

PLAN VIEW
1" = 20'

General Notes

General:

- Existing conditions are taken from Contract Drawings.
- All dimensions relative to existing elements are to be field checked prior to fabrication and installation of proposed elements.
- Control datums are those from the Contract Documents.
- Design is based on conditions shown in the Contract Documents. Should conditions encountered in the field vary from those indicated conditions, the design may be invalid and revisions should be investigated.

		
No.	Revision/Issue	Date

Firm Name and Address
TAW Associates
 Waterville Valley, NH
 603-236-4247 www.TAWAssociates.net

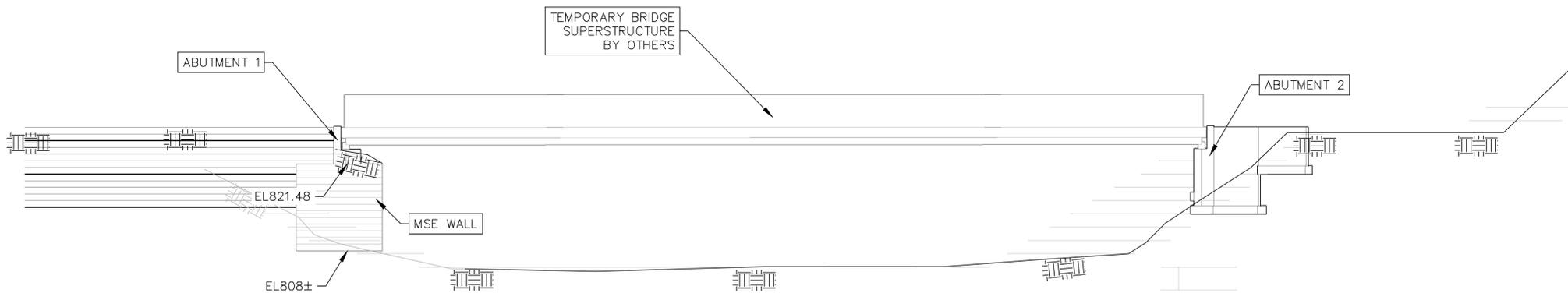
Proposed Improvement Bridge
 Project Bridge No. 13, 15, 16 &
 19 - Rochester, VT
 Vtrans ER BR 0162(19),
 (16), (17) & (18)

Project Name and Address
**Temporary Bridge
 Substructure**

GENERAL PLAN

Project 140401A	Sheet 01
Date March 31, 2014	Scale noted

SCHULTZ CONSTRUCTION, INC.



- Fill:**
- Granular Fill shall consist of stones, rock fragments, and fine, hard durable particles resulting from the natural disintegration of rock.
 - The material shall be free from injurious amounts of organic matter.
 - Not more than 15% of the material passing the No. 4 sieve shall pass the No. 200 sieve and the material shall conform to the following gradations unless otherwise noted:

Sieve Size	% by Weight
3 inch	100
No. 4	70 - 100
 - Structural Fill shall consist of crushed gravel and shall meet the following specifications unless otherwise noted:

Sieve Size	% by Weight
3 inch	100
2 inch	95 - 100
1 inch	55 - 85
No. 4	27 - 52
No. 200	0 - 12 (based on the % passing the No.4)

- Footings:**
- All footings shall be carried down to undisturbed material having a minimum bearing capacity of 3 tons per square foot.
 - Bottom of footing elevations given are minimum depths, and are not to be construed as limiting the excavation required to reach good bearing soil.
 - Footing and slab subgrades shall not be allowed to freeze. In the event that frost penetration does occur, all frozen soils shall be removed and replaced with compacted structural fill.

General Notes

Temporary Bridge Abutments:

- This work shall consist of the design, construction, maintenance, and removal of temporary bridge substructures.
- The Contractor may use any material or combination of materials that will conform to the requirements of Spec Subsection 528.02 and meet the approval of the Engineer.
- The Engineer reserves the right to reject materials and details that are structurally unsafe for the use proposed.
- Any welded connection performed in the absence of and without the approval of the Agency's Welding Inspector will not be approved.
- Fill placed in or adjacent to the stream shall be clean granular or rock material meeting the requirements of Subsection 703.04 or 703.05 and protected with sufficient stone to prevent erosion to a Q 10 headwater elevation (based on the new structure).
- Any fill placed in the stream to protect the temporary bridge and approaches shall be removed to the satisfaction of the Engineer upon completion of the project.
- Design is based on soil characteristics:
 - $\gamma_{soil\ exist} = 110\text{pcf}$
 - $\gamma_{soil\ fill} = 140\text{pcf}$
 - $\phi_{fill} = 38^\circ$
 - $s_{brg} = 3\text{tsf} = 6000\text{psf}$
- Design is based on superstructure per document titled "ACROW 700 XS BRIDGE FOR SHULTZ CONSTRUCTION, INC. BALLSTON SPA, NY FEBRUARY 2014" dated March 12, 2014.

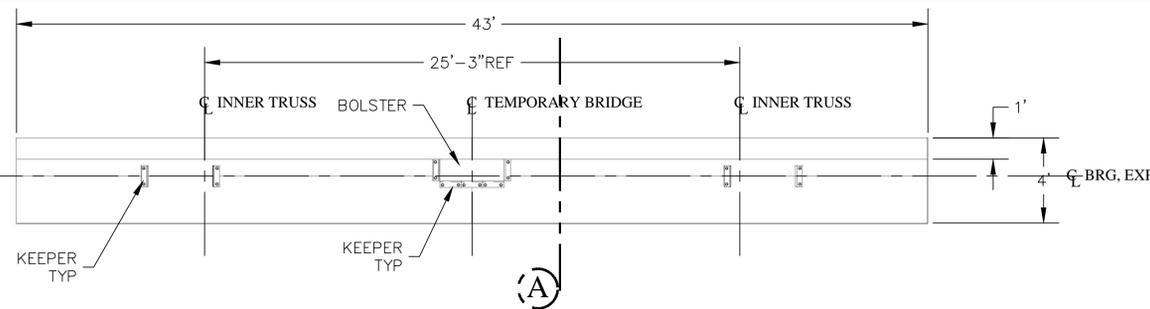
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TAW Associates
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Proposed Improvement Bridge Project Bridge No. 13, 15, 16 & 19 - Rochester, VT
Vtrans ER BR# 0162(19), (16), (17) & (18)

Project Name and Address
Temporary Bridge Substructure
TEMPORARY BRIDGE GENERAL PLAN

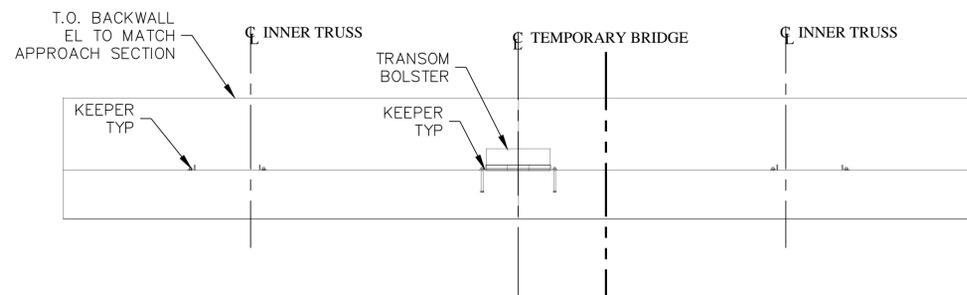
Project 140401A	Sheet 02
Date March 31, 2014	Scale noted

SCHULTZ CONSTRUCTION, INC.



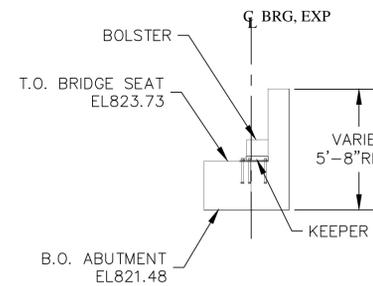
TEMPORARY BRIDGE ABUTMENT 1 PLAN VIEW

1/4" = 1'



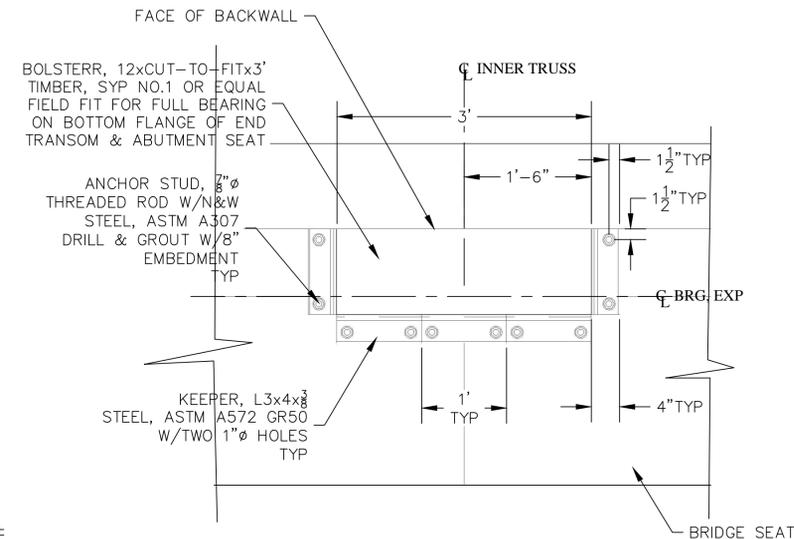
TEMPORARY BRIDGE ABUTMENT 1 ELEVATION

1/4" = 1'



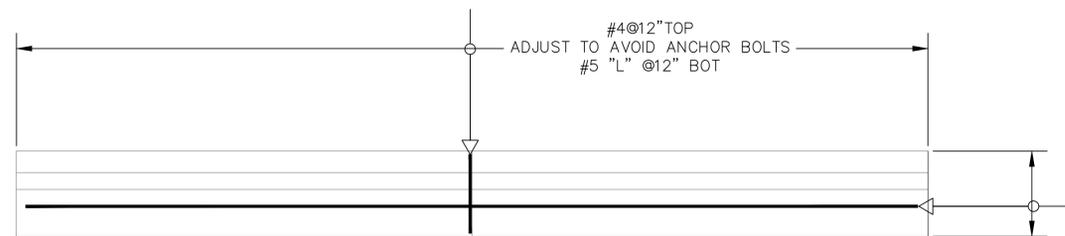
(A) VIEW

1/4" = 1'



BOLSTER VIEW

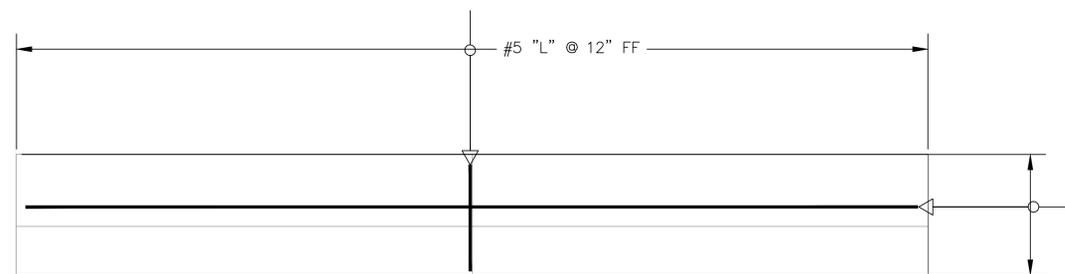
1" = 1'



RESTEEL PLAN VIEW

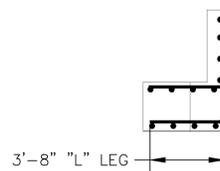
NTS

#4@12" TOP
ADJUST TO AVOID ANCHOR BOLTS
#4@12" BOT



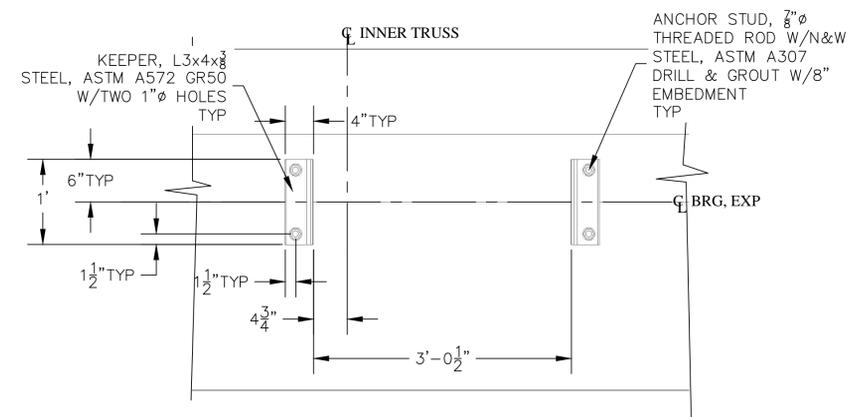
RESTEEL FRONT VIEW

NTS



RESTEEL END VIEW

NTS



TRUSS KEEPER VIEW

1" = 1'

General Notes

Concrete:

1. Portland Cement for concrete shall be in accordance with ASTM C 150, Type I or Type II.
2. Cement used for all concrete shall be of the same type.
3. Aggregates for concrete shall conform to ASTM C33.
4. Concrete shall conform to American Concrete Institute Standard ACI 318.
5. Concrete shall be $f'_c = 3,000$ psi unless otherwise indicated.

