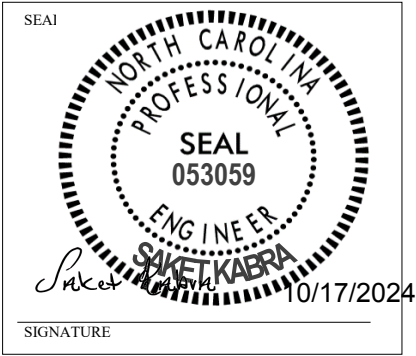


FOUNDATION RECOMMENDATIONS

WBS # DF18203.2010800
T.I.P. NO. N/A
COUNTY BRUNSWICK
STATION 14+33.62 -L-
BRIDGE NO. NA

DESCRIPTION BRIDGE ON SR 1528 (E. MOORE ST)
OVER PRICE'S CREEK BETWEEN
NC HWY 211 AND SR 1527 (E. LEONARD ST.)

	INITIALS	DATE
DESIGN	SK	10/08/24
CHECK	PZ	10/08/24
APPROVAL		



	STATION	FOUNDATION TYPE	FACTORED RESISTANCE	MISCELLANEOUS DETAILS
END BENT 1	14+05	Cap on 16" Prestressed Concrete Pile	145 kips/pile	Bottom of Cap El. = 4.3 ft ± Estimated Pile Length = 45 ft Number of Piles = 7
END BENT 2	14+62	Cap on 16" Prestressed Concrete Pile	145 kips/pile	Bottom of Cap El. = 4.5 ft ± Estimated Pile Length = 45 ft Number of Piles = 7

NOTES ON PLANS & COMMENTS

(See following page)

WBS Element: DF18203.2010800

County BRUNSWICK

FOUNDATION RECOMMENDATION NOTES ON PLANS

1. FOR PILES, SEE SECTION 450 OF THE NCDOT STANDARD SPECIFICATIONS.
2. THE CONTRACTOR MAY CHOOSE TO CONSTRUCT END BENT NO. 2 BEFORE PLACING FILL. PLACE FILL IN ACCORDANCE WITH ARTICLE 410-8 OF THE STANDARD SPECIFICATIONS.

FOUNDATION RECOMMENDATION SPECIAL NOTES ON PLANS

1. FOR SHEET PILE RETAINING WALL, SEE SECTION 452 OF THE NCDOT STANDARD SPECIFICATIONS.
2. METALLIZED PZ35 SHEET PILES ARE TO BE DRIVEN IN FRONT (STREAM SIDE) OF 16" PCP PILES AT END BENT NO. 1 AND NO. 2 AND ALONG WING WALLS AS SHOWN ON PLANS.
3. INSTALL METALLIZED PZ35 SHEET PILES AT END BENT NO. 1 AND NO. 2 TO A MINIMUM TIP ELEVATION OF -36.0 FEET.
4. USE MODIFIED BRIDGE APPROACH FILL DETAILS FOR END BENT NO. 1 AND NO. 2. FOR MODIFIED BRIDGE APPROACH FILL DETAILS, SEE ROADWAY PLANS.

FOUNDATION RECOMMENDATION COMMENTS

1. DYNAMIC RESISTANCE FACTOR OF 0.75 WAS USED AT END BENT NO. 1 AND END BENT NO. 2 DUE
2. LIMESTONE IS ANTICIPATED TO BE AT ELEVATION -36.5 FT AT END BENT NO. 1, AND AT ELEVATION -37.3 FT AT END BENT NO. 2. PILES ARE ANTICIPATED TO BE SEATED ON THE TOP OF THE LIMESTONE.
3. 1.5:1 (H:V) SLOPES AT BOTH END BENT WITH RIP RAP SLOPE PROTECTION AND SHEET PILE WALL AROUND END BENTS ARE OK.

SUMMARY OF PILE INFORMATION/INSTALLATION

(Blank entries indicate item is not applicable to structure)

[illegible]

$$* \text{RDR} = \frac{\text{Factored Resistance} + \text{Factored Drag Load} + \text{Factored Dead Load}}{\text{Dynamic Resistance Factor}} + \text{Nominal Drag Load Resistance} + \text{Nominal Resistance from Scourable Material}$$

**** Predrilling for Piles is required for end bents/bents with a predrilling length and at the Contractor's option for end bents/bents with predrilling information but no predrilling length.**

PILE DESIGN INFORMATION

(Blank entries indicate item is not applicable to structure)

End Bent / Bent No, Pile(s) #(#) (e.g., "Bent 1, Piles 1-5")	Factored Axial Load per Pile KIPS	Factored Drag Load per Pile KIPS	Factored Dead Load * per Pile KIPS	Dynamic Resistance Factor	Nominal Drag Resistance per Pile KIPS	Nominal Scour Resistance per Pile KIPS
End Bent 1, Piles 1-7	145	0	0	0.75	0	0
End Bent 2, Piles 1-7	145	0	0	0.75	0	0

* Factored Dead Load is factored weight of pile above the ground line.

SUMMARY OF DPT/PILE ORDER LENGTHS

(Blank entries indicate item is not applicable to structure)

Dynamic Pile Testing (DPT)		
End Bent / Bent No (e.g., "Bent 1 - Bent 3")	DPT Test Pile Length FT	DPT Testing Quantity EACH
End Bent 1 - End Bent 2	45	2
TOTAL QUANTITY:		2

Pile Order Lengths for Concrete Piles	
End Bent / Bent No (e.g., "Bent 1 - Bent 3")	Pile Order Length Basis* EST or DPT
End Bent 1 - End Bent 2	DPT

* EST = Pile order lengths from estimated pile lengths; DPT = Pile order lengths based on Dynamic Pile Testing. For groups of end bents/bents with pile order lengths based on DPT testing, the first end bent/bent no. listed for each group is the representative end bent/bent with the DPT.

PROJECT NO. DF18203.2010800

BRUNSWICK COUNTY

STATION: 14+33.62 -L-

NOTES:

1. The Pile Foundation Tables are based on the bridge substructure design and foundation recommendations sealed by a North Carolina Professional Engineer (Saket Kabra, #053059) on 10-17-2024.
2. Total Pile Driving Equipment Setup quantity (not shown in Pile Foundation Tables) equals the number of driven piles, i.e., the number of piles with a Required Driving Resistance.
3. The Engineer may adjust the quantity for DPT Testing when necessary.



STATE OF NORTH CAROLINA
DEPARTMENT OF TRANSPORTATION
RALEIGH

PILE FOUNDATION TABLES

SIGNATURE _____ DATE _____

SHEET NO.

REVISIONS						TOTAL SHEETS	
NO.	BY:	DATE:	NO.	BY:	DATE:		
1			3				
2			4				

**DOCUMENT NOT CONSIDERED
FINAL UNLESS ALL
SIGNATURES COMPLETED**



HDR Engineering, Inc., of the Carolinas
555 Fayetteville Street, Suite 900
Raleigh, NC 27601

SUBJECT: BRIDGE ON SR 1528 (E. MOORE ST) OVER PRICE'S CREEK BETWEEN		WBS Element: DF18203.2010800
PREPARED BY: SK		BRUNSWICK County
DATE: 10/01/24		N/A
CHECKED BY: PZ		SHEET: 1
DATE: 10/2/2024		

END BENT 1 SUMMARY

GEOTECHNICAL INFORMATION

BORING ID	GROUND ELEV. (ft)	BORING TERMINATION ELEV. (ft)*	GROUNDWATER ELEV. (ft)	Notes
EB1-A	10.7	-68.8	3.7	0-hr water level
EB1-B	10.5	-88.8	3.5	24-hr water level

Recommended Pile Type: 16" Square CFRP P/S Concrete Piles

Avg Bottom of Cap Elevation: 4.3 ft. *Provided by Structural Engineers*

Pile Tip Elevation: -36.5 ft. *Maximum Tip elevation based on axial analysis*

Pile Length: 42.8 ft. *BOC elevation - Pile Tip Elev+2 ft embedment*

Avg. Estimated Pile Length: 45 ft. *Approx. Avg. Pile Length rounded up to closest 5 foot increment*

Number of Piles: 7 *Provided by Structural Engineers*

Max Factored Load: 145 kips/pile *Provided by Structural Engineers*

Factored Dead Load: 0.0 kips/pile *Factored self weight of pile above scour*

Required Nominal Resistance: 322 kips/pile *AASHTO Resistance Factor = 0.45*
145 kips/0.45 = ~322 kips
(Piles will be seated on the top of Limestone. All required resistance will be from End Bearing).

Required Driving Resistance (R_{ndr}): 195 kips/pile *NCDOT Driving Resistance Factor = 0.75*
145 kips/0.75 = ~195 kips

END BENT 2 SUMMARY

GEOTECHNICAL INFORMATION

BORING ID	GROUND ELEV. (ft)	BORING TERMINATION ELEV. (ft)*	GROUNDWATER ELEV. (ft)	Notes
EB2-A	11.6	-87.7	6.6	0-hr water level
EB2-B	11.1	-68.4	Caved	24-hr water level

Recommended Pile Type: 16" Square CFRP P/S Concrete Piles

Avg Bottom of Cap Elevation: 4.5 ft. *Provided by Structural Engineers*

Pile Tip Elevation: -37.3 ft. *Maximum Tip elevation based on axial analysis*

Pile Length: 43.8 ft. *BOC elevation - Pile Tip Elev+2 ft embedment*

Avg. Estimated Pile Length: 45 ft. *Approx. Avg. Pile Length rounded up to closest 5 foot increment*

Number of Piles: 7 *Provided by Structural Engineers*

Max Factored Load: 145 kips/pile *Provided by Structural Engineers*

Required Nominal Resistance: 322 kips/pile *AASHTO Resistance Factor = 0.45*
145 kips/0.45 = ~322 kips
(Piles will be seated on the top of Limestone. All required resistance will be from End Bearing).

