK PANELS HAVE BEEN DESIGNED PREVIOUSLY BY OTHERS, AND HAVE BEEN USED SUCCESSFULLY ON OTHER PROJECTS
– NO ANALYSIS PERFORMED –

7) NOTE THE H-PILE GUARDRAIL CONFIGURATION HAS BEEN DESIGNED PREVIOUSLY BY OTHERS, AND HAS BEEN USED SUCCESSFULLY ON OTHER PROJECTS
– NO ANALYSIS PERFORMED –

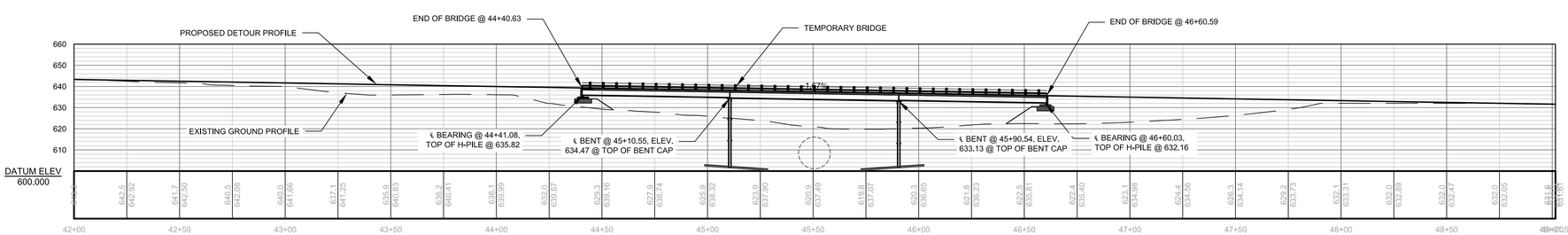


DETOUR LAYOUT PLAN
1" = 30'
0 30' 60'



DETOUR TYPICAL SECTION
1" = 10'
0 10' 20'

NOTES:
1. REFER TO CONTRACT PLAN SHEET 15 OF 60 FOR ADDITIONAL TRAFFIC CONTROL DETAILS.
2. EXISTING CONTOURS DIGITIZED FROM CONTRACT DRAWINGS

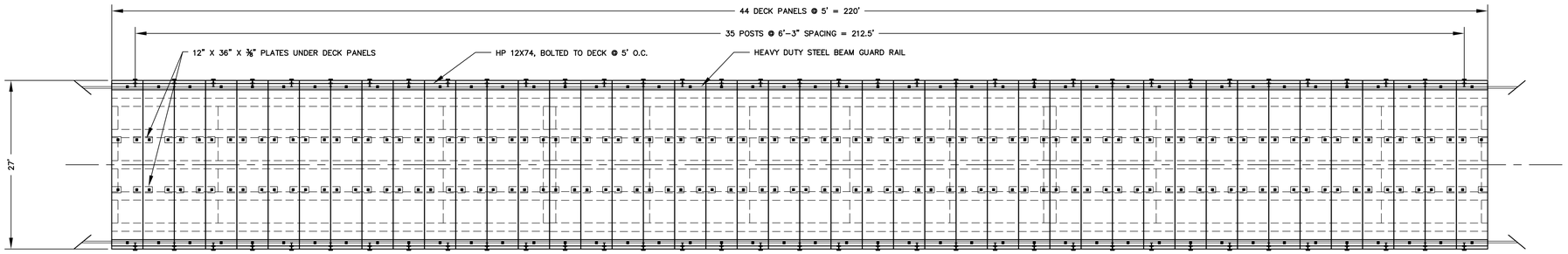


DETOUR PROFILE
1" = 30'
0 30' 60'

