H. B. FLEMING, INC.
Contracting & Engineering
89 Pleasant Avenue
South Portland, ME 04106

Phone (207) 799-8514

LETTER OF TRANSMITTAL

DATE: 3/8/2016
JOB NO.:
ATTENTION: Tim Parent

TO: Parent Construction
ATTN: Tim Parent

RE: Huntington, VT
BRO 1445(35) Bridge Replacement
Abutment 1 Cofferdam

WE ARE SENDING YOU ☒ Attached ☐ Under separate cover via _____ the following items:

☒ Shop drawings ☐ Prints ☐ Plans ☐ Samples ☐ Specifications
☐ Copy of letter ☐ Change order ☐ _____

COPIES	DATE	NO.	DESCRIPTION
1	3/8/16		Abutment 1 Plan
1	3/8/16		Abutment 1 Calculations

THESE ARE TRANSMITTED as checked below:

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☐ As requested ☐ Returned for corrections ☐ Return _____ corrected prints
☐ For review and comment ☐ _____
☐ FOR BIDS DUE _____ ☐ PRINTS RETURNED AFTER LOAN TO US

REMARKS

Tim,

Attached is our design for Abutment 1 in Huntington. Please call with any questions/concerns.

Thanks
John Allen

COPY TO _____

SIGNED: _____

If enclosures are not as noted, kindly notify us at once.

H.B. FLEMING, INC.

CONTRACTING · ENGINEERING

89 Pleasant Ave. South Portland, ME 04106

Phone 207-799-8514 Fax 207-799-8538

www.hbfleming.com

PILE DRIVING BRIDGES SUBMARINE PIPELINES

Abutment #1 Cofferdam Design

For

Parent Construction, Inc.

Vermont Bridge Project: BRO 1445(35)

Item # 208.40

Huntington, VT

3/8/16

STATE OF VERMONT
DAVID GIFFORD
NO. 9124
Civil
LICENSED
PROFESSIONAL ENGINEER

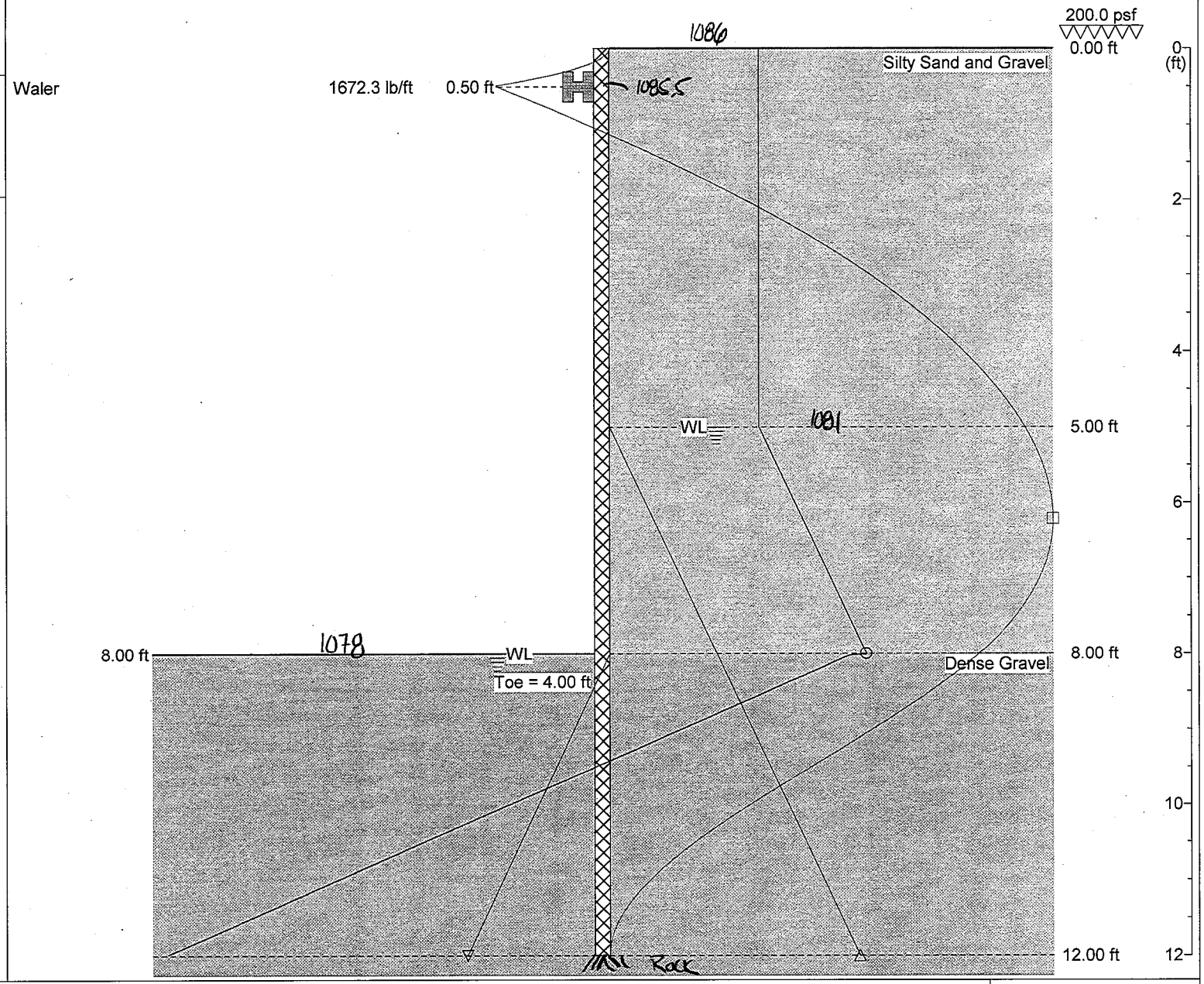
3/8/16

Client: Huntington - AbutA, Full Depth 1 Frame

Date: 3.8.16

Sheet: PZ22
Works: Temporary
Pressure: Terzaghi
Toe: No Earth Support

Maximum		d (ft)
○	448.9 psf	8.00
□	3595.4 ftlb/ft	6.21
△	437.0 psf	12.00
△	249.7 psf	12.00



H.B. Fleming, Inc.

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Fax: 207-799-8538

SupportIT, v2.37

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Tel/Fax: +44 (0)1292 477754
Email: GTSoftLtd@aol.com
Web: www.GTSoft.org

Client: Huntington - AbutA, Full Depth 1 Frame
Date: 3.8.16
Sheet: PZ22
Works: Temporary
Pressure: Terzaghi
Toe: No Earth Support

Input Data

Depth Of Excavation = 8.00ft
Surcharge = 200.0psf

Depth Of Active Water = 5.00ft
Depth Of Passive Water = 8.00ft

Water Density = 62.43pcf
Minimum Fluid Density = 31.82pcf

Soil Profile

Depth (ft)	Soil Name	γ (pcf)	γ' (pcf)	C (psf)	C_a (psf)	ϕ (°)	δ (°)	K_a	K_{ac}	K_p	K_{pc}
0.00	Silty Sand and Gravel	114.00	51.60	0.0	0.0	31.0	0.0	0.33	0.00	3.50	0.00
8.00	Dense Gravel	114.00	65.55	0.0	0.0	40.0	0.0	0.22	0.00	4.60	0.00

Solution

Sheet

Sheet Name	E (psi)	I (in^4/ft)	f (psi)	Z (in^3/ft)	Allowed M_{max} (ftlb/ft)	b (in)	A (in^2/ft)	W (lb/ft)	Upstand (ft)	Toe (ft)	Length (ft)
PZ22	3.04E+07	84.70	24966.8	18.40	38282.3	22.01	6.46	40.3	0.00	4.00	12.00

Load Model: Area Distribution (Hinge Method used for Shear Force, Bending Moment and Deflection)

Supports

d (ft)	Type	Load (lb/ft)
0.50	Waler	1672.3

Maxima

	Maximum	Depth (ft)
Pressure	448.9 psf	8.00
Bending Moment	3595.4 ftlb/ft	6.21
Deflection	0.1 in	11.99
Shear Force	1538.9 lb/ft	0.50

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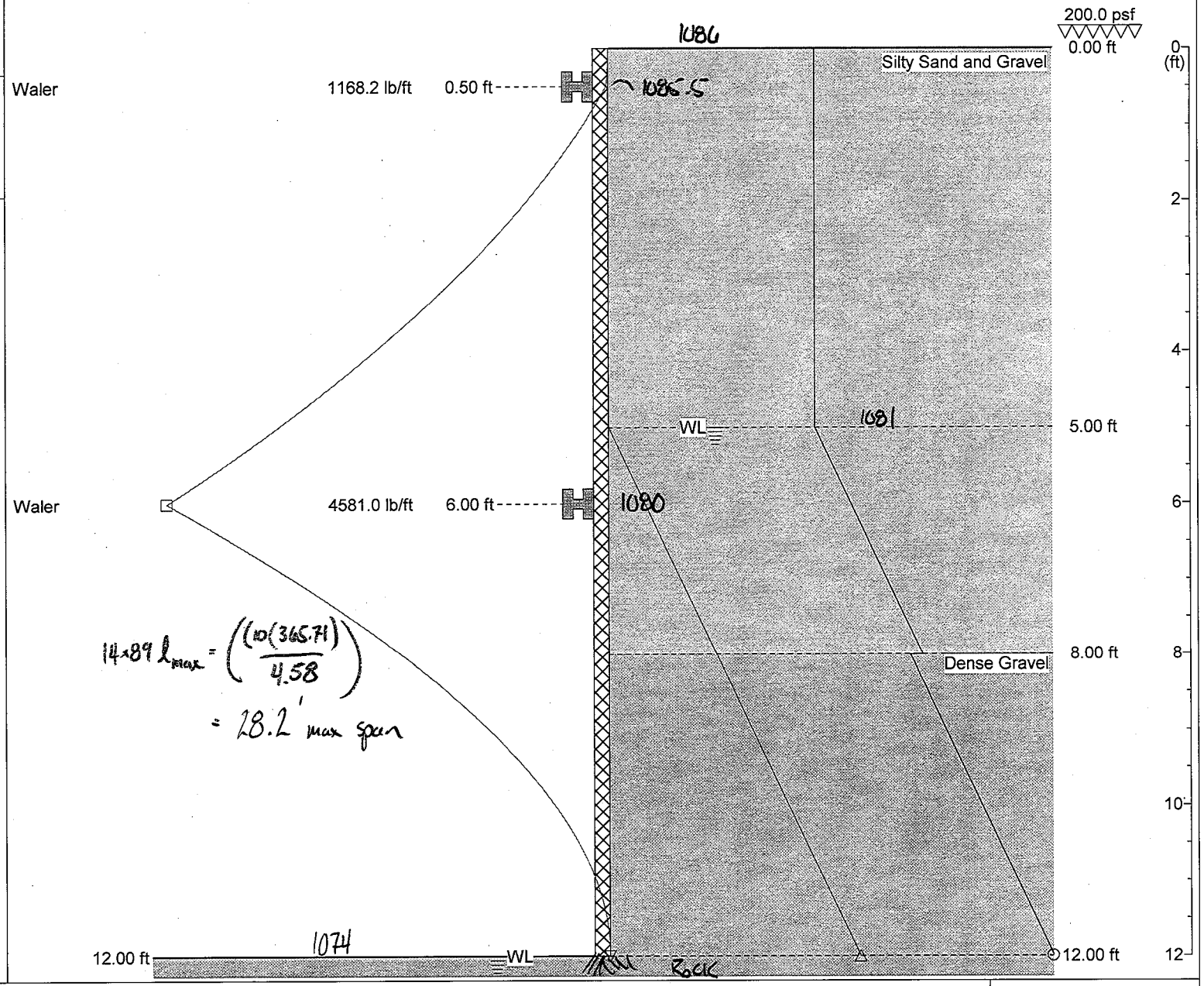
Client: Huntington - AbutA, Full Depth 2 Frames
Date: 3.8.16
Sheet: PZ22
Works: Temporary
Pressure: Terzaghi
Toe: No Earth Support