Required Driving Resistance (R_{ndr}): 195 kips/pile *NCDOT Driving Resistance Factor = 0.75*
145/0.75 = ~195 kips
PDA and WEAP Analysis with two tested piles per site condition
NCDOT- GEU LRFD Driven Pile Foundation Design Policy 3.2.3

DOWNDRAG

1. Piles will be driven to refusal on Limestone at End Bents and therefore, no movement are anticipated at the pile tip.

WEAP ANALYSIS

PDA testing is required. Two PDA is required for the 16" Square CFRP P/S Concrete piles and with the same hammer across the A preliminary analysis indicates, typical Delmag D19-42 hammer should be sufficient to drive the piles below the minimum tip elevations, to the required driving resistance without overstress.

Bent	Required Driving Resistance (kip)	Hammer	Max Comp. Stress (ksi)	Max. Tension Stress (ksi)	Stroke (ft)	Blow Counts (bpf)
EB1	195	D19-42	1.1-1.5	0.1	4-6.25	60-37
EB2	195	D19-42	1.1-1.5	0.1	4-6.25	60-37

PROVIDED INFORMATION

End Bent Geometry and Loads (Cored Slabs)

Based on discussion with Structural Engineer, it was provided that bridge will be 55' long and 33' wide cored slab bridge. Standard loading information was assumed as highlighted in yellow.

Bridge Width	CS Unit Length	Factored Pile Reaction (kips)	Factored Pile Reaction (tons)
27'	25'-0"	106	53
	30'-0"	118	59
	35'-0"	126	63
	40'-0"	132	66
	45'-0"	140	70
	50'-0"	154	77
	55'-0"	162	81
	60'-0"	170	85
	65'-0"	178	89
	70'-0"	184	92
30'	25'-0"	110	55
	30'-0"	122	61
	35'-0"	132	66
	40'-0"	140	70
	45'-0"	148	74
	50'-0"	162	81
	55'-0"	170	85
	60'-0"	180	90
	65'-0"	188	94
	70'-0"	194	97
33'	25'-0"	92	46
	30'-0"	102	51
	35'-0"	110	55
	40'-0"	118	59
	45'-0"	122	61
	50'-0"	134	67
	55'-0"	142	71
	60'-0"	148	74
	65'-0"	156	78
	70'-0"	162	81
36'	25'-0"	96	48
	30'-0"	108	54
	35'-0"	116	58
	40'-0"	122	61
	45'-0"	130	65
	50'-0"	142	71
	55'-0"	148	74
	60'-0"	156	78
	65'-0"	164	82
	70'-0"	170	85
39'	25'-0"	100	50
	30'-0"	112	56
	35'-0"	120	60
	40'-0"	126	63
	45'-0"	136	68
	50'-0"	146	73
	55'-0"	154	77
	60'-0"	162	81
	65'-0"	170	85
	70'-0"	176	88

Bridge Width	Skew	Cap Length	No. of Vertical Piles	Pile Spacing
27'	60/120	38'-2"	5	8'-6"
	75/105	34'-3"	5	7'-6"
	90	33'-0"	5	7'-6"
30'	60/120	41'-8"	5	9'-6"
	75/105	37'-4"	5	8'-3"
	90	36'-0"	5	8'-3"
33'	60/120	45'-2"	7	7'-0"
	75/105	40'-6"	7	6'-0"
	90	39'-0"	7	6'-0"
36'	60/120	48'-7"	7	7'-6"
	75/105	43'-7"	7	6'-6"
	90	42'-0"	7	6'-6"
39'	60/120	52'-0"	7	8'-0"
	75/105	46'-8"	7	7'-0"
	90	45'-0"	7	7'-0"



BRIDGE SURVEY & HYDRAULIC DESIGN REPORT

N. C. DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS
HYDRAULICS UNIT
RALEIGH, N. C.

State Proj. Reference No. BP.10.R029 WBS Project No. DF.818203.2010800 Proj. Station -L- 14+33.5
County BRUNSWICK Bridge Over PRICES CREEK Bridge Inv. No.#BP-010-2039
SR 1528 SR 1527
On Highway (E. MOORE ST.) Between NC. 211 and (LENORAD ST.)
Recommended Structure 1 SPAN, 21" CORED SLAB, 1@55' W/4.0' DEEP CAPS

Recommended Width of Roadway 30'-10" CLEAR ROADWAY (33'-0" OUT-TO-OUT) Skew 90 DEG
Recommended Location is (-Up, A) Down Stream from Existing Crossing.

Longitude -78.00497 Latitude 33.93702

Statewide Tier Regional Tier Sub-Regional Tier

Bench Mark is BM1 BL STA. 19+52.16' RT MAG SPIKE IN 18" PINE

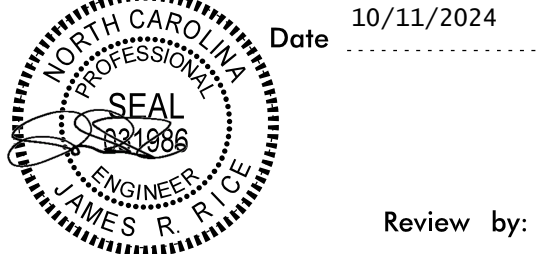
Northing 69467 Easting 2301768 Elev. 5.68' ft. Datum: NAD 88 NA 2011

Temporary Crossing N/A



Designed by: JAMES RICE, PE

Assisted by: KYLE STOFFER, EI & NATALIA WOMACK



Date 10/11/2024

Review by: Craig Lee Date 10/11/2024



HDR Engineering, Inc. of the Carolinas
555 Fayetteville St, Suite 900 Raleigh, N.C. 27601
N.C.B.E.L.S. License Number: F-0116

SITE DATA

Drainage Area 1.13 SQ. MI Source STREAMSTATS
River Basin CAPE FEAR Character URBAN/SALT MARSH (CITY OF SOUTHPORT)
Stream Classification (Such as Trout, High Quality Water, etc.) SC,Sw
Data on Existing Structure 12'11"x7'6" CAAPA, 58.5' ALONG CENTER
Total Waterway Opening 88 s.f.
Debris Potential: Low X Moderate High Waterway Opening Below 100yr. WS EL. 88 s.f.
Data on Structures Up and Down Stream UPSTREAM: 2@36" CULVERT; NO MAJOR STRUCTURE
DOWNSTREAM OF CROSSING, CONFLUENCE'S WITH CAPE FEAR RIVER 0.75 MI DOWNSTREAM

Design Control Elev. 25YR (USGS) WSEL=6.1 ft.
Gage Station No. N/A Period of Records N/A
Max. Discharge N/A c.f.s. Date N/A Frequency N/A

Historical Flood Information:

Date 9/9/24 Elev. 9.0 ft. Est. Freq. +/-100yr. Source NCDOT BRIDGE MAINTENANCE* Period of Knowledge yrs.
ROADWAY EMBANKMENT WASHED OUT AND EX CULVERT DESTROYED DURING STORM.
ROADWAY WAS NOT OVERTOPPED DURING STORM EVENT (WSEL -1-2' BELOW SHOULDER)
Date Elev. ft. Est. Freq. yr. Source Period of Knowledge yrs.
Historical Scour Info: General N/A ft. Contraction N/A ft. Local N/A ft. 0.5'
Channel Slope 0.0005 f/ft Source HEC-RAS MODEL Normal Water Surface Elev. (10/2023 PHOTO) ft.
Manning's n: Left 0.8, 0.08-0.15 Channel 0.025 Right 0.8, 0.08-0.15 Source FEMA MODEL
Flood Study /Status FEMA LIMITED DETAIL STUDY (DATE: 12/6/2019)/ZONE AE
Flood Study 100yr. Discharge 482 c.f.s. WS Elev.: Floodway 9.29 ft. Without Floodway 9.19 ft.
@ River Station 9258.6

DESIGN DATA

Hydrological Method USGS SMALL URBAN REGRESSION EQUATIONS COMPARED WITH FEMA FIS DISCHARGE
Hydraulic Design Method HEC-RAS 6.5.0 FILE NAME: PRICES_CREEK.PRJ (PROPOSED PLAN: P03)

Floods Evaluated:	Freq. (yr.)	Q (c.f.s.)	Elev. (ft.)	Backwater (ft.)	Bridge Opening Velocity (f.p.s.)
@ River Station 9258.6	10	670	4.3	0.6	2.9
	25	780	4.5	0.5	3.2
FEMA	100	482	4.53	0.3	1.9
USGS	100	930	4.6	0.3	3.6
	500	1,100	4.8	0.2	4.1

Waterway Opening Provided Below Design W.S. Elev. 244 s.f., 100yr W.S. Elev. 256 s.f., Total 475 s.f.,
Average Channel Velocity (Design) 2.2 f.p.s. Average Overbank Velocity (Design) 0.4 f.p.s.

Computed Scour: General ft. Contraction 16.0' ft. Local ft.