Reinforcing Steel:

1. Reinforcing steel shall be in accordance with ASTM A615 Grade 60 or better unless otherwise noted.
2. Fabrication shall be in accordance with American Concrete Institute Standard ACI 318-08.
3. There shall be no welding of reinforcing steel.
4. Placement of reinforcing steel shall be in accordance with the American Concrete Institute Standard ACI 318-08.
5. Splicing of reinforcing steel shall be in accordance with the American Concrete Institute Standard ACI 318-08.
6. Cover on reinforcing steel shall be in accordance with the American Concrete Institute Standard ACI 318-08.
7. Reinforcing Steel is to be bent cold.
8. Reinforcing Steel is to be bent to bend radii no less than 6 bar diameters for #3 through #8 bars, 8 bar diameters for #9 through #11 bars, and 10 bar diameters for #14 and #18 bars.
9. Provide 3" cover for reinforcing steel where cast against the ground, 2" cover against a form, and 2" cover against top unformed surface.

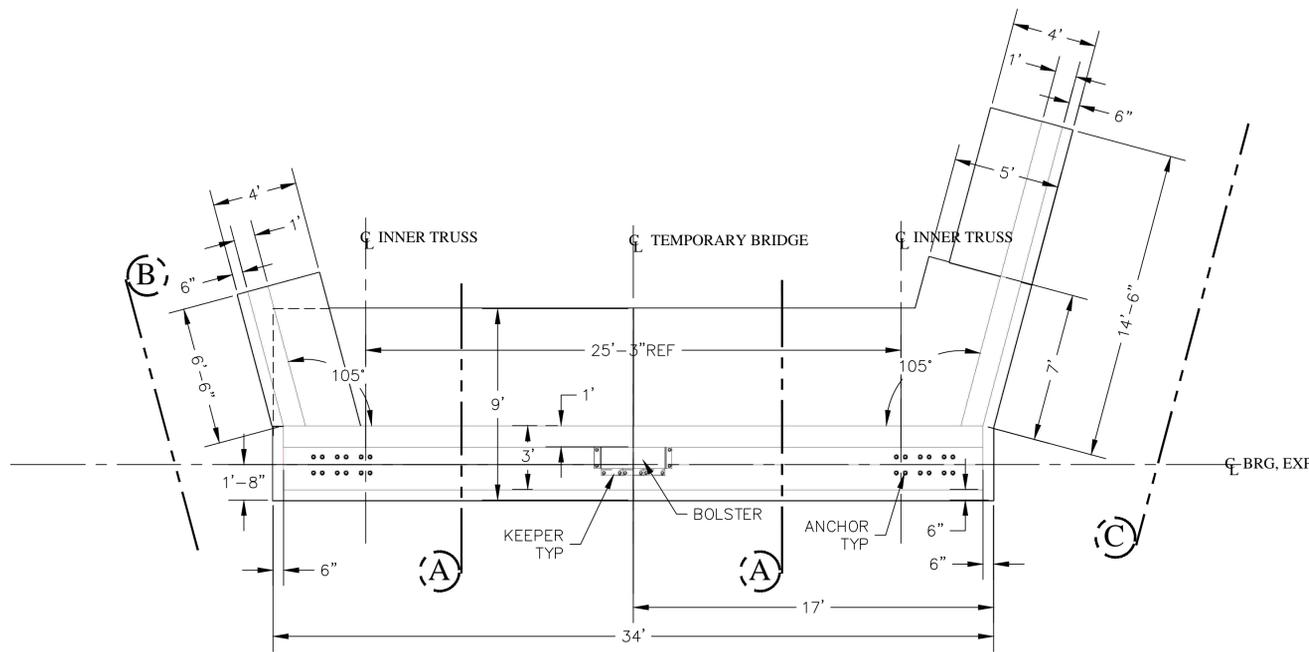
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Vtrans ER BR# 0162(19), (16), (17) & (18)

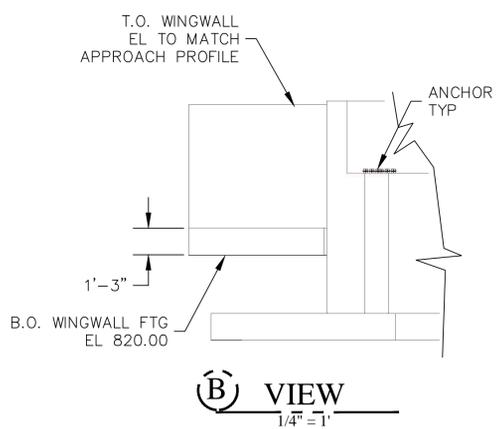
Project Name and Address
Temporary Bridge Substructure
TEMPORARY BRIDGE ABUTMENT 1

Project	140401A	Sheet	03
Date	March 31, 2014	Scale	noted

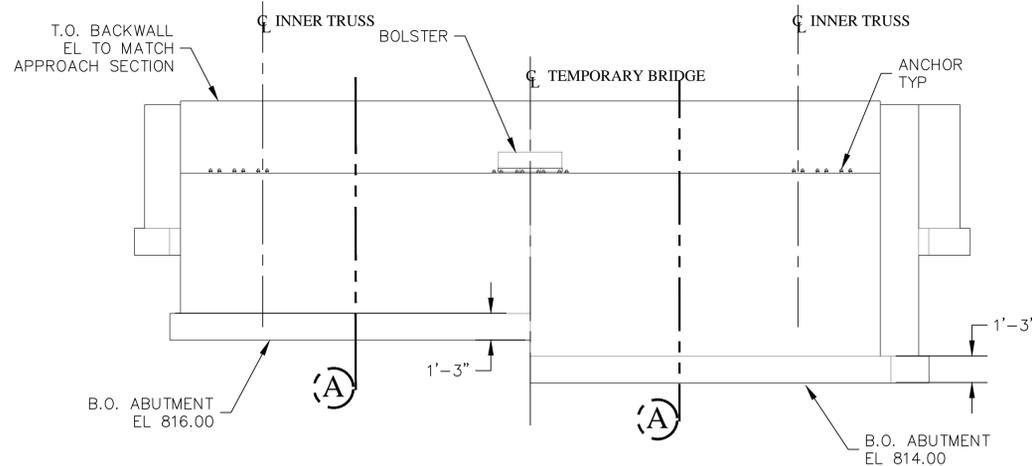
SCHULTZ CONSTRUCTION, INC.



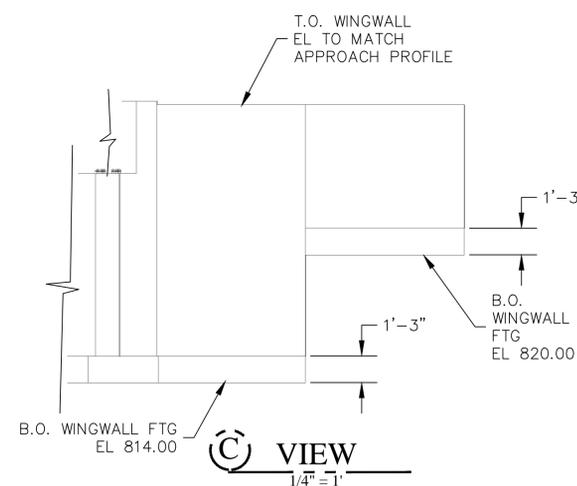
TEMPORARY BRIDGE
ABUTMENT 2 PLAN VIEW
1/4" = 1'



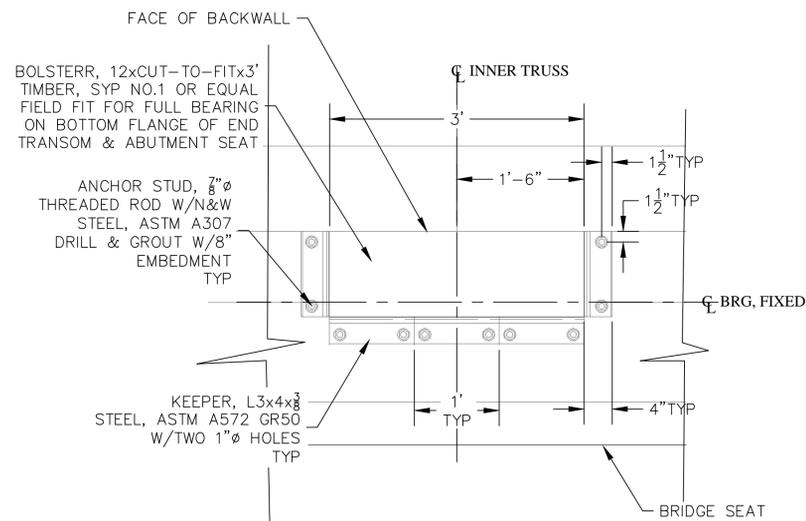
VIEW B
1/4" = 1'



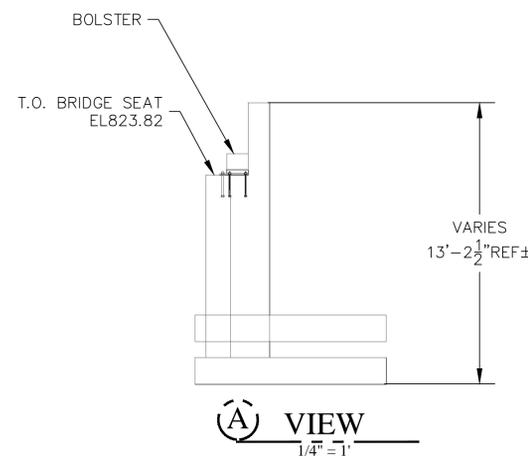
TEMPORARY BRIDGE
ABUTMENT 2 ELEVATION
1/4" = 1'



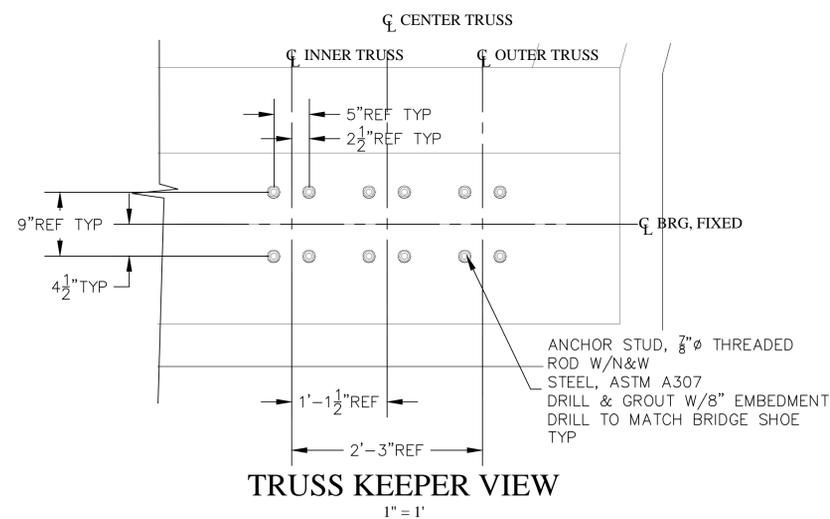
VIEW C
1/4" = 1'



BOLSTER VIEW
1" = 1'



VIEW A
1/4" = 1'



TRUSS KEEPER VIEW
1" = 1'

