

60% Remedial Design Basis of Design Report

Appendix G

Structural Calculations

This design has not changed since Preliminary (30%) Remedial Design and will be progressed during Pre-Final (90%) Remedial Design.

STRUCTURAL CALCULATIONS

LOWER DUWAMISH WATERWAY MIDDLE REACH

30% REMEDIAL DESIGN

PREPARED FOR: ANCHOR QEA

DATE: SEPT 19, 2025

BEI No. 252.02

**LOWER DUWAMISH WATERWAY MIDDLE REACH
30% REMEDIAL DESIGN**

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Wall 2 – Cofferdam.....	2-101 to 2-13



Date: July 2025 By: SL, AB BEI No. Sheet No. 1 of 6 Sheets
Subject: Engineering Services for 30% Remedial Design for Lower Duwamish Waterway Middle Reach

A - DESIGN CRITERIA AND GENERAL INFORMATION

Relevant Codes and Standards

ACI 318-19 Building Code Requirements for Structural Concrete and Commentary, 2019

AISC Steel Construction Manual, Fifteenth Edition, 2017

ASCE/ SEI 7-16 Minimum Design Loads and Associated Criteria for Building and Other Structures

AWS D1.1/D1.1M: 2020 Structural Welding Code-Steel

IBC (International Building Code), 2021

SBC (Seattle Building Code), 2021

B - MATERIAL PROPERTIES

Structural Steel

Wide flange shapes: ASTM A572 or ASTM A992, Grade 50, unless otherwise noted.

Tees, channels, angels, plates & bars: ASTM A36, unless otherwise noted.

Pipe Piles: ASTM A252, Grade 3, $f_y = 45\text{ksi}$, or API 5Lx42 or API 5Lx52

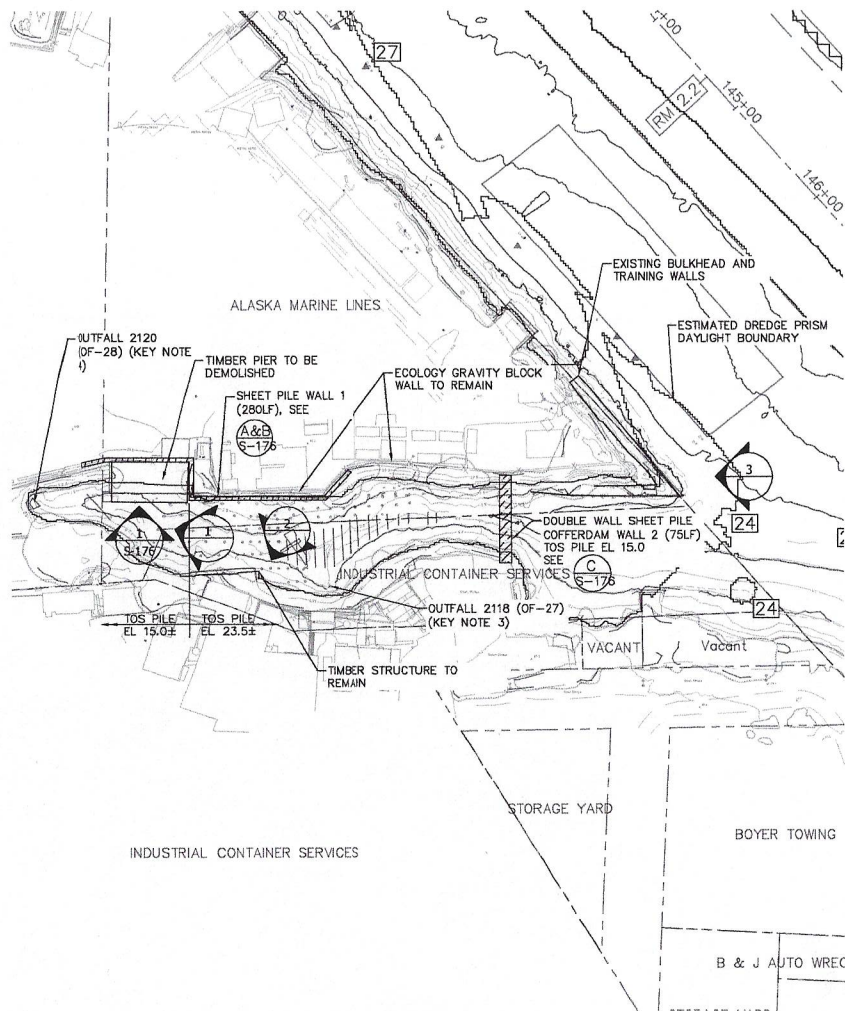
Pipe for Cofferdam: ASTM A252, $f_y = 50\text{ksi}$

Sheet Piles: ASTM A572, Grade 50, $f_y = 50\text{ksi}$ (Type PZ or AZ)

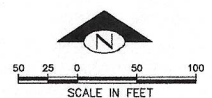
Welding: 70XX Electrodes

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 Author: hahigh Date: 25-06-2025 Time: 10:50am

WALL SYMBOL	DATE	MARK	REVISION



PARTIAL SITE PLAN
 SCALE: 1"=50'

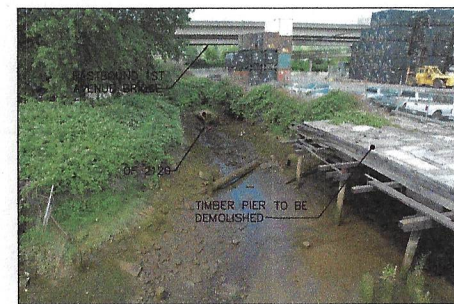


GENERAL NOTES

- EXISTING TOPOGRAPHY, STRUCTURES, AND SITE FEATURES ARE SHOWN SCREENED AND/OR LIGHT-LINED AND ARE INTENDED FOR REFERENCE ONLY. NEW GRADES FOR THIS CONTRACT, STRUCTURES, AND SITE FEATURES, AND EXISTING STRUCTURES AFFECTED BY DREDGING ARE SHOWN HEAVY-LINED EXCEPT WHERE NOTED OTHERWISE ON THE DRAWING.

KEY NOTES

- FOR DREDGING OFFSET AND LIMITS, CUT SLOPE AND RESTORATION, SEE CIVIL DRAWINGS.
- DO NOT MOOR OR OTHERWISE IMPOSE LATERAL LOADS TO THE INLET STRUCTURE.
- PRIOR TO STARTING WORK DIVERT OUTFALL 2120 AND OUTFALL 2118.



TIMBER PIER

PHOTO
 SCALE: NONE



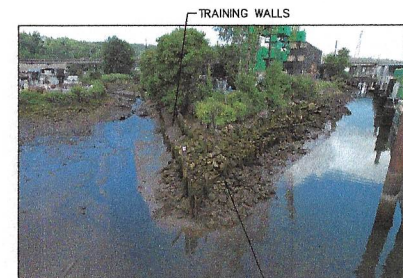
BUILDING

PHOTO
 SCALE: NONE



GOOGLE MAP VIEW

SCALE: NONE



TRAINING WALLS

EXISTING BULKHEAD

PHOTO
 SCALE: NONE

INLET AT RM 2.2W PARTIAL PLAN

30% SUBMITTAL (NOT FOR CONSTRUCTION)

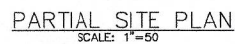
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 Bellevue Washington 98007
 Phone: 425.519.6500

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BY: FAS PURCHASING AND CONTRACTING DIRECTOR	DRAWN XXX CHECKED XXX	RECEIVED
		REVISED AS BUILT

Seattle Public Utilities
 ORDINANCE NO. PW NO.
 SCALE: AS NOTED

LOWER DUWAMISH
 WATERWAY - 30%
 REMEDIAL DESIGN

PC	CD
VP#	#
S-175	
SHEET	---OF---?



**DAVID EVANS
AND ASSOCIATES INC.**
1402 SE Eastgate Way, Suite 400
Bellevue Washington 98007
Phone: 425.519.6500

INITIALS AND DATE		INITIALS AND DATE	
DESIGNED XXXX		REVIEWED:	
CHECKED XXXX		DES.	CONST.
		SDOT	PROJ. MGR.
DRAWN		RECEIVED	
CHECKED XXXX		REVISED AS BUILT	

ALL WORK SHALL BE DONE IN ACCORDANCE WITH THE CITY OF SEATTLE STANDARD PLANS AND SPECIFICATIONS AND OTHER DOCUMENTS CALLED FOR IN SECTION 5-12.3 OF THE PROJECT MANUAL.

INLET AT RM 2.2W PARTIAL PLAN

LOWER DUWAMISH
WATERWAY - 30%
REMEDIAL DESIGN

JOB #	PC
	CO
WPI #	
S-175	
SHEET --- OF --- ?	

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- 3 PRIOR TO STARTING WORK DIVERT OUTFALL 2120 AND OUTFALL 2118

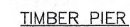


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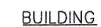
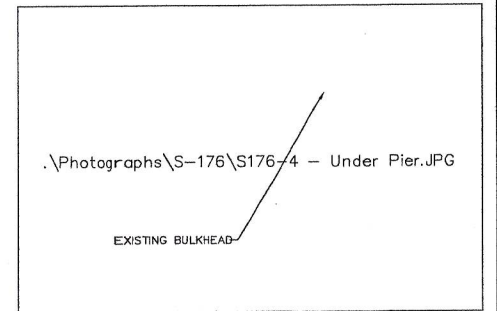
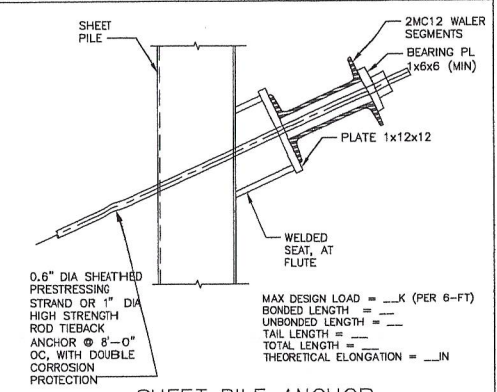
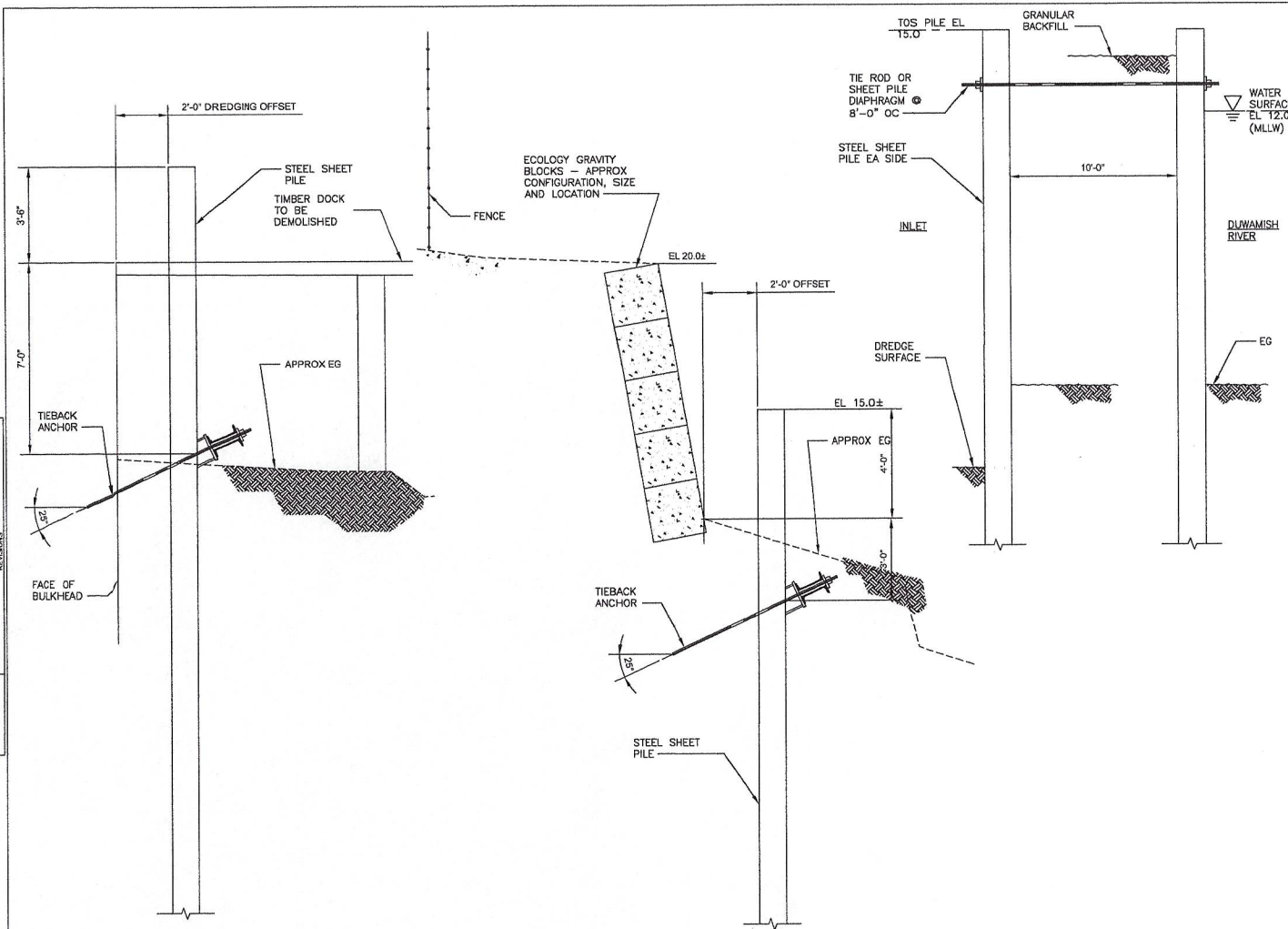


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SCALE: NONE



DATE	MARK	REVISION	MADE BY



WALL 1 AT TIMBER DOCK
SECTION A
SCALE: 1/2"=1'-0"

WALL 1 AT ECOLOGY BLOCKS
SECTION B
SCALE: 1/2"=1'-0"

WALL 2 - COFFERDAM
SECTION C
SCALE: 1/2"=1'-0"

TIMBER PIER
PHOTO 1
SCALE: NONE

INLET AT RM 2.2W SECTIONS AND DETAILS

30% SUBMITTAL (NOT FOR CONSTRUCTION)

LOWER DUWAMISH
WATERWAY - 30%
REMEDIAL DESIGN

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Bellevue, Washington 98007
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SEATTLE, WASHINGTON 20

INITIALS AND DATE		INITIALS AND DATE	
DESIGNED	XXX	REVIEWED:	
CHECKED	XXX	DES.	CONST.
		SDOT	PROJ. MGR.
DRAWN	XXX	RECEIVED	
CHECKED	XXX	REVISED	AS BUILT

Seattle Public Utilities
ORDINANCE NO. PW NO.
SCALE: AS NOTED

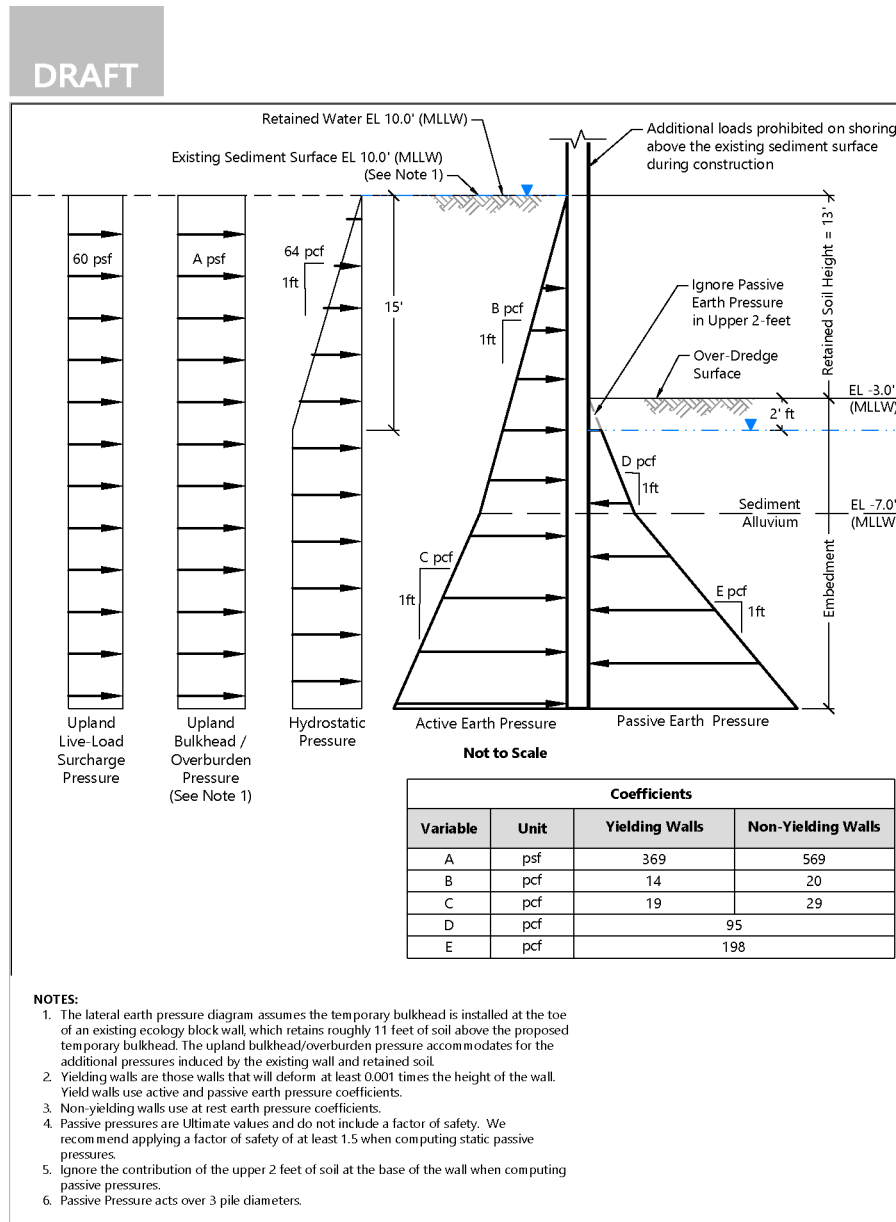
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VP1	#
	S-176
SHEET	— — — — — 9'

Date: July 2025 By: SL, AB BEI No. Sheet No. 1 of 6 Sheets
Subject: Engineering Services for 30% Remedial Design for Lower Duwamish Waterway Middle Reach

C - FOUNDATION

1. Retaining Walls

Design Soil Lateral Pressures – RM 2.2W



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Filepath: D:\Users\jgregg\Desktop\0067-RP-032 Lateral Earth Pressures.dwg Figure E4-1

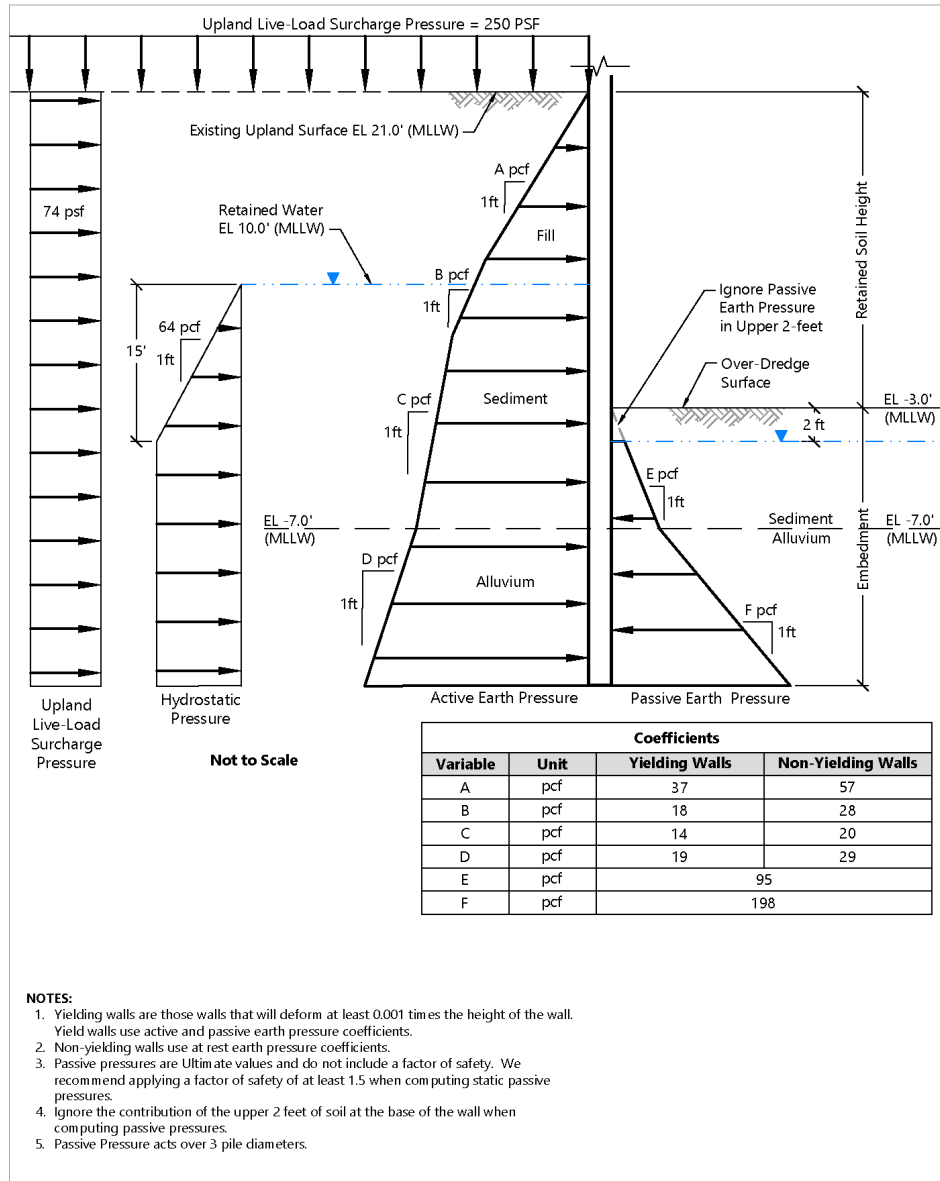


Figure E4-1
Lateral Earth Pressure Diagram - RM 2.2 Temporary Bulkhead

Appendix D - Geotechnical Design Analysis
Preliminary (30%) Remedial Design Basis of Design Report for LDW Middle Reach