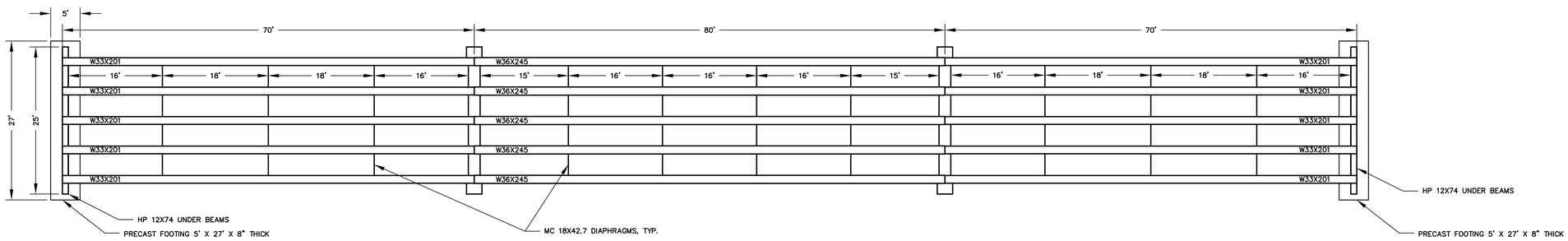
RUGGLES ENGINEERING SERVICES, INC.
1667 SHADOW LAKE ROAD, GLOVER, VT 05839
Civil Engineering-Site Development
Septic System Design-Soils Analysis
802-525-9130

TEMPORARY DETOUR
A.L. ST. ONGE CONTRACTOR, INC.
HYDE PARK STP CULV(26)
HYDE PARK, VERMONT

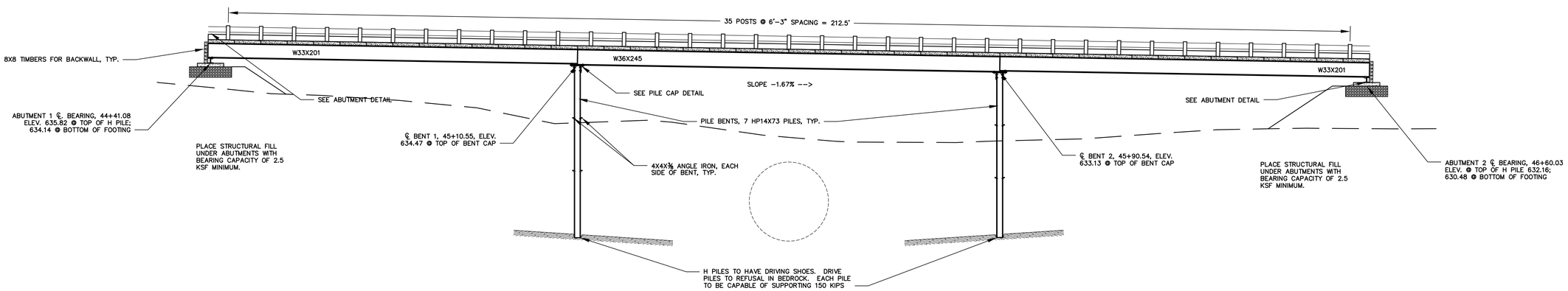
DRAWN BY: T.R.	DATE: 04/17/2014
CHECKED BY:	DRAWING NO.: DETOUR PLAN
JOB NO.: 14011	SHEET 1 OF 3



BRIDGE DECK PLAN
1" = 10'



BRIDGE FRAMING PLAN
1" = 10'



BRIDGE ELEVATION
1" = 10'

0 10' 20'

