SHORING PLAN
COASTLINE DR 12-INCH
WATERLINE IMPROVEMENT

REV #2

DESIGN CALCULATIONS
May 1, 2025

PREPARED BY:
SCOTT F CANNON, PE

MZB ENGINEERING, INC

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1192 Athlone Lane Corona, CA 92882

Table of Contents

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PLANS FOR CONSTRUCTION ON

COASTLINE ROAD

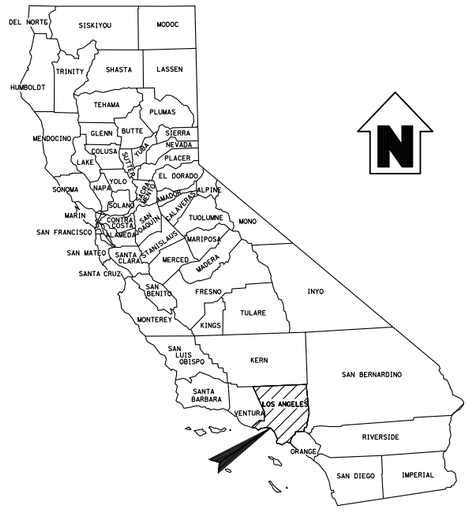
IN LOS ANGELES COUNTY

12-INCH WATERLINE
SHORING PLAN
REVISION 2

May 1, 2025

INDEX TO PLANS

LOCATION MAP



REGISTERED PROFESSIONAL ENGINEER
SCOTT F. CANNON
84327
Exp. 09-30-25
CIVIL
STATE OF CALIFORNIA

REV.	DATE	DESCRIPTION
0	3-26-25	RFC SUBMITTAL
1	4-17-25	LACPW COMMENTS DATED 4/15/25
2	4-30-25	LACPW COMMENTS DATED 4/29/25

DESIGN BY: S. CANNON
DRAWN BY: S. CANNON
SCALE: AS SHOWN

MZB
ENGINEERING INC.
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MZB ENGINEERING

COASTLINE DR SHORING PLAN

COVER

PROJECT: COASTLINE DR.

JOB NUMBER: -

CONTRACT NO.: WWD2900063

SHEET NUMBER: 1 OF 6 SHEETS

GENERAL NOTES:
1. ALL EXCAVATIONS SHALL BE CONSTRUCTED AND MAINTAINED IN ACCORDANCE WITH OSHA CFR 29, PART 1926, SUBPART P, AND CAL/OSHA SAFETY ORDERS TITLE 8, SECTION 1504, AND 1539–1547.

2. THE DESIGN OF THIS EXCAVATION IS IN ACCORDANCE WITH THE 2024 CALTRANS STANDARD SPECIFICATIONS AND THE 2011 CT TRENCHING AND SHORING MANUAL. 1

3. THE SURCHARGE SETBACK TABLE LIMIT FOR HORIZONTAL SHORING LOADS TO 72 PSF FOR 1 TO 10 FT AND 50 PSF FOR 10 20 FT.

LOCATION AND PROTECTION OF EXISTING UTILITIES:
1. THE CONTRACTOR SHALL VERIFY THE LOCATION OF ALL EXISTING UTILITIES, OTHER OBSTACLES, DIMENSIONS, OFFSETS, ELEVATIONS AND CONDITIONS IN THE FIELD PRIOR TO STARTING ANY WORK. ALL EXISTING UTILITIES SHOWN ON THE CONTRACT PLANS WITHIN THE WORK ZONE SHALL BE POSITIVELY IDENTIFIED PRIOR TO STARTING WORK. THE CONTRACTOR IS RESPONSIBLE TO POTHOLE ALL UTILITIES (AS NEEDED) BEFORE SHORING WALL CONSTRUCTION IS TO BEGIN. THE ENGINEER SHALL BE NOTIFIED OF ANY DISCREPANCIES OR INCONSISTENCIES BEFORE PROCEEDING FURTHER WITH THE WORK.

SURVEYING AND GROUND ELEVATION INFORMATION:
1. EXISTING GROUND ELEVATIONS AND CONSEQUENTIAL ELEVATION HEIGHTS HAVE BEEN DETERMINED BASED ON TOPOGRAPHICAL INFORMATION PROVIDED BY THE PLANS AND OR ACTUAL FIELD DATA.

COMPETENT PERSONS:
1. A COMPETENT PERSON IS CAPABLE OF IDENTIFYING EXISTING AND PREDICTABLE HAZARDS IN THE SURROUNDINGS, OR WORKING CONDITIONS WHICH ARE UNSANITARY, HAZARDOUS, OR DANGEROUS TO EMPLOYEES AND WHO HAS AUTHORIZATION TO TAKE PROMPT CORRECTIVE MEASURES TO ELIMINATE THEM.

2. BEFORE COMMENCING ANY EXCAVATION, THE CONTRACTOR SHALL OBTAIN UNDERGROUND SERVICE ALERT (USA) INQUIRY I.D. NUMBER. A MINIMUM OF 3 DAYS SHALL BE ALLOWED AFTER THE I.D. NUMBER IS OBTAINED AND BEFORE THE EXCAVATION WORK IS STARTED TO NOTIFY UTILITY OWNERS. IF THE UTILITY OWNER IS THE CITY, A CONFIRMATION NUMBER INDICATING THE CITY HAS BEEN NOTIFIED SHALL BE OBTAINED BY USA AND/OR THE CONTRACTOR FROM THE APPROPRIATE CITY DEPARTMENT. THE I.D. NUMBER TOGETHER WITH THE DATE ACQUIRED SHALL BE REPORTED TO THE INSPECTOR WHEN CALLING FOR INSPECTION. USA I.D. NUMBERS WILL NOT BE GIVEN MORE THAN TEN (10) WORK DAYS BEFORE STARTING EXCAVATION WORK.

3. THE CONTRACTORS COMPETENT PERSON SHALL BE ON–SITE OBSERVING THE EXCAVATION PROCESS AND SHALL BE THE RESPONSIBLE PARTY IN THE DETERMINATION OF THE SOIL TYPE EXPOSED IN THE EXCAVATION WALLS. IF THE SOIL TYPE ENCOUNTERED IS DIFFERENT THAN THAT SPECIFIED ON THE PLANS, THE DESIGN ENGINEER MUST BE NOTIFIED.

4. THE COMPETENT PERSON SHALL INSPECT THE TRENCH OR EXCAVATION AT THE BEGINNING OF EACH SHIFT PRIOR TO WORKERS ENTERING THE TRENCH OR EXCAVATION AND/OR IF WEATHER HAS CHANGED OR EFFECTED THE WORK AREA.

ENVIRONMENTAL/SWPPP COMPLIANCE:
1. DESIGN OF EXCAVATIONS IS BASED ON ASSUMPTIONS THAT SOIL PROPERTIES AND GROUND CONDITIONS REMAIN CONSTANT THROUGH THE LIFE OF THE EXCAVATION. WATER CAN EFFECT THE STRENGTH OF SOILS AND GREAT CARE SHOULD BE TAKEN TO PREVENT CHANGES FROM EXISTING SOIL CONDITIONS. SLOPES MUST BE PROTECTED FROM EXCESSIVE SOIL SATURATION AND EROSION DURING CONSTRUCTION. WATER PONDING IN THE BASE OF EXCAVATIONS IS UNACCEPTABLE AND SHOULD BE DIVERTED OR REMOVED. PROPER SWPPP AND BMP MEASURES SHALL BE USED TO PREVENT ENVIRONMENTAL INDUCED SLOPE INSTABILITY.

CAL/OSHA REQUIREMENTS:
1. A CAL/OSHA EXCAVATION PERMIT MUST BE OBTAINED PRIOR TO ANY EXCAVATION.

2. A COPY OF THIS SHORING PLAN MUST BE AT THE JOB SITE DURING CONSTRUCTION.

3. INGRESS AND EGRESS TO THE EXCAVATION SHALL CONFORM TO ALL OSHA REQUIREMENTS INCLUDING: HANDRAILS, LADDER ACCESS AND FALL PROTECTION AS REQUIRED. IN ADDITION TO OSHA REQUIREMENTS, OPEN TRENCHES SHALL BE PROTECTED BY PROTECTIVE & SECURITY FENCING OR PLATES WITH LACDPW STANDARD PLAN 6008. 1

4. CONTINGENCY PLANS FOR EMERGENCY SITUATIONS SHALL BE ADDRESSED IN JHA.

5. LADDERS TO BE PLACED EVERY 25 FEET OF WORKING AREA PER OSHA REQUIREMENTS. 1

CONSTRUCTION REQUIREMENTS:
1. CONTACT THE DESIGN ENGINEER IF EXCAVATION SHOWS SIGNS OF SLOUGHING, SWELLING OR PUMPING.

2. CAUTION SHALL BE TAKEN WHEN EXCAVATIONS ARE ADJACENT TO TRAFFIC AND THE TRAVELING PUBLIC.

CONTROLLING FIELD DIMENSIONS
1. THE FIELD SUPERINTENDENT WILL VERIFY ALL CONTROLLING FIELD DIMENSIONS BEFORE ORDERING, FABRICATING, OR INSTALLING SHORING. UPON APPROVAL BY THE DESIGN ENGINEER DIMENSIONS OF THE SHORING WILL BE ADJUSTED TO FIT THE ACTUAL DIMENSIONS.

2. IF AT ANY POINT THE EXCAVATION EXCEEDS THE DEPTH SHOWN ON THE PLANS BY MORE THAN 1 FT, NOTIFY THE DESIGN ENGINEER IMMEDIATELY.

SOIL LAYER DESCRIPTIONS:
1. THE FOLLOWING SOIL DESCRIPTIONS ARE ASSUMED TO BE PRESENT DURING EXCAVATION. IF SOILS DIFFER FROM THOSE DESCRIBED BELOW, STOP THE EXCAVATION AND CONSULT WITH THE DESIGN ENGINEER.

SOIL TYPES & DESCRIPTIONS:

0' TO 6'	– SAND, SILTY
6' TO 12'	– SHALE CLAYEY
12' TO BELOW	– SANDSTONE

1

DESIGN PARAMETERS:
1. EXCAVATION SLOPE DESIGN BASED ON BORING B–1 TO B–7 OF THE CONTRACT PLANS (SHEET 9 OF 12).

SOIL PARAMETERS:

0' TO 6'	6' TO 12
γ = 119 PCF	γ = 112 PCF
Φ = 31°	Φ = 37°
Su = 0 PSF	Su = 0 PSF
Ka = 0.31	Ka = 0.25
Kw = 36.6 PCF	Kw = 27.8 PCF

1

DESIGN SURCHARGE PARAMETERS:
1. IF K–RAIL IS LESS THAN 2 FT FROM TOP OF SLOPE IT MUST BE PINNED. SEE 2024 CALTRANS STANDARD PLAN T3B. 1

2. K–RAIL MAY NOT BE PLACED CLOSER THAN 3" FROM TOP OF SLOPE. (200PSF).

3. SLOPES WERE DESIGNED WITH A HS20–44 TRAFFIC SURCHARGE (300PSF) PLACED 2 FT FROM TOP OF SLOPE OR AS SHOWN IN THE SURCHARGE TABLE(S) IN THESE PLANS.

4. FOR SURCHARGE OFFSETS REFER TO "ASSUMED SURCHARGES & MIN. OFFSETS" TABLES ON SECTION VIEWS.

5. IF HIGHER GROUND PRESSURE IS ANTICIPATED, CONSULT WITH THE DESIGN ENGINEER.

ROAD PLATES:
1. PLATES ARE A MINIMUM ASTM A36 MIN Fy=36 KSI.
2. TRENCH PLATE INSTALLATION INCLUDING MIX RAMPING WITHIN THE CITY OF LOS ANGELES AND ALL PAVEMENT REPAIRS SHALL BE IN ACCORDANCE LAPW STANDARD S–601–3.
3. THERE SHALL BE NO PAINT ON THE SURFACE OF THE ROAD PLATES.
4. ALL TOPS OF T HE ROAD PLATES MUST BE FLUSH.
5. DESIGN IS BASED ON ALLOWABLE BENDING STRENGTH.
6. REFER TO TRENCH SHORING PRODUCT DATA.

1

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May 1, 2025

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SCOTT F. CANNON
84327
Exp. 09-30-25
CIVIL
STATE OF CALIFORNIA

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0	3–26–25	RFC SUBMITTAL
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DRAWN BY: S. CANNON
SCALE: AS SHOWN

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(949) 254–4792

MZB ENGINEERING

COASTLINE DR SHORING PLAN

GENERAL & SHORING NOTES

PROJECT: COASTLINE DR.
JOB NUMBER: –
CONTRACT NO.: WWD2900063

SHEET NUMBER: 2
OF 6 SHEETS

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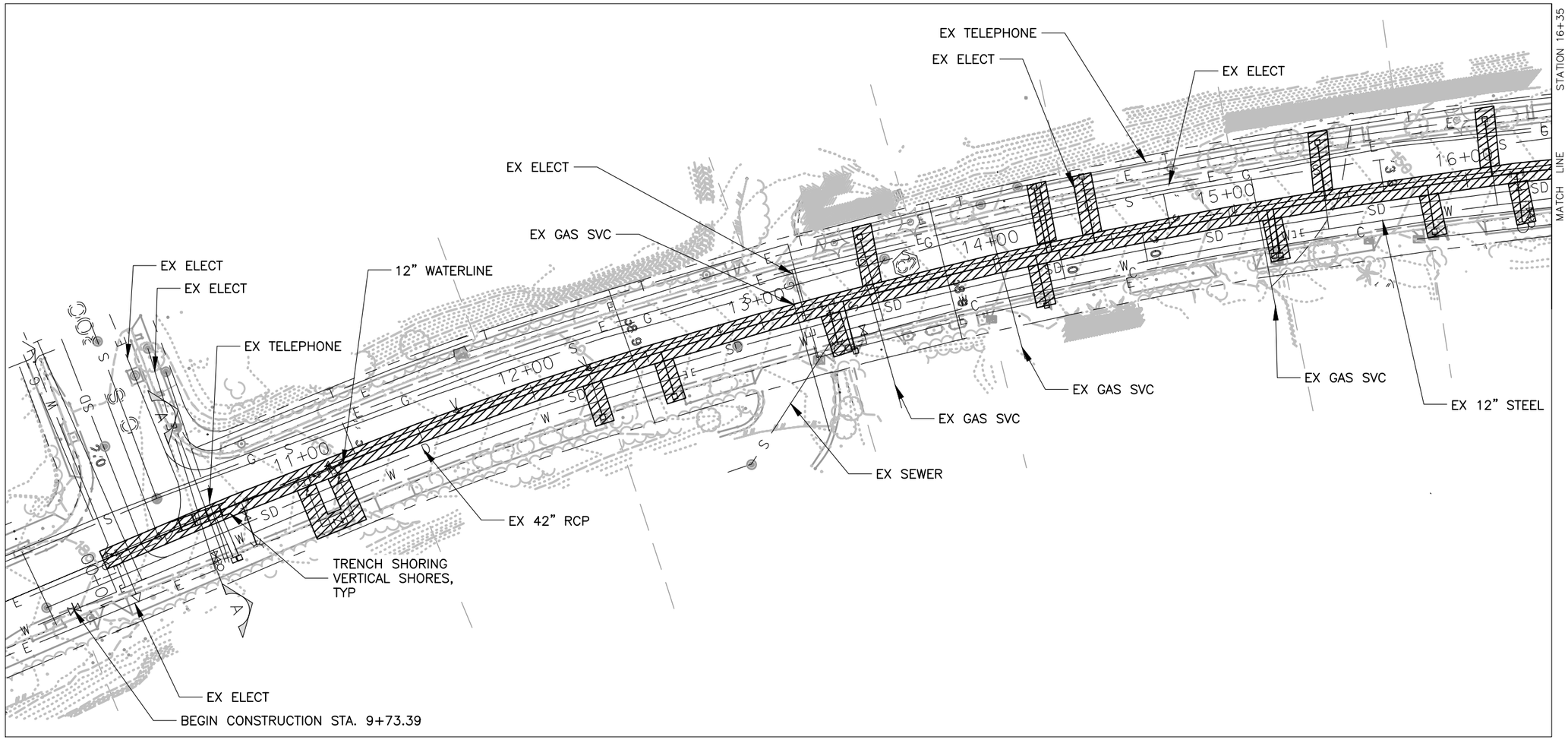

PLAN VIEW

SCALE: ¼" – 1'–0"

LEGEND:

LIMITS OF SHORING

1

NOTES:

1. CONTRACTOR TO VERIFY ALL UTILITY LOCATIONS.
2. VERTICAL RAILS ARE FOR LAYOUT ONLY.
3. REFER TO THE COASTLINE DRIVE TRAFFIC CONTROL PLAN.
4. LIMITS OF SHORING DESIGN ARE FROM STATION 9+73.39 TO 30+08.61.

1

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MZB ENGINEERING

COASTLINE DR SHORING PLAN

PLAN VIEW

PROJECT: COASTLINE DR.
JOB NUMBER: -
CONTRACT NO.: WWD2900063

SHEET NUMBER: 3
OF 6 SHEETS

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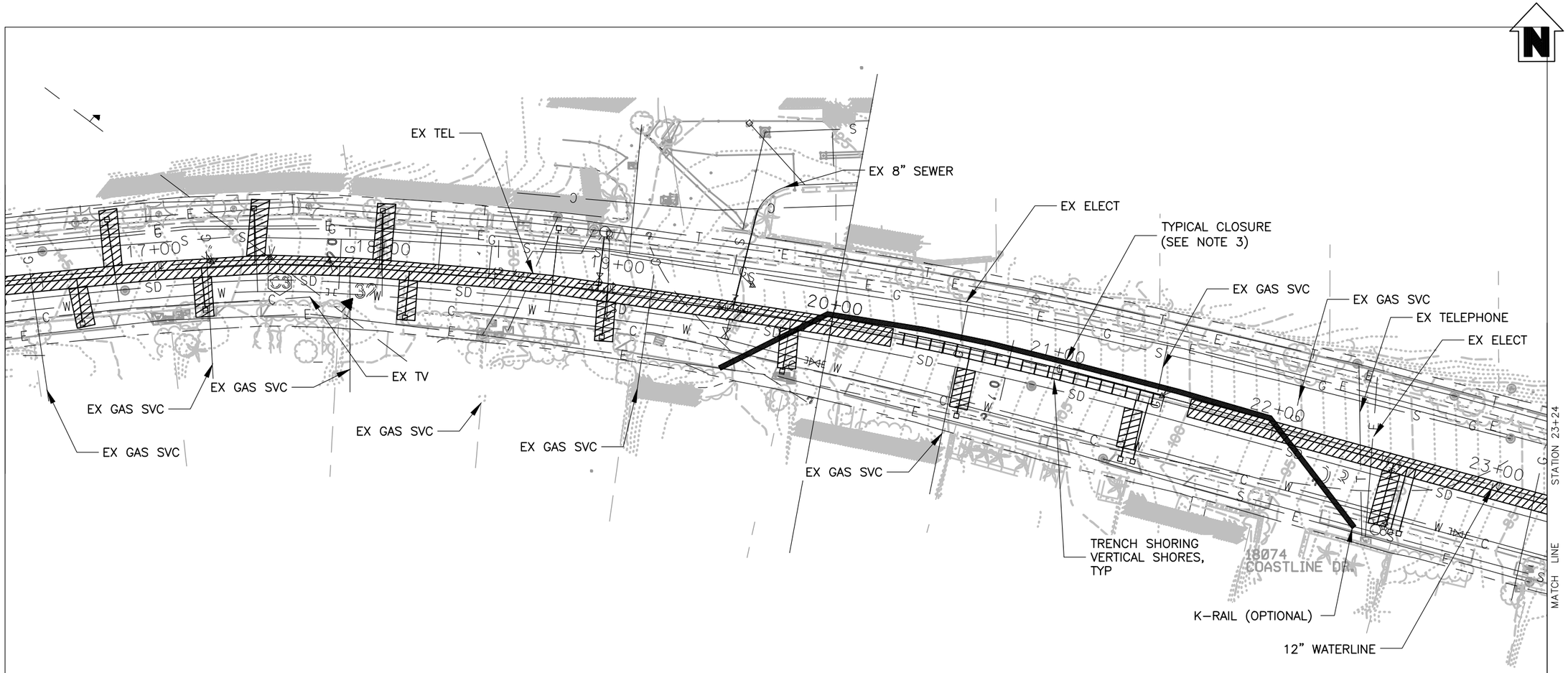

PLAN VIEW
SCALE: ¼" – 1'–0"

NOTES:

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LEGEND:

LIMITS OF SHORING

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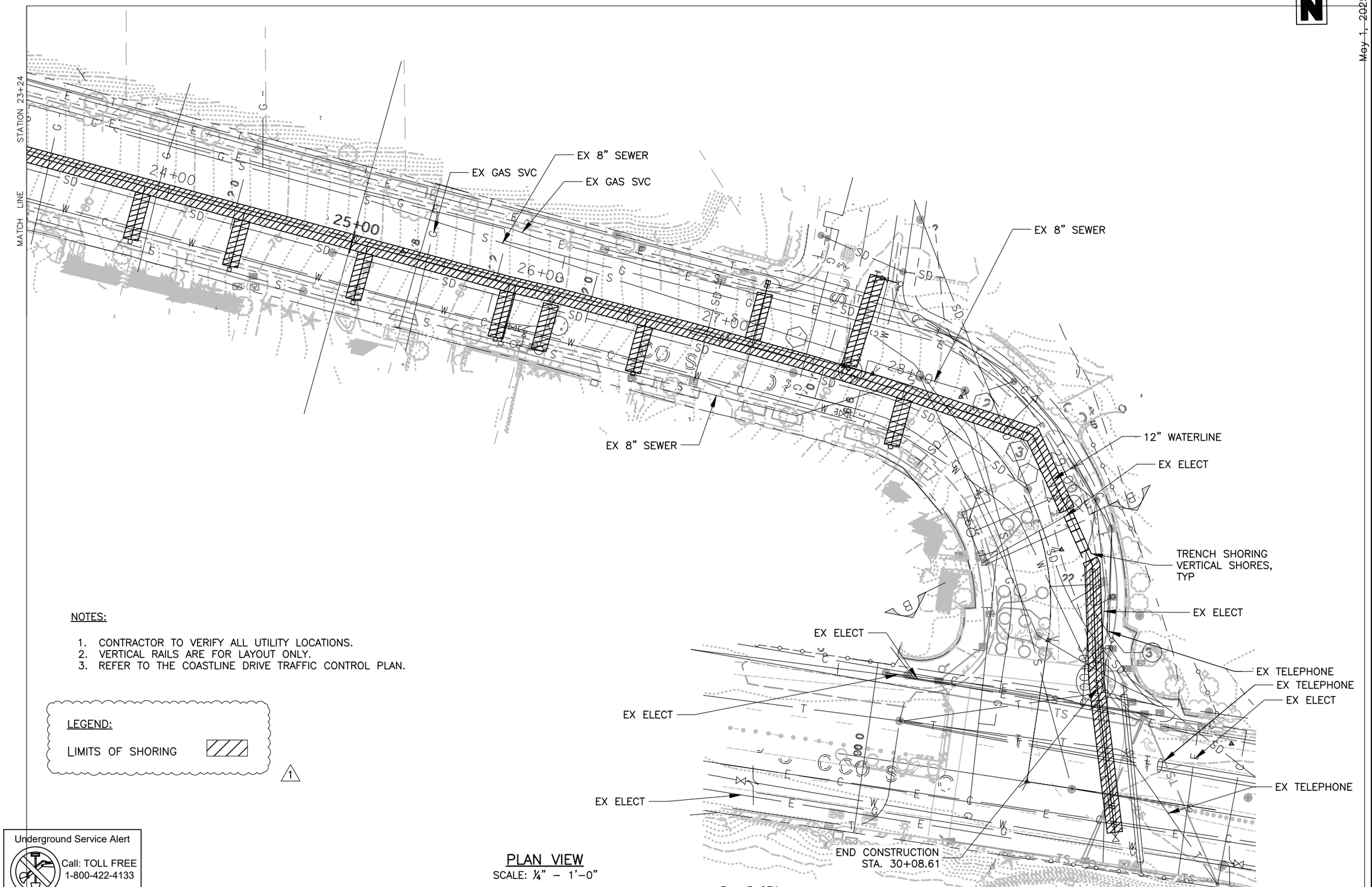
COASTLINE DR SHORING PLAN

PLAN VIEW

PROJECT: COASTLINE DR.
JOB NUMBER: –
CONTRACT NO.: WWD2900063

SHEET NUMBER: 4
OF 6 SHEETS



May 1, 2025

NOTES:

1. CONTRACTOR TO VERIFY ALL UTILITY LOCATIONS.
2. VERTICAL RAILS ARE FOR LAYOUT ONLY.
3. REFER TO THE COASTLINE DRIVE TRAFFIC CONTROL PLAN.

LEGEND:

LIMITS OF SHORING

1

PLAN VIEW
SCALE: ¼" – 1'–0"

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MZB ENGINEERING

COASTLINE DR SHORING PLAN

PLAN VIEW

PROJECT: COASTLINE DR.