State Floodway Compliance Type SCF TYPE B (BFE DECREASE OUTSIDE NCDOT RW) (MAX DECREASE 0.34' AT RS 9505.5) (MAX INCREASE 0.03' AT RS 9165.6)

INFORMATION TO BE SHOWN ON PLANS

HYDRAULIC DATA	
DESIGN DISCHARGE (USGS)	= 780 C.F.S.
FREQUENCY OF DESIGN FLOOD	= 25 YRS.
DESIGN HIGH WATER ELEVATION	= 4.5
DRAINAGE AREA	= 1.13 SQ. MI.
BASIC DISCHARGE Q100 (USGS)	= 930 C.F.S.
BASIC HIGH WATER ELEVATION	= 4.6
OVERTOPPING FLOOD DATA	
OVERTOPPING DISCHARGE	= 4,500 C.F.S.
FREQUENCY OF OVERTOPPING FLOOD	= 500 YRS.
OVERTOPPING FLOOD ELEVATION	= 10.8*
*ROADWAY SAG -L- 13+65	
WS EL. Taken @ River Station 9258.6	

ADDITIONAL INFORMATION AND COMPUTATIONS

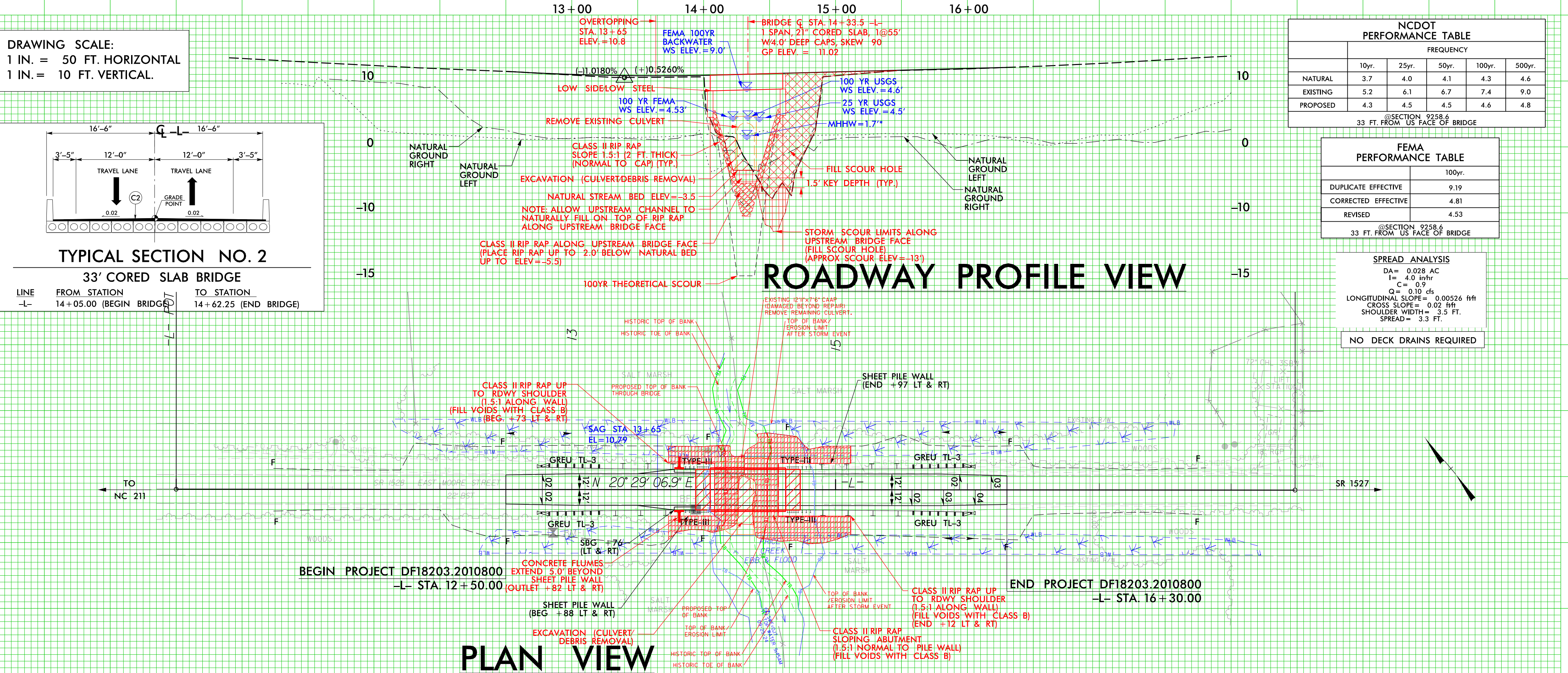
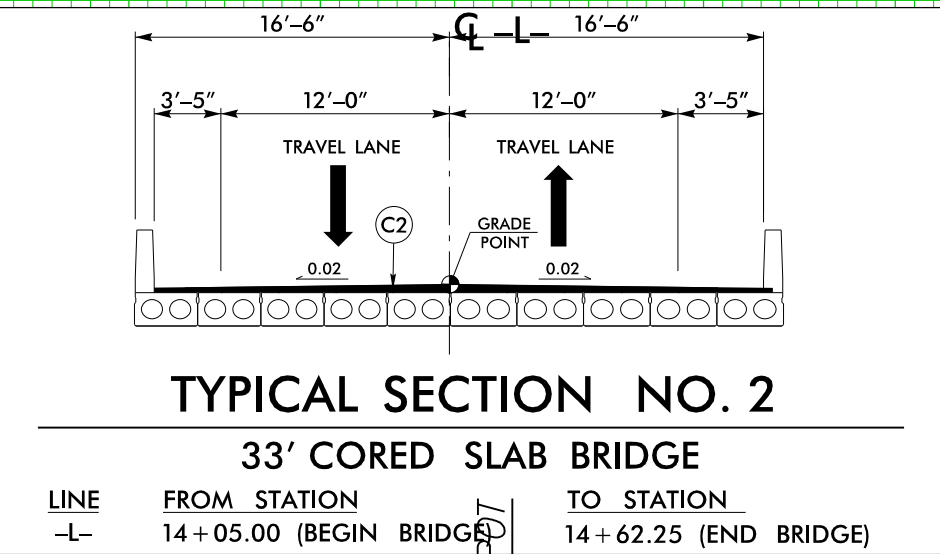
USGS REGRESSION EQUATIONS
SIR 2014-5030. (IA=34.8%) (I24H50Y=10.9in)
REGION 4, 0.1 SQ. MI. < DA < 53.5 SQ. MI. SAY
Q10 = 51.8 (1.13) 0.6004 (10) 0.010134.8 (10) 0.064410.9 = 667 cfs 670 cfs
Q25 = 67.1 (1.13) 0.6007 (10) 0.007534.8 (10) 0.070810.9 = 780 cfs 780 cfs
Q50 = 78.4 (1.13) 0.6111 (10) 0.0058734.8 (10) 0.073810.9 = 857 cfs 860 cfs
Q100 = 90.5 (1.13) 0.6154 (10) 0.0043734.8 (10) 0.076210.9 = 932 cfs 930 cfs 482 cfs
Q500 = 119 (1.13) 0.6261 (10) 0.0012734.8 (10) 0.081310.9 = 1,090 cfs 1,100 cfs
USGS DISCHARGES USED FOR NCDOT DESIGN. FEMA DISCHARGES USED FOR SFC COMPLIANCE.

SCOUR ANALYSIS

LIVE-BED CONTRACTION SCOUR (CHANNEL)
Ys SCOUR = Y1 [(Q2/Q1) 0.7 (W1/W2) 1] - Y0 ; ASSUMED D50 = 2.4 mm
Ys100 = 6.7 [(927.95) 0.7 (1237.4) 64] - 6.7 = 16.0'
Y1, Q1, W1, TAKEN @ RIVER STATION: 9505.5, Q2, TAKEN @ RIVER STATION: 9212.1 BR
SCOUR NOTE: THE 100YR THEORETICAL SCOUR RANGES FROM 1' TO 16' (CLEAR-WATER TO LIVE-BED).
SIGNIFICANT SCOUR WAS OBSERVED AFTER THE STORM THAT WASHED OUT THE ROAD AND CULVERT. THE STORM SCOUR RANGES FROM ELEV -5' TO ELEV -13'. IT IS RECOMMENDED TO CONSIDER THE STORM SCOUR (ELEV -13') OR GREATER, FOR SCOUR CONSIDERATIONS. THERE HAVE BEEN NO PRIOR HISTORICAL SCOUR ISSUES REPORTED BY NCDOT.

BASED ON RAINFALL DATA IN THIS LOCALIZED AREA, THE STORM ON SEPT 16TH 2024 IS ESTIMATED TO HAVE BEEN A 300-500 YR STORM EVENT.
FEMA BACKWATER BEF=9.0'
*NOAA TIDAL RANGE FROM NEAREST STATION (WRIGHTSVILLE BEACH) MHHW=+1.7' & MLLW=-2.8'

DRAWING SCALE:
1 IN. = 50 FT. HORIZONTAL
1 IN. = 10 FT. VERTICAL.



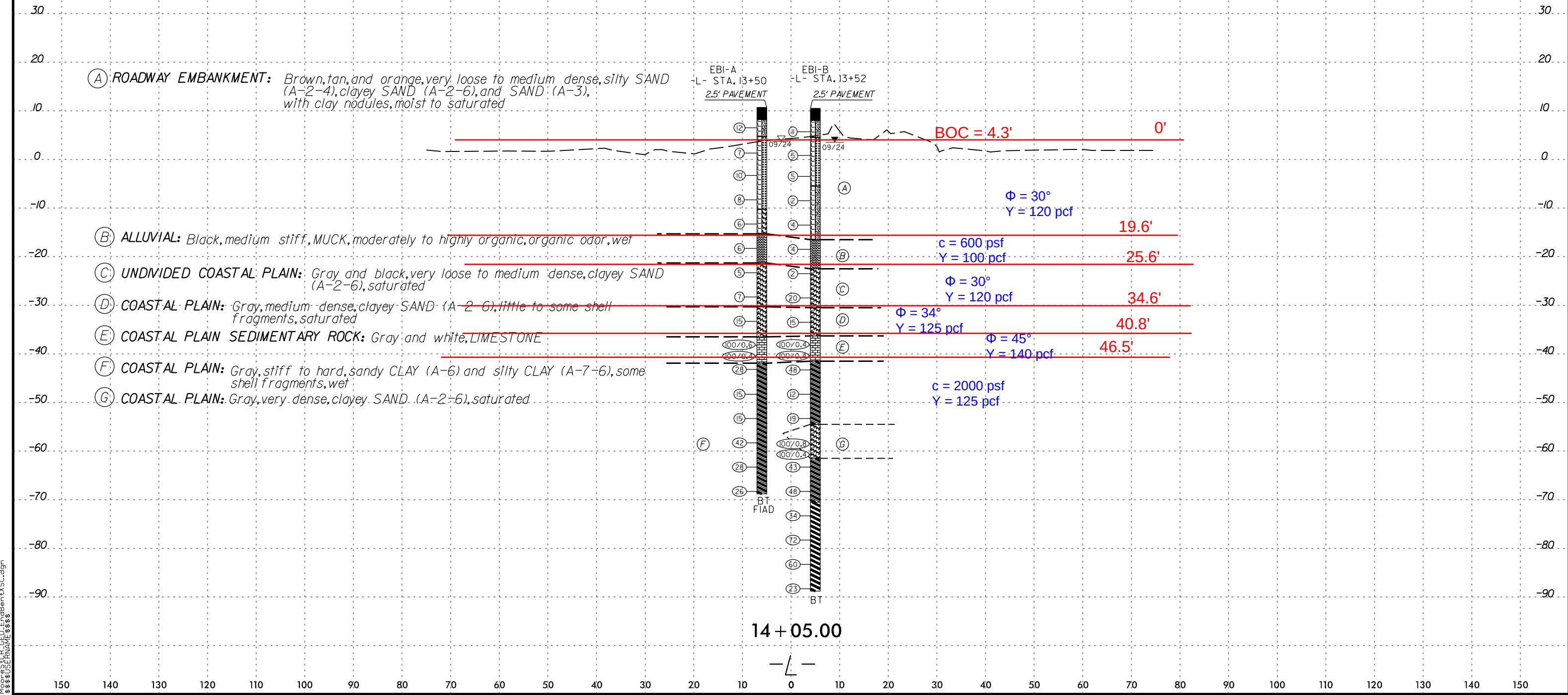
NCDOT PERFORMANCE TABLE					
FREQUENCY					
	10yr.	25yr.	50yr.	100yr.	500yr.
NATURAL	3.7	4.0	4.1	4.3	4.6
EXISTING	5.2	6.1	6.7	7.4	9.0
PROPOSED	4.3	4.5	4.5	4.6	4.8