RUGGLES
ENGINEERING SERVICES, INC.
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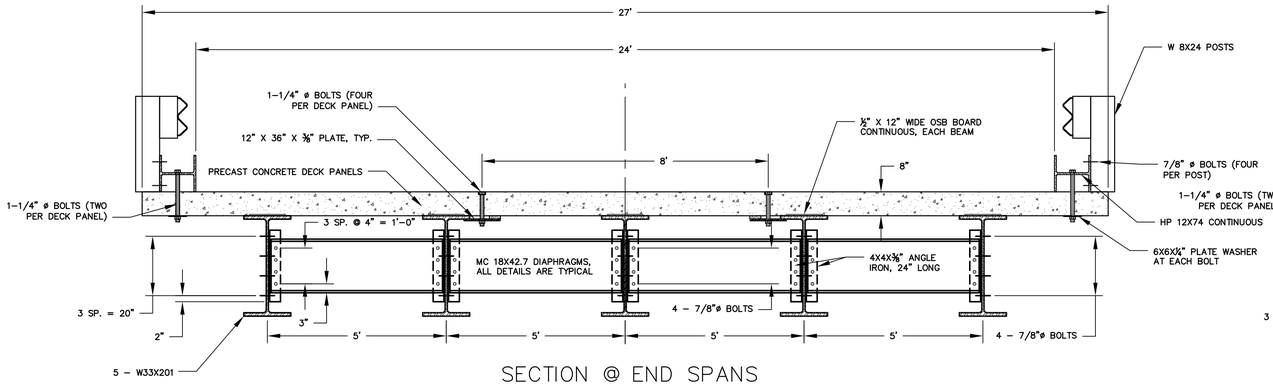
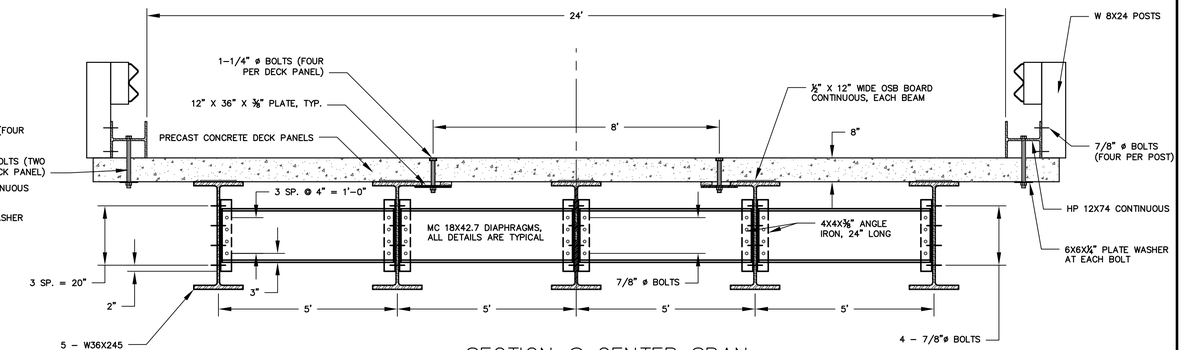
TEMPORARY BRIDGE
A.L. ST. ONGE CONTRACTOR, INC.
HYDE PARK STP CULV(26)
HYDE PARK, VERMONT

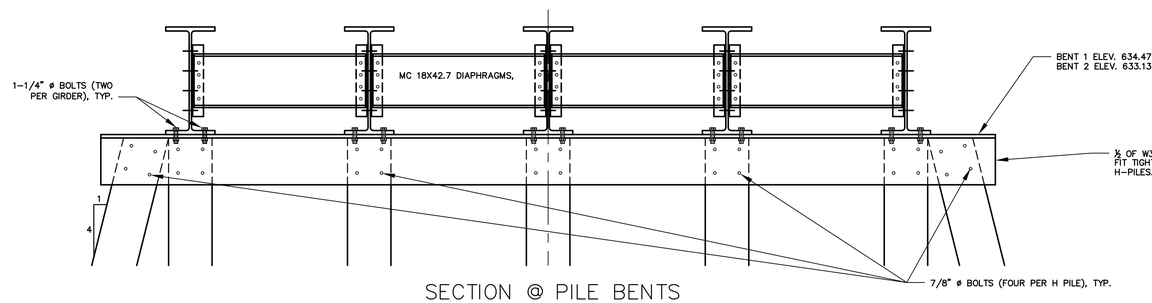
DRAWN BY: T.R.	DATE: 04/17/2014
CHECKED BY:	DRAWING NO.: BRIDGE PLAN
JOB NO.: 14011	SHEET 2 OF 3



SECTION @ END SPANS
1" = 2'



