KUBRICKY CONSTRUCTION CORP
269 BALLARD ROAD

WILTON, NY 12831
518 792-5864

KUBRICKY CONSTRUCTION CORP.
A PROUD MEMBER OF THE D.A. COLLINS COMPANIES

Rutland City BRF 3000 (2014036)
SUBMITTAL 22

Issued 12/12/14
Respond by 12/19/14

To

Timothy Pockette, PE

Topic	Cofferdam Design (Abutment 1) (BR2)
Status	For Approval
Spec section	208.40
Received from submitter	12/11/14
Sent to approver	12/12/14
Required from approver	12/19/14

From

Volker H.D. Burkowski

Signed by [signature] Date 12/12/14

Proceed as Indicated ____________________ Date __________
Owner Authorized Representative

Printed by VHB as of 12/12/14 10:58AM

GENERAL NOTES:

THESE PLANS AND ACCOMPANYING DESIGN SUBMITTAL ADDRESS THE COFFERDAM TO BE USED TO FACILITATE CONSTRUCTION OF ABUTMENT NO. 1 OF THE PROPOSED RIVER STREET BRIDGE.

1. CONFORM TO THE GENERAL NOTES AND CONSTRUCTION SEQUENCE AND ALL OTHER REQUIREMENTS OF THIS SUBMISSION UNLESS OTHERWISE APPROVED BY WILLIAM J. FRANK ENGINEERING, P.C.
2. REPORT LOCATIONS AND ELEVATIONS OF UTILITIES, STRUCTURES AND OBSTRUCTIONS WHICH CONFLICT WITH THE DESIGN LOCATIONS SHEETPILES AND BRACING SO THAT THE DESIGN CAN BE MODIFIED AS REQUIRED.
3. REPORT CHANGES IN CONTRACT DOCUMENTS AND SUBSURFACE CONDITIONS TO WILLIAM J. FRANK ENGINEERING, P.C. SO THAT THE DESIGN CAN BE MODIFIED ACCORDINGLY.
4. LAYOUT AND LIMITS OF THE EXCAVATION SUPPORT SYSTEM SHOWN HEREIN ARE APPROXIMATE. THE CONTRACTOR SHALL VERIFY ACTUAL LAYOUT AND LIMITS OF SHEETING, PRIOR TO DRIVING.
5. THE SUPPORT OF EXCAVATION SYSTEM SHOWN HEREIN IS DESIGNED FOR A UNIFORM 250 PSF VERTICAL CONSTRUCTION SURCHARGE ACTING UP BEHIND THE TEMPORARY SOE. THIS IS CONSISTENT WITH TYPICAL HS-20 HIGHWAY LIVE LOADING. IF THE CONTRACTOR FEELS THIS SURCHAGRE MAY BE EXCEEDED BY THE CONSTRUCTION EQUIPMENT THE DESIGN MAY NEED TO BE MODIFIED.
6. FOR THE PURPOSES OF DESIGN, GROUNDWATER AND SURFACE WATER IS ASSUMED TO BE AT ELEVATION 523 FEET. IF THE WATER LEVEL EXCEEDS ELEVATION 523 FEET WORK SHALL TEMPORARILY CEASE AND THE COFFERDAM SHALL BE FLOODED.
7. CONTRACTOR SHALL NOT EXCAVATE MORE THAN 2 FEET BELOW A PROPOSED BRACE LEVEL PRIOR TO BRACE INSTALLATION.
8. THE INTERIM BRACE LEVEL SHALL BE SUPPORTED VERTICALLY BY THE UPPER BRACE LEVEL USING STRAPS, CHAINS, NYLON OR WIRE ROPE AT EVERY WALE TO STRUT, OR WALE TO WALE CONNECTION. VERTICAL SUPPORT SHALL HAVE A MINIMUM WORKING LOAD LIMIT OF 2 TONS.
9. CONTRACTOR SHALL INSTALL HARDWOOD BLOCKING BETWEEN THE INTERIM BRACE LEVEL WALE AND SHEETPILE FACES AT EVERY SHEET PILE FACE. CONTRACTOR IS RESPONSIBLE FOR ENSURING BLOCKING DOES NOT SLIP AND MOVE FROM GAP BETWEEN SHEETPILE AND WALE.
10. THE ABUTMENT STEM WILL NEED TO BE POURED AROUND THE PROPOSED UPPER LEVEL OF BRACING STRUTS. CONTRACTOR SHALL BLOCK OUT THE AREA AROUND THE STRUT USING STYROFOAM (OR SIMILAR METHOD), THEN REMOVE THE STRUTS AND REPAIR THE BLOCKOUT WHEN THE UPPER LEVEL OF BRACING IS PERMITTED TO BE REMOVED IN ACCORDANCE WITH THE SEQUENCE BELOW.
11. CONTRACTOR MAY DRIVE PIN PILES IF NECESSARY TO SUPPORT WALE BRACING PRIOR TO DRIVING SHEET PILES. PIN PILES SHALL BE HP12X84 (OR LARGER) DRIVEN TO SHEETING TIP ELEVATION.
12. INSPECTION OF THE INSTALLATION OF THE SUPPORT OF EXCAVATION SYSTEM IS BY OTHERS.

MATERIAL NOTES:

1. W SECTIONS SHALL CONFORM TO ASTM A992 GRADE 50.
2. HSS SECTIONS SHALL CONFORM TO ASTM A500, GRADE B.
3. PLATES SHALL BE ASTM A36.
4. WELDING ELECTRODES SHALL BE E70XX.
5. TIMBER FOR BLOCKING SHALL BE RED OAK NO. 1 OR SIMILAR / EQUIVALENT.
6. USED STEEL IS ACCEPTABLE PROVIDED IT IS IN GOOD CONDITION. CONTRACTOR SHALL BE SOLELY RESPONSIBLE FOR DETERMINING THE ADEQUACY OF USED STEEL INCORPORATED INTO THE TEMPORARY SUPPORT OF EXCAVATION SYSTEM.
7. TREMIE CONCRETE SHALL BE VTRANS TYPE D CONCRETE WITH THE EXCEPTION THAT THE SLUMP MAY BE INCREASED TO UP TO 9" USING PLASTICIZERS TO AID IN WORKABILITY AND PLACEMENT.

SUGGESTED CONSTRUCTION SEQUENCE:

THE FOLLOWING SEQUENCE IS A GENERAL SEQUENCE AND MAY BE ADJUSTED IN THE FIELD BY THE CONTRACTOR TO SUIT FIELD CONDITIONS AD THEIR SCHEDULE.

1. ESTABLISH STREAM PROTECTION AS REQUIRED BY CONTRACT DOCUMENTS AND PRE-EXCAVATE AREA TO EL. 525 FEET OR LOWER.
2. LAYOUT THE PROPOSED ABUTMENT LOCATION AND COFFERDAM LIMITS.
3. CONSTRUCT UPPER AND LOWER LEVEL BRACING TO BE USED AS A DRIVING FRAME FOR THE SHEETPILES (AT CONTRACTOR'S OPTION). CONTRACTOR MAY ALSO GRADE AREA AND PREPARE A DRY LEVEL WORK SURFACE WITHIN THE COFFERDAM LIMITS TO CONSTRUCT THE BRACING. DRIVE PIN PILES IF NEEDED TO SUPPORT UPPER LEVEL BRACING ON RIVER SIDE OF COFFERDAM (SEE GENERAL NOTE 11)
4. DRIVE SHEETPILES TO THE REQUIRED TIP ELEVATIONS. PRE-EXCAVATE IF REQUIRED TO EASE SHEETPILE INSTALLATION.
5. INSTALL UPPER LEVEL OF BRACING, IF NOT DONE PREVIOUSLY, AND CONNECT TO SHEETPILES. MAKE SURE THAT INTERIM LEVEL OF BRACING IS PLACED UNDERNEATH UPPER LEVEL WITH STRAPS, CHAINS OR ROPE IN PLACE TO SUPPORT INTERIM LEVEL AS EXCAVATION PROGRESSES.
6. EXCAVATE WITHIN THE COFFERDAM DOWN TO 2 FEET BELOW THE PROPOSED INTERIM WALE BRACING AS SHOWN HEREIN. ALLOW INTERIM LEVEL OF BRACING TO BE LOWERED AS EXCAVATION PROGRESSES.
7. INSTALL BLOCKING BETWEEN SHEETPILE FACES AND INTERIM WALE BRACING.
8. CONTINUE EXCAVATION WITHIN COFFERDAM TO BOTTOM OF PROPOSED TREMIE SEAL.
9. DRIVE PROPOSED FOUNDATION PILES PER CONTRACT DOCUMENTS.
10. POUR TREMIE CONCRETE SEAL TO A MINIMUM OF 6 FEET THICK.
11. DEWATER COFFERDAM TO BOTTOM OF PROPOSED ABUTMENT FOOTING.
12. PREPARE SUBGRADE FOR ABUTMENT FOOTING PER CONTRACT DOCUMENTS.
13. REMOVE INTERIM BRACING LEVEL.
14. POUR ABUTMENT FOOTING PER CONTRACT DOCUMENTS.
15. POUR WINGWALLS AND ABUTMENT STEM PER CONTRACT DOCUMENTS. SEE GENERAL NOTE 10.
16. BACKFILL TO WITHIN 2 FEET TO THE UPPER LEVEL OF BRACING PER CONTRACT DOCUMENTS.
17. REMOVE UPPER LEVEL BRACING.
18. REMOVE SHEET PILES PER CONTRACT DOCUMENTS.
19. COMPLETE CONSTRUCTION OF ABUTMENT PER CONTRACT DOCUMENTS.

STATE OF VERMONT WILLIAM J. FRANK No. 8706 Civil LICENSED PROFESSIONAL ENGINEER

DESIGNED BY DLF					
DRAWN BY ST					
CHECKED BY WJF/DLF	NO.	DATE	DRWN.	CHKD	APPVD
APPROVED BY WJF	REVISIONS				

WARNING
IT IS A VIOLATION OF SECTION 7209.2 OF THE NEW YORK STATE EDUCATION LAW FOR ANY PERSON, UNLESS ACTING UNDER THE DIRECTION OF A LICENSED PROFESSIONAL ENGINEER, TO ALTER IN ANY WAY PLANS, SPECIFICATIONS, PLATS OR REPORTS TO WHICH THE SEAL OF A PROFESSIONAL ENGINEER HAS BEEN APPLIED. IF AN ITEM BEARING THE SEAL OF A PROFESSIONAL ENGINEER IS ALTERED THE ALTERING ENGINEER SHALL AFFIX TO THE ITEM HIS SEAL AND THE NOTATION "ALTERED BY" FOLLOWED BY HIS SIGNATURE, THE DATE, AND A SPECIFIC DESCRIPTION OF THE ALTERATION.'

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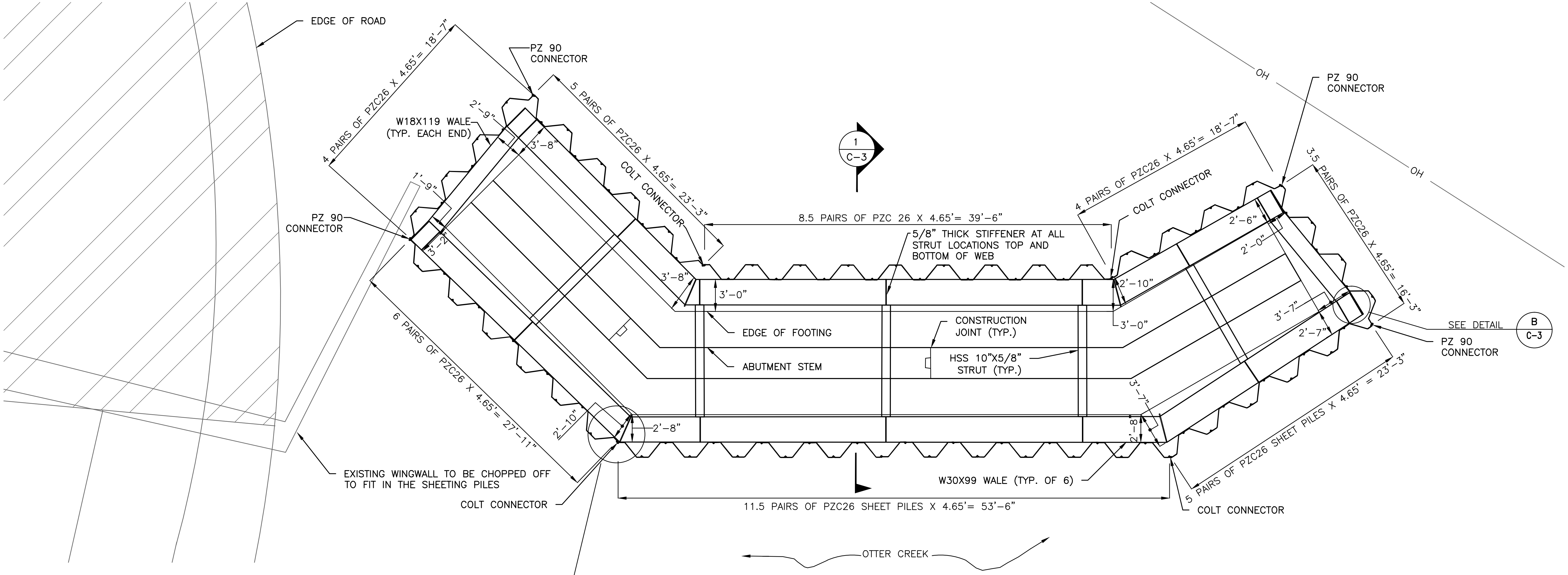
Construction, Structural, GeoStructural, and Value Engineering
4 Old Route 6
Brewster, New York 10509
wjfrankengineering.com
845-490-1393

DWG. TITLE
ABUTMENT NO. 1 COFFERDAM LAYOUT NOTES AND SEQUENCE

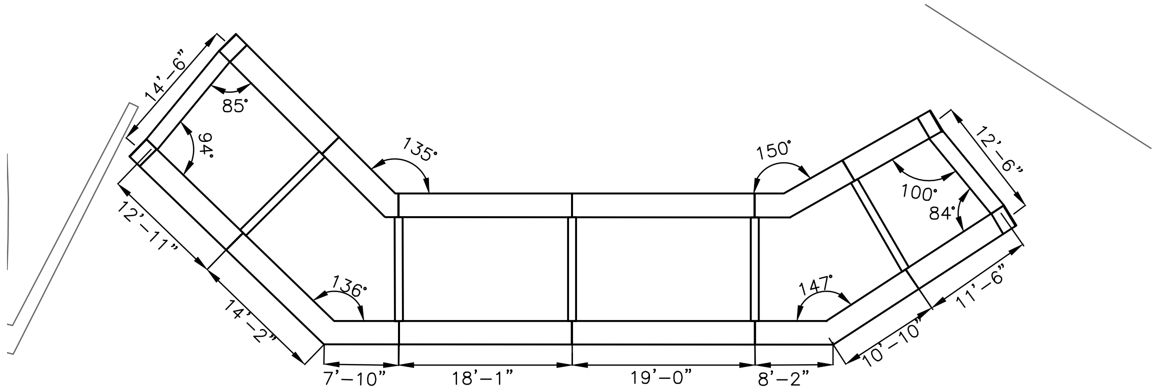
PROJECT
RIVER STREET BRIDGE
CITY OF RUTLAND
VTRANS PROJECT NO. BRF3000(16)