Date: July 2025 By: SL, AB BEI No. Sheet No. 2 of 6 Sheets
Subject: Engineering Services for 30% Remedial Design for Lower Duwamish Waterway Middle Reach

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Filepath: D:\Users\jgregg\Desktop\0067-RP-032 Lateral Earth Pressures.dwg Figure E4-1b



Figure E4-1b

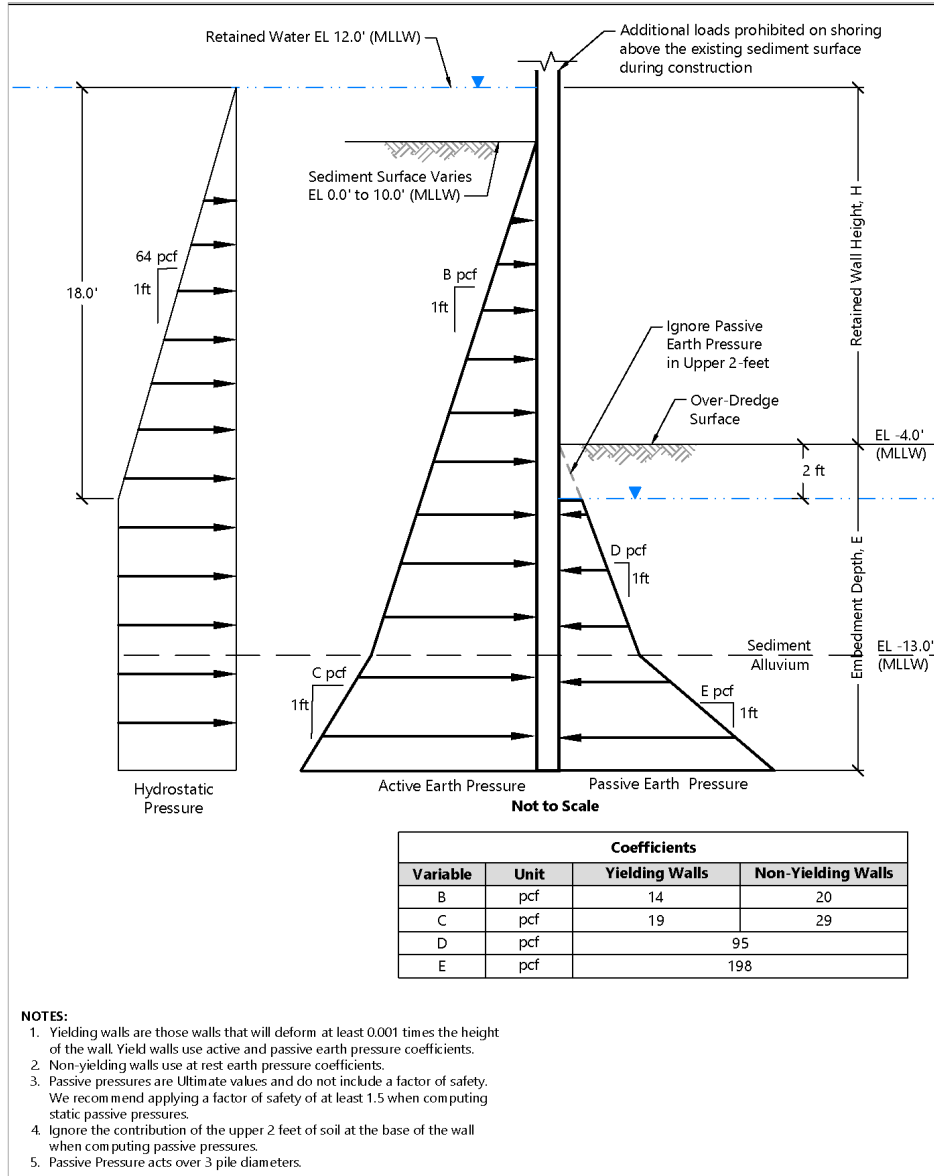
Lateral Earth Pressure Diagram - RM 2.2 Temporary Bulkhead

Appendix D - Geotechnical Design Analysis

Preliminary (30%) Remedial Design Basis of Design Report for LDW Middle Reach

Date: July 2025 By: SL, AB BEI No. Sheet No. 3 of 6 Sheets
Subject: Engineering Services for 30% Remedial Design for Lower Duwamish Waterway Middle Reach

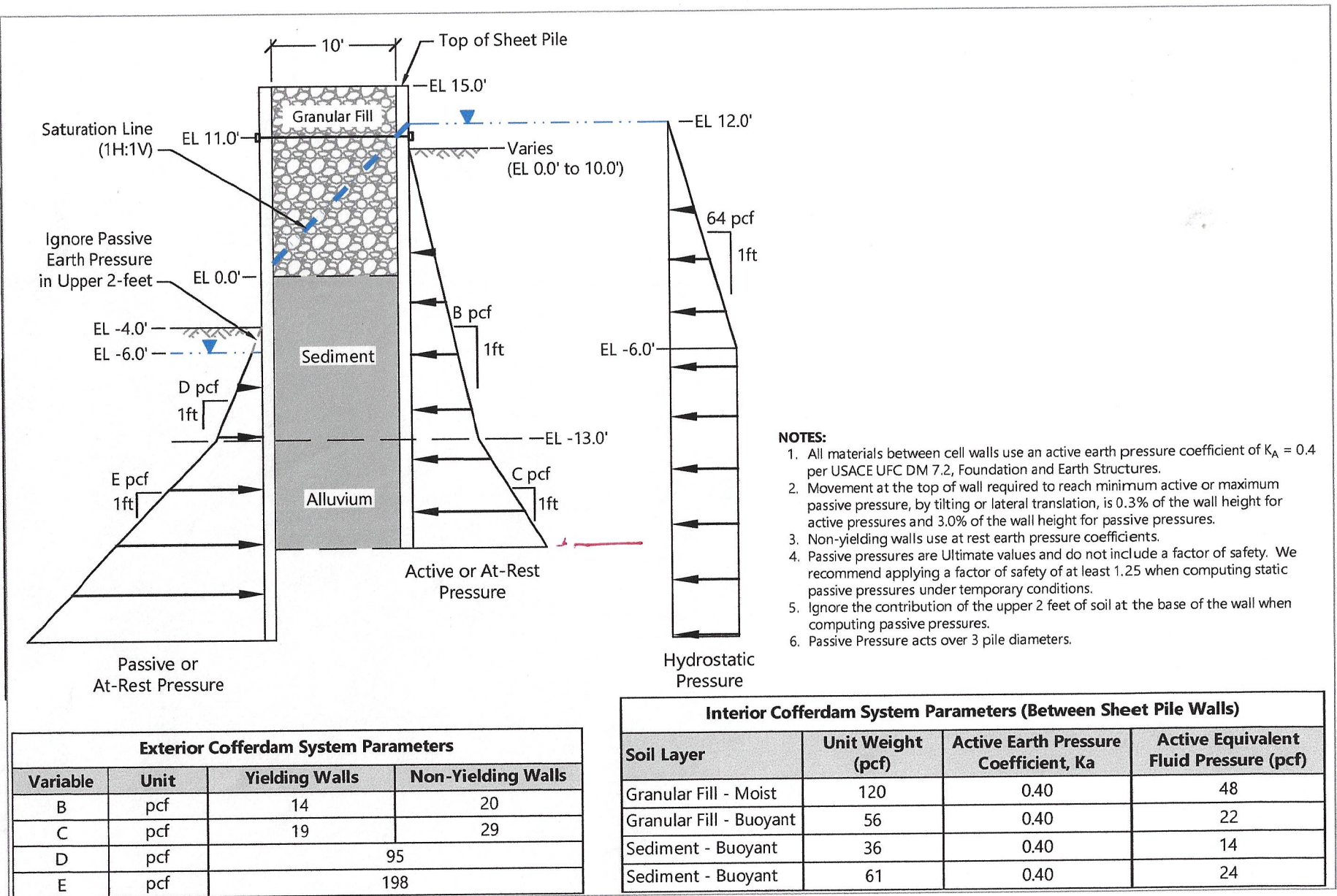
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Filepath: D:\Users\jgregg\Desktop\0067-RP-032 Lateral Earth Pressures.dwg Figure E4-2



Figure E4-2
Lateral Earth Pressure Diagram - RM 2.2 Temporary Cofferdam
Appendix D - Geotechnical Design Analysis
Preliminary (30%) Remedial Design Basis of Design Report for LDW Middle Reach



Publish Date: 2025/09/18 4:32 PM | User: jgregg
 Filepath: D:\Users\jgregg\Desktop\0067-RP-032 Lateral Earth Pressures.dwg | Figure S-3



Figure S-3
Construction Sequence - RM 2.2 Temporary Cofferdam

Appendix E - Geotechnical Design Analysis
 30% Remedial Design Basis of Design Report

Date: July 2025 By: SL, AB BEI No. Sheet No. 4 of 6 Sheets
Subject: Engineering Services for 30% Remedial Design for Lower Duwamish Waterway Middle Reach

Additional Design Soil Lateral Pressures Notes:

- a) Diagram applies to drilled or driven soldier pile walls with lagging and sheet pile walls designed as a cantilevered wall or with a single row of tieback.
- b) All pressures expressed as an equivalent fluid unit weight
- c) Active earth and surcharge pressures act over the pile spacing within retained wall height and over pile width or shaft diameter below bottom of excavation, whichever is lesser.
- d) Passive resistance are ultimate values. Divide with a safety factor of 1.5 for allowable values.
- e) Passive earth pressure acts over 3 times shaft diameter or pile width; or pile spacing, whichever is lesser.
- f) 50% of active surcharge pressure act on all lagging between soldier piles.

2. Single Piles:

L-PILE Modeling Parameters

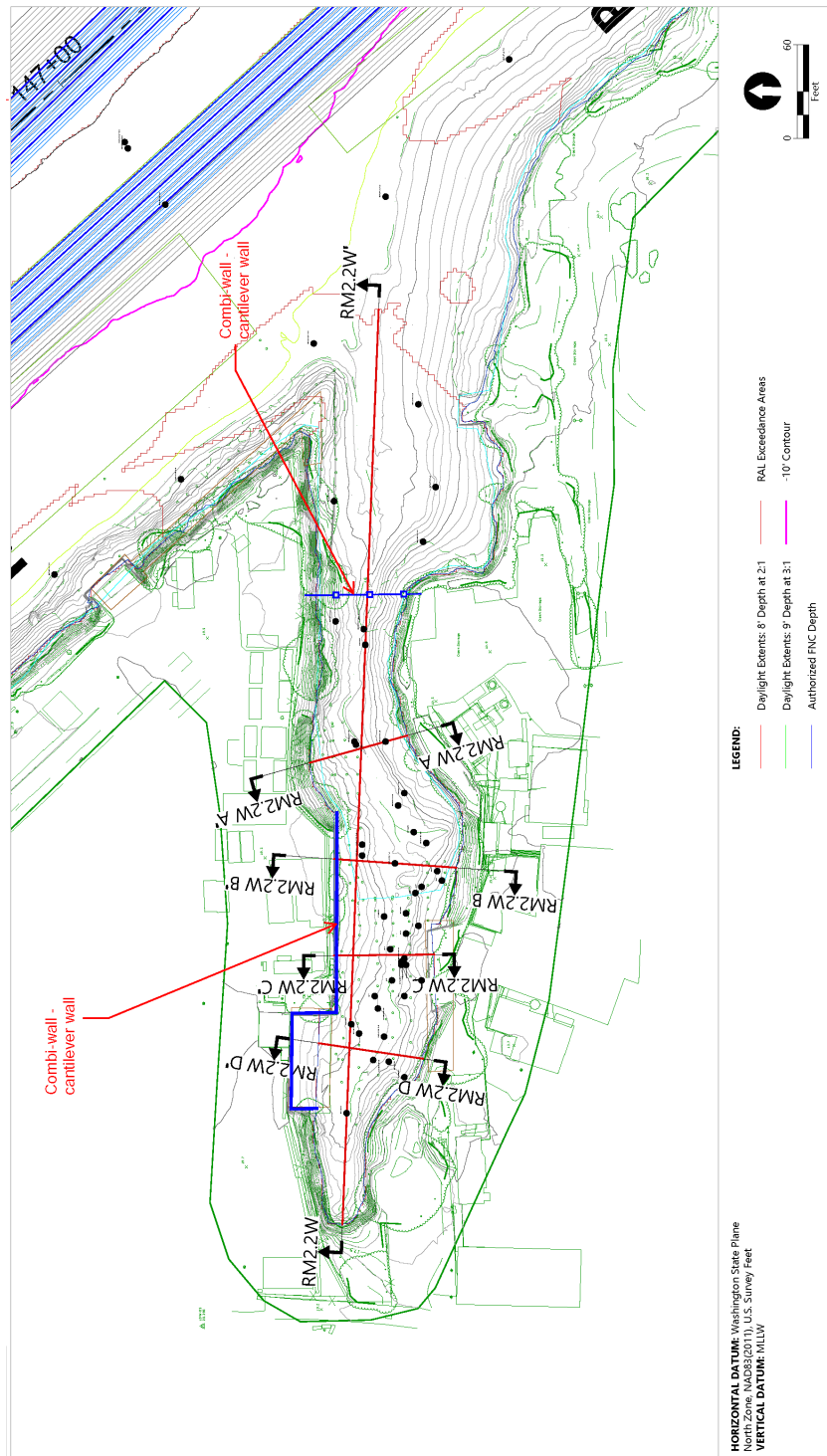
Layer	Effective Unit Weight γ (pcf)	Friction Angle ϕ (°)	Undrained Shear Strength c_u (kip/ft ²)	P-Y Curve Model	Spring Constant; K ($E_s = Kx$) k (pci)	Strain Factor; @50% max E ϵ_{50}
Recent sediment	36	27	0.08	Soft clay (Matlock)	--	0.020
Alluvium	61	32	--	Sand (Reese)	20	--

<TO BE REPLACED>

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Subject: Engineering Services for 30% Remedial Design for Lower Duwamish Waterway Middle Reach

D - DESIGN ELEMENTS

1. Inlet at RM 2.2W (ST16)

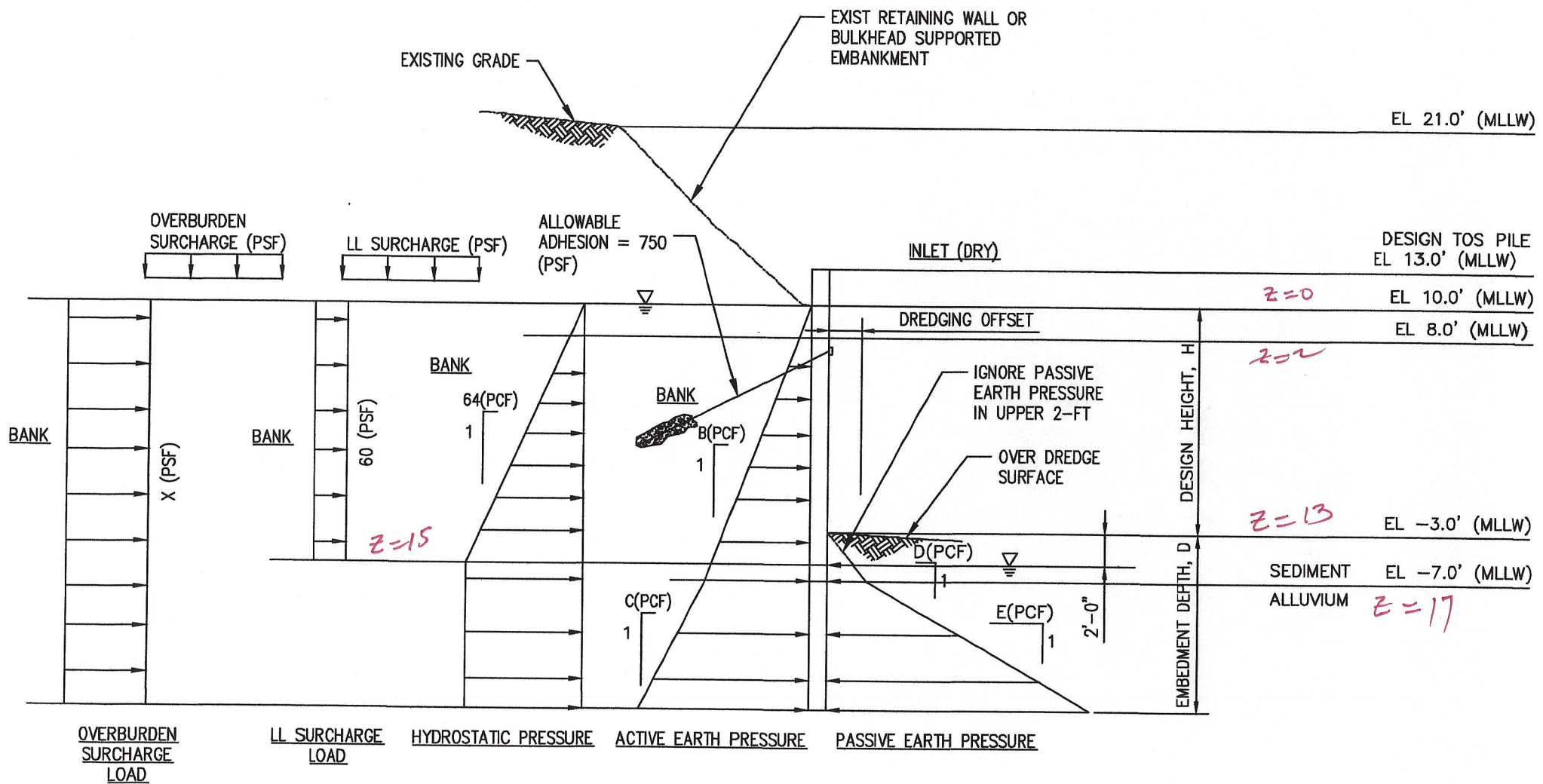


RM2.2W_RAA24
Figure Title
Phase II Preliminary Design
Lower Duwamish Middle Reach

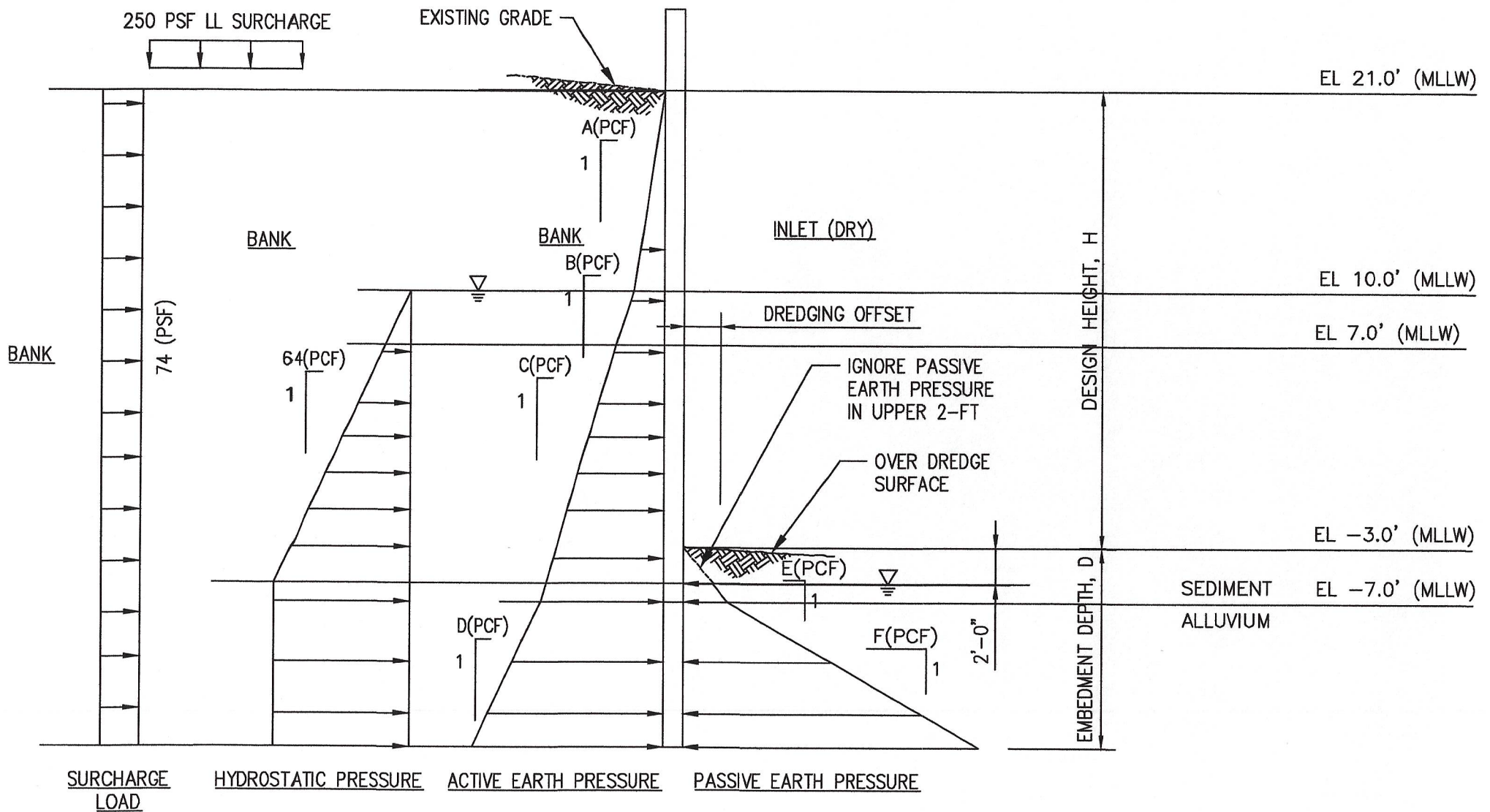
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OEA