FEMA PERFORMANCE TABLE	
100yr.	
DUPLICATE EFFECTIVE	9.19
CORRECTED EFFECTIVE	4.81
REVISED	4.53

SPREAD ANALYSIS
DA= 0.028 AC
I= 4.0 in/hr
C= 0.9
Q= 0.10 cfs
LONGITUDINAL SLOPE= 0.00526 f/ft
CROSS SLOPE= 0.02 f/ft
SHOULDER WIDTH= 3.5 FT.
SPREAD= 3.3 FT.
NO DECK DRAINS REQUIRED

END BENT 1

6/23/



APILE ANALYSIS

=====

APILE for Windows, Version 2023.10.5

Serial Number : 226375647

A Program for Analyzing the Axial Capacity
and Short-term Settlement of Driven Piles
under Axial Loading.
(c) Copyright ENSOFT, Inc., 1987-2023
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This program is licensed to :

HDR, Inc.
APILE Global, Global License

Path to file locations : C:\Users\skabra\OneDrive - HDR, Inc\Projects\Emergency
Bridge\Recs\Analysis\APILE\End Bent 1\
Name of input data file : End Bent 1.ap10d
Name of output file : End Bent 1.ap10o
Name of plot output file : End Bent 1.ap10p

Time and Date of Analysis

Date: October 02, 2024 Time: 06:48:02

1

* INPUT INFORMATION *

PROJECT DESCRIPTION :
E. Moore St Emergency Bridge Repair
DESIGNER : S. Kabra
JOB NUMBER : U-

METHOD FOR UNIT LOAD TRANSFERS :
- FHWA (Federal Highway Administration)
Unfactored Unit Side Friction and Unit Side Resistance are used.

COMPUTATION METHOD(S) FOR PILE CAPACITY :
- FHWA (Federal Highway Administration)

TYPE OF LOADING :
- COMPRESSION

PILE TYPE :
Precast concrete pile (Square/Rectangular/Orthogonal)

AVERAGE DEPTH TO ESTIMATE TIP RESISTANCE:
- USE 1.5 DIAMETERS ABOVE AND BELOW TIP

DATA FOR AXIAL STIFFNESS :
- MODULUS OF ELASTICITY = 0.285E+08 PSI
- CROSS SECTION AREA = 256.00 IN2

NONCIRCULAR PILE PROPERTIES :
- TOTAL PILE LENGTH, TL = 45.00 FT.
- BATTER ANGLE = 0.00 DEG
- PILE STICKUP LENGTH, PSL = 4.20 FT.
- ZERO FRICTION LENGTH, ZFL = 5.00 FT.

- PERIMETER OF PILE = 64.00 IN.
 - TIP AREA OF PILE = 256.00 IN²
 - INCREMENT OF PILE LENGTH
 USED IN COMPUTATION = 1.00 FT.
 - PRINTING INCREMENT = 1

SOIL INFORMATIONS :

DEPTH FT.	SOIL TYPE	LATERAL EARTH PRESSURE	EFFECTIVE UNIT WEIGHT LB/FT ³	FRICTION ANGLE DEGREES	Nq FACTOR FHWA
0.00	SAND	0.80*	57.60	30.00	30.00**
19.60	SAND	0.80*	57.60	30.00	30.00**
19.60	CLAY	0.80*	37.60	0.00	4.80**
25.60	CLAY	0.80*	37.60	0.00	4.80**
25.60	SAND	0.80*	57.60	30.00	30.00**
34.60	SAND	0.80*	57.60	30.00	30.00**
34.60	SAND	0.80*	62.60	34.00	55.60**
40.80	SAND	0.80*	62.60	34.00	55.60**
40.80	SAND	0.80*	77.60	45.00	475.00**
46.50	SAND	0.80*	77.60	45.00	475.00**
46.50	CLAY	0.80*	62.60	0.00	4.80**
66.00	CLAY	0.80*	62.60	0.00	4.80**

* VALUE ASSUMED BY THE PROGRAM

** VALUE ESTIMATED BY THE PROGRAM BASED ON FRICTION ANGLE

MAXIMUM UNIT FRICTION KSF	MAXIMUM UNIT BEARING KSF	UNDISTURB SHEAR STRENGTH KSF	REMOLDED SHEAR STRENGTH KSF	BLOW COUNT	UNIT SKIN FRICTION KSF	UNIT END BEARING KSF
0.10E+08*	0.10E+08*	0.00	0.00	0.00	0.00	0.00
0.10E+08*	0.10E+08*	0.00	0.00	0.00	0.00	0.00
0.10E+08*	0.10E+08*	0.60	0.00	0.00	0.00	0.00
0.10E+08*	0.10E+08*	0.60	0.00	0.00	0.00	0.00
0.10E+08*	0.10E+08*	0.00	0.00	0.00	0.00	0.00
0.10E+08*	0.10E+08*	0.00	0.00	0.00	0.00	0.00
0.10E+08*	0.10E+08*	0.00	0.00	0.00	0.00	0.00
0.10E+08*	0.10E+08*	0.00	0.00	0.00	0.00	0.00
0.10E+08*	0.10E+08*	0.00	0.00	0.00	0.00	0.00
0.10E+08*	0.10E+08*	0.00	0.00	0.00	0.00	0.00
0.10E+08*	0.10E+08*	2.00	0.00	0.00	0.00	0.00
0.10E+08*	0.10E+08*	2.00	0.00	0.00	0.00	0.00

* MAXIMUM UNIT FRICTION AND/OR MAXIMUM UNIT BEARING
 WERE SET TO LARGE VALUES INDICATING THAT APILE
 USES THE LIMITS SPECIFIED BY EACH SELECTED
 CRITERIA (IF ANY).

DEPTH FT.	LRFD FACTOR ON UNIT FRICTION	LRFD FACTOR ON UNIT BEARING
0.00	1.000	1.000
19.60	1.000	1.000
19.60	1.000	1.000
25.60	1.000	1.000
25.60	1.000	1.000
34.60	1.000	1.000
34.60	1.000	1.000
40.80	1.000	1.000
40.80	1.000	1.000
46.50	1.000	1.000
46.50	1.000	1.000
66.00	1.000	1.000

DEPTH	Z PEAK	T RESIDUAL
FT.	IN.	
0.00	0.204 *	0.00
19.60	0.204 *	0.00
19.60	0.204 *	0.90 **
25.60	0.204 *	0.90 **
25.60	0.204 *	0.00
34.60	0.204 *	0.00
34.60	0.204 *	0.00
40.80	0.204 *	0.00
40.80	0.204 *	0.00
46.50	0.204 *	0.00
46.50	0.204 *	0.90 **
66.00	0.204 *	0.90 **

* DEFAULT VALUE = 0.01 D
** DEFAULT VALUE = 0.9

1

* COMPUTATION RESULT *

* FED. HWY. METHOD *

PILE LENGTH	SKIN	END	ULTIMATE
BELOW GND.	FRICTION	BEARING	CAPACITY
FT.	KIP	KIP	KIP
0.00	0.0	1.1	1.1
1.00	0.0	2.2	2.2
2.00	0.0	3.6	3.6
3.00	0.0	5.3	5.3
4.00	0.0	7.1	7.1
5.00	0.4	8.9	9.3
6.00	1.3	10.7	12.0
7.00	2.4	12.5	14.9
8.00	3.6	14.3	17.9
9.00	5.0	16.0	21.0
10.00	6.6	17.8	24.4
11.00	8.3	19.6	27.9
12.00	10.2	21.1	31.3
13.00	12.2	22.2	34.5
14.00	14.5	23.1	37.5
15.00	16.8	23.5	40.4
16.00	19.4	23.7	43.1
17.00	22.1	23.7	45.8
18.00	25.0	22.2	47.1
19.00	28.0	19.4	47.4
20.00	31.2	16.6	47.9
21.00	34.5	13.9	48.3
22.00	37.7	11.1	48.8
23.00	40.9	9.6	50.5
24.00	44.1	11.1	55.2
25.00	47.3	13.9	61.1
26.00	50.5	16.6	67.1
27.00	54.1	19.4	73.5
28.00	58.3	22.2	80.5

29.00	62.6	23.7	86.3
30.00	67.1	23.7	90.8
31.00	71.8	23.7	95.5
32.00	76.6	23.7	100.3
33.00	81.6	34.6	116.2
34.00	86.8	55.1	141.9
35.00	92.1	76.1	168.2
36.00	99.3	97.1	196.4
37.00	108.3	118.1	226.4
38.00	117.6	130.1	247.7
39.00	127.2	257.3	384.5
40.00	137.1	489.2	626.2

Anticipated Pile Tip.
End Bearing on
limestone is greater
than the Required
Nominal
Resistance.