Maximum		d (ft)
○	773.8 psf	12.00
□	11684.7 ftlb/ft	6.00
△	437.0 psf	12.00
△	0.0 psf	12.00

$S_{x-x} = \frac{11.68\,(12'')}{50ksi\,(0.65)}$

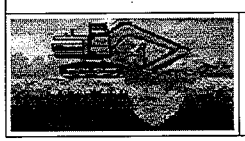
Min $S_{x-x} = 4.31 in^3$

PZ-22 $S_{x-x} = 18.4 in^3$ ∴ OK



$14 \times 89\ l_{max} = \left(\frac{(10(365.71))}{4.58}\right)$

$= 28.2'$ max span



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Client: Huntington - AbutA, Full Depth 2 Frames
Date: 3.8.16
Sheet: PZ22
Works: Temporary
Pressure: Terzaghi
Toe: No Earth Support

Input Data

Depth Of Excavation = 12.00ft
Surcharge = 200.0psf

Depth Of Active Water = 5.00ft
Depth Of Passive Water = 12.00ft

Water Density = 62.43pcf
Minimum Fluid Density = 31.82pcf

Soil Profile

Depth (ft)	Soil Name	γ (pcf)	γ' (pcf)	C (psf)	C_a (psf)	ϕ (°)	δ (°)	K_a	K_{ac}	K_p	K_{pc}
0.00	Silty Sand and Gravel	114.00	51.60	0.0	0.0	31.0	0.0	0.33	0.00	3.50	0.00
8.00	Dense Gravel	114.00	65.55	0.0	0.0	40.0	0.0	0.22	0.00	4.60	0.00

Solution

Sheet

Sheet Name	E (psi)	I (in^4/ft)	f (psi)	Z (in^3/ft)	Allowed M_{max} (ftlb/ft)	b (in)	A (in^2/ft)	W (lb/ft)	Upstand (ft)	Toe (ft)	Length (ft)
PZ22	3.04E+07	84.70	24966.8	18.40	38282.3	22.01	6.46	40.3	0.00	0.00	12.00

Load Model: Area Distribution (Hinge Method used for Shear Force, Bending Moment and Deflection)

Supports

d (ft)	Type	Load (lb/ft)
0.50	Waler	1168.2
6.00	Waler	4581.0

Maxima

	Maximum	Depth (ft)
Pressure	773.8 psf	12.00
Bending Moment	11684.7 ftlb/ft	6.00
Deflection	0.1 in	11.99
Shear Force	3561.1 lb/ft	6.00

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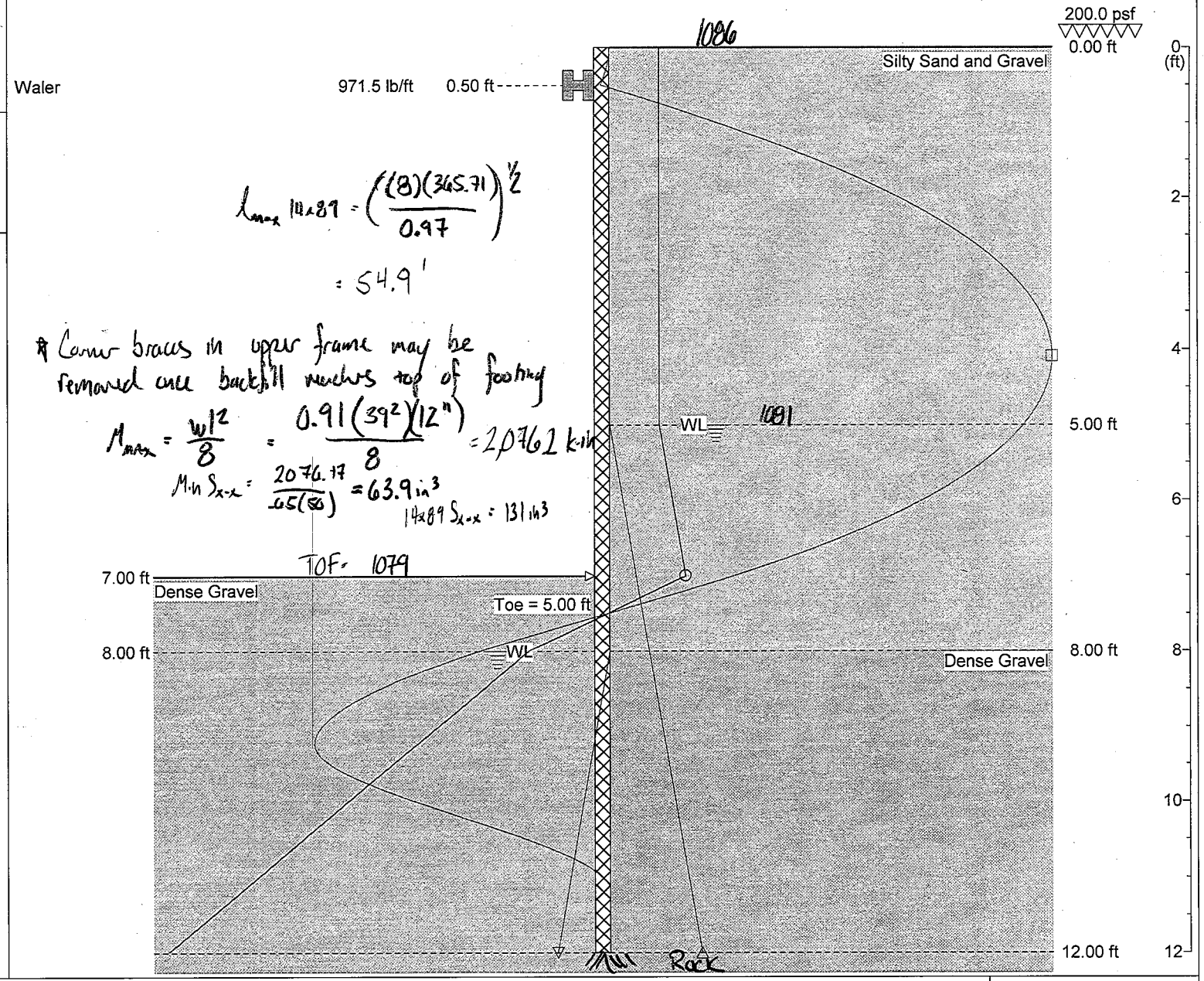
BACKFILLED TO TOP OF FOOTING

Client: Huntington - AbutA, Backfill to TOF w/1 Frame
Date: 3.8.16

Sheet: PZ22
Works: Temporary
Pressure: Terzaghi
Analysis: Net Pressure
FOS: 8.02
Toe: Fixed Earth Support

	Maximum	d (ft)
○	362.0 psf	7.00
□	1504.0 ftlb/ft	4.09
△	437.0 psf	12.00
△	249.7 psf	12.00



$$l_{max}\ 14\times89 = \left(\frac{(8)(365.71)}{0.97}\right)^{1/2}$$

$$= 54.9'$$

* Corner braces in upper frame may be removed once backfill reaches top of footing

$$M_{max} = \frac{wl^2}{8} = \frac{0.91(39^2)(12^{in})}{8} = 2076.2\ k\text{-}in$$

$$Min\ S_{x-x} = \frac{2076.17}{.65(50)} = 63.9\ in^3$$

$14\times89\ S_{x-x} = 131\ in^3$

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Client: Huntington - AbutA, Backfill to TOF w/1 Frame
Date: 3.8.16
Sheet: PZ22
Works: Temporary
Pressure: Terzaghi
Analysis: Net Pressure
FOS: 8.02
Toe: Fixed Earth Support

Input Data

Depth Of Excavation = 7.00ft
Surcharge = 200.0psf

Depth Of Active Water = 5.00ft
Depth Of Passive Water = 8.00ft

Water Density = 62.43pcf
Minimum Fluid Density = 31.82pcf

Soil Profile — Active Side

Depth (ft)	Soil Name	γ (pcf)	γ' (pcf)	C (psf)	C_a (psf)	ϕ (°)	δ (°)	K_a	K_{ac}	K_p	K_{pc}
0.00	Silty Sand and Gravel	114.00	51.60	0.0	0.0	31.0	0.0	0.33	0.00	3.50	0.00
8.00	Dense Gravel	114.00	65.55	0.0	0.0	40.0	0.0	0.22	0.00	4.60	0.00

Soil Profile — Passive Side

Depth (ft)	Soil Name	γ (pcf)	γ' (pcf)	C (psf)	C_a (psf)	ϕ (°)	δ (°)	K_a	K_{ac}	K_p	K_{pc}
0.00	Dense Gravel	125.00	65.55	0.0	0.0	40.0	0.0	0.22	0.00	6.50	0.00

Solution

Sheet

Sheet Name	E (psi)	I (in^4/ft)	f (psi)	Z (in^3/ft)	Allowed M_{max} (ftlb/ft)	b (in)	A (in^2/ft)	W (lb/ft)	Upstand (ft)	Toe (ft)	Length (ft)
PZ22	3.04E+07	84.70	24966.8	18.40	38282.3	22.01	6.46	40.3	0.00	5.00	12.00

Load Model: Area Distribution

Supports

d (ft)	Type	Load (lb/ft)
0.50	Waler	971.5

Maxima

	Maximum	Depth (ft)
Pressure	362.0 psf	7.00
Bending Moment	1504.0 ftlb/ft	4.09
Deflection	0.0 in	4.61
Shear Force	902.3 lb/ft	7.48

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3/8/16 - Huntington, VT Abutment 1

Size Wales

Worst Case: Full Depth Excavation to Elev 1074 (Rock) w/ 2 Frames

Max Wale Load = 4.581 k/f $\quad M_{max} = \frac{wl^2}{10} = \frac{4.581(27.1)^2(12")}{10} = 4037.2$ k-in

$$\text{Min } S_{x-x} = \frac{4{,}037.2}{.65(50\text{ ksi})} = 124.22 \text{ in}^3$$