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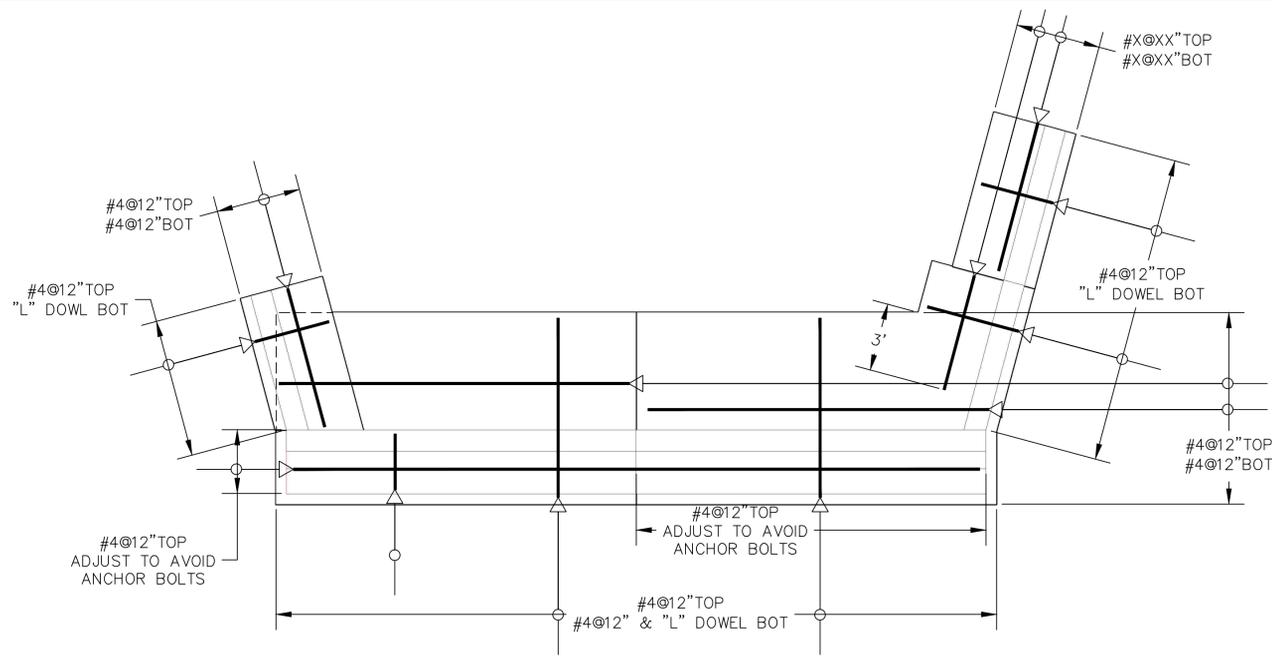
Proposed Improvement Bridge
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Project Name and Address
**Temporary Bridge
 Substructure**

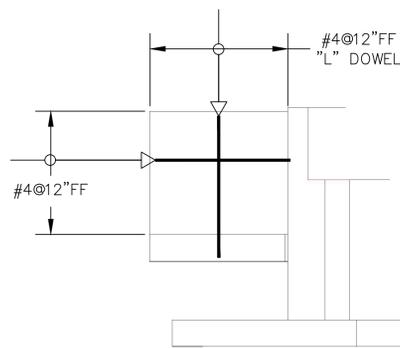
**TEMPORARY BRIDGE
 ABUTMENT 2**

Project 140401A	Sheet 04
Date March 31, 2014	Scale noted

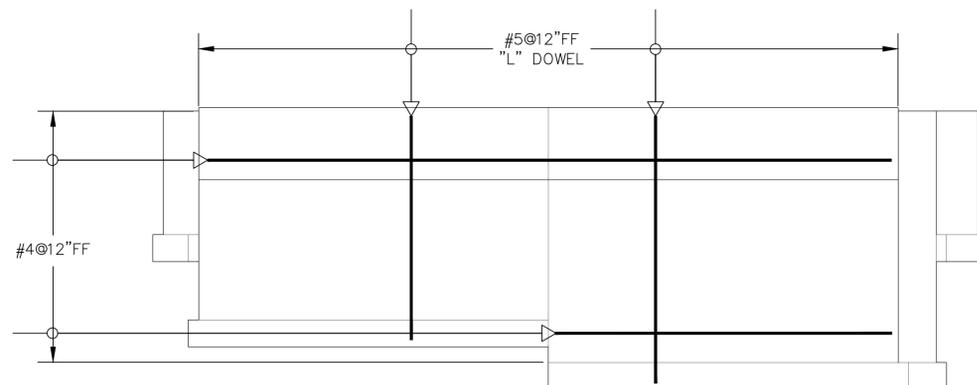
SCHULTZ CONSTRUCTION, INC.



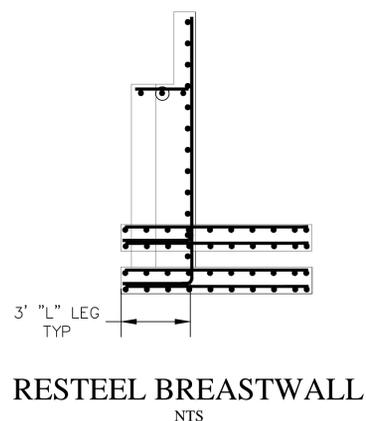
RESTEEL PLAN VIEW
NTS



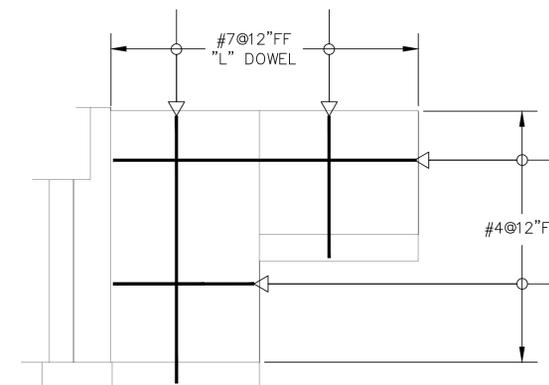
RESTEEL NE WINGWALL
NTS



RESTEEL FRONT VIEW
NTS



RESTEEL BREASTWALL
NTS



RESTEEL SE WINGWALL
NTS

General Notes

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Project Name and Address
Temporary Bridge
Substructure
TEMPORARY BRIDGE
ABUTMENT 2

Project 140401A	Sheet 04
Date March 31, 2014	
Scale noted	

SCHULTZ CONSTRUCTION, INC.

DOCUMENT: 140401A

Engineering Computations

**Temporary Bridge
Abutments**

-

For The Project:

**Proposed Improvement Bridge Project Bridge No. 13, 15, 16 & 19 –
Rochester, VT
Vtrans ER BRF 0162(19), (16), (17) & (18)**

-

for

SCHULTZ CONSTRUCTION, INC.

by

TAW ASSOCIATES



March 31, 2014

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SCOPE

Design the abutments for the Temporary Bridge for the referenced Project.

GENERAL:

General:

1. Existing conditions are taken from Contract Drawings.
2. All dimensions relative to existing elements are to be field checked prior to fabrication and installation of proposed elements.
3. Control datums are those from the Contract Documents.
4. Design is based on conditions shown in the Contract Documents. Should conditions encountered in the field vary from those indicated conditions, the design may be invalid and revisions should be investigated.

Temporary Bridge Abutment Design:

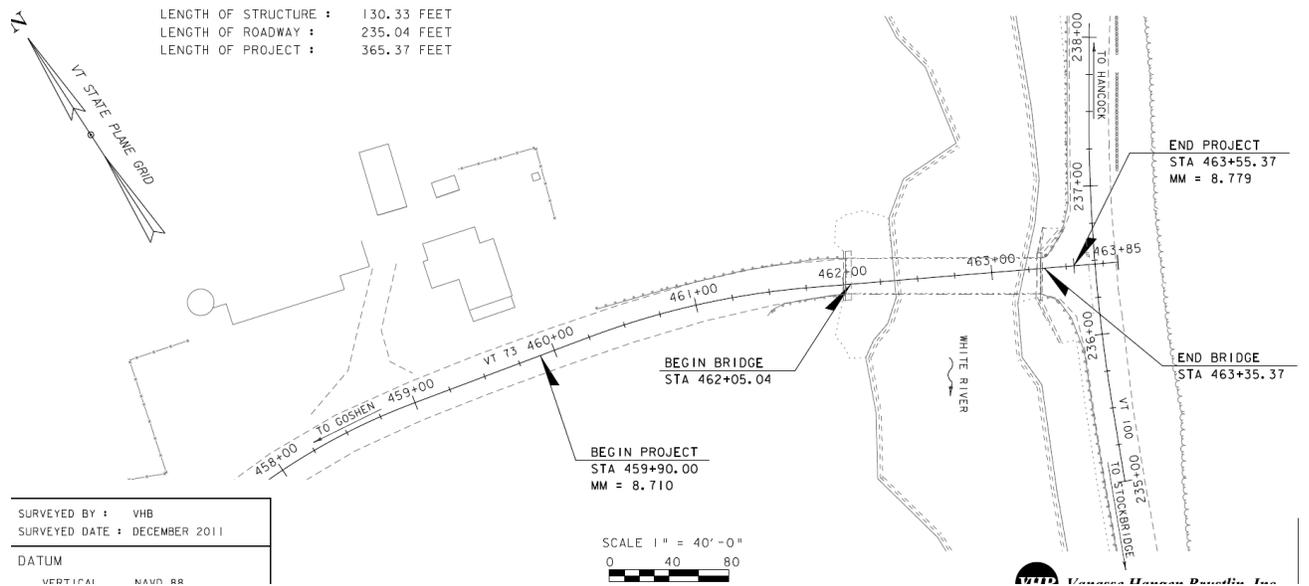
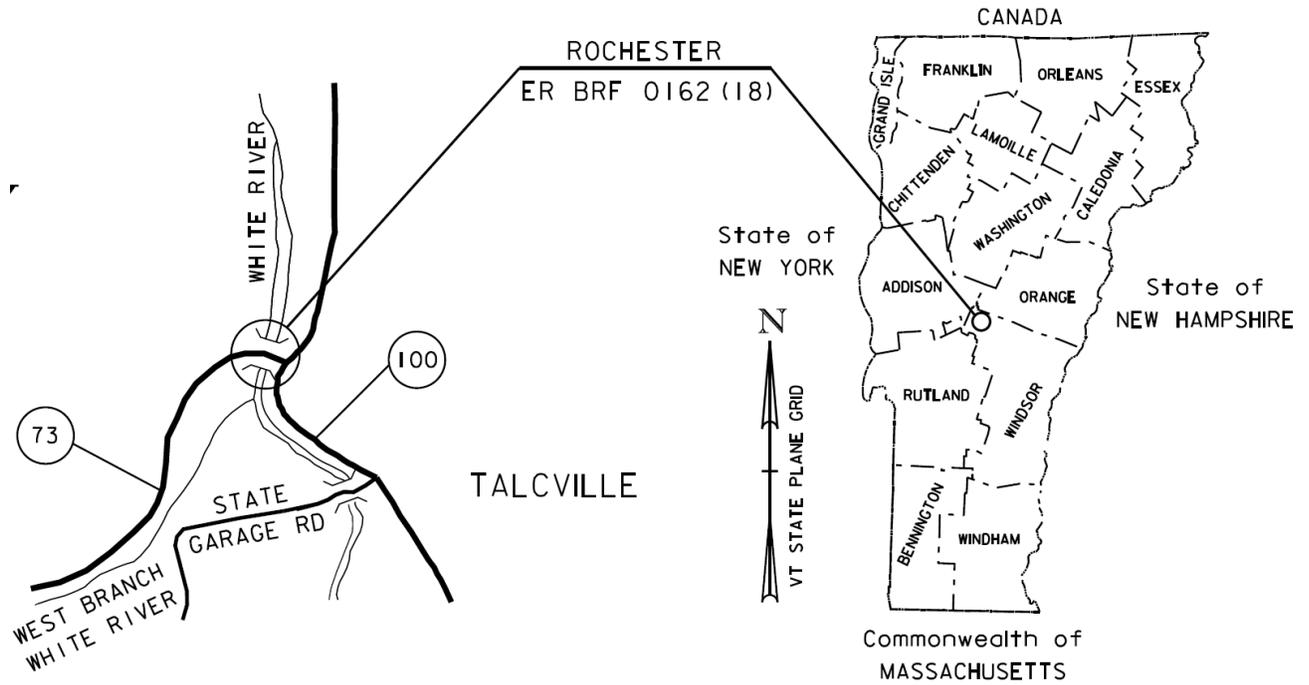
1. This work shall consist of the design, construction, maintenance, and removal of temporary bridge substructures.
2. The Contractor may use any material or combination of materials that will conform to the requirements of Spec Subsection 528.02 and meet the approval of the Engineer.
3. The Engineer reserves the right to reject materials and details that are structurally unsafe for the use proposed.
4. Any welded connection performed in the absence of and without the approval of the Agency's Welding Inspector will not be approved.
5. Any welding must be detailed on the Working Drawings and performed in conformance with Section 506.
6. Working Drawings shall be prepared by the Contractor for the proposed work under this item in accordance with Section 105.
7. Plan, elevation, and section views shall include size and spacing of all members or components for Abutments:
8. The design and structural details of the temporary bridge substructures shall be signed, stamped, and dated by a Professional Engineer (Structural or Civil).
9. When temporary bridge requirements are not shown on the Plans, the opening area shall be at least equal to 40 percent of the waterway provided for the 100-year event (Q 100) for the new structure, with a clear height equal to a ten-year event (Q 10) headwater; this waterway to be adequate for safely conveying a mean annual flood (Q 2.33) at a headwater no greater than what would be created by the existing structure during a ten-year event.
10. Fill placed in or adjacent to the stream shall be clean granular or rock material meeting the requirements of Subsection 703.04 or 703.05 and protected with sufficient stone to prevent erosion to a Q 10 headwater elevation (based on the new structure).
11. Any fill placed in the stream to protect the temporary bridge and approaches shall be removed to the satisfaction of the Engineer upon completion of the project.
12. Questions regarding hydraulic information not furnished shall be addressed to the Engineer.