NOTES:
- AN ASTERISK IS PLACED IN THE END-BEARING COLUMN
IF THE TIP RESISTANCE IS CONTROLLED BY THE FRICTION
OF SOIL PLUG INSIDE AN OPEN-ENDED PIPE PILE.

* COMPUTE LOAD-DISTRIBUTION AND LOAD-SETTLEMENT *
* CURVES FOR AXIAL LOADING *

T-Z CURVE NO.	NO. OF POINTS	DEPTH TO CURVE FT.	LOAD TRANSFER PSI	PILE MOVEMENT IN.
1	10	0.4167E-01	0.0000E+00	0.0000E+00
			0.0000E+00	0.3259E-01
			0.0000E+00	0.6315E-01
			0.0000E+00	0.1161E+00
			0.0000E+00	0.1630E+00
			0.0000E+00	0.2037E+00
			0.0000E+00	0.4074E+00
			0.0000E+00	0.6112E+00
			0.0000E+00	0.1019E+01
			0.0000E+00	0.4074E+01
2	10	0.9800E+01	0.0000E+00	0.0000E+00
			0.6289E+00	0.3259E-01
			0.1048E+01	0.6315E-01
			0.1572E+01	0.1161E+00
			0.1887E+01	0.1630E+00
			0.2096E+01	0.2037E+00
			0.2096E+01	0.4074E+00
			0.2096E+01	0.6112E+00
			0.2096E+01	0.1019E+01
			0.2096E+01	0.4074E+01
3	10	0.1956E+02	0.0000E+00	0.0000E+00
			0.1255E+01	0.3259E-01
			0.2092E+01	0.6315E-01
			0.3138E+01	0.1161E+00
			0.3766E+01	0.1630E+00
			0.4184E+01	0.2037E+00
			0.4184E+01	0.4074E+00
			0.4184E+01	0.6112E+00
			0.4184E+01	0.1019E+01
			0.4184E+01	0.4074E+01
4	10	0.1964E+02	0.0000E+00	0.0000E+00
			0.1261E+01	0.3259E-01
			0.2101E+01	0.6315E-01
			0.3151E+01	0.1161E+00
			0.3782E+01	0.1630E+00

DRIVEABILITY ANALYSIS

DEPARTMENT OF TRANSPORTATION

SUBJECT: Prestressed Concrete Pile Driving Stress Analysis

GEOTECHNICAL ENGINEERING UNIT

1589 MAIL SERVICE CENTER

RALEIGH, NC 27699

PREPARED BY: SK DATE: 10/01/24 STATION: 14+33.62 -L-

CHECKED BY: PZ DATE: 10/03/24 STR. NO.: PAGE: OF

DISCLAIMER: The application of this spreadsheet is the responsibility of the user. It is imperative that the user understands the potential accuracy limitations and examines the reasonableness of the results with engineering knowledge and experience. There are no expressed or implied warranties.

Parameters for Prestressed Concrete PileResistance Factor during Pile Driving $\phi_{da} = 1.00$

resistance factor as specified in AASHTO LRFD 5.5.4.2.1 and Table 10.5.5.2.3-1

Concrete Pile Parameters

Pile Type: 16" Standard Prestressed Concrete Pile

Strand Size: 0.5 in

Concrete Area = 256 in²Compressive Strength of the Concrete, f'_c = 7.5 ksi

Number of Strands = 8

Strand Area = 0.153 in²Effective Prestressing Stress per Strand (after loss), f_{pe_strand} = 170 ksi

*** For Standard Piles see NCDOT
Structure Design Standard
Prestressed Concrete Pile Sheets
for details.

Effective Prestressing Stress in Concrete

$$f_{pe} = (f_{pe_strand}) \times (\text{strand area}) \times (\text{number of strand}) / (\text{concrete area})$$

NCDOT LRFD Pile Policy 2.2.2

 $f_{pe_strand} = 170$ ksiStrand Area = 0.153 in²

Number of Strands = 8

Concrete Area = 256 in²

$$f_{pe} = 0.813 \text{ ksi}$$

Driving Stress AnalysisDriving Stress, (σ_{dr}), In Compression (for both normal and severe corrosive environments)

$$\sigma_{dr} = \phi_{da} (0.85 f'_c - f_{pe}) = 5.6 \text{ ksi}$$

AASHTO LRFD Eq. 10.7.8-4

Driving Stress, (σ_{dr}), In Tension

For Normal Environments

$$\sigma_{dr} = \phi_{da} (0.095 \sqrt{f'_c} + f_{pe}) = 1.1 \text{ ksi}$$

AASHTO LRFD Eq. 10.7.8-5

For Severe Corrosive Environments

$$\sigma_{dr} = \phi_{da} f_{pe} = 0.8 \text{ ksi}$$

AASHTO LRFD Eq. 10.7.8-6

Project Description:	E. Moore St Emergency Bridge - End Bent 1	File Name:	16" PCP
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Hammer Information [9/7/2021]

Source: ALL ID: 1 Type: ALL Manufacturer: ALL

ID	Make	Model	Type	Ram Wt/Ecc. M.	Energy/Power	Stroke/Freq.
1	DELMAG	D 5	OED	1.1	10.505	9.55
2	DELMAG	D 8-22	OED	1.76	20.099	11.42
3	DELMAG	D 12	OED	2.75	22.605	8.22
4	DELMAG	D 15	OED	3.3	27.093	8.21
5	DELMAG	D 16-32	OED	3.52	40.198	11.42

Selected hammers:

ID	Make	Model	Type	Ram Wt/Ecc. M.	Energy/Power	Stroke/Freq.
41	DELMAG	D 19-42	OED	4	43.24	10.81

Hammer Parameter

Efficiency

Pressure psi %

Stroke ft

☒ Concrete
 ☐ Steel
 ☐ Timber

Cushion Information			
	Hammer	Pile	
Area	415.000	256.000	in ²
E. Modulus	530.0	30.0	ksi
Thickness	2.0	9.0	in
C.O.R	0.80	0.50	
Stiffness	109976.01	853.34	kips/in
Helmet Weight	4.000		kips

Pile Information			
Length	45.00	ft	
Penetration	40.80	ft	
Inclination	0	deg	Ratio: x 1 : z 0
Section Area	256.000	in ²	Segments Auto
E. Modulus	5000.0	ksi	S-Length Auto
Spec. Weight	150.000	lb/ft ³	S-St. Wt Auto
End Bg. Area	256.000	in ²	Splices 0
Perimeter	5.333	ft	Pile Type
Pile Size	16.00	in	Square

Resistance Gain/Loss Factors			
Shaft		Toe	
1	1.000	1	1.000
2	0	2	0
3	0	3	0
4	0	4	0
5	0	5	0

Soil Parameters

2nd Toe - No.