USE HP14×89 $S_{x-x} = 131 \text{ in}^3$

Check Moment in Sheets

$$M_{max} = 11.68 \text{ k-ft } (12") = 140.2 \text{ k-in}$$

$$\text{Min } S_{x-x} = \frac{140.2}{.65(50)} = 4.31 \text{ in}^3$$

PZ-22 $S_{x-x} = 18.4 \text{ in}^3$ ∴ OK

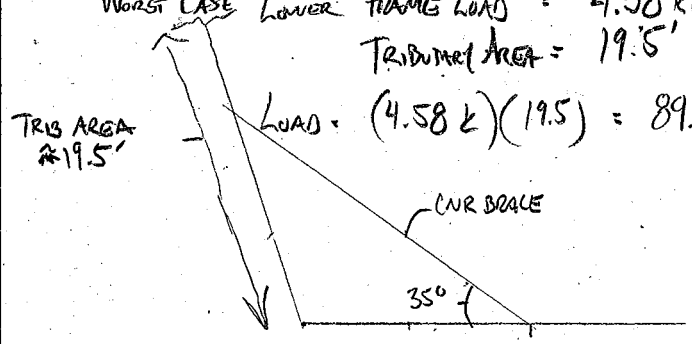
Size Corner Braces

- Smallest internal ∡

Worst Case Lower Frame Load = 4.58 k/f

Tributary Area = 19.5'

Load = (4.58 k)(19.5) = 89.31 K



$\sin\gamma = \frac{O}{H} = \frac{89.31}{H}$

$H = 89.31 / \sin 35°$

$H = 155.7$ K

For KL = 9' using Gr 50 material, ϕP_n for HP10×42 = 455 kips → 10×42 OK

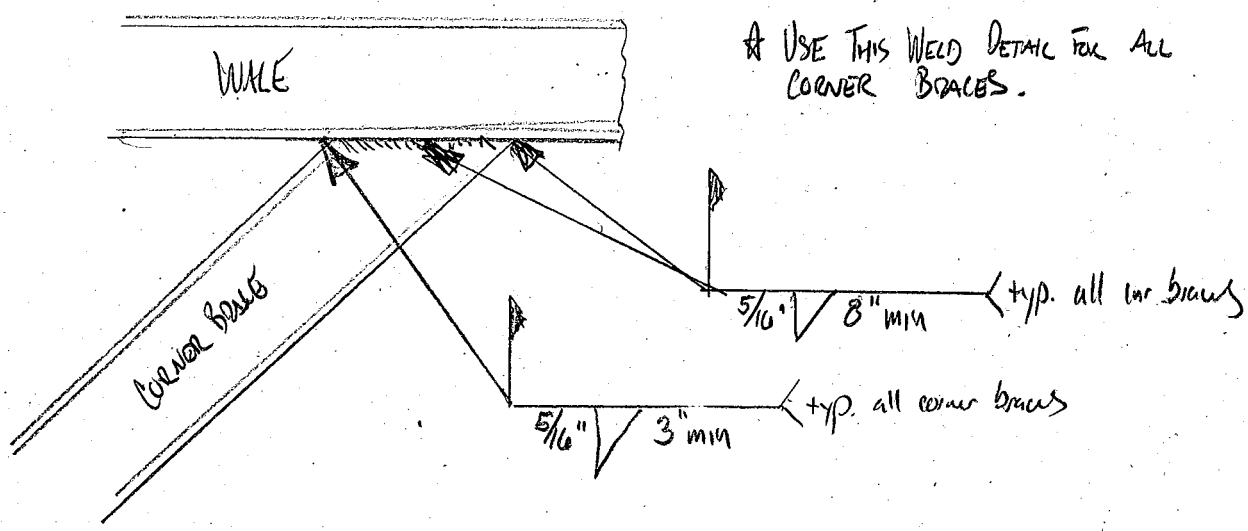
Size Welds

Corner Braces - Max Load = 4.58 k/f, Trib Area = 19.5' > Max Load (shear) = 89.31 k

Using 5/16" weld

$$l_{min} = \frac{1.33(89.31\text{ k})}{0.60(70\text{ ksi})(0.707)(5/16")} = 12.8" \text{ total weld}$$

HUNTINGTON, ABUT 1 CONT.



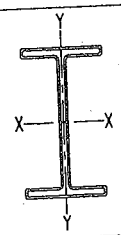
☆ USE THIS WELD DETAIL FOR ALL CORNER BRACES.

TOPS 35500

F_y = 36 ksi

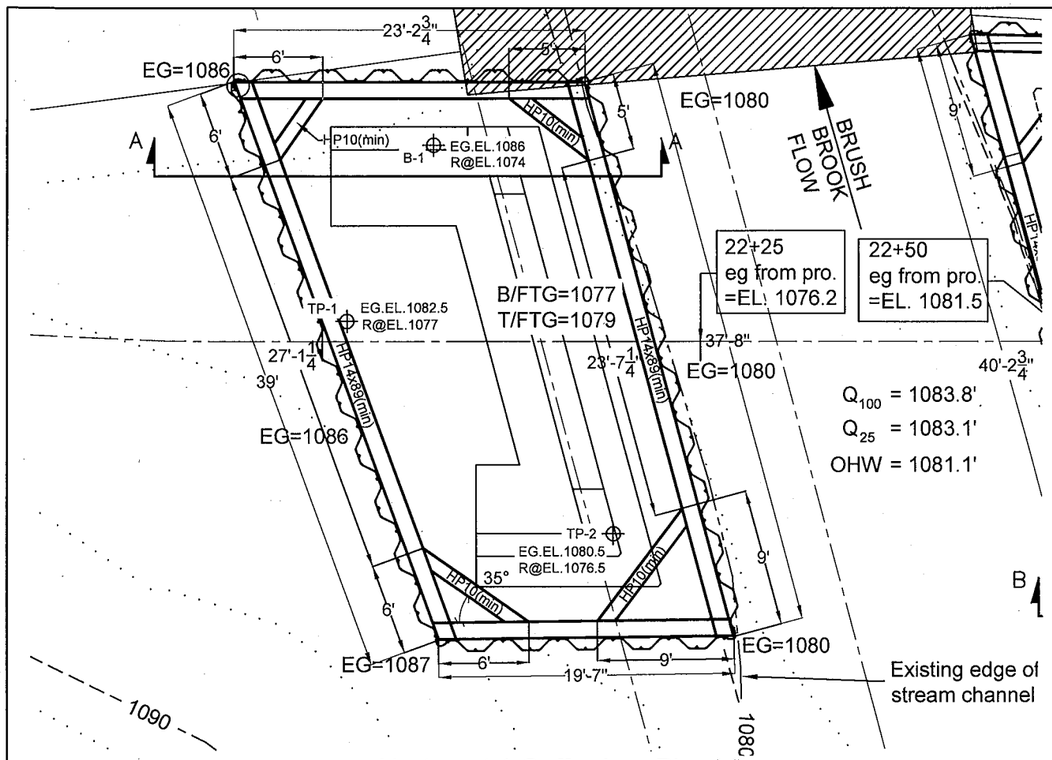
F_y = 50 ksi

COLUMNS
HP shapes
Design axial strength in kips (ϕ = 0.85)



Designation	HP12				HP10				HP8	
Wt./ft	63		53		57		42		36	
F_y	36	50	36	50	36	50	36	50	36	50
Effective length KL (ft) with respect to least radius of gyration r_y										
0	563	782	474	659	514	714	379	527	324	451
6	545	747	459	629	491	670	362	494	302	408
7	538	735	453	618	483	655	356	482	294	393
8	531	721	447	607	474	638	349	469	286	377
9	523	706	440	594	464	619	341	455	276	360
10	514	689	432	579	453	599	333	440	266	342
11	504	671	424	564	441	577	324	423	255	322
12	494	651	415	547	429	555	314	406	243	302
13	482	631	406	530	415	531	304	388	232	282
14	471	610	396	512	401	506	294	369	219	262
15	458	588	385	493	387	481	283	350	207	242
16	446	565	374	474	372	456	272	331	195	222
17	432	542	363	454	357	430	260	312	182	202
18	419	518	351	434	341	404	249	293	170	184
19	405	495	339	414	326	379	237	274	158	165
20	391	471	327	394	310	354	225	255	146	149
22	362	423	303	353	279	305	202	219	123	123
24	333	376	278	314	248	259	179	185	104	104
26	304	332	253	276	219	221	157	158	88	88
28	275	288	229	240	191	191	136	136	76	76
30	247	251	206	209	166	166	119	119	66	66
32	221	221	183	183	146	146	104	104	58	58
34	196	196	163	163	129	129	92	92	52	52
36	174	174	145	145	115	115	82	82	46	46
38	157	157	130	130	103	103	74	74	41	41
40	141	141	117	117	93	93	67	67	37	37
Properties										
P_{wo} (kips)	116	161	88	122	121	168	79	110	75	104
P_{wl} (kips/in.)	19	26	16	22	20	28	15	21	16	22
P_{wb} (kips)	311	366	188	221	508	599	202	238	309	364
P_{fb} (kips)	54	75	38	53	65	90	36	50	40	56
L_p (ft)	12.0	10.2	11.9	10.1	10.2	8.7	10.0	8.5	8.1	6.9
L_r (ft)	43.0	30.7	38.7	28.3	45.6	31.1	35.9	25.6	35.7	24.4
A (in.^{2})	18.4		15.5		16.8		12.4		10.6	
I_x (in.^{4})	472		393		294		210		119	
I_y (in.^{4})	153		127		101		71.7		40.3	
r_y (in.)	2.88		2.86		2.45		2.41		1.95	
Ratio r_x / r_y	1.76		1.76		1.71		1.71		1.72	
$P_{ex}(KL)^2 / 10^4$	13500		11200		8400		6050		3420	
$P_{ey}(KL)^2 / 10^4$	4370		3630		2890		2060		1150	

Note: Heavy line indicates Kl / r of 200.



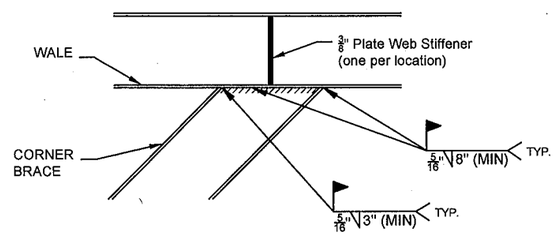
Abutment 1 Cofferdam Plan View
1" = 10'

Notes:

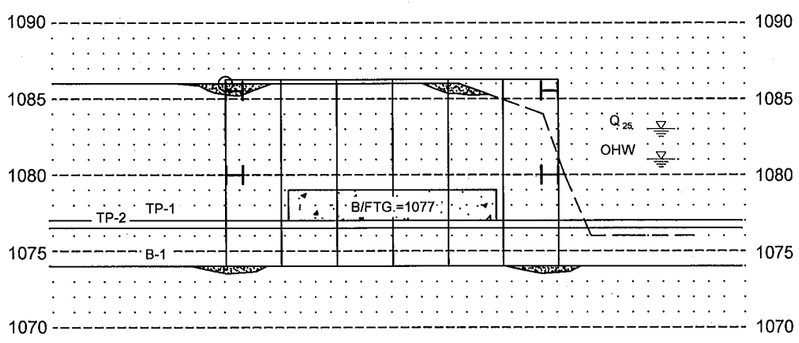
1. All sheets are to have a minimum section modulus of 18.4³.
2. Sheeting and bracing material to conform to ASTM A572 grade 50 requirements.
3. All wales will be HP14x89(min), corner braces will be HP10(min) sections.
4. The perimeter of the cofferdam may need to be pre-trenched to allow for sheetpiles to advance to bedrock.
5. If the elevation of the rock is higher than the bottom of footing, the sheetpiles may need to be drilled and pinned to allow for rock excavation.