JOB NUMBER: –

CONTRACT NO.: WD2900063

SHEET NUMBER: 5 OF 6 SHEETS

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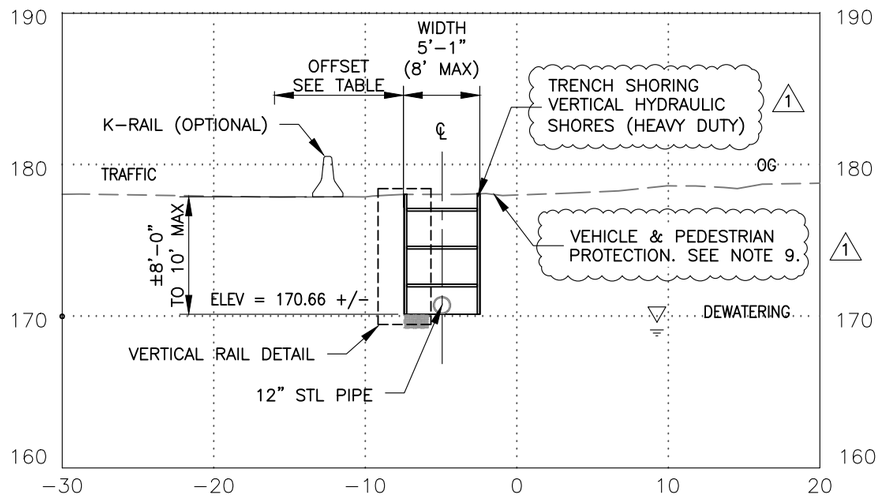
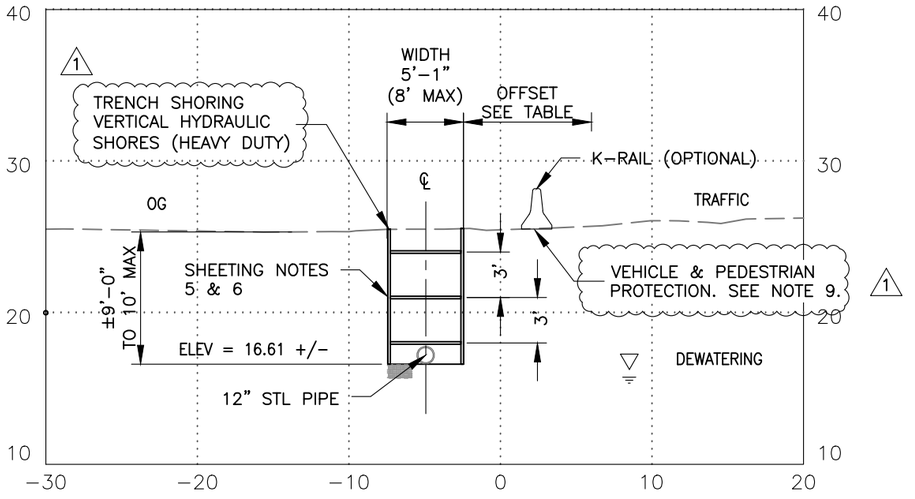


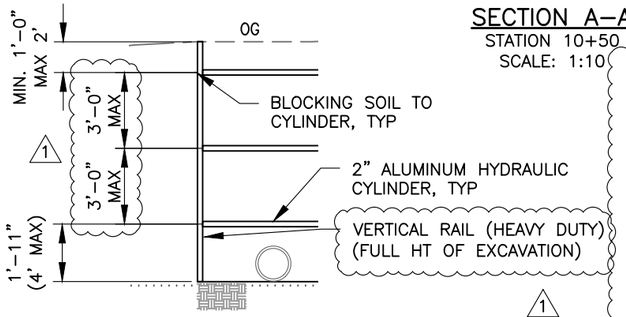
SECTION A−A

STATION 10+50
SCALE: 1:10



SECTION B−B

STATION 29+70
SCALE: 1:10

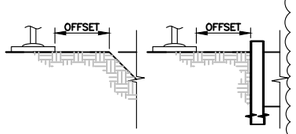


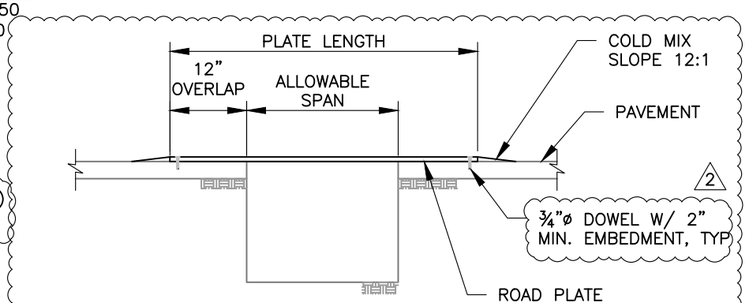
VERTICAL SHORE SPACING: 6 FT MAX HORIZONTAL SPACING 1

VERTICAL RAIL DETAIL

SCALE: 1:5

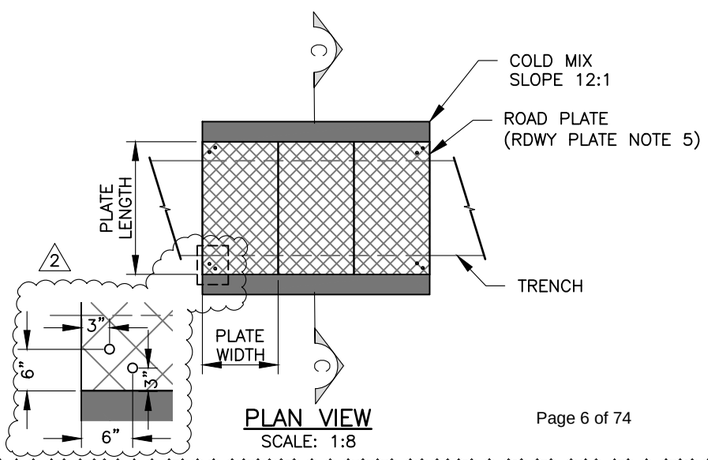
MINIMUM OFFSETS	
SURCHARGE	OFFSET
K−RAIL	1 FT
TRAFFIC	4 FT
SPOIL PILE (HT=4FT)	2 FT
CAT 325 EXCAVATOR	3 FT
3 CY LOADER	2 FT
5 CY LOADER	3 FT
DUMP TRUCK	3 FT
12 CY CONCRETE TRUCK	3 FT
BOOM TRUCK	6 FT





SECTION C−C

SCALE: 1:5



PLAN VIEW

SCALE: 1:8

NOTES:

VERTICAL SHORES

1. THERE MUST BE A MINIMUM OF THREE COLUMNS OF SHORES SPACED EQUALLY IN THE TRENCH AT ALL TIMES.
2. MAY USE SHEETING FOR THE PREVENTION OF LOCAL RAVELING OR SLOUGHING. TYPES OF SHEETING ARE 2 EA SHEETS OF 1⅛" HDO STRUCTURAL 1 OR EQUIVALENT. MAY ALSO USE ½" A36 STEEL PLATE. 2
3. SHORING SYSTEM SHALL BE FULLY ASSEMBLED WITH ALL HYDRAULIC CYLINDERS IN PLACE PRIOR TO TO PLACING IT IN THE EXCAVATION.
4. DESIGNED FOR TYPE C−60 SOIL.
5. SHEETING IS REQUIRED WHEN SLOUGHING OR RAVELING OCCURS AND IN C−60 OVER 8 FT.
6. IN TYPE C−60 SOIL, SHEETING MUST EXTEND TO BOTTOM OF EXCAVATION. SHEETING IS 4 FT WIDE.
7. MINIMUM OF THREE SHORES IN TRENCHES GREATHER THAN 12 FT.
8. REFER TO TAB DATA.
9. OPEN TRENCH WILL BE BACKFILLED AT THE END OF EACH SHIFT. IF NOT, USE EITHER STEEL PLATES OR FENCING TO PROTECT PEDESTRIANS AND TRAFFIC FROM THE TRENCH OPENING. 1

ROADWAY PLATES:

1. SPAN MEASUREMENT IS AC EDGE TO AC EDGE.
2. TRAFFIC MAY RUN IN ANY DIRECTION ON THE PLATES.
3. PLATE MAY BE PLACED IN EITHER DIRECTION OF THE TRENCH IN ACCORDANCE WITH THE CONDITIONS AND NOTES SPECIFIED HEREIN.
4. IT IS THE PLATE INSTALLERS RESPONSIBILTY TO INSTALL & MAINTAIN THE PLATES IN ACCORDANCE WITH THE TRENCH SHORING DATA SHEET AND LOCAL JURISDICTION REQUIREMENTS.
5. REFER TO ALLOWABLE SPANS AND PLATE SIZES ON SHEET 2.
6. REFER TO TRENCH SHORING PRODUCT DATA.

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MZB ENGINEERING

COASTLINE DR SHORING PLAN

SECTION VIEW

PROJECT: COASTLINE DR.
JOB NUMBER: -
CONTRACT NO.: WWD2900063

SHEET NUMBER:
6
OF 6 SHEETS

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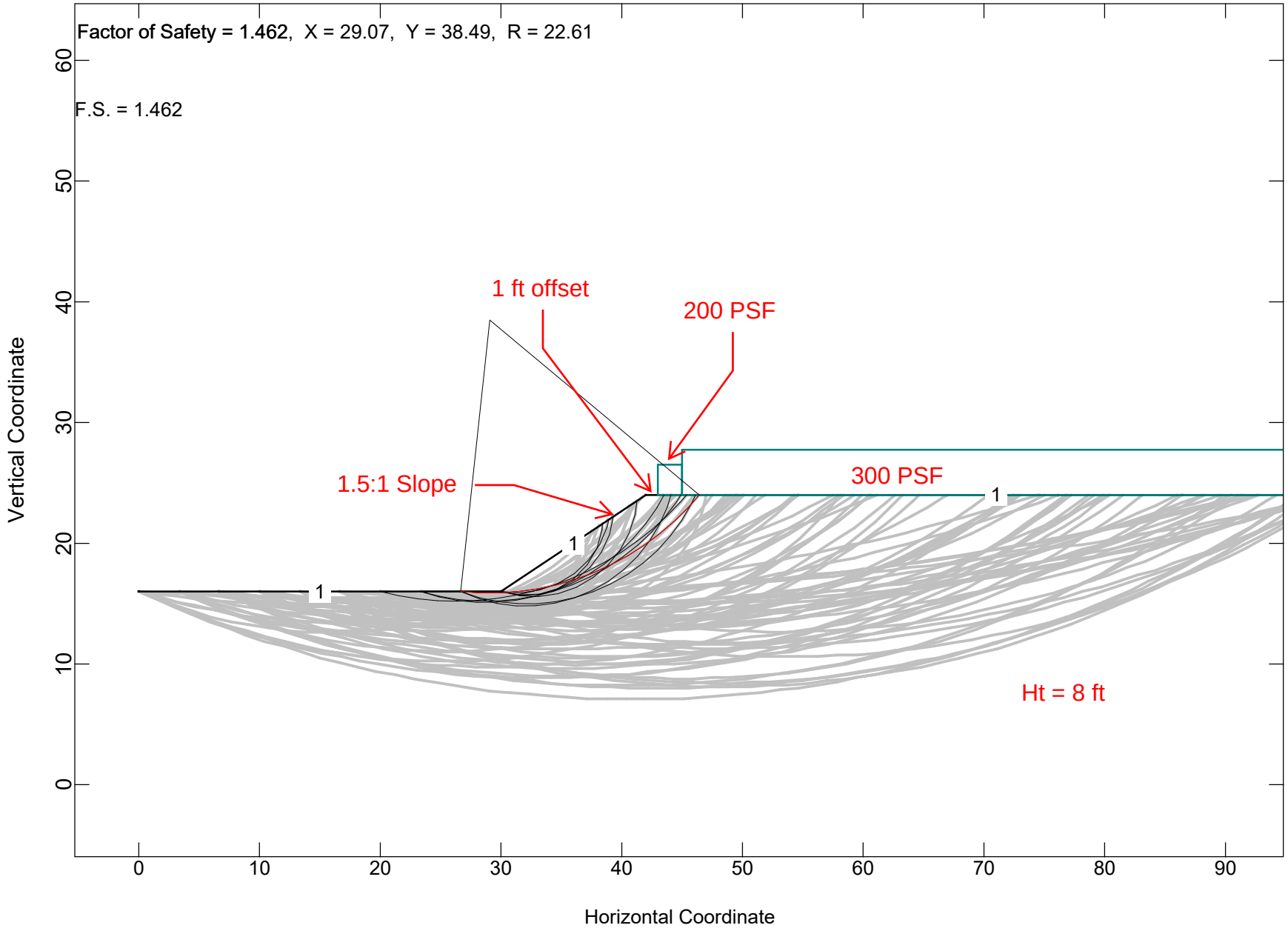
Calculations

Section A
Type C Soil
Traffic & K-Rail Surcharge



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                     STABLPro for Windows, Version 2015.4.5

                            Upgraded from:
                            FHWA-PCSTABLE

                      Serial Number :  357267753

                         --Slope Stability Analysis--
                       Simplified Janbu, Simplified Bishop
                         or Spencer Method of Slices

     ============================================================================


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     Path to file locations      :
D:\Dropbox\Korpi_Cannon_Engineering\Projects\KC-0119 - MZB Engineering\Design\Excav
- Shoring\4.0 Coastline Dr\Design\
     Name of input data file     : Sect A Excav.sl4d
     Name of output file         : Sect A Excav.sl4o
     Name of plot output file    : Sect A Excav.sl4p

     ----------------------------------------------------------------------------
                          Time and Date of Analysis
     ----------------------------------------------------------------------------

               Date:  March 26, 2025     Time:  13:23:25




1
          PROBLEM DESCRIPTION   New Slope




          BOUNDARY COORDINATES

              3 Top   Boundaries
              3 Total Boundaries
```

Boundary No.	X-Left ft.	Y-Left ft.	X-Right ft.	Y-Right ft.	Soil Type Below Bnd
1	0.00	16.00	30.00	16.00	1
2	30.00	16.00	42.00	24.00	1
3	42.00	24.00	100.00	24.00	1

1

ISOTROPIC SOIL PARAMETERS

1 Type(s) of Soil

Soil Type No.	Total Unit Wt. pcf	Saturated Unit Wt. pcf	Cohesion Intercept psf	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant psf	Piez. Surface No.
1	118.0	118.0	0.0	37.0	0.00	0.0	0

1

BOUNDARY LOAD(S)

2 Load(s) Specified

Load No.	X-Left ft.	X-Right ft.	Intensity psf	Deflection (deg)
1	43.00	45.00	200.0	0.0
2	45.00	100.00	300.0	0.0

NOTE - Intensity Is Specified As A Uniformly Distributed
Force Acting On A Horizontally Projected Surface.

1

A Critical Failure Surface Searching Method, Using A Random
Technique For Generating Circular Surfaces, Has Been Specified.

100 Trial Surfaces Have Been Generated.

10 Surfaces Initiate From Each Of 10 Points Equally Spaced
Along The Ground Surface Between X = 0.00 ft.

and X = 30.00 ft.

Each Surface Terminates Between X = 37.00 ft.
and X = 100.00 ft.

Unless Further Limitations Were Imposed, The Minimum Elevation
At Which A Surface Extends Is Y = 0.00 ft.

1.60 ft. Line Segments Define Each Trial Failure Surface.

Restrictions Have Been Imposed Upon The Angle Of Initiation.
The Angle Has Been Restricted Between The Angles Of -25.0
And 0.0 deg.

1

Following Are Displayed The Ten Most Critical Of The Trial
Failure Surfaces Examined. They Are Ordered - Most Critical
First.

* * Safety Factors Are Calculated By The Modified Bishop Method * *

Failure Surface Specified By 15 Coordinate Points

Point No.	X-Surf ft.	Y-Surf ft.
1	26.67	16.00
2	28.26	15.89
3	29.86	15.89
4	31.46	16.00
5	33.04	16.22
6	34.61	16.56
7	36.14	17.01
8	37.65	17.56
9	39.10	18.22
10	40.51	18.98
11	41.86	19.84
12	43.15	20.79
13	44.37	21.83
14	45.50	22.95
15	46.43	24.00

Circle Center At X = 29.1 ; Y = 38.5 and Radius, 22.6

*** 1.462 ***

Individual data on the 18 slices

Slice No.	Width Ft	Weight Lbs	Water Force Top Lbs	Water Force Bot Lbs	Tie Force Norm Lbs	Tie Force Tan Lbs	Earthquake Force Hor Lbs	Earthquake Force Ver Lbs	Surcharge Load Lbs
1	1.6	0.11E+02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
2	1.6	0.21E+02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
3	0.1	0.18E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
4	1.5	0.93E+02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
5	1.6	0.26E+03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
6	1.6	0.40E+03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
7	1.5	0.51E+03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
8	1.5	0.59E+03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
9	1.5	0.64E+03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
10	1.4	0.65E+03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
11	1.4	0.65E+03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
12	0.1	0.66E+02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
13	1.0	0.44E+03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
14	0.1	0.57E+02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.30E+02
15	1.2	0.39E+03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.24E+03
16	0.6	0.14E+03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.13E+03
17	0.5	0.77E+02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.15E+03
18	0.9	0.57E+02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.28E+03

Failure Surface Specified By 9 Coordinate Points

Point No.	X-Surf ft.	Y-Surf ft.
1	30.00	16.00
2	31.60	15.90
3	33.18	16.12
4	34.69	16.65
5	36.06	17.48
6	37.23	18.57
7	38.15	19.88

8	38.80	21.34
9	38.93	21.95

Circle Center At X = 31.3 ; Y = 23.8 and Radius, 7.9

*** 1.547 ***

1

Failure Surface Specified By 17 Coordinate Points

Point No.	X-Surf ft.	Y-Surf ft.
1	23.33	16.00
2	24.88	15.61
3	26.46	15.34
4	28.06	15.21
5	29.66	15.22
6	31.25	15.36
7	32.83	15.63
8	34.38	16.03
9	35.89	16.55
10	37.35	17.21
11	38.75	17.98
12	40.08	18.87
13	41.33	19.86
14	42.50	20.96
15	43.57	22.15
16	44.54	23.42
17	44.90	24.00

Circle Center At X = 28.8 ; Y = 34.3 and Radius, 19.1

*** 1.586 ***

Failure Surface Specified By 16 Coordinate Points

Point No.	X-Surf ft.	Y-Surf ft.
1	23.33	16.00
2	24.87	15.55

3	26.44	15.26
4	28.04	15.11
5	29.64	15.12
6	31.23	15.28
7	32.80	15.59
8	34.33	16.05
9	35.81	16.66
10	37.23	17.40
11	38.56	18.28
12	39.81	19.28
13	40.96	20.40
14	41.99	21.62
15	42.91	22.93
16	43.51	24.00

Circle Center At X = 28.8 ; Y = 31.8 and Radius, 16.7

*** 1.643 ***

1

Failure Surface Specified By 19 Coordinate Points

Point No.	X-Surf ft.	Y-Surf ft.
1	20.00	16.00
2	21.56	15.65
3	23.14	15.40
4	24.73	15.25
5	26.33	15.20
6	27.93	15.26
7	29.53	15.41
8	31.10	15.67
9	32.66	16.03
10	34.20	16.48
11	35.70	17.04
12	37.16	17.68
13	38.58	18.42
14	39.95	19.25
15	41.27	20.16
16	42.52	21.16
17	43.71	22.23
18	44.82	23.37
19	45.36	24.00

Circle Center At X = 26.3 ; Y = 40.3 and Radius, 25.1

*** 1.646 ***

Failure Surface Specified By 16 Coordinate Points

Point No.	X-Surf ft.	Y-Surf ft.
1	26.67	16.00
2	28.19	15.50
3	29.75	15.17
4	31.34	15.00
5	32.94	15.00
6	34.54	15.16
7	36.10	15.49
8	37.62	15.98
9	39.09	16.63
10	40.48	17.42
11	41.77	18.36
12	42.96	19.43
13	44.04	20.61
14	44.98	21.90
15	45.79	23.29
16	46.11	24.00

Circle Center At X = 32.2 ; Y = 30.3 and Radius, 15.3

*** 1.684 ***

1

Failure Surface Specified By 9 Coordinate Points

Point No.	X-Surf ft.	Y-Surf ft.
1	30.00	16.00
2	31.58	15.72
3	33.17	15.80
4	34.72	16.22
5	36.13	16.96
6	37.35	18.00
7	38.32	19.27

8	38.99	20.73
9	39.30	22.20

Circle Center At X = 32.0 ; Y = 23.0 and Radius, 7.3

*** 1.704 ***

Failure Surface Specified By 11 Coordinate Points

Point No.	X-Surf ft.	Y-Surf ft.
1	30.00	16.00
2	31.56	15.65
3	33.16	15.60
4	34.74	15.84
5	36.25	16.37
6	37.64	17.16
7	38.86	18.20
8	39.87	19.44
9	40.63	20.85
10	41.11	22.38
11	41.26	23.50

Circle Center At X = 32.7 ; Y = 24.2 and Radius, 8.7

*** 1.743 ***

1

Failure Surface Specified By 15 Coordinate Points

Point No.	X-Surf ft.	Y-Surf ft.
1	26.67	16.00
2	28.15	15.41
3	29.70	15.01
4	31.29	14.82
5	32.89	14.82
6	34.48	15.04
7	36.02	15.45
8	37.50	16.06

9	38.89	16.85
10	40.17	17.81
11	41.32	18.93
12	42.31	20.19
13	43.13	21.56
14	43.78	23.02
15	44.06	24.00

Circle Center At X = 32.0 ; Y = 27.3 and Radius, 12.5

*** 1.755 ***

Failure Surface Specified By 9 Coordinate Points

Point No.	X-Surf ft.	Y-Surf ft.
1	30.00	16.00
2	31.57	15.69
3	33.17	15.77
4	34.69	16.25
5	36.06	17.09
6	37.17	18.24
7	37.96	19.63
8	38.39	21.17
9	38.40	21.60

Circle Center At X = 32.0 ; Y = 22.1 and Radius, 6.4

*** 1.766 ***

1

```
           Y           A     X     I     S           F     T

           0.00     12.50     25.00     37.50     50.00     62.50

X      0.00 +---------+--*------+---------+---------+---------+
            -           ..
            -          ...
            -          ...
            -         ....
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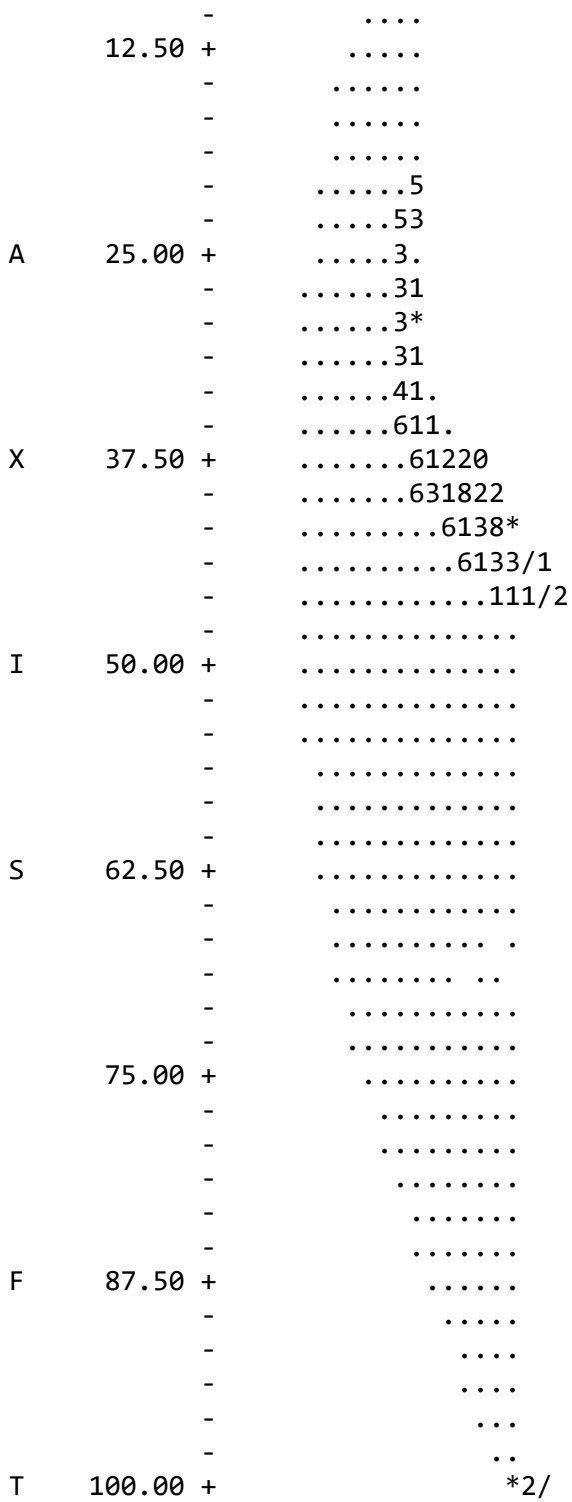
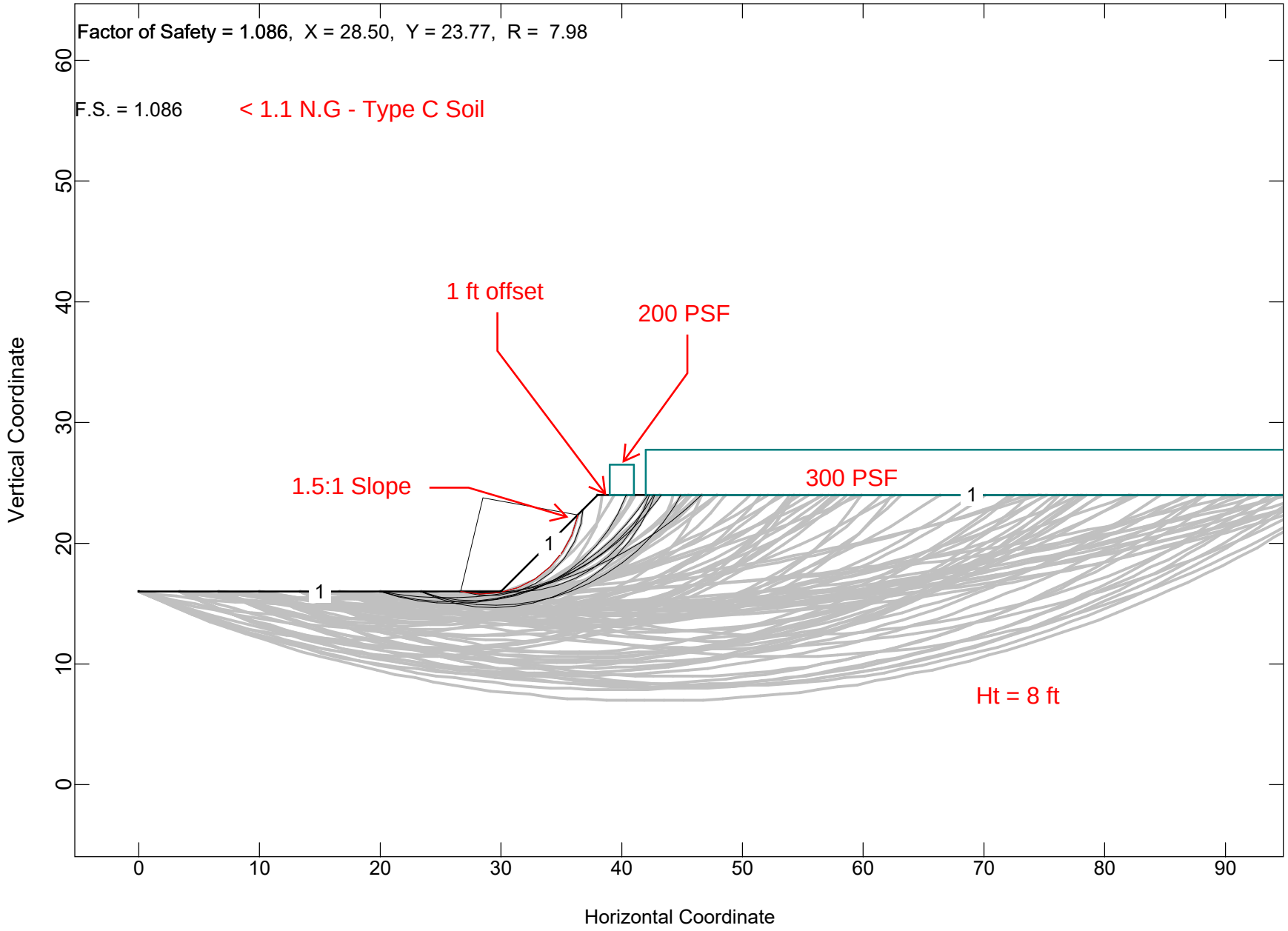

A
X
I
S
F
T
12.50
25.00
37.50
50.00
62.50
75.00
87.50
100.00

Section A
Type B Soil
Traffic & K-Rail Surcharge



Rev 1

Soil

Bore Location	N field	EH	CR	CS	CB	N60	Unit Weight (y)	Friction Angle	Soil	45-ϕ/2	ka	Kw=ka*y (pcf)
B-1	22	0.7	0.75	1	1.05	20	119	32	Type C	29	0.31	36.56
B-2	38	0.7	0.75	1	1.05	35	118	37	Type C	26.5	0.25	29.33
B-3	53	0.7	0.75	1	1.05	49	117	38	Type B	26	0.24	27.83
B-4	14	0.7	0.75	1	1.05	13	109	31	Type C	29.5	0.32	34.89
B-5	36	0.7	0.75	1	1.05	33	112	37	Type C	26.5	0.25	27.84
B-6	111	0.7	0.75	1	1.05	102	126	41	Type B	24.5	0.21	26.17
B-7	18	0.7	0.75	1	1.05	17	99	31	Type C	29.5	0.32	31.69

N60=(Nfield x EH x CR x CS x CB)/0.6

9608 Aqua Harbor Way
Las Vegas. NV. 89178
(702) 808-1295

Boussinesq Lateral Earth Pressure

Coastline Section A

Date: 3/26/2025

Design values per CALTRANS 2015 Standard Specs
& 2011 Trenching and Shoring Manual (Revision 1, August 2011)

Shoring & Surcharge Parameters

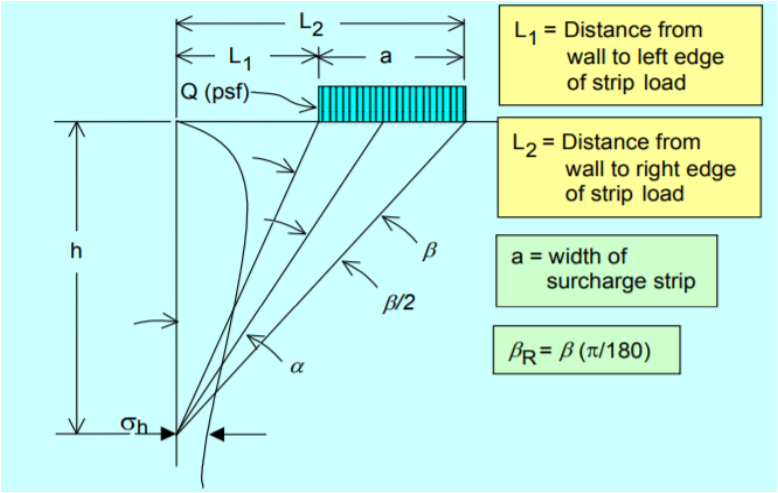
Shoring Depth = h =	10.0 ft
Offset Distance = L_1 =	4.0 ft
Total Length = L_2 =	19.0 ft
Strip Width = a =	15.0 ft
Surcharge Pressure = Q =	300 psf

TRAFFIC

Soil Parameters

Unit Weight = λ =	99 pcf
Cohesion = C =	0 psf
Friction Angle = ϕ =	31.0°

Note to user: Spreadsheet only works for shoring < 49.9ft.