Quake

Shaft in

Toe in

Damping

Shaft s/ft

Toe s/ft

Shift Resistance

Percentage %

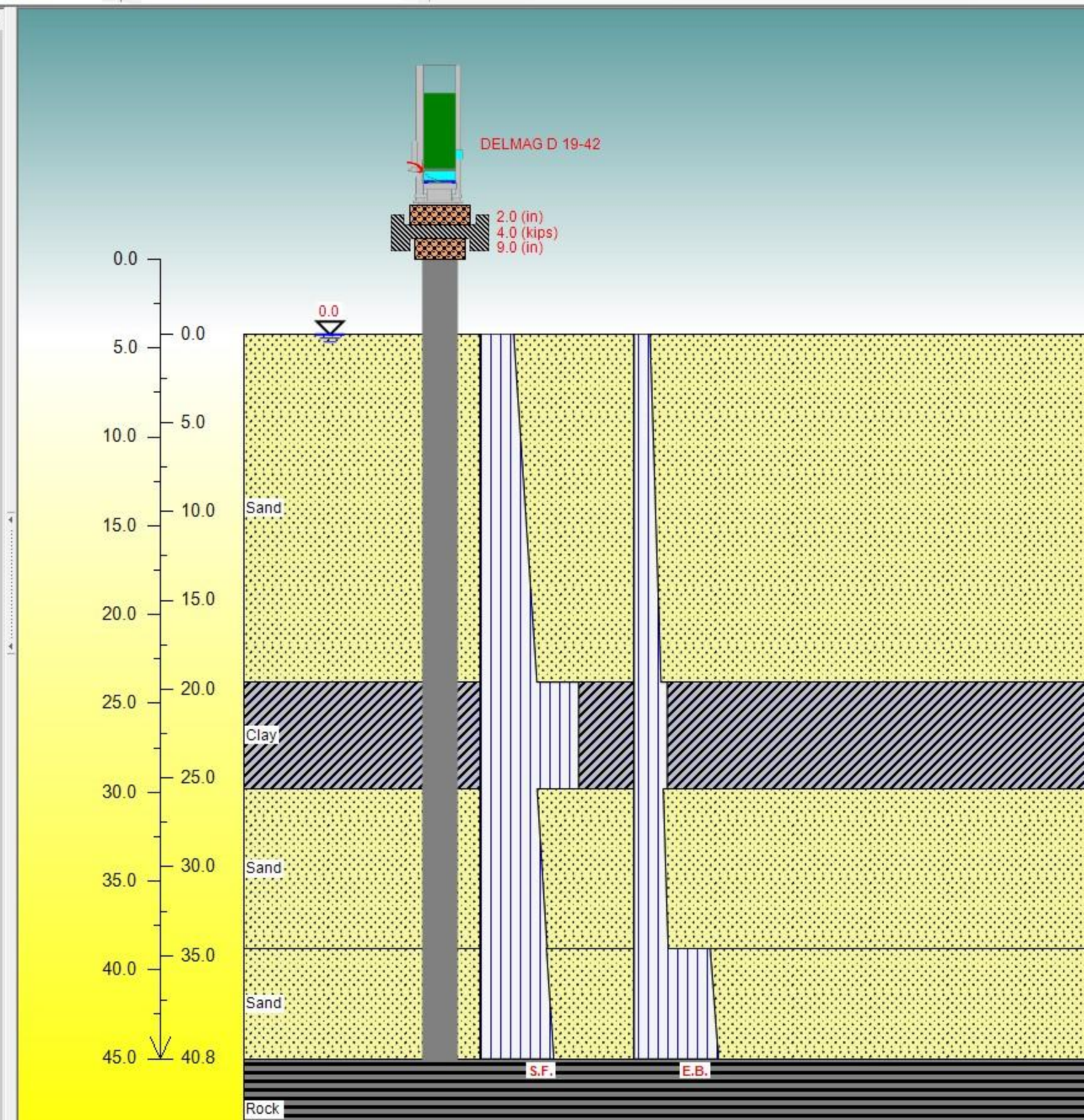


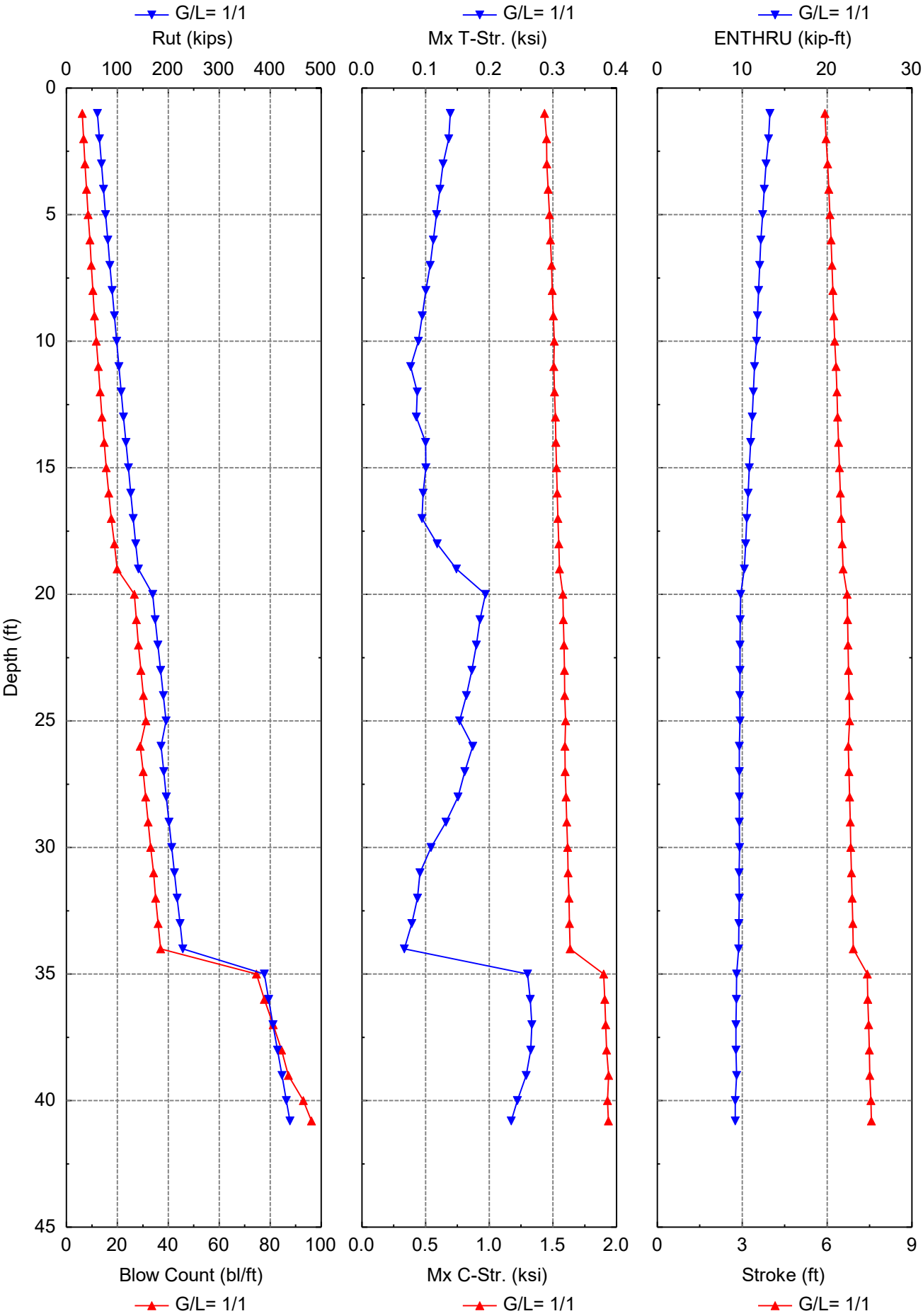
The slider bar is a horizontal line with a vertical marker at the 29% position. The bar is divided into 10 equal segments, each representing 10% of the range. The segments are numbered 1 through 10 from left to right. The marker is positioned between the 2nd and 3rd segments, closer to the 3rd segment.

Residual Stress Analysis	No
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Two Pile Model - Off

Converge Stroke with Fix Pressure





Driveability Analysis Summary
Gain/Loss Factor at Shaft/Toe = 1.000/1.000

Depth ft	Rut kips	Rshaft kips	Rtoe kips	Blow CtMx bl/ft	C-StrMx ksi	T-Str. ksi	Stroke ft	ENTHRU kip-ft	Hammer -
1.0	60.9	1.8	59.1	6.2	1.434	0.139	5.93	13.3	D 19-42
2.0	64.8	3.7	61.2	6.7	1.450	0.136	5.97	13.1	D 19-42
3.0	68.8	5.6	63.2	7.3	1.451	0.127	6.02	12.8	D 19-42
4.0	72.9	7.6	65.3	7.9	1.462	0.122	6.06	12.6	D 19-42
5.0	77.0	9.6	67.3	8.5	1.473	0.117	6.10	12.4	D 19-42
6.0	81.1	11.8	69.4	9.2	1.481	0.112	6.14	12.2	D 19-42
7.0	85.4	13.9	71.4	9.8	1.489	0.107	6.17	12.1	D 19-42
8.0	89.7	16.2	73.5	10.4	1.495	0.100	6.20	11.9	D 19-42
9.0	94.0	18.5	75.5	11.0	1.503	0.095	6.24	11.8	D 19-42
10.0	98.4	20.9	77.6	11.7	1.511	0.089	6.27	11.7	D 19-42
11.0	102.9	23.3	79.6	12.5	1.506	0.077	6.32	11.4	D 19-42
12.0	107.5	25.8	81.7	13.2	1.513	0.087	6.35	11.3	D 19-42
13.0	112.1	28.4	83.7	13.9	1.519	0.086	6.37	11.2	D 19-42
14.0	116.8	31.0	85.8	14.8	1.522	0.100	6.40	11.0	D 19-42
15.0	121.5	33.7	87.8	15.6	1.528	0.100	6.43	10.8	D 19-42
16.0	126.3	36.4	89.9	16.6	1.534	0.096	6.46	10.7	D 19-42
17.0	131.2	39.3	91.9	17.6	1.540	0.094	6.50	10.5	D 19-42
18.0	136.1	42.1	94.0	18.8	1.546	0.118	6.53	10.4	D 19-42
19.0	141.1	45.1	96.1	19.9	1.552	0.148	6.56	10.3	D 19-42
20.0	169.4	48.8	120.5	26.7	1.579	0.194	6.71	9.8	D 19-42
21.0	174.3	53.8	120.5	27.5	1.583	0.186	6.72	9.8	D 19-42
22.0	179.4	58.9	120.5	28.3	1.587	0.180	6.74	9.7	D 19-42
23.0	184.7	64.2	120.5	29.2	1.591	0.173	6.76	9.7	D 19-42
24.0	190.1	69.5	120.5	30.2	1.593	0.164	6.78	9.7	D 19-42
25.0	195.6	75.1	120.5	31.2	1.600	0.153	6.80	9.7	D 19-42
26.0	185.8	79.7	106.1	29.0	1.594	0.174	6.75	9.7	D 19-42
27.0	191.0	82.8	108.2	30.1	1.597	0.161	6.77	9.6	D 19-42
28.0	196.2	85.9	110.2	31.1	1.604	0.151	6.79	9.7	D 19-42
29.0	201.4	89.1	112.3	32.1	1.609	0.132	6.82	9.7	D 19-42
30.0	206.7	92.4	114.4	33.1	1.616	0.108	6.84	9.7	D 19-42
31.0	212.1	95.7	116.4	34.2	1.619	0.091	6.86	9.6	D 19-42
32.0	217.5	99.1	118.5	35.0	1.626	0.087	6.88	9.6	D 19-42
33.0	223.0	102.5	120.5	36.0	1.630	0.078	6.90	9.6	D 19-42
34.0	228.6	106.0	122.6	37.0	1.634	0.067	6.93	9.6	D 19-42
35.0	388.4	109.6	278.8	74.6	1.899	0.260	7.42	9.3	D 19-42
36.0	396.9	113.1	283.8	77.7	1.907	0.264	7.44	9.3	D 19-42
37.0	405.6	116.8	288.8	81.2	1.914	0.267	7.47	9.3	D 19-42
38.0	414.3	120.5	293.8	84.5	1.922	0.265	7.49	9.3	D 19-42
39.0	423.0	124.3	298.8	87.1	1.937	0.258	7.51	9.3	D 19-42
40.0	431.9	128.1	303.7	93.0	1.928	0.244	7.55	9.2	D 19-42
40.8	439.0	131.2	307.7	96.2	1.936	0.234	7.56	9.2	D 19-42

Total driving time: 27 minutes; Total Number of Blows: 1226 (starting at penetration 1.0 ft)

GRLWEAP: Wave Equation Analysis of Pile Foundations

E. Moore St Emergency Bridge - End Bent 1 + 16" PCP

10/2/2024

HDR ENGINEERING

GRLWEAP 14.1.20.1

ABOUT THE WAVE EQUATION ANALYSIS RESULTS

The GRLWEAP program simulates the behavior of a preformed pile driven by either an impact hammer or a vibratory hammer. The program is based on mathematical models, which describe motion and forces of hammer, driving system, pile and soil under the hammer action. Under certain conditions, the models only crudely approximate, often complex, dynamic situations.