Construction Procedure:

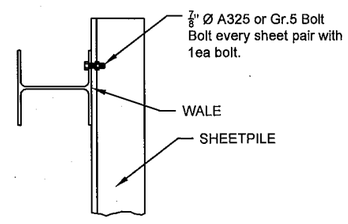
1. Pre-excavate around the perimeter of the cofferdam to a minimum elevation of 1086.
2. Install sheets as shown in plan view.
3. Excavate to approximately elevation 1083 and install upper frame & corner braces.
4. Continue excavating to elevation 1078 and install lower frame and corner braces as shown in plan view.
5. Continue to excavate as needed to bedrock in accordance with contract drawings and specifications.
6. In the event that bedrock is encountered higher than elevation 1077 and rock needs to be excavated for footing placement, **H.B. Fleming must be notified prior to any rock excavation** .
7. Construct/place subfooting and abutment footing as required.
8. Lower frame may be removed when backfill reaches top of footing (EL.1079).
9. Corner braces in upper frame may be removed when backfill reaches top of footing (EL.1079).
10. Construct abutment components as required.
11. Continue backfilling as required, remove upper frame when backfill reaches +/- 1083.
12. Complete backfill as required and pull sheets.



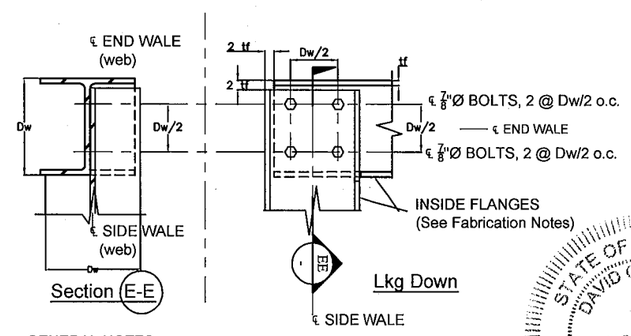
Corner Brace Weld Detail (typ)
NTS



Section A-A
NTS



Sheet/Wale Connection Detail
NTS



GENERAL NOTES:
1. Wales are assumed to be Matching HP Sections (Scale is for HP 14s)
2. Dw = Depth of Wales, tf = Flange Thickness
3. Bolts are 7/8"Ø A325 or SAE Grade 5

FABRICATION NOTES:
1. CUT INSIDE BOTT FLG OF SIDE WALE (tight fit) IN WAY OF END WALE
2. CUT INSIDE TOP FLG OF END WALE (tight fit) IN WAY OF SIDE WALE
3. LAP SIDE WALE WEB OVER END WALE WEB, AS SHOWN
4. BOLT WALES TOGETHER w/4 - 7/8"Ø BOLTS AT HALF-DEPTH SPACING EACH WAY

STATE OF VERMONT
DAVID GIFFORD
NO. 9124
Civil
LICENSED
PROFESSIONAL ENGINEER
3/8/16

Wale Connection Detail (typ)
NTS

Item # 208.40

H.B. FLEMING
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www.hbfleming.com

TITLE: Abutment #1 Cofferdam Plan	
PROJECT: BRO 1445(35) Bridge Replacement	
LOCATION: Huntington, VT	
DATE: 03/08/16	
SCALE: As Noted	

H. B. FLEMING, INC.
Contracting & Engineering
89 Pleasant Avenue
South Portland, ME 04106

Phone (207) 799-8514

LETTER OF TRANSMITTAL

DATE: 3/8/16
JOB NO.:
ATTENTION: Tim Parent

TO: Parent Construction
Attn: Tim Parent

RE: Huntington VT BRO 1445(35)
Bridge Replacement
Abutment 2 Cofferdam

WE ARE SENDING YOU ☒ Attached ☐ Under separate cover via _____ the following items:

☒ Shop drawings ☐ Prints ☐ Plans ☐ Samples ☐ Specifications
☐ Copy of letter ☐ Change order ☐ _____

COPIES	DATE	NO.	DESCRIPTION
1	3/8/16		Abutment 2 Cofferdam Plan
1	3/8/16		" " " Calcs

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☐ As requested ☐ Returned for corrections ☐ Return _____ corrected prints
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☐ FOR BIDS DUE _____ ☐ PRINTS RETURNED AFTER LOAN TO US

REMARKS

Tim,
Attached is our design for Abutment 2 in Huntington.
Please call with any questions regarding the cofferdam design.

Thanks
Jonathan

COPY TO _____

SIGNED: _____

If enclosures are not as noted, kindly notify us at once.

H.B. FLEMING, INC.

CONTRACTING · ENGINEERING

89 Pleasant Ave. South Portland, ME 04106

Phone 207-799-8514 Fax 207-799-8538

www.hbfleming.com

PILE DRIVING BRIDGES SUBMARINE PIPELINES

Abutment #2 Cofferdam Design

For

Parent Construction, Inc.

Vermont Bridge Project: BRO 1445(35)

Item # 208.40

STATE OF VERMONT
DAVID GIFFORD
NO. 9124
Civil
LICENSED
PROFESSIONAL ENGINEER
3/8/16

Huntington, VT

3/8/16

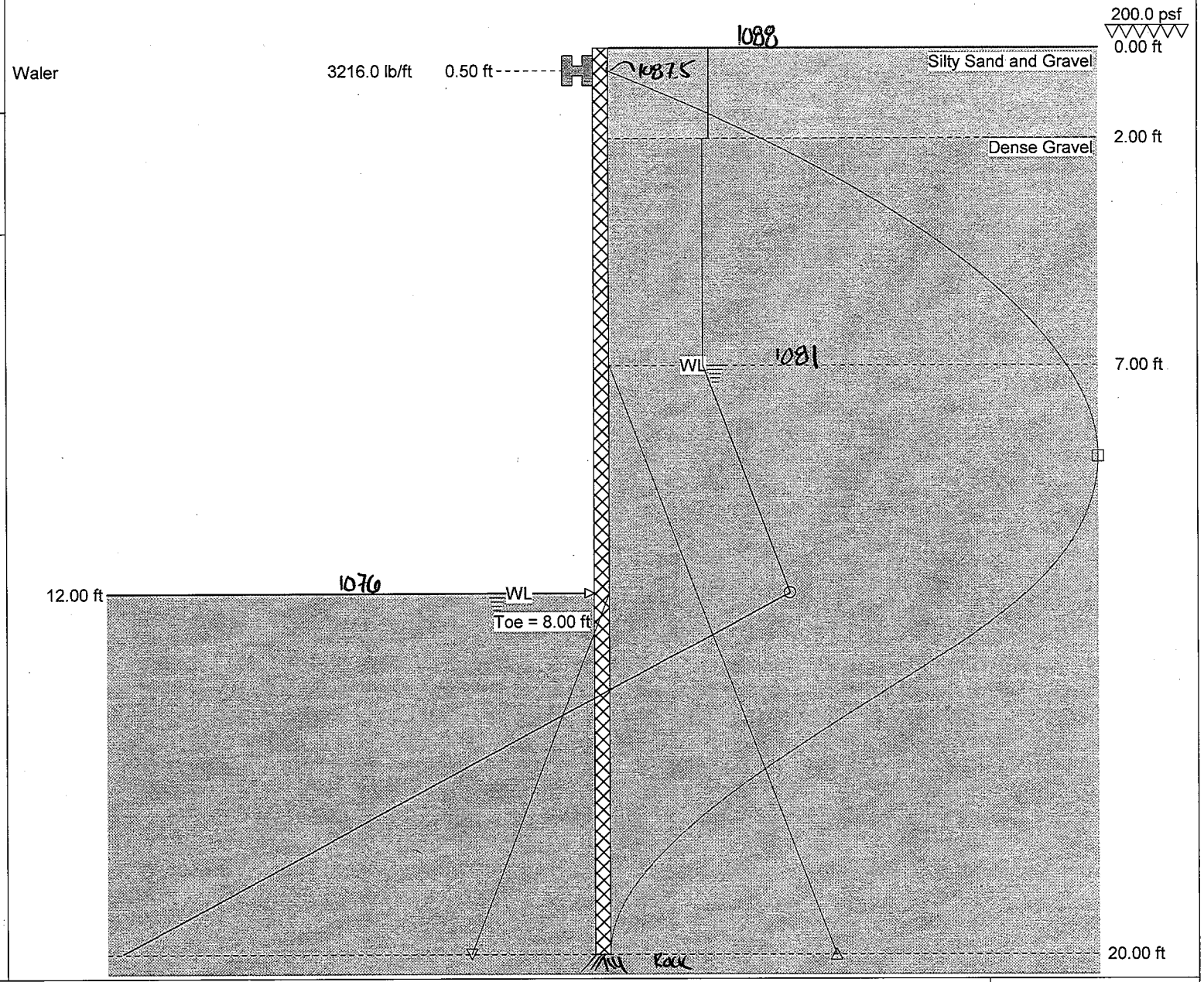
1ST CUT PRIOR TO SETTING LONGER FRAME

Client: Abutment B Full Depth 3' Precut-1st Cut

Date: 3.8.16

Sheet: PZ22
Works: Temporary
Pressure: Terzaghi
Analysis: Net Pressure
FOS: 2.35
Toe: Free Earth Support

	Maximum	d (ft)
○	649.6 psf	12.00
□	13233.2 ftlb/ft	9.02
△	811.6 psf	20.00
△	499.4 psf	20.00



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Web: www.GTSoft.org

Client: Abutment B Full Depth 3' Precut-1st Cut
Date: 3.8.16
Sheet: PZ22
Works: Temporary
Pressure: Terzaghi
Analysis: Net Pressure
FOS: 2.35
Toe: Free Earth Support

Input Data

Depth Of Excavation = 12.00ft
Surcharge = 200.0psf
Depth Of Active Water = 7.00ft
Depth Of Passive Water = 12.00ft
Water Density = 62.43pcf
Minimum Fluid Density = 31.82pcf

Soil Profile

Depth (ft)	Soil Name	γ (pcf)	γ' (pcf)	C (psf)	C_a (psf)	ϕ (°)	δ (°)	K_a	K_{ac}	K_p	K_{pc}
0.00	Silty Sand and Gravel	114.00	51.60	0.0	0.0	31.0	0.0	0.33	0.00	3.50	0.00
2.00	Dense Gravel	114.00	65.55	0.0	0.0	40.0	0.0	0.22	0.00	4.60	0.00

Solution

Sheet

Sheet Name	E (psi)	I (in^4/ft)	f (psi)	Z (in^3/ft)	Allowed M_{max} (ftlb/ft)	b (in)	A (in^2/ft)	W (lb/ft)	Upstand (ft)	Toe (ft)	Length (ft)
PZ22	3.04E+07	84.70	24966.8	18.40	38282.3	22.01	6.46	40.3	0.00	8.00	20.00

Load Model: Area Distribution

Supports

d (ft)	Type	Load (lb/ft)
0.50	Waler	3216.0

Maxima

	Maximum	Depth (ft)
Pressure	649.6 psf	12.00
Bending Moment	13233.2 ftlb/ft	9.02
Deflection	0.3 in	9.70
Shear Force	3030.3 lb/ft	0.50