Subject: Engineering Services for 30% Remedial Design for Lower Duwamish Waterway Middle Reach





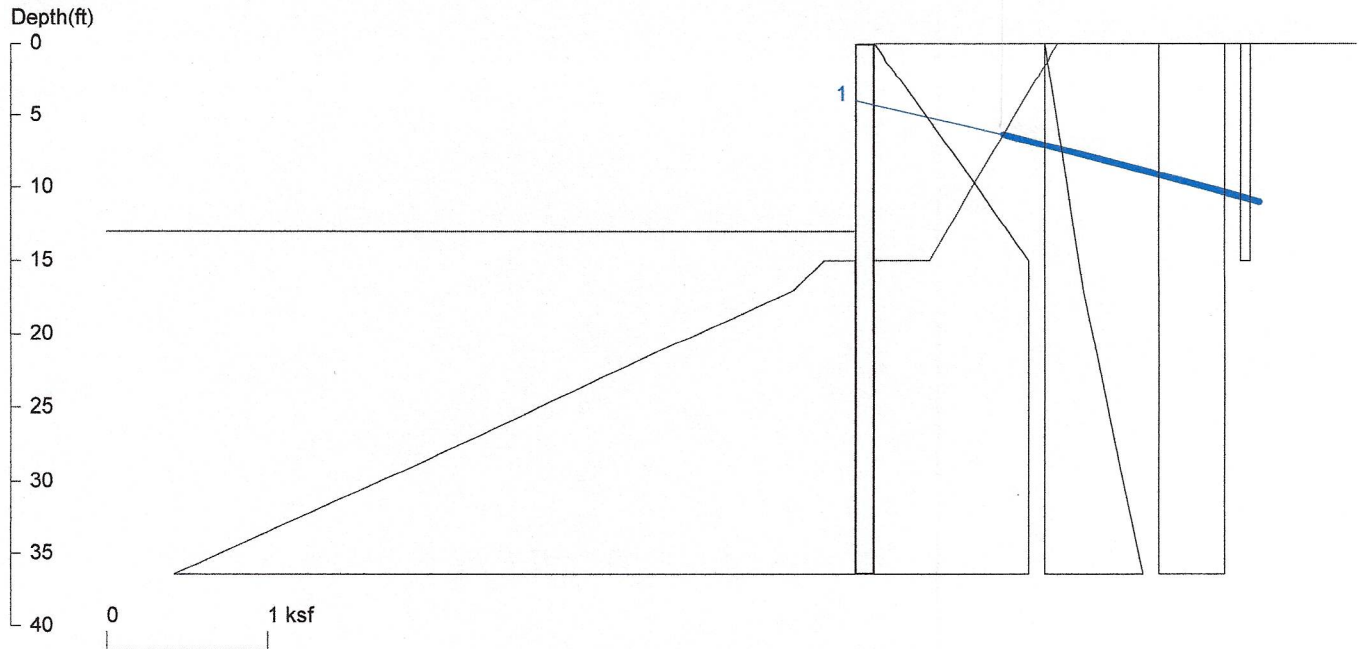
WALL 1 – BULKHEAD ALONG NORTH BANK
(REF: FIGURE E4-1)



WALL 1 - BULKHEAD ALONG NORTH BANK
(REF: FIGURE E4-1B)

Not used

Wall 1 - North Bank, Figure E4-1_Rev 1



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File: C:\Users\slor\Desktop\LDWMR\LDWMRBH1XT.sh8

Wall Height=13.0 Pile Diameter=1.0 Pile Spacing=1.0 Wall Type: 1. Sheet Pile

PILE LENGTH: Min. Embedment=23.45 Min. Pile Length=36.45

MOMENT IN PILE: Max. Moment=96.37 per Pile Spacing=1.0 at Depth=16.20

PILE SELECTION:

Request Min. Section Modulus = 35.0 in³/ft=1883.94 cm³/m, F_y= 50 ksi = 345 MPa, F_b/F_y=0.66

-> Piles meet Min. Section Requirements: Top Deflection is shown in (in)

6M (-0.28) CZ128 (-0.89) 6H (-0.26) AZ19 (-0.78) AZ20700 (-0.70)
H155 (-0.96) RZ11 (-0.95) PZ32 (-0.96) BZ20.7L (-0.86) CZ141 (-0.81)
CZ148 (-0.77) 4N (-0.72) AZ25 (-0.55) FSPZ25 (-0.75)

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

No. & Type	Depth	Angle	Space	Total F.	Horiz. F.	Vert. F.	L _{free}	Fixed Length
1. Tieback	4.0	15.0	6.0	108.3	104.6	28.0	9.1	91.9

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	15	.96	0.064000
15	.96	100	.96	0.000000
0	0	17	.238	0.014000
17	.238	100	1.815	0.019000
0	.407	100	.407	0.000000
0	.06	15	.06	0.000000

PASSIVE PRESSURES: Pressures below will be divided by a Factor of Safety =1.25

Z1	P1	Z2	P2	Slope
15.0	0.19	17.0	0.38	0.095

17.0 0.38 100.0 16.81 0.198

ACTIVE SPACING:

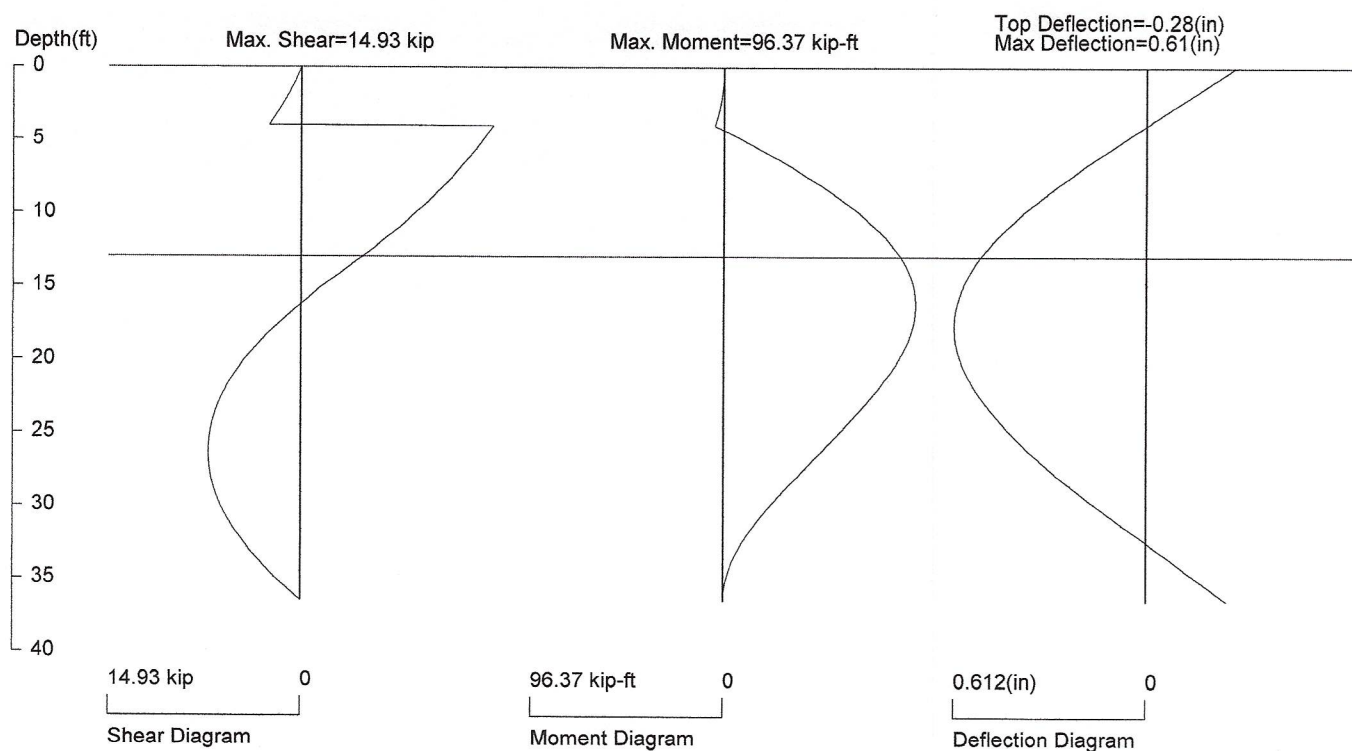
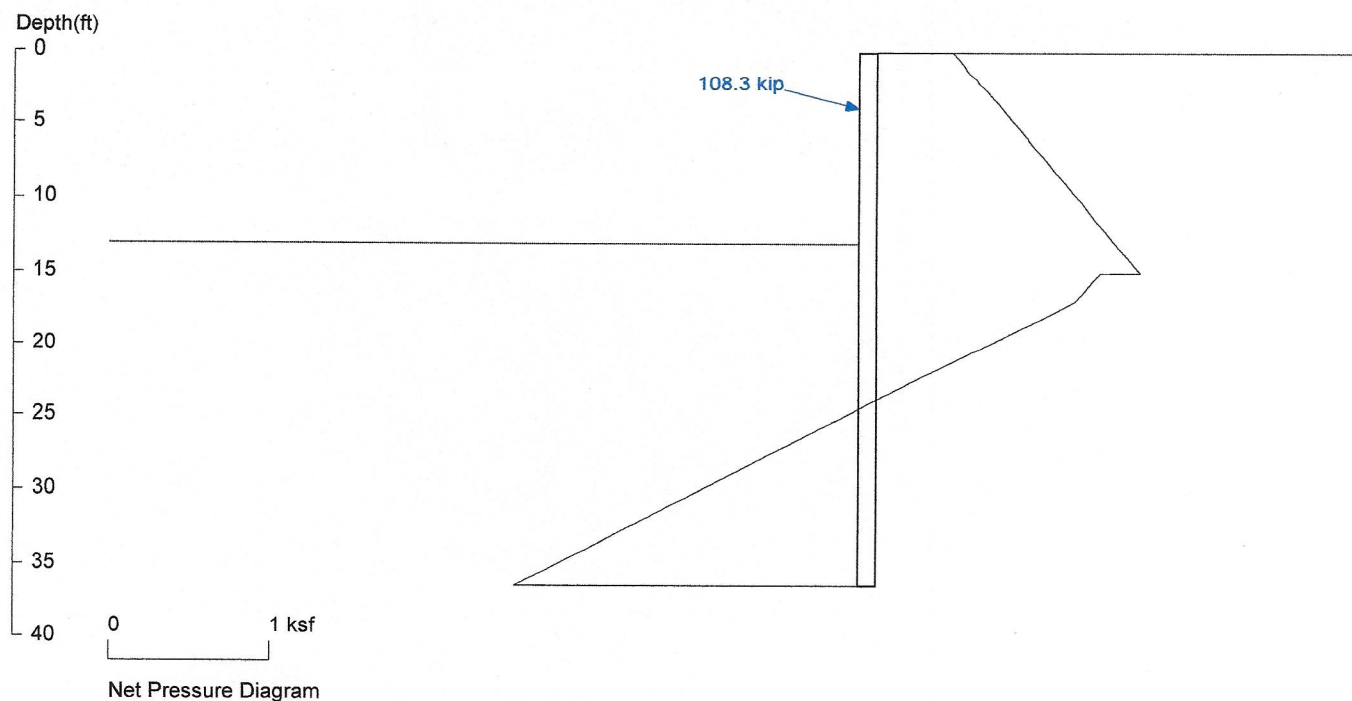
No.	Z depth	Spacing
1	0.00	1.00
2	13.00	1.00

PASSIVE SPACING:

No.	Z depth	Spacing
1	15.00	1.00
2	99.00	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

Wall 1 - North Bank, Figure E4-1_Rev 1



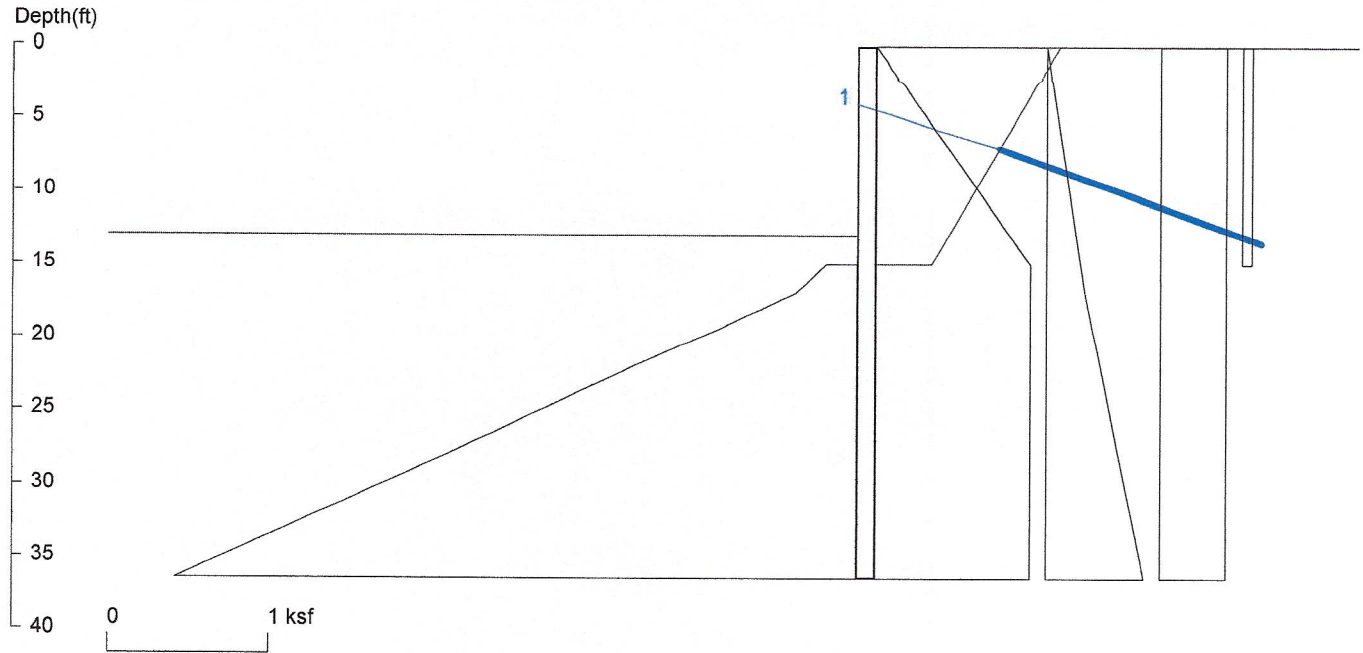
PRESSURE, SHEAR, MOMENT, AND DEFLECTION DIAGRAMS

Based on pile spacing: 1.0 foot or meter

First Suitable Pile: 6M: E (ksi)=29000.0, I (in⁴)/foot=753.2

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Wall 1 - North Bank, Figure E4-1_Rev 1



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File: C:\Users\slor\Desktop\LDWMR\LDWMRBH1XT.sh8

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No. & Type	Depth	Angle	Space	Total F.	Horiz. F.	Vert. F.	L _{free}	Fixed Length
1. Tieback	4.0	20.0	6.0	111.3	104.6	38.1	8.9	94.5

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	15	.96	0.064000
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17.0 0.38 100.0 16.81 0.198

ACTIVE SPACING:

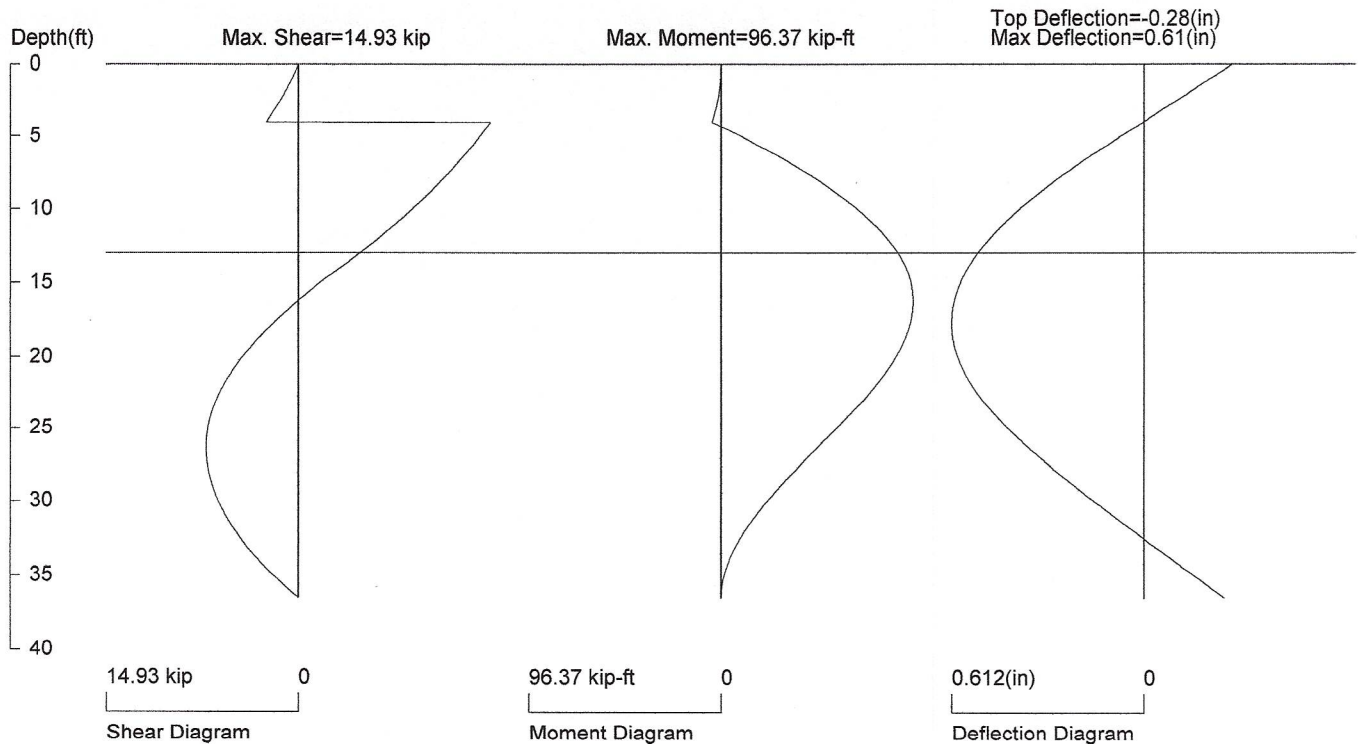
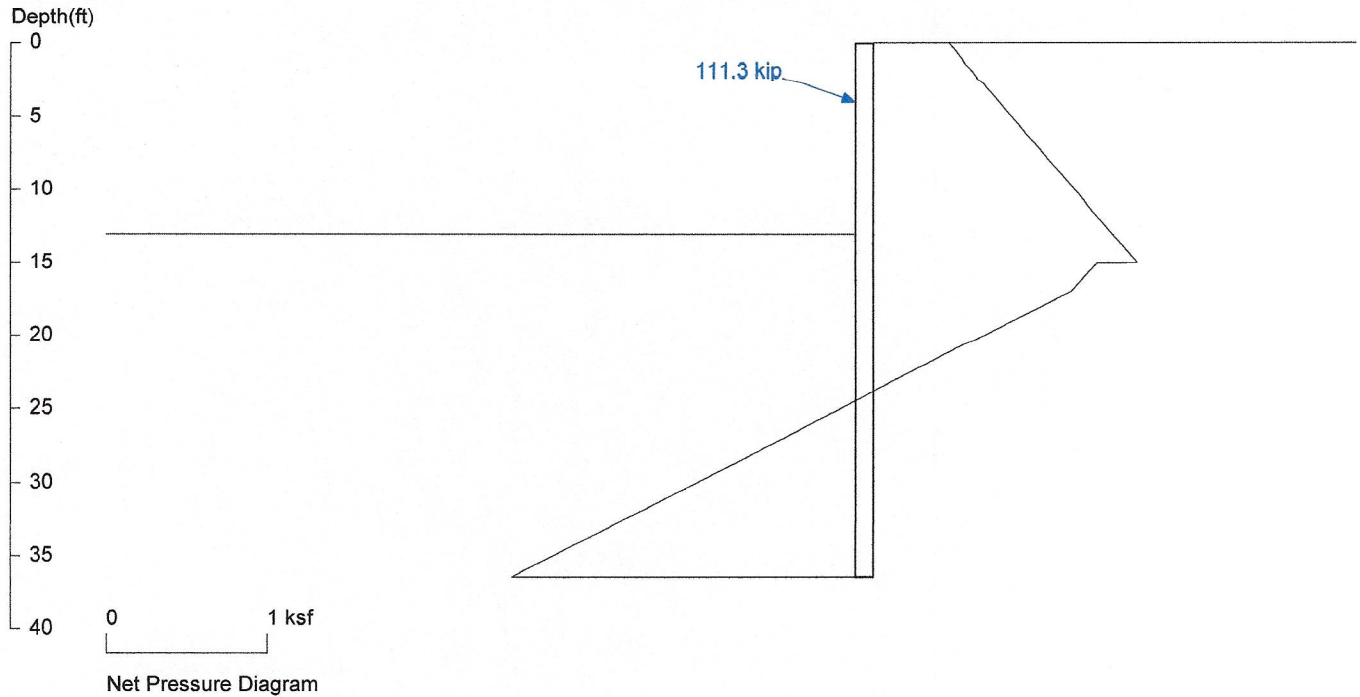
No.	Z depth	Spacing
1	0.00	1.00
2	13.00	1.00