A wave equation analysis generally relies on input data, which represents normal situations. In particular, the hammer data file supplied with the program assumes that the hammer is in good working order. All of the input data selected by the user may be the best available information at the time when the analysis is performed. However, input data and therefore results may significantly differ from actual field conditions.

Therefore, the program authors recommend prudent use of the GRLWEAP results. Soil response and hammer performance should be verified by static and/or dynamic testing and measurements. Estimates of bending or other local stresses (e.g., helmet or clamp contact, uneven rock surfaces etc.), prestress effects and others must also be accounted for by the user.

The calculated capacity-blow count relationship, i.e. the bearing graph, should be used in conjunction with observed blow counts for the capacity assessment of a driven pile. Soil setup occurring after pile installation may produce bearing capacity values that differ substantially from those expected from a wave equation analysis due to soil setup or relaxation. This is particularly true for pile driven with vibratory hammers. The GRLWEAP user must estimate such effects and should also use proper care when applying blow counts from restrike because of the variability of hammer energy, soil resistance and blow count during early restriking.

Finally, the GRLWEAP capacities are ultimate values. They MUST be reduced by means of an appropriate factor of safety to yield a design or working load. The selection of a factor of safety should consider the quality of the construction control, the variability of the site conditions, uncertainties in the loads, the importance of structure and other factors.

E. Moore St Emergency Bridge - End Bent 1 + 16" PCP

HDR ENGINEERING

HAMMER DATA

Hammer Model:	D 19-42	Made By:	DELMAG
Hammer ID:	41	Hammer Type:	OED
Hammer Database Type:	PDI		
Hammer Database Name:			PDIHammer.gwh

Hammer and Drive System Segment Data

Segment	Weight	Stiffness	COR	C-Slack	Damping
-	kips	kips/in	-	in	kips/ft/s
1	0.800	140,084.4	1.000	0.000	
2	0.800	140,084.4	1.000	0.000	
3	0.800	140,084.4	1.000	0.000	
4	0.800	140,084.4	1.000	0.000	
5	0.800	70,754.7	0.900	0.120	
Imp Block	0.753	109,976.0	0.800	0.120	
Helmet	4.000				5.3

Ram Weight: (kips)	4.00	Ram Length: (ft)	10.76
Ram Area: (in ²)	124.69		
Maximum (Eq) Stroke: (ft)	10.81	Actual (Eq) Stroke: (ft)	6.00
Efficiency:	0.800	Rated Energy: (kip-ft)	43.24
Maximum Pressure: (psi)	1,600.00	Actual Pressure: (psi)	1,600.00
Combustion Delay: (ms)	2.00	Ignition Duration: (ms)	2.00
Expansion Exponent:	1.25		

Hammer Cushion

Pile Cushion

Cross Sect. Area: (in ²)	415.00	Cross Sect. Area: (in ²)	256.00
Elastic Modulus: (ksi)	530.0	Elastic Modulus: (ksi)	30.0
Thickness: (in)	2.00	Thickness: (in)	9.00
Coeff. of Restitution:	0.800	Coeff. of Restitution:	0.500
RoundOut: (in)	0.120	RoundOut: (in)	0.120
Stiffness: (kips/in)	109,976.0	Stiffness: (kips/in)	853.3
Helmet Weight: (kips)	4.000		

PILE INPUT

Uniform Pile		Pile Type:	Square
Pile Length: (ft)	45.000	Pile Penetration: (ft)	40.800
Pile Size: (ft)	1.33	Toe Area: (in ²)	256.00

E. Moore St Emergency Bridge - End Bent 1 + 16" PCP

HDR ENGINEERING

Table of Depths Analyzed with Driving System Modifiers

Depth ft	Temp Length ft	Wait Time Hr	Hammer -
1.00	45.0	0.0	DELMAG D 19-42
2.00	45.0	0.0	DELMAG D 19-42
3.00	45.0	0.0	DELMAG D 19-42
4.00	45.0	0.0	DELMAG D 19-42
5.00	45.0	0.0	DELMAG D 19-42
6.00	45.0	0.0	DELMAG D 19-42
7.00	45.0	0.0	DELMAG D 19-42
8.00	45.0	0.0	DELMAG D 19-42
9.00	45.0	0.0	DELMAG D 19-42
10.00	45.0	0.0	DELMAG D 19-42
11.00	45.0	0.0	DELMAG D 19-42
12.00	45.0	0.0	DELMAG D 19-42
13.00	45.0	0.0	DELMAG D 19-42
14.00	45.0	0.0	DELMAG D 19-42
15.00	45.0	0.0	DELMAG D 19-42
16.00	45.0	0.0	DELMAG D 19-42
17.00	45.0	0.0	DELMAG D 19-42
18.00	45.0	0.0	DELMAG D 19-42
19.00	45.0	0.0	DELMAG D 19-42
20.00	45.0	0.0	DELMAG D 19-42
21.00	45.0	0.0	DELMAG D 19-42
22.00	45.0	0.0	DELMAG D 19-42
23.00	45.0	0.0	DELMAG D 19-42
24.00	45.0	0.0	DELMAG D 19-42
25.00	45.0	0.0	DELMAG D 19-42
26.00	45.0	0.0	DELMAG D 19-42
27.00	45.0	0.0	DELMAG D 19-42
28.00	45.0	0.0	DELMAG D 19-42
29.00	45.0	0.0	DELMAG D 19-42
30.00	45.0	0.0	DELMAG D 19-42
31.00	45.0	0.0	DELMAG D 19-42
32.00	45.0	0.0	DELMAG D 19-42
33.00	45.0	0.0	DELMAG D 19-42
34.00	45.0	0.0	DELMAG D 19-42
35.00	45.0	0.0	DELMAG D 19-42
36.00	45.0	0.0	DELMAG D 19-42
37.00	45.0	0.0	DELMAG D 19-42
38.00	45.0	0.0	DELMAG D 19-42
39.00	45.0	0.0	DELMAG D 19-42

E. Moore St Emergency Bridge - End Bent 1 + 16" PCP			HDR ENGINEERING
40.00	45.0	0.0	DELMAG D 19-42
40.80	45.0	0.0	DELMAG D 19-42

Other Information for DELMAG D 19-42

Depth ft	Stroke ft	Diesel Pressure %	Efficiency -
1.00	6.0	100.0	0.80
2.00	6.0	100.0	0.80
3.00	6.0	100.0	0.80
4.00	6.0	100.0	0.80
5.00	6.0	100.0	0.80
6.00	6.0	100.0	0.80
7.00	6.0	100.0	0.80
8.00	6.0	100.0	0.80
9.00	6.0	100.0	0.80
10.00	6.0	100.0	0.80
11.00	6.0	100.0	0.80
12.00	6.0	100.0	0.80
13.00	6.0	100.0	0.80
14.00	6.0	100.0	0.80
15.00	6.0	100.0	0.80
16.00	6.0	100.0	0.80
17.00	6.0	100.0	0.80
18.00	6.0	100.0	0.80
19.00	6.0	100.0	0.80
20.00	6.0	100.0	0.80
21.00	6.0	100.0	0.80
22.00	6.0	100.0	0.80
23.00	6.0	100.0	0.80
24.00	6.0	100.0	0.80
25.00	6.0	100.0	0.80
26.00	6.0	100.0	0.80
27.00	6.0	100.0	0.80
28.00	6.0	100.0	0.80
29.00	6.0	100.0	0.80
30.00	6.0	100.0	0.80
31.00	6.0	100.0	0.80
32.00	6.0	100.0	0.80
33.00	6.0	100.0	0.80
34.00	6.0	100.0	0.80
35.00	6.0	100.0	0.80
36.00	6.0	100.0	0.80

E. Moore St Emergency Bridge - End Bent 1 + 16" PCP			HDR ENGINEERING
37.00	6.0	100.0	0.80
38.00	6.0	100.0	0.80
39.00	6.0	100.0	0.80
40.00	6.0	100.0	0.80
40.80	6.0	100.0	0.80

PILE, SOIL, ANALYSIS OPTIONS

Analysis type:	Driveability Analysis	Soil Damping Option:	Smith
Max No Analysis Iterations:	0	Time Increment/Critical:	160
Residual Stress Analysis:	0	Analysis Time-Input(ms):	0
Output Level:	Normal	Gravitational Acceleration (ft/s²):	32.169
Hammer Gravity (ft/s²):	32.169	Pile Gravity (ft/s²):	32.169

E. Moore St Emergency Bridge - End Bent 1 + 16" PCP

HDR ENGINEERING

DRIVEABILITY ANALYSIS

Analysis Depth (ft)	40.80	Standard Soil Setup	
Hammer Name	DELMAG D 19-42	Hammer ID	41
Diesel Pressure: (psi)	230.40	Stroke (ft)	6.00
Efficiency	0.80		
Pile C. Stiff. (kips/in)	853.34	Pile C. COR.	0.5
Shaft Gain/Loss Factor	1.000	Toe Gain/Loss Factor	1.000