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Full Depth to Rock

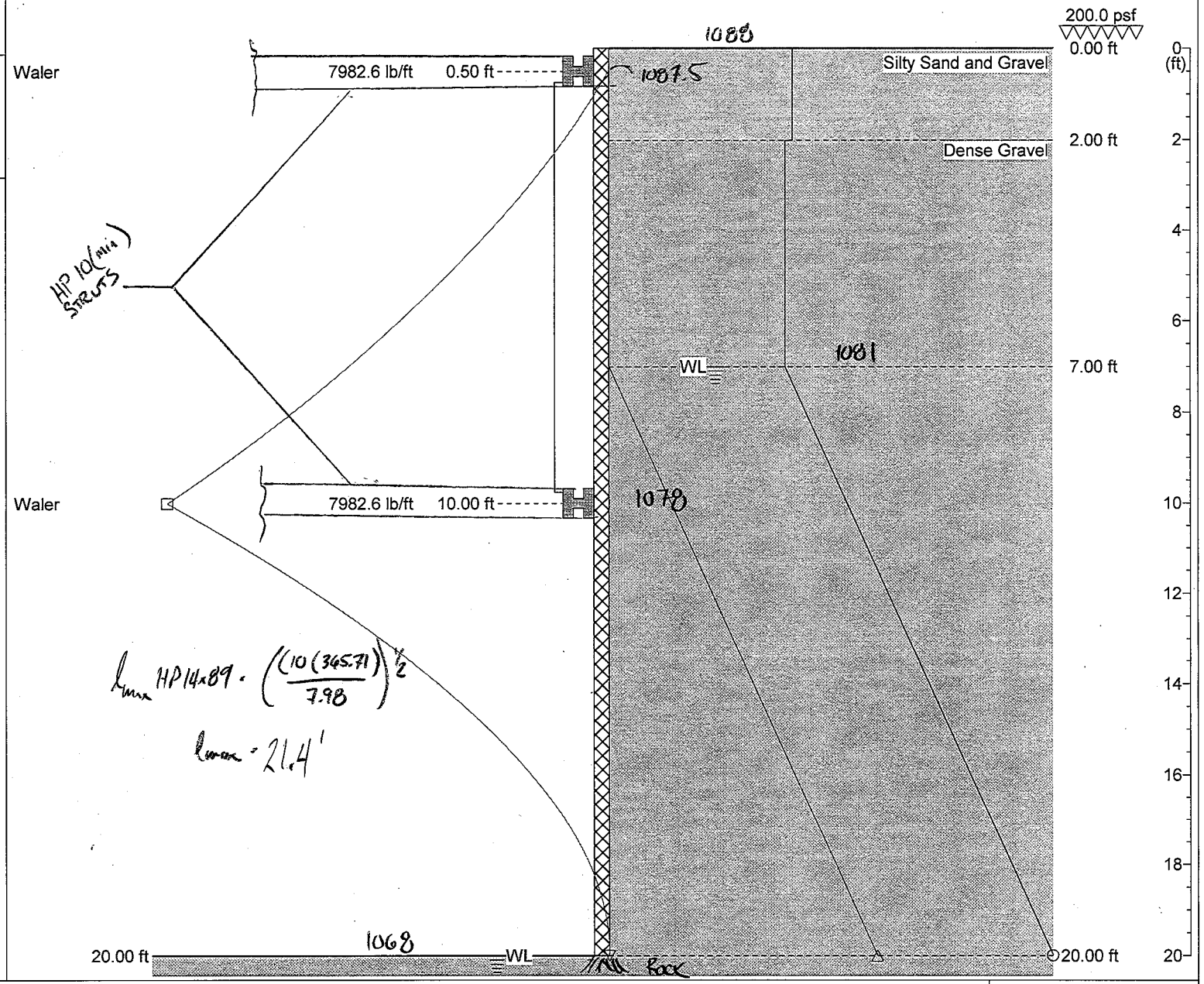
Client: AbutmentB, Full Depth-2 Frames
Date: 3.8.16

Sheet: PZ22
Works: Temporary
Pressure: Terzaghi
Toe: No Earth Support

	Maximum	d (ft)
○	1343.6 psf	20.00
□	56514.2 ftlb/ft	10.00
△	811.6 psf	20.00
△	0.0 psf	20.00

$S_{x-x} = \frac{56.51(12")}{50ksi(0.67)} = 20.24 in^3$

See attached supplemental calculation to analyze "kicking" effect of sheets to rock



l_{max} HP14x89 = $\left(\frac{(10(345.71))}{7.98}\right)^{1/2}$

$l_{max} = 21.4'$

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Client: AbutmentB, Full Depth-2 Frames
Date: 3.8.16
Sheet: PZ22
Works: Temporary
Pressure: Terzaghi
Toe: No Earth Support

Input Data

Depth Of Excavation = 20.00ft
Surcharge = 200.0psf

Depth Of Active Water = 7.00ft
Depth Of Passive Water = 20.00ft

Water Density = 62.43pcf
Minimum Fluid Density = 31.82pcf

Soil Profile

Depth (ft)	Soil Name	γ (pcf)	γ' (pcf)	C (psf)	C_a (psf)	ϕ (°)	δ (°)	K_a	K_{ac}	K_p	K_{pc}
0.00	Silty Sand and Gravel	114.00	51.60	0.0	0.0	31.0	0.0	0.33	0.00	3.50	0.00
2.00	Dense Gravel	115.00	65.55	0.0	0.0	40.0	0.0	0.22	0.00	4.60	0.00

Solution

Sheet

Sheet Name	E (psi)	I (in^4/ft)	f (psi)	Z (in^3/ft)	Allowed M_{max} (ftlb/ft)	b (in)	A (in^2/ft)	W (lb/ft)	Upstand (ft)	Toe (ft)	Length (ft)
PZ22	3.04E+07	84.70	24966.8	18.40	38282.3	22.01	6.46	40.3	0.00	0.00	20.00

Load Model: Area Distribution (Hinge Method used for Shear Force, Bending Moment and Deflection)

Supports

d (ft)	Type	Load (lb/ft)
0.50	Waler	▸ 7982.6
10.00	Waler	◂ 7982.6

↯ - Load sharing

Maxima

	Maximum	Depth (ft)
Pressure	1343.6 psf	20.00
Bending Moment	56514.2 ftlb/ft	10.00
Deflection	1.0 in	19.98
Shear Force	10307.8 lb/ft	10.00

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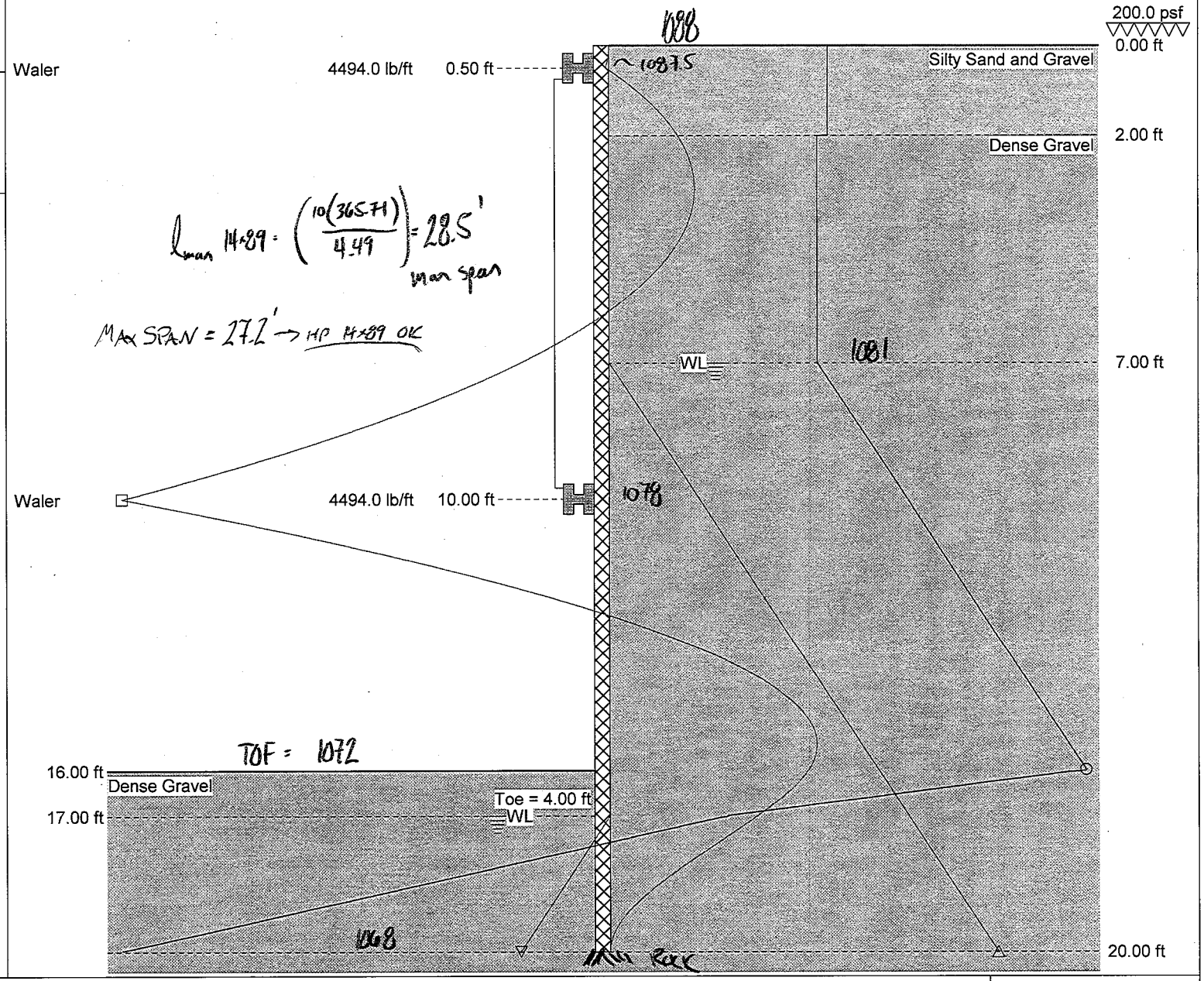
BACKFILLED TO TOP of Footing

Client: Huntington - AbutB, Backfilled to TOF

Date: 3.8.16

Sheet: PZ22
Works: Temporary
Pressure: Terzaghi
Toe: No Earth Support

Maximum		d (ft)
○	997.1 psf	16.00
□	8841.5 ftlb/ft	10.00
△	811.6 psf	20.00
△	187.3 psf	20.00



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Client: Huntington - AbutB, Backfilled to TOF
Date: 3.8.16
Sheet: PZ22
Works: Temporary
Pressure: Terzaghi
Toe: No Earth Support

Input Data

Depth Of Excavation = 16.00ft
Surcharge = 200.0psf

Depth Of Active Water = 7.00ft
Depth Of Passive Water = 17.00ft

Water Density = 62.43pcf
Minimum Fluid Density = 31.82pcf

Soil Profile — Active Side

Depth (ft)	Soil Name	γ (pcf)	γ' (pcf)	C (psf)	C_a (psf)	ϕ (°)	δ (°)	K_a	K_{ac}	K_p	K_{pc}
0.00	Silty Sand and Gravel	114.00	51.60	0.0	0.0	31.0	0.0	0.33	0.00	3.50	0.00
2.00	Dense Gravel	114.00	65.55	0.0	0.0	40.0	0.0	0.22	0.00	4.50	0.00