-
13. Unless otherwise specified, all temporary bridge structures shall be designed for an MS-18 (HS-20) or HL-93 live load, and for all other applicable forces, in accordance with the AASHTO Standard Specifications for Highway Bridges or LRFD Bridge Design Specifications.
 14. Submittal of the computations indicating magnitude of stresses in the segments is not required.

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6. Any fill placed in the stream to protect the temporary bridge and approaches shall be removed to the satisfaction of the Engineer upon completion of the project.
7. Design is based on soil characteristics;
 $\gamma_{\text{soil exist}} = 110\text{pcf}$
 $\gamma_{\text{soil fill}} = 140\text{pcf}$
 $\theta_{\text{fill}} = 38^\circ$
 $S_{\text{brg}} = 3\text{tsf} = 6000\text{psf}$
8. Design is based on superstructure per document titled "ACROW 700 XS BRIDGE FOR SHULTZ CONSTRUCTION, INC. BALLSTON SPA, NY FEBRUARY 2014" dated March 12, 2014.

EXISTING CONDITIONS







LOADING:

Temporary Bridge Superstructure Reaction Loads:

The Temporary Bridge superstructure is a prefabricated steel truss structure by others designed to the following specifications:

The reactions for the Pedestrian Bridge from the supplier are:

ACROW PANEL BRIDGE REACTIONS PER CORNER OF BRIDGE

130 ft. x TSR3
24 ft. Roadway

Design Truck : HS 20-44
Bridge Coating: 2" Asphalt Overlay

REACTION (KIPS):

Bridge Dead Load :	53
Bridge Coating :	20
HS 20-44 (w/ Ecc.) :	73

TOTAL (KIPS) 146

TRANSVERSE (WIND) 30

130ft * (0.45 klf) ÷ 2 SIDES = 29.25 kips

NOTE:

- MAX. REACTIONS GIVEN PER CORNER OF SPAN
- LOADS ARE NOT FACTORED FOR IMPACT
- ECCENTRICITY INCLUDED
- WIND BASED ON AASHTO MIN .450 KLF

$$DL_{\text{superstructure}} = 53k + 53k = \mathbf{106k} \text{ per abutment}$$

$$DL_{\text{coating}} = 20k + 20k = \mathbf{40k} \text{ per abutment}$$

$$LL = 73k + 73k = \mathbf{146k} \text{ per abutment}$$

The WL reactions are:

$$WL_{\text{bridge}} = 30\text{k} + 30\text{k} = 60\text{k}$$

And overturning from wind, the WL_{OT} reactions are:

$$WL_{\text{OT}} = (WL_{\text{bridge}} * \text{Height}/2) / \text{Width} = 60\text{k} \text{ distributed @ } \mathbf{10.2\text{k}}$$
 to the 2 leeward corners

Where:

$$\text{Height} = 8.17'$$

$$\text{Width} = 24.0'$$

Total bearing load of abutment is

$$P_{\text{abutment}} = DL_{\text{superstructure}} + DL_{\text{coating}} + LL + WL_{\text{OT}} = \mathbf{302.2\text{k}}$$
 per abutment

B-102: West End

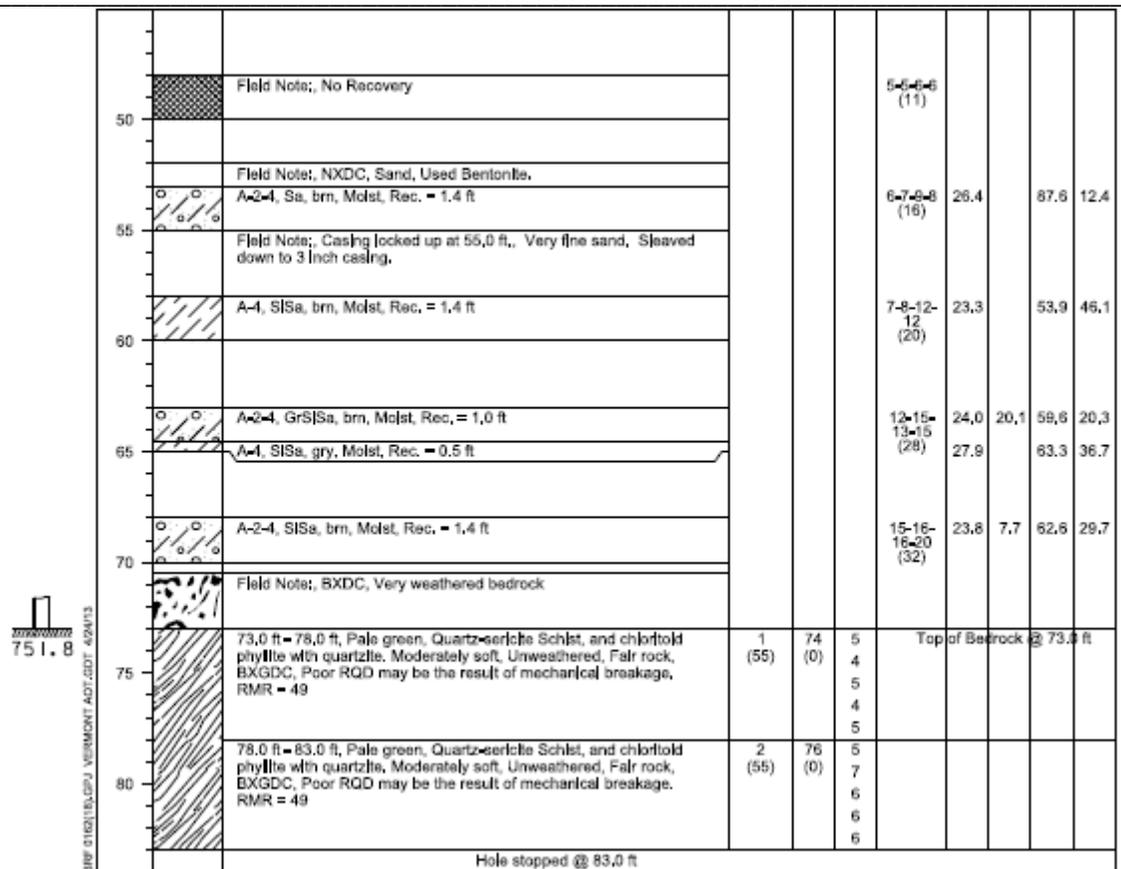
VT Trans		STATE OF VERMONT AGENCY OF TRANSPORTATION MATERIALS & RESEARCH SECTION SUBSURFACE INFORMATION		BORING LOG		Boring No.: <u>B-102</u>					
				ROCHESTER ER-BRF 0162(18) VT-73 BR-19		Page No.: <u>1 of 2</u>					
						Pin No.: <u>11C332</u>					
						Checked By: <u>CEE</u>					
Boring Crew: <u>SALISBURY, GARROW</u>		Casing: <u>WB</u> Sampler: <u>SS</u>		Groundwater Observations							
Date Started: <u>3/27/12</u> Date Finished: <u>3/29/12</u>		Type: <u>WB</u> I.D.: <u>4 in</u> <u>1.5 in</u>		Date	Depth (ft)	Notes					
VTSPG NAD83: <u>N 497119,90 ft E 1558458,40 ft</u>		Hammer Wt: <u>N/A</u> <u>140 lb.</u>		03/28/12	8.0	AM					
Station: <u>461+97.2</u> Offset: <u>2.99</u>		Hammer Fall: <u>N/A</u> <u>30 in</u>									
Ground Elevation: <u>824.8 ft</u>		Hammer/Rod Type: <u>Auto/AWJ</u>									
		Rtg: <u>CME 45C TRACK</u> <u>C = 1.34</u>									
Depth (ft)	Strata (1)	CLASSIFICATION OF MATERIALS (Description)		Run (DB deg.)	Cure Rec. % (RQD %)	DPI Rate (in/min)	Blows/ft (N Value)	Moisture Content %	Gravel %	Sand %	Fines %
		Asphalt Pavement, 0.0 ft - 0.5 ft									
		A-1-b, SaGr, bm, Molst, Rec. = 1.0 ft, NXDC					6-12-10 (20)	8.1	44.9	38.7	16.4
		A-1-a, SaGr, bm, Molst, Rec. = 1.0 ft, NXDC					5-13-12 (26)	7.4	54.9	32.4	12.7
5		A-1-b, SaGr, gm-bm, Molst, Rec. = 0.8 ft, NXDC					20-15-18-25 (33)	6.8	52.6	32.8	14.6
		Field Note: No Recovery, Rock In sampler.					R@5.0'				
		Field Note: NXDC, Cobbles									
10		A-1-a, SaGr, bm, Molst, Rec. = 1.3 ft, NXDC					12-23-23-18 (45)	9.8	52.4	35.1	12.5
		A-1-b, GrSa, bm, Molst, Rec. = 1.1 ft, NXDC					3-2-2-4 (14)	13.9	43.1	44.5	12.4
		A-1-b, GrSa, bm, Molst, Rec. = 1.1 ft, NXDC, Lost water return at 13.0 ft.					4-3-2-5 (5)	15.3	34.8	51.7	13.5
15		A-1, SiSa Varved, bm, Molst, Rec. = 1.3 ft, NXDC					3-2-2-4 (4)	33.2	EL 808.0		
		A-2-4, GrSa Varved, bm, Molst, Rec. = 1.0 ft, NXDC					3-2-2-4 (4)	27.9	43.0	45.9	11.1
		A-1-b, SaGr, bm, Molst, Rec. = 1.0 ft, NXDC					7-6-5-4 (13)	12.8	48.5	42.6	8.9
		Field Note: No Recovery, NXDC, Gravel					3-4-4-1 (8)				
		Field Note: No Recovery, Rock In sampler.					5-5-5-6 (10)				
25		A-1-a, SaGr, bm, Molst, Rec. = 1.2 ft, NXDC					6-7-8-8 (15)	12.4	52.3	38.3	9.4
		A-2-4, GrSa, bm, Molst, Rec. = 1.1 ft, NXDC					6-4-5-6 (9)	17.2	26.8	54.7	18.5
		A-1-b, GrSa, bm, Molst, Rec. = 0.8 ft, NXDC					6-5-4-5 (10)	15.1	32.8	57.4	9.8
		A-1-a, SaGr, bm, Molst, Rec. = 0.8 ft, NXDC					3-3-4-9 (7)	15.0	64.7	26.3	9.0
		Field Note: NXDC, Gravel									
40		A-4, SiSa, bm, Molst, Rec. = 1.0 ft					6-5-6-7 (11)	25.4	0.2	63.4	36.4
		A-2-4, Sa, bm, Molst, Rec. = 1.0 ft					3-4-4-5 (8)	26.3	7.4	75.7	16.9