PROJECT NO. 14-049.01
SCALE AS NOTED
DATE 12/11/14
DRAWING NO. C-1
SHEET 1 OF 3



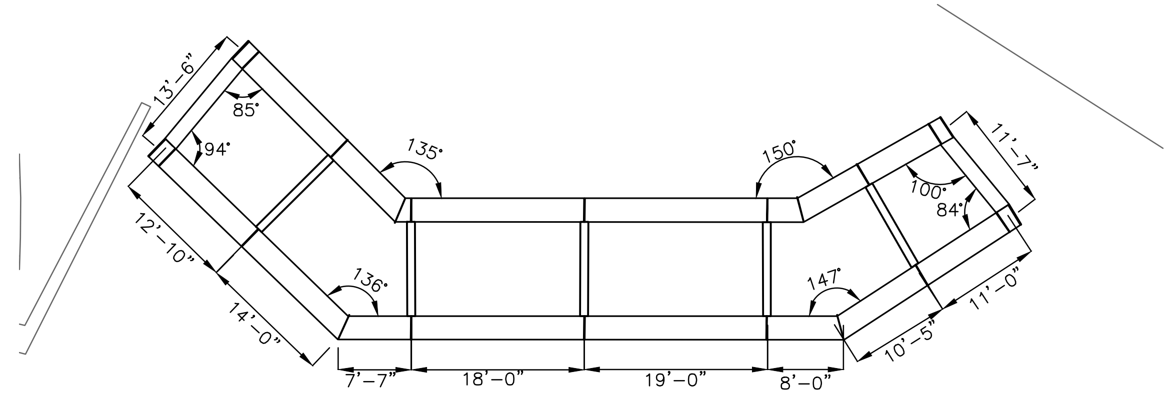
COFFERDAM LAYOUT PLAN

0 10' 20'
SCALE: 1" = 10'-0"



UPPER BRACING LEVEL LAYOUT

0 20' 40'
SCALE: 1" = 20'-0"



LOWER BRACING LEVEL LAYOUT

0 20' 40'
SCALE: 1" = 20'-0"

STATE OF VERMONT
WILLIAM J. FRANK
No. 8706
Civil
LICENSED
PROFESSIONAL ENGINEER

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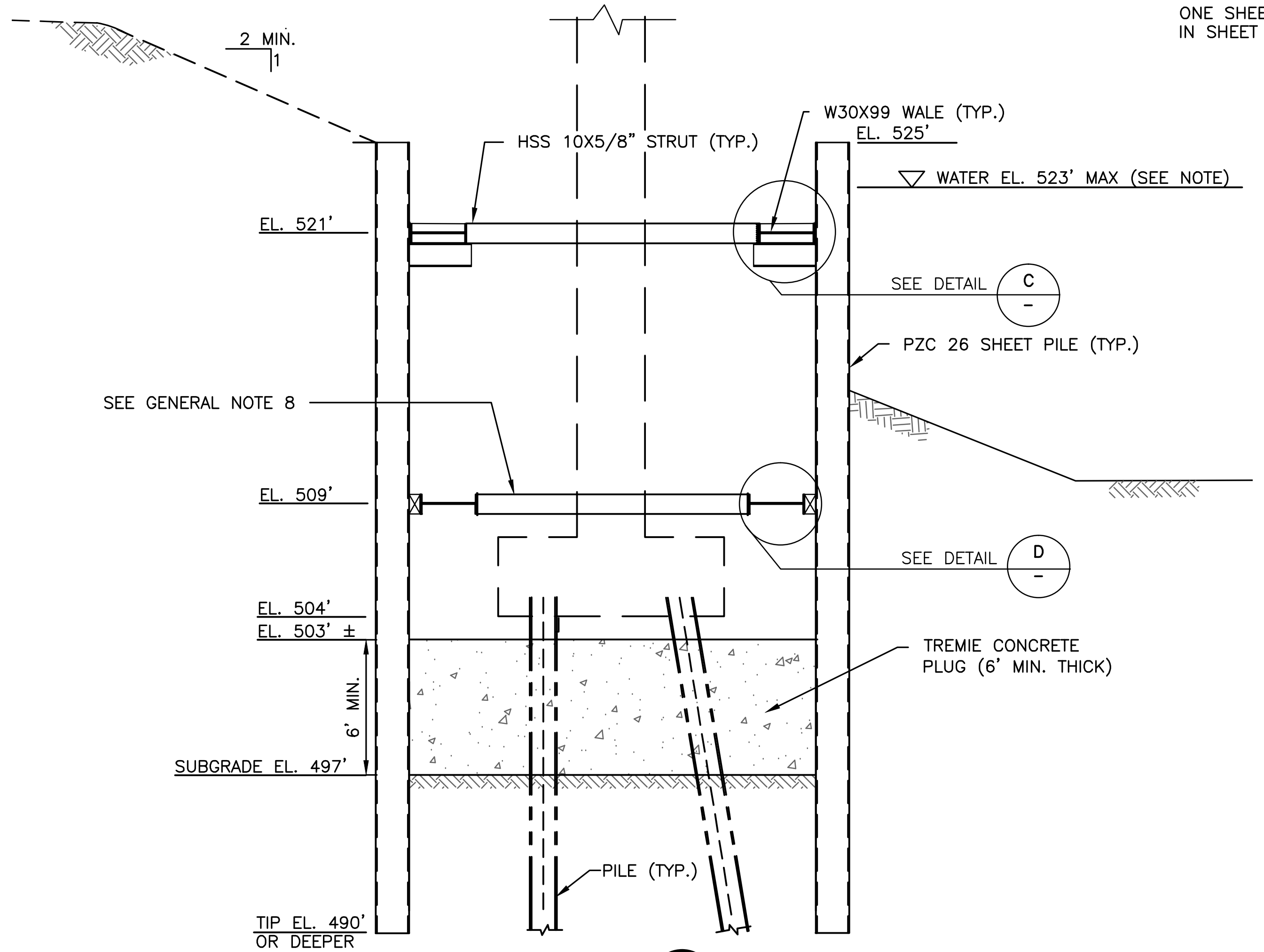
DWG. TITLE
ABUTMENT NO. 1 COFFERDAM LAYOUT PLAN

PROJECT
RIVER STREET BRIDGE
CITY OF RUTLAND
VTRANS PROJECT NO. BRF3000(16)

PROJECT NO. 14-049.01
SCALE AS NOTED
DATE 12/11/14
DRAWING NO. C-2
SHEET 2 OF 3

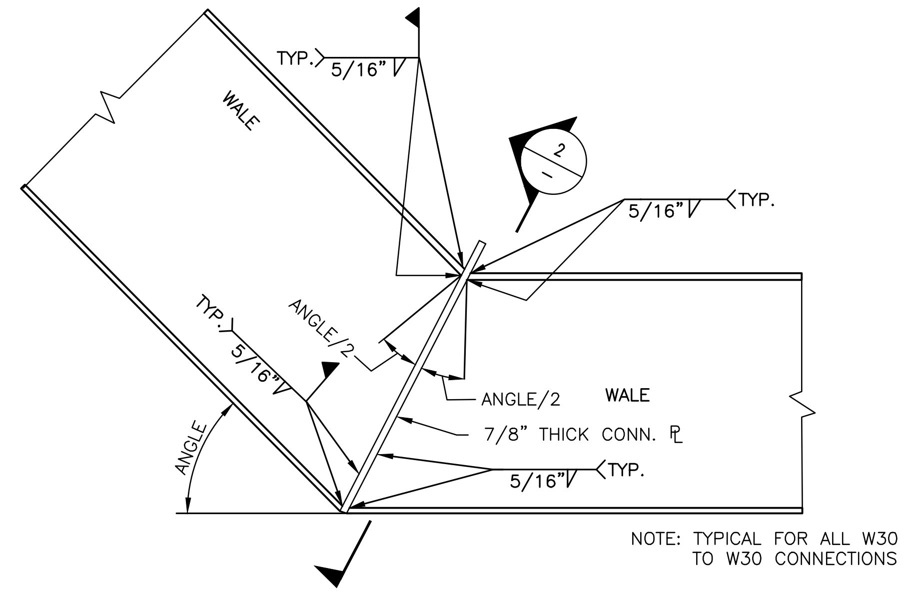
NOTE: ENSURE MAX. WATER EL. OF 523' BY LEAVING AT LEAST ONE SHEET PILE NO HIGHER THAN EL. 523' OF PROVIDING OPENING IN SHEET PILES.



SECTION 1 C-2

0 8' 16'

SCALE: 1/8" = 1'-0"

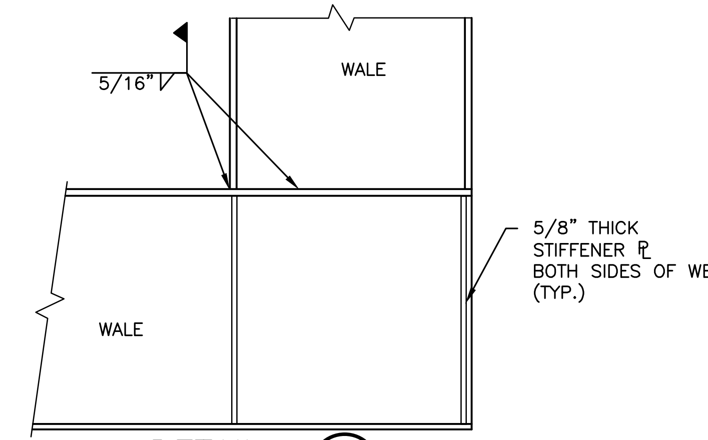


NOTE: TYPICAL FOR ALL W30 TO W30 CONNECTIONS

DETAIL A C-2

0 2' 4'

SCALE: 1/2" = 1'-0"

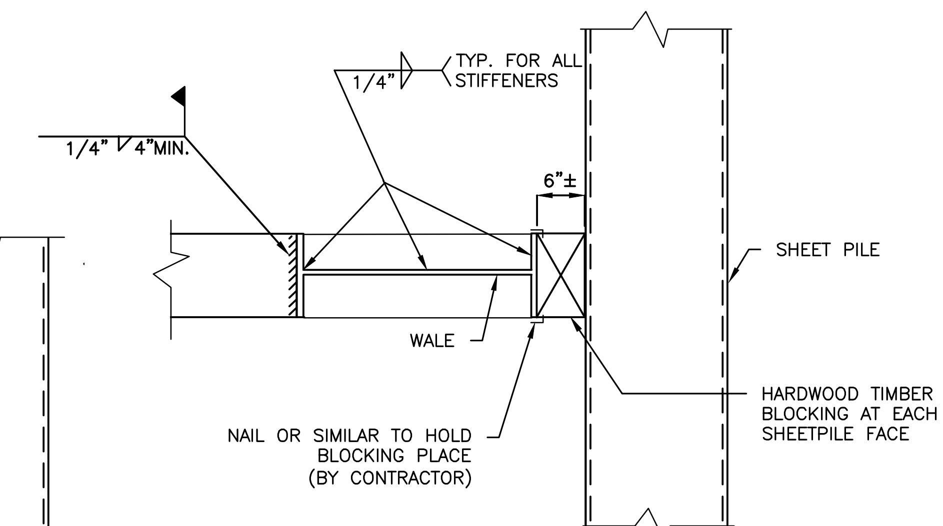


DETAIL B C-2

0 2' 4'

SCALE: 1/2" = 1'-0"

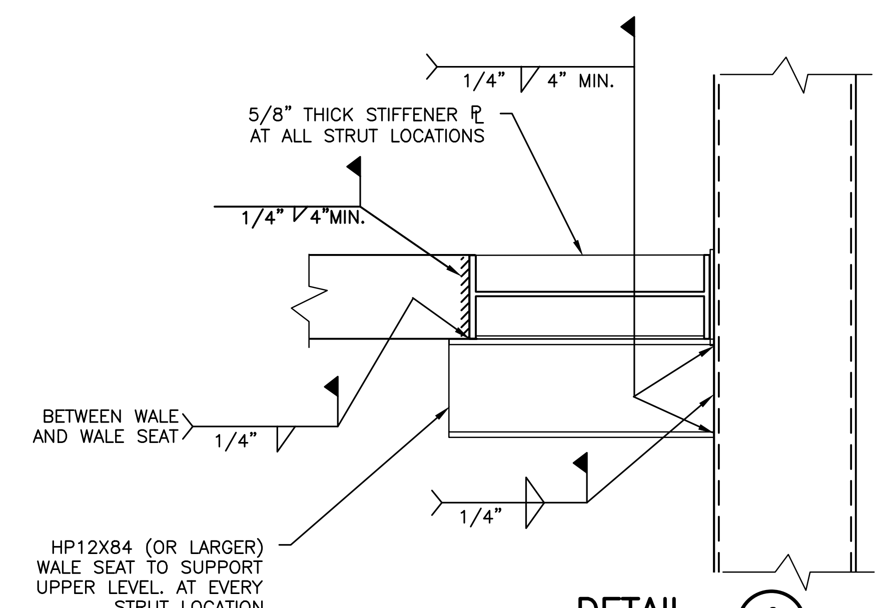
NOTE: TYPICAL FOR ALL W18 TO W30 CONNECTIONS



DETAIL D –

0 2' 4'

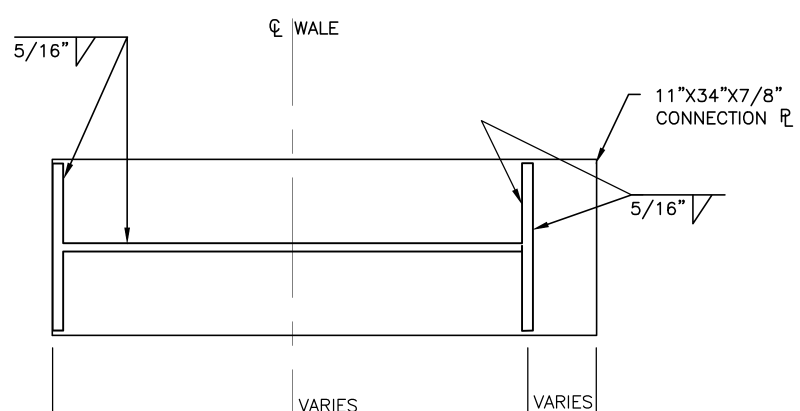
SCALE: 1/2" = 1'-0"



DETAIL C –

0 2' 4'

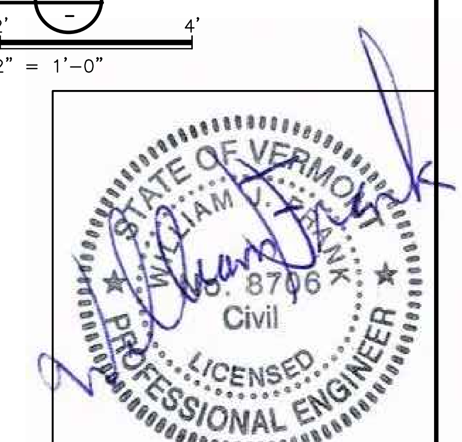
SCALE: 1/2" = 1'-0"



SECTION 2 –

0 1' 2'

SCALE: 1" = 1'-0"



DESIGNED BY DLF						
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DWG. TITLE
ABUTMENT NO. 1 COFFERDAM SECTIONS AND DETAILS

PROJECT
RIVER STREET BRIDGE
CITY OF RUTLAND
VTRANS PROJECT NO. BRF3000(16)

PROJECT NO.	14-049.01
SCALE AS NOTED	DATE 12/11/14
DRAWING NO.	C-3
SHEET 3 OF 3	

Design Submittal

Temporary Cofferdam at Abutment No. 1

River Street over Otter Creek
Rutland, VT

State of Vermont Agency of Transportation

Project Name: Rutland City
Project No.: BRF 3000 (16)

Prepared for:

Kubricky Construction Corp.
295 Ballard Road
Wilton, NY 12831

Prepared by:

William J. Frank Engineering, P.C.
4 Old Route 6
Brewster, NY 10509
845-490-1393

December 11, 2014

Job No. 14-049.01

SUPPORTING DESIGN CALCULATIONS

References:

1. Contract Drawings from State of Vermont Agency of Transportation for 'Rutland City' Project No. BRF 3000 (16)
2. AISC Manual of Steel Construction 14th Edition.