Soil Profile — Passive Side

Depth (ft)	Soil Name	γ (pcf)	γ' (pcf)	C (psf)	C_a (psf)	ϕ (°)	δ (°)	K_a	K_{ac}	K_p	K_{pc}
0.00	Silty Sand and Gravel	114.00	51.60	0.0	0.0	31.0	0.0	0.33	0.00	3.50	0.00
2.00	Dense Gravel	125.00	65.55	0.0	0.0	40.0	0.0	0.22	0.00	6.50	0.00

Solution

Sheet

Sheet Name	E (psi)	I (in^4/ft)	f (psi)	Z (in^3/ft)	Allowed M_{max} (ftlb/ft)	b (in)	A (in^2/ft)	W (lb/ft)	Upstand (ft)	Toe (ft)	Length (ft)
PZ22	3.04E+07	84.70	24966.8	18.40	38282.3	22.01	6.46	40.3	0.00	4.00	20.00

Load Model: Area Distribution (Hinge Method used for Shear Force, Bending Moment and Deflection)

Supports

d (ft)	Type	Load (lb/ft)
0.50	Waler	▸ 4494.0
10.00	Waler	◂ 4494.0

↹ - Load sharing

Maxima

	Maximum	Depth (ft)
Pressure	997.1 psf	16.00
Bending Moment	8841.5 ftlb/ft	10.00
Deflection	0.0 in	4.12
Shear Force	4308.7 lb/ft	10.00

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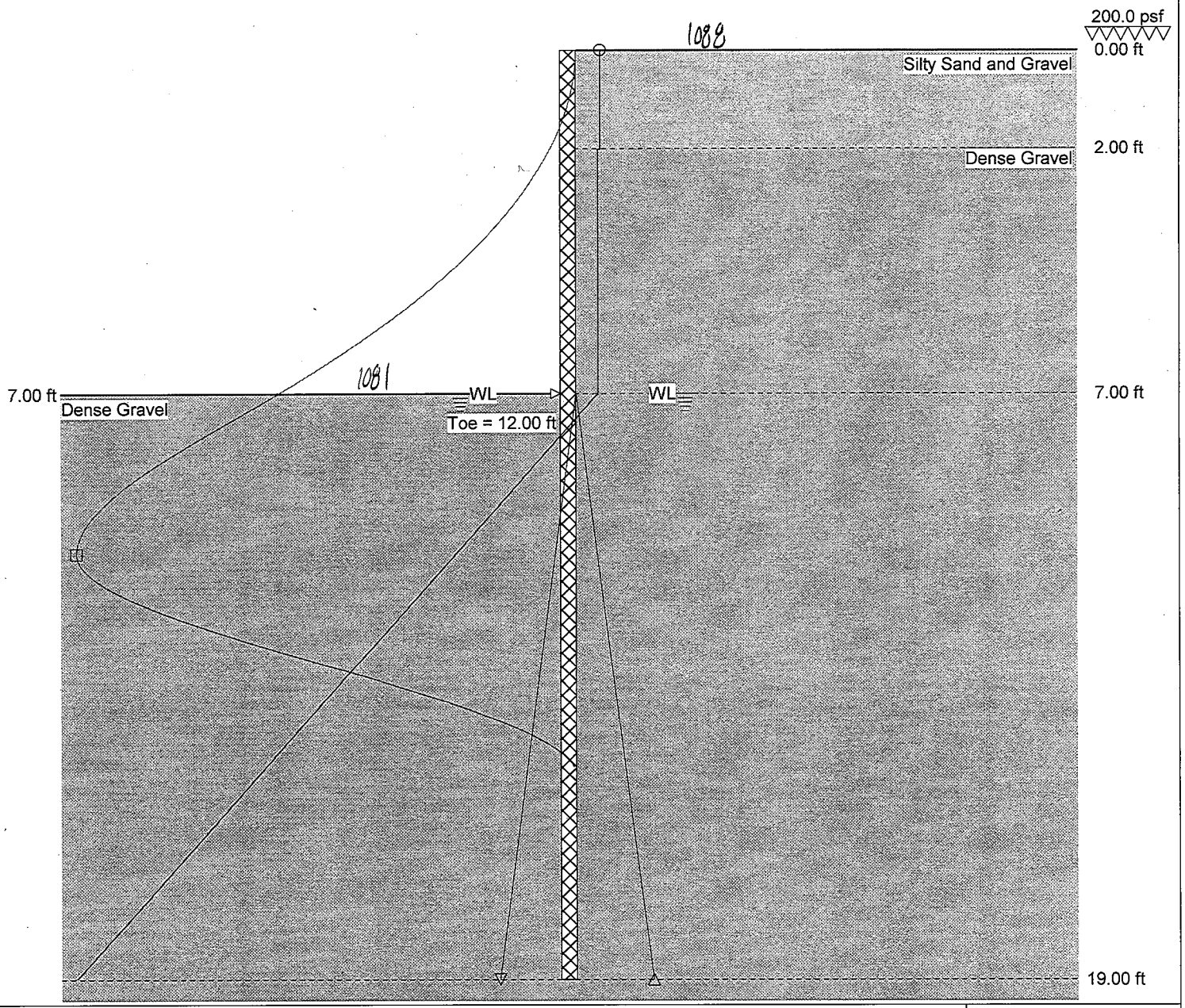
BACKFILL TO 1081, CANTILEVER SITUATION

Client: Huntington - AbutB, Backfilled to EL 1081

Date: 3.8.16

Sheet: PZ22
Works: Temporary
Pressure: Terzaghi
Analysis: Net Pressure
FOS: 2.87
Toe: Cantilever

	Maximum	d (ft)
○	237.2 psf	0.00
□	9276.6 ftlb/ft	10.26
△	749.2 psf	19.00
△	749.2 psf	19.00



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Client: Huntington - AbutB, Backfilled to EL 1081
Date: 3.8.16
Sheet: PZ22
Works: Temporary
Pressure: Terzaghi
Analysis: Net Pressure
FOS: 2.87
Toe: Cantilever

Input Data

Depth Of Excavation = 7.00ft
Surcharge = 200.0psf

Depth Of Active Water = 7.00ft
Depth Of Passive Water = 7.00ft

Water Density = 62.43pcf
Minimum Fluid Density = 31.82pcf

Soil Profile — Active Side

Depth (ft)	Soil Name	γ (pcf)	γ' (pcf)	C (psf)	C_a (psf)	ϕ (°)	δ (°)	K_a	K_{ac}	K_p	K_{pc}
0.00	Silty Sand and Gravel	114.00	51.60	0.0	0.0	31.0	0.0	0.33	0.00	3.50	0.00
2.00	Dense Gravel	114.00	65.55	0.0	0.0	40.0	0.0	0.22	0.00	4.50	0.00

Soil Profile — Passive Side

Depth (ft)	Soil Name	γ (pcf)	γ' (pcf)	C (psf)	C_a (psf)	ϕ (°)	δ (°)	K_a	K_{ac}	K_p	K_{pc}
0.00	Silty Sand and Gravel	114.00	51.60	0.0	0.0	31.0	0.0	0.33	0.00	3.50	0.00
2.00	Dense Gravel	125.00	65.55	0.0	0.0	40.0	0.0	0.22	0.00	6.50	0.00

Solution

Sheet

Sheet Name	E (psi)	I (in^4/ft)	f (psi)	Z (in^3/ft)	Allowed M_{max} (ftlb/ft)	b (in)	A (in^2/ft)	W (lb/ft)	Upstand (ft)	Toe (ft)	Length (ft)
PZ22	3.04E+07	84.70	24966.8	18.40	38282.3	22.01	6.46	40.3	0.00	12.00	19.00

Maxima

	Maximum	Depth (ft)
Pressure	237.2 psf	0.00
Bending Moment	9276.6 ftlb/ft	10.26
Deflection	0.4 in	0.00
Shear Force	1607.0 lb/ft	7.49

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3/8/2016 - HUNTINGTON, ABUTMENT 2

SIZE WALES

CONTROLLING CASE = 2 FRAMES, BACKFILLED TO TOP OF FOOTING, STRUTS REMOVED

MAX WALE LOAD = 4.49 klf

$$M_{max} = \frac{wl^2}{10} = \frac{4.49 \cdot (27.2)^2 (12")}{10} = 3{,}986.2$$

$$\text{Min } S_{x-x} = \frac{3{,}986.2}{.65(50\text{ ksi})} = 122.65 \text{ in}^3$$

→ USE HP14x89 (min) $S_{x-x} = 131 \text{ in}^3$

CHECK CENTER STRUT LOADING IN LOWER FRAME/UPPER FRAME

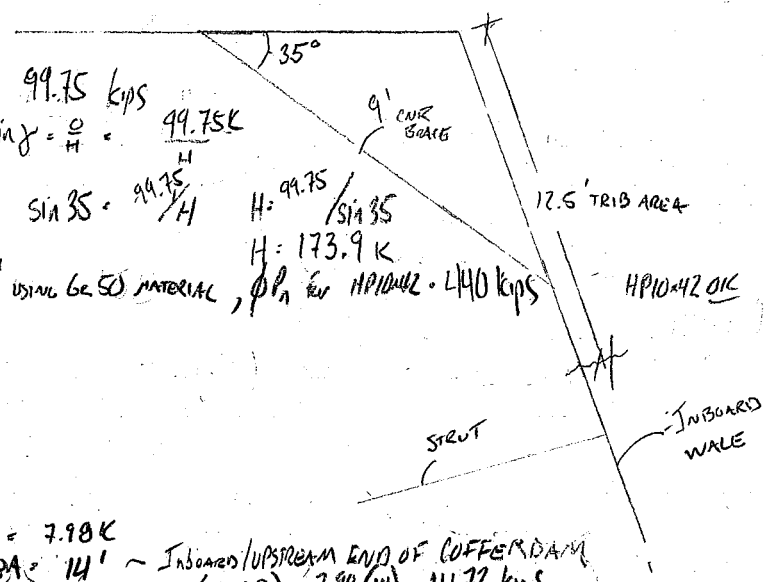
MAX LOAD = 7.98 klf
MAX TRIBUTARY AREA = 16.1' } MAX LOAD = 128.48 kips