PASSIVE SPACING:

No.	Z depth	Spacing
1	15.00	1.00
2	99.00	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

Wall 1 - North Bank, Figure E4-1_Rev 1



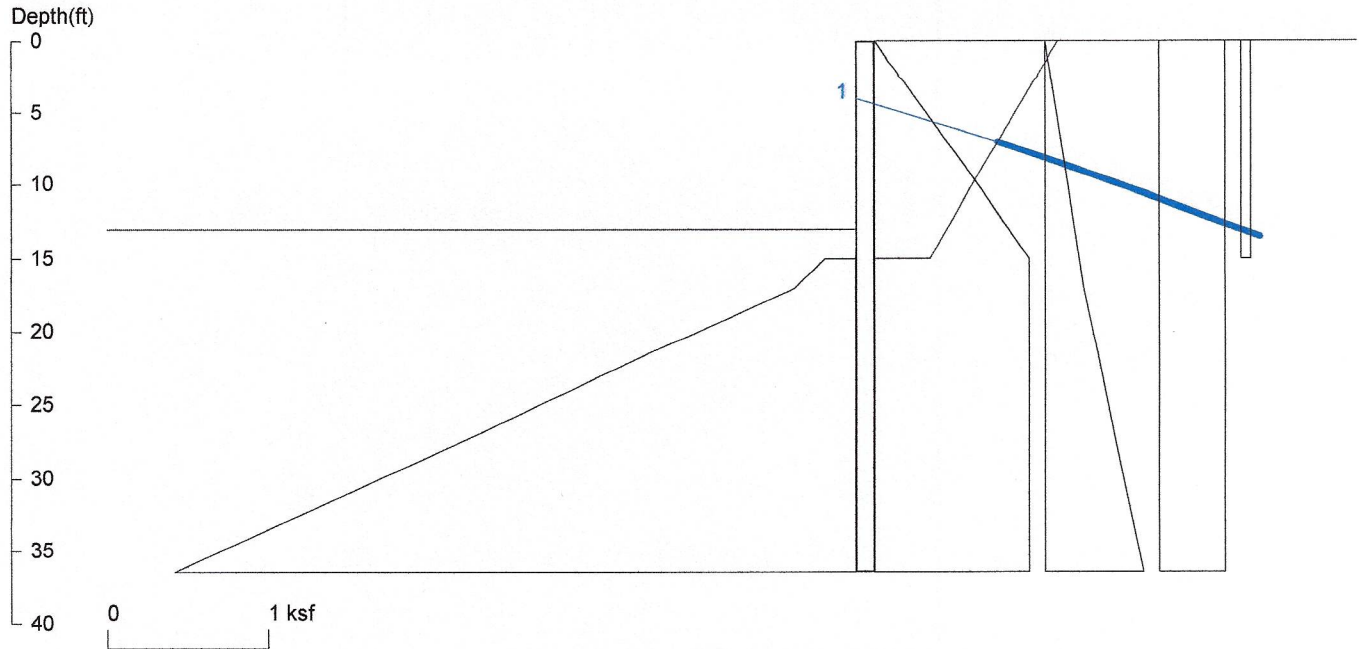
PRESSURE, SHEAR, MOMENT, AND DEFLECTION DIAGRAMS

Based on pile spacing: 1.0 foot or meter

First Suitable Pile: 6M: E (ksi)=29000.0, I (in4)/foot=753.2

File: C:\Users\slor\Desktop\LDWMR\LDWMRBH1XT.sh8

Wall 1 - North Bank, Figure E4-1_Rev 1



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H155 (-0.96) RZ11 (-0.95) PZ32 (-0.96) BZ20.7L (-0.86) CZ141 (-0.81)
CZ148 (-0.77) 4N (-0.72) AZ25 (-0.55) FSPZ25 (-0.75)

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

No. & Type	Depth	Angle	Space	Total F.	Horiz. F.	Vert. F.	L _{free}	Fixed Length
1. Tieback	4.0	20.0	8.0	148.4	139.5	50.8	8.9	126.0

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
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15	.96	100	.96	0.000000
0	0	17	.238	0.014000
17	.238	100	1.815	0.019000
0	.407	100	.407	0.000000
0	.06	15	.06	0.000000

PASSIVE PRESSURES: Pressures below will be divided by a Factor of Safety =1.25

Z1	P1	Z2	P2	Slope
15.0	0.19	17.0	0.38	0.095

17.0 0.38 100.0 16.81 0.198

ACTIVE SPACING:

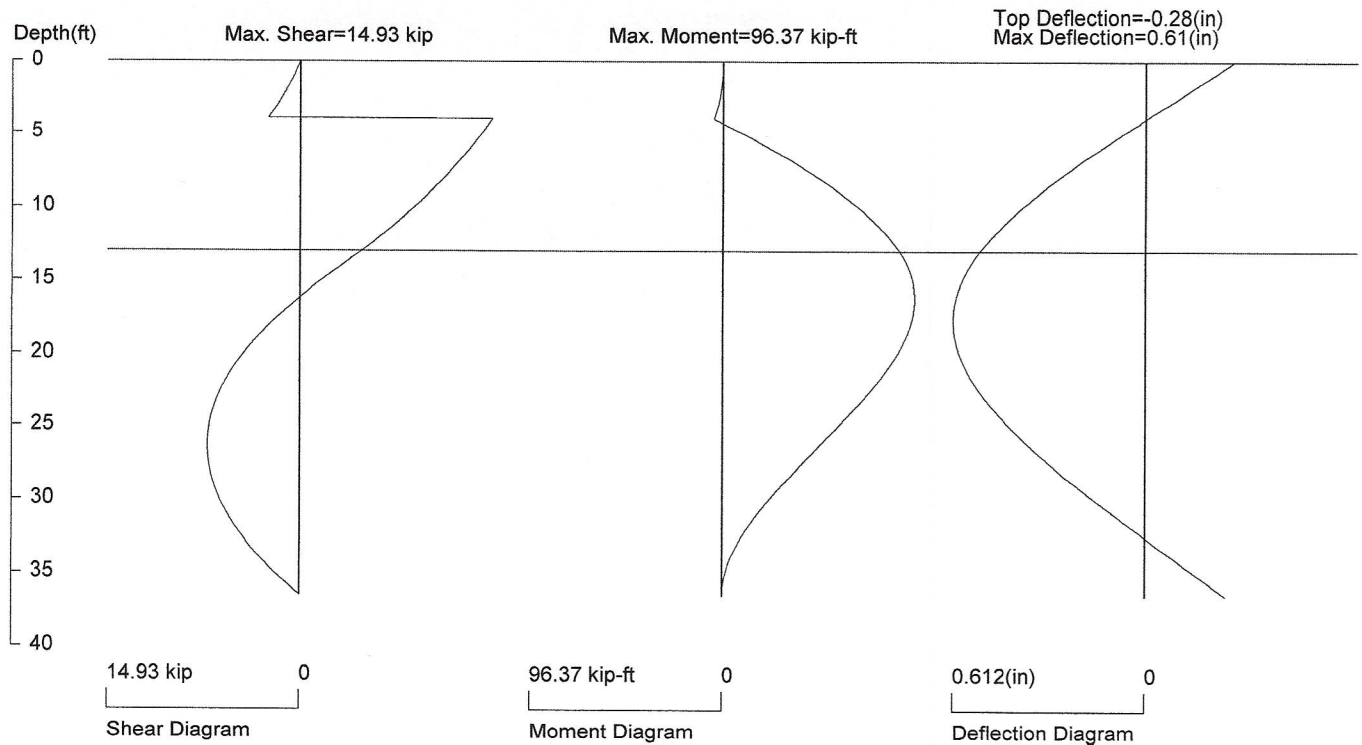
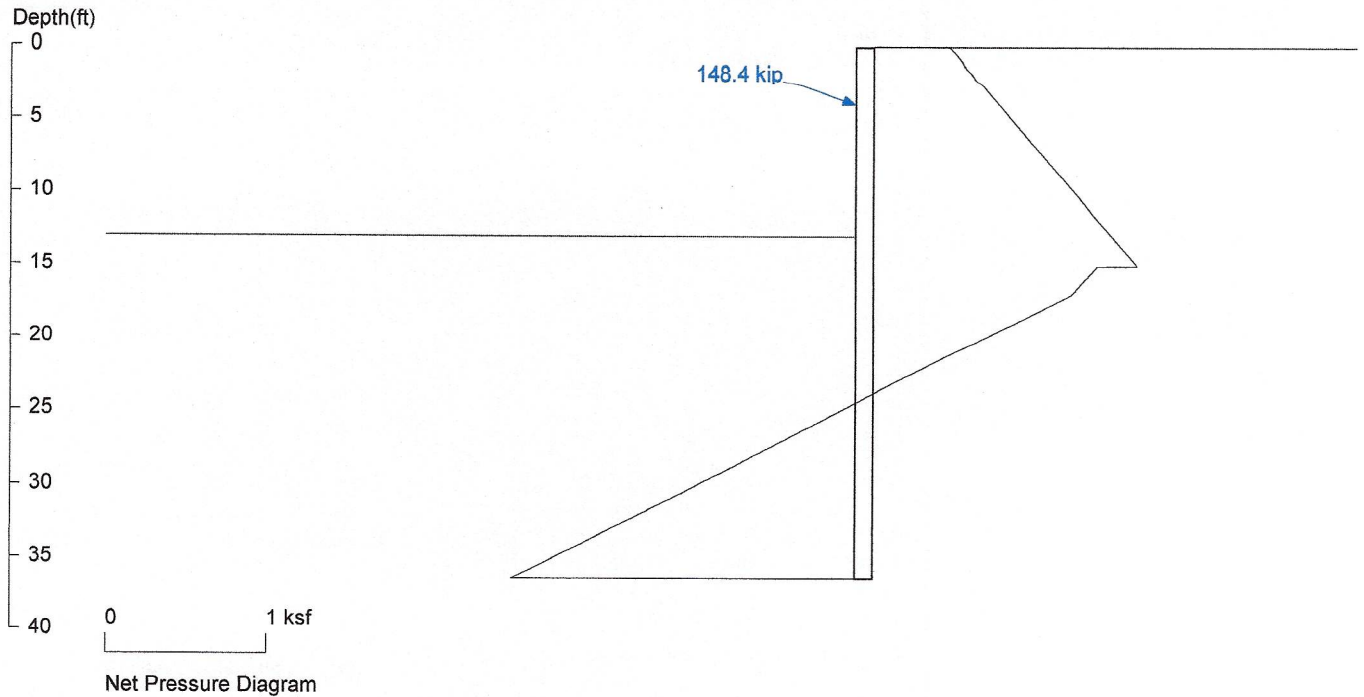
No.	Z depth	Spacing
1	0.00	1.00
2	13.00	1.00

PASSIVE SPACING:

No.	Z depth	Spacing
1	15.00	1.00
2	99.00	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

Wall 1 - North Bank, Figure E4-1_Rev 1



PRESSURE, SHEAR, MOMENT, AND DEFLECTION DIAGRAMS

Based on pile spacing: 1.0 foot or meter

First Suitable Pile: 6M: E (ksi)=29000.0, I (in⁴)/foot=753.2

File: C:\Users\slor\Desktop\LDWMR\LDWMRBH1XT.sh8

SHORING WALL CALCULATION SUMMARY
The leading shoring design and calculation software
Software Copyright by CivilTech Software
www.civiltechsoftware.com

ShoringSuite Software is developed by CivilTech Software, Bellevue, WA, USA.
The calculation method is based on the following references:

1. FHWA 98-011, FHWA-RD-97-130, FHWA SA 96-069, FHWA-IF-99-015
2. STEEL SHEET PILING DESIGN MANUAL by Pile Buck Inc., 1987
3. DESIGN MANUAL DM-7 (NAVFAC), Department of the Navy, May 1982
4. TRENCHING AND SHORING MANUAL Revision 12, California Department of Transportation, January 2000
6. EARTH SUPPORT SYSTEM & RETAINING STRUCTURES, Pile Buck Inc. 2002
5. DESIGN OF SHEET PILE WALLS, EM 1110-2-2504, U.S. Army Corps of Engineers, 31 March 1994
7. EARTH RETENTION SYSTEMS HANDBOOK, Alan Macnab, McGraw-Hill. 2002
8. AASHTO HB-17, American Association of State and Highway Transportation Officials, 2 September 2002

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

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Date: 9/6/2025 File: C:\Users\slor\Desktop\LDWMR\LDWMBH1XT.sh8

Title: Wall 1 - North Bank, Figure E4-1_Rev 1
Subtitle:

*****INPUT DATA*****

Wall Type: 1. Sheet Pile
Wall Height: 13.00
Pile Diameter: 1.00
Pile Spacing: 1.00
Factor of Safety (F.S.): 1.25
Lateral Support Type (Braces): 3. Tieback
Top Brace Increase (Multi-Bracing): Add 15%*
Brace Position (One Brace Case): Normal Brace*
No-Load Zone:
Vertical Depth for No-Load Zone: 15.00
H-Distance (Input H/V ratio) for No-Load Zone: 0.25
Angle from H. Line for No-Load Zone: 60.00
Embedment Option: 1. Yes
Friction at Pile Tip: No
Pile Properties:
Steel Strength, Fy: 50 ksi = 345 MPa
Allowable Fb/Fy: 0.66
Elastic Module, E: 29000.00

Moment of Inertia, I: 2000

User Input Pile: W14X90

* DRIVING PRESSURE (ACTIVE, WATER, & SURCHARGE) *

No.	Z1 top	Top Pres.	Z2 bottom	Bottom Pres.	Slope
1	0	0	15	.96	0.064000
2	15	.96	100	.96	0.000000
3	0	0	17	.238	0.014000
4	17	.238	100	1.815	0.019000
5	0	.407	100	.407	0.000000
6	0	.06	15	.06	0.000000
7					

* PASSIVE PRESSURE *

The pressures below will be divided by a Factor of Safety =1.25

No.	Z1 top	Top Pres.	Z2 bottom	Bottom Pres.	Slope
1	15.00	0.19	17.00	0.38	0.0950
2	17.00	0.38	100.00	16.81	0.1980

* ACTIVE SPACE *

No.	Z depth	Spacing
1	0.00	1.00
2	13.00	1.00

* PASSIVE SPACE *

No.	Z depth	Spacing
1	15.00	1.00
2	99.00	1.00

* BRACE: STRUT, TIEBACK, ANCHOR PLATE, OR DEADMAN *

No.	Z brace	Angle	Spacing	Input1*	Input2*
Type					
1	4.00	20.0	8.00	0.50	0.75
Tieback					

*For Tieback: Input1 = Diameter; Input2 = Bond Stength

*For Plate: Input1 = Diameter; Input2 = Allowable Pressure

*For Deaman: Input1 = Horz. Width; Input2 = Allowable Pressure; Angle = 0

*****CALCULATION*****

The calculated moment and shear are per pile spacing. Sheet piles are per one foot or meter; Soldier piles are per pile.

Top Pressures start at depth = 0.00

NUMBER OF BRACE LEVEL = 1

```

      |      D1=0.00
      |
      | <-- D2=4.00      R1=17.44
      |
      |
  ==  |  == D3=13.00
      |
      |      D4=36.45
  
```

D1 - TOP DEPTH
 D2 - BRACE DEPTH R1 - REACTION
 D3 - EXCAVATION BASE
 D4 - PILE TIP

TOTAL REACTION: R1 = 17.44
 TOTAL PRESSURES ACTING ON WALL = 17.44
 Total Reactions = Total Pressures, OK!

BRACE NO.1 AT DEPTH = 4.00
 R1 = Brace Load = 17.44

*****RESULTS*****

* EMBEDMENT *

MINIMUM EMBEDMENT = 23.45
 TOTAL MINIMUM PILE LENGTH = 36.45

* MOMENT IN PILE (per pile spacing)*

Pile Spacing: sheet piles are one foot or one meter; soldier piles are one pile.

No.	Depth	M @ Brace	Mmax in Span	Depth of Mmax
1	4.00	4.49	96.37	16.20

Overall Maximum Moment = 96.37 at 16.20
 Maximum Shear = 14.93

Moment and Shear are per pile spacing: 1.0 foot or meter

* BRACE: STRUT, TIEBACK, ANCHOR PLATE, OR DEADMAN *

The calculated brace force are per brace spacing.

No.	DEPTH	Tangle	SPACING	HORIZONTAL	VERTICAL
TOTAL LOAD					
1	4.00	20.0	8.00	139.49	50.77
148.45					

No.	DEPTH	Free length	Type and Data
1	4.00	8.88	Tieback, Bond length = 126.00

* VERTICAL LOADING *

Vertical Loading from Braces = 6.35

Vertical Loading from External Load = 0.00

Total Vertical Loading = 6.35

*****SHEET PILE SELECTION*****

Overall Maximum Moment = 96.37 at 16.20

Request Min. Section Modulus = 35.04 in³/ft = 1883.94 cm³/m, Fy= 50 ksi = 345 MPa, Fb/Fy=0.66

The pile selection is based on the magnitude of the moment only. Axial force is neglected.

Sx(in³) and Ix(in⁴) are per one foot of horizontal width of the pile

* Note: The sheet pile properties are in English Units and based on one foot width (even in Metric unit).