Introduction:

This submittal addresses the design of the temporary cofferdam to be used for construction of Abutment No. 1 for the River Street Bridge over Otter Creek. The cofferdam will be approximately 100 feet by 18 feet in plan, and will have a height from ground surface to bottom of tremie concrete seal of 28 feet. Design high water elevation will be 523 feet. At least some of the sheetpiles will be driven such that the top will be El. 523', to ensure that a water elevation greater than this will flood the cofferdam rather than exert more load on it.

A uniform vertical surcharge of 250 psf is assumed at the top of the wall to represent construction equipment and traffic load from the nearby River Street.

Per the borings on the contract drawings, the soil consists of a very compact sand and/or gravel. For design purposes the soil is considered granular with a friction angle of 37 degrees, a moist unit weight of 120 pcf and a saturated unit weight of 135 pcf.

The following calculations are included in this submittal:

- Estimate of the required tremie concrete thickness
- Shoring calculations to determine bracing loads, required sheetpile size and embedment.
- Calculations to check structural members to be used as bracing and check of connections.
- Calculations to check bracing connection to sheet piles.

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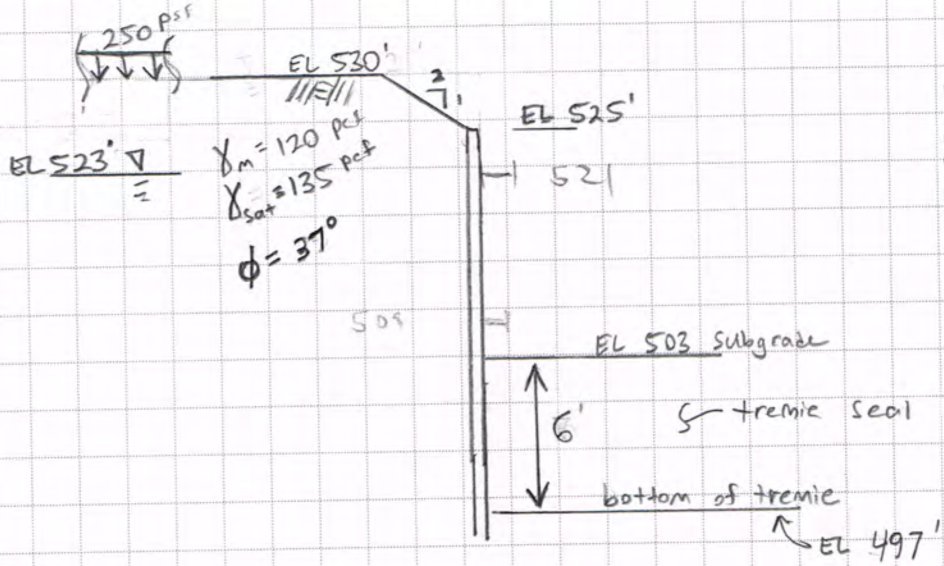
SOIL PROPERTIES FOR COFFERDAM DESIGN

Reference: boring B-101, B-102, B-102A

material is generally fill from about el. 522' to el. 530'. Then dense to v. dense sand and gravel below. Top of sheets will be @ el. 520'

Soil profile for cofferdam:



$K_a = 0.25$

$K_p = 4.0$

$\gamma_b = 135 - 62 = 73$ lbs/ft³

Brace @ EL 521' and EL 509'

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JOB 14-049.01
SHEET NO. 3 OF 40
CALCULATED BY DJF DATE 11-4-14
CHECKED BY CJF DATE 11-23-14
SCALE

DETERMINE HEIGHT of TREMIE SEAL

try 6' deep tremie seal

tremie footprint = 1500 sf

uplift = (20' + 5') × 62.4 lbs/ft³ × 1500 sf = 2340000 lbs = 2340 k

tremie weight = 6' × 1500 sf × 145 pcf = 1305000 lbs = 1305 k

net uplift = 1035 k

Consider abutment piles to resist uplift

Determine uplift of abutment pile group on following page.

Nominal uplift resistance = 1520 k + 561 k = 2081 k
(1520 k: straight piles (19 total); 561 k: battered piles (19 Total))

Consider adhesion to sheeting. Use 2 psi on (3' × 240') × 144 in²/ft² (5' thick − 2')

total resistance from sheeting = 2 psi × 3' × 240' × 144 in²/ft² = 207360 lbs.
= 207 k

Check weight of Sheeting = 30' long × 240' × 74 lbs/ft = 532800 lbs
= 533 k < 207 k

F.S. against uplift = $\frac{1305 + 2081 + 207}{2340}$ = 1.54 ≈ 1.5 ∴ say (OK)

PRODUCT 204-1 (Single Sheets) 205-1 (Padded)

ESTIMATE PILE UPLIFT RESISTANCE

per AASHTO 10.7.3.10 estimate uplift resistance per AASHTO 10.7.3.8.6

$R_s = q_s A_s$

$q_s = K_\delta C_F \sigma_v' \dfrac{\sin(\delta+\omega)}{\cos\omega}$ $\qquad \sigma_v' = (135^{pcf} - 62^{pcf})(29'/2) = 1059$ psf

$V = 34.4\ in^2/144 \times 1' = 0.24\ ft^3/ft$ $\qquad K_\delta = 1.15$ (figure 10.7.3.8.6f-3)

$\delta/\phi = 0.85$ (figure 10.7.3.8.6f-6) $\qquad \delta = 0.85(35°) = 30°$ $\qquad \phi = 37°$ say (ok)

$C_F = 0.93$ (figure 10.7.3.8.6f-5)

$q_s = 1.15(0.93)(1.06^{ksf})\sin(30°) = 0.57^{ksf}$

$A_s = \left[\left(14.2''/12 \times 2\right) + \left(14.9''/12 \times 2\right)\right] \times 29' = 141^{sf}$

$R_s = 0.57^{ksf} \times 141^{sf} = 80^k$

Pile group uplift resistance per AASHTO 10.7.3.11

$R_{ug} = 19 \times 80^k = 1520^k$ ← controls

or based on uplift of the soil — only soil adjacent to battered piles considered

$V_{soil} = (88 + 29/4) * (1 + 29/4) \times 29' = 22789^{cf}$

(↑ length, ↑ width, ↑ height)

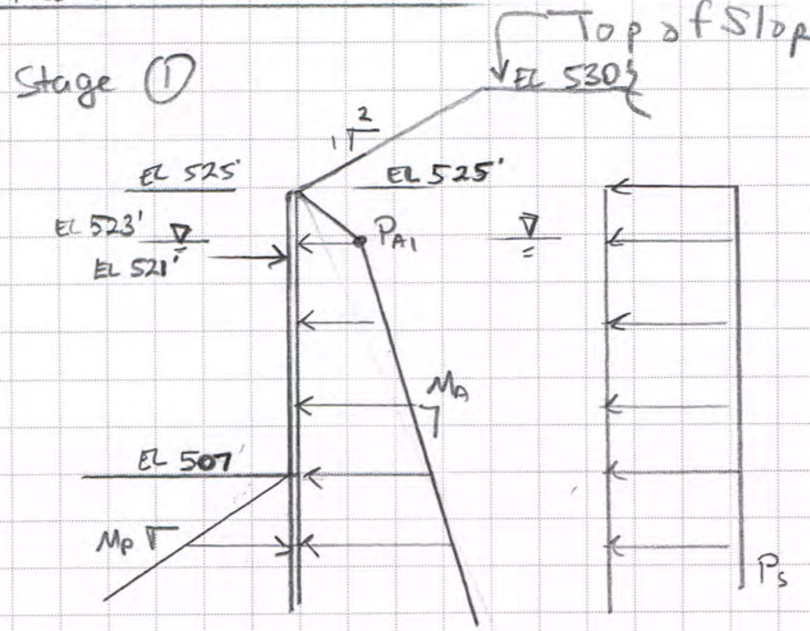
$R_{ug} = (135-62) \times 22789^{cf} = 1663597^{lbs} = 1664^k$

For straight piles consider friction between tremie concrete & steel

$10^{psi} \times 5' \times 4.6' \times 144^{in^2/ft^2} = 33^{k/pile} < 80^k$ ∴ use $33^k \times 17^{pile} = 561^k$ for straight piles.

PRESSURE DIAGRAMS -

Stage (1)



$P_{A_1} = 2'(0.120\ kcf)(0.25)$
$= 0.06\ ksf$

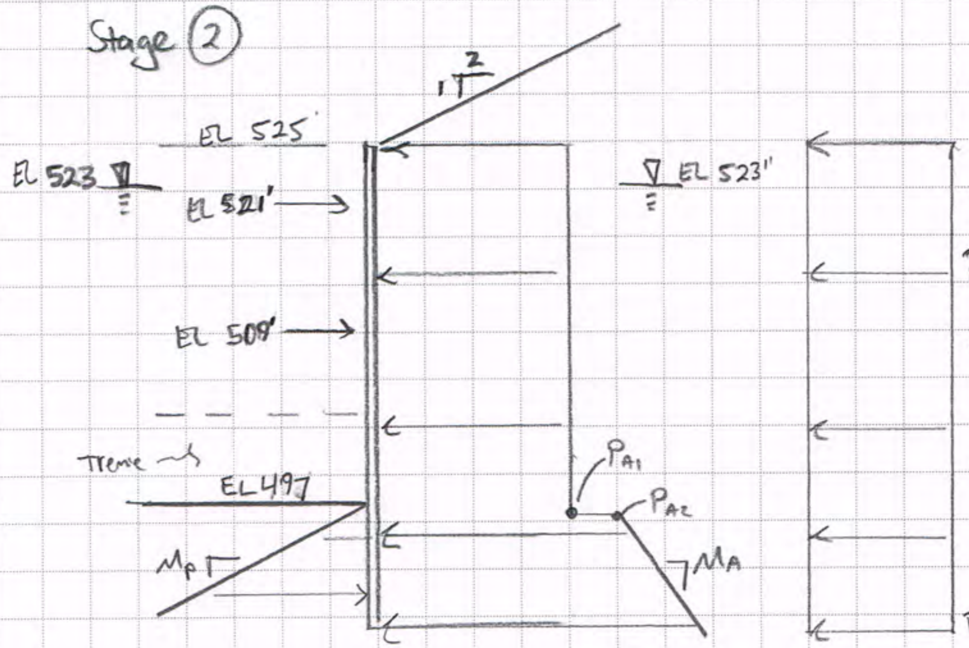
$M_A = 0.25(0.073\ kcf) = 0.0183\ ksf/ft$

$P_s = [250\ psf + (5 \times 120)](0.25) = 0.213$

Weight of soil from slope

$M_p = 4.0(0.073\ kcf) = 0.292\ ksf/ft$

Stage (2)



$\gamma_{Avg} = \frac{2(.120) + 26(0.073)}{28'} = 0.076\ kcf$

$P_{A1} = 0.65\ K_A\ \gamma_{Avg}\ h$

$P_{A1} = (0.65)(28)(0.076)(0.25) = 0.346\ ksf$

$P_{A2} = 28(0.076)(0.25) = 0.532\ ksf$

$M_A = 0.0183\ ksf/ft$

$M_p = 0.292\ ksf/ft$

$P_s = 0.213$

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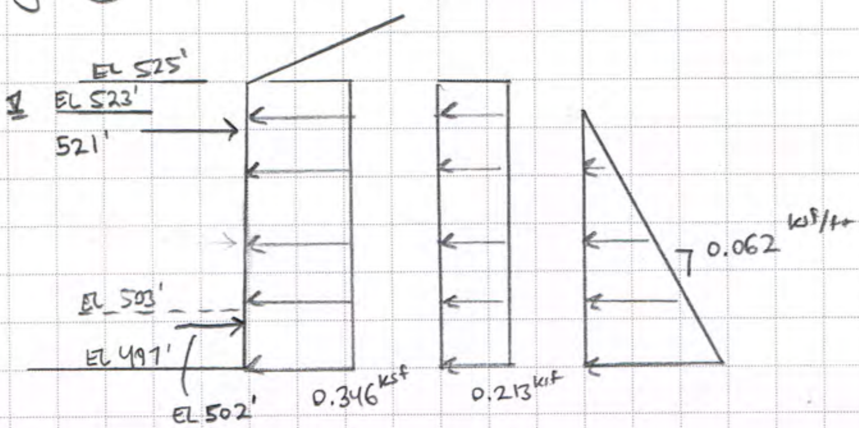
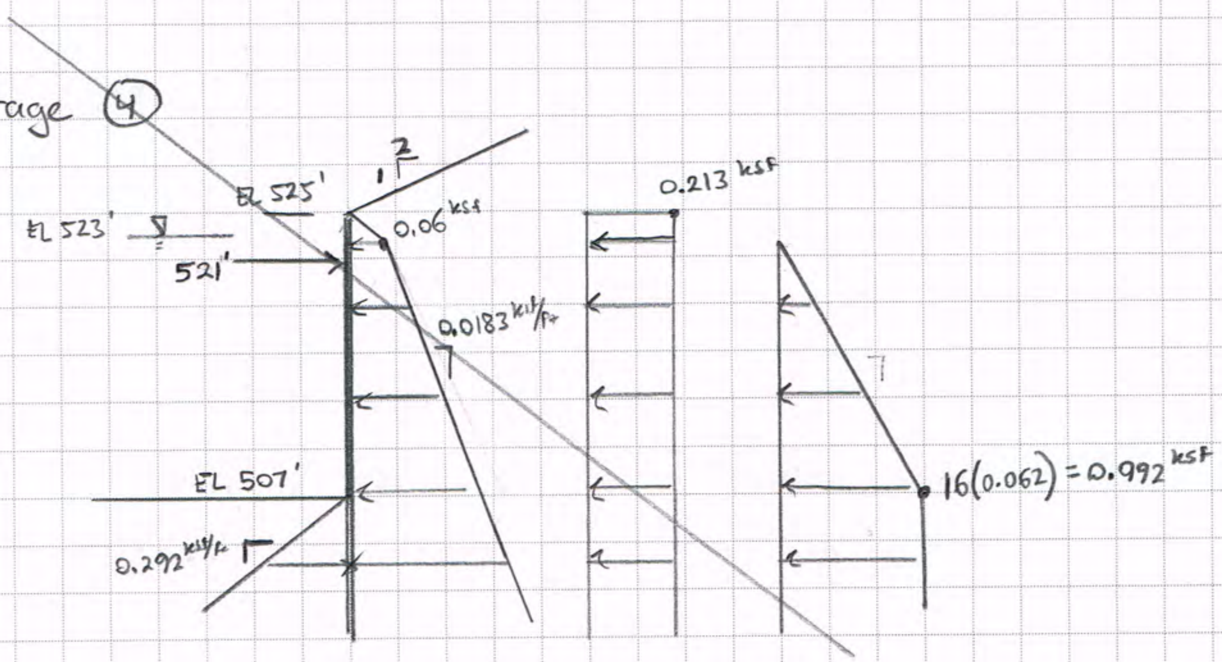
JOB 14-049.01
SHEET NO. 6 OF 40
CALCULATED BY DJF DATE 11-19-14
CHECKED BY CJF DATE 11-23-14
SCALE