EXISTING GRADE
EL 824.8

APPROXIMATE
ABUTMENT NO 1
BOTTOM PILE CAP
EL 814.0

BOE
EL 808.0

08 2 ROCHESTER ER-BRF 0162(18) GPJ VERMONT AOT-GDT 4/24/13



Assume

$$\gamma_{\text{soil exist}} = 110 \text{ pcf}$$

$$\gamma_{\text{soil fill}} = 140 \text{ pcf}$$

$$\theta_{\text{fill}} = 38^\circ$$

$$s_{\text{brg}} = 3 \text{ tsf} = 6000 \text{ psf}$$

Abutment 1 Design:

Criteria

Retained Height	=	3.25 ft
Wall height above soil	=	0.00 ft
Slope Behind Wall	=	0.00 : 1
Height of Soil over Toe	=	0.00 in
Water height over heel	=	0.0 ft

Soil Data

Allow Soil Bearing	=	6,000.0 psf
Rankine Soil Pressure calculation		
Soil Friction Angle	=	38.0 deg
Active Pressure:Ka*Gamma	=	33.3 psf/ft
Passive Pressure:Kp*Gan	=	588.5 psf/ft
Soil Density, Heel	=	140.00 pcf
Soil Density, Toe	=	110.00 pcf
Footings Soil Friction	=	0.400
Soil height to ignore for passive pressure	=	12.00 in



Surcharge Loads

Surcharge Over Heel	=	300.0 psf
Used To Resist Sliding & Overturning		
Surcharge Over Toe	=	0.0 psf
Used for Sliding & Overturning		

Lateral Load Applied to Stem

Lateral Load	=	0.0 #/ft
...Height to Top	=	0.00 ft
...Height to Bottom	=	0.00 ft
The above lateral load has been increased by a factor of	=	1.00
Wind on Exposed Stem	=	0.0 psf

Adjacent Footing Load

Adjacent Footing Load	=	0.0 lbs
Footing Width	=	0.00 ft
Eccentricity	=	0.00 in
Wall to Ftg CL Dist	=	0.00 ft
Footing Type	=	Line Load
Base Above/Below Soil at Back of Wall	=	0.0 ft
Poisson's Ratio	=	0.300

Axial Load Applied to Stem

Axial Dead Load	=	3,395.0 lbs
Axial Live Load	=	3,395.0 lbs
Axial Load Eccentricity	=	11.0 in

Design Summary

Wall Stability Ratios	
Overturning	= 6.54 OK
Sliding	= 3.72 OK
Total Bearing Load	= 8,749 lbs
...resultant ecc.	= 1.80 in
Soil Pressure @ Toe	= 2,624 psf OK
Soil Pressure @ Heel	= 1,750 psf OK
Allowable	= 6,000 psf
Soil Pressure Less Than Allowable	
ACI Factored @ Toe	= 3,535 psf
ACI Factored @ Heel	= 2,358 psf
Footing Shear @ Toe	= 8.4 psi OK
Footing Shear @ Heel	= 0.0 psi OK
Allowable	= 82.2 psi
Sliding Calcs (Vertical Component Used)	
Lateral Sliding Force	= 896.2 lbs
less 100% Passive Force	= - 1,195.4 lbs
less 100% Friction Force	= - 2,141.8 lbs
Added Force Req'd	= 0.0 lbs OK
....for 1.5 : 1 Stability	= 0.0 lbs OK

Stem Construction

Design Height Above Ftg	
ft =	Stem OK
0.00	
Wall Material Above "Ht"	= Concrete
Thickness	= 15.00
Rebar Size	= # 5
Rebar Spacing	= 12.00
Rebar Placed at	= Edge
Design Data	
fb/FB + fa/Fa	= 0.531
Total Force @ Section	lbs = 713.7
Moment....Actual	ft-# = 9,551.2
Moment....Allowable	= 17,971.3
Shear....Actual	psi = 4.5
Shear....Allowable	psi = 82.2
Wall Weight	= 187.5
Rebar Depth 'd'	in = 13.19
LAP SPLICE IF ABOVE	in = 21.36
LAP SPLICE IF BELOW	in =
HOOK EMBED INTO FTG	in = 9.59

Load Factors

Building Code	AASHTO LRFD
Dead Load	1.250
Live Load	1.500
Earth, H	1.750
Wind, W	1.400
Seismic, E	1.000

Masonry Data	
f _m	psi =
F _s	psi =
Solid Grouting	=
Use Half Stresses	=
Modular Ratio 'n'	=
Short Term Factor	=
Equiv. Solid Thick.	=
Masonry Block Type	= Medium Weight
Masonry Design Method	= ASD

Concrete Data	
f _c	psi = 3,000.0
F _y	psi = 60,000.0

Footing Dimensions & Strengths

Toe Width	=	2.75 ft
Heel Width	=	1.25
Total Footing Width	=	4.00
Footing Thickness	=	27.00 in
Key Width	=	0.00 in
Key Depth	=	0.00 in
Key Distance from Toe	=	2.75 ft
Fc =	3,000 psi	Fy = 60,000 psi
Footing Concrete Density	=	150.00 pcf
Min. As %	=	0.0018
Cover @ Top	2.00	@ Btm.= 3.00 in

Footing Design Results

	<u>Toe</u>	<u>Heel</u>
Factored Pressure	= 3,535	2,358 psf
Mu' : Upward	= 12,348	0 ft-#
Mu' : Downward	= 1,595	0 ft-#
Mu: Design	= 10,751	0 ft-#
Actual 1-Way Shear	= 8.41	0.00 psi
Allow 1-Way Shear	= 82.16	0.00 psi
Toe Reinforcing	= # 4 @ 18.00 in	
Heel Reinforcing	= # 4 @ 18.00 in	
Key Reinforcing	= # 7 @ 14.00 in	

Other Acceptable Sizes & Spacings

Toe: Not req'd, Mu < S * Fr
Heel: Not req'd, Mu < S * Fr
Key: No key defined

Summary of Overturning & Resisting Forces & Moments

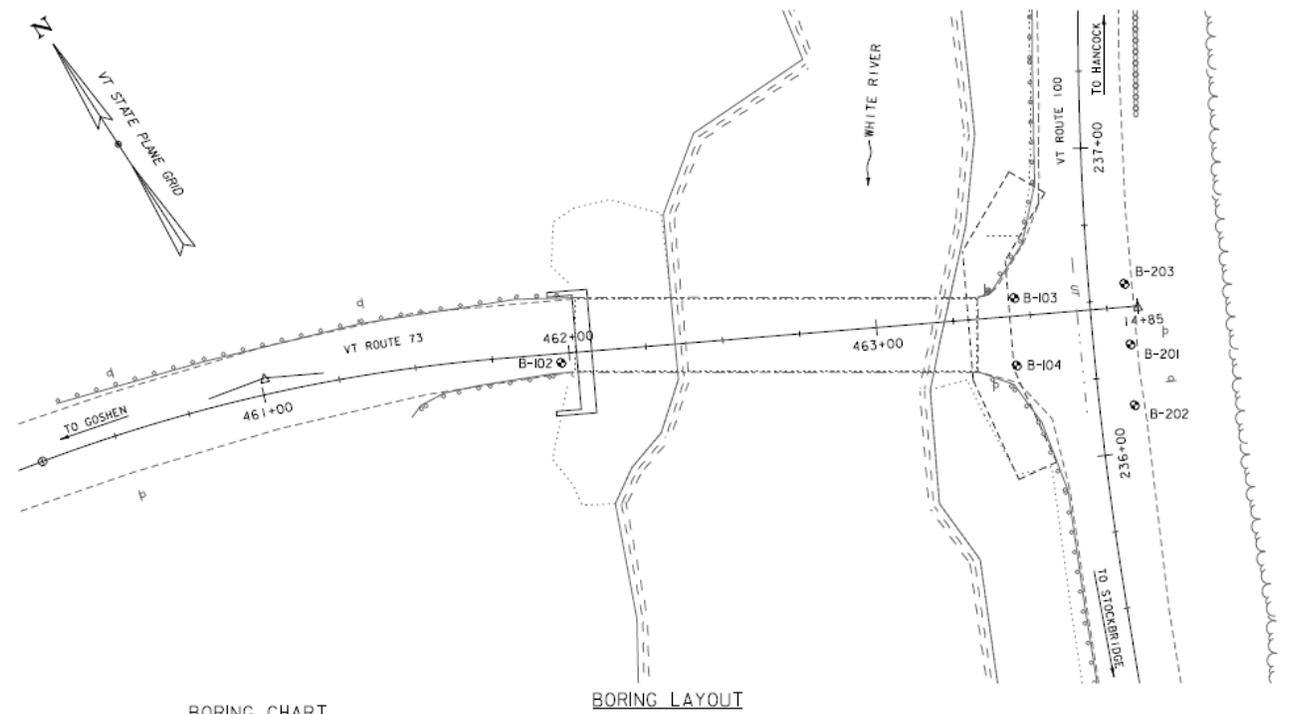
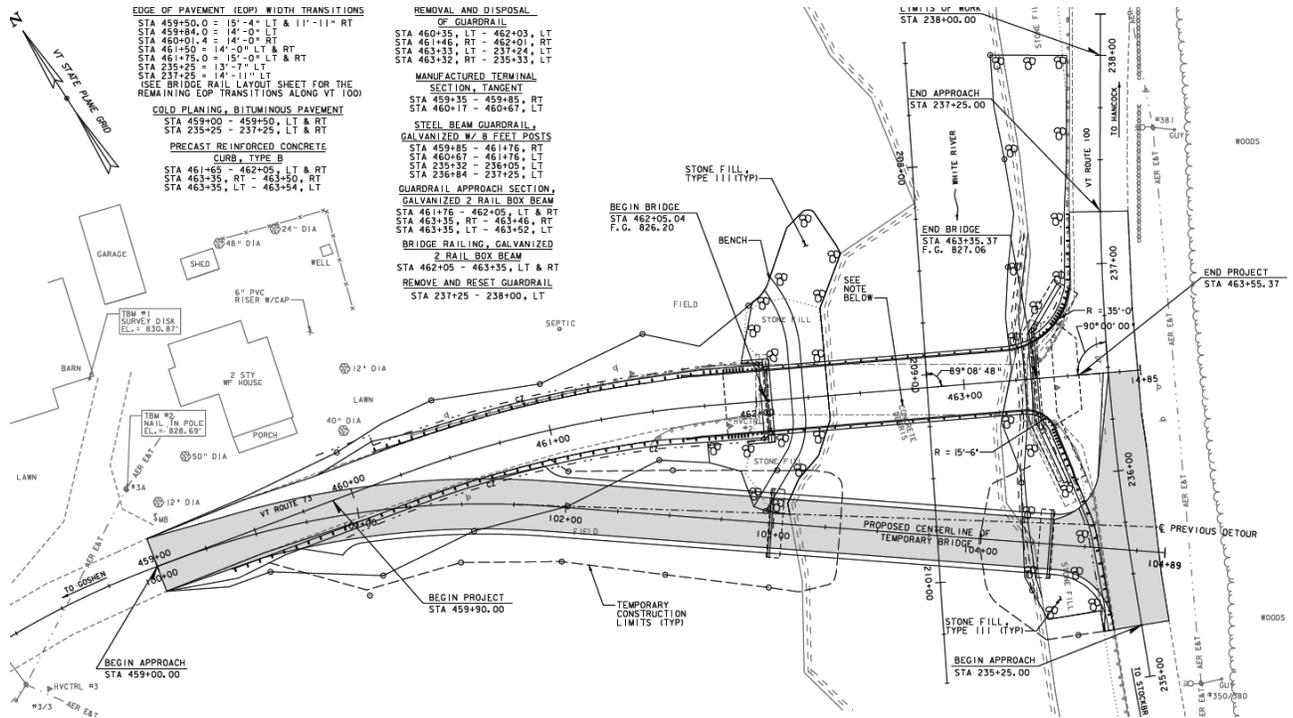
ItemOVERTURNING.....		RESISTING.....		
	Force lbs	Distance ft	Moment ft-#	Force lbs	Distance ft	Moment ft-#
Heel Active Pressure	= 503.7	1.83	923.5	Soil Over Heel	=	4.00
Surcharge over Heel	= 392.5	2.75	1,079.4	Sloped Soil Over Heel	=	
Surcharge Over Toe	=			Surcharge Over Heel	=	4.00
Adjacent Footing Load	=			Adjacent Footing Load	=	
Added Lateral Load	=			Axial Dead Load on Stem	= 3,395.0	2.46 8,346.0
Load @ Stem Above Soil	=			* Axial Live Load on Stem	= 3,395.0	2.46 8,346.0
	=			Soil Over Toe	=	
				Surcharge Over Toe	=	
Total	896.2	O.T.M.	2,002.9	Stem Weight(s)	= 609.4	3.38 2,056.6
	=	=		Earth @ Stem Transitions	=	
Resisting/Overturning Ratio		=	6.54	Footing Weight	= 1,350.0	2.00 2,700.0
Vertical Loads used for Soil Pressure	=	8,749.4 lbs		Key Weight	=	2.75
				Vert. Component	=	
				Total =	5,354.4 lbs	R.M.= 13,102.7

* Axial live load NOT included in total displayed, or used for overturning resistance, but is included for soil pressure calculation.