6M(English): Sx= 35.30 in³/ft Ix= 753.23 in⁴/ft Weight= 63.90 lb/ft

6M(Metrics): Sx= 1897.73 cm³/m Ix= 1028.61 x100cm⁴/m Weight= 0.933 kN/m

Top deflection = -0.280(in)

CZ128(English): Sx= 35.34 in³/ft Ix= 236.50 in⁴/ft Weight= 26.20 lb/ft

CZ128(Metrics): Sx= 1899.88 cm³/m Ix= 322.96 x100cm⁴/m Weight= 0.383 kN/m

Top deflection = -0.892(in)

6H(English): Sx= 35.50 in³/ft Ix= 816.13 in⁴/ft Weight= 67.60 lb/ft

6H(Metrics): Sx= 1908.48 cm³/m Ix= 1114.51 x100cm⁴/m Weight= 0.987 kN/m

Top deflection = -0.258(in)

AZ19(English): Sx= 36.10 in³/ft Ix= 270.80 in⁴/ft Weight= 26.34 lb/ft

AZ19(Metrics): Sx= 1940.74 cm³/m Ix= 369.80 x100cm⁴/m Weight= 0.385 kN/m

Top deflection = -0.779(in)

AZ20700(English): Sx= 36.20 in³/ft Ix= 300.00 in⁴/ft Weight= 24.43 lb/ft

AZ20700(Metrics): Sx= 1946.11 cm³/m Ix= 409.68 x100cm⁴/m Weight= 0.357 kN/m

Top deflection = -0.703(in)

H155(English): Sx= 37.20 in³/ft Ix= 219.70 in⁴/ft Weight= 31.70 lb/ft

H155(Metrics): Sx= 1999.87 cm³/m Ix= 300.02 x100cm⁴/m Weight= 0.463 kN/m

Top deflection = -0.960(in)

RZ11(English): Sx= 37.20 in³/ft Ix= 221.90 in⁴/ft Weight= 30.00 lb/ft

RZ11(Metrics): Sx= 1999.87 cm³/m Ix= 303.03 x100cm⁴/m Weight= 0.438 kN/m

Top deflection = -0.950(in)

PZ32(English): Sx= 38.30 in³/ft Ix= 220.40 in⁴/ft Weight= 32.00 lb/ft

PZ32(Metrics): Sx= 2059.01 cm³/m Ix= 300.98 x100cm⁴/m Weight= 0.467 kN/m

Top deflection = -0.957(in)

BZ20.7L(English): Sx= 38.40 in³/ft Ix= 245.90 in⁴/ft Weight= 30.20 lb/ft

BZ20.7L(Metrics): Sx= 2064.38 cm³/m Ix= 335.80 x100cm⁴/m Weight= 0.441 kN/m

Top deflection = -0.858(in)

CZ141(English): Sx= 39.06 in³/ft Ix= 261.40 in⁴/ft Weight= 28.90 lb/ft

CZ141(Metrics): Sx= 2099.87 cm³/m Ix= 356.97 x100cm⁴/m Weight= 0.422 kN/m

Top deflection = -0.807(in)

CZ148(English): Sx= 40.92 in³/ft Ix= 273.90 in⁴/ft Weight= 30.30 lb/ft

CZ148(Metrics): Sx= 2199.86 cm³/m Ix= 374.04 x100cm⁴/m Weight= 0.442 kN/m

Top deflection = -0.770(in)

4N(English): Sx= 44.90 in³/ft Ix= 291.70 in⁴/ft Weight= 35.00 lb/ft

4N(Metrics): Sx= 2413.82 cm³/m Ix= 398.35 x100cm⁴/m Weight= 0.511 kN/m

Top deflection = -0.723(in)

AZ25(English): Sx= 45.70 in³/ft Ix= 382.60 in⁴/ft Weight= 29.74 lb/ft

AZ25(Metrics): Sx= 2456.83 cm³/m Ix= 522.48 x100cm⁴/m Weight= 0.434 kN/m

Top deflection = -0.551(in)

FSPZ25(English): Sx= 46.70 in³/ft Ix= 280.00 in⁴/ft Weight= 37.90 lb/ft

FSPZ25(Metrics): Sx= 2510.59 cm³/m Ix= 382.37 x100cm⁴/m Weight= 0.553 kN/m

Top deflection = -0.753(in)

Date: 8-2025 By: AB

BEI No. _____ Sheet No. _____ of _____ Sheets

Subject: LDWNR - 30% Remedial Design

RM 2.2 Wall 1 - North Bank Anchored Wall
Buttress

Req S_f min $\approx$ ~~30~~³⁵ k/ft

Use PZ 35 or AZ 26 or equal

$\left\{ \begin{array}{l} F_y = 50 \text{ ksi} \\ F_B = 33 \text{ ksi} \end{array} \right.$

Anchor force $\approx$ 18 k/ft $\left\{ \begin{array}{l} 130'' @ 8' \text{ OC} \\ 100'' @ 6' \text{ OC} \end{array} \right.$

w/ 0.6" Dia Strands, 270k
 $A_{ps} = 0.217 \text{ in}^2$

Max design Load = $0.6 A_{ps} f_{pu}$
 $= 0.6 \times 0.217 \times 270 = 35.2 \text{ k/strand}$

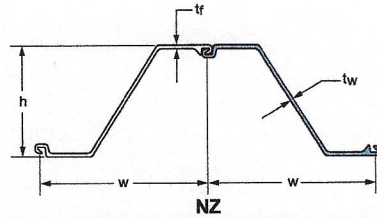
Max Jacking Load = $0.8 A_{ps} \times f_{pu}$
 $= 0.8 \times 0.217 \times 270 = 46.9 \text{ k/strand}$

Max Anchor Spcy = 4 @ 8' OC
or 3 @ 6' OC

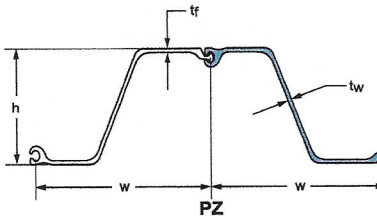
Provide ~~112~~¹³⁰ ft Fixed anchor length
Nominal Snug-tight force
Snug ~~to~~ 5' to 10' k

HOT ROLLED STEEL SHEET PILE

NZ/PZ

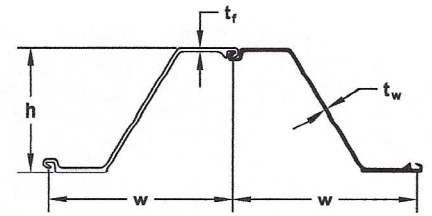


SECTION	THICKNESS				Cross Sectional Area	WEIGHT		SECTION MODULUS		Moment of Inertia	COATING AREA	
	Width (w)	Height (h)	Flange (tf)	Web (tw)		Single Pile	Wall Area	Elastic	Plastic		Both Sides	Wall Surface
	in	in	in	in	in ² /ft	lb/ft	lb/ft ²	in ³ /ft	in ³ /ft	in ⁴ /ft	ft ² /ft of single	ft ² /ft ²
	mm	mm	mm	mm	cm ² /m	kg/m	kg/m ²	cm ³ /m	cm ³ /m	cm ⁴ /m	m ² /m	m ² /m ²
NZ 14	30.31	13.39	0.375	0.375	6.40	55	21.77	25.65	30.50	171.7	6.10	1.20
	770	340	9.5	9.5	135.4	81.26	106.30	1379	1640	23447	1.86	1.20
NZ 19	27.56	16.14	0.375	0.375	7.07	55	24.05	35.08	41.33	283.1	6.18	1.35
	700	410	9.5	9.5	149.6	81.85	117.40	1886	2222	38659	1.88	1.35
NZ 20	27.56	16.16	0.394	0.394	7.34	57	24.82	36.24	42.80	292.8	6.18	1.35
	700	411	10.0	10.0	155.4	85.37	122.00	1948	2301	39984	1.88	1.35
NZ 21	27.56	16.20	0.433	0.433	7.80	61	26.56	38.69	45.85	313.4	6.18	1.35
	700	412	11.0	11.0	165.2	90.78	129.70	2080	2465	42797	1.88	1.35
NZ 22	27.56	16.25	0.480	0.480	8.57	67	29.20	41.47	49.34	336.9	6.18	1.35
	700.0	413.0	12.20	12.20	181.4	99.71	142.44	2230	2653	46006	1.88	1.35
NZ 26	27.56	17.32	0.500	0.500	9.08	71	30.99	48.50	57.01	419.9	6.49	1.41
	700	440	12.7	12.7	192.2	105.66	151.30	2608	3065	57340	1.98	1.41
NZ 28	27.56	17.38	0.560	0.560	9.98	78	33.96	52.62	62.16	457.4	6.49	1.41
	700	441	14.2	14.2	211.2	116.08	165.82	2829	3342	62461	1.98	1.41
NZ 38	27.56	19.69	0.689	0.500	11.00	86	37.45	70.84	81.57	697.3	6.58	1.43
	700	500	17.5	12.7	232.9	127.99	182.83	3809	4386	95214	2.01	1.43
NZ 40	27.56	19.73	0.735	0.551	11.77	92	40.06	74.97	86.75	739.6	6.58	1.43
	700.0	501.0	18.70	14.00	249.1	136.91	195.59	4031	4664	100997	2.01	1.43
NZ 42	27.56	19.77	0.769	0.589	12.41	97	42.24	78.17	90.80	772.5	6.58	1.43
	700.0	502.0	19.50	15.0	262.7	144.36	206.23	4203	4881	105490	2.01	1.43



SECTION	THICKNESS				Cross Sectional Area	WEIGHT		SECTION MODULUS		Moment of Inertia	COATING AREA	
	Width (w)	Height (h)	Flange (tf)	Web (tw)		Single Pile	Wall Area	Elastic	Plastic		Both Sides	Wall Surface
	in	in	in	in	in ² /ft	lb/ft	lb/ft ²	in ³ /ft	in ³ /ft	in ⁴ /ft	ft ² /ft of single	ft ² /ft ²
	mm	mm	mm	mm	cm ² /m	kg/m	kg/m ²	cm ³ /m	cm ³ /m	cm ⁴ /m	m ² /m	m ² /m ²
PZ 22	22.00	9.0	0.375	0.375	6.47	40.3	22.0	18.1	21.79	84.38	4.48	1.22
	559	229	9.50	9.50	136.9	60.0	107.4	973	1171.4	11500	1.37	1.22
PZ 27	18.00	12.0	0.375	0.375	7.94	40.5	27.0	30.2	36.49	184.20	4.48	1.49
	457	305	9.50	9.50	168.1	60.3	131.8	1620	1961.9	25200	1.37	1.49
PZ 35	22.64	14.9	0.600	0.500	10.29	66.0	35.0	48.5	57.17	361.22	5.37	1.42
	575	378	15.21	12.67	217.8	98.2	170.9	2608	3073.5	49300	1.64	1.42
PZ 40	19.69	16.1	0.600	0.500	11.77	65.6	40.0	60.7	71.92	490.85	5.37	1.64
	500	409	15.21	12.67	249.1	97.6	195.3	3263	3866.7	67000	1.64	1.64

AZ HOT ROLLED STEEL SHEET PILE SERIES



JD FIELDS & COMPANY, INC. ESTABLISHED 1952	THICKNESS		THICKNESS		WEIGHT		SECTION MODULUS		COATING AREA			
	Width (w)	Height (h)	Flange (t _f)	Web (t _w)	Cross Sec Area (A)	Single Pile	Wall Area	Elastic	Plastic	Moment of Inertia	Both Sides	Wall Surface
	in	in	in	in	in ² /ft	lb/ft	lb/ft ²	in ³ /ft	in ³ /ft	in ⁴ /ft	ft ² /ft of single	ft ² /ft ²
SECTION	mm	mm	mm	mm	cm ² /m	kg/m	kg/m ²	cm ³ /m	cm ³ /m	cm ⁴ /m	m ² /m	m ² /m ²
AZ 12-770	30.31 770	13.52 344	0.335 8.5	0.335 8.5	5.67 120.1	48.78 72.6	19.31 94.3	23.2 1245	27.5 1480	156.9 21430	6.07 1.85	1.20 1.20
AZ 13-770	30.31 770	13.54 344	0.354 9.0	0.354 9.0	5.94 125.8	51.14 76.1	20.24 98.8	24.2 1300	28.8 1546	163.7 22360	6.07 1.85	1.20 1.20
*AZ 14-770	30.31 770	13.56 345	0.375 9.5	0.375 9.5	6.21 131.5	53.42 79.5	21.14 103.2	25.2 1355	30.0 1611	170.6 23300	6.07 1.85	1.20 1.20
AZ 17-700	27.56 700	16.52 420	0.335 8.5	0.335 8.5	6.28 133.0	49.12 73.1	21.38 104.4	32.2 1730	37.7 2027	265.3 36230	6.10 1.86	1.33 1.33
AZ 18-700	27.56 700	16.54 420	0.354 9.0	0.354 9.0	6.58 139.2	51.41 76.5	22.39 109.3	33.5 1800	39.4 2116	276.8 37800	6.10 1.86	1.33 1.33
AZ 19-700	27.56 700	16.56 421	0.375 9.5	0.375 9.5	6.88 145.6	53.76 80.0	23.35 114.3	34.8 1870	41.0 2206	288.4 39380	6.10 1.86	1.33 1.33
AZ 20-700	27.56 700	16.57 421	0.394 10.0	0.394 10.0	7.18 152.0	56.11 83.5	24.43 119.3	36.2 1945	42.7 2296	300.0 40960	6.10 1.86	1.33 1.33
AZ 18-800	31.5 800	17.68 449	0.335 8.5	0.335 8.5	6.07 128.6	54.26 80.7	20.67 100.9	34.2 1840	39.7 2135	302.6 41320	6.82 2.08	1.30 1.30
*AZ 20-800	31.5 800	17.72 450	0.375 9.5	0.375 9.5	6.66 141.0	59.50 88.6	22.67 110.7	37.2 2000	43.3 2330	329.9 45050	6.82 2.08	1.30 1.30
AZ 22-800	31.5 800	17.76 451	0.413 10.5	0.413 10.5	7.25 153.5	64.77 96.4	24.68 120.5	40.3 2165	47.0 2525	357.3 48790	6.82 2.08	1.30 1.30
AZ 23-800	31.50 800	18.66 474	0.453 11.5	0.354 9.0	7.12 150.6	63.56 94.6	24.22 118.2	43.3 2330	49.9 2680	404.6 55260	6.94 2.11	1.32 1.32
*AZ 25-800	31.50 800	18.70 475	0.492 12.5	0.394 10.0	7.71 163.3	68.91 102.6	26.26 128.2	46.5 2500	53.8 2890	435.1 59410	6.94 2.11	1.32 1.32
AZ 27-800	31.50 800	18.74 476	0.531 13.5	0.433 11.0	8.31 176.0	74.26 110.5	28.29 138.1	49.7 2670	57.6 3100	465.5 63570	6.94 2.11	1.32 1.32
AZ 24-700	27.56 700	18.07 459	0.441 11.2	0.441 11.2	8.23 174.1	64.30 95.7	28.00 136.7	45.2 2430	53.5 2867	408.8 55820	6.33 1.93	1.38 1.38
AZ 26-700	27.56 700	18.11 460	0.480 12.2	0.480 12.2	8.84 187.2	69.12 102.9	30.10 146.9	48.4 2600	57.1 3070	437.3 59720	6.33 1.93	1.38 1.38
AZ 28-700	27.56 700	18.15 461	0.520 13.2	0.520 13.2	9.46 200.2	73.93 110.0	32.19 157.2	51.3 2760	60.9 3273	465.9 63620	6.33 1.93	1.38 1.38
AZ 28-750	29.53 750.0	20.04 509.0	0.472 12.00	0.394 10.00	8.09 171.2	67.73 100.80	27.53 134.40	52.3 2810	60.3 3245	523.9 71540	6.93 2.11	1.41 1.41
AZ 30-750	29.53 750.0	20.08 510.0	0.512 13.00	0.433 11.00	8.73 184.7	73.08 108.80	29.70 145.00	55.9 3005	64.8 3485	561.5 76670	6.93 2.11	1.41 1.41
AZ 32-750	29.53 750.0	20.12 511.0	0.551 14.00	0.472 12.00	9.37 198.3	78.44 116.70	31.88 155.60	59.5 3200	69.2 3720	599.0 81800	6.93 2.11	1.41 1.41
AZ 36-700N	27.56 700	19.65 499	0.591 15.0	0.441 11.2	10.20 215.9	79.72 118.6	34.71 169.5	66.8 3590	76.4 4110	656.2 89610	6.73 2.05	1.47 1.47
*AZ 38-700N	27.56 700	19.69 500	0.630 16.0	0.480 12.2	10.87 230.0	84.94 126.4	36.98 180.6	70.6 3795	81.1 4360	694.5 94840	6.73 2.05	1.47 1.47
AZ 40-700N	27.56 700	19.72 501	0.669 17.0	0.520 13.2	11.54 244.2	90.16 134.2	39.26 191.7	74.3 3995	85.7 4605	732.9 100080	6.73 2.05	1.47 1.47
AZ 42-700N	27.56 700	19.65 499	0.709 18.0	0.551 14.0	12.22 258.7	95.51 142.1	41.59 203.1	78.2 4205	90.3 4855	768.4 104930	6.75 2.06	1.47 1.47
AZ 44-700N	27.56 700	19.69 500	0.748 19.0	0.591 15.0	12.89 272.8	100.74 149.9	43.87 214.2	81.9 4405	95.0 5105	806.6 110150	6.75 2.06	1.47 1.47
AZ 46-700N	27.56 700	19.72 501	0.787 20.0	0.630 16.0	13.56 287.0	105.97 157.7	46.14 225.3	85.7 4605	99.5 5350	844.9 115370	6.75 2.06	1.47 1.47
AZ 48-700	27.56 700.0	19.80 503.0	0.866 22.00	0.591 15.00	13.63 288.4	106.49 158.50	46.37 226.40	88.4 4755	102.1 5490	876.2 119650	6.70 2.04	1.46 1.46
AZ 50-700	27.56 700.0	19.84 504.0	0.906 23.00	0.630 16.00	14.30 302.6	111.73 166.30	48.65 237.50	92.2 4955	106.7 5735	914.6 124890	6.70 2.04	1.46 1.46
AZ 52-700	27.56 700.0	19.88 505.0	0.945 24.00	0.669 17.00	14.97 317.0	116.97 174.10	50.93 248.70	95.9 5155	111.3 5985	953.0 130140	6.70 2.04	1.46 1.46

*Indicates standard stocking sections. Please check with your local sales representative for material availability.

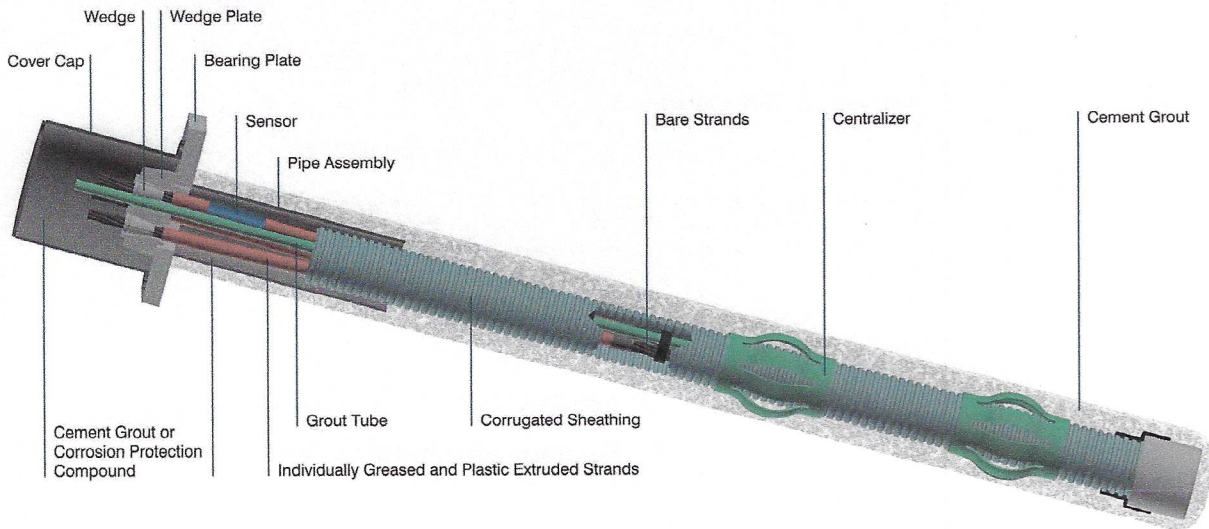
STRAND ANCHORS

PERMANENT (DCP) ANCHOR – KEY FEATURES

- Long-lasting system for permanent use
- Variable anchor head and angle compensation designs
- Double Corrosion Protection (DCP) is achieved by protecting the strands with barrier against corrosion. It consists of a corrugated sheathing, a pipe welded to the bearing plate and a cover cap along with encasement in cement grout.

FIELDS OF APPLICATION

- Retaining walls
- Rock and slope stabilization
- Tiedown anchors
- Excavations

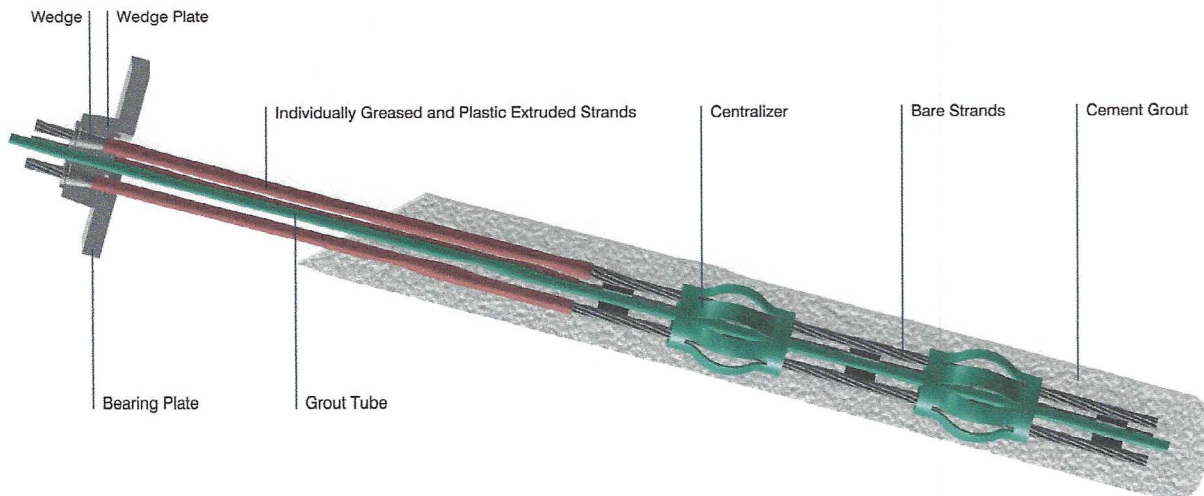


TEMPORARY ANCHOR – KEY FEATURES

- Temporary system for a service life of up to two years
- Variable anchor head and angle compensation designs

FIELDS OF APPLICATION

- Excavations
- Temporary structures



STRAND ANCHORS

STRAND ANCHORS PROPERTIES

Strand Anchors utilize 0.6" dia. 7-wire, low relaxation 270 ksi Strand conforming to ASTM A416 (bare strand) or ASTM A882 (epoxy coated strand).