Results Summary

The maximum total lateral pressure acting on the shoring is 438.84psf and occurs 10ft from the top of shoring.
The maximum lateral soil pressure acting on the shoring is 316.9psf and occurs 10ft from the top of shoring.
The maximum lateral surcharge pressure acting on the shoring is 168.83psf and occurs 4.6ft from the top of shoring.

Sample Calculation at h = 10ft

Rankine's Active Earth Pressure Coefficient = $K_a = \tan^2(45° - (\phi/2))$
= tan^2(45° -(31°/2))
= 0.32

[Trenching and Shoring Manual, Eq. 4-9]

Lateral Pressure Due to Soil = $\sigma_{h(Soil)} = (\lambda \times h \times K_a) - (2 \times C \times \mathrm{Sqrt}(K_a))$
= (99pcf x 10ft x 0.32) - (2 x 0psf x Sqrt(0.32))
= 316.90 psf

[Trenching and Shoring Manual, Eq. 4-33]

Lateral Pressure Due to Surcharge = $\sigma_{h(Surcharge)} = (2Q/\pi) \times [\beta_R - (\sin(\beta) \times \cos(2\alpha))]$
= (2 x 300 psf/π) x [0.71 Rad - (Sin(40.4°) x Cos(2 x 42°))]
= 121.94 psf

[Trenching and Shoring Manual, Eq. 4-67]

Total Lateral Pressure = $\sigma_{h(Total)} = \sigma_{h(Soil)} + \sigma_{h(Surcharge)}$
= 316.9psf + 121.94psf
= 438.84 psf

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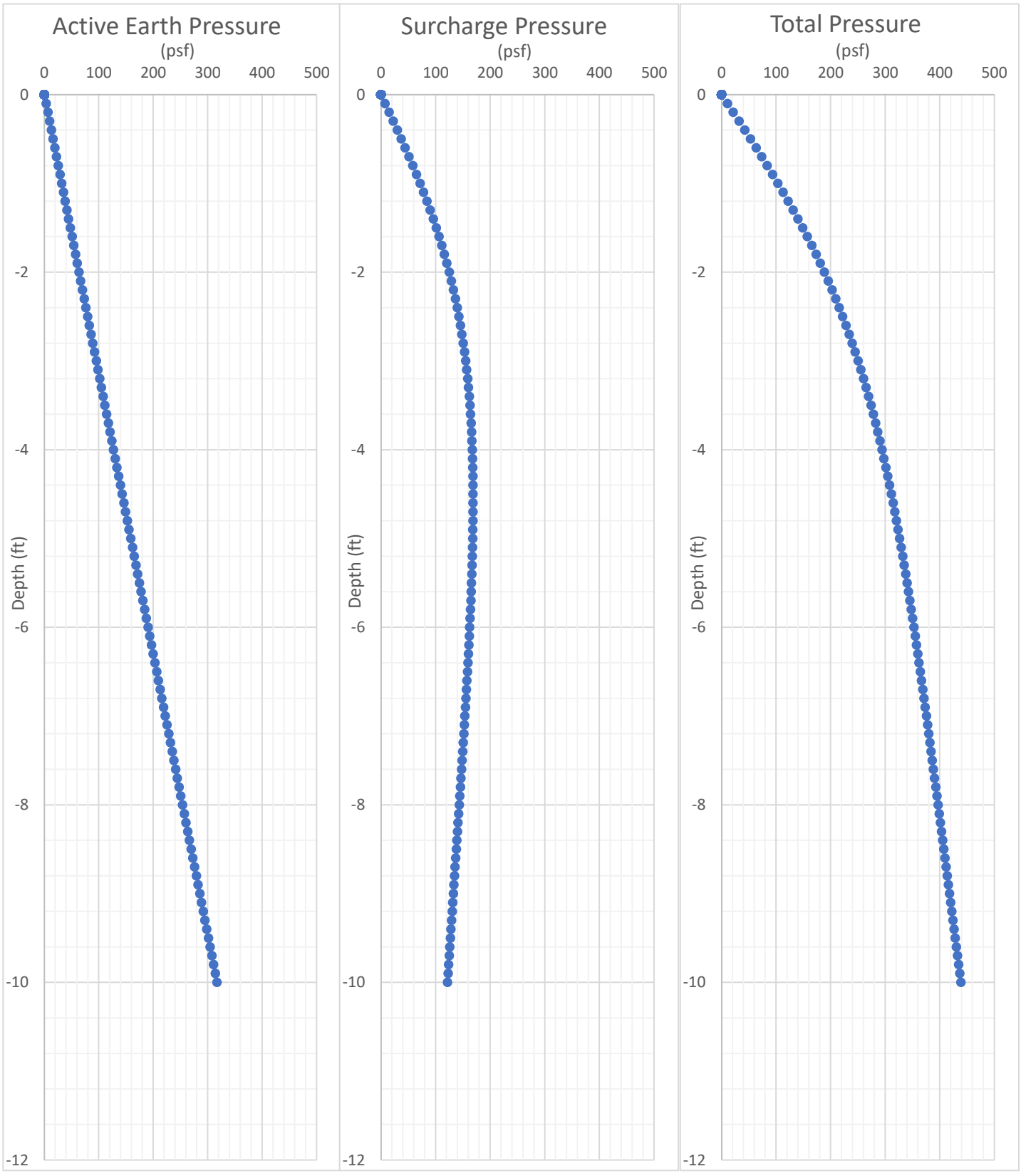
Boussinesq Lateral Earth Pressure

Coastline Section A

Date: 3/26/2025

Design values per CALTRANS 2015 Standard Specs
& 2011 Trenching and Shoring Manual (Revision 1, August 2011)



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Boussinesq Lateral Earth Pressure

Coastline Section A

Date: 3/26/2025

Design values per CALTRANS 2015 Standard Specs
& 2011 Trenching and Shoring Manual (Revision 1, August 2011)

Detailed Results Summary

h	θ_1	θ_2	β	β_R	α	$\sigma_{h(Soil)}$	$\sigma_{h(Surcharge)}$	$\sigma_{h(Total)}$
0.0 ft	-	-	-	-	-	0.0 psf	0.0 psf	0.0 psf
1.0 ft	14.0°	3.0°	11.0°	0.19 Rad	81.5°	31.7 psf	71.7 psf	103.3 psf
2.0 ft	26.6°	6.0°	20.6°	0.36 Rad	73.7°	63.4 psf	125.0 psf	188.4 psf
3.0 ft	36.9°	9.0°	27.9°	0.49 Rad	67.1°	95.1 psf	155.2 psf	250.3 psf
4.0 ft	45.0°	11.9°	33.1°	0.58 Rad	61.6°	126.8 psf	167.4 psf	294.1 psf
5.0 ft	51.3°	14.7°	36.6°	0.64 Rad	57.0°	158.4 psf	168.1 psf	326.6 psf
6.0 ft	56.3°	17.5°	38.8°	0.68 Rad	53.1°	190.1 psf	162.6 psf	352.7 psf
7.0 ft	60.3°	20.2°	40.0°	0.70 Rad	49.8°	221.8 psf	153.8 psf	375.6 psf
8.0 ft	63.4°	22.8°	40.6°	0.71 Rad	46.9°	253.5 psf	143.4 psf	396.9 psf
8.7 ft	65.3°	24.6°	40.7°	0.71 Rad	45.0°	275.7 psf	135.9 psf	411.6 psf

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Boussinesq Lateral Earth Pressure

DS-11

Date: 3/26/2025

Design values per CALTRANS 2015 Standard Specs
& 2011 Trenching and Shoring Manual (Revision 1, August 2011)

Shoring & Surcharge Parameters

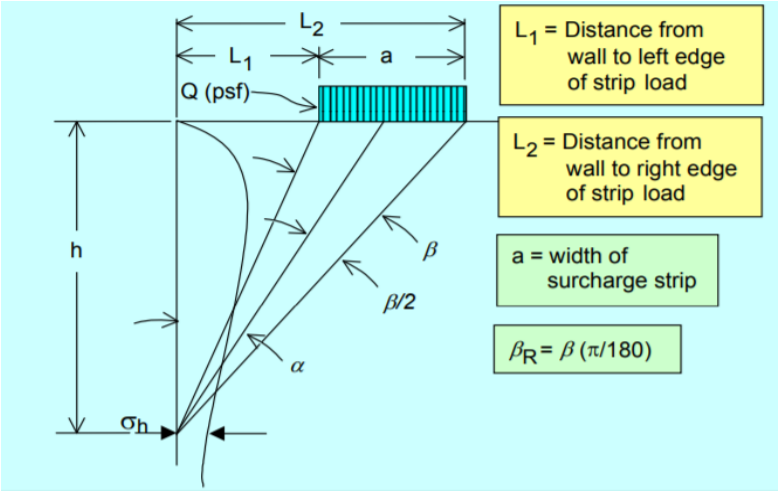
Shoring Depth = h =	10.0 ft
Offset Distance = L_1 =	3.0 ft
Total Length = L_2 =	5.8 ft
Strip Width = a =	2.8 ft
Surcharge Pressure = Q =	900 psf

CAT 315 Excavator

Soil Parameters

Unit Weight = λ =	99 pcf
Cohesion = C =	0 psf
Friction Angle = ϕ =	31.0°

Note to user: Spreadsheet only works for shoring < 49.9ft.



Results Summary

The maximum total lateral pressure acting on the shoring is 359psf and occurs 10ft from the top of shoring.
The maximum lateral soil pressure acting on the shoring is 316.9psf and occurs 10ft from the top of shoring.
The maximum lateral surcharge pressure acting on the shoring is 235.87psf and occurs 2.4ft from the top of shoring.

Sample Calculation at h = 10ft

Rankine's Active Earth Pressure Coefficient = $K_a = \tan^2(45° - (\phi/2))$
= tan^2(45° -(31°/2))
= 0.32

[Trenching and Shoring Manual, Eq. 4-9]

Lateral Pressure Due to Soil = $\sigma_{h(Soil)} = (\lambda \times h \times K_a) - (2 \times C \times \mathrm{Sqrt}(K_a))$
= (99pcf x 10ft x 0.32) - (2 x 0psf x Sqrt(0.32))
= 316.90 psf

[Trenching and Shoring Manual, Eq. 4-33]

Lateral Pressure Due to Surcharge = $\sigma_{h(Surcharge)} = (2Q/\pi) \times [\beta_R - (\mathrm{Sin}(\beta) \times \mathrm{Cos}(2\alpha))]$
= (2 x 900 psf/π) x [0.23 Rad - (Sin(13.2°) x Cos(2 x 23.3°))]
= 42.10 psf

[Trenching and Shoring Manual, Eq. 4-67]

Total Lateral Pressure = $\sigma_{h(Total)} = \sigma_{h(Soil)} + \sigma_{h(Surcharge)}$
= 316.9psf + 42.1psf
= 359.00 psf

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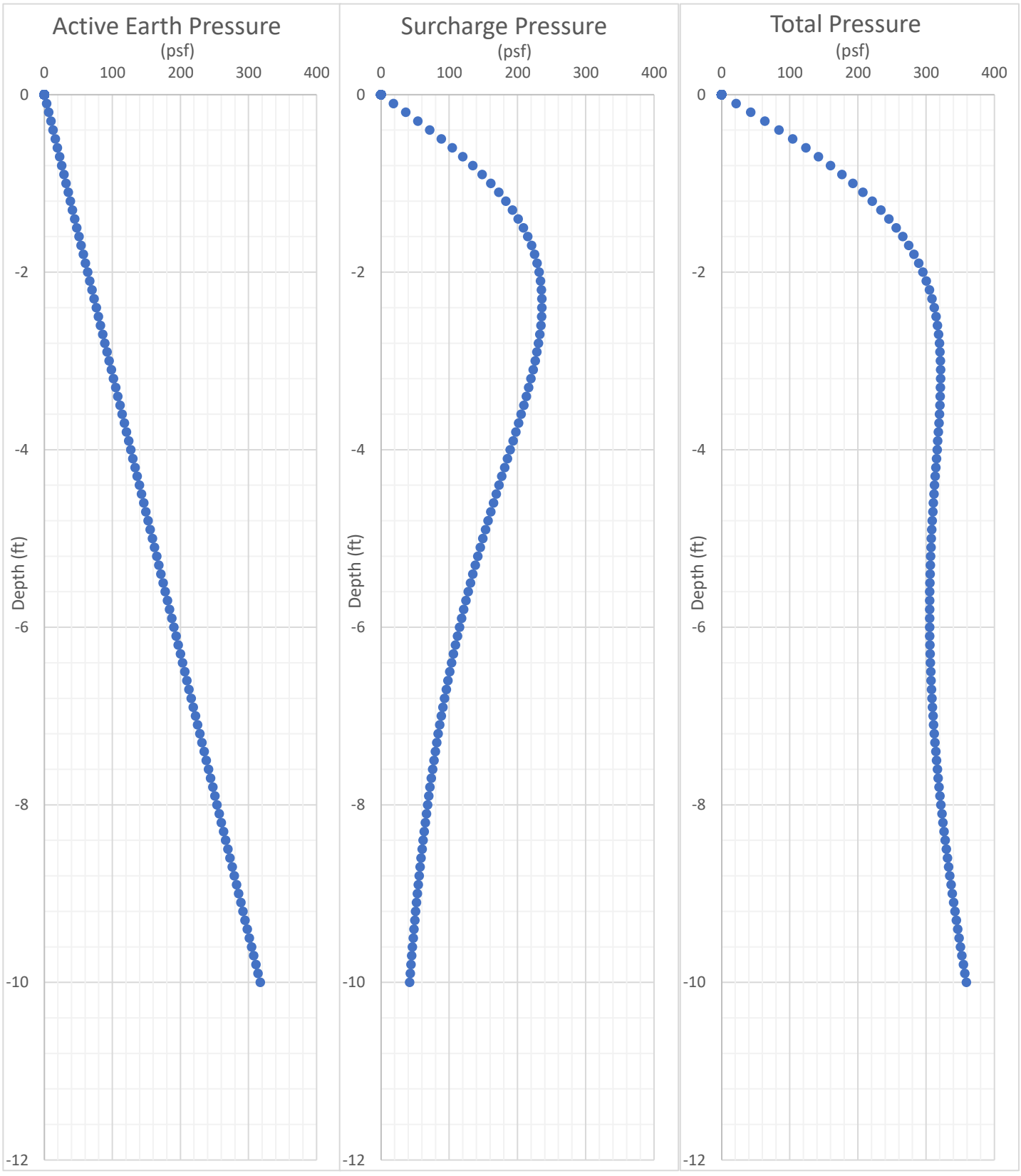
Boussinesq Lateral Earth Pressure

DS-11

Date: 3/26/2025

Design values per CALTRANS 2015 Standard Specs
& 2011 Trenching and Shoring Manual (Revision 1, August 2011)



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Boussinesq Lateral Earth Pressure

DS-11

Date: 3/26/2025

Design values per CALTRANS 2015 Standard Specs
& 2011 Trenching and Shoring Manual (Revision 1, August 2011)

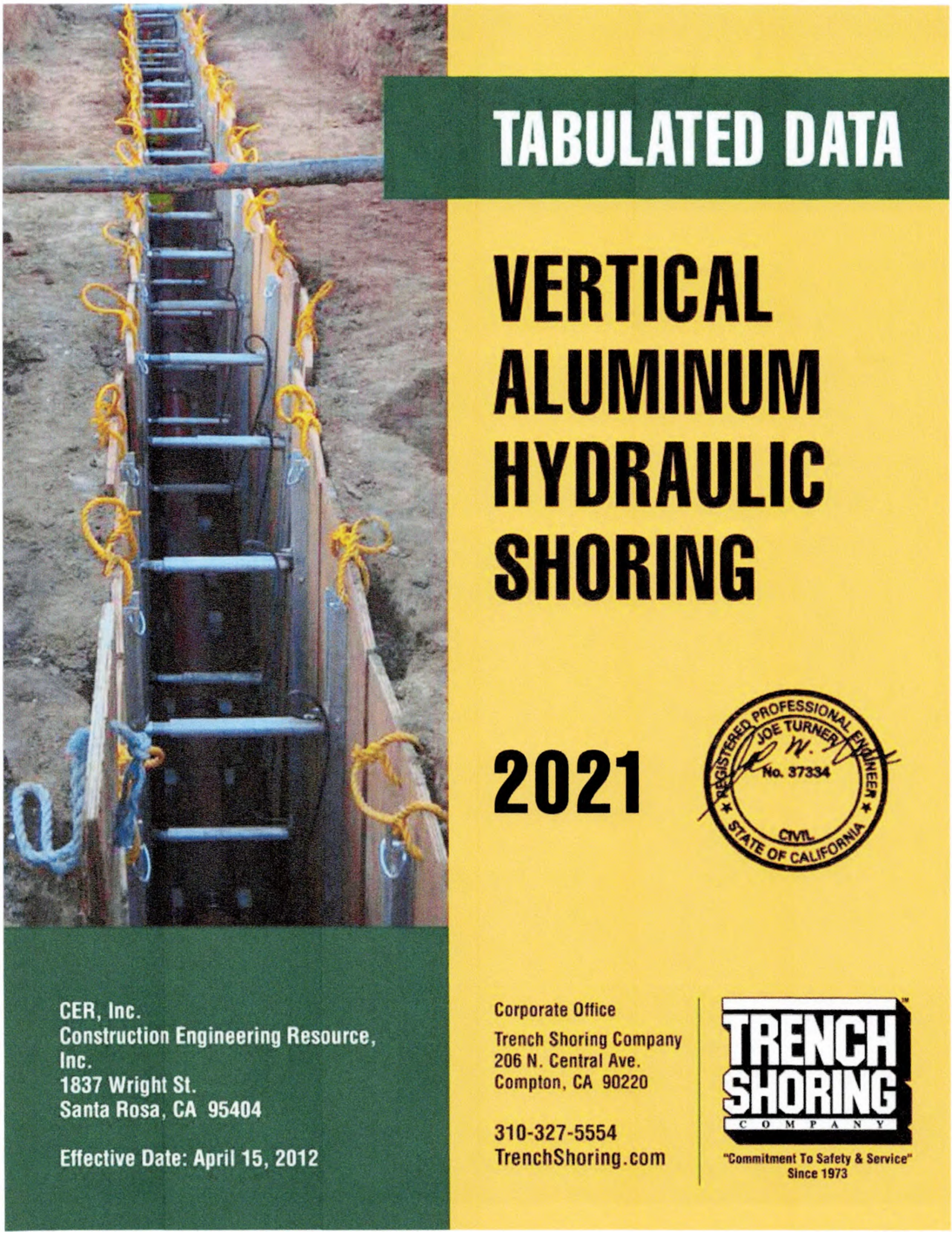
Detailed Results Summary

h	θ_1	θ_2	β	β_R	α	$\sigma_{h(Soil)}$	$\sigma_{h(Surcharge)}$	$\sigma_{h(Total)}$
0.0 ft	-	-	-	-	-	0.0 psf	0.0 psf	0.0 psf
1.0 ft	18.4°	9.9°	8.6°	0.15 Rad	75.8°	31.7 psf	160.9 psf	192.5 psf
2.0 ft	33.7°	19.2°	14.5°	0.25 Rad	63.6°	63.4 psf	231.8 psf	295.2 psf
3.0 ft	45.0°	27.6°	17.4°	0.30 Rad	53.7°	95.1 psf	226.0 psf	321.0 psf
4.0 ft	53.1°	34.8°	18.3°	0.32 Rad	46.0°	126.8 psf	189.5 psf	316.2 psf
5.0 ft	59.0°	41.0°	18.0°	0.31 Rad	40.0°	158.4 psf	149.3 psf	307.8 psf
6.0 ft	63.4°	46.2°	17.2°	0.30 Rad	35.2°	190.1 psf	115.1 psf	305.3 psf
7.0 ft	66.8°	50.6°	16.2°	0.28 Rad	31.3°	221.8 psf	88.4 psf	310.3 psf
8.0 ft	69.4°	54.3°	15.2°	0.26 Rad	28.1°	253.5 psf	68.3 psf	321.9 psf
8.7 ft	71.0°	56.5°	14.4°	0.25 Rad	26.2°	275.7 psf	57.4 psf	333.1 psf

Dominguez General Engineering, Inc.
11096 Pipeline Ave. Pomona, CA 91766 dominguezgeneral@gmail.com

SHORING PLAN

Project Name: Coastline Drive 12-Inch Waterline Improvements Project



Contents

About Trench Shoring Safety Vertical Aluminum Hydraulic Shore Tabulated Data

Vertical Aluminum Hydraulic Shores were first developed in the late 1950's and early 1960's. To this day, the shores are built practically the same as they were then. There are several major manufacturers all with similar parts and their own version of manufacturer's tabulated data. Some parts are also interchangeable. Due to the interchangeability and variety of tabulated data available, Trench Shoring has developed this set of universal tabulated data under;

> Federal OSHA 29CFR, Part 1926, Subpart P-Excavations and Trenches
>
> 1926.652(c)(3)-**Option (3)** - Designs Using other Tabulated Data.
>
> 1926.652(c)(3)(i) -Design of support systems, shield systems, or other protective systems shall be in accordance with tabulated data, such as tables and charts.

Note that **manufacturer's** tabulated data is developed under;

> 1926.652(c)(3)-**Option (2)** - Designs Using Manufacturers Tabulated Data.

Federal OSHA 29CFR also has tabulated data for vertical hydraulic shores under;

> 1926 Subpart P-**Appendix D**-Aluminum Hydraulic Shoring for Trenches

Federal OSHA 29CFR only allows use of Appendix D when Option 2 is not available. Appendix D tabulated data is more restrictive than manufacturer's tabulated data in two major ways;

1. There is no category for OSHA Type C soil
2. The tables only allow trench depths to 20 ft deep

Use of this Trench Shoring Universal Vertical Aluminum Hydraulic Shore tabulated data will result in selection of a system that, at a minimum, conforms to manufacturers tabulated data developed by;

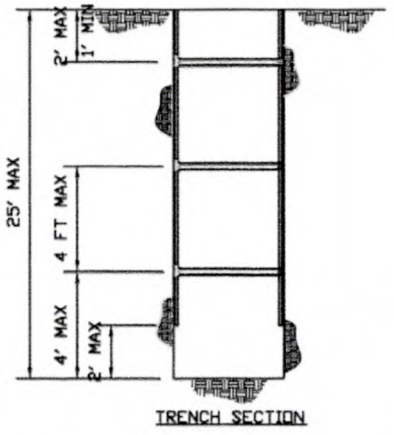
- Allied Tren-Shore
- Cerda
- Efficiency Corporation
- GME Corporation
- Kundle Tren-Shore
- Pacific Shoring, LLC
- Quick Shore
- Safety Shore
- Speed Shore Corporation

In some cases, this tabulated data will be more restrictive than the manufacturers version; however it is always less restrictive than the OSHA Appendix D version. The competent person utilizing this tabulated data should have a clear understanding that he is selecting a shoring system under Option 3, Designs Using other Tabulated Data.

Vertical Aluminum Hydraulic Shoring Quick Use Guide

This quick use guide provides a step-by-step methodology for determining the proper configuration of a vertical aluminum hydraulic shoring system. Proper use of this process will result in a system constructed in accordance with the tabulated data presented here. To be in conformance with this tabulated data, all of the information presented in this document shall be read and understood by the person utilizing this data.