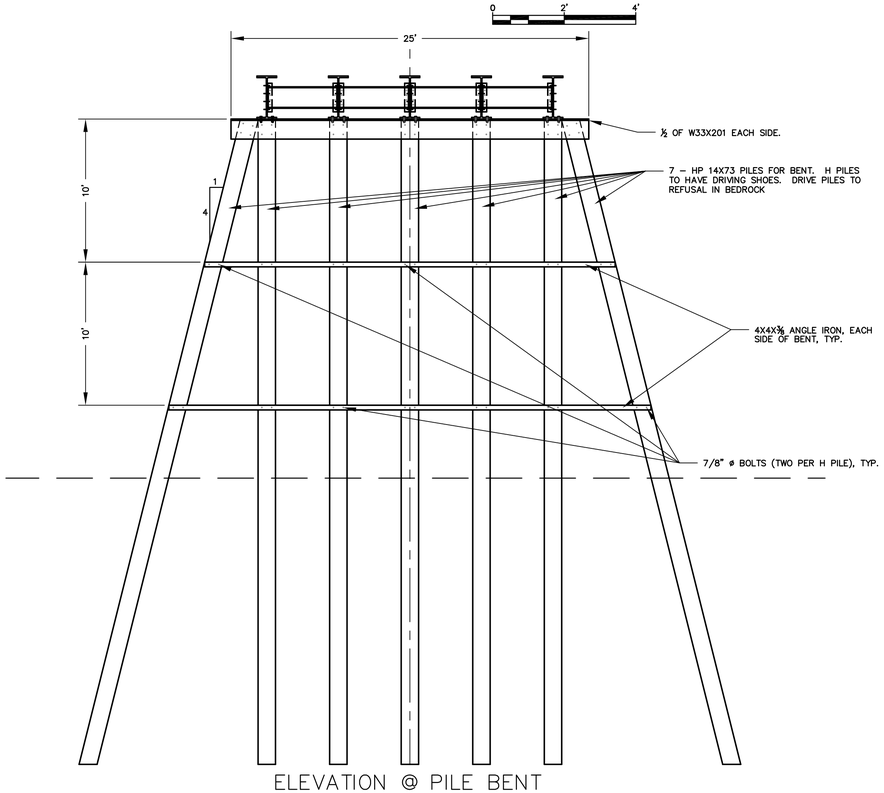
SECTION @ CENTER SPAN
1" = 2'



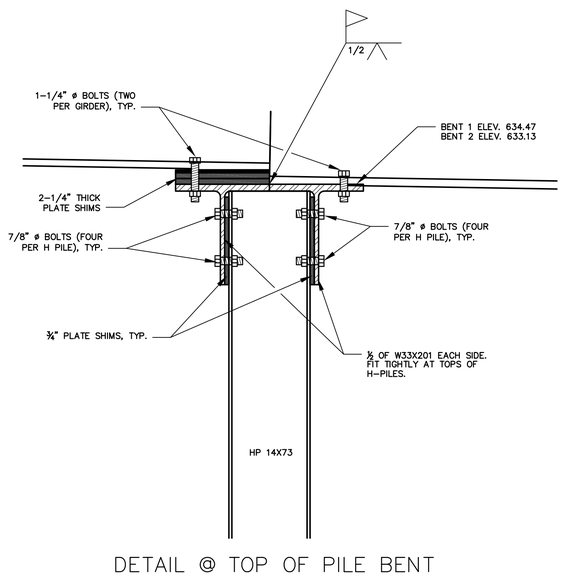
SECTION @ PILE BENTS
1" = 2'

NOTES:

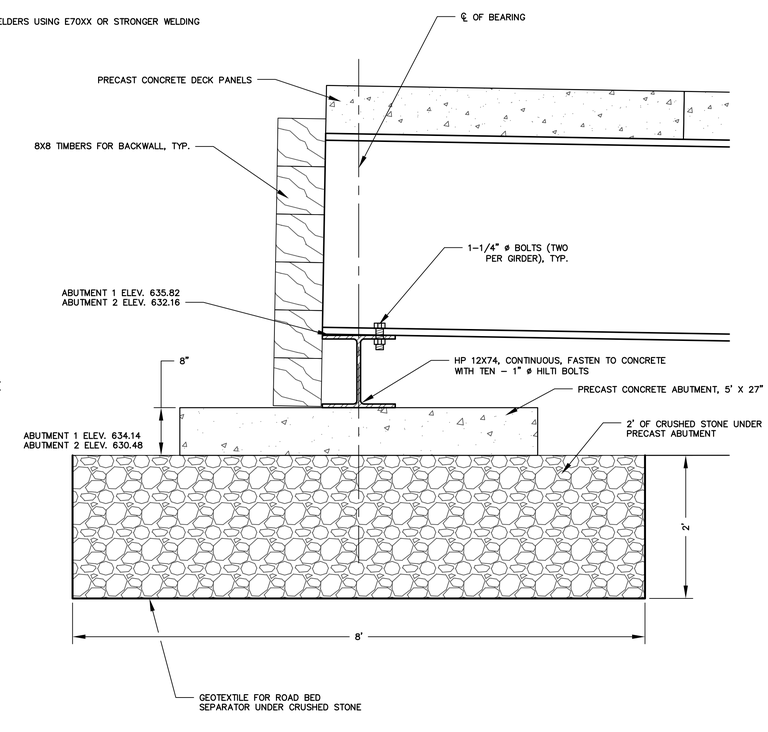
1. ALL BEAMS ARE TO BE IN GOOD CONDITION WITH A MINIMUM YIELD STRENGTH OF 36 KSI.
2. STEEL FOR BRACING SHALL BE NEW OR IN LIKE NEW CONDITION AND ASTM A36 OR STRONGER.
3. BOLTS AND NUTS FOR CONNECTIONS SHALL BE H.S. A-325 WITH ALL HOLES DRILLED. ALL BOLTED CONNECTIONS TO HAVE A FLAT WASHER ON EACH END.
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.