Stage (3)



Stage (4)



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JOB 14-049.01
SHEET NO. 7 OF 40
CALCULATED BY DLF DATE 11-19-14
CHECKED BY CJF DATE 11-23-14
SCALE

CT-SHORING RESULTS

S_x required = 12.4 in^3/ft < 48.4 in^3/ft ∴ PZC26 OK

tip el. 490' or deeper (7' embedment)

upper brace force = 11.4 k/ft

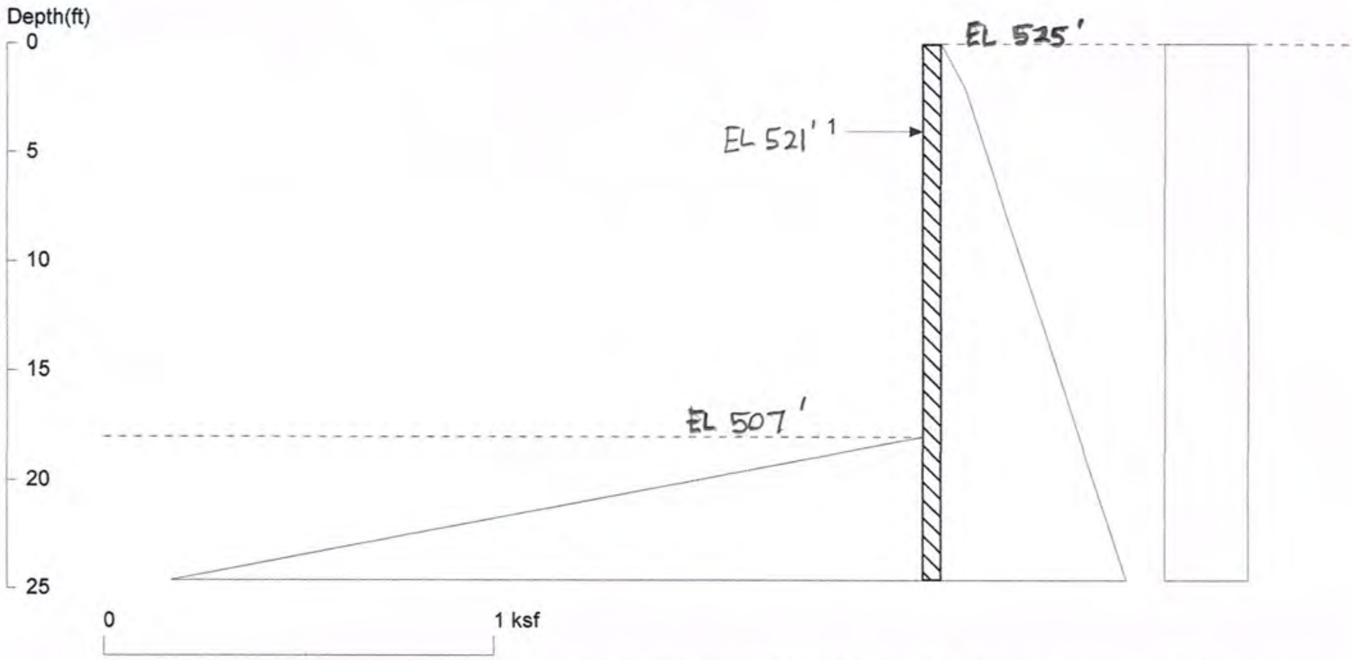
interim brace force = 12.0 k/ft

force on tremie = 25.1 k/ft

PRODUCT 204-1 (Single Sheets) 205-1 (Padded)

BY DJF 11-19-14 8/40
Chk CJF 11-23-14

River Road Cofferdam
Stage 1



<ShoringSuite> CIVILTECH SOFTWARE USA www.civiltechsoftware.com

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File: P:\Project Files\2014\14-049 Rutland VT Bridges (Kubricky)\14-049.01 Rutland VT Bridges\Calculations\River Road

Wall Height=18.0 Pile Diameter=1.0 Pile Spacing=1.0 Wall Type: 1. Sheet Pile

x1.2 = 7.9' tip el. 499'

PILE LENGTH: Min. Embedment=6.60 (8~10ft is recommended!!!) Min. Pile Length=24.60 (in graphics and analysis)
MOMENT IN PILE: Max. Moment=18.50 per Pile Spacing=1.0 at Depth=13.77

PILE SELECTION:
Request Min. Section Modulus = 6.7 in3/ft=361.66 cm3/m, Fy= 50 ksi = 345 MPa, Fb/Fy=0.66
-> Piles meet Min. Section Requirements: Top Deflection is shown in (in)

CS60 (-1.26) NSZ10 (-0.94) NSZ11 (-0.86) CS69 (-1.08) SZ12 (-0.71)
CS76 (-0.98) NSZ12 (-0.74) SZ14 (-0.71) SZ15 (-0.71) NSZ14 (-0.65)
CZ67 (-0.61) PDA27 (-0.65) NSZ15 (-0.62) CZ72 (-0.56)

BRACE FORCE: Strut, Tieback, Plate Anchor, and Deadman

No. & Type	Depth	Angle	Space	Total F.	Horiz. F.	Vert. F.	N/A	N/A
1. Strut	4.0	0.0	1.0	5.0	5.0	0.0	0.0	0.0

UNITS: Width,Diameter,Spacing,Length,Depth,and Height - ft; Force - kip; Bond Strength and Pressure - ksf

DRIVING PRESSURES (ACTIVE, WATER, & SURCHARGE):

Z1	P1	Z2	P2	Slope
0	0	2	.06	0.030000
2	.06	50	0.935	0.018318
0	.213	50	0.213	0

PASSIVE PRESSURES:

Z1	P1	Z2	P2	Slope
18	0	50	9.344	.292

ACTIVE SPACING:

No.	Z depth	Spacing
1	0.00	1.00
2	18.00	1.00

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Chk CJF 11-23-14

PASSIVE SPACING:

No.	Z depth	Spacing
1	0.00	1.00

UNITS: Width,Spacing,Diameter,Length,and Depth - ft; Force - kip; Moment - kip-ft
Friction,Bearing,and Pressure - ksf; Pres. Slope - kip/ft3; Deflection - in

River Road Cofferdam
Stage 2

BY DJF 11-19-14
Chk CSF 11-23-14
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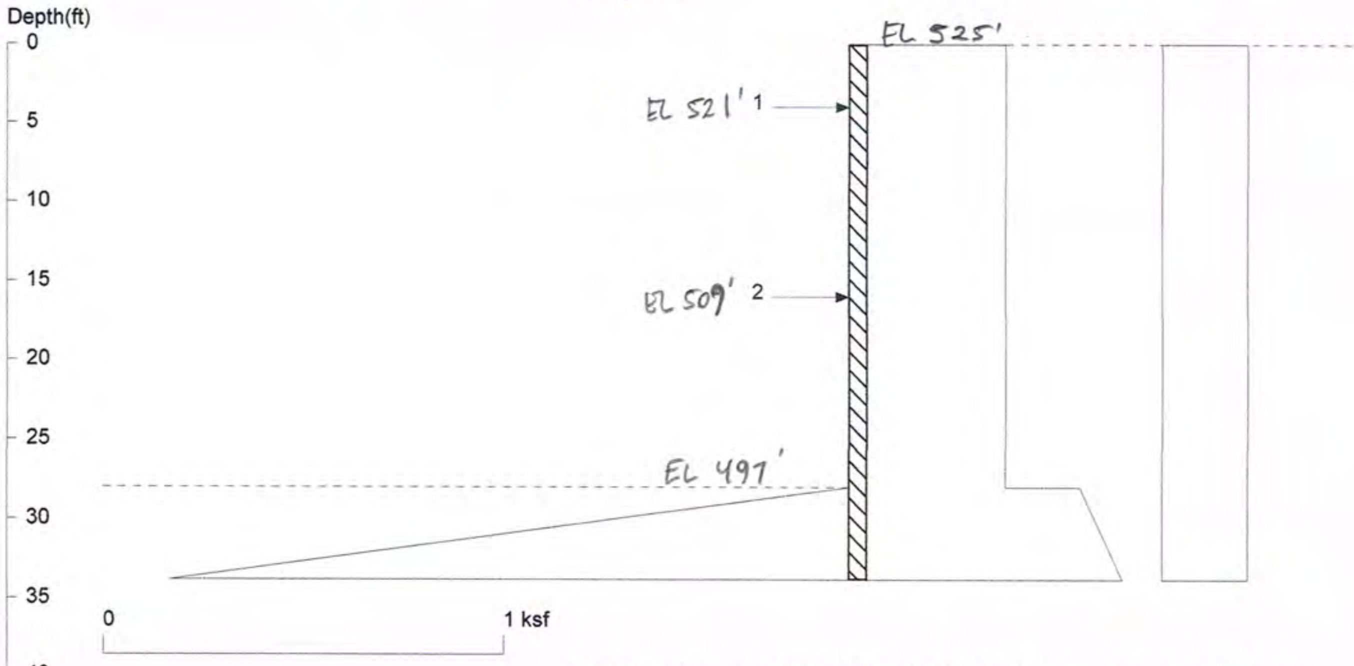

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File: P:\Project Files\2014\14-049 Rutland VT Bridges (Kubricky)\14-049.01 Rutland VT Bridges\Calculations\River Road S

Wall Height=28.0 Pile Diameter=1.0 Pile Spacing=1.0 Wall Type: 1. Sheet Pile

x1.2 = 7' tip el. 490' controls.

PILE LENGTH: Min. Embedment=5.80 (8~10ft is recommended!!!) Min. Pile Length=33.80 (in graphics and analysis)
User inputted Embedment=5.80, Pile Length=33.80
MOMENT IN PILE: Max. Moment=32.43 per Pile Spacing=1.0 at Depth=15.99

PILE SELECTION:
Request Min. Section Modulus = 11.8 in3/ft=633.88 cm3/m, Fy= 50 ksi = 345 MPa, Fb/Fy=0.66
-> Piles meet Min. Section Requirements: Top Deflection is shown in (in)
1BXN (0.00) SZ14.5 (0.00) 1N (0.00) Z65 (0.00) CZ84 (0.00)
BZ7 (0.00) H95 (0.00) SZ145U (0.00) CZ14 (0.00) Z70 (0.00)
CZ95RD (0.00) CZ95 (0.00) Z75 (0.00) CZ16 (0.00)

BRACE FORCE: Strut, Tieback, Plate Anchor, and Deadman

No. & Type	Depth	Angle	Space	Total F.	Horiz. F.	Vert. F.	N/A	N/A
1. Strut	4.0	0.0	1.0	3.3	3.3	0.0	0.0	0.0
2. Strut	16.0	0.0	1.0	12.0	12.0	0.0	0.0	0.0

UNITS: Width,Diameter,Spacing,Length,Depth,and Height - ft; Force - kip; Bond Strength and Pressure - ksf

DRIVING PRESSURES (ACTIVE, WATER, & SURCHARGE):

Z1	P1	Z2	P2	Slope
0	.346	28	0.346	0
28	.532	50	0.935	0.018318
0	.213	50	0.213	0

PASSIVE PRESSURES:

Z1	P1	Z2	P2	Slope
28	0	50	6.424	.292

ACTIVE SPACING:

No.	Z depth	Spacing
1	0.00	1.00
2	28.00	1.00

PASSIVE SPACING:

By DLF 11-19-14

~~Chk CJF 11-23-14~~

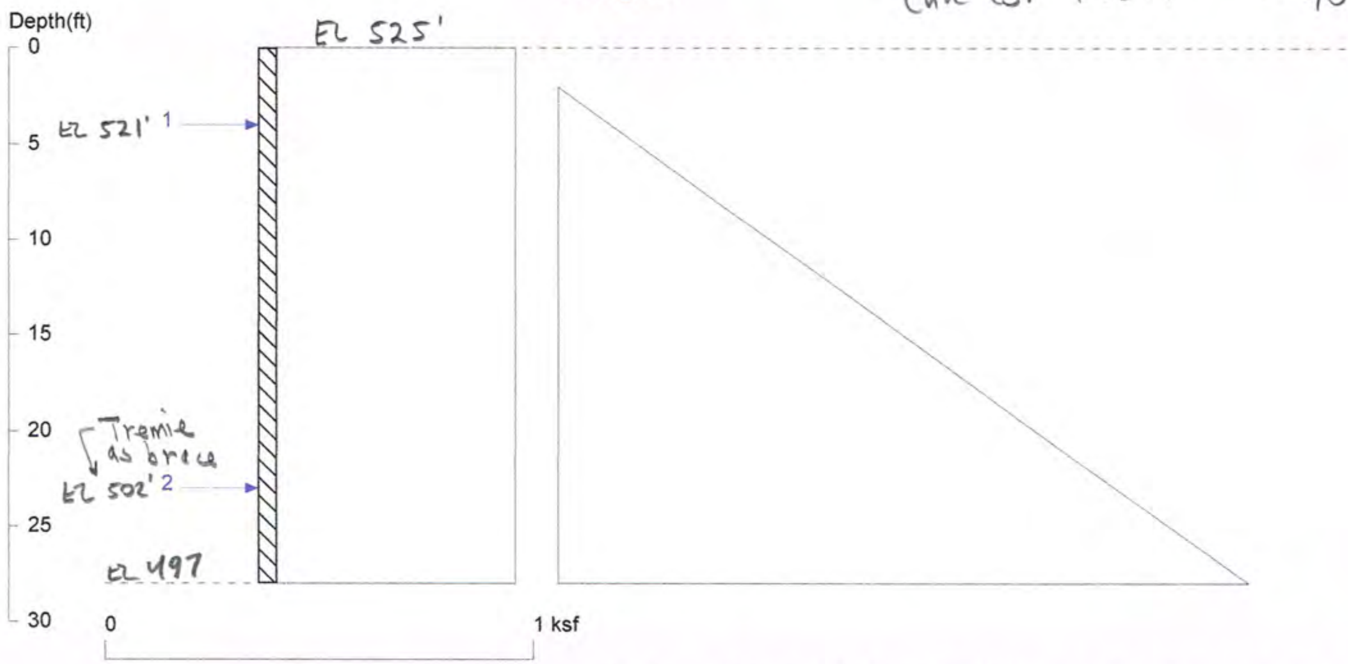
No.	Z depth	Spacing
1	0.00	1.00

UNITS: Width,Spacing,Diameter,Length,and Depth - ft; Force - kip; Moment - kip-ft
Friction,Bearing,and Pressure - ksf; Pres. Slope - kip/ft3; Deflection - in