1) VERTICAL SPACING



2) HORIZONTAL SPACING

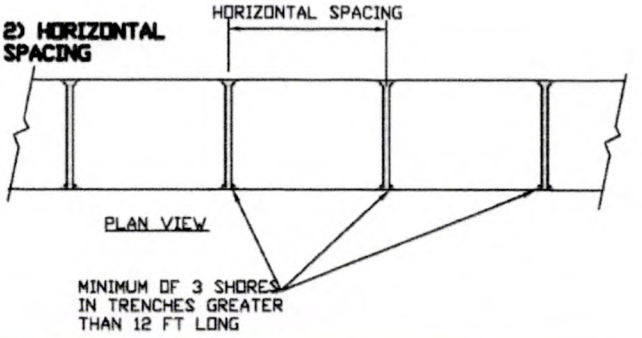
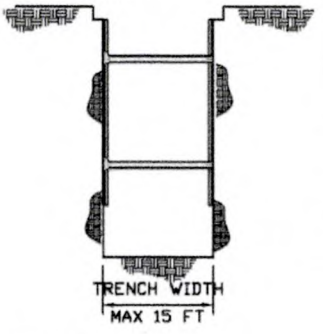


Table 5-HORIZONTAL SHORE SPACING			
Depth	OSHA Soil Type		
ft	A	B	C-60
over 5 to 10	8	8	6
over 10 to 15	8	6	4
over 15 to 20	8	6	4
over 20 to 25	6	4	3

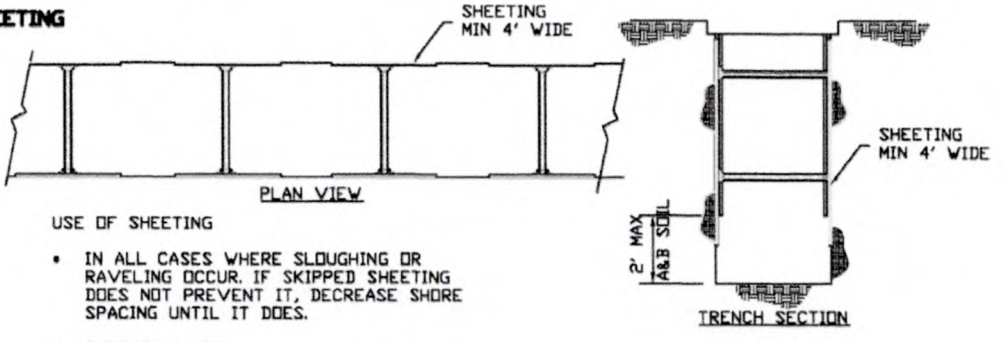
3) TRENCH WIDTH



TRENCH WIDTH OVERSLEEVE REQUIREMENTS:

- 0 TO 8 FT WIDE — NO OVERSLEEVE REQUIRED TYPE A & B SOIL
- 8 TO 12 FT WIDE — 3" ROUND ALUMINUM OVERSLEEVE
- 12 TO 15 FT WIDE — 3.5" X 3.5" X ¼" WALL SQUARE STEEL OVERSLEEVE

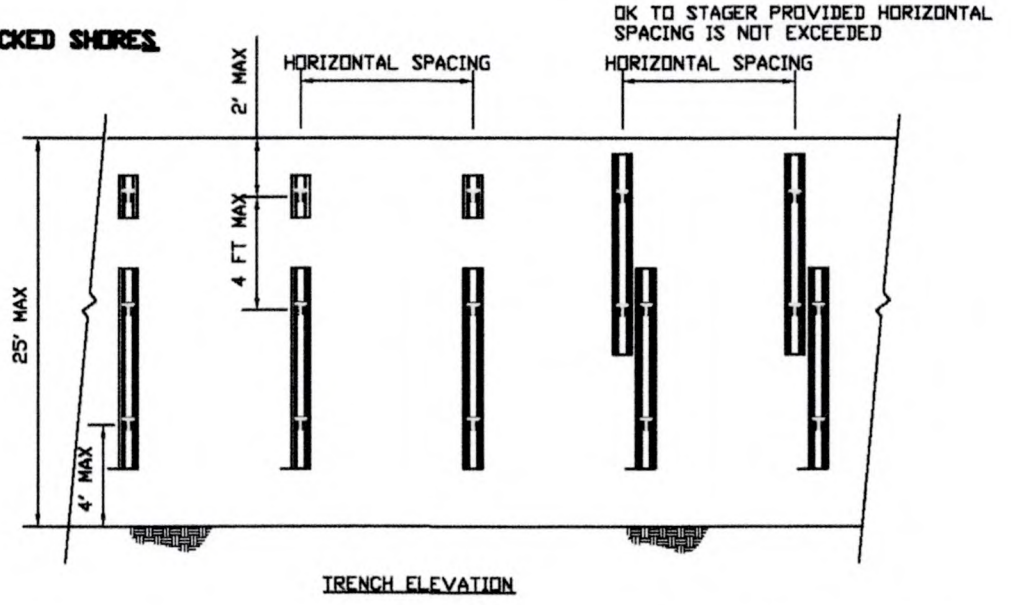
4) SHEETING



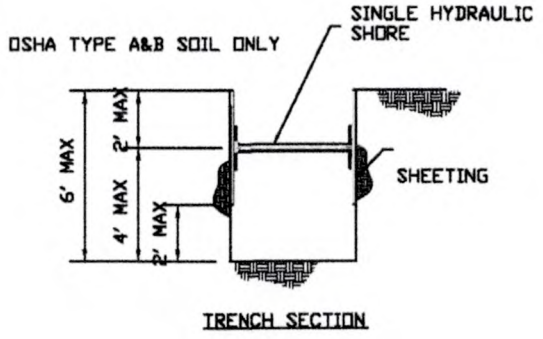
USE OF SHEETING

- IN ALL CASES WHERE SLOUGHING OR RAVELING OCCUR. IF SKIPPED SHEETING DOES NOT PREVENT IT, DECREASE SHORE SPACING UNTIL IT DOES.
- TYPE C-60 SOIL
- MAXIMUM 2 FT ABOVE BOTTOM IN TYPE A & B SOIL TO BOTTOM IN C-60 SOIL

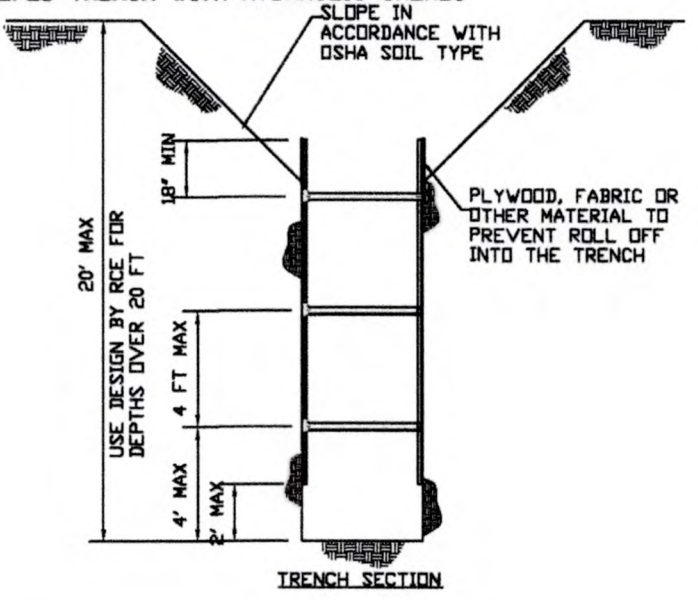
5) STACKED SHORES



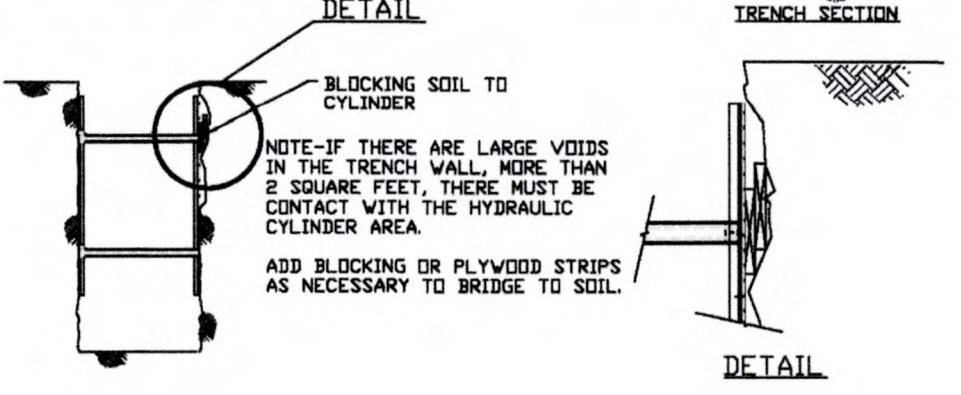
6) SINGLE SHORE IN 6 FT TRENCH



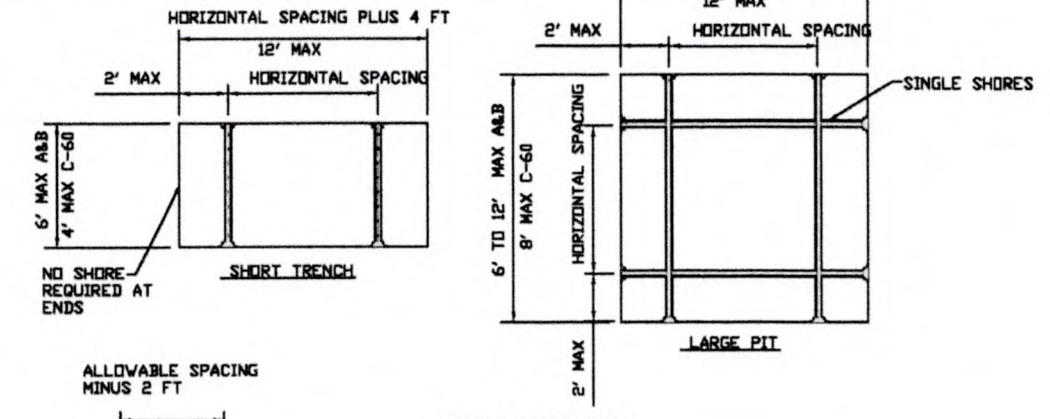
7) SLOPED TRENCH WITH HYDRAULIC SHORES



8) SOIL CONTACT WITH CYLINDERS



9) NON LINEAR TRENCH CONFIGURATIONS



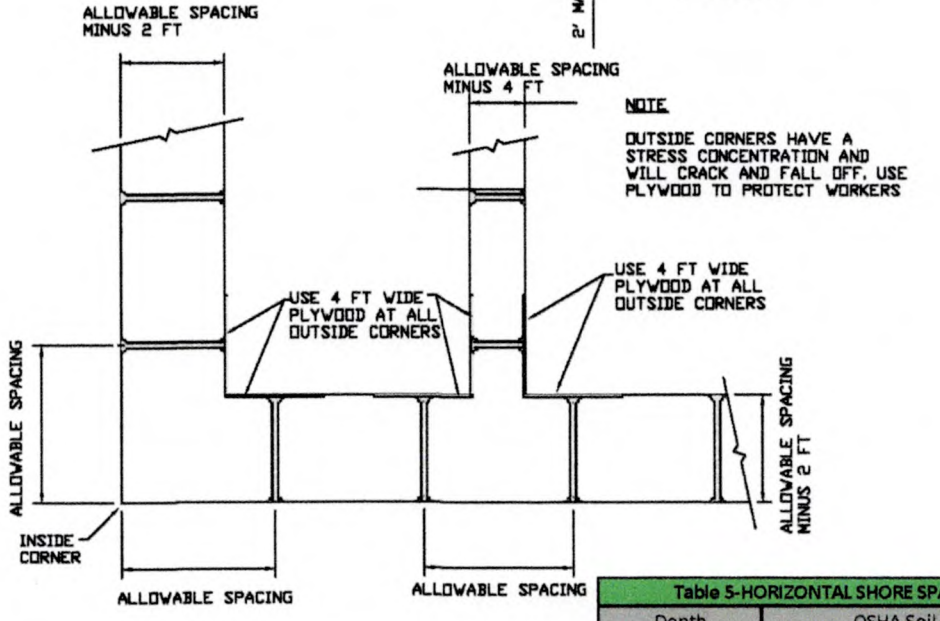


Table 5-HORIZONTAL SHORE SPACING			
Depth	OSHA Soil Type		
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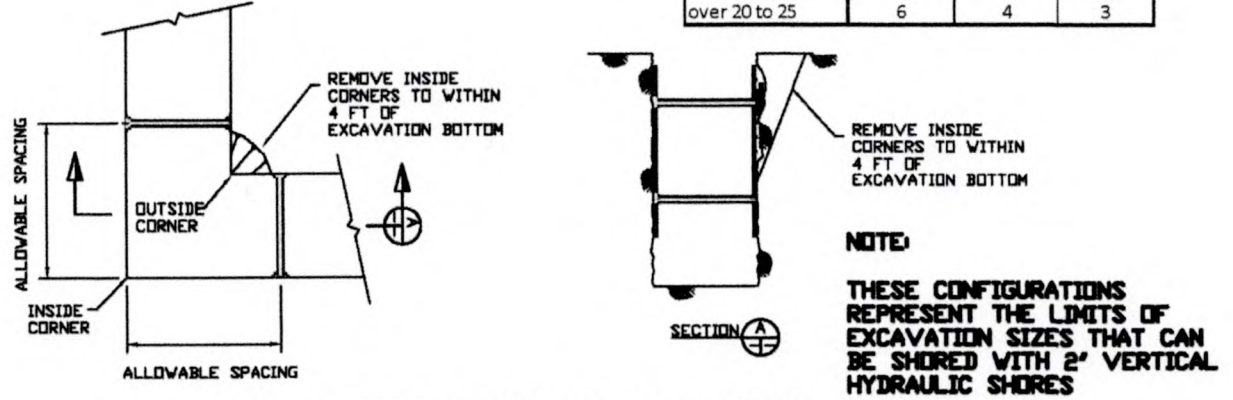
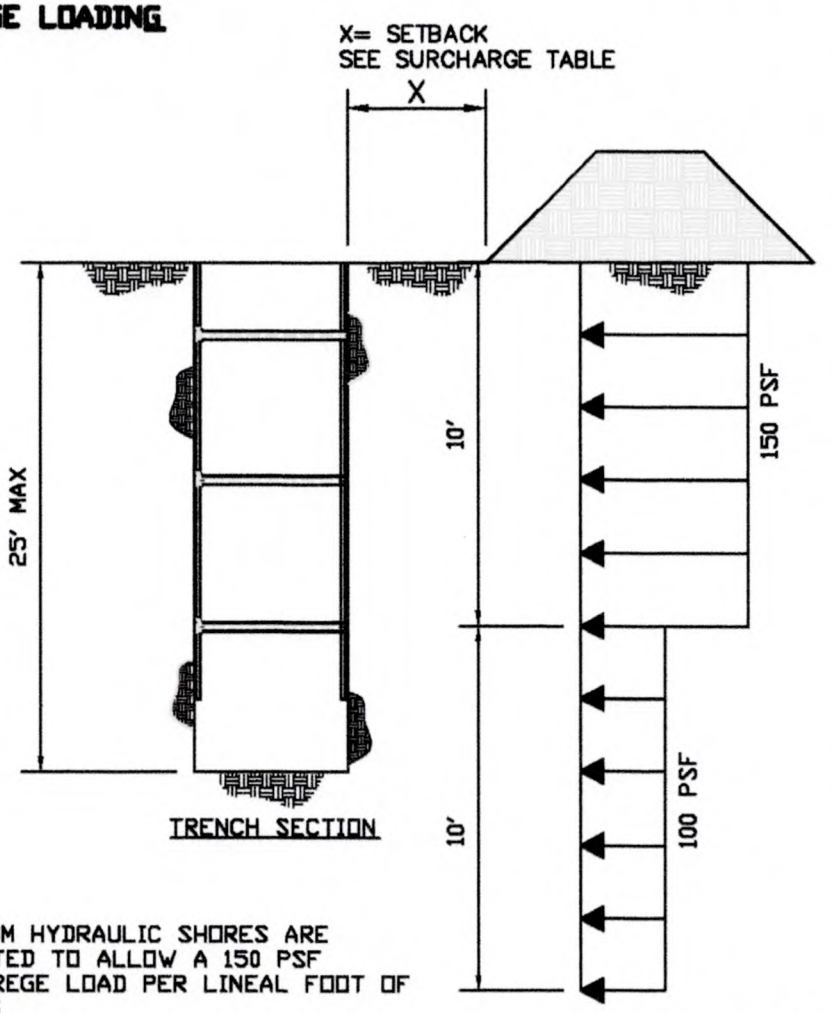
over 15 to 20	8	6	4
over 20 to 25	6	4	3



CORNER AND T TRENCH ALTERNATIVE TO USING PLYWOOD AT OUTSIDE CORNERS

10) SURCHARGE LOADING



TRENCH SECTION

NOTE

ALUMINUM HYDRAULIC SHORES ARE TABULATED TO ALLOW A 150 PSF SURCHAREGE LOAD PER LINEAL FOOT OF SPACING

SURCHARGE LOADING DIAGRAM
SURCHARGE AFTER 20 FT DEEP IS 50 PSF OR LESS

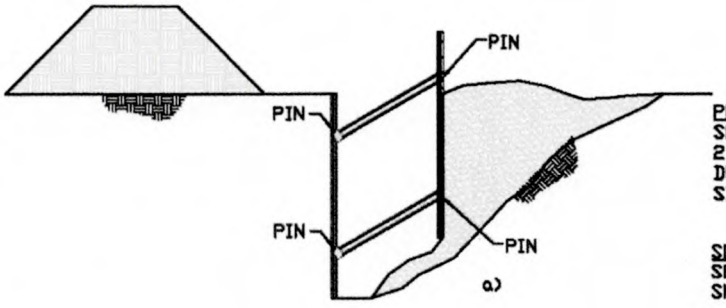
SURCHARGE SETBACK TABLE			
Surcharge	Setback Distance x	Surcharge	Setback Distance x
K-Rail	1 ft	3 Cy Loader	2 ft
HS20-44 Traffic	4 ft	5 Cy Loader	3 ft
Spoil Pile 4 ft high	2 ft	225 Excavator	2 ft
Backhoe	2 ft	325 Excavator	3 ft
Equipment < 20,000 lb	2 ft	Dump Truck and Haul Trucks	3 ft
Equipment >20,000 lb	3 ft	12 CY Concrete Truck	3 ft
		Boom Truck Pad	6 ft

Table Notes:

1 These setbacks limit horizontal shoring loads to 72 psf for 0 to 10 ft and 50 psf 10 to 20 ft
2 Provide separate surcharge analysis for all cranes and structures within 15 ft of the excavation
3 Table setbacks are for open trenches. When traffic covers are in place HS20-44 traffic can pass over the covered excavation

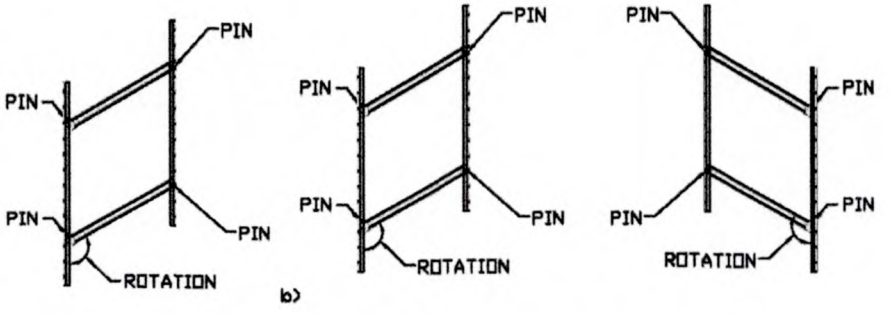
Hydraulic Shore Safety Issues

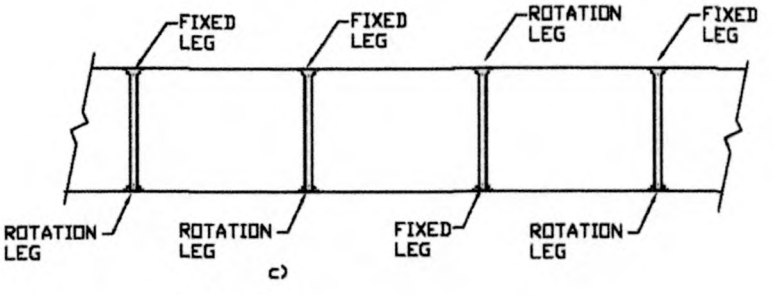
1) SHORE FOLD UP



PROBLEM
SHORES WITH 2 HYDRAULIC CYLINDERS OR 2 SINGLE CYLINDER SHORES CAN ROTATE DUE TO UNBALLANCED LOADING ON ONE SIDE

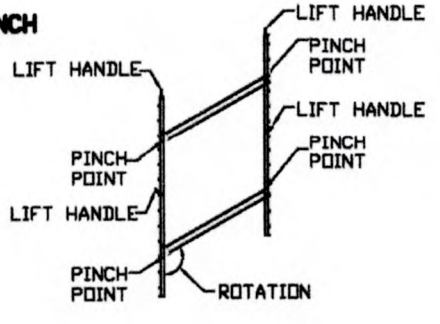
SOLUTION
SET EVERY THIRD SHORE SO THAT THE SHORE ROTATION IS OPPOSITE





PLAN VIEW

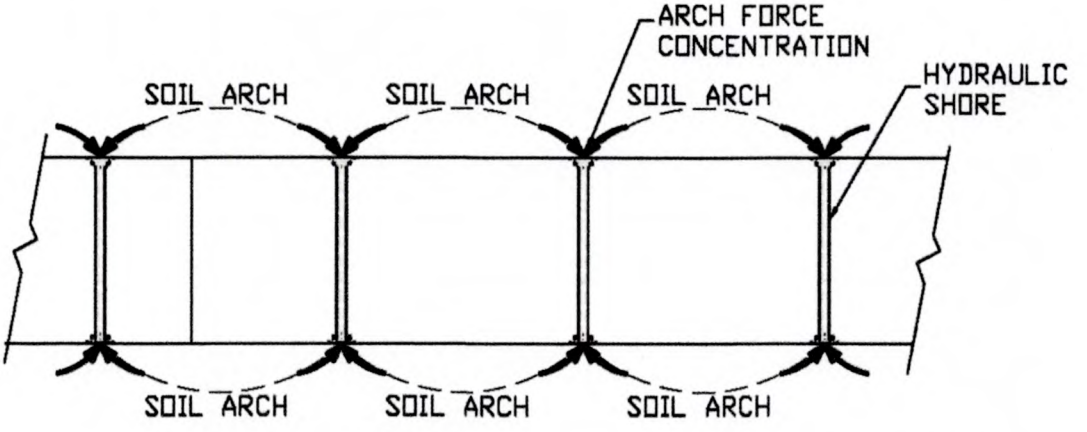
2) FINGER PINCH



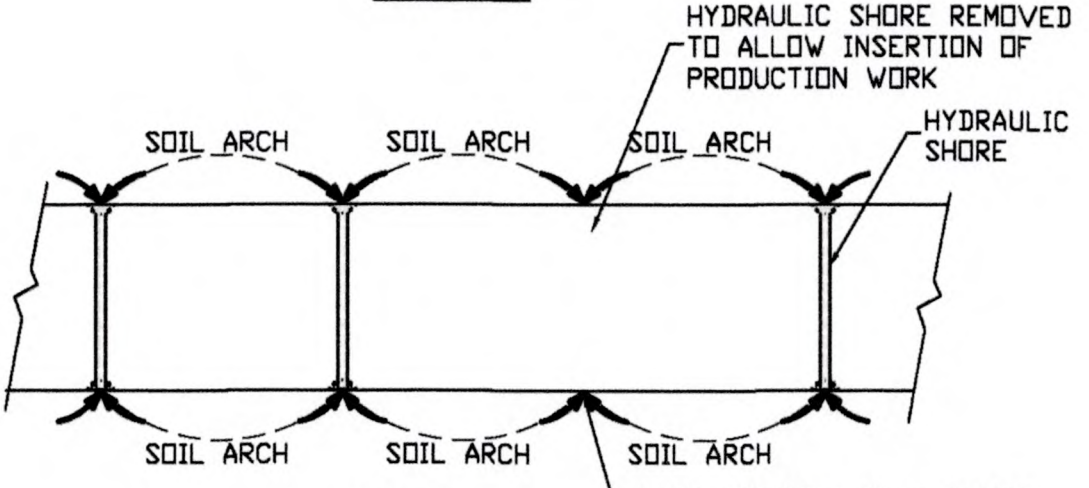
PROBLEM
FINGERS CAN BE PINCHED OR SEVERED BETWEEN THE RAIL AND THE CYLINDER BLOCK WHEN MOVING OR SETTING SHORES

SOLUTION
USE LIFT HANDLES ONLY TO LIFT AND SET THE SHORE

3) REMOVAL OF SOIL ARCH



PLAN VIEW



PLAN VIEW

PROBLEM

SOIL ARCHING IS ESTABLISHED WHEN SHORES ARE INSTALLED. TEMPORARY OR PERMANENT REMOVAL OF THE SHORE IS A POTENTIAL FOR IMMINENT COLLAPSE

SOLUTION

1. WHEN REMOVING SHORES KEEP BACKFILL CLOSE TO SHORES BEING REMOVED

2. WHEN REMOVING AND RESETTING SHORES TO ALLOW PLACEMENT OF PRODUCTION WORK USE REMOTE EQUIPMENT SUCH AS BACKHOE OR BOOM TRUCK TO PICK AND RESET SHORES. OPERATE SHORE HYDRAULICS FROM SHORED AREA.

Vertical Aluminum Hydraulic Shores Description

Vertical Aluminum Hydraulic Shores are constructed from standard duty or heavy-duty vertical rails attached to 2" hydraulic cylinders. The rail lengths vary from 18" to 20 ft long. The cylinders can extend from 18" to 88". Cylinder extensions can be added to obtain lengths to 15'. The hydraulic cylinder consists of a 2" OD piston, a 2" ID x 3/16" barrel, and a 3" OD x 3/16" oversleeve. The cylinders provide a 23,000 lb safe working load for cylinder bulging at a 1.5 factor of safety. At lengths 8 ft to 12 ft an additional 3" round aluminum over sleeve is required and at 12 ft to 15 ft a 3.5" x 3.5"x 3/16"wall a square steel oversleeve is required to prevent buckling. Based on the principal of soil arching Vertical Aluminum Hydraulic Shores can be spaced horizontally as much as 8 ft apart without sheeting on the trench walls. Plywood sheeting is used either attached or separate behind the rails to prevent the trench walls from sloughing or raveling.

Vertical Aluminum Hydraulic Shores are installed from outside the excavation. The shores are hinged so that they can be folded when lowered into the trench and then opened up and pressurized with a hydraulic hand pump. The hydraulic fluid is water soluble, environmentally safe, and biodegradable. Rails 5 ft long and less can typically be moved, set, and removed by a two man crew. Larger shores are typically handled by backhoe, loader or boom truck.

Vertical Aluminum Hydraulic Shores are typically used in linear trench applications in OSHA Type A, Type B, and Type C-60 soils at depths to 23 ft and trench widths to 15 ft. Constraints such as the requirement that the bottom cylinder be set a maximum of 4 ft from the bottom of the excavation , bedding requirements, and pipe wall thicknesses limits the pipe diameter or duct height to approximately 36" maximum. The 8 ft maximum horizontal spacing limits large pipe lengths to approximately 8 ft, while smaller diameters with longer lengths to 20 ft such as PVC sewer and water lines can be maneuvered between the cylinders to fit into the trench.

General Information for Use of Vertical Aluminum Hydraulic Shores

1. The vertical aluminum hydraulic shoring system tabulated here is based on requirements of Federal OSHA 29CFR, Part 1926, Subpart P-Excavations and Trenches

   1926.652(c)(3)-Option (3) - Designs Using other Tabulated Data.

   1926.652(c)(3)(i) -Design of support systems, shield systems, or other protective systems shall be in accordance with tabulated data, such as tables and charts.

   All provisions of Subpart P apply when utilizing this tabulated data. The contractor's competent person shall use this data to select:

   - allowable trench depth
   - vertical and horizontal shore spacing
   - proper oversleeve requirement based on trench width
   - plywood use requirements

2. The competent person utilizing this tabulated data shall be experienced and knowledgeable of all requirements of Subpart P, and trained in the use and safety procedures for aluminum vertical hydraulic shores.

3. For specific Subpart P requirements regarding aluminum hydraulic shoring that is in addition to the tabulated data requirements, see OSHA Subpart P additional requirements related to aluminum hydraulic shoring. Some of these requirements are listed at the end of this document, See **Header PG. 29**

4. Use of this tabulated data is dependent on first classifying the soil in accordance with OSHA Appendix A, Soil Classification. Classification shall be just prior to installing Vertical Hydraulic Shoring. Soil conditions may change at a later date and require Vertical Hydraulic Shoring to be reset at a different spacing.

5. Hydraulic vertical shores are tabulated based on the effect of a 20,000 lb surcharge load set back 2 ft from the edge of the trench and the equivalent weight effect of the OSHA soil type, See classification of soil types, 2.

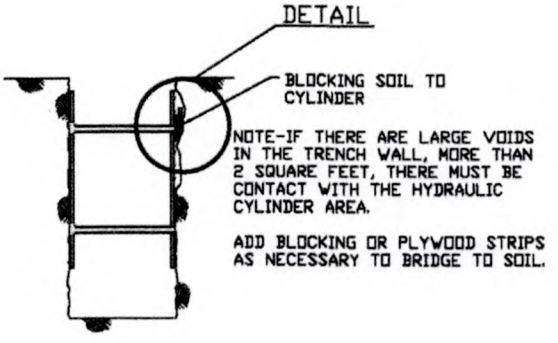


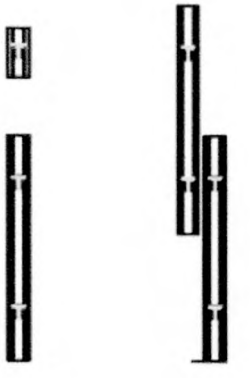
Figure 1. – See note 7

6. The depth and spacing given in **Table 1** governs the use of Vertical Hydraulic Shores and not tabulations given in OSHA Appendix C

7. Faces of excavations shall be vertical and there shall be in contact with the soil at each cylinder, **Figure 1**.

8. Shores shall be set near vertical; however, they may be set as much as 30 degrees from vertical provided that vertical and horizontal spacing is maintained.

9. Vertical Hydraulic Shores may be stacked or longitudinally lapped, **Figure 2**, provided shore spacing is maintained.