FOR KL = 24' USING GR. 50 MATERIAL, ϕP_n FOR HP10x42 = 185 K

→ USE HP10 (min) STRUTS

SIZE CORNER BRACES

12' CORNER BRACE - LOWER FRAME - INBOARD WALL - WORST CASE



LOAD = (7.98k)(12.5) = 99.75 kips

$\sin\gamma = \frac{O}{H} = \frac{99.75K}{H}$

$\sin 35 = 99.75/H$ $H = 99.75/\sin 35$

$H = 173.9$ K

FOR KL = 10' USING GR. 50 MATERIAL, ϕP_n FOR HP10x42 = 440 kips HP10x42 OK

SIZE WELDS

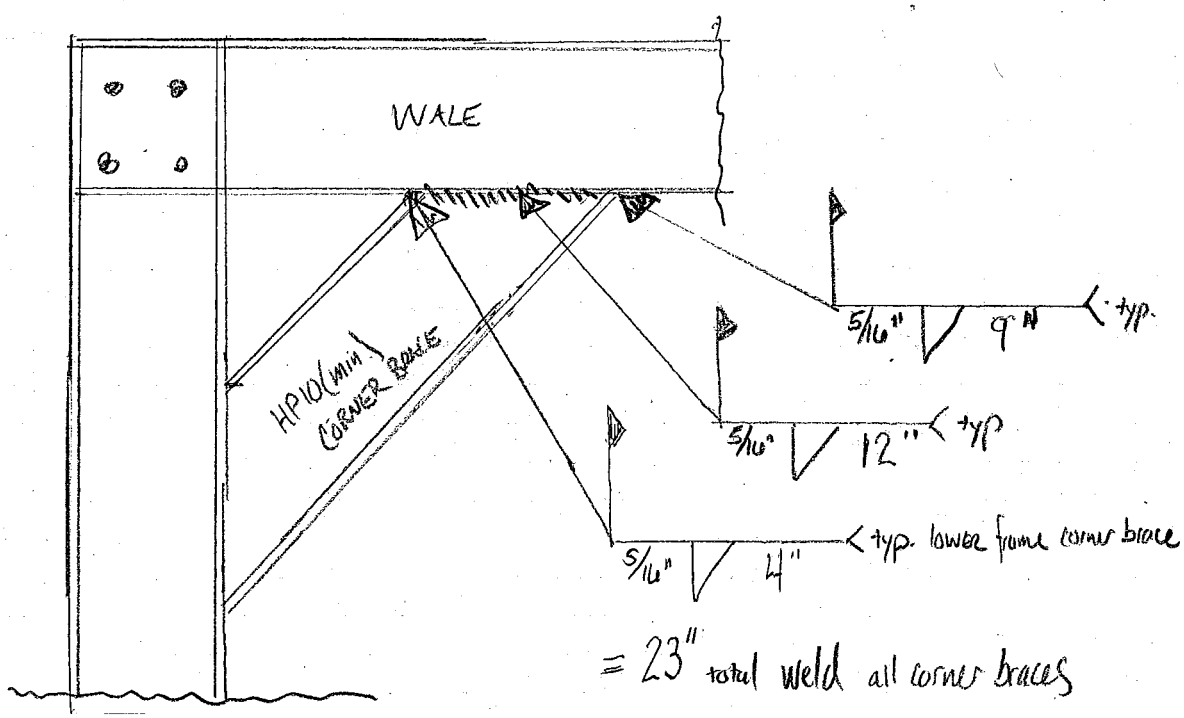
CORNER BRACES

τ_{max} = MAX LOAD = 7.98 K
TRIB AREA = 14' ~ INBOARD/UPSTREAM END OF COFFERDAM
MAX LOAD (SHEAR) = 7.98(14) = 111.72 kips

USING 5/16" fillet weld

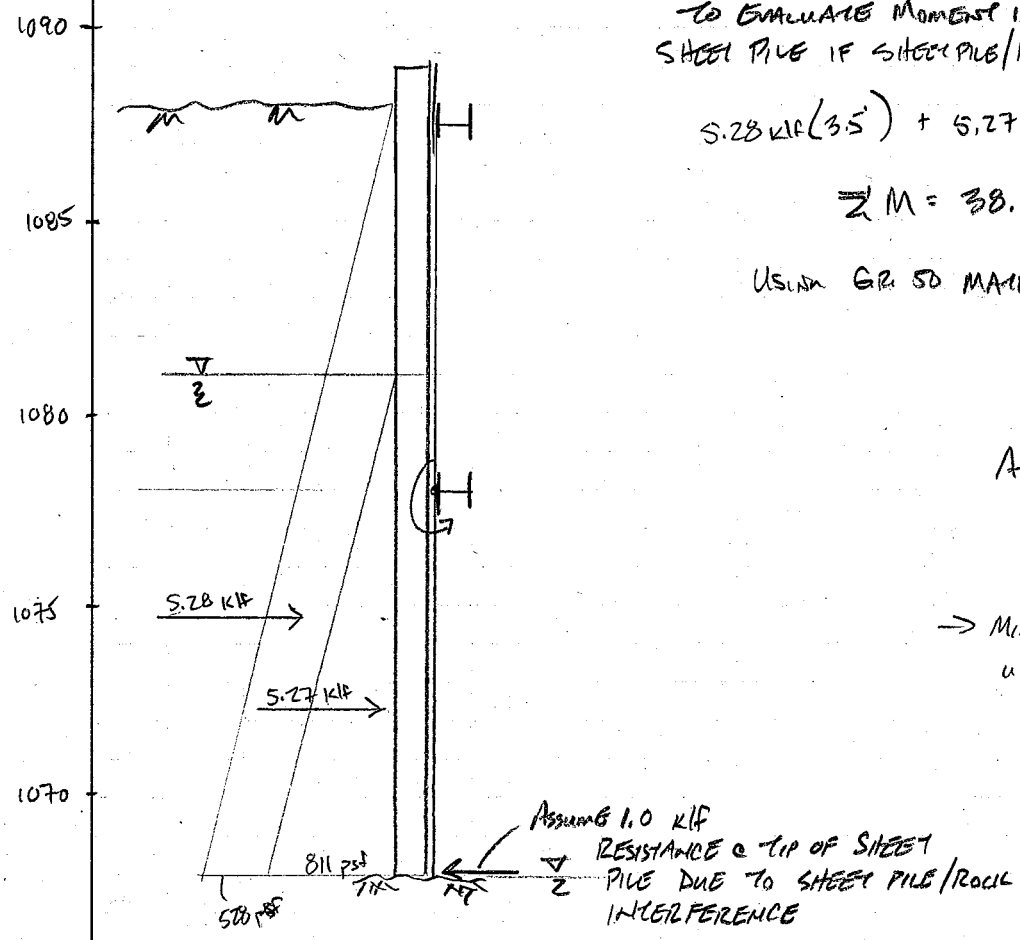
$$l_{min} = \frac{1.33(111.72K)}{0.60(70\text{ ksi})(0.707)(5/16")} = 21.2" \text{ WELD}$$

About Calcs Cont.



= 23" total weld all corner braces

CHECK SHEET PILE MOMENT, ANALYZE "KEYING" EFFECT FROM RESISTANCE FROM ROCK @ SHEET TIP



SUM MOMENTS ABOUT LOWER FRAME TO EVALUATE MOMENT IN LOWER PORTION OF SHEET PILE IF SHEET PILE/ROCK RESISTANCE = 1.0 klf:

$$5.28\,klf(3.5') + 5.27\,klf(5.75') - 1.0\,klf(10)$$

$$\Sigma M = 38.78\ k\text{-}ft$$

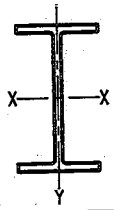
USING GR 50 MATERIAL, $S_x = \frac{38.78(12)}{50\ ksi}$

$$S_x = 9.31\ in^3$$

APPLYING REDUCTION FACTOR OF 0.67, $S_x = 9.31/0.67 = 13.89\ in^3$

→ MINIMUM S_x IS $13.89\ in^3$ ASSUMING "KEYING" EFFECT OF SHEETS/ROCK @ 1.0 klf

TOPS



$F_y = 50$ ksi

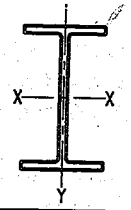
COLUMNS
HP shapes
Design axial strength in kips ($\phi = 0.85$)

Designation	HP13						HP12			
Wt./ft	87		73		60		84		74	
F_y	36	50	36	50	36	50	36	50	36	50
Effective length KL (ft) with respect to least radius of gyration r_y										
0	780	1080	661	918	536	744	753	1050	667	[illegible]
6	759	1040	642	882	520	714	729	1000	646	[illegible]
7	751	1030	636	870	515	704	721	985	639	[illegible]
8	743	1010	628	856	509	692	712	967	630	[illegible]
9	733	993	620	840	502	679	701	947	621	[illegible]
10	722	973	611	823	494	665	690	926	610	[illegible]
11	711	952	601	804	486	650	677	902	599	[illegible]
12	698	928	590	784	477	633	663	877	587	[illegible]
13	685	904	578	763	467	616	649	851	574	[illegible]
14	670	878	566	741	457	597	634	823	560	[illegible]
15	656	851	553	717	447	578	618	795	546	[illegible]
16	640	823	540	693	436	559	601	765	531	[illegible]
17	624	794	526	669	424	539	584	735	516	[illegible]
18	607	765	512	644	413	518	567	705	500	[illegible]
19	590	735	497	618	401	497	548	674	484	[illegible]
20	573	705	482	592	388	476	530	642	467	[illegible]
22	537	644	451	540	363	433	492	580	434	[illegible]
24	500	584	420	488	337	391	454	518	400	[illegible]
26	462	524	388	438	311	350	416	459	366	[illegible]
28	425	467	356	389	285	310	378	402	332	[illegible]
30	389	411	325	342	260	272	342	350	300	[illegible]
32	353	361	295	300	235	239	307	308	268	[illegible]
34	319	320	266	266	211	211	273	273	238	[illegible]
36	286	286	237	237	189	189	243	243	213	[illegible]
38	256	256	213	213	169	169	218	218	191	[illegible]
40	231	231	192	192	153	153	197	197	172	[illegible]
Properties										
P_{wo} (kips)	165	229	127	177	93	129	170	235	143	[illegible]
P_{wi} (kips/in.)	24	33	20	28	17	23	25	34	22	[illegible]
P_{wb} (kips)	624	735	384	453	206	243	732	862	506	[illegible]
P_{fb} (kips)	90	124	65	90	43	60	95	132	75	[illegible]
L_p (ft)	13.0	11.1	12.9	11.0	12.8	10.9	12.3	10.4	12.2	[illegible]
L_r (ft)	53.2	36.9	47.0	33.4	41.2	30.2	54.0	36.9	48.9	[illegible]
A (in.^{2})	25.5		21.6		17.5		24.6		21.8	
I_x (in.^{4})	755		630		503		650		569	
I_y (in.^{4})	250		207		165		213		186	
r_y (in.)	3.13		3.10		3.07		2.94		2.92	
Ratio r_x / r_y	1.74		1.74		1.75		1.75		1.75	
$P_{ex}(KL)^2/10^4$	21700		18000		14400		18600		16300	
$P_{ey}(KL)^2/10^4$	7150		5940		4720		6090		5324	

Note: Heavy line indicates Kl/r of 200.