River Road Cofferdam

Stage 3

BY DJF 11-19-14
Chk CJF 11-23-14



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Wall Height=28.0 Pile Diameter=1.0 Pile Spacing=1.0 Wall Type: 1. Sheet Pile

MOMENT IN PILE: Max. Moment=34.01 per Pile Spacing=1.0 at Depth=12.62

PILE SELECTION:
Request Min. Section Modulus = 12.4 in3/ft=664.94 cm3/m, Fy= 50 ksi = 345 MPa, Fb/Fy=0.66
-> Piles meet Min. Section Requirements: Top Deflection is shown in (in)
1BXN (0.00) SZ14.5 (0.00) 1N (0.00) Z65 (0.00) CZ84 (0.00)
BZ7 (0.00) H95 (0.00) SZ145U (0.00) CZ14 (0.00) Z70 (0.00)
CZ95RD (0.00) CZ95 (0.00) Z75 (0.00) CZ16 (0.00)

BRACE FORCE: Strut, Tieback, Plate Anchor, and Deadman

No. & Type	Depth	Angle	Space	Total F.	Horiz. F.	Vert. F.	N/A	N/A
1. Strut	4.0	0.0	1.0	11.4	11.4	0.0	0.0	0.0
2. Strut	23.0	0.0	1.0	25.1	25.1	0.0	0.0	0.0

UNITS: Width,Diameter,Spacing,Length,Depth,and Height - ft; Force - kip; Bond Strength and Pressure - ksf

DRIVING PRESSURES (ACTIVE, WATER, & SURCHARGE):

Z1	P1	Z2	P2	Slope
0	.556	28	.556	0.000000
2	0	28	1.612	.062

PASSIVE PRESSURES:

Z1	P1	Z2	P2	Slope
28	0	50	6.424	.292

ACTIVE SPACING:

No.	Z depth	Spacing
1	0.00	1.00
2	28.00	1.00

PASSIVE SPACING:

No.	Z depth	Spacing
1	0.00	1.00

BY DLF 11-19-14
Chk CJF 11-23-14

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UNITS: Width,Spacing,Diameter,Length,and Depth - ft; Force - kip; Moment - kip-ft
Friction,Bearing,and Pressure - ksf; Pres. Slope - kip/ft3; Deflection - in

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Nodes

Node	X (ft)	Y (ft)	Z (ft)
1	-18.772	18.772	0.000
2	-7.379	7.379	0.000
3	0.000	0.000	0.000
4	8.000	0.000	0.000
5	27.000	0.000	0.000
6	46.000	0.000	0.000
7	53.500	0.000	0.000
8	61.705	4.748	0.000
9	74.134	12.017	0.000
10	-7.458	30.085	0.000
11	3.935	18.692	0.000
12	8.000	16.000	0.000
13	27.000	16.000	0.000
14	46.000	16.000	0.000
15	53.729	18.618	0.000
16	66.138	25.876	0.000

Beams

Beam	Node A	Node B	Length (ft)	Property	β (degrees)
1	1	2	16.112	1	0
2	2	3	10.435	1	0
3	3	4	8.000	1	0
4	4	5	19.000	1	0
5	5	6	19.000	1	0
6	6	7	7.500	1	0
7	7	8	9.480	1	0
8	9	8	14.398	1	0
9	1	10	16.000	2	0
10	2	11	16.000	2	0
11	4	12	16.000	2	0
12	5	13	16.000	2	0
13	6	14	16.000	2	0
14	8	15	16.000	2	0
15	9	16	16.000	2	0

Section Properties

Prop	Section	Area (in^2)	I_{yy} (in^4)	I_{zz} (in^4)	J (in^4)	Material
1	W30X99	29.100	128.000	3.99E+3	3.454	STEEL
2	HSSP10X0.5	13.900	159.000	159.000	317.349	STEEL

Materials

Mat	Name	E (kip/in²)	ν	Density (kip/in³)	α (/°F)
1	STEEL	29E+3	0.300	0.000	6E -6
2	STAINLESSSTEEL	28E+3	0.300	0.000	10E -6
3	ALUMINUM	10E+3	0.330	0.000	13E -6
4	CONCRETE	3.15E+3	0.170	0.000	5E -6

Supports

Node	X (kip/in)	Y (kip/in)	Z (kip/in)	rX (kip˙ft/deg)	rY (kip˙ft/deg)	rZ (kip˙ft/deg)
1	-	-	Fixed	-	-	-
2	-	-	Fixed	-	-	-
4	-	-	Fixed	-	-	-
5	-	-	Fixed	-	-	-
6	-	-	Fixed	-	-	-
8	-	-	Fixed	-	-	-
9	-	-	Fixed	-	-	-
10	Fixed	Fixed	Fixed	-	-	-
11	Fixed	Fixed	Fixed	-	-	-
12	Fixed	Fixed	Fixed	-	-	-
13	Fixed	Fixed	Fixed	-	-	-
14	Fixed	Fixed	Fixed	-	-	-
15	Fixed	Fixed	Fixed	-	-	-
16	Fixed	Fixed	Fixed	-	-	-

Releases

Beam ends not shown in this table are fixed in all directions.

Beam	Node	x	y	z	rx	ry	rz
2	3	Fixed	Fixed	Fixed	Pin	Pin	Pin
3	3	Fixed	Fixed	Fixed	Pin	Pin	Pin
6	7	Fixed	Fixed	Fixed	Pin	Pin	Pin
7	7	Fixed	Fixed	Fixed	Pin	Pin	Pin
9	1	Fixed	Fixed	Fixed	Pin	Pin	Pin
10	2	Fixed	Fixed	Fixed	Pin	Pin	Pin
11	4	Fixed	Fixed	Fixed	Pin	Pin	Pin
12	5	Fixed	Fixed	Fixed	Pin	Pin	Pin
13	6	Fixed	Fixed	Fixed	Pin	Pin	Pin
14	8	Fixed	Fixed	Fixed	Pin	Pin	Pin
15	9	Fixed	Fixed	Fixed	Pin	Pin	Pin

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Basic Load Cases

Number	Name
1	BRACING LOAD

Combination Load Cases

There is no data of this type.

Beam Loads : 1 BRACING LOAD

Beam	Type		Direction	Fa	Da (ft)	Fb	Db	Ecc. (ft)
1	UNI	lbf/ft	Y	12E+3	-	-	-	-
2	UNI	lbf/ft	Y	12E+3	-	-	-	-
3	UNI	lbf/ft	Y	12E+3	-	-	-	-
4	UNI	lbf/ft	Y	12E+3	-	-	-	-
5	UNI	lbf/ft	Y	12E+3	-	-	-	-
6	UNI	lbf/ft	Y	12E+3	-	-	-	-
7	UNI	lbf/ft	Y	12E+3	-	-	-	-
8	UNI	lbf/ft	Y	12E+3	-	-	-	-
9	UNI	lbf/ft	Y	-12E+3	-	-	-	-
15	UNI	lbf/ft	Y	-12E+3	-	-	-	-

Beam Maximum Axial Forces

Distances to maxima are given from beam end A.

Beam	Node A	Length (ft)	L/C		d (ft)	Max Fx (kip)
1	1	16.112	1:BRACING LC	Max -ve	0.000	96.000
				Max +ve		
2	2	10.435	1:BRACING LC	Max -ve	0.000	96.000
				Max +ve		
3	3	8.000	1:BRACING LC	Max -ve	0.000	102.696
				Max +ve		
4	4	19.000	1:BRACING LC	Max -ve	0.000	102.696
				Max +ve		
5	5	19.000	1:BRACING LC	Max -ve	0.000	102.696
				Max +ve		
6	6	7.500	1:BRACING LC	Max -ve	0.000	102.696
				Max +ve		
7	7	9.480	1:BRACING LC	Max -ve	0.000	97.368
				Max +ve		
8	9	14.398	1:BRACING LC	Max -ve	0.000	96.435
				Max +ve		
9	1	16.000	1:BRACING LC	Max -ve	0.000	88.009
				Max +ve		

Compression load at shear splice connection

max. wale axial load

Max axial for end wales

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Beam Maximum Axial Forces Cont...

Beam	Node A	Length (ft)	L/C		d (ft)	Max Fx (kip)
10	2	16.000	1:BRACING LC	Max -ve	0.000	181.322
				Max +ve		
11	4	16.000	1:BRACING LC	Max -ve	0.000	160.809
				Max +ve		
12	5	16.000	1:BRACING LC	Max -ve	0.000	255.455
				Max +ve		
13	6	16.000	1:BRACING LC	Max -ve	0.000	175.731
				Max +ve		
14	8	16.000	1:BRACING LC	Max -ve	0.000	176.162
				Max +ve		
15	9	16.000	1:BRACING LC	Max -ve	0.000	73.722
				Max +ve		

Max Strut Axial Load

18/40

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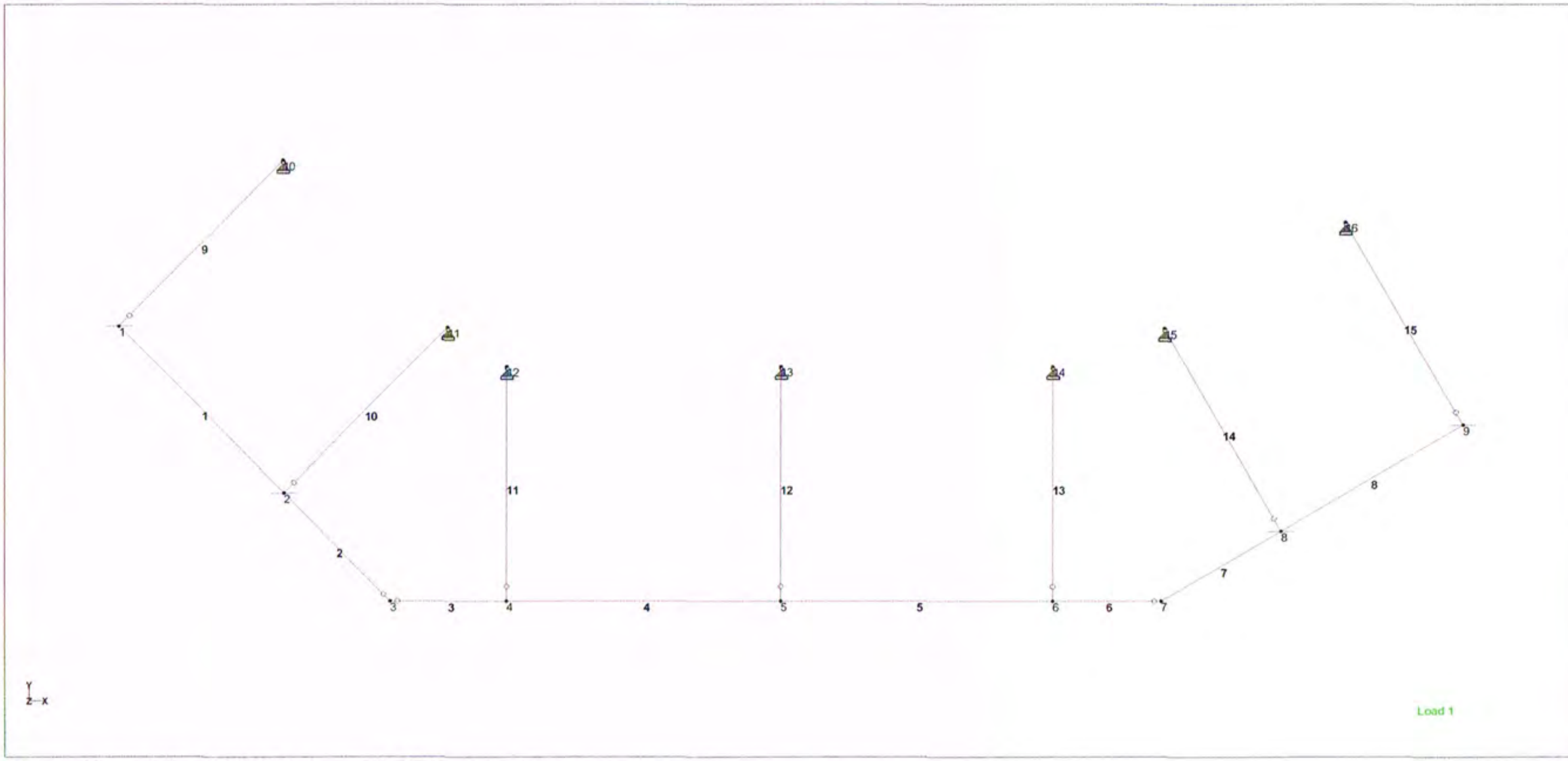

Node and Beam Labels (Input data was modified after picture taken)

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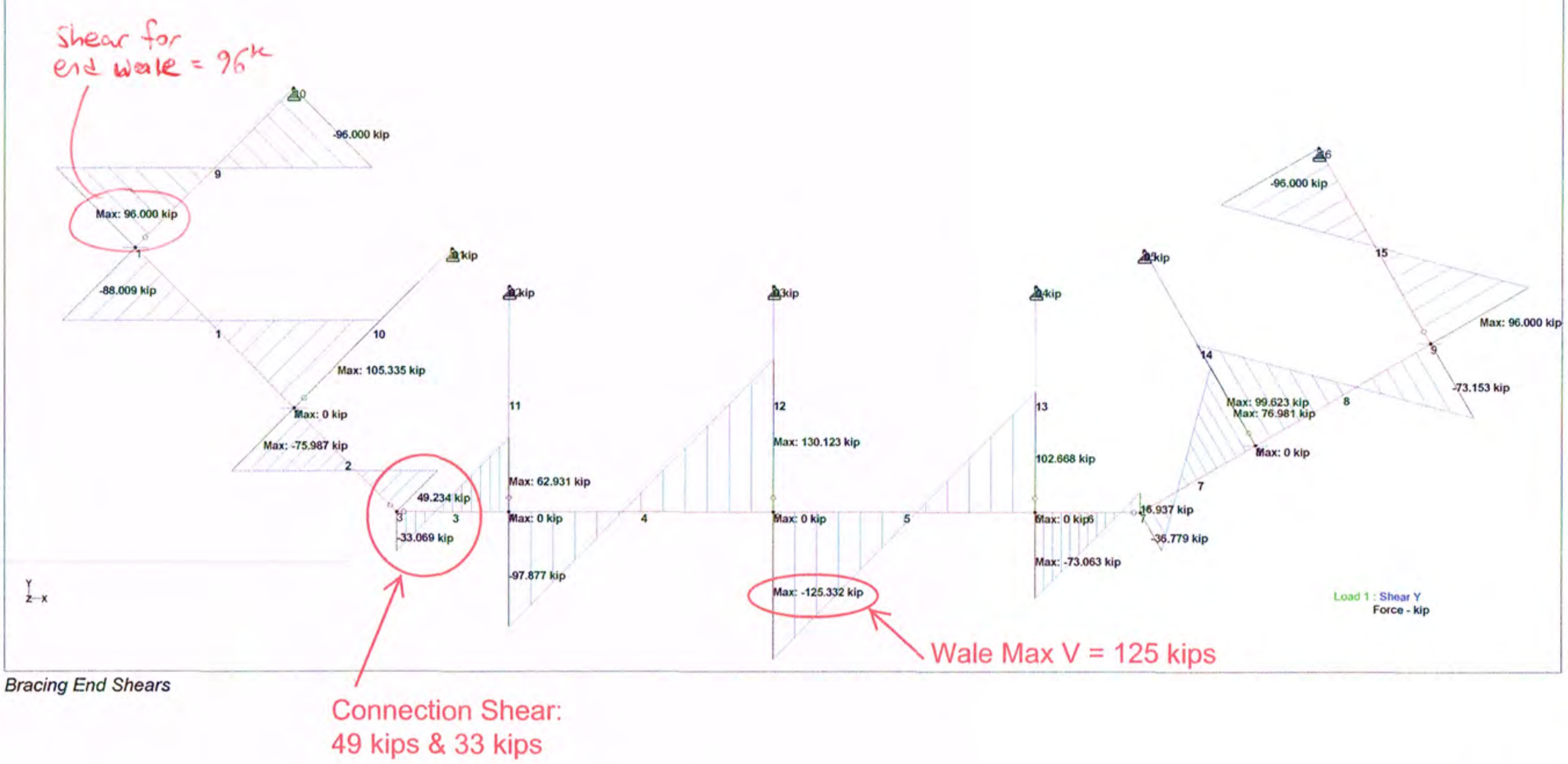