Stacked **Lapped**

Figure 2. – See note 9

10. Trenches maximum 12 ft long or horizontal spacing 4 ft or less shall have a minimum of 2 shores set in accordance with spacing requirements. Longer trenches shall have a minimum of 3 shores set at required spacing. See **Figure 3.**

11. Shores shall be installed and removed from outside the trench, see installation and removal procedure.

12. Single cylinder shores may be used in place of multiple cylinder shores provided that horizontal and vertical spacing is maintained.

13. The competent person shall continually monitor the shored excavation for changed conditions such as water seepage, soil movement cracks at the surface, sloughing or raveling, proper surcharge load weight less than 20,000 lbs and setback a minimum of 2 ft and damaged shores.

14. Workers shall always enter, exit, and work inside the shored area of the trench.

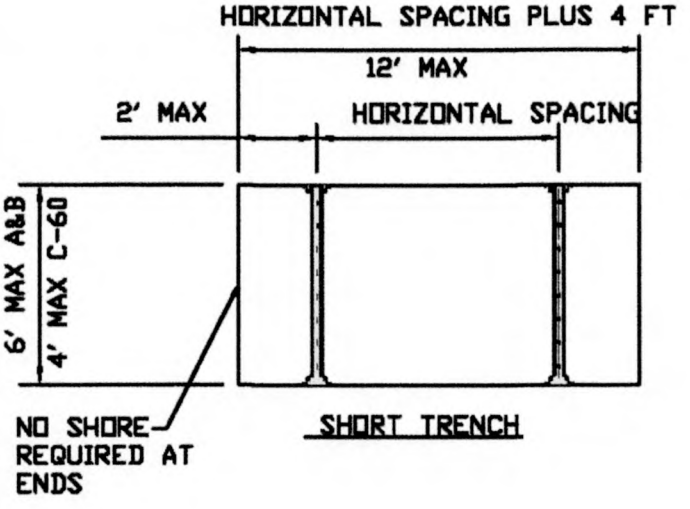


Figure 3. - Short trench, **See Note 10**

Classification of Soil Types

1. Soil classification shall be in accordance with OSHA Appendix A and classified just prior to installing hydraulic vertical shores. Soil conditions may change at a later date and require hydraulic vertical shores to be reset at a different spacing.

2. The equivalent weight of OSHA soil types* is assumed to be as follows:

• OSHA Type "A" Soil	25 PSF per ft of depth
• OSHA Type "B" Soil	45 PSF per ft of depth
• Type "C-60" Soil	60 PSF per ft of depth**
• OSHA Type "C" Soil	80 PSF per ft of depth

* These equivalent weights were adapted from OSHA 1926 Subpart P App C, Timber Shoring for Trenches, Tables C-1.1, C-1.2, and C-1.3

** Type C-60 soil is not identified or classified in OSHA Appendix A

3. Type C-60 soil is;
   - soil that does not qualify as OSHA Type A, or Type B, can be cut with vertical walls and will stand up long enough to safely insert and pressurize the hydraulic shore,
   - the water table must be at or below the bottom of the excavation with no visible water seeping from the sides of the excavation

4. Hydraulic shores shall not be used in OSHA Type C-80 Soil

Vertical Aluminum Hydraulic Shore Selection Guide

Table 1 Vertical Hydraulic Shore Selection Guide[1]

Depth of Trench (ft)	Hydraulic Cylinder Requirements					Sheeting
	Maximum Horizontal Spacing (ft)	Maximum Vertical Cylinder Spacing (ft)	Cylinder Size Width of Excavation (ft)			
			to 8	8 to 12	12 to 15	
TYPE "A" Soil						
to 10'	8'	4'	2"	2"	2"+OS2	NOTE 2
10' to 15'	↓	↓	↓	2"	2"+OS2	↓
15' to 20'	↓	↓	↓	2"+OS1	2"+OS2	↓
20' to 25'	↓	↓	↓	2"+OS1	2"+OS2	↓
TYPE "B" Soil						
to 10'	8'	4'	2"	2"	2"+OS2	NOTE 2
10' to 15'	7'	↓	↓	2"	2"+OS2	↓
15' to 20'	6'	↓	↓	2"+OS1	2"+OS2	↓
20' to 25'	5'	↓	↓	2"+OS1	2"+OS2	NOTE 3, 4
TYPE "C-60" Soil						
to 10'	6'	4'	2"	2"	2"+OS2	NOTE 3
10' to 15'	5'	↓	↓	2"	2"+OS2	↓
15' to 20'	4'	↓	↓	2"+OS1	2"+OS2	↓
20' to 25'	3'	↓	↓	2"+OS1	2"+OS2	NOTE 3, 4

OS1 = 3"X3/16" Wall Aluminum Oversleeve
OS2 = 3.5"x3.5"x3/16" Wall Steel Oversleeve

Notes

1. Soil shall first be classified in accordance with OSHA Appendix A Soil Classification for use with this selection guide. Type C-60 soil is OSHA Appendix A Type C soil that will stand up long enough to install the hydraulic shores.

2. Sheeting is required at any depth whenever sloughing or raveling occur. If sloughing or raveling occurs between sheeting, decrease spacing until it is prevented. See **Table 2** for allowable sheeting. Sheeting may be attached to jack or set into trench separately.

Table 2-ALLOWABLE SHEETING

Plywood	Other Materials
3/4" Finn Form	1/2" thick steel plate 4 ft wide x depth
3/4" Omni Form	Steel sheet piling
3/4" plyform, Class 1 Exterior	Aluminum sheet piling
3/4" HDO, High Debsity Overlay	Buildable box panels
3/4" HDO, High Density Overlay	
3/4" 14 Ply Artic White Birch	
1-1/8" CDX	
2 sheets of 3/4" CDX	

Timber Lagging Set Horizontal			
Thickness	Soil Type/Span		
	A	B	C-60
2"	4 ft		
3"	5 ft	4 ft	
4"	8 ft	6 ft	4 ft
DF#2 or Oak			

3. Sheeting is required at this depth.

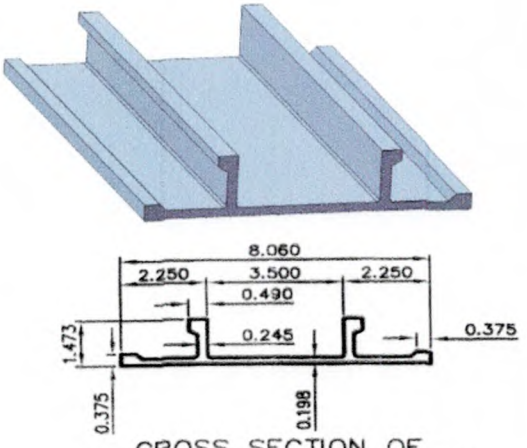
4. Sheeting must extend to the bottom of the excavation.

5. This tabulation includes lateral loading from equipment weighing 20,000 lbs or less and a maximum 2 ft high spoil pile set back a minimum of 2 ft. The competent person shall determine the effect of all other surcharge loads and reduce hydraulic shore spacing as required to resist those loads.

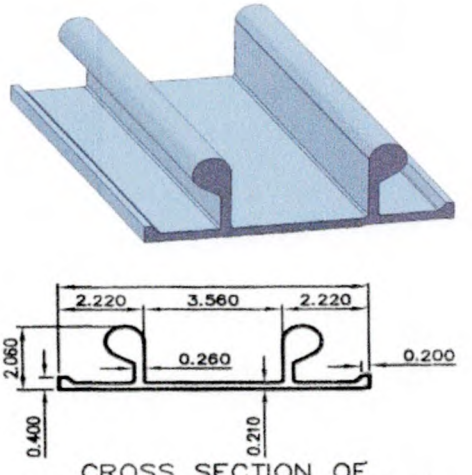
Vertical Aluminum Rail Specification

VERTICAL RAIL SPECIFICATION SHEET

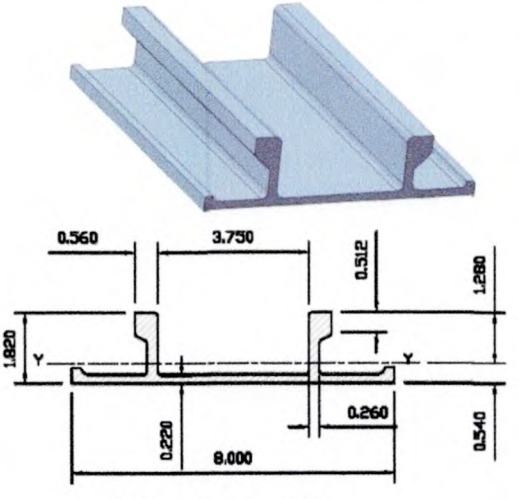
SECTION PROPERTIES	STANDARD RAIL	HEAVY DUTY RAIL
MATERIAL	ALUMINUM	ALUMINUM
ALLOY	6061–T6	6061–T6
AREA	2.45 in^2	3.47 in^2
WEIGHT	2.94 plf	4.17 plf
SECTION–MODULUS – TOP (LEG SIDE)	0.44 in^3	1.25 in^3
SECTION–MODULUS – BOTTOM (BLADE SIDE)	1.29 in^3	2.38 in^3
EQUIVALENT TIMBER SIZE * (#2 DOULAS FIR)	3x10 (FLAT)	4x10 (FLAT)



CROSS SECTION OF
STANDARD VERTICAL RAIL

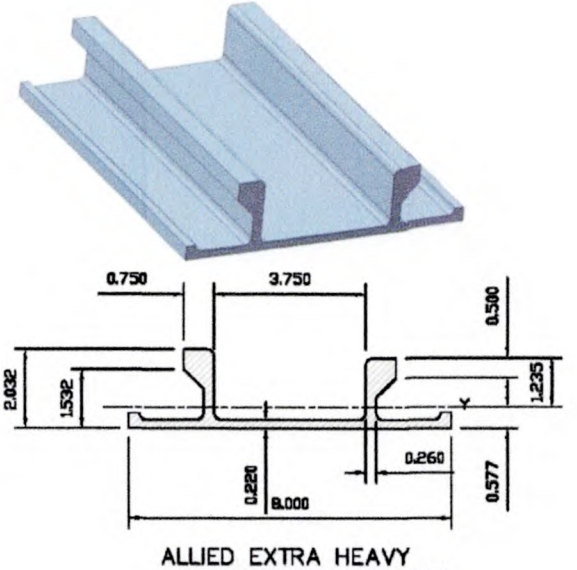


CROSS SECTION OF
HEAVY DUTY VERTICAL RAIL



ALLIED HEAVY DUTY
TRENCH JACK RAIL

AREA	=3.08 IN^2
WEIGHT	=3.52 PLF
MOMENT OF INERTIA	=0.52 IN^4
SECTION MODULUS TENSION	=0.99 IN^3
SECTION MODULUS,COMPRESSION	=2.37 IN^3



ALLIED EXTRA HEAVY
DUTY TRENCH JACK RAIL

AREA	=3.49 IN^2
WEIGHT	=3.98 PLF
MOMENT OF INERTIA	=1.565 IN^4
SECTION MODULUS TENSION	=1.26 IN^3
SECTION MODULUS,COMPRESSION	=2.71 IN^3

Figure 4. Vertical Rail Specifications

Typical Vertical Aluminum Hydraulic Rail Dimensions

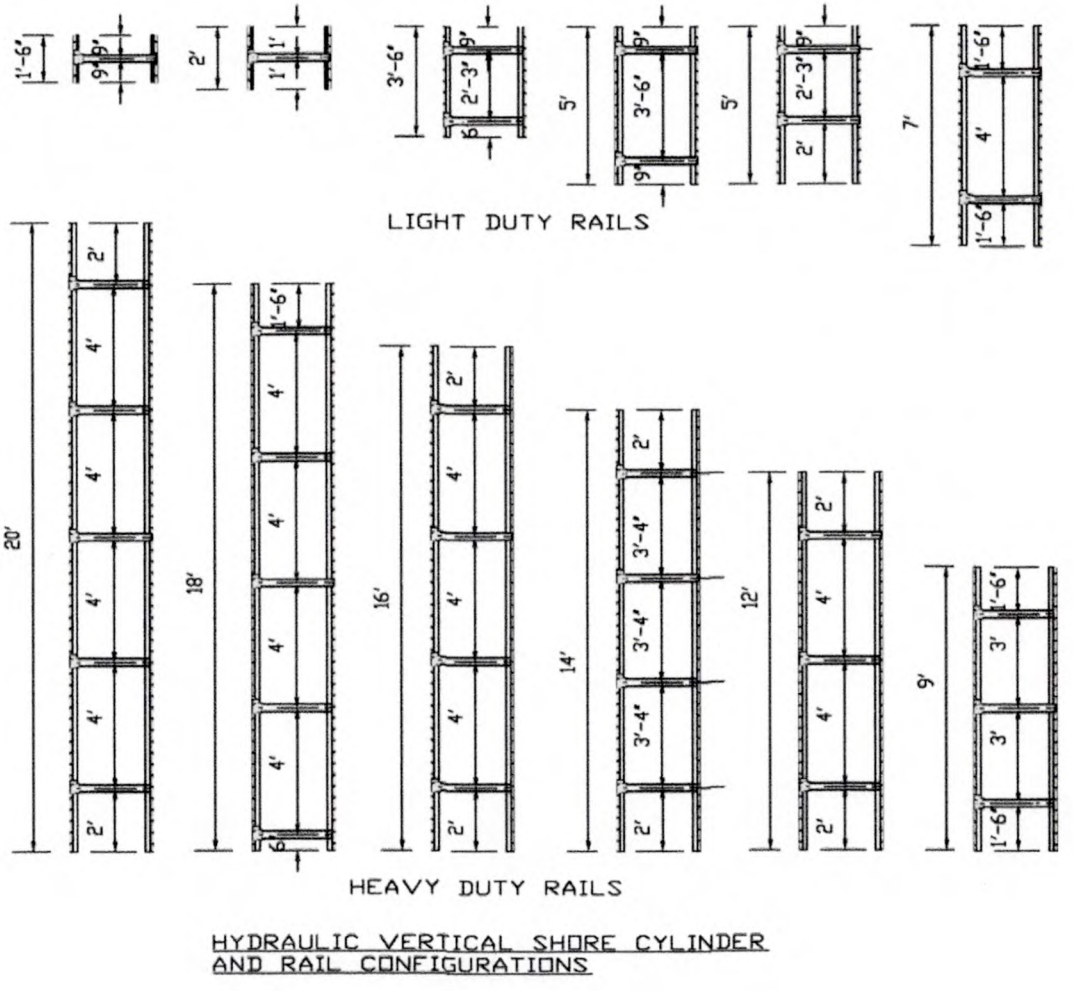


Figure 5 – Rail Dimensions

Note - Custom rail and cylinder spacing available upon request, however when using them with this tabulated data all spacing requirements of the data shall be met.

Hydraulic Cylinder Specifications

To configure for trench width, the proper cylinder range, extension if necessary, and oversleeve must be determined. **Table 3** lists some of the available cylinder ranges and some of the ranges with extensions.

Table 3- HYDRAULIC CYLINDER RANGE

Extension	Range		Extension	Range	
	Cylinder	w/ Extension		Cylinder	w/ Extension
(in)	(in)	(in)	(in)	(in)	(in)
11	17-27	28-38	21	40-64	61-85
22		39-49	42		82-106
33		50-60	56		96-120
11	22-36	33-47	24	52-88	76-112
22		44-58	42		94-130
33		55-69	56		108-144
15	28-46	43-61	74	52-88	126-162
30		58-76	82		132-168
45		73-91	92		144-180
18	34-55	52-73	128		180-216
36		70-91			
54		88-109			

Oversleeve requirements are given in **Table 4** and shown in **Figures 6, 7, 8.**

Table 4-OVERSLEEVE REQUIREMENTS

Trench Width	Oversleeve Required
to 8 ft	No oversleeve required
8 ft to 12 ft	3" x3/16" round aluminum oversleeve
12 ft to 15 ft	3-1/2" x 3-1/2" x 3/16" steel oversleeve

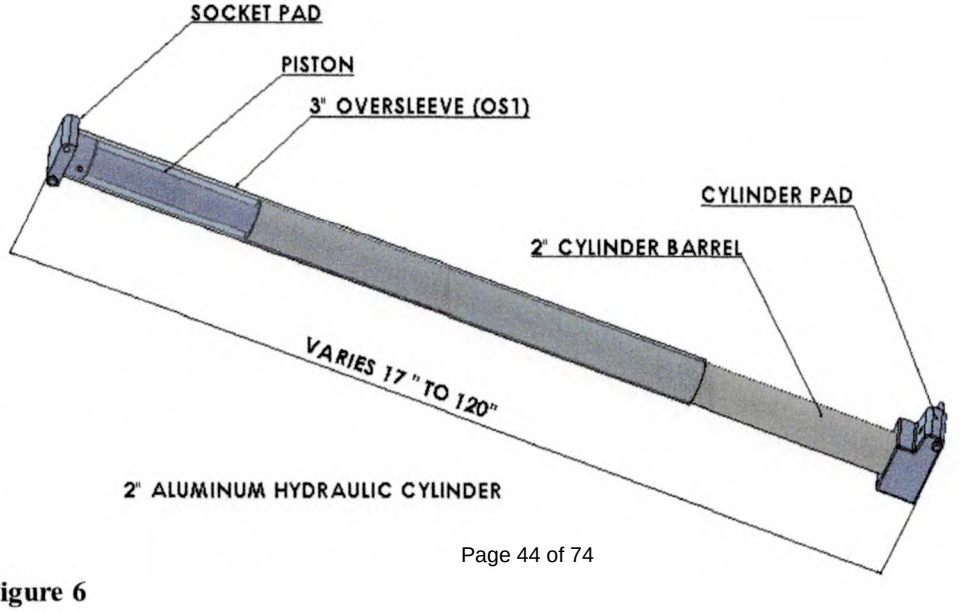


Figure 6

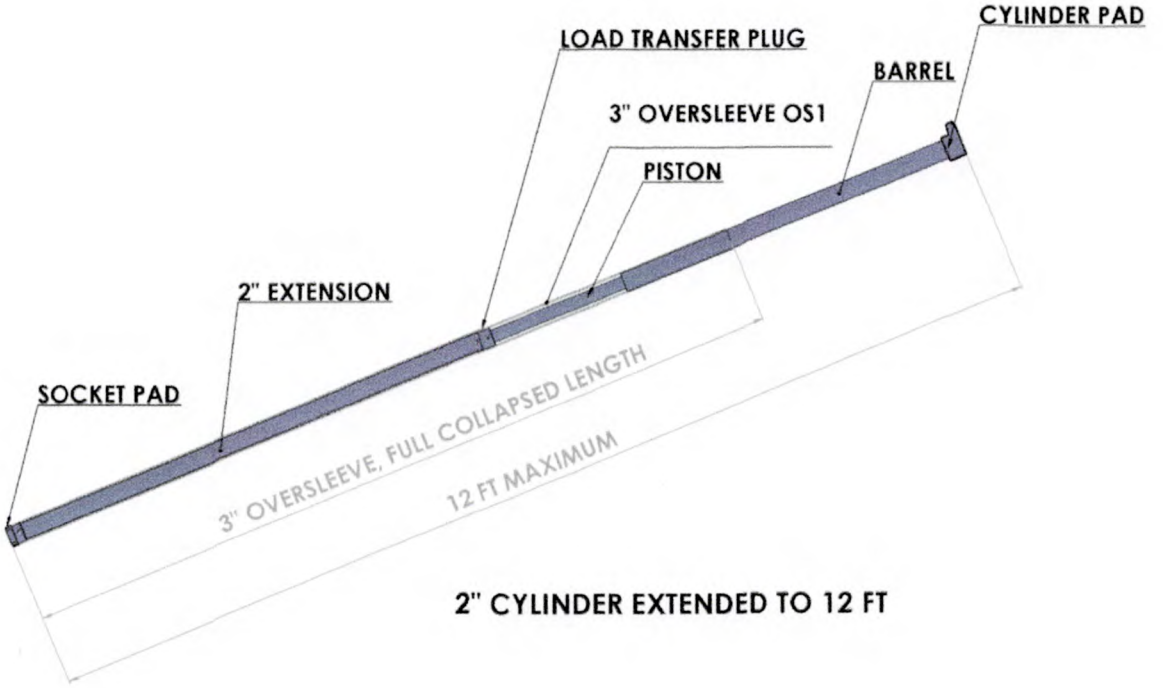


Figure 7

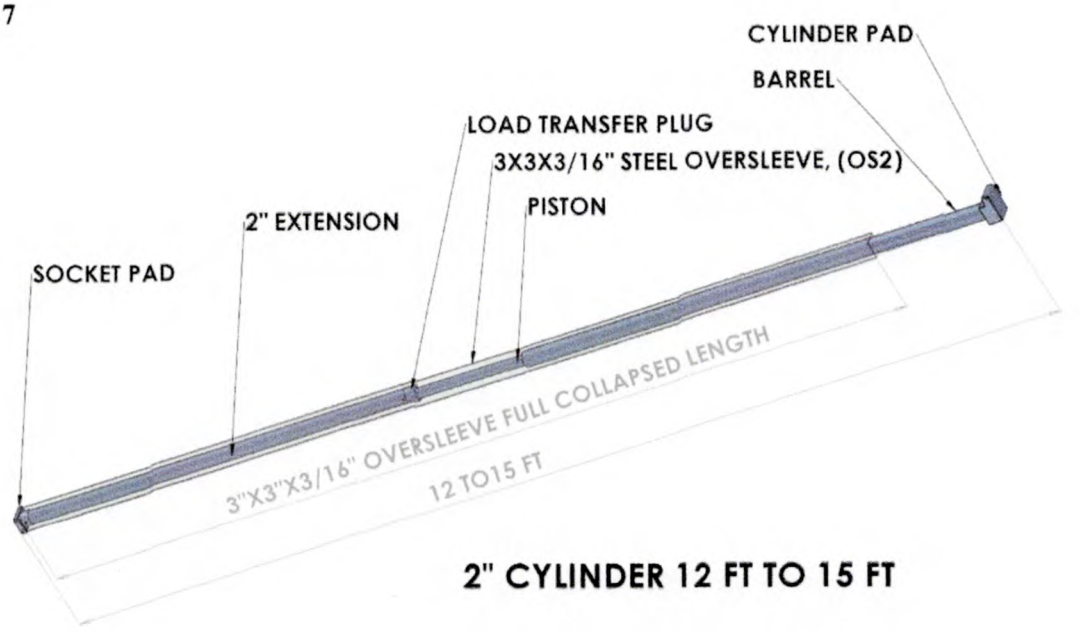


Figure 8

Vertical Aluminum Hydraulic Shore Installation and Removal Procedure

Required for installation

- Vertical Hydraulic Jack
- Pump with fluid and operating pressure gauge
- Release tool

Installation Procedure

Step 1 Attach hydraulic hose to hydraulic fitting on shore. Open the valve on the pump can so that the shore cannot be pressurized. Set plywood if required and not attached to the shore into trench.

Step 2 Lower shore into trench with folded up blade toward opposite trench wall and hydraulic fitting toward adjacent wall. After the shore is set to elevation, hold adjacent blade in place with release tool and let go of opposite blade allowing it to completely unfold and lock into position. In order for the shore to lock into position, the cylinder must be 90 degrees from the blade. Heavy or wide shores that cannot be safely lifted by one person should be set in with lifting equipment such as backhoe, boom truck or crane.

Step 3 Close the valve on the pump can and pressurize the hydraulic shore to between 750 and 1500 psi. Pressure gauge should hold at pressure and not indicate any loss of pressure.

Step 4 Remove the hydraulic hose by prying off with release tool. Clip hose to top of pump to prevent contamination by dragging it in the dirt. Move to next shore location and repeat process.

While trench shores are in place

- Check at least at start of shift for loose shores. This can be done by tapping the top of the shore with a metal rod; it will sound loose, sort of like kicking a tire to see if it is flat. Remove and replace loose shores.
- Check for sloughing or raveling. If it is occurring, sheeting must be used.
- Confirm that soil classification has not changed.

Required for Removal

- Vertical Hydraulic shore
- Release tool
- Removal tool or lifting equipment

Removal Procedure

Step 1 Place release tool over hydraulic fitting and removal hook in handle on opposite blade.

Step 2 Push release tool away to release fluid and pressure. Pull up on the removal hook to fold the shore up and then lift it out of trench.

Note - Depending on the length of the shore and width of the trench different installation procedures may be used. It is the responsibility of the contractor and his competent person to establish a safe installation and removal procedure for each application. All trench shore installers shall be instructed in the procedure prior to installing the shores.