MSE Wall Requirements:

1. Top of MSE Wall EL 821.5±
2. Bot of MSE Wall EL 808±
3. Surcharge of Temporary Bridge Superstructure (through its west abutment)
4. Surcharge of Temporary Bridge Abutment 1 (west abutment)
5. Surcharge HS-20 AASHTO loading (two lanes)
6. Assumed backfill characteristics:
structural fill compacted to 95%
 $\gamma' = 140\text{pcf}$
 $\phi = 38^\circ$

EAST ABUTMENT:



The soil conditions are represented in the boring log for B-103 & B-104.

B-103: East End

VTTrans		STATE OF VERMONT AGENCY OF TRANSPORTATION MATERIALS & RESEARCH SECTION SUBSURFACE INFORMATION		BORING LOG			Boring No.: B-103					
				ROCHESTER ER-BRF 0162(18) VT-73 BR-19			Page No.: 1 of 1					
							Pln No.: 11C332					
							Checked By: CEE					
Boring Crew: SALISBURY, GARROW				Casing	Sampler	Groundwater Observations						
Date Started: 3/27/12 Date Finished: 3/28/12				Type: WB	SS	Date	Depth (ft)	Notes				
VTSPG NAD83: N 497057.50 ft E 1558593.00 ft				I.D.: 4 in	1.5 in	03/27/12	7.4	AM				
Station: 463+45.3 Offset: -5.86				Hammer Wt: N.A.	140 lb.							
Ground Elevation: 826.6 ft				Hammer Fall: N.A.	30 in.							
				Hammer/Rod Type: Auto/AWJ								
				Rlg: CME 45C TRACK	C = 1.34							
Depth (ft)	Strata (1)	CLASSIFICATION OF MATERIALS (Description)			Run (blp deg.)	Core Rec. % (ROD %)	Drill Rate minutes/ft	Blows/ft (N Value)	Moisture Content %	Gravel %	Sand %	Fines %
		Asphalt Pavement, 0.0 ft - 1.3 ft										
5		A-1-b, SaGr, brn, Molst, Rec. = 1.0 ft						5-5-6-10 (11)	10.7	44.3	41.3	14.4
		A-1-b, SaGr, brn, Molst, Rec. = 0.7 ft						2-4-4-3 (8)	15.7	54.7	27.0	18.3
		A-2-4, SiGrSa, brn, Molst, Rec. = 1.0 ft						6-3-2-3 (5)	17.3	29.0	49.8	21.2
		A-2-4, GrSa, brn, Molst, Rec. = 0.7 ft						3-3-3-3 (6)	12.4	31.8	50.7	17.5
10		A-2-4, GrSa, brn, Molst, Rec. = 0.7 ft						3-2-3-2 (5)	12.6	29.2	56.9	13.9
		A-1-b, GrSa, brn, Molst, Rec. = 0.3 ft, Broken Rock was within sample. Advanced casing. Field Note: NXMDC, Boulders						R@3.5"	14.1	29.3	56.4	14.3
15		Field Note: Possible Void										
		Field Note: NXMDC, Boulders										
20		Field Note: Possible Void										
		A-1-b, Weathered Rock with Sandy Gravel, brn, Molst, Rec. = 0.8 ft						4-5-R@6.0"	11.4	49.0	34.4	16.6
25		24.0 ft - 29.0 ft, Gray, Grading to pale green quartz-sericite Schist, with quartzite. Medium hard, Unweathered, Fair rock, NXMDC, RMR = 59			1 (55)	86 (54)	8					
							5					
							6					
							5					
							5					
30		29.0 ft - 34.0 ft, Pale green, Quartz-sericite Schist, with quartzite. Moderately hard, Unweathered, Good rock, NXMDC, RMR = 63			2 (55)	94 (86)	5					
							7					
							7					
							7					
							8					
35		Hole stopped @ 34.0 ft										

EXISTING GRADE
EL 826.6

BOE
EL 804.0

APPROXIMATE
ABUTMENT NO 2
TOP OF FOOTING
EL 806.0

EL 804±

IT AOT.50T 4/24/13

Abutment 2 Design:

Breastwall/Backwall:

Criteria

Retained Height	=	12.00 ft
Wall height above soil	=	0.00 ft
Slope Behind Wall	=	0.00 : 1
Height of Soil over Toe	=	0.00 in
Water height over heel	=	8.0 ft

Soil Data

Allow Soil Bearing	=	6,000.0 psf
Rankine Soil Pressure calculation		
Soil Friction Angle	=	38.0 deg
Active Pressure:Ka*Gamma	=	33.3 psf/ft
Passive Pressure:Kp*Gan	=	588.5 psf/ft
Soil Density, Heel	=	140.00 pcf
Soil Density, Toe	=	110.00 pcf
Footings Soil Friction	=	0.400
Soil height to ignore for passive pressure	=	12.00 in

Surcharge Loads

Surcharge Over Heel	=	300.0 psf
Used To Resist Sliding & Overturning		
Surcharge Over Toe	=	0.0 psf
Used for Sliding & Overturning		

Lateral Load Applied to Stem

Lateral Load	=	0.0 #/ft
...Height to Top	=	0.00 ft
...Height to Bottom	=	0.00 ft
The above lateral load has been increased by a factor of	=	1.00
Wind on Exposed Stem	=	0.0 psf

Adjacent Footing Load

Adjacent Footing Load	=	0.0 lbs
Footing Width	=	0.00 ft
Eccentricity	=	0.00 in
Wall to Ftg CL Dist	=	0.00 ft
Footing Type	=	Line Load
Base Above/Below Soil at Back of Wall	=	0.0 ft
Poisson's Ratio	=	0.300

Axial Load Applied to Stem

Axial Dead Load	=	3,395.0 lbs
Axial Live Load	=	3,395.0 lbs
Axial Load Eccentricity	=	0.0 in

Design Summary

Wall Stability Ratios		
Overturing	=	3.88 OK
Sliding	=	1.48 Ratio < 1.5!
Total Bearing Load	=	24,788 lbs
...resultant ecc.	=	17.86 in
Soil Pressure @ Toe	=	5,483 psf OK
Soil Pressure @ Heel	=	21 psf OK
Allowable	=	6,000 psf
Soil Pressure Less Than Allowable		
ACI Factored @ Toe	=	7,041 psf
ACI Factored @ Heel	=	27 psf
Footing Shear @ Toe	=	0.0 psi OK
Footing Shear @ Heel	=	25.3 psi OK
Allowable	=	82.2 psi
Sliding Calcs (Vertical Component Used)		
Lateral Sliding Force	=	5,903.5 lbs
less 100% Passive Force	=	- 165.5 lbs
less 100% Friction Force	=	- 8,549.0 lbs
Added Force Req'd	=	0.0 lbs OK
...for 1.5 : 1 Stability	=	140.8 lbs NG

Stem Construction

Design Height Above Ftg		ft =	0.00
Wall Material Above "Ht"		=	Concrete
Thickness		=	36.00
Rebar Size		=	# 5
Rebar Spacing		=	12.00
Rebar Placed at		=	Edge
Design Data			
fb/FB + fa/Fa	=		0.696
Total Force @ Section	lbs =		8,358.1
Moment....Actual	ft-# =		32,878.7
Moment....Allowable	=		47,266.3
Shear.....Actual	psi =		20.4
Shear.....Allowable	psi =		82.2
Wall Weight	=		450.0
Rebar Depth 'd'	in =		34.19
LAP SPLICE IF ABOVE	in =		21.36
LAP SPLICE IF BELOW	in =		
HOOK EMBED INTO FTG	in =		9.59

Top Stem

Stem OK

Masonry Data

fm	psi =	
Fs	psi =	
Solid Grouting	=	
Use Half Stresses	=	
Modular Ratio 'n'	=	
Short Term Factor	=	
Equiv. Solid Thick.	=	
Masonry Block Type	=	Medium Weight
Masonry Design Method	=	ASD

Concrete Data

Fc	psi =	3,000.0
Fy	psi =	60,000.0

Load Factors

Building Code	AASHTO LRFD
Dead Load	1.250
Live Load	1.500
Earth, H	1.750
Wind, W	1.400
Seismic, E	1.000

Footing Dimensions & Strengths

Toe Width	=	0.50	ft
Heel Width	=	8.50	
Total Footing Width	=	9.00	
Footing Thickness	=	15.00	in
Key Width	=	0.00	in
Key Depth	=	0.00	in
Key Distance from Toe	=	0.50	ft
F_c	=	3,000	psi
F_y	=	60,000	psi
Footing Concrete Density	=	150.00	pcf
Min. As %	=	0.0018	
Cover @ Top	=	2.00	
Cover @ Btm.	=	3.00	in

Footing Design Results

	Toe	Heel
Factored Pressure	= 7,041	27 psf
Mu' : Upward	= 864	22,021 ft-#
Mu' : Downward	= 29	43,248 ft-#
Mu: Design	= 835	21,228 ft-#
Actual 1-Way Shear	= 0.00	25.26 psi
Allow 1-Way Shear	= 82.16	82.16 psi
Toe Reinforcing	= # 4 @ 18.00 in	
Heel Reinforcing	= # 4 @ 18.00 in	
Key Reinforcing	= # 7 @ 14.00 in	

Other Acceptable Sizes & Spacings

Toe: Not req'd, $M_u < S * Fr$
 Heel: #4@ 5.00 in, #5@ 7.50 in, #6@ 10.75 in, #7@ 14.50 in, #8@ 19.00 in, #9@ 24.
 Key: No key defined

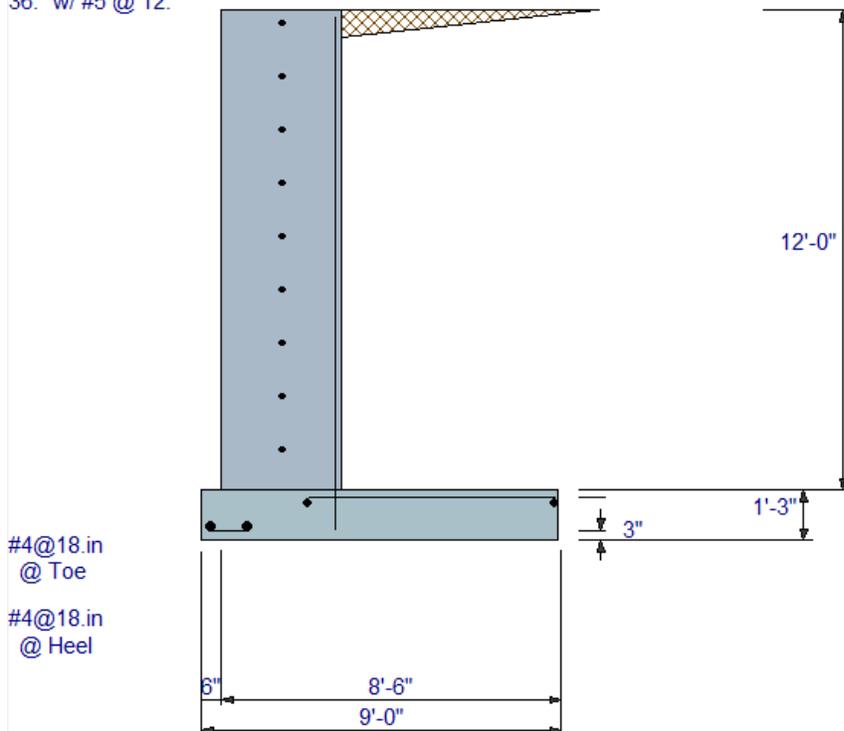
Summary of Overturning & Resisting Forces & Moments