Bracing End Shears

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Job Title

Client

Bracing Max Moments

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JOB 14-049.01
SHEET NO. 21 OF 40
CALCULATED BY DJF DATE 12-4-14
CHECKED BY CJF DATE 12-5-14
SCALE

CHECK W30x99 WALES

MOMENT CAPACITY OF ROLLED W SHAPE: **-Wales**

This spreadsheet determines the allowable moment of a rolled W-shape in accordance with AISC 14th Edition Section F2 Note: Compact flanges and webs are assumed

Member Information:

Designation: W30x99

Zx =	312 in^3	rts =	2.62 in
Zy =	38.6 in^3	ry =	2.1 in
Sx =	269 in^3	J =	3.77 in^4
Sy =	24.5 in^3	ho =	29 in

Mp = Fy * Zx = 15600 kip-in

$$L_p = 1.76 r_y \sqrt{\frac{E}{F_y}} \qquad \text{(F2-5)}$$

$$L_r = 1.95 r_{ts} \frac{E}{0.7F_y} \sqrt{\frac{J_c}{S_x h_o}} \sqrt{1 + \sqrt{1 + 6.76\left(\frac{0.7F_y}{E}\frac{S_x h_o}{J_c}\right)}} \qquad \text{(F2-6)}$$

Lp = 7.42 ft
Lr = 21.34 ft

STRONG AXIS

Mnx is governed by one of the following equations:

Lb < Lp use F2-1; Lp<Lb<Lr use F2-2; Lb>Lr use F2-3 and F2-4

$$M_n = M_p = F_y Z_x \qquad \text{(F2-1)}$$

$$M_n = C_b\left[M_p - \left(M_p - 0.7F_y S_x\right)\left(\frac{L_b - L_p}{L_r - L_p}\right)\right] \le M_p \qquad \text{(F2-2)}$$

$$M_n = F_{cr} S_x \le M_p \qquad \text{(F2-3)}$$

$$F_{cr} = \frac{C_b \pi^2 E}{\left(\frac{L_b}{r_{ts}}\right)^2}\sqrt{1 + 0.078\frac{J_c}{S_x h_o}\left(\frac{L_b}{r_{ts}}\right)^2} \qquad \text{(F2-4)}$$

Mnx =	10453.16 kip-in	=	871.0966 kip-ft	
Mcx = Mnx/1.67 =	6259.38 kip-in	=	521.61 kip-ft	**426.00 kip-ft**

WEAK AXIS

$$M_n = M_p = F_y Z_y \leq 1.6 F_y S_y \qquad \text{(F6-1)}$$

Mny =	1930.00 kip-in	=<	1960.00 kip-in	**OK**
Mcy = Mny/1.67 =	1155.69 kip-in	=	96.31 kip-ft	**7.00 kip-ft**

SHEAR CAPACITY OF ROLLED W SHAPE: **All Wales**

This spreadsheet determines the allowable moment of a rolled W-shape in accordance with AISC 14th Edition Section G. Only applicable to members where Cv = 1

$$V_n = 06 F_y A_{web} C_v \qquad \text{(G2-1)}$$

Cv = 1

d =	29.7 in
tw =	0.52 in
Fy =	50 ksi
Vn =	463.32 kips

Vn / 1.67	277.44 kips	>	**125.00 kips**	Therefore OK

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AXIAL CAPACITY OF ROLLED W SHAPE: **Wales** **BY:**
CK:

This spreadsheet determines the allowable axial load of a rolled W-shape in accordance with AISC 14th Edition Section E3 Note: Compact flanges and webs are assumed

Member Information:

Designation: W30x99

Zx =	312 in^3	rts =	2.62 in
Zy =	38.6 in^3	ry =	2.1 in
Sx =	269 in^3	J =	3.77 in^4
Sy =	24.5 in^3	ho =	29 in
Ag =	29 in^2		

$$F_e = \frac{\pi^2 E}{\left(\frac{KL}{r}\right)^2} \quad \text{(E3-4)}$$

Fe = 37.76 ksi

Pn is governed by one of the following equations:

(a) When $\frac{KL}{r} \leq 4.71\sqrt{\frac{E}{F_y}}$ (or $\frac{F_y}{F_e} \leq 2.25$)

$$F_{cr} = \left[0.658^{\frac{F_y}{F_e}}\right] F_y \quad \text{(E3-2)}$$

(b) When $\frac{KL}{r} > 4.71\sqrt{\frac{E}{F_y}}$ (or $\frac{F_y}{F_e} > 2.25$)

$$F_{cr} = 0.877 F_e \quad \text{(E3-3)}$$

Fcr = 28.72 ksi

$$P_n = F_{cr} A_g \quad \text{(E3-1)}$$

Pn = 833.01 kips

Pc = Pn/1.67 = 498.81 kips > **101.00** kips

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COMBINED FORCES AND TORSION CAPACITY OF ROLLED W SHAPE: **Wales** **BY:** **CK:**

This spreadsheet determines the allowable forces and torsion of a rolled W-shape in accordance with AISC 14th Edition Section F2

Note: Compact flanges and webs are assumed

Member Information:

Designation: W30x99

Zx =	312 in^3	rts =	2.62 in
Zy =	38.6 in^3	ry =	2.1 in
Sx =	269 in^3	J =	3.77 in^4
Sy =	24.5 in^3	ho =	29 in

Doubly and Singly Symetric Members Subject to Flexture and Compression

(a)For $\frac{P_r}{P_c} \geq 0.2$

$$\frac{P_r}{P_c} + \frac{8}{9}\left(\frac{M_{rx}}{M_{cx}} + \frac{M_{ry}}{M_{cy}}\right) \leq 1.0 \quad \text{(H1-1a)}$$

(a)For $\frac{P_r}{P_c} < 0.2$

$$\frac{P_r}{2P_c} + \left(\frac{M_{rx}}{M_{cx}} + \frac{M_{ry}}{M_{cy}}\right) \leq 1.0 \quad \text{(H1-1b)}$$

Pr/Pc =	0.20	>	0.2	
therefore,	0.80	=<	1.0	**OK** W30x99 (OK)

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	CHECKED BY CJF DATE 12-5-14
	SCALE

CHECK W18x119 END WALES

MOMENT CAPACITY OF ROLLED W SHAPE: ~~All~~ END **Wales** **BY:**

CK:

This spreadsheet determines the allowable moment of a rolled W-shape in accordance with AISC 14th Edition Section F2 Note: Compact flanges and webs are assumed

Member Information:

Designation: W18x119

Zx =	262 in^3	rts =	3.13 in
Zy =	69.1 in^3	ry =	2.69 in
Sx =	231 in^3	J =	10.6 in^4
Sy =	44.9 in^3	ho =	17.9 in

Mp = Fy * Zx = 13100 kip-in

$$L_p = 1.76 r_y \sqrt{\frac{E}{F_y}} \quad \text{(F2-5)}$$

$$L_r = 1.95 r_{ts} \frac{E}{0.7F_y} \sqrt{\frac{Jc}{S_x h_o}} \sqrt{1 + \sqrt{1 + 6.76\left(\frac{0.7F_y}{E}\frac{S_x h_o}{Jc}\right)}} \quad \text{(F2-6)}$$

Lp = 9.50 ft

Lr = 34.28 ft

STRONG AXIS

Mnx is governed by one of the following equations:

Lb < Lp use F2-1; Lp<Lb<Lr use F2-2; Lb>Lr use F2-3 and F2-4

Lb < Lp therefore use F2-1

$$M_n = M_p = F_y Z_x \quad \text{(F2-1)}$$

$$M_n = C_b\left[M_p - \left(M_p - 0.7F_y S_x\right)\left(\frac{L_b - L_p}{L_r - L_p}\right)\right] \le M_p \quad \text{(F2-2)}$$

$$M_n = F_{cr} S_x \le M_p \quad \text{(F2-3)}$$

$$F_{cr} = \frac{C_b \pi^2 E}{\left(\frac{L_b}{r_{ts}}\right)^2} \sqrt{1 + 0.078 \frac{Jc}{S_x h_o}\left(\frac{L_b}{r_{ts}}\right)^2} \quad \text{(F2-4)}$$

BY:

				CK:
Mnx =	11784.63 kip-in	=	982.0527 kip-ft	
Mcx = Mnx/1.67 =	7056.67 kip-in	=	588.06 kip-ft	**384.00 kip-ft**

WEAK AXIS

$$M_n = M_p = F_y Z_y \leq 1.6 F_y S_y \quad \text{(F6-1)}$$

Mny =	3455.00 kip-in	=<	3592.00 kip-in	**OK**
Mcy = Mny/1.67 =	2068.86 kip-in	=	172.41 kip-ft	**6.00 kip-ft**

SHEAR CAPACITY OF ROLLED W SHAPE: **All Wales**

This spreadsheet determines the allowable moment of a rolled W-shape in accordance with AISC 14th Edition Section G. Only applicable to members where Cv = 1

$$V_n = 06 F_y A_{web} C_v \quad \text{(G2-1)}$$

Cv = 1

d =	19 in
tw =	0.655 in
Fy =	50 ksi

Vn = 373.35 kips

Vn / 1.67	223.56 kips	>	**96.00 kips**	Therefore OK

AXIAL CAPACITY OF ROLLED W SHAPE: ~~**All**~~ END **Wales** **BY:**
CK:

This spreadsheet determines the allowable axial load of a rolled W-shape in accordance with AISC 14th Edition Section E3 Note: Compact flanges and webs are assumed

Member Information:

Designation: W18x119

Zx =	262 in^3	rts =	3.13 in
Zy =	69.1 in^3	ry =	2.69 in
Sx =	231 in^3	J =	10.6 in^4
Sy =	44.9 in^3	ho =	17.9 in
Ag =	35.1 in^2		

$$F_e = \frac{\pi^2 E}{\left(\frac{KL}{r}\right)^2} \quad \text{(E3-4)}$$

Fe = 75.99 ksi

Pn is governed by one of the following equations:

(a) When $\frac{KL}{r} \leq 4.71\sqrt{\frac{E}{F_y}}$ $\left(\text{or } \frac{F_y}{F_e} \leq 2.25\right)$

$$F_{cr} = \left[0.658^{\frac{F_y}{F_e}}\right] F_y \quad \text{(E3-2)}$$

(b) When $\frac{KL}{r} > 4.71\sqrt{\frac{E}{F_y}}$ $\left(\text{or } \frac{F_y}{F_e} > 2.25\right)$

$$F_{cr} = 0.877 F_e \quad \text{(E3-3)}$$

Fcr = 37.96 ksi

$$P_n = F_{cr} A_g \quad \text{(E3-1)}$$

Pn = 1332.51 kips

Pc = Pn/1.67 = 797.91 kips > **88.00 kips**

COMBINED FORCES AND TORSION CAPACITY OF ROLLED W SHAPE: ~~**All**~~ END **Wales** **BY:**
CK:

This spreadsheet determines the allowable forces and torsion of a rolled W-shape in accordance with AISC 14th Edition Section F2

Note: Compact flanges and webs are assumed

Member Information:

Designation: W18x119

Zx =	262 in^3	rts =	3.13 in
Zy =	69.1 in^3	ry =	2.69 in
Sx =	231 in^3	J =	10.6 in^4
Sy =	44.9 in^3	ho =	17.9 in

Doubly and Singly Symetric Members Subject to Flexure and Compression

(a)For $\frac{P_r}{P_c} \geq 0.2$

$$\frac{P_r}{P_c} + \frac{8}{9}\left(\frac{M_{rx}}{M_{cx}} + \frac{M_{ry}}{M_{cy}}\right) \leq 1.0 \qquad \text{(H1-1a)}$$

(a)For $\frac{P_r}{P_c} < 0.2$

$$\frac{P_r}{2P_c} + \left(\frac{M_{rx}}{M_{cx}} + \frac{M_{ry}}{M_{cy}}\right) \leq 1.0 \qquad \text{(H1-1b)}$$

Pr/Pc =	0.11	<	0.2	
therefore,	0.74	=<	1.0	**OK**

W18x119 OK

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CHECK STRUTS

$P_r = 255^k$

try HSS 10" x 5/8" 63 lbs/ft add 100 lbs/ft for LL

$M_r = wl^2/8 = (0.163^{k/ft})\frac{16'^2}{8} = 5^{k\text{-}ft}$ flexure check per AISC F8

$D/t = 10"/0.625 = 16 < 0.45(E/F_y) = \frac{0.45(29000^{ksi})}{42^{ksi}} = 311$

$M_p = F_y Z = 42^{ksi}(51.6\ in^3) = 2167^{k\text{-}in}$

$\lambda_r = 0.11 E/F_y = 0.11(29000)/42 = 76 > 16$ ∴ compact

$M_n/\Omega = M_p/\Omega = 2167^{k\text{-}in}/1.67 = 1298^{k\text{-}in} = 108^{k\text{-}ft} >> 5^{k\text{-}ft}$

Axial check per AISC E3

$r = 3.34"$ $\quad kl/r = \frac{1.0(16' \times 12)}{3.34} = 57$

$4.71\sqrt{E/F_y} = 4.71\sqrt{\frac{29000}{42}} = 124 > 57$

$F_{cr} = \left[0.658^{F_y/F_e}\right] F_y \qquad F_e = \frac{\pi^2 E}{\left(\frac{kL}{r}\right)^2} = \frac{\pi^2(29000)}{57^2} = 88^{ksi}$