Installation steps for use of Vertical Aluminum Hydraulic Trench Shores

Step 1 - Determine trench shoring requirements (Figure 9)

- Trench Depth
- Trench Width
- Trench Length

Note - Dewatering must be to the bottom of the excavation

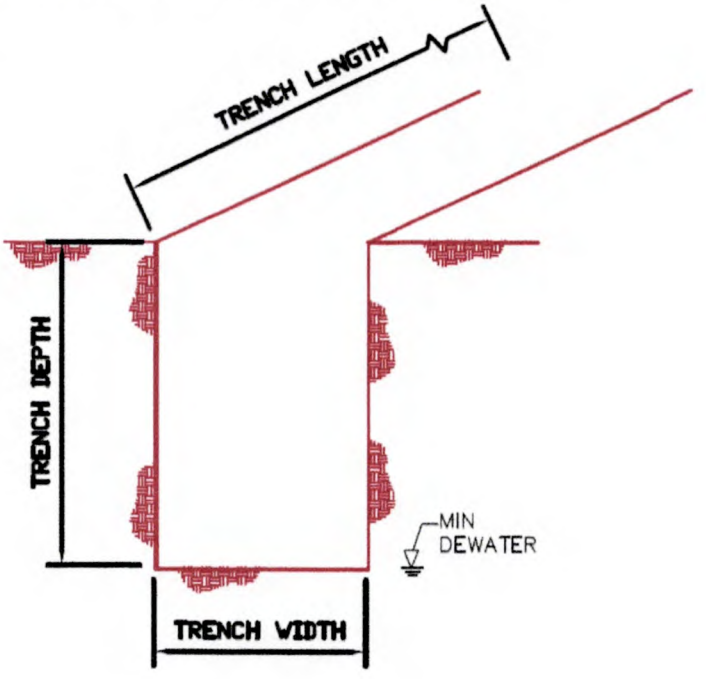


Figure 9 - Trench Parameters

Step 2 - Determine soil type in conformance with OSHA Appendix A

- **Type A-25 Sloping ¾ :1**
- **Type B-45 Sloping 1:1**
- **Type C-60 Sloping 1-1 ½ :1**

Hydraulic Shores cannot be used in Type C-80 soil

Step 3 - Determine horizontal shore spacing (Figure 10)

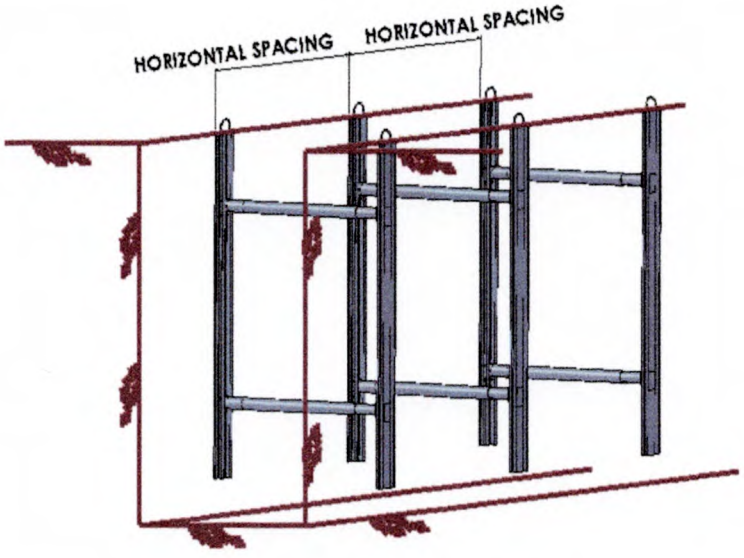


Figure 10 - Horizontal

Table 5 Notes

1. A competent person must decide whether trenches under 5 ft deep are stable or will require shoring.
2. Aluminum hydraulic shores are not allowed at any spacing in C-80 soil

Table 5-HORIZONTAL SHORE SPACING			
Depth	OSHA Soil Type		
ft	A	B	C-60
over 5 to 10	8	8	6
over 10 to 15	8	6	4
over 15 to 20	8	6	4
over 20 to 25	6	4	3

Step 4 - Determine vertical cylinder spacing (Figure 11)

Table 6-VERTICAL CYLINDER SPACING		
Between	Maximum (ft)	Minimum (ft)
Top cylinder and surface	2	1
Between cylinders (note 3)	4	—
Bottom to first cylinder	4	—
Bottom of trench and lowest element of shoring (note 1)	—	2

Table 6 Notes

1. See OSHA 1926.652 (e) (2) Additional requirements for trench excavations (i)
2. — Indicates no limitation
3. When stacking hydraulic shores do not set hydraulic cylinders more than 4 ft apart

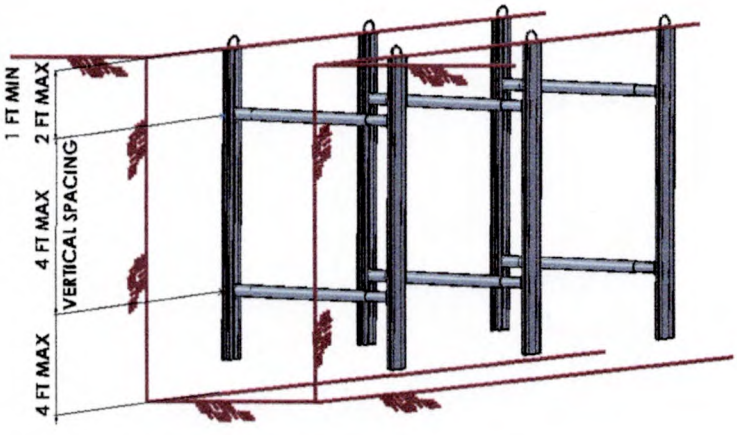


Figure 11 - Vertical

Step 5 - Determine Cylinder size and Oversleeve Requirement for trench width

Table 7-ALLOWABLE TRENCH WIDTH			
Depth	OSHA Type A, B, and C-60 Trench Width		
	To 8	8 to 12	12 to 15
(ft)	(ft)	(ft)	(ft)
to 5	2"	2" +OS 1	2" +OS2
over 5 to 10	2"	2" +OS 1	2" +OS2
over 10 to 15	2"	2" +OS 1	2" +OS2
over 15 to 20	2"	2" +OS2	2" +OS2
over 20 to 25	2"	2" +OS2	2" +OS2
Depth	OSHA Type B-45 Soil Trench Width		
	To 8	8 to 12	12 to 15
(ft)	(ft)	(ft)	(ft)
to 5	2"	2" +OS 1	2" +OS2
over 5 to 10	2"	2" +OS 1	2" +OS2
over 10 to 15	2"	2" +OS2	2" +OS2
over 15 to 20	2"	2" +OS2	2" +OS2
over 20 to 25	2"	2" +OS2	2" +OS2
Depth	OSHA Type C-60 Soil Trench Width		
	To 8	8 to 12	12 to 15
(ft)	(ft)	(ft)	(ft)
to 5	2"	2" +OS 1	2" +OS2
over 5 to 10	2"	2" +OS 1	2" +OS2
over 10 to 15	2"	2" +OS2	2" +OS2
over 15 to 20	2"	2" +OS2	2" +OS2
over 20 to 25	2"	2" +OS2	2" +OS2
OS 1 = 3" round x 3/16" wall aluminum ovesleeve OS2 = 3x3x3/16" wall square steel oversleeve			

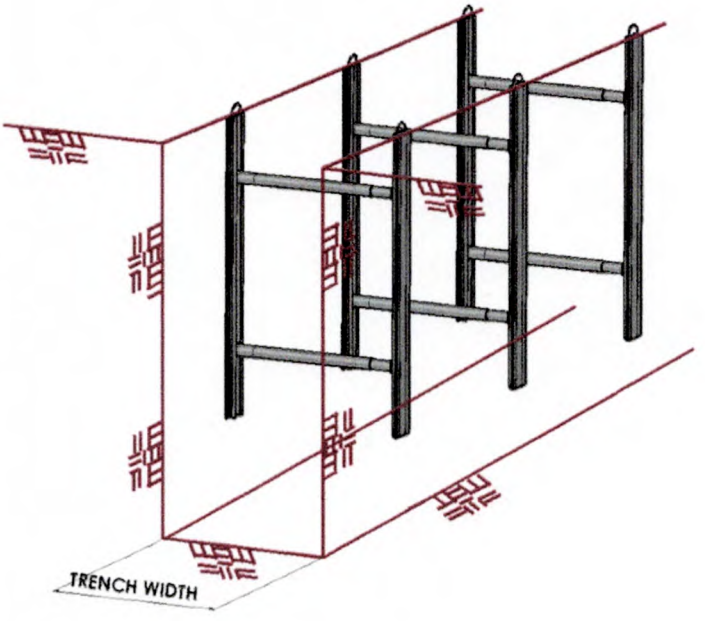


Figure 12 - Trench Width

Step 6 - Determine sheeting requirements (Figure 13)

Table 8-SHEETING REQUIREMENTS			
Depth	OSHA Soil Type		
ft	A	B	C-60
to 8	Not Required	Not Required	Not Required
over 8 to 10	↓	↓	Required
over 10 to 15	↓	↓	↓
over 15 to 20	↓	↓	↓
over 20 to 25	↓	↓	↓

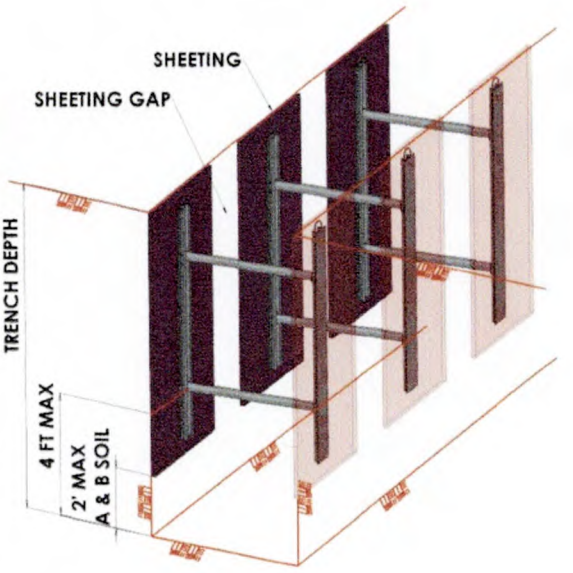


Figure 13 Sheeting Requirements

Table 8 Notes:

1. Sheeting is always required when sloughing or raveling occurs and in C-60 soil over 8' deep.
2. If there is a sheeting gap due to allowable shore spacing, the gap must be reduced until sloughing or raveling is prevented.
3. Sloughing is associated with soft cohesive soil that squeezes around the rail or sheeting. Raveling is associated with non-cohesive soil, sands and gravels that fall off the face of the trench wall. Trench wall face exposure over time can create raveling as moisture cohesion weakens due to drying.
4. Sheeting is not considered a structural part of the shore. Sheeting material requirements are strictly to meet minimum durability and handling requirements.
5. Sheeting may be set separately or connected to the shore.
6. In C-60 soil sheeting shall extend to the bottom of the excavation.
7. See **Table 2** for allowable sheeting material.

Table 2-ALLOWABLE SHEETING				
Plywood				Other Materials
3/4" Finn Form				1/2" thick steel plate 4 ft wide x depth
3/4" Omni Form				Steel sheet piling
3/4" plyform, Class 1 Exterior				Aluminum sheet piling
3/4" HDO, High Debsity Overlay				Buildable box panels
3/4" HDO, High Density Overlay				
3/4" 14 Ply Artic White Birch				
1-1/8" CDX				
2 sheets of 3/4" CDX				
Timber Lagging Set Horizontal				
Thickness	Soil Type/Span			
	A	B	C-60	
2"	4 ft			
3"	5 ft	4 ft		
4"	8 ft	6 ft	4 ft	
DF#2 or Oak				

Step 7 - Stacked Configurations (Figure 14)

- Shores may be stacked vertically as long as the hydraulic cylinders are no more than 4 ft apart
- Shores may be staggered as long as allowable shore spacing is not exceeded

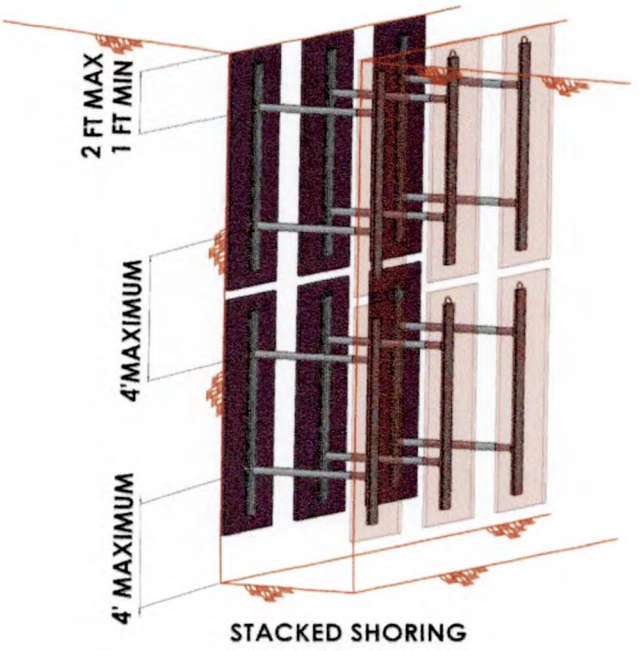
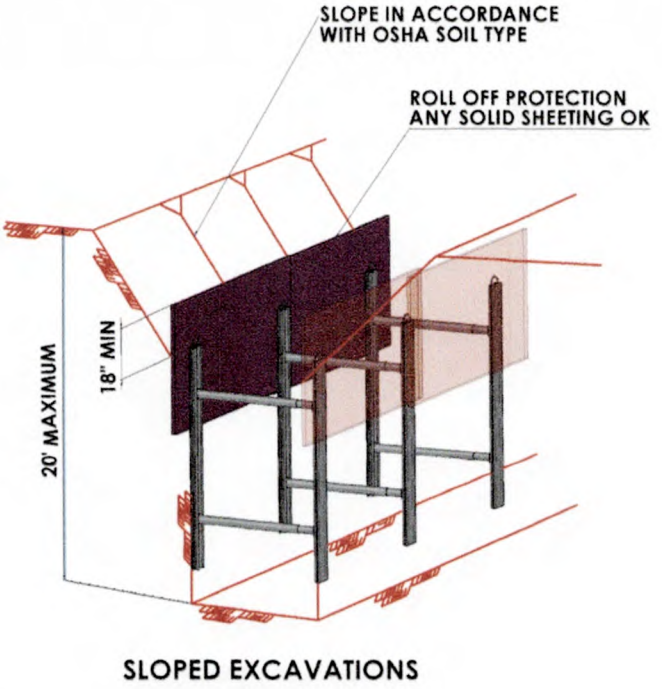
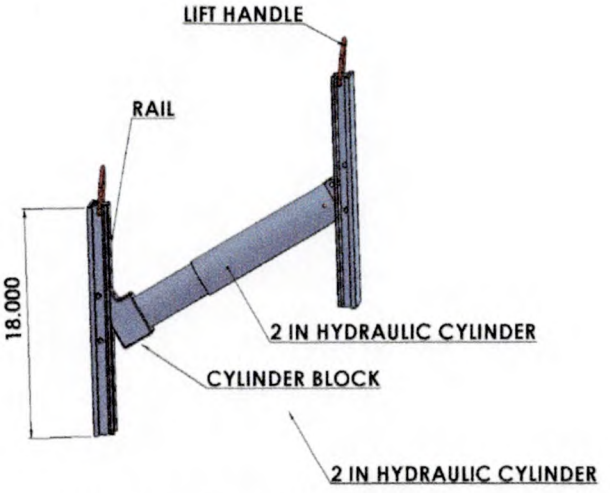


Figure 14

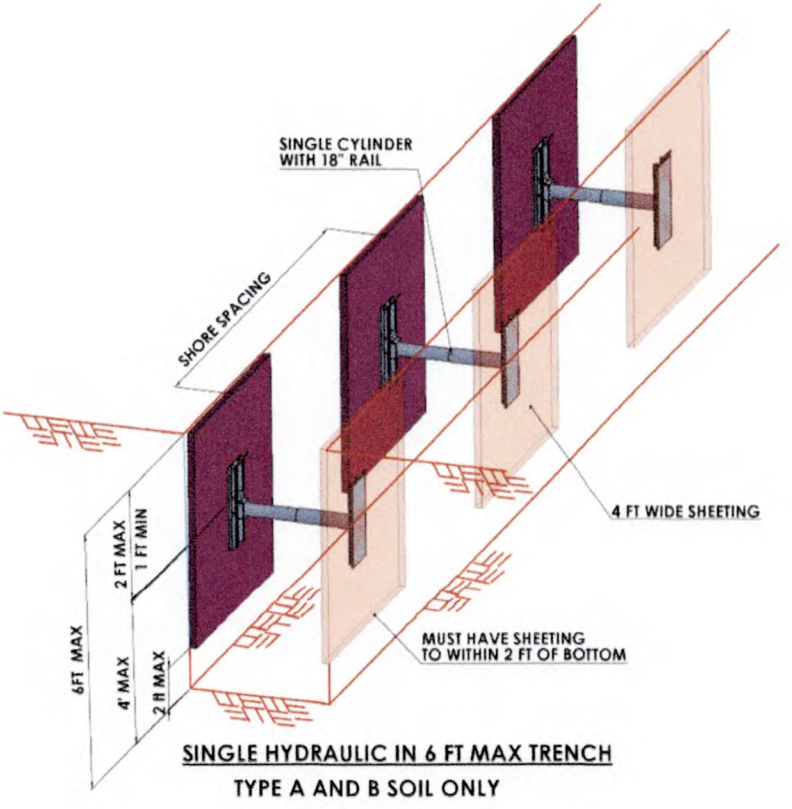
Step 8 - Combined sloping and shoring configurations



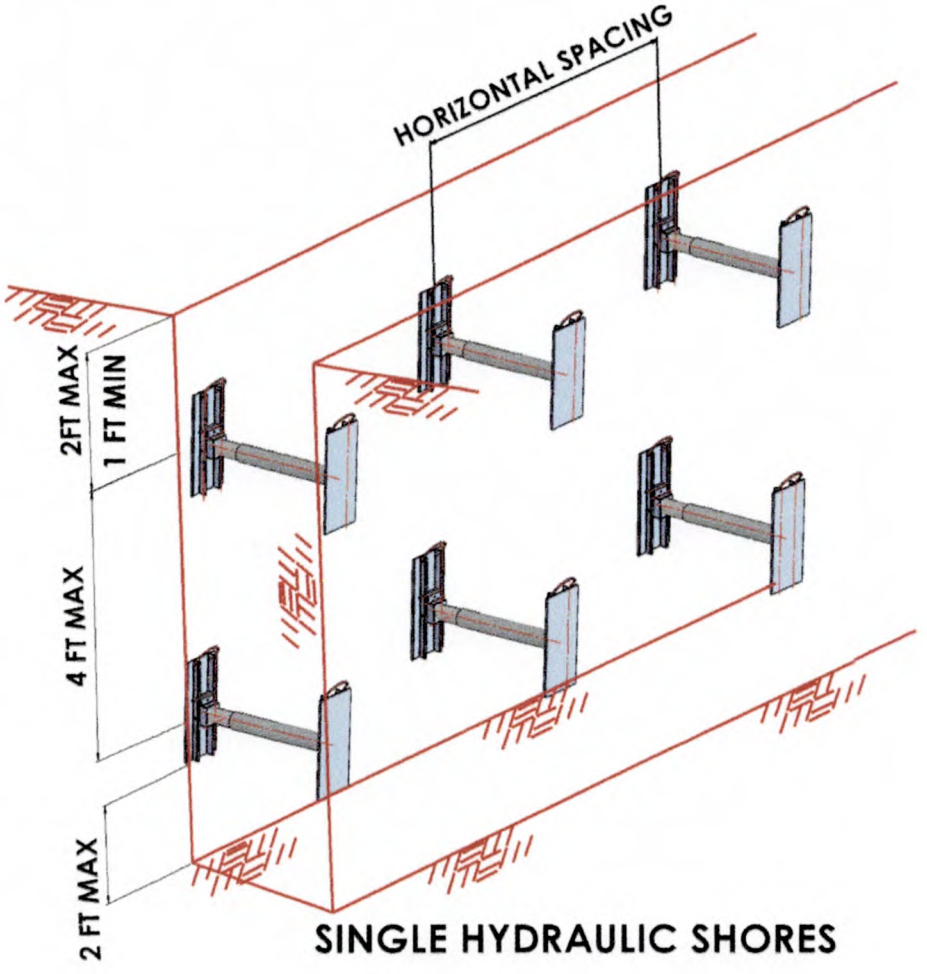
Step 9 - Single Hydraulic Shore



SINGLE HYDRAULIC SHORE

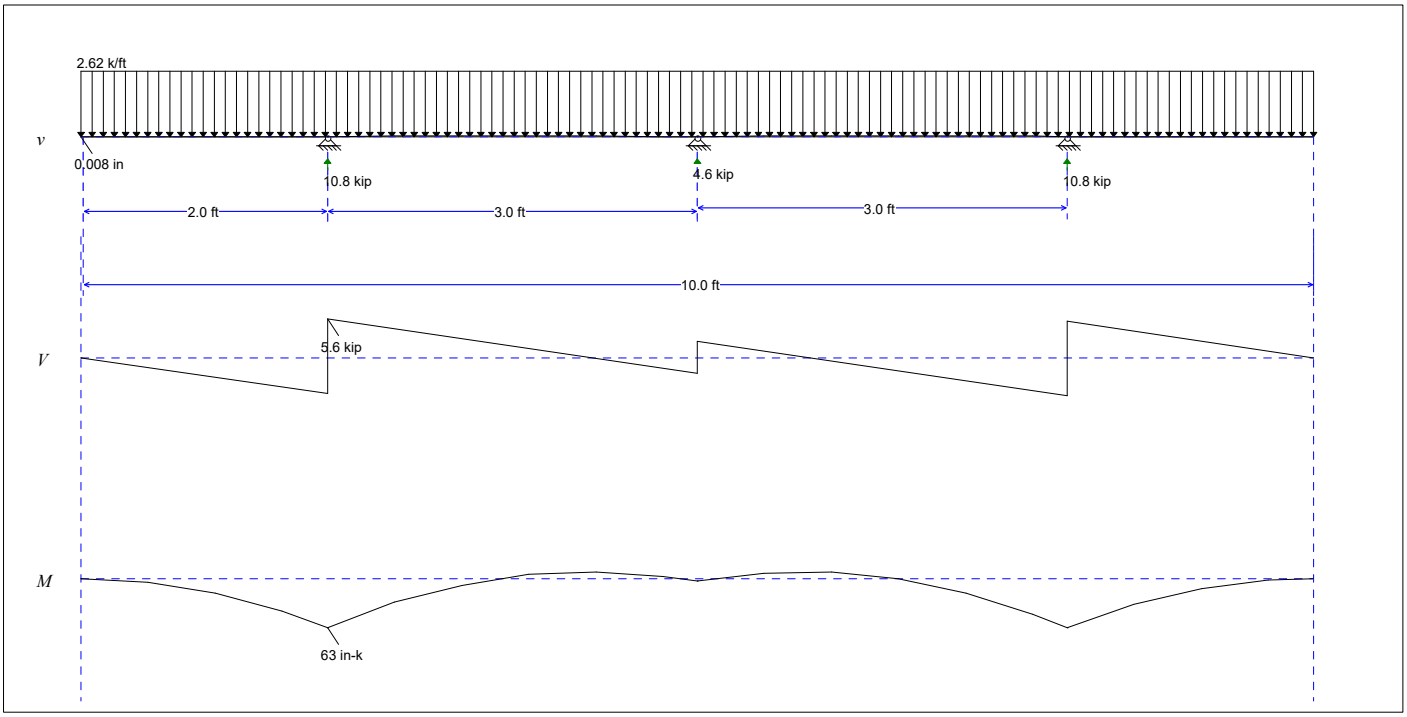


SINGLE HYDRAULIC IN 6 FT MAX TRENCH
TYPE A AND B SOIL ONLY



SINGLE HYDRAULIC SHORES

Rev 1



Beam Parameters: Length = 10.0 ft, E = 16000.0 ksi, I = 140.0 in^4, A = 2.5 in^2

Assume Max Ht = 10 ft
M = wl^2/10 - Per Caltrans Trench & Shoring Manual Section 5.2
Fy = 40,000 psi x 0.60 = 24,000 psi

w = 438 psf * 6 ft spacing = 2628 lb/ft

fb = Moment / Sx = 52 in-k / 2.38 in^3 = 21,849 psi < Fy OK

Cylinder Load = 10,800 lbs < 23,000 lbs ok

Revision 2 Calculations

Hydraulic Vertical Shores

Check Sheeting Placed Parallel to Vertical Rail

$D_1 := 2\ ft$ Depth to Top Strut

$D_2 := 5\ ft$ Depth to Mid Strut

$P_1 := 459\ \frac{lb}{ft^2}$ Loading at D1

$P_2 := 459\ \frac{lb}{ft^2}$ Loading at D2

$W := P_1 = 459\ \frac{lb}{ft^2}$ Avg loading on panel, used for end plate loading

$a := 0.6$ Soil Arching factor for sheeting or lagging per Caltrans Shoring Manual

$W_d := P_1 \cdot a = 275.4\ \frac{lb}{ft^2}$ Design Soil Load on Shoring

$w_S := 4\ ft$ Sheeting Width

$w_R := 0.67\ ft$ Rail Width

$Arch := 2$ Rail Width Arch Factor

$L := 1.33\ ft$ Span of end panel sheeting

$M_u := \frac{W \cdot L^2 \cdot a \cdot 1\ ft}{2} = 243.578\ lb \cdot ft$ Sheeting max Moment

$V_u := \frac{W \cdot a \cdot L \cdot ft}{2} = 183.141\ lb$ Sheeting max Shear

Check Plywood Sheeting

$Ldf := 1.25$ Load Duration Factor

Per NDS Specification Table 1A

$F_b := 1545\ \frac{lb}{in^2}$ Bending Stress

$F_v := 57 \frac{lb}{in^2}$ Rolling Shear

$E := 1500000 \frac{lb}{in^2}$ Modulus of Elasticity

$F'_b := F_b \cdot Ldf = 1931 \frac{lb}{in^2}$ Allowable Bending Stress

$F'_v := F_v \cdot Ldf = 71.25 \frac{lb}{in^2}$ Allowable Bending Stress

$t := 1.125\ in$ Sheeting Thickness

$n := 2$ Number of Sheets

Section Properties

$KS := 0.955\ in^3$ $I := 0.623\ in^3$

$lb.Q := 8.841\ in^2$

$f_b := \frac{M_u}{KS \cdot n} = 1530 \frac{lb}{in^2}$ < F'b OK

$f_v := \frac{V_u}{lb.Q \cdot n} = 10 \frac{lb}{in^2}$ < F'v OK

$\Delta := \frac{W \cdot L^4}{8 \cdot E \cdot I} = 0.028\ in$ < 1 in OK

Check Steel Plate Sheeting

$Ov := 1.33$ Temporary Loading Overstress Factor

$\Omega := 1.67$ ASD bending/shear reduction factor

$F_y := 36000 \frac{lb}{in^2}$

Bending Stress

$S_{req} := \frac{\Omega \cdot M_u}{Ov \cdot F_y} = 0.102\ in^3$

Shear Stress

$$A_{req} := \frac{\Omega \cdot V_u}{0.6 \cdot Ov \cdot F_y} = 0.011\ in^2$$

1/2" Steel Plate

$$w_{plate} := 12\ in$$

$$ht_{plate} := 0.5\ in$$

$$S_{plate} := \frac{w_{plate} \cdot ht_{plate}^{\ 2}}{6} = 0.5\ in^3 \qquad > \text{ Sreq OK}$$

$$S_{plate} := w_{plate} \cdot ht_{plate} = 6\ in^2 \qquad > \text{ Areq OK}$$

Table 4.13: Effective section properties for B-B Plyform plywood (12 in. widths)*

Plyform grade	Sanded plywood, net thickness, in.	12 in. width, used with face grain parallel to span			12 in. width, used with face grain perpendicular to span			Approximate weight, lb	
		Moment of inertia *I*, in.⁴	Effective section modulus *KS*, in.³	Rolling shear constant *Ib/Q*, in.²	Moment of inertia *I*, in.⁴	Effective section modulus *KS*, in.³	Rolling shear constant *Ib/Q*, in.²	4x8 ft sheet	per ft²
Class I	15/32	0.066	0.244	4.743	0.018	0.107	2.419	45	1.4
	1/2	0.077	0.268	5.153	0.024	0.130	2.739	48	1.5
	19/32	0.115	0.335	5.438	0.029	0.146	2.834	57	1.8
	5/8	0.130	0.358	5.717	0.038	0.175	3.094	60	1.9
	11/16	0.164	0.409	6.175	0.044	0.183	3.524	66	2.1
	23/32	0.180	0.430	7.009	0.072	0.247	3.798	69	2.2
	3/4	0.199	0.455	7.187	0.092	0.306	4.063	72	2.3
	7/8	0.296	0.584	8.555	0.151	0.422	6.028	84	2.6
	1	0.427	0.737	9.374	0.270	0.634	7.014	96	3.0
	1-1/8	0.554	0.849	10.430	0.398	0.799	8.419	108	3.4
Structural I	15/32	0.067	0.246	4.503	0.021	0.147	2.405	45	1.4
	1/2	0.078	0.271	4.908	0.029	0.178	2.725	48	1.5
	19/32	0.116	0.338	5.018	0.034	0.199	2.811	57	1.8
	5/8	0.131	0.361	5.258	0.045	0.238	3.073	60	1.9
	11/16	0.167	0.418	5.621	0.051	0.249	3.493	66	2.1
	23/32	0.183	0.439	6.109	0.085	0.338	3.780	69	2.2
	3/4	0.202	0.464	6.189	0.108	0.418	4.047	72	2.3
	7/8	0.317	0.626	7.539	0.179	0.579	5.991	84	2.6
	1	0.479	0.827	7.978	0.321	0.870	6.981	96	3.0
	1-1/8	0.623	0.955	8.841	0.474	1.098	8.377	108	3.4

*Use listed *KS* value in bending calculations and use *I* only in deflection calculations. Properties from APA Form No. V345V-12.

any reuse is desired. Plywood grades and types are defined in a commercial standard, NIST PS 1-09, "Structural Plywood." The product standard defines grades of veneer—N and A through D—depending on the freedom of the surface from knots and other defects. Grades B-B and B-C are commonly used for formwork. B-B has both faces of B-grade veneer, which is a smoothly sanded solid surface sheet with repair plugs and small tight knots permitted. B-C has one face of C-grade veneer, which allows small knots, knot holes, and patches. The product standard also establishes three classes of plywood depending on the kinds of woods used in manufacture—Class I, Class II, and Structural I. Class I and Structural I are stronger and stiffer than Class II, and also the most widely available.