ItemOVERTURNING.....		RESISTING.....			
	Force lbs	Distance ft	Moment ft-#	Force lbs	Distance ft	Moment ft-#	
* Heel Active Pressure	= 4,957.9	3.87	19,184.9	Soil Over Heel	= 9,240.0	6.25	57,750.0
Surcharge over Heel	= 945.6	6.63	6,264.5	Sloped Soil Over Heel	=		
Surcharge Over Toe	=			Surcharge Over Heel	= 1,650.0	6.25	10,312.5
Adjacent Footing Load	=			Adjacent Footing Load	=		
Added Lateral Load	=			Axial Dead Load on Stem	= 3,395.0	2.00	6,790.0
Load @ Stem Above Soil	=			* Axial Live Load on Stem	= 3,395.0	2.00	6,790.0
				Soil Over Toe	=		
				Surcharge Over Toe	=		
				Stem Weight(s)	= 5,400.0	2.00	10,800.0
				Earth @ Stem Transitions	=		
Total	5,903.5	O.T.M.	25,449.4	Footing Weight	= 1,687.5	4.50	7,593.7
				Key Weight	=	0.50	
Resisting/Overturning Ratio			= 3.66	Vert. Component	=		
Vertical Loads used for Soil Pressure	=	24,767.5	lbs				
				Total =	21,372.5	lbs	R.M. = 93,246.2

*Includes water table effect

* Axial live load NOT included in total displayed, or used for overturning resistance, but is included for soil pressure calculation.

36." w/ #5 @ 12."



SE Wingwall, LWR:

Criteria

Retained Height	=	9.00 ft
Wall height above soil	=	0.00 ft
Slope Behind Wall	=	0.00 : 1
Height of Soil over Toe	=	0.00 in
Water height over heel	=	8.0 ft

Soil Data

Allow Soil Bearing	=	6,000.0 psf
Rankine Soil Pressure calculation		
Soil Friction Angle	=	38.0 deg
Active Pressure:Ka*Gamma	=	33.3 psf/ft
Passive Pressure:Kp*Gan	=	588.5 psf/ft
Soil Density, Heel	=	140.00 pcf
Soil Density, Toe	=	110.00 pcf
Footings Soil Friction	=	0.400
Soil height to ignore for passive pressure	=	12.00 in

Surcharge Loads

Surcharge Over Heel	=	300.0 psf
Used To Resist Sliding & Overturning		
Surcharge Over Toe	=	0.0 psf
Used for Sliding & Overturning		

Lateral Load Applied to Stem

Lateral Load	=	0.0 #/ft
...Height to Top	=	0.00 ft
...Height to Bottom	=	0.00 ft
The above lateral load has been increased by a factor of	=	1.00
Wind on Exposed Stem	=	0.0 psf

Adjacent Footing Load

Adjacent Footing Load	=	0.0 lbs
Footing Width	=	0.00 ft
Eccentricity	=	0.00 in
Wall to Ftg CL Dist	=	0.00 ft
Footing Type	=	Line Load
Base Above/Below Soil at Back of Wall	=	0.0 ft
Poisson's Ratio	=	0.300

Axial Load Applied to Stem

Axial Dead Load	=	0.0 lbs
Axial Live Load	=	0.0 lbs
Axial Load Eccentricity	=	0.0 in

Design Summary

Wall Stability Ratios	
Overturning	= 4.40 OK
Sliding	= 1.34 Ratio < 1.5!
Total Bearing Load	= 14,738 lbs
...resultant ecc.	= 9.73 in
Soil Pressure @ Toe	= 2,523 psf OK
Soil Pressure @ Heel	= 752 psf OK
Allowable	= 6,000 psf
Soil Pressure Less Than Allowable	
ACI Factored @ Toe	= 3,153 psf
ACI Factored @ Heel	= 940 psf
Footing Shear @ Toe	= 0.0 psi OK
Footing Shear @ Heel	= 23.6 psi OK
Allowable	= 82.2 psi
Sliding Calcs (Vertical Component Used)	
Lateral Sliding Force	= 4,515.5 lbs
less 100% Passive Force	= - 165.5 lbs
less 100% Friction Force	= - 5,895.0 lbs
Added Force Req'd	= 0.0 lbs OK
...for 1.5 : 1 Stability	= 712.7 lbs NG

Stem Construction

Design Height Above Ftg	
ft =	Stem OK
0.00	
Wall Material Above "Ht" = Concrete	
Thickness	= 12.00
Rebar Size	= # 7
Rebar Spacing	= 12.00
Rebar Placed at	= Edge
Design Data	
fb/FB + fa/Fa	= 0.794
Total Force @ Section	lbs = 6,147.5
Moment.....Actual	ft-# = 19,240.9
Moment.....Allowable	= 24,225.8
Shear.....Actual	psi = 53.6
Shear.....Allowable	psi = 82.2
Wall Weight	= 150.0
Rebar Depth 'd'	in = 9.56
LAP SPLICE IF ABOVE	in = 37.57
LAP SPLICE IF BELOW	in =
HOOK EMBED INTO FTG	in = 10.51

Top Stem

Masonry Data Hook embedment reduced by stress ratio

f _m	psi =
F _s	psi =
Solid Grouting	=
Use Half Stresses	=
Modular Ratio 'n'	=
Short Term Factor	=
Equiv. Solid Thick.	=
Masonry Block Type	= Medium Weight
Masonry Design Method	= ASD

Concrete Data

f _c	psi = 3,000.0
F _y	psi = 60,000.0

Load Factors

Building Code	AASHTO LRFD
Dead Load	1.250
Live Load	1.500
Earth, H	1.750
Wind, W	1.400
Seismic, E	1.000

Footing Dimensions & Strengths

Toe Width	=	0.50	ft
Heel Width	=	8.50	
Total Footing Width	=	9.00	
Footing Thickness	=	15.00	in
Key Width	=	0.00	in
Key Depth	=	0.00	in
Key Distance from Toe	=	0.50	ft
f_c	=	3,000	psi
F_y	=	60,000	psi
Footing Concrete Density	=	150.00	pcf
Min. As %	=	0.0018	
Cover @ Top	=	2.00	@ Btm.= 3.00 in

Footing Design Results

	<u>Toe</u>	<u>Heel</u>
Factored Pressure	= 3,153	940 psf
Mu' : Upward	= 389	43,738 ft-#
Mu' : Downward	= 29	65,654 ft-#
Mu : Design	= 360	21,916 ft-#
Actual 1-Way Shear	= 0.00	23.60 psi
Allow 1-Way Shear	= 82.16	82.16 psi
Toe Reinforcing	= # 4 @ 12.00 in	
Heel Reinforcing	= # 7 @ 12.00 in	
Key Reinforcing	= # 7 @ 0.00 in	

Other Acceptable Sizes & Spacings

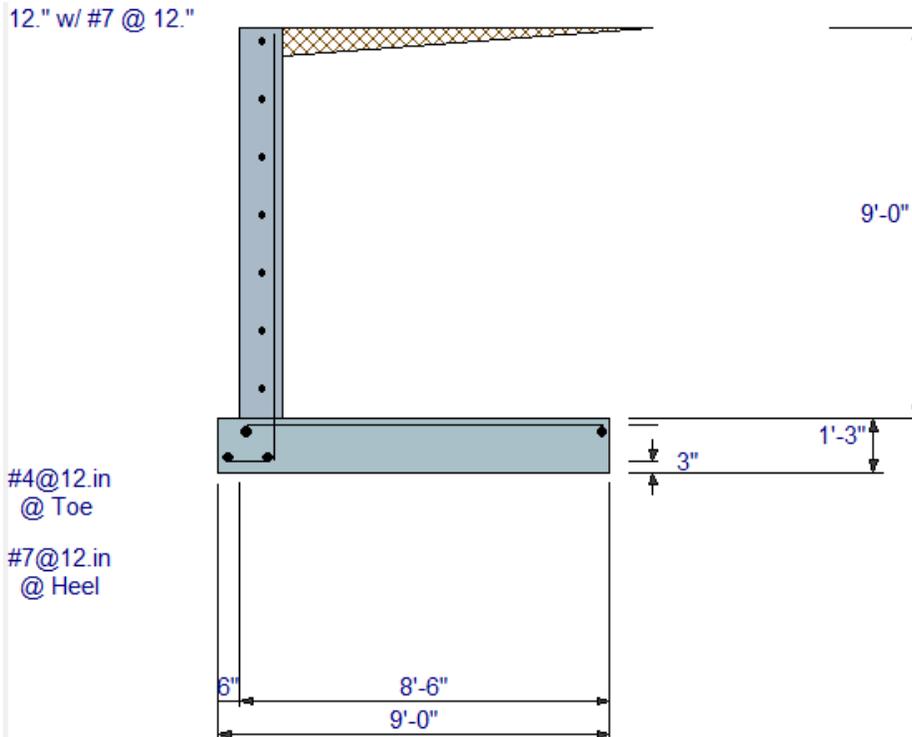
Toe: Not req'd, $M_u < S * F_r$
 Heel: #4@ 5.00 in, #5@ 7.50 in, #6@ 10.75 in, #7@ 14.50 in, #8@ 19.00 in, #9@ 24.
 Key: No key defined

Summary of Overturning & Resisting Forces & Moments

ItemOVERTURNING.....		RESISTING.....			
	Force lbs	Distance ft	Moment ft-#	Force lbs	Distance ft	Moment ft-#	
*Heel Active Pressure	= 3,784.0	3.24	12,250.5	Soil Over Heel	= 9,450.0	5.25	49,612.5
Surcharge over Heel	= 731.5	5.13	3,748.9	Sloped Soil Over Heel	=		
Surcharge Over Toe	=			Surcharge Over Heel	= 2,250.0	5.25	11,812.5
Adjacent Footing Load	=			Adjacent Footing Load	=		
Added Lateral Load	=			Axial Dead Load on Stem	=		
Load @ Stem Above Soil	=			* Axial Live Load on Stem	=		
				Soil Over Toe	=		
				Surcharge Over Toe	=		
Total	4,515.5	O.T.M.	15,999.4	Stem Weight(s)	= 1,350.0	1.00	1,350.0
				Earth @ Stem Transitions	=		
Resisting/Overturning Ratio			= 4.40	Footing Weight	= 1,687.5	4.50	7,593.8
Vertical Loads used for Soil Pressure	=	14,737.5	lbs	Key Weight	=	0.50	
				Vert. Component	=		
				Total =	14,737.5	lbs R.M.=	70,388.8

*Includes water table effect

* Axial live load NOT included in total displayed, or used for overturning resistance, but is included for soil pressure calculation.