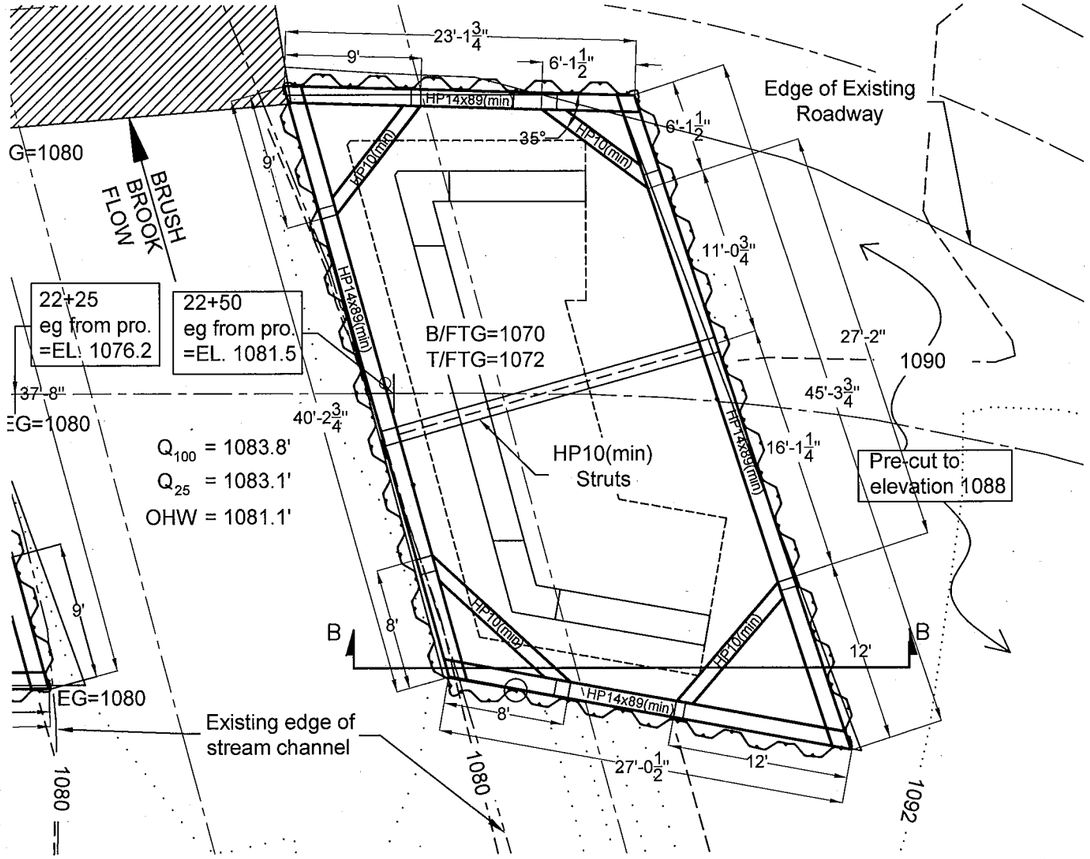
$F_y = 50$ ksi

COLUMNS
HP shapes
Design axial strength in kips ($\phi = 0.85$)



Designation	HP12				HP10				HP8	
Wt./ft	63		53		57		42		36	
F_y	36	50	36	50	36	50	36	50	36	50
Effective length KL (ft) with respect to least radius of gyration r_y										
0	563	782	474	659	514	714	379	527	324	451
6	545	747	459	629	491	670	362	494	302	408
7	538	735	453	618	483	655	356	482	294	393
8	531	721	447	607	474	638	349	469	286	377
9	523	706	440	594	464	619	341	455	276	360
10	514	689	432	579	453	599	333	440	266	342
11	504	671	424	564	441	577	324	423	255	322
12	494	651	415	547	429	555	314	406	243	302
13	482	631	406	530	415	531	304	388	232	282
14	471	610	396	512	401	506	294	369	219	262
15	458	588	385	493	387	481	283	350	207	242
16	446	565	374	474	372	456	272	331	195	222
17	432	542	363	454	357	430	260	312	182	202
18	419	518	351	434	341	404	249	293	170	184
19	405	495	339	414	326	379	237	274	158	165
20	391	471	327	394	310	354	225	255	146	149
22	362	423	303	353	279	305	202	219	123	123
24	333	376	278	314	248	259	179	185	104	104
26	304	332	253	276	219	221	157	158	88	88
28	275	288	229	240	191	191	136	136	76	76
30	247	251	206	209	166	166	119	119	66	66
32	221	221	183	183	146	146	104	104	58	58
34	196	196	163	163	129	129	92	92	52	52
36	174	174	145	145	115	115	82	82	46	46
38	157	157	130	130	103	103	74	74	41	41
40	141	141	117	117	93	93	67	67	37	37
Properties										
P_{wo} (kips)	116	161	88	122	121	168	79	110	75	104
P_{wi} (kips/in.)	19	26	16	22	20	28	15	21	16	22
P_{wb} (kips)	311	366	188	221	508	599	202	238	309	364
P_{fb} (kips)	54	75	38	53	65	90	36	50	40	56
L_p (ft)	12.0	10.2	11.9	10.1	10.2	8.7	10.0	8.5	8.1	6.9
L_r (ft)	43.0	30.7	38.7	28.3	45.6	31.1	35.9	25.6	35.7	24.4
A (in.^{2})	18.4		15.5		16.8		12.4		10.6	
I_x (in.^{4})	472		393		294		210		119	
I_y (in.^{4})	153		127		101		71.7		40.3	
r_y (in.)	2.88		2.86		2.45		2.41		1.95	
Ratio r_x / r_y	1.76		1.76		1.71		1.71		1.72	
$P_{ex}(KL)^2/10^4$	13500		11200		8400		6050		3420	
$P_{ey}(KL)^2/10^4$	4370		3630		2890		2060		1150	

Note: Heavy line indicates Kl/r of 200.



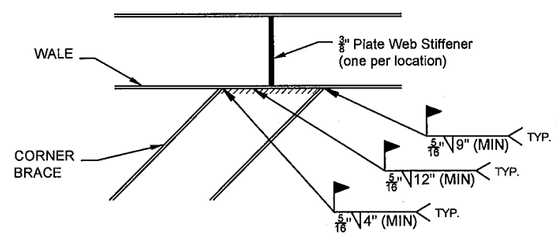
Abutment 2 Cofferdam Plan View
1" = 10'

Notes:

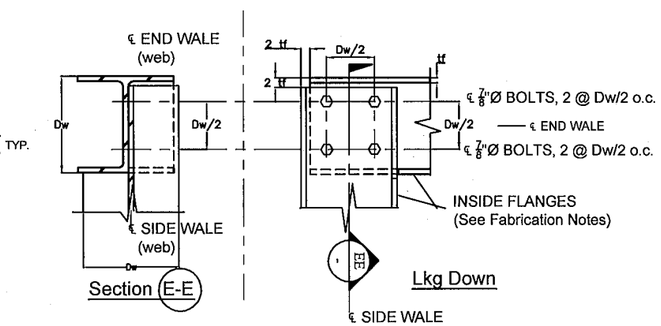
1. All sheets are to have a minimum section modulus of 18.4³.
2. Sheeting and bracing material to conform to ASTM A572 grade 50 requirements.
3. All wales will be HP14x89(min), struts (HP10min), and corner braces will be HP10(min) sections.
4. The perimeter of the cofferdam may need to be pre-trenched to allow for sheetpiles to advance to bedrock.
5. If the elevation of the rock is higher than the bottom of footing, the sheetpiles may need to be drilled and pinned to allow for rock excavation.

Construction Procedure:

1. Pre-excavate around the perimeter of the cofferdam to a minimum elevation of 1088.
2. Install sheets as shown in plan view.
3. Excavate to approximately elevation 1085 and install upper frame.
4. Install corner braces and center strut as shown in plan view.
5. Continue excavating to elevation 1076 and install lower frame.
6. Install corner braces and strut as shown in plan view.
7. Continue to excavate as needed to bedrock in accordance with contract drawings and specifications.
8. In the event that bedrock is encountered higher than elevation 1070 and rock needs to be excavated for footing placement, **H.B. Fleming must be notified prior to any rock excavation** .
9. Construct/place subfooting and abutment footing as required.
10. Center strut(s) can be removed once abutment footing has been backfilled to top of footing (EL. 1072).
11. Construct abutment components as required.
12. Remove lower frame once backfill reaches elevation 1076.
13. Continue backfilling as required. Upper framework may be removed once backfill has reached a minimum elevation of 1081.
14. Complete backfill as required and pull sheets.



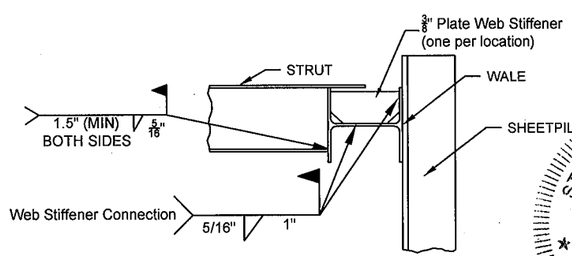
Corner Brace Weld Detail (typ)
NTS



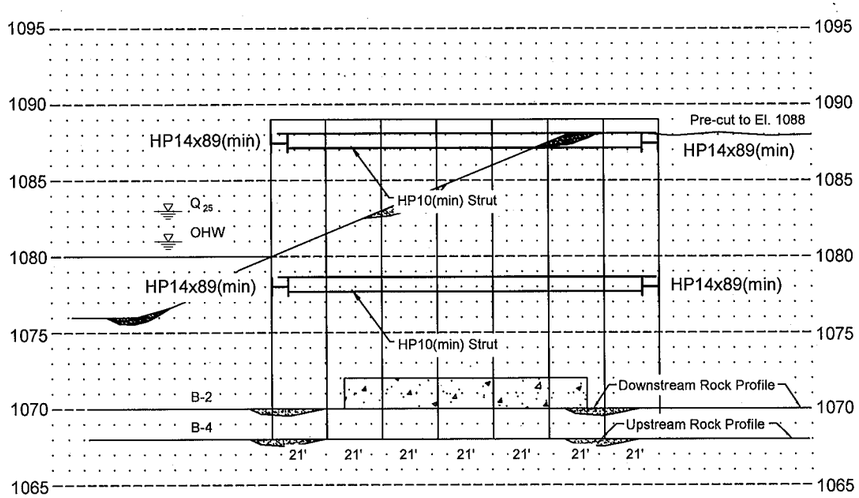
GENERAL NOTES:
1. Wales are assumed to be Matching HP Sections (Scale is for HP 14s)
2. Dw = Depth of Wales, tf = Flange Thickness
3. Bolts are 7/8"Ø A325 or SAE Grade 5

FABRICATION NOTES:
1. CUT INSIDE BOTT FLG OF SIDE WALE (tight fit) IN WAY OF END WALE
2. CUT INSIDE TOP FLG OF END WALE (tight fit) IN WAY OF SIDE WALE
3. LAP SIDE WALE WEB OVER END WALE WEB, AS SHOWN
4. COL. WALES TOGETHER w/4 - 7/8"Ø BOLTS AT HALF-DEPTH SPACING EACH WAY

Wale Connection Detail (typ)
NTS



Sheet/Wale/Strut Connection Detail (typ)
NTS



Section B-B
1" = 10'

STATE OF VERMONT
DAVID GIFFORD
NO. 9124
Civil
LICENSED
PROFESSIONAL ENGINEER
3/8/16

Item # 208.40

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TITLE: Abutment #2 Cofferdam Plan	
PROJECT: BRO 1445(35) Bridge Replacement	
LOCATION: Huntington, VT	
DATE: 03/08/16	
SCALE: As Noted	