Number of Strands	Nominal Cross Section Area (A_{ps})		Ultimate Strength ($F_{pu} \times A_{ps}$)		Prestressing Force						Nominal Weight (Bare Steel only)	
					$0.80 F_{pu} \times A_{ps}$		$0.70 F_{pu} \times A_{ps}$		$0.60 F_{pu} \times A_{ps}$			
ea	in ²	mm ²	kips	kN	kips	kN	kips	kN	kips	kN	lbs/ft	kg/m
1	0.217	140	58.6	261	46.9	208	41	182	35.2	156	0.74	1.09
2	0.434	280	117.2	521	93.7	417	82	365	70.3	313	1.48	1.64
3	0.651	420	175.8	782	140.6	625	123	547	105.5	469	2.22	3.27
4	0.868	560	234.4	1,043	187.5	834	164.1	730	140.6	626	2.96	4.46
5	1.085	700	293.0	1,303	234.4	1,043	205.1	912	175.8	782	3.70	5.51
6	1.302	840	351.6	1,564	281.3	1,251	246.1	1,095	210.9	938	4.44	6.55
7	1.519	980	410.2	1,825	328.2	1,460	287.2	1,277	246.2	1,095	5.18	7.74
8	1.736	1,120	468.8	2,085	375.0	1,668	328.1	1,460	281.3	1,251	5.92	8.78
9	1.953	1,260	527.4	2,346	421.9	1,877	369.2	1,642	316.4	1,408	6.66	9.97
12	2.604	1,680	703.2	3,128	562.6	2,503	492.3	2,190	422.0	1,877	8.88	13.24
15	3.255	2,100	879.0	3,910	703.2	3,128	615.3	2,737	527.4	2,346	11.10	16.52
19	4.123	2,660	1,113.4	4,953	890.7	3,962	779.4	3,467	668.0	2,972	14.06	20.98
27	5.859	3,780	1,582.2	7,038	1,265.8	5,631	1,107.6	4,927	949.4	4,223	19.98	29.76
37	8.029	5,180	2,168.2	9,645	1,734.6	7,716	1,517.8	6,751	1,301.0	5,787	27.38	40.78
48	10.416	6,720	2,812.8	12,512	2,250.2	10,009	1,968.9	8,758	1,687.7	7,507	35.52	52.83
54	11.718	7,560	3,164.4	14,076	2,531.5	11,261	2,215.1	9,853	1,898.6	8,446	39.96	59.38
61	13.237	8,540	3,574.6	15,901	2,859.7	12,721	2,502.2	11,131	2,144.8	9,540	45.14	67.12

A_{ps} = Area Prestressing Steel.

F_{pu} = Minimum Ultimate Strength.

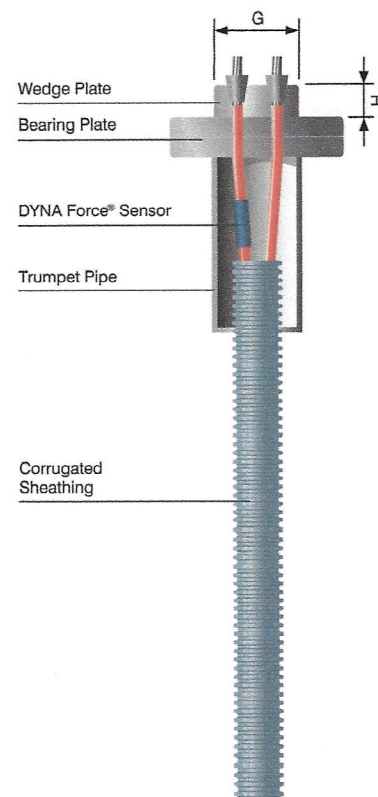
Please consult your local sales office for systems exceeding 61 strands.

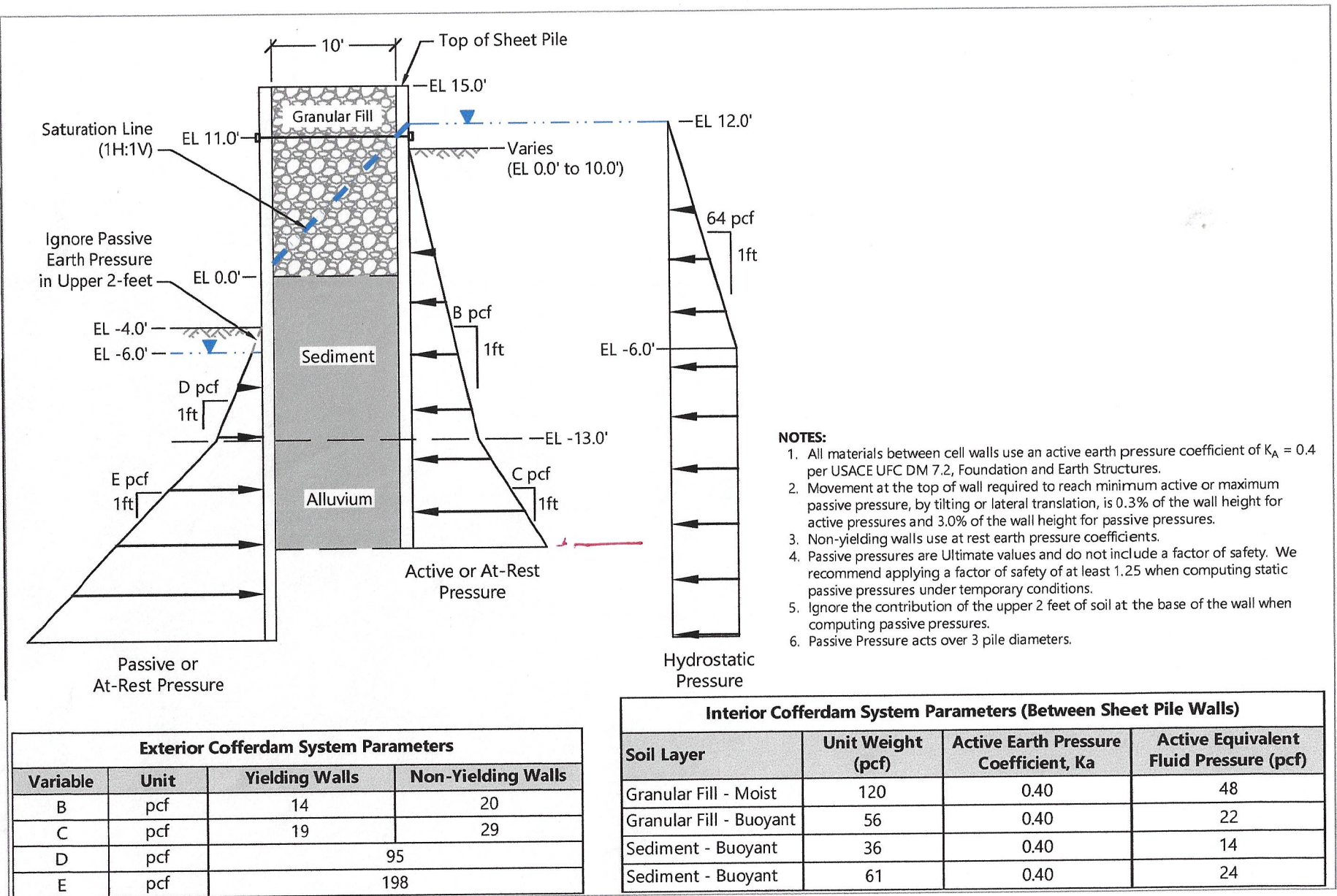
DCP STRAND ANCHOR AND WEDGE PLATE DIMENSIONS

Strand Range Inside Sheathing ¹⁾	HDPE Corrugated			Trumpet Pipe		Wedge Plate Dimensions			
ea	Nom. Size in	O.D. in	O.D. mm	O.D. in	O.D. mm	ØG in	ØG mm	H in	H mm
1-3	2	2.44	62	4.5	114	4.69	119	1.8	46
4	2.5	2.92	74	4.5	114	4.69	119	1.8	46
5-6	2.5	2.92	74	4.5	114	5.61	142	2.2	56
7	3	3.60	91	4.5	114	5.61	142	2.2	56
8-9	3	3.60	91	5.63	143	5.75	146	1.69	43
10-12	4	4.60	117	5.63	143	6.75	171	1.95	50
13-15	4	4.60	117	6.63	168	7.09	180	1.97	50
16-17	4	4.60	117	8.63	219	7.87	200	2.17	55
18-19	5	5.85	149	8.63	219	7.87	200	2.17	55
20-24	5	5.85	149	8.63	219	9.45	240	2.95	75
25-27	6	6.8	173	8.63	219	9.45	240	2.95	75

¹⁾ Based on the use of a single 0.5" ID x 0.75" OD internal grout tube. Bearing plate sizes subject to project specific requirements.

Strand anchors larger than 27 strand systems also available.





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 Filepath: D:\Users\jgregg\Desktop\0067-RP-032 Lateral Earth Pressures.dwg | Figure S-3

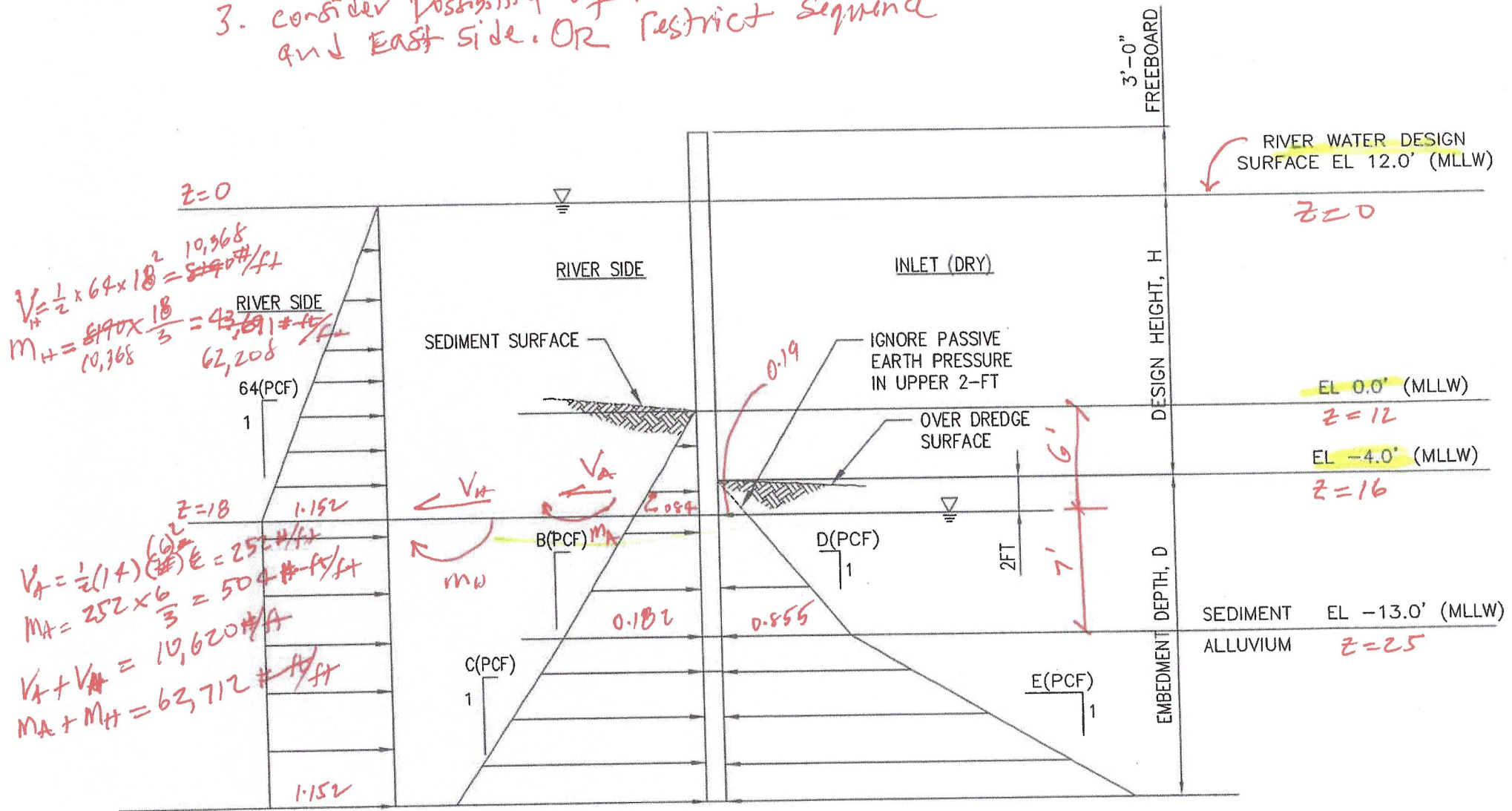


Figure S-3
Construction Sequence - RM 2.2 Temporary Cofferdam

Appendix E - Geotechnical Design Analysis
 30% Remedial Design Basis of Design Report

Notes

1. This assumes Dredging in Inlet only (West of Cofferd dam)
2. Consider Dredging at East of Cofferd dam
3. consider Possibility of Simultaneous Dredging at West and East Side. OR Restrict Sequence



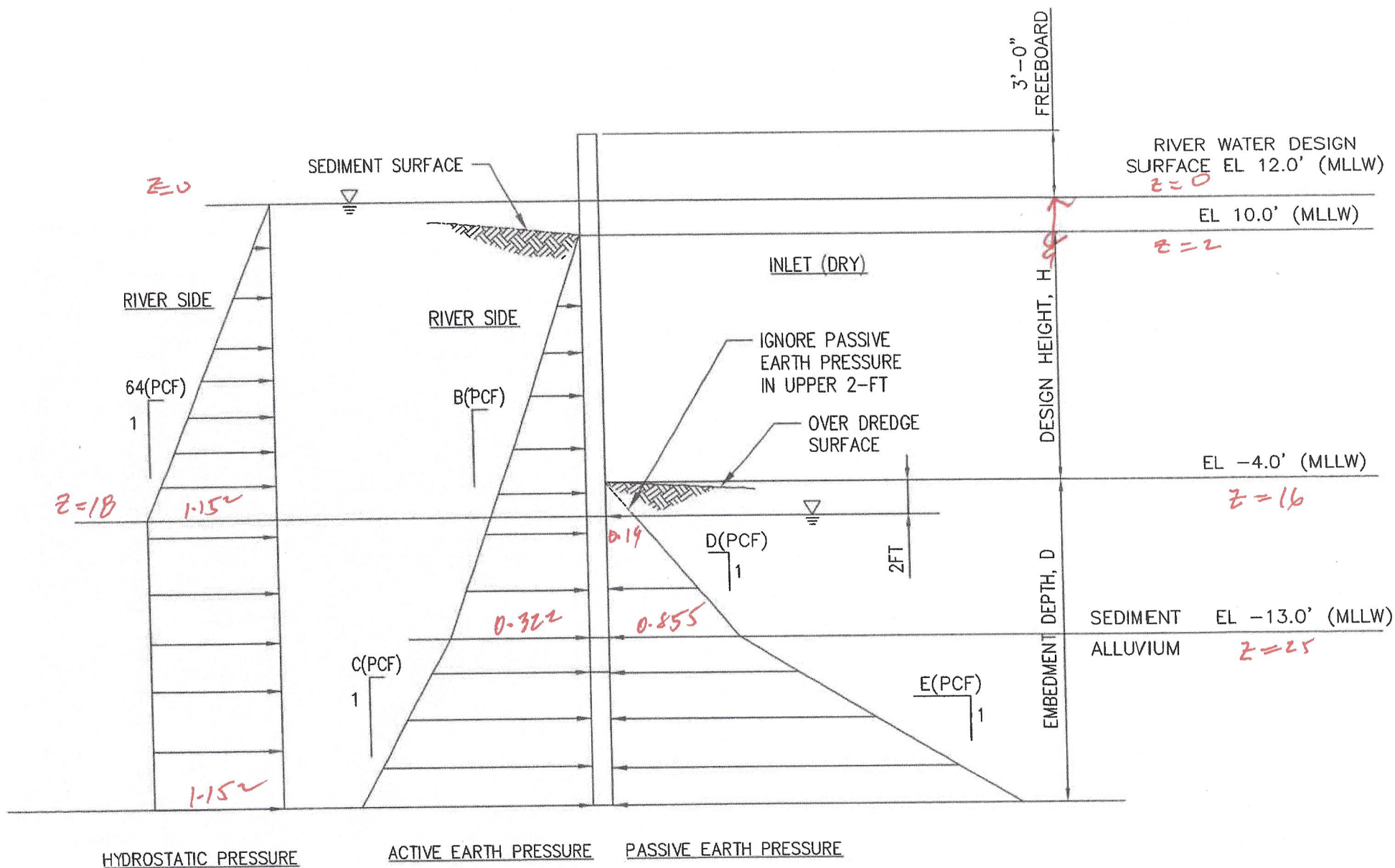
$$S_{min} = \frac{63,712 \times 10}{0.66 \times 50} = 12,801 \text{ #/ft}$$

HYDROSTATIC PRESSURE

ACTIVE EARTH PRESSURE

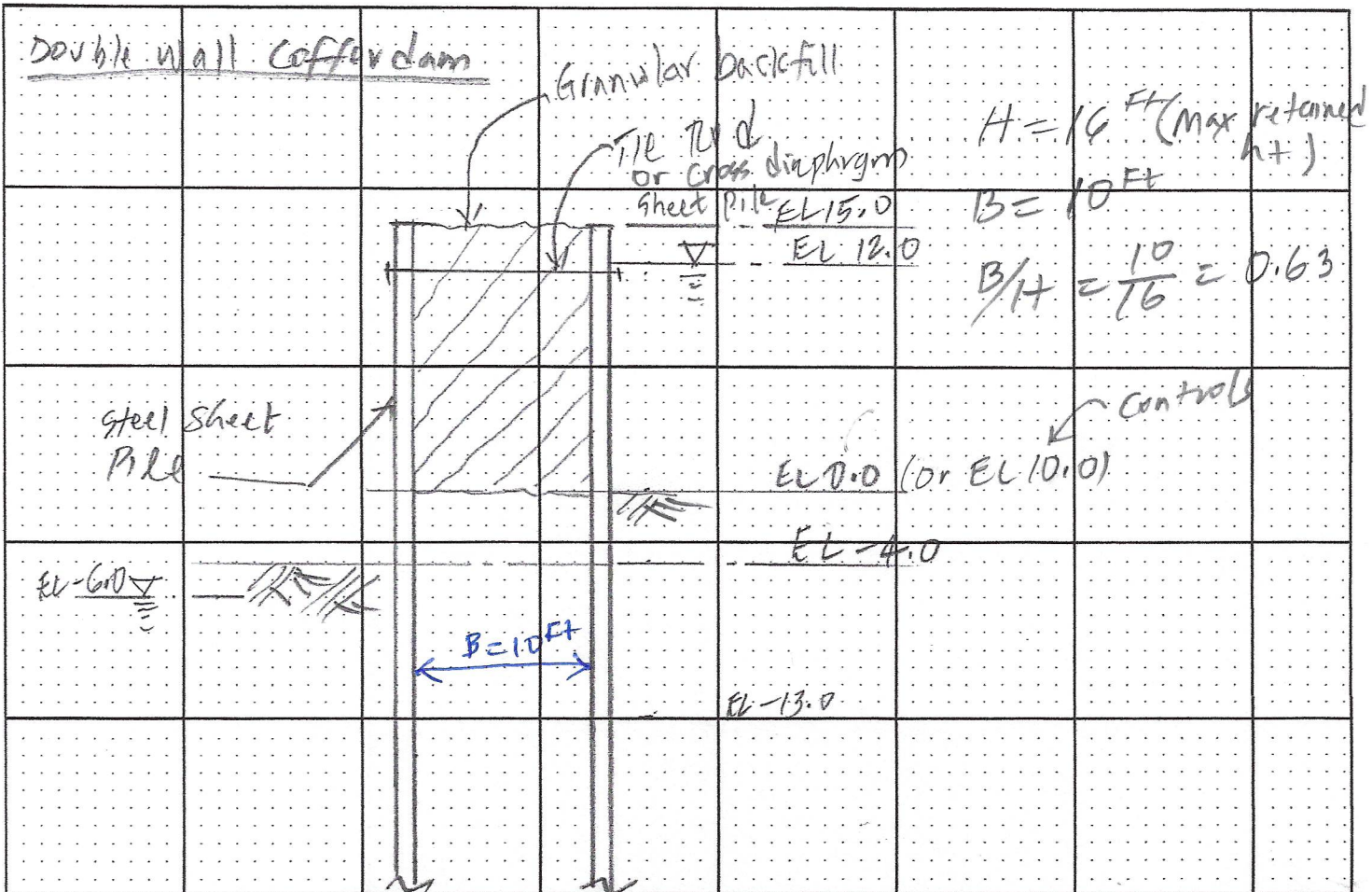
PASSIVE EARTH PRESSURE

WALL 2 - COFFERDAM WITH SEDIMENT SURFACE AT EL 0.0 (REF: FIGURE E4-2)



WALL 2 – COFFERDAM WITH SEDIMENT
SURFACE AT EL 10.0 (REF: FIGURE E4-2)

Date: 9-20-15 By: AB BEI No. _____ Sheet No. _____ of _____ Sheets
 Subject: LDWMR - 30% Remedial Design



$$M_{max} \text{ (single pile)} = 677.23 \text{ K-ft/ft } FS=1.50$$

$$U_{le} \rightarrow = 557.46 \text{ " } FS=1.25$$

Assume loose sand & gravel backfill

$$E = 1450 \text{ to } 3630 \text{ psi}; \phi = 30 \text{ to } 35^\circ$$

$$\nu = 0.20 \text{ to } 0.40$$

$$U_{le} E = 3630 \text{ psi}, \nu = 0.30$$

$$C_{s1} = \frac{3630}{2(1+0.3)} = 1390 \text{ psi}; L_{\text{Apparent length of fixity}} = 35 \text{ ft} \approx 420"$$

$$M_{\text{net wall}} \approx \frac{M_{max}}{2} \times \frac{1}{1L} [\tanh(\alpha L)]$$