NE Wingwall & SE Wingwall, UPR:

Criteria

Retained Height	=	6.00 ft
Wall height above soil	=	0.00 ft
Slope Behind Wall	=	0.00 : 1
Height of Soil over Toe	=	36.00 in
Water height over heel	=	0.0 ft

Soil Data

Allow Soil Bearing	=	6,000.0 psf
Rankine Soil Pressure calculation		
Soil Friction Angle	=	38.0 deg
Active Pressure:Ka*Gamma	=	33.3 psf/ft
Passive Pressure:Kp*Gan	=	588.5 psf/ft
Soil Density, Heel	=	140.00 pcf
Soil Density, Toe	=	110.00 pcf
Footings Soil Friction	=	0.400
Soil height to ignore for passive pressure	=	12.00 in

Surcharge Loads

Surcharge Over Heel	=	300.0 psf
Used To Resist Sliding & Overturning		
Surcharge Over Toe	=	0.0 psf
Used for Sliding & Overturning		

Lateral Load Applied to Stem

Lateral Load	=	0.0 #/ft
...Height to Top	=	0.00 ft
...Height to Bottom	=	0.00 ft
The above lateral load has been increased by a factor of		1.00
Wind on Exposed Stem	=	0.0 psf

Adjacent Footing Load

Adjacent Footing Load	=	0.0 lbs
Footing Width	=	0.00 ft
Eccentricity	=	0.00 in
Wall to Ftg CL Dist	=	0.00 ft
Footing Type		Line Load
Base Above/Below Soil at Back of Wall	=	0.0 ft
Poisson's Ratio	=	0.300

Axial Load Applied to Stem

Axial Dead Load	=	0.0 lbs
Axial Live Load	=	0.0 lbs
Axial Load Eccentricity	=	0.0 in

Design Summary

Wall Stability Ratios	
Overturning	= 2.24 OK
Sliding	= 4.65 OK
Total Bearing Load	= 3,654 lbs
...resultant ecc.	= 7.25 in
Soil Pressure @ Toe	= 1,796 psf OK
Soil Pressure @ Heel	= 70 psf OK
Allowable	= 6,000 psf
Soil Pressure Less Than Allowable	
ACI Factored @ Toe	= 2,245 psf
ACI Factored @ Heel	= 88 psf
Footing Shear @ Toe	= 0.0 psi OK
Footing Shear @ Heel	= 17.0 psi OK
Allowable	= 82.2 psi
Sliding Calcs (Vertical Component NOT Used)	
Lateral Sliding Force	= 1,392.7 lbs
less 100% Passive Force	= - 5,020.8 lbs
less 100% Friction Force	= - 1,461.8 lbs
Added Force Req'd	= 0.0 lbs OK
...for 1.5 : 1 Stability	= 0.0 lbs OK

Stem Construction

Design Height Above Ftg	
ft =	6.00
Wall Material Above "Ht"	= Concrete
Thickness	= 12.00
Rebar Size	= # 4
Rebar Spacing	= 12.00
Rebar Placed at	= Edge
Design Data	
fb/FB + fa/Fa	= 0.000
Total Force @ Section	lbs = 0.0
Moment....Actual	ft-# = 0.0
Moment....Allowable	= 9,048.0
Shear.....Actual	psi = 0.0
Shear.....Allowable	psi = 82.2
Wall Weight	= 150.0
Rebar Depth 'd'	in = 10.25
LAP SPLICE IF ABOVE	in = 17.09
LAP SPLICE IF BELOW	in =
HOOK EMBED INTO FTG	in = 7.67

Load Factors

Building Code	AASHTO LRFD
Dead Load	1.250
Live Load	1.500
Earth, H	1.750
Wind, W	1.400
Seismic, E	1.000

Masonry Data

fm	psi =
Fs	psi =
Solid Grouting	=
Use Half Stresses	=
Modular Ratio 'n'	=
Short Term Factor	=
Equiv. Solid Thick.	=
Masonry Block Type	= Medium Weight
Masonry Design Method	= ASD

Concrete Data

fc	psi = 3,000.0
Fy	psi = 60,000.0

Footing Dimensions & Strengths

Toe Width	=	0.50 ft
Heel Width	=	3.42
Total Footing Width	=	3.92
Footing Thickness	=	15.00 in
Key Width	=	0.00 in
Key Depth	=	0.00 in
Key Distance from Toe	=	0.50 ft
f_c	=	3,000 psi
F_y	=	60,000 psi
Footing Concrete Density	=	150.00 pcf
Min. As %	=	0.0018
Cover @ Top	=	2.00
@ Btm.	=	3.00 in

Footing Design Results

	<u>Toe</u>	<u>Heel</u>
Factored Pressure	= 2,245	88 psf
Mu' : Upward	= 289	1,551 ft-#
Mu' : Downward	= 95	5,284 ft-#
Mu: Design	= 174	3,732 ft-#
Actual 1-Way Shear	= 0.00	17.02 psi
Allow 1-Way Shear	= 82.16	82.16 psi
Toe Reinforcing	= # 4 @ 12.00 in	
Heel Reinforcing	= # 4 @ 12.00 in	
Key Reinforcing	= None Spec'd	

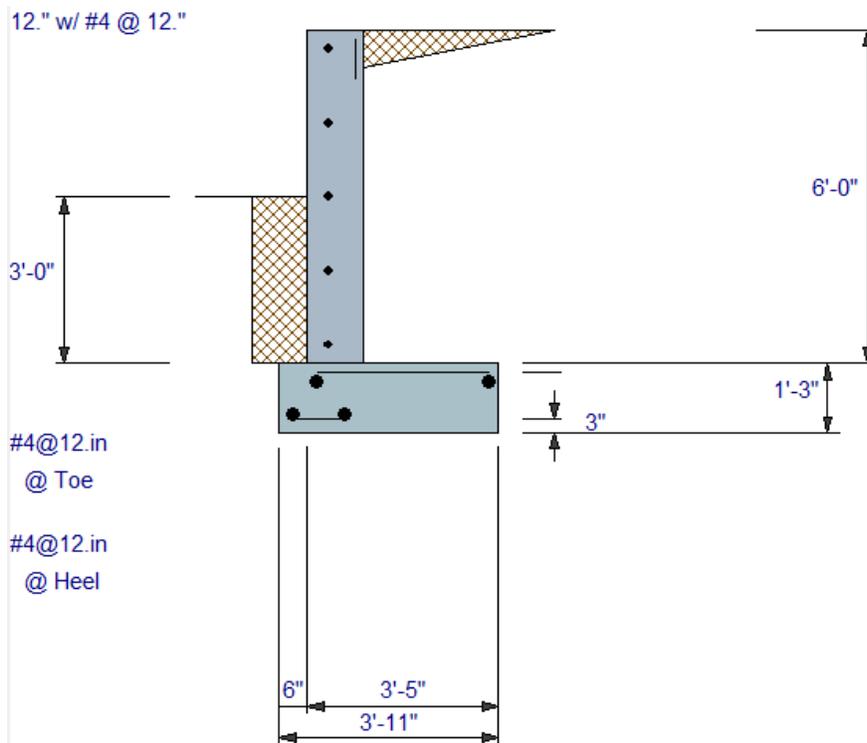
Other Acceptable Sizes & Spacings

Toe: Not req'd, $M_u < S * F_r$
 Heel: Not req'd, $M_u < S * F_r$
 Key: No key defined

Summary of Overturning & Resisting Forces & Moments

ItemOVERTURNING.....		RESISTING.....			
	Force lbs	Distance ft	Moment ft-#	Force lbs	Distance ft	Moment ft-#	
Heel Active Pressure	= 875.3	2.42	2,115.2	Soil Over Heel	= 2,030.0	2.71	5,497.9
Surcharge over Heel	= 517.4	3.63	1,875.8	Sloped Soil Over Heel	=		
Surcharge Over Toe	=			Surcharge Over Heel	= 725.0	2.71	1,963.5
Adjacent Footing Load	=			Adjacent Footing Load	=		
Added Lateral Load	=			Axial Dead Load on Stem	=		
Load @ Stem Above Soil	=			* Axial Live Load on Stem	=		
				Soil Over Toe	= 165.0	0.25	41.3
				Surcharge Over Toe	=		
				Stem Weight(s)	=		
				Earth @ Stem Transitions	=		
Total	1,392.7	O.T.M.	3,990.8	Footing Weight	= 734.4	1.96	1,438.2
				Key Weight	=	0.50	
				Vert. Component	=		
Resisting/Overturning Ratio		= 2.24		Total =	3,654.4 lbs	R.M. =	8,940.9
Vertical Loads used for Soil Pressure =		3,654.4 lbs					

* Axial live load NOT included in total displayed, or used for overturning resistance, but is included for soil pressure calculation.



Anchors:

Bridge shoes are to be held in place with anchors into the concrete bridge abutments. From the superstructure reactions provided by the mfr,

$$V = 30k \text{ per corner}$$

Anchor Studs, Four 7/8" dia Threaded Studs per shoe, Steel, ASTM A307;

$$\begin{aligned} F_y &= 36\text{ksi} \\ F_v &= 11.0\text{ksi} \quad [\text{AASHTO Table 10.32.3A}] \\ A_{\text{bolt}} &= 0.845\text{in}^2 \\ N &= 4 \text{ bolts/shoe} * 3 \text{ shoes/corner} = 12 \text{ bolts/corner} \end{aligned}$$

$$f_v = V/NA = 2.96\text{ksi} < 11.0\text{ksi} \text{ OK}$$

Transom Bolster:

The superstructure design calls for a transom bolster to support the end transoms at their midspans against deflection at the backwalls. This will be accomplished by fixing a timber block bearing on the abutment bridge seat and bottom flange of the end transoms at midspan.

Bolster, 12 x Cut-To-Fit x 3' long Bearing Block, Timber, SYP No.1 Or Equal;

Assume the full load of two wheels of the HS20 loading will be resisted by the bolster.

$$\begin{aligned} C &= 2 * 16k = 32k \\ b_{\text{transom flange}} &= \text{W24x76} = 8.99'' \\ L_{\text{block}} &= 3.0' = 36'' \\ A_{\text{brg}} &= Lb = 324\text{in}^2 \end{aligned}$$

Based on NDS and subject to adjustment factors,

$F_b =$	1,350	psi	[ASD Table4D]
$F_t =$	900	psi	
$F_v =$	165	psi	
$F_{\text{cperp}} =$	375	psi	
$F_{\text{cpara}} =$	800	psi	
$E =$	1,300,000	psi	
$E_{\text{min}} =$	470,000	psi	

$C_D = \text{Duration} =$	impact	instant	2.00	[ASD Table 2.3.2]
$C_M = \text{Wet Service} > 19\%$ ("wet"/"dry")		wet		[ASD Table 4A]
for $F_b =$			1.00	
for $F_b C_F =$	999	psi		
for $F_t =$			1.00	
for $F_v =$			0.97	
for $F_{cperp} =$			0.67	
for $F_{cpara} =$			0.80	
for $F_c C_F =$	800	psi		
for $E =$			0.90	
$C_t = \text{Temperature Factor} =$			1.00	[ASD Table 2.3.3]
$C_L = \text{Beam Stability Factor} =$			1.00	[ASD 3.3.3]
where				
$b =$			12.00 in	
$d =$			12.00 in	
$\ell_u =$			3.00 ft	
$\ell_e =$			3.33 ft	
$E_{min}' =$			474,901 psi	[ASD Appx D.4]
for $COV_E =$			0.25	[ASD Appx F.4]
$F_b^* =$			2,700 psi	
$R_B = (\ell_e d / b^2)^{1/2} =$			0.5268	
$F_{bE} = 1.20 E_{min}' / R_B^2 =$			2,053,627 psi	
$F_b' = F_b^* C_L = F_b^* \{ (1 + F_{bE} / F_b^*) / 1.9 - [((1 + F_{bE} / F_b^*) / 1.9)^2 - F_{bE} / F_b^* / 0.95]^{1/2} \} =$			2,700 psi	
$C_F = \text{Size Factor}$				[ASD 4.3.6]
for $F_b =$			0.74	
for $F_t =$			1.00	
for $F_{cpara} =$			1.00	
$C_{fu} = \text{Flat Use} = 1.05$			1.15	[ASD Table 4A]

$C_i =$ Incising ("yes"/"no")	no		[ASD Table 4.3.8]
for $F_b =$		1.00	
for $F_t =$		1.00	
for $F_v =$		1.00	
for $F_{cperp} =$		1.00	
for $F_{cpara} =$		1.00	
for $E =$		1.00	
$C_r =$ Repetitive Member ("yes"/"no")	no	1.00	[ASD 4.3.9]
$C_b =$ Bearing Area Factor =		1.00	[ASD Table 3.10.4]
$C_{Fb} = C_D * C_M * C_t * C_L * C_F * C_{fu} * C_i * C_r =$		1.702	
$C_{Ft} = C_D * C_M * C_t * C_F * C_i =$		2.000	
$C_{Fv} = C_D * C_M * C_t * C_i =$		1.940	
$C_{FcpERP} = C_M * C_t * C_i * C_b =$		0.670	
$C_{FcpARA} = C_D * C_M * C_t * C_F * C_i * C_p =$		1.600	
$E = C_M * C_t * C_i =$		0.900	
$E_{min} = C_M * C_t * C_i * C_T =$		0.900	
Applying the above factors as and the condition and construction factors,			
Condition Factor =		1.00	assumed
Construction Factor =		1.00	non-specified
F_{cperp}' =	251 psi	=	0.251 ksi
$f_{cperp} = C/A = 0.0987\text{ksi} < 0.251\text{ksi}$ OK			