$F_{cr} = \left[0.658^{42/88}\right] 42 = 34.4^{ksi}$

$P_n = A_g F_{cr} = 17.2\ in^2 (34.4^{ksi}) = 592^k$

$P_n/\Omega = 592^k/1.67 = 354^k > 255^k$ ∴ by inspection combined Axial and bending (OK)

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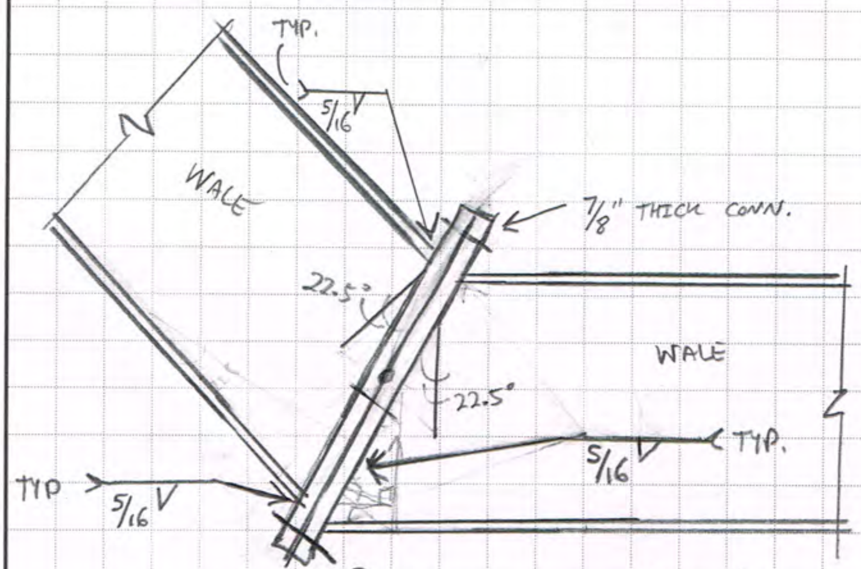
DESIGN SHEAR CONNECTION BETWEEN WALES



Shear on connection = $49^k / \cos 22.5°$

$= 53^k$

try (6) 7/8" Ø A325 BOLTS $A_b = 0.60\ in^2$

$R_n = F_n A_b = (54^{ksi})(0.60\ in^2) = 32.4^k$

$R_n/\Omega = 32.4^k/2.0 = 16.2^k$ $\quad R_n/\Omega$ group $= 16.2^k \times 6 = 97.2^k > 53^k \therefore$ ok

Check bearing -

$R_n = 1.5 l_c t F_u < 3.0 d t F_u$

$R_n = 1.5(1.06'')(7/8)(58^{ksi}) < 3.0(7/8)(7/8)(58^{ksi})$

$= 80.7^k < 133^k$

$R_n = 80.7^k$

$R_n/\Omega = 80.7^k/2 = 40.4^k$

R_n/Ω group $= 40.4^k \times 6 = 242^k > 53^k \therefore$ OK

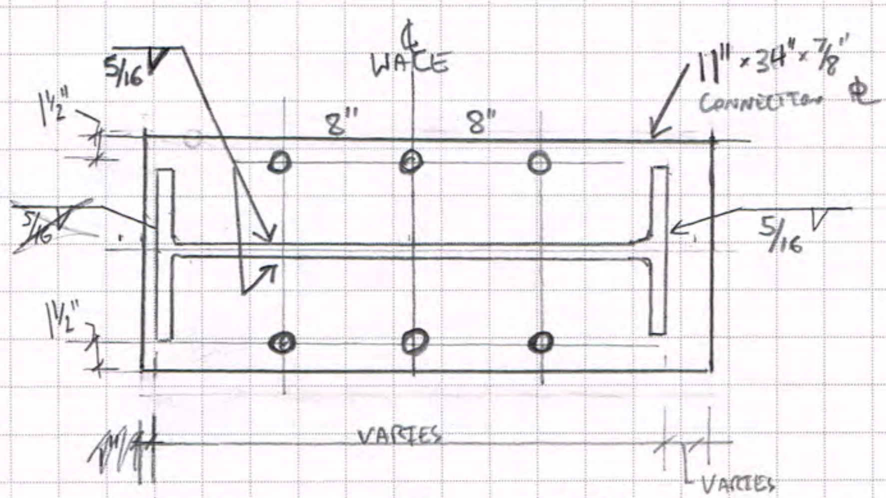
Check weld -

$R_n = 0.6 F_{exx} A_{weld}$ $\quad A_{weld} = [(26.5) + (1 \times 10.5)] \times 0.707 \times 5/16 = 8.2 \text{ in}^2$

$= 0.6(70^{ksi})(8.2 \text{ in}^2)$

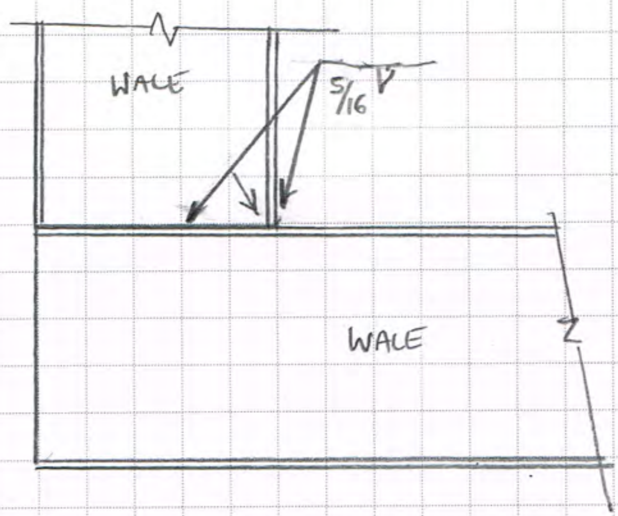
$= 344^k$

$R_n/\Omega = 344^k/2 = 172^k > 53^k \therefore$ OK



* In lieu of bolting connection plates together, use one ℙ and field weld both beams to single ℙ, or shop weld one beam and field weld to other.

CHECK CORNER CONNECTION



$V = 96^k$

$R_n = 0.6 F_{exx} A_{weld}$ $\quad A_{weld} = 0.707(5/16)(26.5 + 10.5 + 5) = 9.3\ in^2$

$R_n = 0.6(70\ ksi)(9.3\ in^2) = 391^k$

$R_n/\Omega = 391^k/2.0 = 195^k \gg 96^k \therefore$ OK

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JOB 14-049.01
SHEET NO. 33 OF 40
CALCULATED BY DJ DATE 12-4-14
CHECKED BY WJF DATE 12/9/14
SCALE

SUPPORT FOR INTERIM BRACE LEVEL

Lower brace level will hang from upper brace level using straps. Determine strap capacity and number required.

Total weight of bracing = 5 struts × 13' × 62.6 lbs/ft = 4026 lbs.
220' × 99 lbs/ft = 21780 lbs
25806 lbs = 26 k

Put straps at corners and around wale at strut connections

14 vertical straps, capacity/strap = $26^k/14$ = 1.86^k provide 2 ton min. capacity.

WALE SEAT

use HP12×84 wale seat

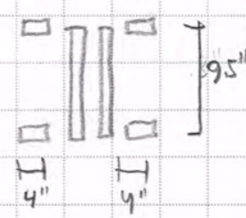
by inspection (ok) for bending and shear

Check weld -

$V = 26^k \times 2 \text{ levels} / 14 \text{ wale seats} = 3.7^k$

$M = 3.7^k/2 \times 3' = 5.6^{k\text{-}ft} = 67^{k\text{-}in}$ $t_{weld} = 0.707(1/4) = 0.18''$

$I_{weld\,group} = (2 \times 0.18'')(9.5'')^3/12 + \left(0.18''(4'')(9.5''/2)^2 \times 4\right) = 90.7\ in^4$



$f_{b\,weld} = Mc/I = 67^{k\text{-}in}(9.5/2)/90.7 = 3.5^{ksi}$

$f_{v\,weld} = 3.7^k / 0.18((4\times4)+(2\times9.5)) = 0.59^{ksi}$ $f_{weld} = 3.5^{ksi}$ $F_n/\Omega = 0.6(70)/2 = 21^{ksi} > 3.5^{ksi}$ ∴ (ok)

PRODUCT 204-1 (Single Sheets) 205-1 (Padded)

CHECK WALES FOR CONCENTRATED LOADS

W30x99 $R = 255^k$ @ dist. from end > d

$R = 88^k$ @ dist. from end < d

Based on analysis on following pages, stiffeners not required by code, however provide 5/8" thick web stiffeners at strut locations as a precaution.

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AISC J10.2: Web Local Yielding **W30x99 Not at Ends**

Note: Tension and compression concentrated forces.

Fy =	50 ksi	Lb = Length of Bearing =	10 in
tw =	0.52 in	d =	29.7 in
k =	1.32 in	Le = Distance from Force to End of Member=	36 in

Rn = Fy x tw x (5k + Lb)

Rn = 431.60 kips

Rn/Ω = 287.73 kips > 255 kips Therefore OK

AISC J10.3: Web Local Crippling **W30x99 Not at Ends**

Note: Applies to compressive forces only.

Fy =	50 ksi	Lb = Length of Bearing =	10 in
tw =	0.52 in	Le = Distance from Force to End of Member =	36 in
tf =	0.67 in	d = Depth of Member =	29.7 in

for Le > d/2: APPLIES

$$R_n = 0.80t_w^2\left[1+3\left(\frac{N}{d}\right)\left(\frac{t_w}{t_f}\right)^{1.5}\right]\sqrt{\frac{EF_{yw}t_f}{t_w}}$$

for Le < d/2 and Lb/d < 0.2:

$$R_n = 0.40t_w^2\left[1+3\left(\frac{N}{d}\right)\left(\frac{t_w}{t_f}\right)^{1.5}\right]\sqrt{\frac{EF_{yw}t_f}{t_w}}$$

for Le < d/2 and Lb/d > 0.2:

$$R_n = 0.40t_w^2\left[1+\left(\frac{4N}{d}-0.2\right)\left(\frac{t_w}{t_f}\right)^{1.5}\right]\sqrt{\frac{EF_{yw}t_f}{t_w}}$$

Rn = 499.88 kips

Rn/Ω = 249.94 kips ≈ 255 kips Stiffeners not needed

AISC J10.2: Web Local Yielding **W30x99 Ends**

Note: Tension and compression concentrated forces.

Fy =	50 ksi	Lb = Length of Bearing =	18 in
tw =	0.52 in	d =	29.7 in
k =	1.32 in	Le = Distance from Force to End of Member=	9 in

Rn = Fy x tw x (2.5k + Lb)

Rn = 553.80 kips

Rn/Ω = 369.20 kips > 88 kips Therefore OK

AISC J10.3: Web Local Crippling **W30x99 Ends**

Note: Applies to compressive forces only.

Fy =	50 ksi	Lb = Length of Bearing =	18 in
tw =	0.52 in	Le = Distance from Force to End of Member =	9 in
tf =	0.67 in	d = Depth of Member =	29.7 in

for Le > d/2:

$$R_n = 0.80t_w^2\left[1+3\left(\frac{N}{d}\right)\left(\frac{t_w}{t_f}\right)^{1.5}\right]\sqrt{\frac{EF_{yw}t_f}{t_w}}$$

for Le < d/2 and Lb/d < 0.2:

$$R_n = 0.40t_w^2\left[1+3\left(\frac{N}{d}\right)\left(\frac{t_w}{t_f}\right)^{1.5}\right]\sqrt{\frac{EF_{yw}t_f}{t_w}}$$

for Le < d/2 and Lb/d > 0.2: APPLIES

$$R_n = 0.40t_w^2\left[1+\left(\frac{4N}{d}-0.2\right)\left(\frac{t_w}{t_f}\right)^{1.5}\right]\sqrt{\frac{EF_{yw}t_f}{t_w}}$$

Rn = 372.67 kips

Rn/Ω = 186.34 kips > 88 kips Stiffeners not needed

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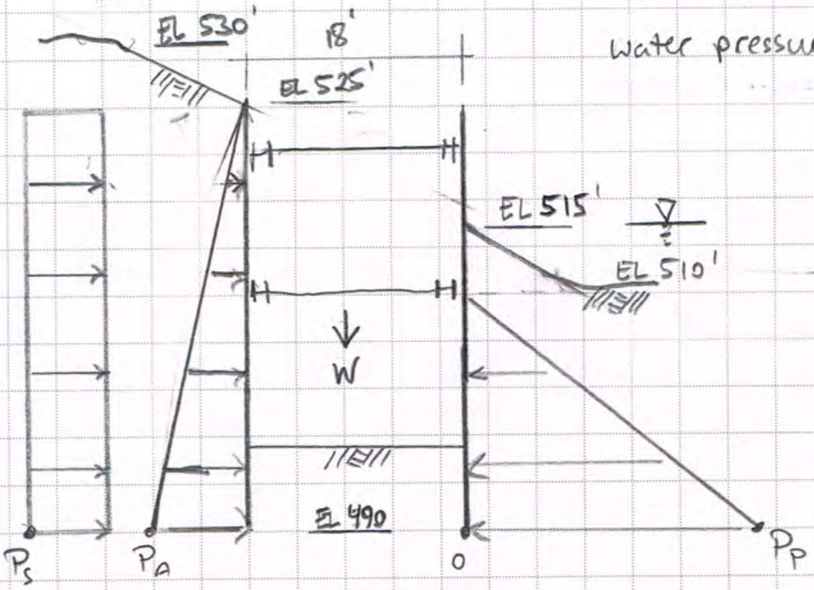
CHECK GLOBAL STABILITY of THE COFFERDAM

Because cofferdam will be installed on a river bank which is on an approx. 2 horizontal : 1 vertical slope, consider unbalanced forces and potential for cofferdam to slide or overturn.



water pressure balance ∴ neglect

$\gamma_{avg} = \dfrac{10'(120\ pcf) + 25'(73\ pcf)}{35'} = 86\ pcf = 0.086\ kcf$

$P_S = 0.213\ ksf$

$P_A = 0.086\ kcf\,(35')(0.25) = 0.75\ ksf$

$P_P = 20'(0.073\ kcf)(4) = 5.8\ ksf$

$W_{sat} = 7' \times 0.073\ kcf \times 18' = 9.2\ k/ft$

W = weight of cofferdam = $26^k \times 2 = 52^k$ bracing

$+\ 73.9\ lbs/ft \times 35' \times 52\ pairs \times 2 = 269^k$

$321^k \longrightarrow 321/98' = 3\ k/ft$

SLIDING – (per foot basis)

$\overrightarrow{\Sigma F} = 0.213\ ksf(35') + 0.75\ ksf(35')(\tfrac{1}{2}) = 20.6^k$

$\overleftarrow{\Sigma F} = 5.8\ ksf(20')(\tfrac{1}{2}) + \tan 35°(9.2 + 3) = 66.5^k$ (63.8)

F.S. $= 66.5^k / 20.6^k = 3.2$ (3.1) > 1.5 (OK)

OVERTURNING –

ΣM_o (overturning) $= 0.213(35)(35/2) + 0.75(35)(\tfrac{1}{2})(35/3) = 284\ k\text{-}ft$ ✓