Date: 9-2025 By: AB
Subject: LDWMR - 30% Remedial Design

BEI No. _____ Sheet No. _____ of _____ Sheets

$$\lambda = \sqrt{\frac{B G_{soil}}{Z E I}} ; B = 10^6 = 120 \text{ in}$$

$$E = 29 \times 10^6 \text{ PSI}$$

$$I = 419.9 \text{ in}^4/\text{ft} \text{ (N.E. 26)}$$

$$361.22 \text{ in}^4/\text{ft} \text{ (P.E. 35)} \leftarrow \text{use}$$

$$\lambda = \sqrt{\frac{120 \times 1390}{2 \times 29 \times 10^6 \times 361.22}}$$

$$\lambda = 0.00028 \text{ small}$$

$$\begin{aligned} W &= 14 \times 9 \text{ in} \\ A &= 10.29 \text{ in}^2 \\ I &= 361.22 \text{ in}^4 \\ S &= 48.5 \text{ in}^3 \end{aligned}$$

$$M_{dbi \text{ wall}} = \frac{551.46}{\lambda} \times \frac{1}{0.00028 \times 40} \times 0.829 = 195.38 \text{ K-ft/ft}$$

$$S_{50} = \frac{195.38 \times 12}{66 \times 50} = 72 \text{ in}^3/\text{ft}$$

w/ sufficient tie rod tension $S_{60} = 60 \text{ in}^3/\text{ft}$

$$I_{dis \text{ wall}} = 2(361.22) + 2(10.29)d^2 \left\{ \begin{array}{l} 14.9 \text{ in} \\ 120 \text{ in} \end{array} \right.$$

$$2d = 120 \text{ in} + 14.9 \text{ in} = 134.9 \text{ in}$$

$$= 2(361.22) + 2(10.29) \left(\frac{134.9}{2} \right)^2 =$$

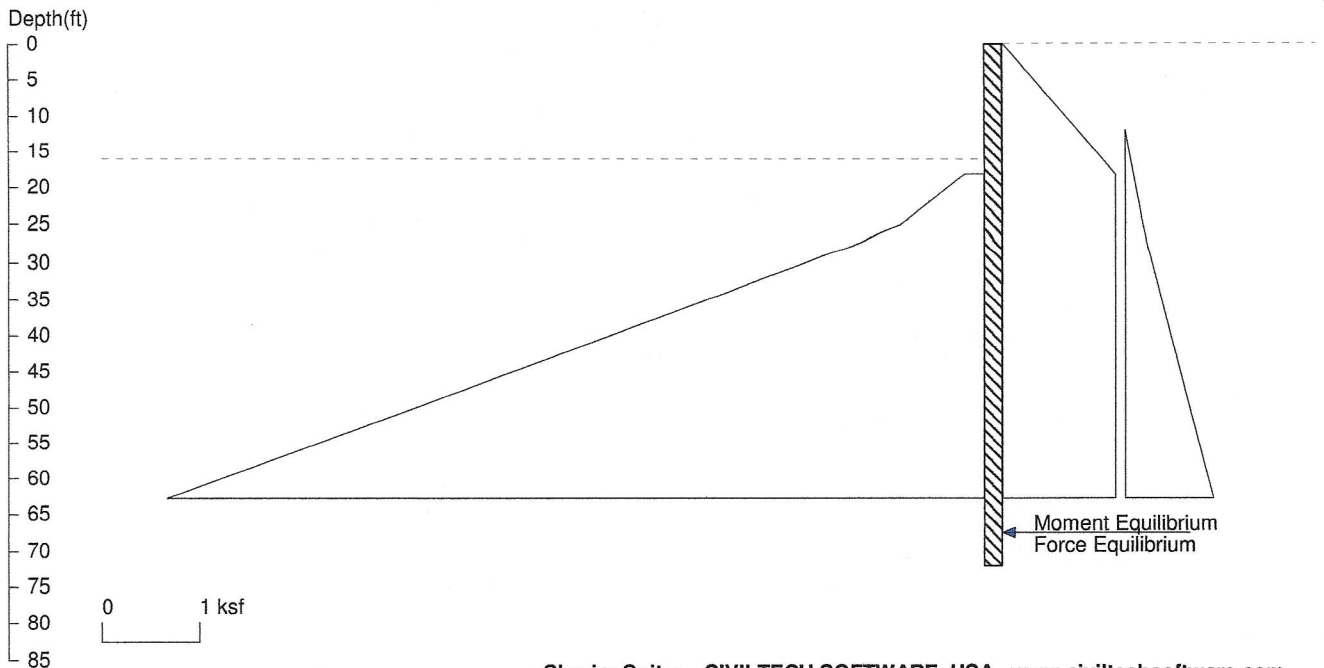
$$= 94,350 \text{ in}^4 \quad = 67.45$$

$$I_{req'd} = 94,350 / 67.45 = 1390 \text{ in}^4/\text{ft}$$

$$f_b = \frac{551.46 \times 12}{1390} = 4.76 \text{ KSI} < 33 \text{ KSI}$$

Subject: CI/WORK - 3070 / Immediate Design

Cofferdam EL 0.0 Sediment Surface, EL -4.0 Dredge



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Date: 9/21/2025

File: C:\Users\abright\OneDrive - Bright Engineering, Inc\Desktop\LDWMR Calculations\LDWMRCD0125.sh8

Wall Height=16.0

Pile Diameter=1.0

Pile Spacing=1.0

Wall Type: 1. Sheet Pile

PILE LENGTH: Min. Embedment=56.17 Min. Pile Length=72.17

MOMENT IN PILE: Max. Moment=438.73 per Pile Spacing=1.0 at Depth=45.82

PILE SELECTION:

Request Min. Section Modulus = 159.5 in³/ft=8576.79 cm³/m, Fy= 50 ksi = 345 MPa, Fb/Fy=0.66

User Input I (Moment of Inertia):

Top Deflection = 2.56(in) based on E (ksi)=29000.00 and I (in⁴)/foot=2000.0

DRIVING PRESSURES (ACTIVE, WATER, & SURCHARGE):

Z1	P1	Z2	P2	Slope
0	0	18	1.152	.064
18	1.152	100	1.152	0.000000
12	0	25	0.182	.014
25	.182	100	1.607	.01900

PASSIVE PRESSURES: Pressures below will be divided by a Factor of Safety =1.25

Z1	P1	Z2	P2	Slope
18.0	0.19	25.0	0.86	0.095
25.0	0.86	100.0	15.70	0.198

ACTIVE SPACING:

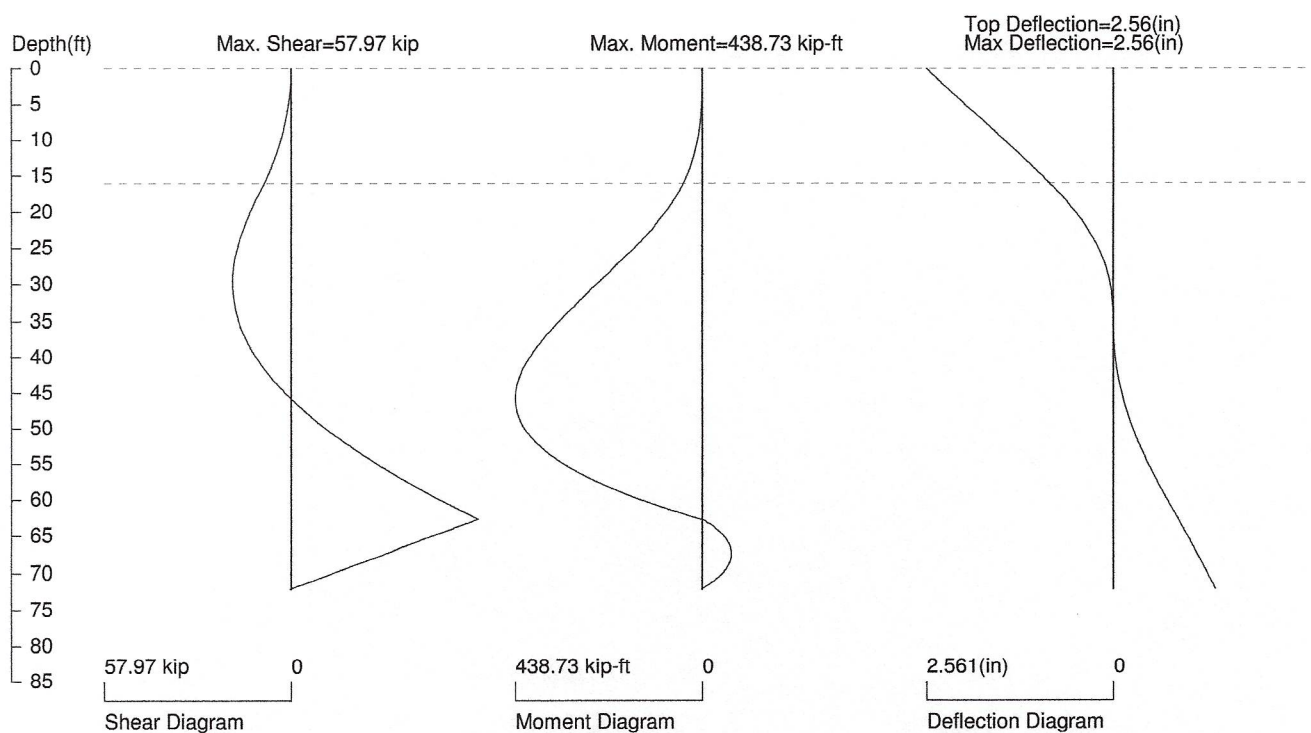
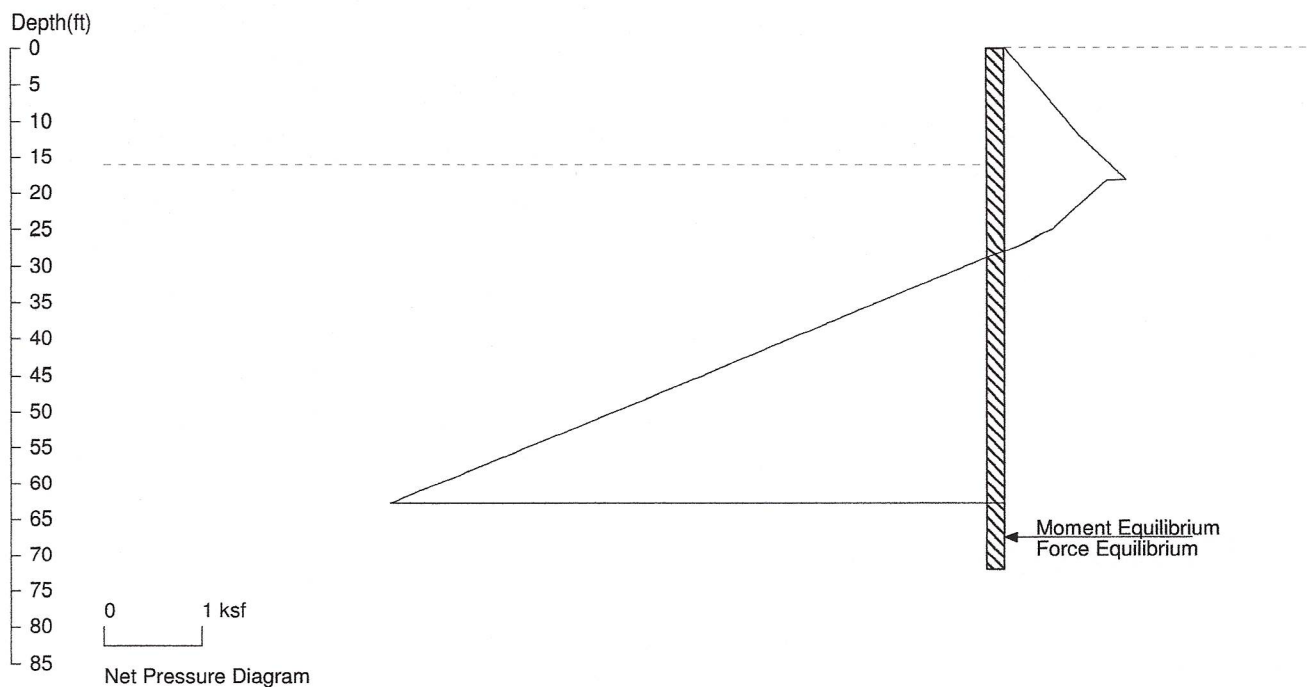
No.	Z depth	Spacing
1	0.00	1.00
2	16.00	1.00

PASSIVE SPACING:

No.	Z depth	Spacing
1	18.00	1.00
2	99.00	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

Cofferdam EL 0.0 Sediment Surface, EL -4.0 Dredge



PRESSURE, SHEAR, MOMENT, AND DEFLECTION DIAGRAMS

Based on pile spacing: 1.0 foot or meter

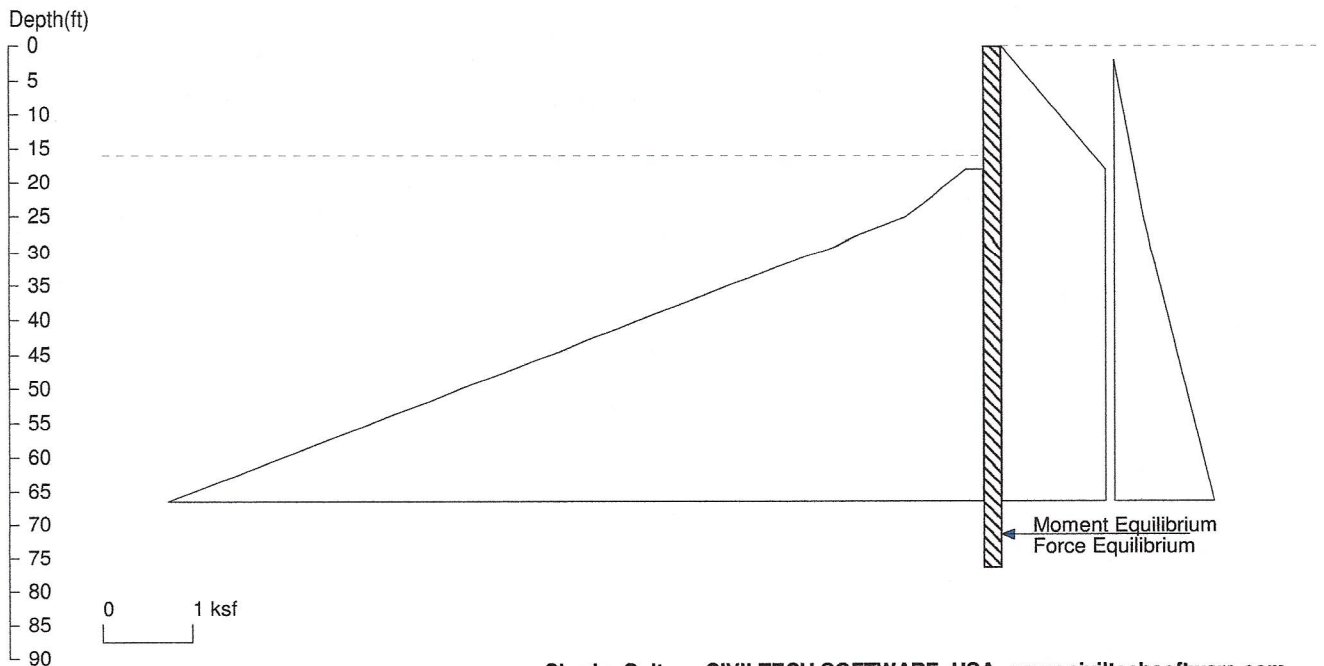
User Input I: E (ksi)=29000.0, I (in4)/foot=2000.0

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Cofferdam EL 10.0 Sediment Surface, EL -4.0 Dredge



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Date: 9/21/2025

File: C:\Users\abright\OneDrive - Bright Engineering, Inc\Desktop\LDWMR Calculations\LDWMRCD10.sh8

Wall Height=16.0

Pile Diameter=1.0

Pile Spacing=1.0

Wall Type: 1. Sheet Pile

PILE LENGTH: Min. Embedment=60.60 Min. Pile Length=76.60

MOMENT IN PILE: Max. Moment=551.46 per Pile Spacing=1.0 at Depth=48.20

PILE SELECTION:

Request Min. Section Modulus = 200.5 in³/ft=10780.62 cm³/m, Fy= 50 ksi = 345 MPa, Fb/Fy=0.66

User Input I (Moment of Inertia):

Top Deflection = 3.50(in) based on E (ksi)=29000.00 and I (in⁴)/foot=2000.0

DRIVING PRESSURES (ACTIVE, WATER, & SURCHARGE):

Z1	P1	Z2	P2	Slope
0	0	18	1.152	.064
18	1.152	100	1.152	0.000000
2	0	25	0.322	.014
25	.322	100	1.747	.01900

PASSIVE PRESSURES: Pressures below will be divided by a Factor of Safety =1.25

Z1	P1	Z2	P2	Slope
18.0	0.19	25.0	0.86	0.095
25.0	0.86	100.0	15.70	0.198

ACTIVE SPACING:

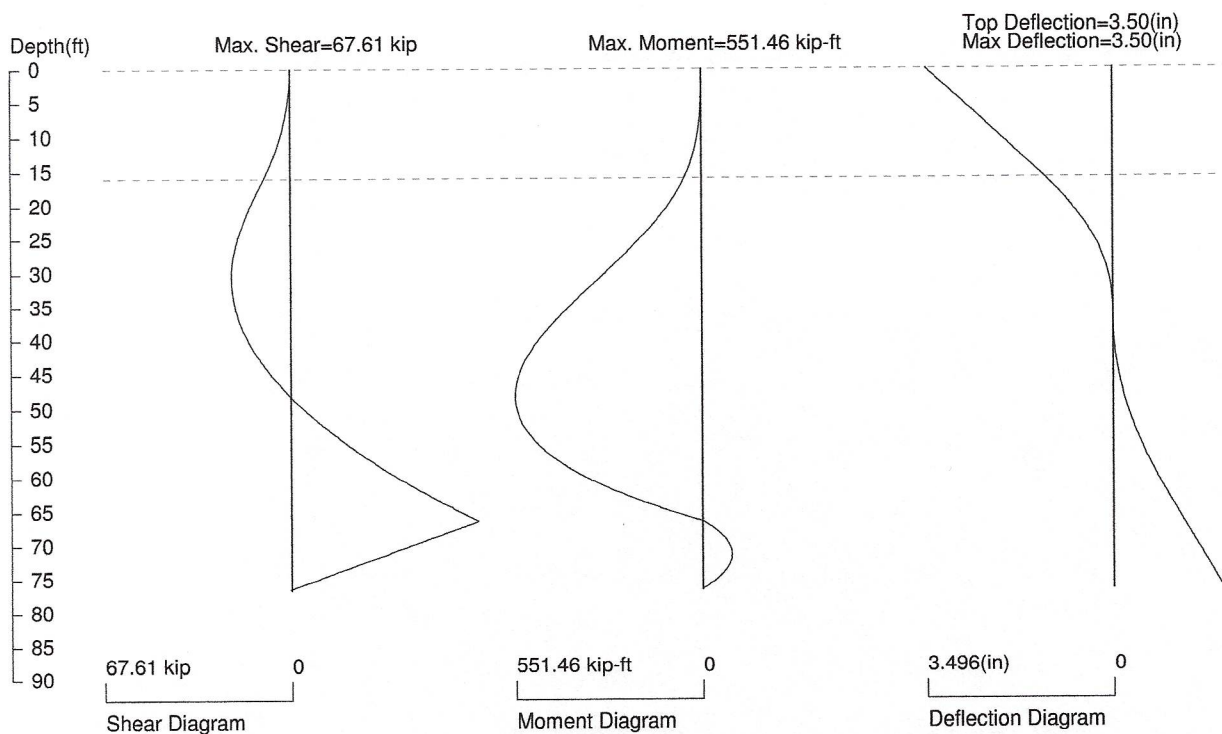
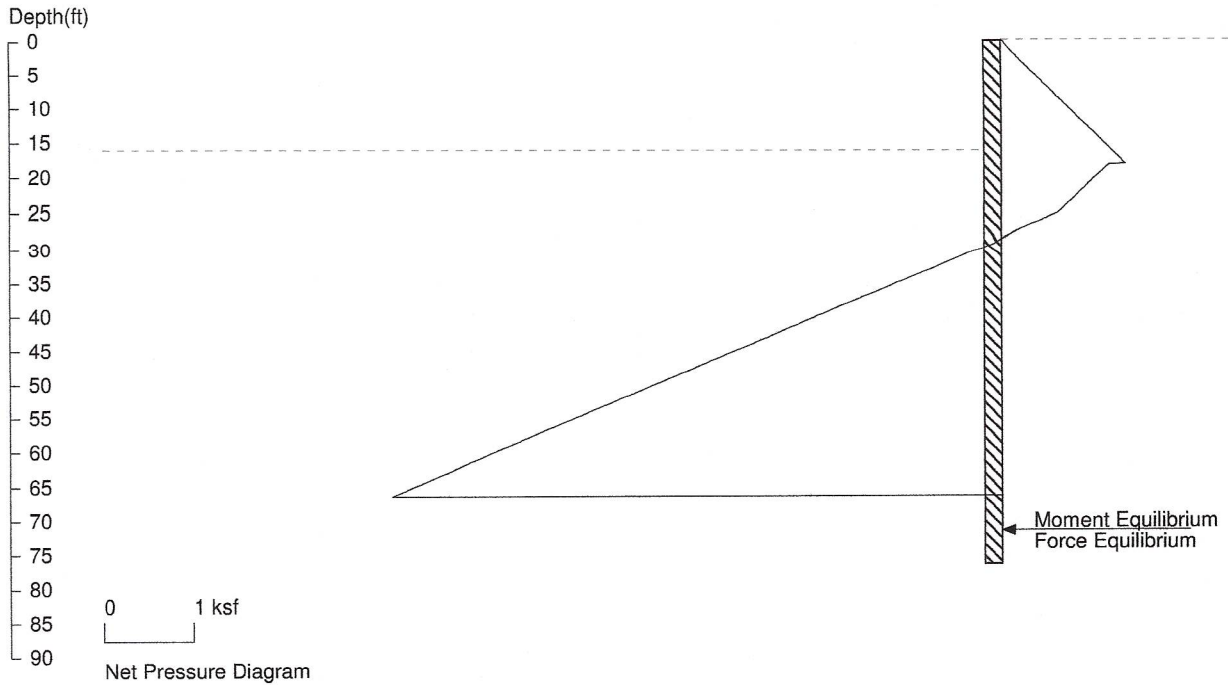
No.	Z depth	Spacing
1	0.00	1.00
2	16.00	1.00