ELEVATION @ PILE BENT
1" = 5'



DETAIL @ TOP OF PILE BENT
1" = 1'



DETAIL @ ABUTMENTS
1" = 1'

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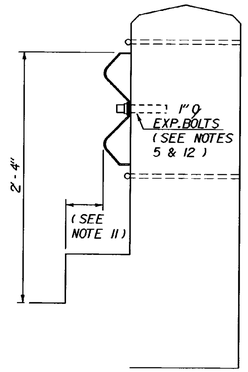
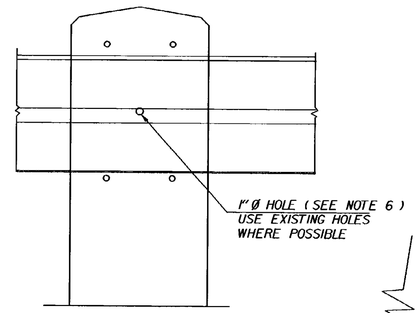
TEMPORARY BRIDGE
A.L. ST. ONGE CONTRACTOR, INC.
HYDE PARK STP CULV(26)
HYDE PARK, VERMONT

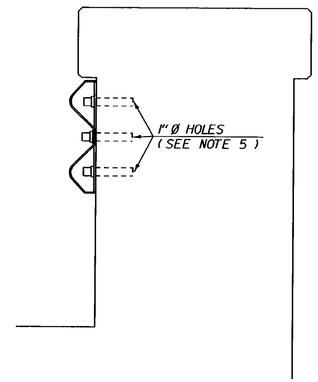
DRAWN BY: T.R.	DATE: 04/17/2014
CHECKED BY:	DRAWING NO.: SECT/DETAIL
JOB NO.: 14011	SHEET 3 OF 3

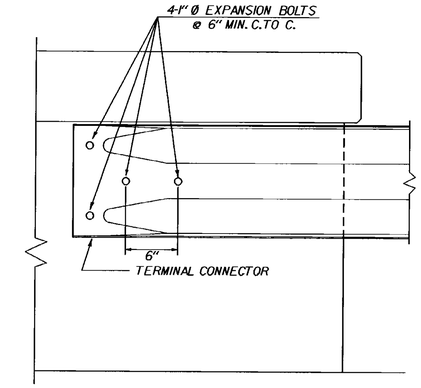




DETAIL "B"