The standard further provides that plywood labeled as concrete form-grade shall be mill oiled unless otherwise agreed between buyer and seller. Mill oiling does not eliminate the need for oiling on the job, but mill-oiled plywood does give better service than that which is job treated only. Some form release agents require an unoiled base. If the use of such agents is planned, it is important to specify unoiled plywood. Edge sealing of plywood adds protection against moisture and is recommended before the first use of any concrete form plywood. Moisture ingress through unprotected edges may cause swelling and deterioration of wood layers even though the glue itself is waterproof. Plywood designated OES indicates it has been oiled and edge-sealed during manufacture. Resealing the edges and tie holes after a number of uses, or sealing freshly cut edges, helps prolong the life of the forms.

It is a good practice to specify panels carrying the mark of an approved inspection and testing agency that indicates type and grade, species of veneer, and conformance with applicable standards. If there is any doubt as to quality of plywood purchased, a certification of type and grade may be requested. Structural properties of Class I and Structural I Plyform are listed in Table 4.13 based on APA V345V-2012, "Concrete Forming – Design/Construction Guide."

ACI SP-4 (14)
Formwork for Concrete

Table 4.14: Plyform (used wet) reference and adjusted design values for Class I and Structural I

	Value	Reference design value used wet, psi	Concrete setting factor $C_s = C_e \times C_D$			Adjusted design value for	
			Experience factor	Duration factor		C_D = 1.0, psi	C_D = 1.25, psi
Bending	F_b' =	(F_b = 1190)	(C_e = 1.3)	C_D	=	1545	1933
Rolling shear (Class I)	F_{rs}' =	(F_{rs} = 44)	(C_e = 1.3)	C_D	=	57	72
Rolling shear (Structural I)	F_{rs}' =	(F_{rs} = 63)	(C_e = 1.3)	C_D	=	82	102
Bearing on face	$F_{c\perp}'$ =	($F_{c\perp}$ = 210)	—	C_D	=	210	263
Modulus of elasticity (for bending deflection when shear deflection is not considered)	E' =	(E = 1,500,000)	—	—	=	1,500,000	1,500,000
Modulus of elasticity (for shear deflection)	E_e' =	(E_e = 1,500,000)	—	—	=	1,500,000	1,500,000
Modulus of elasticity (for bending deflection when shear deflection is considered)	E' =	(E = 1,650,000)	—	—	=	1,650,000	1,650,000

Note: values from APA Form No. V345V-12

4.3.4 Textured Surfaces

Plywood textures range from the very smooth PSF and HDO to striations, wood grain, or patterned board-and-batten siding panels. The pattern or design of the plywood is transferred to the concrete, providing decorative surfaces that may have a marked reduction in light reflection and glare.

Exterior-type textured plywood may be used as a form liner or as the basic forming panel. Fewer reuses of textured panels can be expected because the repeated stripping damages plywood. Coating the plywood with a film-forming material such as epoxy or polyurethane, along with the use of a proper release agent, will make stripping easier and allow more reuses of the material.

4.3.5 Strength Properties

ASD values for plywood are based on the strength properties and reference design values for wood as determined by the U.S. Forest Products Laboratory. Recommended reference design values and ASD adjusted design values for Plyform sheathing are included in Table 4.14 for the most commonly used formwork grade of plywood from APA V345V. Design values for other grades should be based on tables in APA D510C-2012, "Panel Design Specification," or other manufacturers' recommendations.

Table 4.14 includes the reference design values, usual adjustment factors for formwork applications, and the adjusted design values for Class I and Structural I concrete form plywood. Design values shown in Table 4.14 have already been adjusted for wet use as recommended by the plywood manufacturers because form sheathing will generally become wet when loaded with fresh concrete. For high-density overlaid plywood or plywood coated on the job to make it impervious to moisture, higher design values are permissible because the reduction for moisture no longer applies.

Plywood sheathing acts as a beam, but plies with grain running perpendicular to the span contribute little to the bending strength and stiffness of the panel. Table 4.13 gives the effective section properties for various thicknesses of plywood for two cases—face plies parallel to the plywood span and face plies perpendicular to the span. For a given thickness of plywood panel, *I* and *KS* are larger when the face grain is parallel to the span. This is referred to as using plywood the strong way. Conversely, plywood with its face grain perpendicular to the span is said to be used the weak way. Due to involved considerations concerning properties of plywood, the effective moment of inertia *I* divided by distance to extreme fiber *c* does not equal effective section modulus *KS* (Table 4.13). Therefore, effective section modulus, *KS*, as tabulated should be used for all bending stress calculations and moment of inertia, *I*, should be used only for deflection calculation.

4.3.6 Bending Plywood to Curved Surfaces

Simple curves with radii not less than 24 in. can readily be made in plywood form sheathing. Table 4.15 shows minimum radii for bending panels that are manually nailed. Note that shorter radius curves can be obtained when plywood is bent across the grain. Shorter radii than those tabulated may be developed by wetting or steaming, but this

Reference Material

Safe Handling and Use of Trench Shores

By removing the shoring installer from the unshored trench and making shoring equipment more available and easy to install, trench jacks have no doubt had a huge impact on excavation safety. Utilizing trench jacks for shoring still has safety hazards that users should understand and protect workers from these hazards. These things happen rarely however it is still important that workers be informed of the risks they are taking before placing them at risk. The following are hazards and safety procedures associated with the use of trench jacks

- Injury to back and muscles from lifting heavy objects - An 8 ft long 52x88 extension trench jack weighs approximately 120 lbs. A two-man crew can safely lift, set and remove it from the trench. Anything longer or heavier should be lifted and set with equipment such as a backhoe or boom truck.

- Overhead lifting hazard - When jacks are being hoisted by sling from a tractor bucket or boom truck, the swinging jack presents a hazard to workers guiding it. Loose plywood and rocks can also fall off onto workers. Workers should stand clear and guide with a lead rope.

- Finger and hand protection - Trench jacks have moving parts at the connection between the cylinder and the rail. When the jack swings open fingers can be crushed under the cylinder block and when it is swung closed fingers can easily be sheared off if they are between the block and the rail leg. When the hydraulic hose is being connected to the block, fitting and when the jack is being lifted by hand shearing and crushing is most likely to happen.
  Awareness through safety instruction and hand placement a safe distance, 12", from the blocks is safe practice. Trench jacks may have optional finger guards however, it is still possible to get fingers under the block and wrists cut and banged when the jack folds or unfolds. See **Figure 15.**

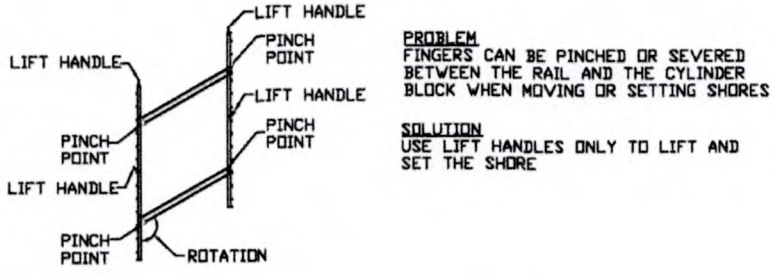


Figure 15. Trench Safety issues

- Bank collapse with worker standing on it - When the jack is being set it is still possible for the trench wall to collapse from the additional weight and activity going on around it. Trench jack installation should closely follow the excavation activity.

  During jack removal, the arch column is being literally removed with the load still on it. Pipe bedding and initial backfill cut the trench depth adding some stability prior to removing the jack. If backfill operations are closely following jack removal, the length of unshored collapsible trench wall becomes short. Soil arching back to the backfilled area is likely and trench wall failure becomes less likely. Remote backfill operation such as

excavator wheel or vibraplate, or remote operated compactors must always be used for compaction outside the shored area. When trench jacks are being removed to allow pipe installation and then reset there is a greater likelihood of trench wall collapse. Equipment and personnel in close proximity are at risk of loosing the ground under their feet. Keep equipment and personnel except those needed to remove the jack a safe distance away. This type of operation is not uncommon and most often works safely, however if there is any evidence of trench wall collapse the operation should be discontinued and a different method of getting production materials into the trench or a different shoring system should be used. Several bad accidents have occurred in conjunction with this type of operation.

- Get the surcharge loads right - Equipment over 20,000 lbs and large spoil piles over 2 ft high quickly add additional surcharges, especially in the top 10 ft, that can easily overload the trench jack. If one cylinder fails, a progressive failure to the bottom of the trench and then down the length of the trench is possible. A boom truck or backhoe outrigger placed next to a trench jack can trigger this. The way to adjust for additional surcharge load is to move the load away from the trench, spread the load with timber pad or steel plate, or decrease the trench jack spacing. Centering the load on the jack, places most of the load on that jack. The alternative, centering the load between the jacks distributes the load evenly between the jacks, however it increases the possibility of the arch void to fall out or arch shear failure at the jack. One alternative may not be any better than the other.

- Trench Jack fold-up failure - If all of the jacks were unfolded into the trench from one side of the trench, it is possible to get a bank failure that can lift the rotating jack leg. This type of failure is not common; however, the author has spoken with more than one worker that has, fortunately from outside the trench, witnessed this type of failure.

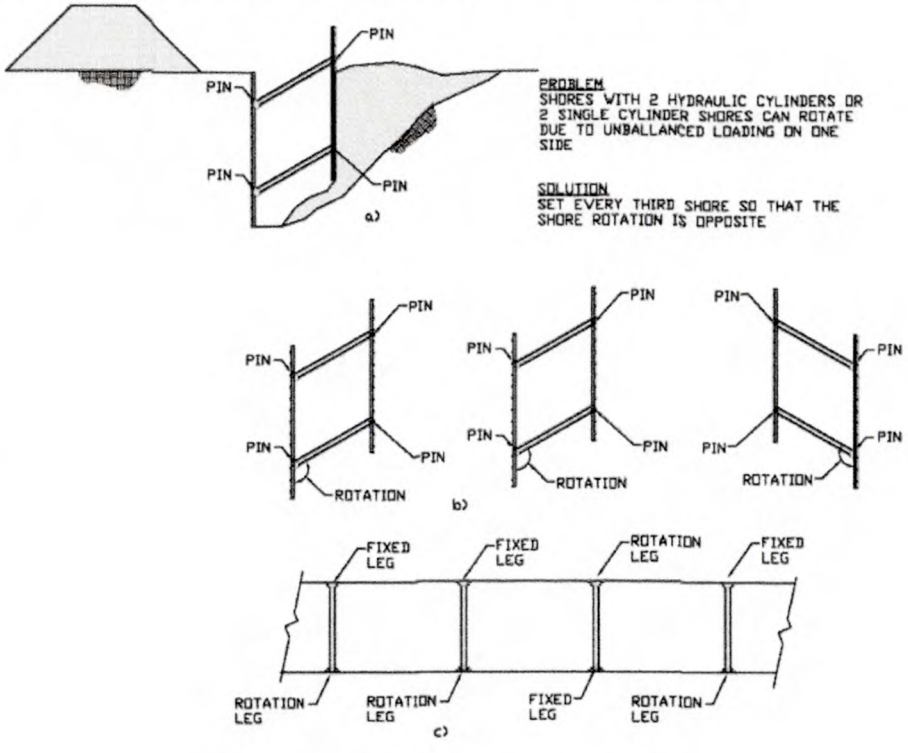


Figure 16. a) Trench jack fold up failure, **b)** leg rotation, **c)** jack rotation to prevent fold up failure

No workers were inside the trench. The story goes that 40 ft of trench folded up the jacks and collapsed. The solution is to rotate the jack so that the rotation leg is on the other side of the trench. The problem is that the installers have to move to the other side of the trench to set and pressurize the jack. Two soil conditions that this would be most likely to happen are in medium dense to loose non-cohesive soils and soft clays with high surcharge loads. See **Figure 16**

- Loose trench jacks in the trench - Jacks that are not pressurized in the trench are not setting up arching and preventing trench collapse. In this condition the jacks can also fall down on workers below them. Jacks should not leak at all. Pressure can change slightly up or down due to temperature changes or increase due to loading however it should never loosen up in the ditch. If jacks are left overnight they should be checked before entering the trench in the morning. Simply tap them with a hammer or bar of metal, they will sound loose if they are. Remove and replace jacks that bleed off.
  If the trench wall has voids where the cylinder hits the wall, use wood blocking to extend the connection to the soil.

- Non-vertical trench walls - Trench walls that are not vertical, an inverted A shape, the trench jack is not stable. Assuming a coefficient of friction of 0.1 between the soil and the aluminum rail and applying a factor of safety of 1.5 calculations indicate that the slope of the trench wall should not exceed 3 degrees or the jack will lift up and fail to provide an arching point.

- In trenches that are sloped above, extending the jack 18" above the hinge point does not provide roll off protection for workers below due to the fact that the jack is spaced. Place fabric or boards behind the jack rail to stop objects at the surface and bank ravel from falling on workers, See **Figure 17**.

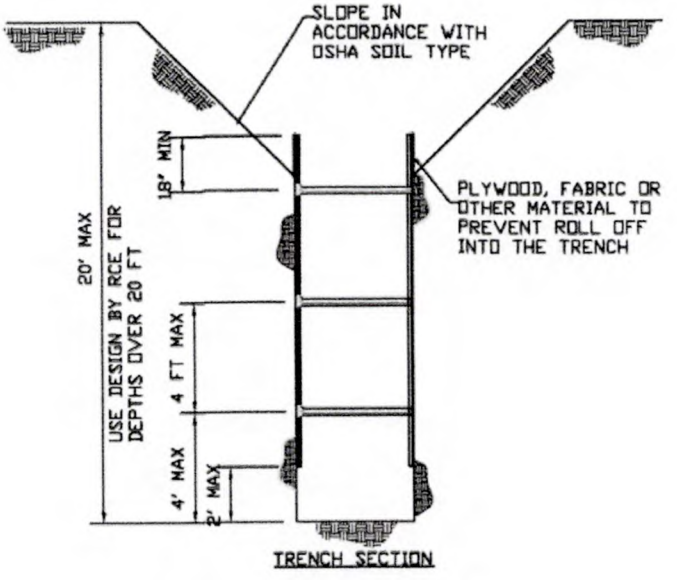


Figure 17. Trench Safety issues

Subpart P Additional Requirements Related to Hydraulic Shoring with Commentary

The following are excerpts from Subpart P that are relative to hydraulic shoring use.

1926.652(e)(1)(ii) Support systems shall be installed and removed in a manner that protects employees from cave-ins, structural collapses, or from being struck by members of the support system.

1926.652(e)(2)(ii)
Installation of a support system shall be closely coordinated with the excavation of trenches.

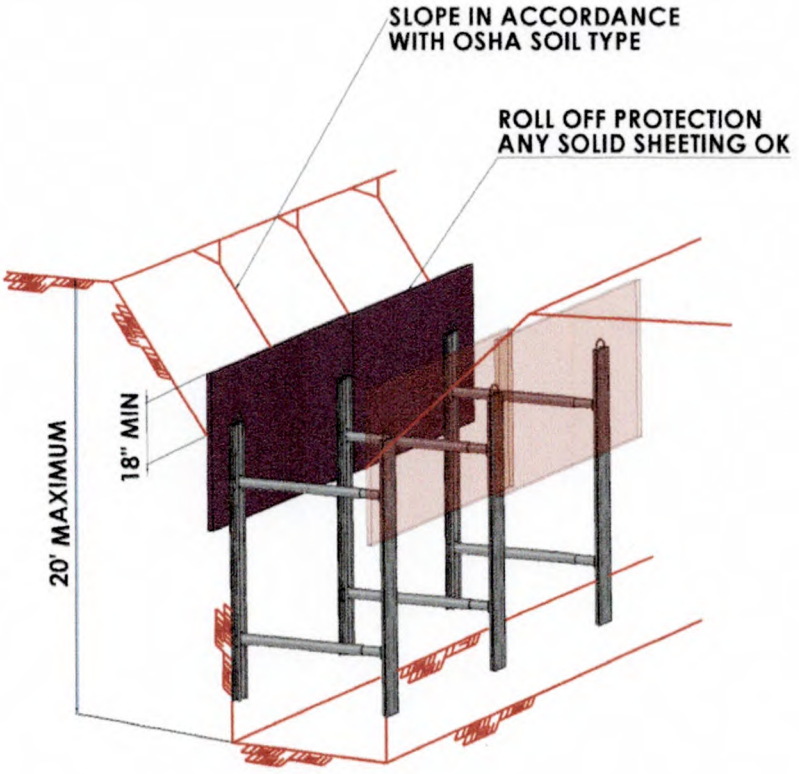
Commentary - Hydraulic shores were developed so that they could be installed and removed from outside the excavation. Cave-in from the surface is still a hazard while installing and removing the shore. Hydraulic shores should be installed as soon as possible after the trench is excavated. This means that if the shores are being installed horizontally at 6 ft on center there should be no more than 6 to 10 ft of trench unshored at any time. It is not acceptable to open a length of trench and then go back and install the shores later.

When hydraulic shores are being removed use caution, stand away from the trench edge and backfill as close to the shore removal location as possible.

It is not allowed to remove and replace a hydraulic shore in order to install production work that will not fit within the shore spacing. If a hydraulic shore is being removed and replaced in order to set pipe into the excavation the soil arching support that was originally set up is being removed similar to removing a column from under an arch. Collapse is imminent and can occur immediately or at the time of resetting the shore.

1926.652(f) Sloping and benching systems. Employees shall not be permitted to work on the faces of sloped or benched excavations at levels above other employees except when employees at the lower levels are adequately protected from the hazard of falling, rolling, or sliding material or equipment.

Commentary - When hydraulic shores are used in sloped excavations without sheeting some form of roll off protection must be provided.



SLOPED EXCAVATIONS

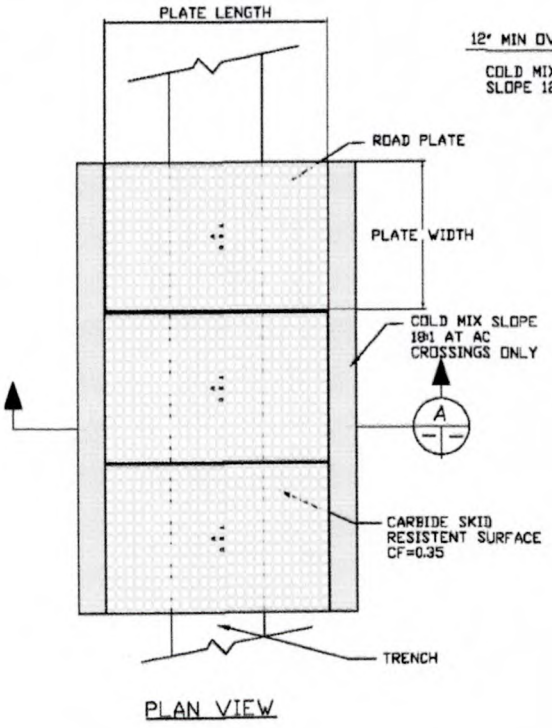
1926.652(e)(2)(i) Excavation of material to a level no greater than 2 feet (.61 m) below the bottom of the members of a support system shall be permitted, but only if the system is designed to resist the forces calculated for the full depth of the trench, and there are no indications while the trench is open of a possible loss of soil from behind or below the bottom of the support system.

Commentary - Either the rail or the plywood must be within 2 ft of the bottom of the excavation.

1926.652(d)(2) Manufactured materials and equipment used for protective systems shall be used and maintained in a manner that is consistent with the recommendations of the manufacturer, and in a manner that will prevent employee exposure to hazards.

Commentary - Daily inspections are required to check for equipment malfunctions.

ROAD PLATE WITH or WITHOUT CARBIDE SKID RESISTANT SURFACE TABULATED DATA
Effective 11-15-16



PLAN VIEW

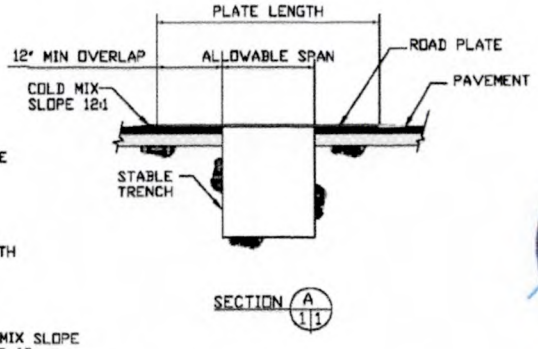


TABLE NOTES:

1. SPAN MEASUREMENT IS AC EDGE TO AC EDGE.
2. TRAFFIC MAY RUN IN ANY DIRECTION ON THE PLATES.
3. PLATE MAY BE PLACED IN EITHER DIRECTION OF THE TRENCH IN ACCORDANCE WITH THE CONDITIONS AND NOTES SPECIFIED HEREIN.
4. IT IS THE PLATE INSTALLERS RESPONSIBILITY TO INSTALL AND MAINTAIN THE PLATES IN ACCORDANCE WITH THIS DATA SHEET AND LOCAL JURISDICTION REQUIREMENTS.

Table 1-ALLOWABLE SPANS AND WEIGHTS FOR STEEL ROAD PLATES

Plate Thickness	Allowable Span	Plate Size / Weight					
1"	2.5'	Size	4'x5'				
		Weight (lbs)	816				
	4.5'	Size	4'x6'	4'x8'			
		Weight (lbs)	979	1306			
		Size	5'x8'	5'x10'			
		Weight (lbs)	1632	2040			
		Size	6'x8'	6'x10'	6'x12'		
		Weight (lbs)	1958	2448	2938		
		Size	8'x10'	8'x12'	8'x15'	8'x16'	8'x20'
		Weight (lbs)	3264	3917	4896	5222	6528
1.25"	7'	Size	8'x10'				
		Weight (lbs)	4080				
1.5"	10'	Size	8'x12'	8'x15'	8'x16'	8'x20'	
		Weight (lbs)	5875	7344	7834	9792	

Note-Plates must always be set in a direction that provides a 1' overlap on the each side of the excavation

Table 2-ALLOWABLE SPANS AND WEIGHTS FOR DOUBLE STACKED STEEL ROAD PLATES

Plate Thickness	Allowable Span	Plate Size / Weight					
2-1"	8'	Size	5'x10'				
		Weight (lbs)	4080				
		Size	6'x10'	6'x12'			
		Weight (lbs)	4896	5875			
		Size	8'x10'	8'x12'	8'x15'	8'x16'	8'x20'
		Weight (lbs)	6528	7834	9792	10445	13056
2-1.25"	11'	Size	8'x15'	8'x16'	8'x20'		
		Weight (lbs)	14688	15667	19584		
2-1.5"	15'	Size	8'x20'				
		Weight (lbs)	19584				

Note-Plates must always be set in a direction that provides a 1' overlap on each side of the excavation

General Conditions

ROAD PLATE WITH or WITHOUT CARBIDE SKID RESISTANT SURFACE TABULATED DATA
Effective 11-15-16

1. Plates are minimum ASTM A36 Min Fy= 36 ksi
2. Trench plate installations including cold mix ramping within the City of Los Angeles and all pavement repairs shall be in accordance Los Angeles Public Works Standard S-601-3, WATCH Manual and all other jurisdiction requirements.
3. Plates are designed for HS20-44 and HL-93 axel loading with 1.33 impact factor
4. Design is based on allowable bending strength
5. Minimum overlap is 12"
6. There shall be no paint on the surface of the road plates.
7. When skid resistance is required, the non-skid surface shall have a dynamic coefficient of friction of 0.35 per California Test Method No. 342 or equivalent skid number of 0.35 as tested per ASTM E274. Any trench plate with non-skid surface less than specified frictional resistance shall be removed and replaced
8. This data sheet applies to general use in all locations, areas where skid resistance is required and where it is not required.
9. All road plates with carbide skid resistant surface are manufactured in Trench Shoring Company Plant at 206 N. Central Ave., Compton, CA 90220.
10. All tops of the road plates must be flush.

CER, Inc.
Construction Engineering Resource, Inc.
1837 Wright Street
Santa Rosa, CA 95404
(707) 484-4704 jmtengr2@aol.com

SUBMITTAL TRANSMITTAL

TO:	Los Angeles County Public Works Project Management Division III, 8th Floor 900 S Fremont Ave, Alhambra, CA 91803 Attention: Mr. Navid Ehsan	**SUBMITTAL NUMBER:**	60
FROM:	Dominguez General Engineering, Inc. 11096 Pipeline Avenue Pomona, CA 91766	**DATE REQUESTED:**	09/25/2024
PROJECT: COASTLINE DRIVE 12-INCH WATERLINE IMPROVEMENTS PROJECT (PROJECT ID NO. WWD2900063)			

SUBMITTAL SUBJECT:		Shoring Plan
SPECIFICATION SECTION NUMBER:		
PARAGRAPH NUMBER:		
NUMBER OF PAGES		**35**
NUMBER OF COPIES	**DATE**	**DESCRIPTION**
1	**02/21/2025**	Shoring Plan

TRANSMITTED BY:	Jesus Carvajal	**DATE:**	02/21/2025

REVIEW COMMENTS

Please provide project specific plans (plot plan and sections) with the responsible engineers stamp and signature on the plans. Please provide any reference information related to the shores such as manufacturer data sheets and diagrams etc or calculations for components that are not included as part of the data sheets. Note: addition shoring related information is provided in the project specifications, such as minimum active and surcharge pressures.

The plan shall include the types of shoring that is proposed at various portions of project, maximum heights that the shoring is to be constructed to, any utilities in the vicinity of the excavation and any other detail related to the shoring such as the number of shores, spacing of shores, type of sheathing, and limitation on live loading adjacent to the excavations.

Please see project specifications including Section 306-4.3 and Los Angele County Department of Public Works Standard Plan 3090-1 for shoring plan submittal requirements.

REVIEW BY:	Hakop Meymarian	**DATE:**	3-20-2025

Cc: File - Submittal # _____

underground excavations shall be in accordance with the Tunnel Safety Orders of the State of California, Department of Industrial Relations.

Prior to the beginning of work, the Contractor shall designate in writing to the Engineer someone whose responsibility it is to supervise the installation and removal of sheeting, shoring and bracing.

306–4.3 Submittals.

The Contractor shall prepare and submit in accordance with 3–8 Working Drawings and supporting information for its proposed shoring system showing the reaches, design criteria, calculations, sketches, sequence of placement and removal, and other data required in order to shore the excavation for the appropriate cases of shoring expected to be used on the Project. Where shields are to be used, the Working Drawings shall include a typical cross section of the proposed conduit showing adjacent utilities. If a previously approved shield is to be used, submittal of calculations for the shield are not required if the current calculated load does not exceed the load for which the shield was previously approved. If it is requested that the limitation on the use of shields in the vicinity of existing utilities be waived, the submittal shall also include the written statements from the affected utility owners and Working Drawings and calculations of the required utility support. The submitted Working Drawings shall be of the same format as that shown on LACDPW Standard Plan 3091. In particular, the Working Drawings shall indicate the methods of sheeting, shoring and bracing which will be used, applicable reaches, and the installation and removal sequence. The Working Drawings shall also show the positioning of said sheeting, shoring and bracing with respect to the planned location of the proposed structures. Existing improvements which may be affected by the proposed excavation shall also be shown. It is the Contractor's responsibility to submit to the Engineer all test data and calculations required to substantiate the load supporting ability of special components of shoring systems such as screw jacks, speed shores, etc.