ΣM_o (resisting) $= 5.8(20)(\tfrac{1}{2})(20/3) + (9.2+3)(9) = 496\ k\text{-}ft$

F.S. $= 496\ k\text{-}ft / 284\ k\text{-}ft = 1.75 > 1.5$ (ok)

CHECK COFFERDAM UNDER LOW WATER

Assume LW EL 518' (sheet 123 of contract drawings)

Consider excavation stages 1 & 2 with water elevation @ EL 518'

by inspection stage 1 will not control for brace force, embedment, or sheeting size.

re-run stage 2 analysis: $\gamma_{avg} = \frac{7(0.120) + 21(0.073)}{28} = 0.085$

$P_{A_1} = 0.346(0.085/0.076) = 0.387$ ksf

$P_{A2} = 0.532(0.085/0.076) = 0.595$ ksf

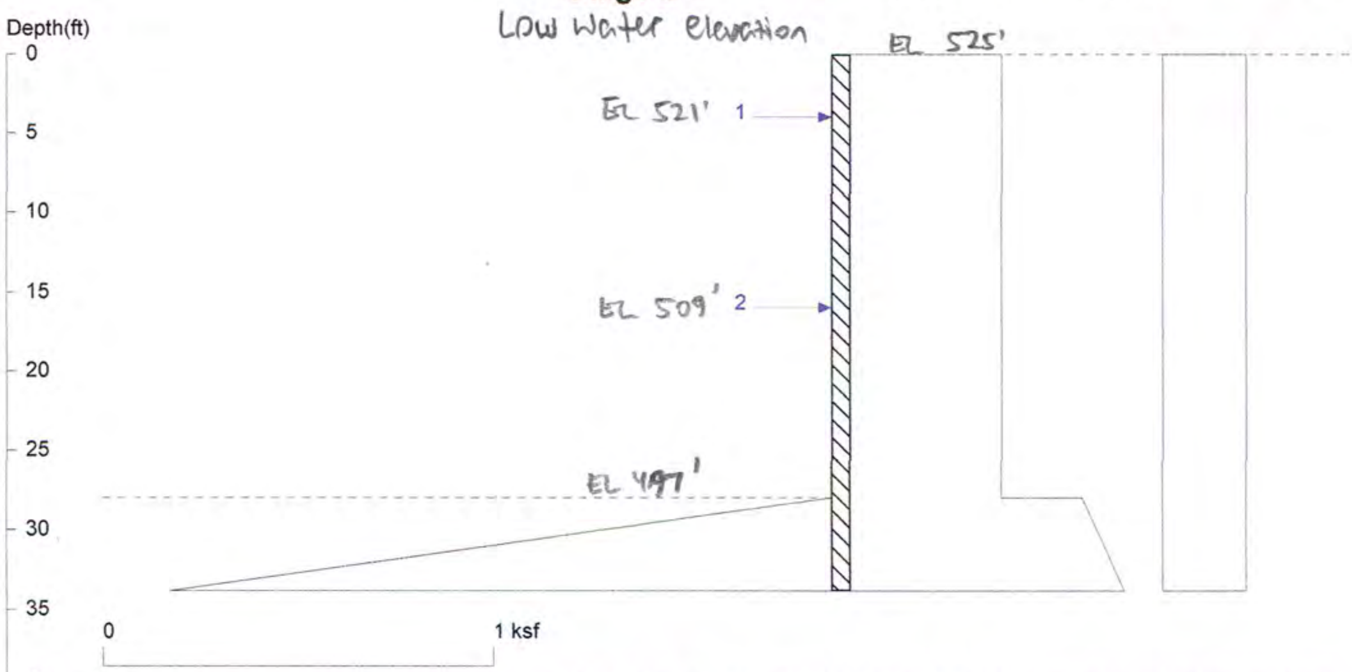
See following CT-Shoring analysis $S_x = 14.8$ in³/ft < 48.4 in³/ft
Brace Force $= 13.8$ k/ft > 12.0 k/ft

By inspection increasing brace force by 15%, ($13.8/12 = 1.15$) wales and struts still (ok) connections still (ok). connections wales and struts are all oversized by more than 15%.

River Road Cofferdam

Stage 2

BY DJF 12-8-14
CHK WJF 12/9/14
39/40



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File: P:\Project Files\2014\14-049 Rutland VT Bridges (Kubricky)\14-049.01 Rutland VT Bridges\Calculations\River Road S

Wall Height=28.0 Pile Diameter=1.0 Pile Spacing=1.0 Wall Type: 1. Sheet Pile

PILE LENGTH: Min. Embedment=5.80 (8~10ft is recommended!!!) Min. Pile Length=33.80 (in graphics and analysis)
User inputted Embedment=5.80, Pile Length=33.80
MOMENT IN PILE: Max. Moment=40.80 per Pile Spacing=1.0 at Depth=15.99

PILE SELECTION:
Request Min. Section Modulus = 14.8 in3/ft=797.61 cm3/m, Fy= 50 ksi = 345 MPa, Fb/Fy=0.66
-> Piles meet Min. Section Requirements: Top Deflection is shown in (in)
CZ95RD (0.00) CZ95 (0.00) Z75 (0.00) CZ16 (0.00) BZ8.6 (0.00)
SZ18 (0.00) CZ101 (0.00) SPZ19-5 (0.00) SZ250 (0.00) Z80 (0.00)
CZ17 (0.00) CZ107 (0.00) SZ20 (0.00) CZ18 (0.00)

BRACE FORCE: Strut, Tieback, Plate Anchor, and Deadman

No. & Type	Depth	Angle	Space	Total F.	Horiz. F.	Vert. F.	N/A	N/A
1. Strut	4.0	0.0	1.0	3.1	3.1	0.0	0.0	0.0
2. Strut	16.0	0.0	1.0	13.8	13.8	0.0	0.0	0.0

UNITS: Width,Diameter,Spacing,Length,Depth,and Height - ft; Force - kip; Bond Strength and Pressure - ksf

DRIVING PRESSURES (ACTIVE, WATER, & SURCHARGE):

Z1	P1	Z2	P2	Slope
0	.387	28	.387	0.000000
28	.595	50	0.998	.0183
0	.213	50	0.213	0

PASSIVE PRESSURES:

Z1	P1	Z2	P2	Slope
28	0	50	6.424	.292

ACTIVE SPACING:

No.	Z depth	Spacing
1	0.00	1.00
2	28.00	1.00

PASSIVE SPACING:

No.	Z depth	Spacing
1	0.00	1.00

By DLF 12-8-14
Chk WJF 12/9/14

40/40

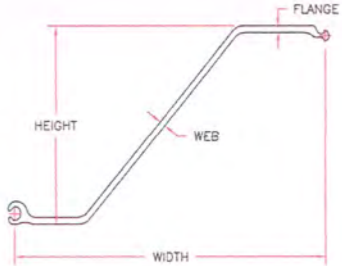
UNITS: Width,Spacing,Diameter,Length,and Depth - ft; Force - kip; Moment - kip-ft
Friction,Bearing,and Pressure - ksf; Pres. Slope - kip/ft3; Deflection - in

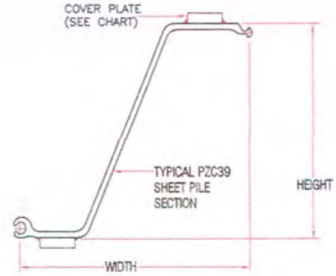
APPENDIX ‘A’

Catalog Cut for Sheet Piles

A 1/2

Z Pile Profile





Cover Plated Z Profiles

Section	Width+	Height+	Web Thick-ness+	Flange Thick-ness+	Weight		Moment of Inertia		Section Modulus		Nominal Coating Area*
	in.	in.	in.	in.	lb / lft	lb / ft^2	in^4	in^4 / wft	in^3	in^3 / wft	ft^2 / lft
	mm	mm	mm	mm	kg / lm	kg / m^2	cm^4	cm^4 / wm	cm^3	cm^3 / wm	m^2 / lm
PZC 13	**27.88**	**12.56**	**0.375**	**0.375**	**50.4**	**21.7**	**353.0**	**152.0**	**56.2**	**24.2**	**5.60**
	708	**319**	**9.5**	**9.5**	**75.1**	**106.0**	**14,690**	**20,760**	**920**	**1,300**	**1.71**
PZC 14	27.88	12.60	0.420	0.420	55.0	23.7	381.6	164.3	60.5	26.0	5.60
	708	320	10.7	10.7	81.8	115.5	15,890	22,440	990	1,400	1.71
PZC 18	**25.00**	**15.25**	**0.375**	**0.375**	**50.4**	**24.2**	**532.2**	**255.5**	**69.8**	**33.5**	**5.60**
	635	**387**	**9.5**	**9.5**	**75.1**	**118.2**	**22,150**	**34,890**	**1,145**	**1,800**	**1.71**
PZC 19	25.00	15.30	0.420	0.420	55.0	26.4	576.3	276.6	75.3	36.1	5.60
	635	388	10.7	10.7	81.8	128.8	23,990	37,780	1,235	1,945	1.71
PZC 25	27.88	17.66	0.485	0.560	69.4	29.9	938.7	404.1	106.3	45.7	6.15
	708	449	12.3	14.2	103.3	145.9	39,070	55,190	1,740	2,455	1.87
PZC 26	**27.88**	**17.70**	**0.525**	**0.600**	**73.9**	**31.8**	**994.3**	**428.1**	**112.4**	**48.4**	**6.15**
	708	**450**	**13.3**	**15.2**	**110.0**	**155.4**	**41,390**	**58,460**	**1,840**	**2,600**	**1.87**
PZC 28	27.88	17.75	0.570	0.645	79.0	34.0	1,057	455.1	119.1	51.3	6.15
	708	451	14.5	16.4	117.6	166.1	44,000	62,150	1,950	2,755	1.87
Sections in development — inquire for availability.											
PZC 37	22.50	21.02	0.488	0.563	69.6	37.1	1,349	719.6	128.4	68.5	6.15
	572	534	12.4	14.3	103.6	181.2	56,160	98,270	2,100	3,680	1.87
PZC 39	**22.50**	**21.05**	**0.525**	**0.600**	**74.0**	**39.5**	**1,429**	**762.1**	**135.6**	**72.3**	**6.15**
	572	**535**	**13.3**	**15.2**	**110.2**	**192.8**	**59,480**	**104,100**	**2,220**	**3,890**	**1.87**
PZC 41	22.50	21.09	0.561	0.636	78.4	41.8	1,507	803.6	142.7	76.1	6.15
	572	536	14.2	16.2	116.6	204.1	62,720	109,700	2,340	4,090	1.87

Available Grades: ASTM A572 Gr. 50 and 60, A588 and A690
+Values stated are nominal
*Both sides of sheet: excludes socket interior and ball interlock

PZC™ is a trademark of Gerdau

Section	Normal Width	Plate Size	Per Single Section				Per Unit of Wall			
			Area	Weight	Total Surface Area	Nominal Coating Area*	Weight: Full Length Plates	Weight: Half Length Plates	Moment of Inertia	Section Modulus
	in.	in.	in^2	lb / ft	ft^2 / lin ft	ft^2 / lin ft	lb / ft^2	lb / ft^2	in^4 / ft	in^3 / ft
	mm	mm	mm^2	kg / m	m^2 / m	m^2 / m	kg / m^2	kg / m^2	cm^4 / m	cm^3 / m
PZC 38-CP	**27.88**	**3.5 x 1.00**	**28.72**	**97.7**	**6.98**	**5.48**	**42.1**	**36.9**	**691.4**	**70.2**
(PZC26)	708		185.3	145.3	2.13	1.67	205.6	180.2	94,420	3,770
PZC 39-CP	**27.88**	**3.5 x 1.125**	**29.60**	**100.6**	**7.03**	**6.53**	**43.3**	**37.6**	**728.3**	**73.0**
(PZC26)	708		191.0	149.7	2.14	1.99	211.4	183.6	99,460	3,930
PZC 41-CP	**27.88**	**3.5 x 1.25**	**30.47**	**103.6**	**7.07**	**6.57**	**44.6**	**38.2**	**766.1**	**75.8**
(PZC26)	708		196.6	154.2	2.15	2.00	217.8	186.5	104,600	4,080

*Excludes socket interior and ball interlock
• Filet weld should be sized to adequately resist design loads and should be continuous and all around.
• Cover plate length depends upon moment curve. Best economy is obtained when plate length is limited to area of high moment.

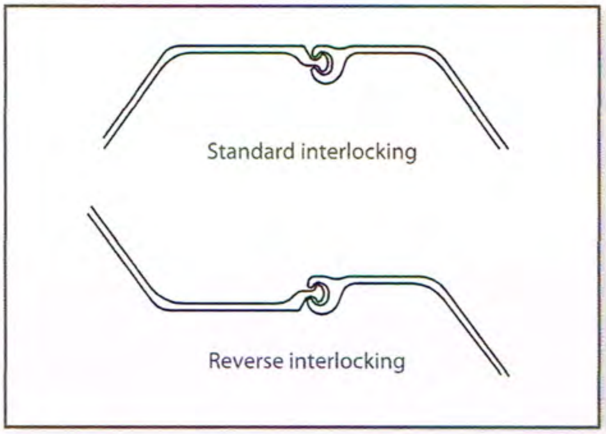
Available Grades: ASTM A572 Gr. 50

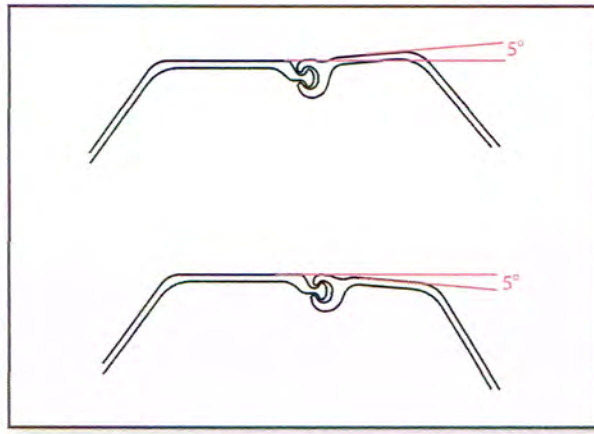
A2/2

Z-Profile Interlock

All Gerdau Z-pile sections can be interlocked with each other. As such, the ball and socket interlocks can be installed with using either the standard or reverse position. This adds to greater ease of use and flexibility at the job site. Normal setting width of pairs can be altered to accommodate job site conditions through increasing or decreasing the laying width at the interlocks.

*Z-pile: Gerdau does not publish a swing value for Z-sections. As a "rule of thumb" it might be assumed that a 40 foot length would obtain a swing of up to 5 degrees.





*From Gerdau's Sheet Piling Handbook 2006

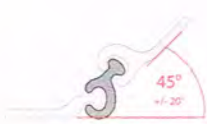
Extruded Z-Profile Connectors

PZ 90

Cobra

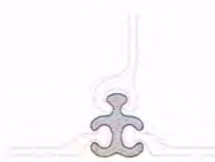
PZ Tee

PZT-S



Colt

Note: all interlocks can be placed in reverse position with extruded connectors.



Joker

Bullhead

L.B. Foster can also provide special fabricated corners and tees when the job requires them.