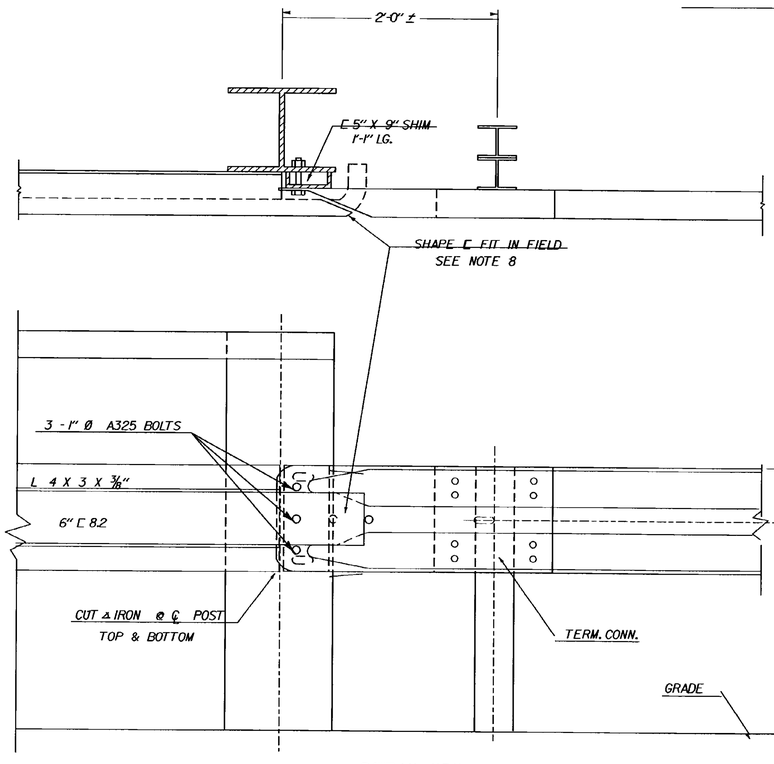
STEEL BEAM INSTALLATION
ON CONCRETE POST
SCALE: 1½" = 1'-0"





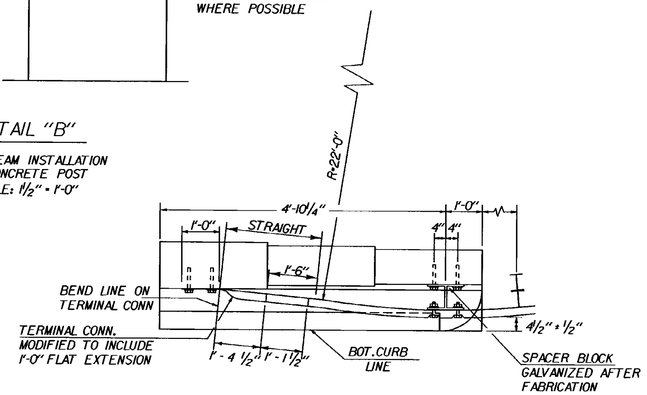
DETAIL "C"

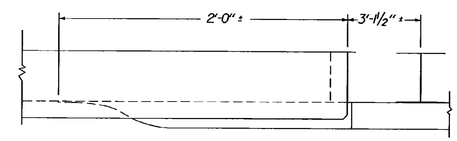
TERMINAL CONNECTION
TO SOLID RAIL
SCALE: 1½" = 1'-0"

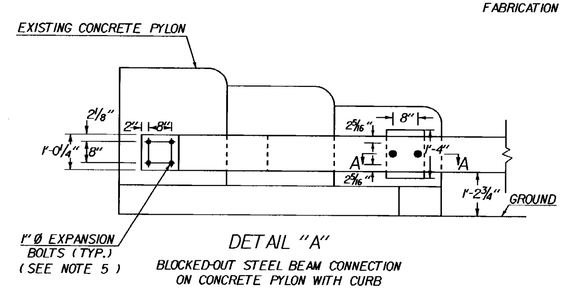


DETAIL "D"

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

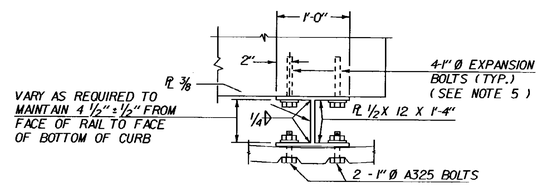






DETAIL "A"

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



SECTION A-A

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

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 (¼" THICK) SHALL BE INSTALLED ON THE BACK SIDE OF THE POST.

REVISIONS AND CORRECTIONS

NOV. 29, 1977 - ORIGINAL APPROVAL DATE
FEB. 15, 1978 - CONSTRUCTION DETAILS REVISED
NOV. 25, 1980 - TITLE BLOCK REVISED
JUNE 1, 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

Robert M. Maughan, P.E.
DESIGN ENGINEER

STEEL BEAM GUARD RAIL ATTACHMENTS TO EXISTING BRIDGE

TERMINAL CONNECTOR FOR STEEL BEAM GUARD RAIL

VERMONT AGENCY OF TRANSPORTATION

STANDARD

G-16