PASSIVE SPACING:

No.	Z depth	Spacing
1	18.00	1.00
2	99.00	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

Cofferdam EL 10.0 Sediment Surface, EL -4.0 Dredge



PRESSURE, SHEAR, MOMENT, AND DEFLECTION DIAGRAMS

Based on pile spacing: 1.0 foot or meter

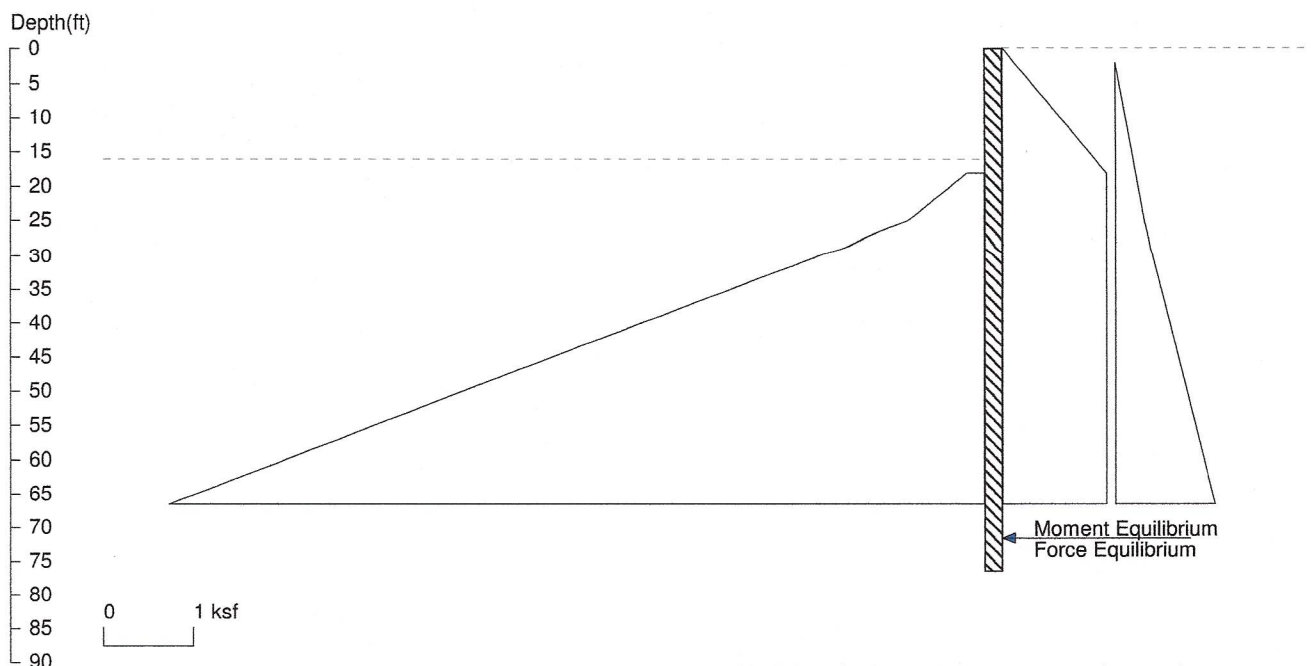
User Input I: E (ksi)=29000.0, I (in⁴)/foot=2000.0

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Wall Height=16.0

Pile Diameter=1.0

Pile Spacing=1.0

Wall Type: 1. Sheet Pile

PILE LENGTH: Min. Embedment=60.60 Min. Pile Length=76.60

MOMENT IN PILE: Max. Moment=551.46 per Pile Spacing=1.0 at Depth=48.20

PILE SELECTION:

Request Min. Section Modulus = 200.5 in³/ft=10780.62 cm³/m, Fy= 50 ksi = 345 MPa, Fb/Fy=0.66

User Input I (Moment of Inertia):

Top Deflection = 3.50(in) based on E (ksi)=29000.00 and I (in⁴)/foot=2000.0

DRIVING PRESSURES (ACTIVE, WATER, & SURCHARGE):

Z1	P1	Z2	P2	Slope
0	0	18	1.152	.064
18	1.152	100	1.152	0.000000
2	0	25	0.322	.014
25	.322	100	1.747	.01900

PASSIVE PRESSURES: Pressures below will be divided by a Factor of Safety =1.25

Z1	P1	Z2	P2	Slope
18.0	0.19	25.0	0.86	0.095
25.0	0.86	100.0	15.70	0.198

ACTIVE SPACING:

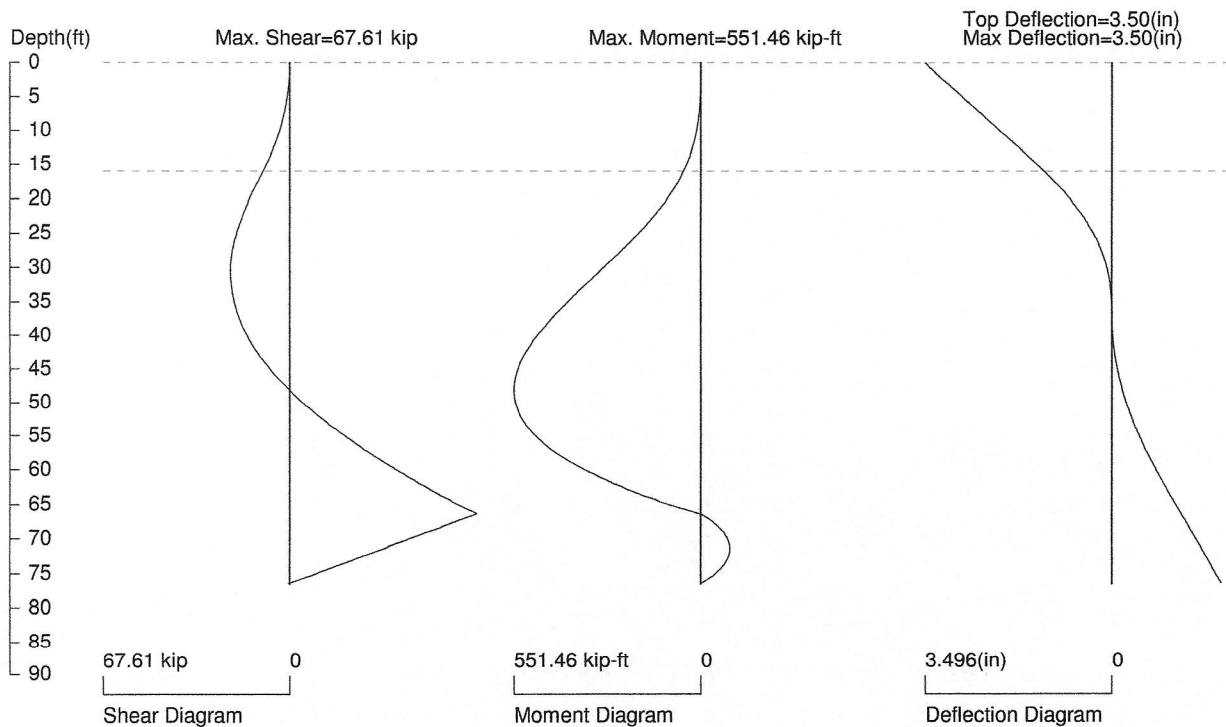
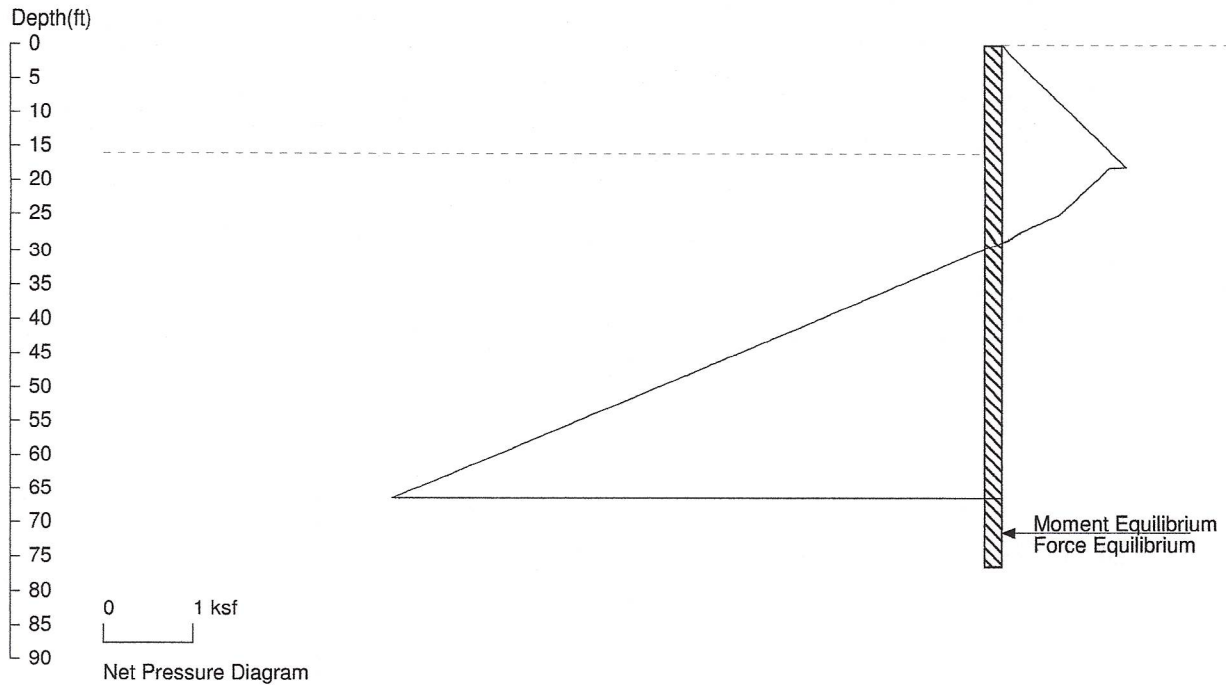
No.	Z depth	Spacing
1	0.00	1.00
2	16.00	1.00

PASSIVE SPACING:

No.	Z depth	Spacing
1	18.00	1.00
2	99.00	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

Cofferdam EL 10.0 Sediment Surface, EL -4.0 Dredge



PRESSURE, SHEAR, MOMENT, AND DEFLECTION DIAGRAMS

Based on pile spacing: 1.0 foot or meter

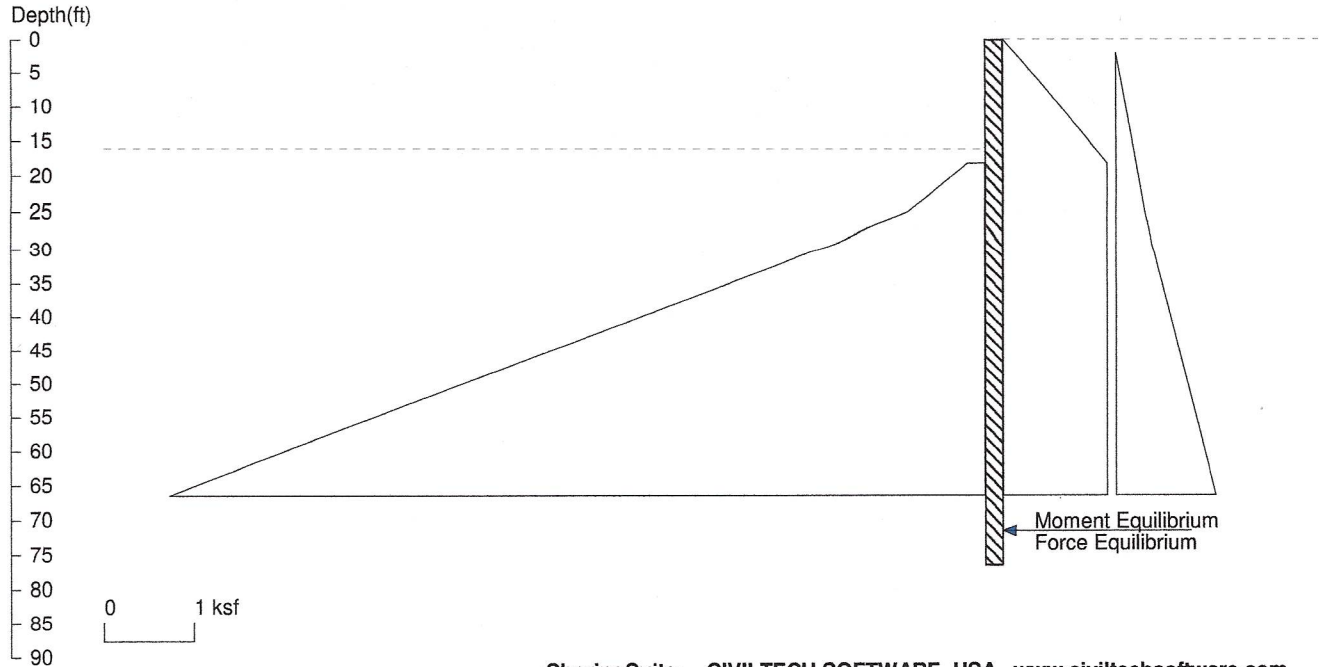
User Input I: E (ksi)=29000.0, I (in⁴)/foot=2000.0

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Date: 9/21/2025

File: C:\Users\abright\OneDrive - Bright Engineering, Inc\Desktop\LDWMP Calculations\LDWMRCD10DbIWall.sh8

Wall Height=16.0

Pile Diameter=1.0

Pile Spacing=1.0

Wall Type: 1. Sheet Pile

PILE LENGTH: Min. Embedment=60.60 Min. Pile Length=76.60

MOMENT IN PILE: Max. Moment=551.46 per Pile Spacing=1.0 at Depth=48.20

PILE SELECTION:

Request Min. Section Modulus = 200.5 in³/ft=10780.62 cm³/m, Fy= 50 ksi = 345 MPa, Fb/Fy=0.66

User Input I (Moment of Inertia):

Top Deflection = 0.07(in) based on E (ksi)=29000.00 and I (in⁴)/foot=94350.0

DRIVING PRESSURES (ACTIVE, WATER, & SURCHARGE):

Z1	P1	Z2	P2	Slope
0	0	18	1.152	.064
18	1.152	100	1.152	0.000000
2	0	25	0.322	.014
25	.322	100	1.747	.01900

PASSIVE PRESSURES: Pressures below will be divided by a Factor of Safety =1.25

Z1	P1	Z2	P2	Slope
18.0	0.19	25.0	0.86	0.095
25.0	0.86	100.0	15.70	0.198

ACTIVE SPACING:

No.	Z depth	Spacing
1	0.00	1.00
2	16.00	1.00

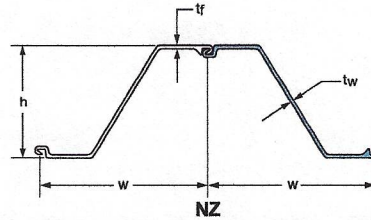
PASSIVE SPACING:

No.	Z depth	Spacing
1	18.00	1.00
2	99.00	1.00

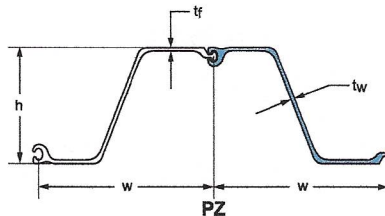
UNITS: Width, Spacing, Diameter, Length, and Depth - ft; Force - kip; Moment - kip-ft
Friction, Bearing, and Pressure - ksf; Pres. Slope - kip/ft³; Deflection - in

HOT ROLLED STEEL SHEET PILE

NZ/PZ



SECTION	THICKNESS				WEIGHT		SECTION MODULUS			COATING AREA		
	Width (w)	Height (h)	Flange (t _f)	Web (t _w)	Cross Sectional Area	Single Pile	Wall Area	Elastic	Plastic	Moment of Inertia	Both Sides	Wall Surface
	in mm	in mm	in mm	in mm	in ² /ft cm ² /m	lb/ft kg/m	lb/ft ² kg/m ²	in ³ /ft cm ³ /m	in ³ /ft cm ³ /m	in ⁴ /ft cm ⁴ /m	ft ² /ft of single m ² /m	ft ² /ft ² m ² /m ²
NZ 14	30.31 770	13.39 340	0.375 9.5	0.375 9.5	6.40 135.4	55 81.26	21.77 106.30	25.65 1379	30.50 1640	171.7 23447	6.10 1.86	1.20 1.20
NZ 19	27.56 700	16.14 410	0.375 9.5	0.375 9.5	7.07 149.6	55 81.85	24.05 11740	35.08 1886	41.33 2222	283.1 38659	6.18 1.88	1.35 1.35
NZ 20	27.56 700	16.16 411	0.394 10.0	0.394 10.0	7.34 155.4	57 85.37	24.82 122.00	36.24 1948	42.80 2301	292.8 39984	6.18 1.88	1.35 1.35
NZ 21	27.56 700	16.20 412	0.433 11.0	0.433 11.0	7.80 165.2	61 90.78	26.56 129.70	38.69 2080	45.85 2465	313.4 42797	6.18 1.88	1.35 1.35
NZ 22	27.56 700.0	16.25 413.0	0.480 12.20	0.480 12.20	8.57 181.4	67 99.71	29.20 142.44	41.47 2230	49.34 2653	336.9 46006	6.18 1.88	1.35 1.35
NZ 26	27.56 700	17.32 440	0.500 12.7	0.500 12.7	9.08 192.2	71 105.66	30.99 151.30	48.50 2608	57.01 3065	419.9 57340	6.49 1.98	1.41 1.41
NZ 28	27.56 700	17.38 441	0.560 14.2	0.560 14.2	9.98 211.2	78 116.08	33.96 165.82	52.62 2829	62.16 3342	457.4 62461	6.49 1.98	1.41 1.41
NZ 38	27.56 700	19.69 500	0.689 17.5	0.500 12.7	11.00 232.9	86 127.99	37.45 182.83	70.84 3809	81.57 4386	697.3 95214	6.58 2.01	1.43 1.43
NZ 40	27.56 700.0	19.73 501.0	0.735 18.70	0.551 14.00	11.77 249.1	92 136.91	40.06 195.59	74.97 4031	86.75 4664	739.6 100997	6.58 2.01	1.43 1.43
NZ 42	27.56 700.0	19.77 502.0	0.769 19.50	0.589 15.0	12.41 262.7	97 144.36	42.24 206.23	78.17 4203	90.80 4881	772.5 105490	6.58 2.01	1.43 1.43



SECTION	THICKNESS					WEIGHT		SECTION MODULUS		Moment of Inertia cm ⁴ /m	COATING AREA	
	Width (w)	Height (h)	Flange (t _f)	Web (t _w)	Cross Sectional Area in ² /ft cm ² /m	Single Pile	Wall Area	Elastic	Plastic		Both Sides	Wall Surface
	in mm	in mm	in mm	in mm		lb/ft kg/m	lb/ft ² kg/m ²	in ³ /ft cm ³ /m	in ³ /ft cm ³ /m		ft ² /ft of single m ² /m	ft ² /ft ² m ² /m ²
PZ 22	22.00 559	9.0 229	0.375 9.50	0.375 9.50	6.47 136.9	40.3 60.0	22.0 107.4	18.1 973	21.79 1171.4	84.38 11500	4.48 1.37	1.22 1.22
PZ 27	18.00 457	12.0 305	0.375 9.50	0.375 9.50	7.94 168.1	40.5 60.3	27.0 131.8	30.2 1620	36.49 1961.9	184.20 25200	4.48 1.37	1.49 1.49
PZ 35	22.64 575	14.9 378	0.600 15.21	0.500 12.67	10.29 217.8	66.0 98.2	35.0 170.9	48.5 2608	5717 3073.5	361.22 49300	5.37 1.64	1.42 1.42
PZ 40	19.69 500	16.1 409	0.600 15.21	0.500 12.67	11.77 249.1	65.6 97.6	40.0 195.3	60.7 3263	71.92 3866.7	490.85 67000	5.37 1.64	1.64 1.64