Partial submittals will be rejected. Submittals shall include the following:

a) Shoring plans which show on each sheet the Project title, sheet number, total number of sheets, and wet stamp and signature of the California Registered Civil or Structural Engineer responsible for the design.

b) Limits of application for the shoring design, with beginning station and end station.

c) Working Drawings (plans, sections, elevations, and details), material specifications, notes, construction and removal procedures, etc. necessary for the construction and inspection of the shoring system.

d) Supporting calculations prepared by the responsible Registered Civil or Structural Engineer, who will wet stamp and sign the first sheet of these calculations. The calculations shall show and justify the design loads on the shoring. The calculations shall also show the capacity of the shoring system is adequate to withstand the imposed loads.

e) Shoring design criteria. A sample of some of the information required is shown on LACDPW Standard Plan 3091.

f) Notes as shown on LACDPW Standard Plan 3091.

g) A statement confirming the Contractor has reviewed the proposed shoring Working Drawings and found them compatible with the site conditions and proposed construction methods.

h) If shields are proposed, the shoring Working Drawings shall show the limits of Zone A and Zone B offset from the toe of excavation as delineated on LACDPW Standard Plan 3090 Case 4. The shoring designer shall verify the field condition and state on the Working Drawings that the design conforms to the requirements shown in Section D "SHIELDS" on Sheet 4 of LACDPW Standard Plan 3090.

The submittal package shall also include:

i) Manufacturer's specifications and other data necessary for the review of the proposed shoring as applicable.

j) Traffic Control Plan, *if not included with the Plans*, if it affects the live load surcharge or the aforementioned Zone A requirements on the shoring system.

306–4.4 Agency Review.

A review of the submitted Working Drawings and supporting information will be performed by the Agency. The review will be for the purpose of determining that the following items have been considered and are in accordance with the stated criteria.

a) Soil Loads.

GENERAL MINIMUM REQUIREMENTS (CONT.)

C. SPECIAL SHORING SYSTEMS

SYSTEMS SUCH AS SPEED-SHORE, TREN-SHORE, ETC., WILL BE ALLOWED ONLY IF THE CONTRACTOR FILES OR HAS FILED WITH THE DEPARTMENT SUBSTANTIATING CERTIFIED TESTS CLEARLY DENOTING THE CAPACITY OF THE SYSTEM. UNTESTED MEMBERS OF SPECIAL SYSTEMS, COMPOSITE MEMBERS, BUILT-UP MEMBERS, ETC., MUST BE THEORETICALLY DESIGNED. VERTICAL SHORES MUST BE AT LEAST 200mm(8") WIDE. STRUTS TESTED UNDER IDEAL OR LABORATORY CONDITIONS SHALL BE USED WITH A MINIMUM SAFETY FACTOR OF 1.5.

D. SHIELDS

1. SHIELDS ARE ACCEPTABLE AS A MEANS OF SHORING EXCAVATIONS, AS SHOWN ON CASE 4, WITH THE FOLLOWING RESTRICTIONS.
   a. ZONE A SHALL NOT INTERCEPT PROPERTY LINES OR INTERCEPT AN AREA REQUIRED BY THE SPECIFICATIONS FOR TRAFFIC.
   b. ZONE A SHALL NOT CONTAIN ANY EXISTING UTILITY OTHER THAN METALLIC ELECTRIC CONDUITS OR PIPE 100mm(4") OR LESS IN DIAMETER USED FOR LOW PRESSURE GAS DISTRIBUTION.
   c. ZONES A AND B SHALL NOT SUPPORT SURCHARGE DEAD LOADS SUCH AS PILING OR BUILDINGS.

   THE RESTRICTIONS STATED IN b ABOVE WILL BE WAIVED PROVIDED THE CONTRACTOR SUBMITS WRITTEN APPROVAL FROM THE OWNER OF THE UTILITY FOR THE PROPOSED CONSTRUCTION METHOD. THE CONTRACTOR COMPLIES WITH ANY SUPPORT OR PROTECTION METHODS REQUIRED BY THE UTILITY COMPANY, AND THE OWNER OF THE UTILITY STATES, IN WRITING, THAT THEY WILL ACCEPT RESPONSIBILITY FOR ALL CLAIMS FOR DAMAGES THAT MAY ARISE AS A RESULT OF DISTURBANCE TO THE UTILITY. AN ACCEPTABLE SHORING SYSTEM MUST BE INSTALLED WHEN THE SHIELD IS REMOVED.
2. THE LENGTH OF UNSUPPORTED TRENCH IN FRONT OF THE SHIELD SHALL BE 2.5m(9'-0") MAXIMUM FROM THE FORWARD EDGE OF THE SHIELD TO THE TOE OF SLOPE BEING EXCAVATED.
3. SHIELDS SHALL CONFORM TO THE DESIGN CRITERIA NOTED HEREON.

E. TEMPORARY BRIDGES

PLANS AND CALCULATIONS FOR SHORING SYSTEMS AT TEMPORARY BRIDGES SHALL MEET THE REQUIREMENTS OF SUBSECTION 7-10.3.6(7) AS AMENDED.

CALCULATIONS AND DRAWINGS

SHORING SYSTEMS SHALL BE DESIGNED BY A CIVIL OR STRUCTURAL ENGINEER REGISTERED IN THE STATE OF CALIFORNIA.

A. COMPLETE CALCULATIONS MUST BE SUBMITTED TO THE DEPARTMENT NOTING ALL ASSUMPTIONS AND REFERENCES. CALCULATIONS SHALL BE BASED ON STANDARD METHODS AND PROCEDURES BY RECOGNIZED AUTHORITIES. COMPUTER PRINTOUTS AND OTHER SUBMITTALS THAT DO NOT CLEARLY INDICATE THE COMPUTATION METHOD WILL NOT BE ACCEPTED. CROSS-SECTIONS OR SKETCHES SHOWING THE LOCATION OF EXISTING IMPROVEMENTS AND UTILITIES SHALL BE INCLUDED WHEN THE TYPE OF SHORING IS AFFECTED.
B. DEPARTMENT STANDARD PLAN 3091 SHOWS THE FORMAT THAT IS TO BE USED. HOWEVER, THE SUPPORTING CALCULATIONS MAY BE ATTACHED ON LETTER-SIZED PAPER.

ACCEPTANCE

IF FOUND IN CONFORMANCE WITH THIS DRAWING AND THE SPECIFICATIONS, THE DEPARTMENT WILL INDICATE ACCEPTANCE BY SIGNING THE SUBMITTED DRAWINGS. IF THE METHOD SELECTED AND ACCEPTED BY THE DEPARTMENT DOES NOT PROVIDE ADEQUATE SUPPORT UNDER ACTUAL FIELD CONDITIONS, IT SHALL BE REPLACED WITH AN ACCEPTED ALTERNATE. THE DETAILS ARE ALSO SUBJECT TO THE REVIEW OF THE DIVISION OF INDUSTRIAL SAFETY. ANY DEVIATION FROM THE ACCEPTED DESIGN MUST BE APPROVED BY THE DEPARTMENT.

LOS ANGELES COUNTY DEPARTMENT OF PUBLIC WORKS

CRITERIA FOR THE DESIGN OF SHORING FOR EXCAVATIONS

STANDARD PLAN METRIC
3090-1
SHEET 4 OF 4

Project: Coastline Dr. Watermain Replacement
Project Location: Coastline Dr.
PCA: Y5292286A
Monitoring Well Installed: Yes (No)

GEOTECHNICAL LOG OF BORING AND SAMPLING
Los Angeles County Department of Public Works
Geotechnical and Materials Engineering Division

Boring No.: B-1 | Date(s) Drilled: 6/3/15 | Logged by: RLM, JJU and K. Burger | Boring Diameter: 6 in. | Ground Elevation: 173' | Page 1 of 1
Boring Location: STA 11+40 | Drilled by: FMD; Puga | Hammer Weight: 140 lbs. | Total Depth: 15' 6" | Depth to Invert: ft.
Latitude & Longitude: 34.042 & -118.573 | Drilling Method: Hollow stem auger Equipment: CME | Drop Height: 30 in. | Depth to Groundwater: N/A | Depth to Bedrock: 6'

DEPTH (FEET)	FIELD DATA: Sample No.	Dyce Test	Bulk	Blow Count (per 6 in.)	Graphic Log	DESCRIPTION	LABORATORY TESTING: USCS	In-situ γ_d (pcf)	In-situ MC (%)	Sieve % Passing No. 4	Sieve % Passing No. 200	LL	PI	Type of Tests
0						0 - 8" Asphalt								
						8" - 1' Aggregate Base								
						1' - 6' Sand, silty, (Terrace deposits), in medium to coarse-grained, reddish brown, quartzite cobbles up to 2", well rounded, moderately well cemented, slightly moist								
5	1R			18/14/8		@ 3' material changes to a yellowish-brown color, abundant very fine gravel, slightly moist	GW	118.9	2.0	45.7	4.4	--	--	SA
	2B									84.3	23.5	--	--	SA SE CR
						6' - 11'6" Shale, clayey, (Tuna Canyon Formation?), yellowish-dark brown, magnesium staining along fractures, moist								
10	3R			7/12/21				119.1	5.0	31.2	7.3	--	--	SA
						11'6" - 15' Siltstone, (Tuna Canyon Formation), light grayish-brown, brittle to very hard, fractures, free water (in fractures?)								
	4B							----	----	---	--	--	--	SE
15	5R			7/23/-/-		15' - TD Sandstone, (Tuna Canyon Formation), arkosic, fine to coarse grained, well sorted, rounded pebbles up to 1/2-in diameter, weakly cemented with iron oxide		106.8	4.4	34.0	5.1	--	--	SA
						TD = 15'6"								
						Free water encountered @ 11'6" & 15'6"								
						Backfilled with cuttings								
20														
25														
30														

LEGEND
California Ring (2.5 in. OD) Sample; California Ring (3 in. OD) Sample; SPT (2 in. OD) Sample; Bulk Sample; Depth to Invert; Seepage Encountered During Drilling; Groundwater Encountered During Drilling; Distinct Contact; Gradational or Uncertain Contact; γ_d - Dry Density; MC - Moisture Content

Types of Tests
CO - Consolidation; CR - Corrosion; DS - Direct Shear; EI - Expansion Index; HY - Hydrometer; MD - Maximum Density; PE - Permeability; SA - Sieve Analysis; SE - Sand Equivalence; TR - Triaxial

Note: This log contains observations and interpretations that are valid only for the specific date and location of the boring. Subsurface conditions vary between borings and with time. Material descriptions are derived using visual classification methods and may vary from descriptions/classifications based on laboratory testing.

Project: Coastline Dr. Watermain Replacement
Project Location: Coastline Dr.
PCA: Y5292286A
Monitoring Well Installed: Yes (No)

GEOTECHNICAL LOG OF BORING AND SAMPLING
Los Angeles County Department of Public Works
Geotechnical and Materials Engineering Division

Boring No.: B-2 | Date(s) Drilled: 6/3/15 | Logged by: RLM, JJU and K. Burger | Boring Diameter: 6 in. | Ground Elevation: 159' | Page 1 of 1
Boring Location: STA 14+22 | Drilled by: FMD; Mendoza | Hammer Weight: 140 lbs. | Total Depth: 16' | Depth to Invert: ft.
Latitude & Longitude: 34.042 & -118.572 | Drilling Method: Hollow stem auger Equipment: CME | Drop Height: 30 in. | Depth to Groundwater: N/A | Depth to Bedrock: 6'

DEPTH (FEET)	FIELD DATA: Sample No.	Dyce Test	Bulk	Blow Count (per 6 in.)	Graphic Log	DESCRIPTION	LABORATORY TESTING: USCS	In-situ γ_d (pcf)	In-situ MC (%)	Sieve % Passing No. 4	Sieve % Passing No. 200	LL	PI	Type of Tests
0						0 - 8" Asphalt								
						8" - 1' Aggregate Base								
						1' - 6' Sand, silty, (Terrace deposits), gravel present up to 20%, angular, yellowish-brown, moist								
5	1R			13/17/21			GM/GC	118.0	6.2	56.4	21.4	29	7	SA
	2B					6' - 11'6" Shale, clayey, (Tuna Canyon Formation), orange-brown, fractured, firm, moist, contact with sandstone in tip of sampler				91.5	61.3	30	13	SA SE CR
10	3R			14/24/50						80.3	43.9	26	8	SA
	4B					11'6" - TD Sandstone, (Tuna Canyon Formation), silty, very fine-grained, dark gray, fractured @ 16' similar material as above, except with 15% more sand				93.4	66.9	30	14	SA SE
15	5R			45/78/-				120.0	5.1	83.9	31.5	--	--	SE
						TD = 16'								
						Groundwater or seepage not encountered								
						Backfilled with cuttings								
20														
25														
30														

LEGEND
California Ring (2.5 in. OD) Sample; California Ring (3 in. OD) Sample; SPT (2 in. OD) Sample; Bulk Sample; Depth to Invert; Seepage Encountered During Drilling; Groundwater Encountered During Drilling; Distinct Contact; Gradational or Uncertain Contact; γ_d - Dry Density; MC - Moisture Content

Types of Tests
CO - Consolidation; CR - Corrosion; DS - Direct Shear; EI - Expansion Index; HY - Hydrometer; MD - Maximum Density; PE - Permeability; SA - Sieve Analysis; SE - Sand Equivalence; TR - Triaxial

Note: This log contains observations and interpretations that are valid only for the specific date and location of the boring. Subsurface conditions vary between borings and with time. Material descriptions are derived using visual classification methods and may vary from descriptions/classifications based on laboratory testing.

Project: Coastline Dr. Watermain Replacement
Project Location: Coastline Dr.
PCA: Y5292286A
Monitoring Well Installed: Yes (No)

GEOTECHNICAL LOG OF BORING AND SAMPLING
Los Angeles County Department of Public Works
Geotechnical and Materials Engineering Division

Boring No.: B-3 | Date(s) Drilled: 6/3/15 | Logged by: RLM, JJU and K. Burger | Boring Diameter: 6 in. | Ground Elevation: 140' | Page 1 of 1
Boring Location: STA 17+41 | Drilled by: FMC; Aldrete | Hammer Weight: 140 lbs. | Total Depth: 16' | Depth to Invert: ft.
Latitude & Longitude: 34.043 & -118.571 | Drilling Method: Hollow stem auger Equipment: CME | Drop Height: 30 in. | Depth to Groundwater: N/A | Depth to Bedrock: 1'

DEPTH (FEET)	FIELD DATA: Sample No.	Dyce Test	Bulk	Blow Count (per 6 in.)	Graphic Log	DESCRIPTION	LABORATORY TESTING: USCS	In-situ γ_d (pcf)	In-situ MC (%)	Sieve % Passing No. 4	Sieve % Passing No. 200	LL	PI	Type of Tests
0						0 - 7" Asphalt								
						7" - 1' Aggregate Base								
						1' - TD Siltstone, (Tuna Canyon Formation), dark gray, hard, fractured								
5	1R			27/ 53 per 4"				117.1	4.5	54.9	19.8	--	--	SA
	2B									90.4	45.6	--	--	SA SE CR
10	3R			37/50/ 48 per 4"		@ 11'4" clay partings, slightly more cemented		128.9	3.6	53.1	16.0	--	--	SA
	4B							----	----	---	--	--	--	SE
15	5R			52/66/-		@ 16' well cemented, free water		120.5	3.8	60.1	17.1	23	6	SA
						TD = 16'								
						Free water encountered @ 16'								
						Backfilled with cuttings								
20														
25														
30														

LEGEND
California Ring (2.5 in. OD) Sample; California Ring (3 in. OD) Sample; SPT (2 in. OD) Sample; Bulk Sample; Depth to Invert; Seepage Encountered During Drilling; Groundwater Encountered During Drilling; Distinct Contact; Gradational or Uncertain Contact; γ_d - Dry Density; MC - Moisture Content

Types of Tests
CO - Consolidation; CR - Corrosion; DS - Direct Shear; EI - Expansion Index; HY - Hydrometer; MD - Maximum Density; PE - Permeability; SA - Sieve Analysis; SE - Sand Equivalence; TR - Triaxial

Note: This log contains observations and interpretations that are valid only for the specific date and location of the boring. Subsurface conditions vary between borings and with time. Material descriptions are derived using visual classification methods and may vary from descriptions/classifications based on laboratory testing.

Project: Coastline Dr. Watermain Replacement
Project Location: Coastline Dr.
PCA: Y5292286A
Monitoring Well Installed: Yes (No)

GEOTECHNICAL LOG OF BORING AND SAMPLING
Los Angeles County Department of Public Works
Geotechnical and Materials Engineering Division

Boring No.: B-4 | Date(s) Drilled: 6/3/15 | Logged by: RLM, JJU and K. Burger | Boring Diameter: 6 in. | Ground Elevation: 111' | Page 1 of 1
Boring Location: STA 20+50 | Drilled by: FMC; Aldrete | Hammer Weight: 140 lbs. | Total Depth: 16'6" | Depth to Invert: ft.
Latitude & Longitude: 34.042 & -118.570 | Drilling Method: Hollow stem auger Equipment: CME | Drop Height: 30 in. | Depth to Groundwater: N/A | Depth to Bedrock: 6'6"

DEPTH (FEET)	FIELD DATA: Sample No.	Dyce Test	Bulk	Blow Count (per 6 in.)	Graphic Log	DESCRIPTION	LABORATORY TESTING: USCS	In-situ γ_d (pcf)	In-situ MC (%)	Sieve % Passing No. 4	Sieve % Passing No. 200	LL	PI	Type of Tests
0						0 - 8" Asphalt								
						8" - 1' Aggregate Base								
						1' - 6'6" Sand, silty, (Fill), sporadic gravel, light brownish-gray, loose, moist								
						@ 6'6" poor recovery, fine to medium grained, dark gray color, few gravels (5%)								
5	NR			7/7/7		@ 5' No Recovery								
	2B					6'6" - TD Sandstone, (Sespe Formation), clayey to silty with sporadic gravel, fine to medium grained, contains very few volcanic pebbles (3%), medium red-brown up to 3/4", very moist				97.8	34.1	32	15	SA CR
10	3R			6/9/7				108.9	10.2	83.5	23.4	--	--	SA DS
	4B									96.9	33.2	32	15	SA
15	5R			6/9/11		@ 16' increased moisture content, color changes to magenta brown		94.2	12.5	99.6	26.6	--	--	SA
						TD = 16'6"								
						Groundwater or seepage not encountered								
						Backfilled with cuttings								
20														
25														
30														

LEGEND
California Ring (2.5 in. OD) Sample; California Ring (3 in. OD) Sample; SPT (2 in. OD) Sample; Bulk Sample; Depth to Invert; Seepage Encountered During Drilling; Groundwater Encountered During Drilling; Distinct Contact; Gradational or Uncertain Contact; γ_d - Dry Density; MC - Moisture Content

Types of Tests
CO - Consolidation; CR - Corrosion; DS - Direct Shear; EI - Expansion Index; HY - Hydrometer; MD - Maximum Density; PE - Permeability; SA - Sieve Analysis; SE - Sand Equivalence; TR - Triaxial

Note: This log contains observations and interpretations that are valid only for the specific date and location of the boring. Subsurface conditions vary between borings and with time. Material descriptions are derived using visual classification methods and may vary from descriptions/classifications based on laboratory testing.

Project: Coastline Dr. Watermain Replacement
Project Location: Coastline Dr.
PCA: Y5292286A
Monitoring Well Installed: Yes (No)

GEOTECHNICAL LOG OF BORING AND SAMPLING
Los Angeles County Department of Public Works
Geotechnical and Materials Engineering Division

Boring No.: B-5 | Date(s) Drilled: 6/4/15 | Logged by: RLM, JJU and K. Burger | Boring Diameter: 6 in. | Ground Elevation: 80' | Page 1 of 1
Boring Location: STA 23+64 | Drilled by: FMD; Puga | Hammer Weight: 140 lbs. | Total Depth: 16'6" | Depth to Invert: ft.
Latitude & Longitude: 34.042 & -118.569 | Drilling Method: Hollow stem auger Equipment: CME | Drop Height: 30 in. | Depth to Groundwater: N/A | Depth to Bedrock: 1'

DEPTH (FEET)	FIELD DATA: Sample No.	Dyce Test	Bulk	Blow Count (per 6 in.)	Graphic Log	DESCRIPTION	LABORATORY TESTING: USCS	In-situ γ_d (pcf)	In-situ MC (%)	Sieve % Passing No. 4	Sieve % Passing No. 200	LL	PI	Type of Tests
0						0 - 8.5" Asphalt								
						8.5" - 1' Aggregate Base								
						1' - TD Sandstone, (Sespe Formation), clayey to silty, fine to medium grained, magenta-brown, slightly moist to moist, moderately dense								
5	1R			8/15/21				112.1	9.5	99.5	29.7	34	11	SA
	2B					@ 6'6" light greenish gray with magenta mottling, friable, weakly to moderatly cemented, slightly moist to moist				99.5	42.7	56	37	SA SE CR
10	3R			10/25/29				115.9	9.2	99.7	29.5	49	25	SA DS
						@ 11'6" same as above, slightly higher clay content								
	4B									98.5	44.4	59	42	SA SE
15	NR			29/52/40		@ 15' No Recovery								
						TD = 16'6"								
						Groundwater or seepage not encountered								
						Backfilled with cuttings								
20														
25														
30														

LEGEND
California Ring (2.5 in. OD) Sample; California Ring (3 in. OD) Sample; SPT (2 in. OD) Sample; Bulk Sample; Depth to Invert; Seepage Encountered During Drilling; Groundwater Encountered During Drilling; Distinct Contact; Gradational or Uncertain Contact; γ_d - Dry Density; MC - Moisture Content

Types of Tests
CO - Consolidation; CR - Corrosion; DS - Direct Shear; EI - Expansion Index; HY - Hydrometer; MD - Maximum Density; PE - Permeability; SA - Sieve Analysis; SE - Sand Equivalence; TR - Triaxial

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Project: Coastline Dr. Watermain Replacement
Project Location: Coastline Dr.
PCA: Y5292286A
Monitoring Well Installed: Yes (No)

GEOTECHNICAL LOG OF BORING AND SAMPLING
Los Angeles County Department of Public Works
Geotechnical and Materials Engineering Division

Boring No.: B-6 | Date(s) Drilled: 6/4/15 | Logged by: RLM, JJU and K. Burger | Boring Diameter: 6 in. | Ground Elevation: 52' | Page 1 of 1
Boring Location: STA 26+48 | Drilled by: FMD; Puga | Hammer Weight: 140 lbs. | Total Depth: 16'6" | Depth to Invert: ft.
Latitude & Longitude: 34.042 & -118.568 | Drilling Method: Hollow stem auger Equipment: CME | Drop Height: 30 in. | Depth to Groundwater: N/A | Depth to Bedrock: 1'

DEPTH (FEET)	FIELD DATA: Sample No.	Dyce Test	Bulk	Blow Count (per 6 in.)	Graphic Log	DESCRIPTION	LABORATORY TESTING: USCS	In-situ γ_d (pcf)	In-situ MC (%)	Sieve % Passing No. 4	Sieve % Passing No. 200	LL	PI	Type of Tests
0						0 - 8.5" Asphalt								
						8.5" - 1' Aggregate Base								
						1' - TD Sandstone, (Sespe Formation), clayey to silty, fine to medium grained, light greenish gray, some magenta mottling, friable, weakly to moderately cemented, very dense, slightly moist to moist								
5	1R			16/48/63				126.1	7.6	98.7	22.4	32	11	SA
	2B									99.7	43.9	--	--	SA SE CR
10	3R			25/51/ 76 per 5"		@ 11' becomes magenta-brown,slightly moist to moist		117.7	8.6	99.7	29.4	32	12	SA DS
	4B									98.5	41.9	--	--	SA SE
15	5R			18/36/72				133.0	8.0	89.2	30.7	38	19	SA
						TD = 16'6"								
						Groundwater or seepage not encountered								
						Backfilled with cuttings								
20														
25														
30														

LEGEND
California Ring (2.5 in. OD) Sample; California Ring (3 in. OD) Sample; SPT (2 in. OD) Sample; Bulk Sample; Depth to Invert; Seepage Encountered During Drilling; Groundwater Encountered During Drilling; Distinct Contact; Gradational or Uncertain Contact; γ_d - Dry Density; MC - Moisture Content

Types of Tests
CO - Consolidation; CR - Corrosion; DS - Direct Shear; EI - Expansion Index; HY - Hydrometer; MD - Maximum Density; PE - Permeability; SA - Sieve Analysis; SE - Sand Equivalence; TR - Triaxial

Note: This log contains observations and interpretations that are valid only for the specific date and location of the boring. Subsurface conditions vary between borings and with time. Material descriptions are derived using visual classification methods and may vary from descriptions/classifications based on laboratory testing.

Project: Coastline Dr. Watermain Replacement
Project Location: Coastline Dr.
PCA: Y5292286A
Monitoring Well Installed: Yes (No)

GEOTECHNICAL LOG OF BORING AND SAMPLING
Los Angeles County Department of Public Works
Geotechnical and Materials Engineering Division

Boring No.: B-7 | Date(s) Drilled: 6/4/15 | Logged by: RLM, JJU and K. Burger | Boring Diameter: 6 in. | Ground Elevation: 29' | Page 1 of 1
Boring Location: STA 29+00 | Drilled by: FMD, Puga | Hammer Weight: 140 lbs. | Total Depth: 16'6" | Depth to Invert: ft.
Latitude & Longitude: 34.042 & -118.567 | Drilling Method: Hollow stem auger Equipment: CME | Drop Height: 30 in. | Depth to Groundwater: N/A | Depth to Bedrock: 6'

DEPTH (FEET)	FIELD DATA: Sample No.	Dyce Test	Bulk	Blow Count (per 6 in.)	Graphic Log	DESCRIPTION	LABORATORY TESTING: USCS	In-situ γ_d (pcf)	In-situ MC (%)	Sieve % Passing No. 4	Sieve % Passing No. 200	LL	PI	Type of Tests
0						0 - 6" Asphalt								
						6" - 9" Aggregate Base								
						9" - 6' Sand, (alluvium), fine to medium grained, medium brownish-gray, loose, slightly moist								
						@ 1' large volcanic cobble encountered (5" diameter)								
5	1R			1/6/12		@ 2' medium volcanic cobble encountered	SM	99.4	13.7	91.5	28.7	--	--	SA
	2B					6' - TD Siltstone-claystone, (Sespe Formation), reddish-brown,fractured, mottled, slighty moist to moist, dense				99.5	65.3	31	14	SA CR
10	3R			13/55/48				120.7	4.7	86.4	55.3	28	9	SA DS
	4B					@ 11'6" oxidized, medium gray color				98.2	66.2	35	19	SA
15	5R			36/27/27				97.9	8.1	90.6	58.0	36	15	SA
						@ 16'6" some oxidation, reddish-brown mottling								
						TD = 16'6"								
						Groundwater or seepage not encountered								
						Backfilled with cuttings								
20														
25														
30														

LEGEND
California Ring (2.5 in. OD) Sample; California Ring (3 in. OD) Sample; SPT (2 in. OD) Sample; Bulk Sample; Depth to Invert; Seepage Encountered During Drilling; Groundwater Encountered During Drilling; Distinct Contact; Gradational or Uncertain Contact; γ_d - Dry Density; MC - Moisture Content

Types of Tests
CO - Consolidation; CR - Corrosion; DS - Direct Shear; EI - Expansion Index; HY - Hydrometer; MD - Maximum Density; PE - Permeability; SA - Sieve Analysis; SE - Sand Equivalence; TR - Triaxial

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FILE NAME: Coastline Dr. 12-inch Waterline Replacement.dgn
DATE LAST SAVED: 5/24/2023
CHECKER: R. HARTOONIAN
DESIGNER: S. MAOULAWI
DRAFTER: L. AWAD / S. MAOULAWI

C-7

DATE	NO.	INITIALS	DESCRIPTION
REVISIONS			

PROFESSIONAL GEOLOGIST
Karin L. Burger
No. 2507
CERTIFIED ENGINEERING GEOLOGIST
STATE OF CALIFORNIA

LOS ANGELES COUNTY PUBLIC WORKS
WATERWORKS DISTRICT NO. 29, MALIBU

COASTLINE DRIVE 12-INCH WATERLINE IMPROVEMENTS

BORING LOGS 1-7

PROJ ID WWD2900063 | PCA Y5292286A | SPEC 29-758 | SHEET 9 OF 12