SOIL RESISTANCE PARAMETERS

Depth ft	Unit Rs ksf	Unit Rt ksf	Qs in	Qt in	Js s/ft	Jt s/ft	Setup F. -	Limit D. ft	Setup TEB Hours	Area in ²
0.00	0.3	32.1	0.10	0.100	0.050	0.1	1.2	6.56	1.0	256.00
1.78	0.4	34.2	0.10	0.100	0.050	0.1	1.2	6.56	1.0	256.00
3.56	0.4	36.2	0.10	0.100	0.050	0.1	1.2	6.56	1.0	256.00
5.35	0.4	38.3	0.10	0.100	0.050	0.1	1.2	6.56	1.0	256.00
7.13	0.4	40.3	0.10	0.100	0.050	0.1	1.2	6.56	1.0	256.00
8.91	0.4	42.4	0.10	0.100	0.050	0.1	1.2	6.56	1.0	256.00
10.69	0.5	44.4	0.10	0.100	0.050	0.1	1.2	6.56	1.0	256.00
12.47	0.5	46.5	0.10	0.100	0.050	0.1	1.2	6.56	1.0	256.00
14.25	0.5	48.6	0.10	0.100	0.050	0.1	1.2	6.56	1.0	256.00
16.04	0.5	50.6	0.10	0.100	0.050	0.1	1.2	6.56	1.0	256.00
17.82	0.5	52.7	0.10	0.100	0.050	0.1	1.2	6.56	1.0	256.00
19.60	0.6	54.7	0.10	0.100	0.050	0.1	1.2	6.56	1.0	256.00
19.60	1.0	67.8	0.10	0.100	0.050	0.1	1.2	6.56	1.0	256.00
25.60	1.0	67.8	0.10	0.100	0.050	0.1	1.2	6.56	1.0	256.00
25.60	0.6	59.2	0.10	0.100	0.050	0.1	1.2	6.56	1.0	256.00
27.40	0.6	61.3	0.10	0.100	0.050	0.1	1.2	6.56	1.0	256.00
29.20	0.6	63.4	0.10	0.100	0.050	0.1	1.2	6.56	1.0	256.00
31.00	0.6	65.5	0.10	0.100	0.050	0.1	1.2	6.56	1.0	256.00
32.80	0.6	67.6	0.10	0.100	0.050	0.1	1.2	6.56	1.0	256.00
34.60	0.7	69.6	0.10	0.100	0.050	0.1	1.2	6.56	1.0	256.00
34.60	0.7	155.7	0.10	0.100	0.050	0.1	1.2	6.56	1.0	256.00
36.67	0.7	161.5	0.10	0.100	0.050	0.1	1.2	6.56	1.0	256.00
38.73	0.7	167.3	0.10	0.100	0.050	0.1	1.2	6.56	1.0	256.00
40.80	0.7	173.1	0.10	0.100	0.050	0.1	1.2	6.56	1.0	256.00

PILE PROFILE

Lb Top ft	X-Area in ²	E-Mod ksi	Spec. Wt lb/ft ³	Perim. ft	C-Index -	Wave Sp ft/s	Impedance kips/ft/s
0.00	256.0	5,000	150.00	5.333	0	12,426.2	103.0
45.00	256.0	5,000	150.00	5.333	0	12,426.2	103.0

E. Moore St Emergency Bridge - End Bent 1 + 16" PCP

HDR ENGINEERING

PILE AND SOIL MODEL											Total Capacity Rut (kips):	438.977
Seg.	Weight	Stiffn.	C-Slk	T-Slk	COR	Ru	Js/Jt	Qs/Qt	LbTop	Perim.	X-Area	
-	kips	kips/in	in	in	-	kips	s/ft	in	ft	ft	in ²	
1	0.86	33,185	0.12	0.00	1.00	0.0	0.000	0.10	3.21	5.33	256.0	
2	0.86	33,185	0.00	0.00	1.00	4.1	0.050	0.10	6.43	5.33	256.0	
3	0.86	33,185	0.00	0.00	1.00	6.5	0.050	0.10	9.64	5.33	256.0	
4	0.86	33,185	0.00	0.00	1.00	7.1	0.050	0.10	12.86	5.33	256.0	
5	0.86	33,185	0.00	0.00	1.00	7.8	0.050	0.10	16.07	5.33	256.0	
6	0.86	33,185	0.00	0.00	1.00	8.4	0.050	0.10	19.29	5.33	256.0	
7	0.86	33,185	0.00	0.00	1.00	9.1	0.050	0.10	22.50	5.33	256.0	
8	0.86	33,185	0.00	0.00	1.00	13.9	0.050	0.10	25.71	5.33	256.0	
9	0.86	33,185	0.00	0.00	1.00	16.9	0.050	0.10	28.93	5.33	256.0	
10	0.86	33,185	0.00	0.00	1.00	11.9	0.050	0.10	32.14	5.33	256.0	
11	0.86	33,185	0.00	0.00	1.00	10.5	0.050	0.10	35.36	5.33	256.0	
12	0.86	33,185	0.00	0.00	1.00	11.1	0.050	0.10	38.57	5.33	256.0	
13	0.86	33,185	0.00	0.00	1.00	11.6	0.050	0.10	41.79	5.33	256.0	
14	0.86	33,185	0.00	0.00	1.00	12.3	0.050	0.10	45.00	5.33	256.0	
Toe						307.7	0.149	0.10	45.00			

12.000 kips total unreduced pile weight (g = 32.169 ft/s²)
12.000 kips total reduced pile weight (g = 32.169 ft/s²)

OTHER OPTIONS

Pile Damping (%):	3	Pile Damping Fact. (kips/ft/s):	6.181
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E. Moore St Emergency Bridge - End Bent 1 + 16" PCP

HDR ENGINEERING

EXTREMA TABLE at 40.8 FT; HAMMER: D 19-42

Shaft/Toe Gain/Loss Factor = 1.000/1.000							
Rut = 439.0 kips		Rtoe = 307.7 kips				Time Inc. = 0.054 ms	
Hammer		DELMAG D 19-42		Efficiency		0.800	
Lb Top	Mx.T-For.	Mx.C-For	Mx.T-Str.	Mx.C-Str.	Mx Vel.	Mx Dis.	ENTHRU
ft	kips	kips	ksi	ksi	ft/s	in	kip-ft
3.2	0.0	435.9	0.00	1.70	3.47	0.331	9.19
6.4	19.7	447.2	0.08	1.75	3.42	0.323	9.30
9.6	35.1	444.1	0.14	1.73	3.51	0.314	9.07
12.9	46.9	435.6	0.18	1.70	3.62	0.304	8.79
16.1	55.6	462.6	0.22	1.81	3.67	0.295	8.52
19.3	60.0	483.6	0.23	1.89	3.63	0.287	8.25
22.5	59.2	494.3	0.23	1.93	3.60	0.278	7.98
25.7	53.6	495.6	0.21	1.94	3.56	0.270	7.67
28.9	41.8	492.1	0.16	1.92	3.45	0.263	7.30
32.1	41.1	485.7	0.16	1.90	3.22	0.255	6.96
35.4	39.3	476.5	0.15	1.86	3.03	0.248	6.69
38.6	32.0	462.6	0.12	1.81	2.87	0.241	6.44
41.8	21.9	447.6	0.09	1.75	2.67	0.233	6.18
45.0	11.5	430.3	0.05	1.68	2.42	0.225	6.00

Converged Stroke (ft)7.56

Fixed Combustion Pressure (psi)1,600.0

(Eq) Strokes Analyzed and Last Return (ft)

6.007.897.507.56

SUMMARY TABLE at 40.8 FT; HAMMER: D 19-42

Rut	Bl Ct	Stk Dn	Stk Up	Mx T-Str	LOp	Mx C-Str	LOp	ENTHRU	Bl Rt	ActRes
kips	b/ft	ft	ft	ksi	ft	ksi	ft	kip-ft	b/min	kips
439.0	96.2	7.56	0.00	0.23	19.3	1.94	25.7	9.2	43.0	439.0

E. Moore St Emergency Bridge - End Bent 1 + 16" PCP

HDR ENGINEERING

SUMMARY OVER DEPTHS

G/L at Shaft and Toe: 1.000/1.000									
Depth ft	Rut kips	Rshaft kips	Rtoe kips	BI Ct b/ft	Mx C-Str ksi	Mx T-Str ksi	Stroke ft	ENTHRU kip-ft	Hammer -
1.0	60.9	1.8	59.1	6.2	1.43	0.14	5.93	13.3	D 19-42
2.0	64.8	3.7	61.2	6.7	1.45	0.14	5.97	13.1	D 19-42
3.0	68.8	5.6	63.2	7.3	1.45	0.13	6.02	12.8	D 19-42
4.0	72.9	7.6	65.3	7.9	1.46	0.12	6.06	12.6	D 19-42
5.0	77.0	9.6	67.3	8.5	1.47	0.12	6.10	12.4	D 19-42
6.0	81.1	11.8	69.4	9.2	1.48	0.11	6.14	12.2	D 19-42
7.0	85.4	13.9	71.4	9.8	1.49	0.11	6.17	12.1	D 19-42
8.0	89.7	16.2	73.5	10.4	1.50	0.10	6.20	11.9	D 19-42
9.0	94.0	18.5	75.5	11.0	1.50	0.09	6.24	11.8	D 19-42
10.0	98.4	20.9	77.6	11.7	1.51	0.09	6.27	11.7	D 19-42
11.0	102.9	23.3	79.6	12.5	1.51	0.08	6.32	11.4	D 19-42
12.0	107.5	25.8	81.7	13.2	1.51	0.09	6.35	11.3	D 19-42
13.0	112.1	28.4	83.7	13.9	1.52	0.09	6.37	11.2	D 19-42
14.0	116.8	31.0	85.8	14.8	1.52	0.10	6.40	11.0	D 19-42
15.0	121.5	33.7	87.8	15.6	1.53	0.10	6.43	10.8	D 19-42
16.0	126.3	36.4	89.9	16.6	1.53	0.10	6.46	10.7	D 19-42
17.0	131.2	39.3	91.9	17.6	1.54	0.09	6.50	10.5	D 19-42
18.0	136.1	42.1	94.0	18.8	1.55	0.12	6.53	10.4	D 19-42
19.0	141.1	45.1	96.1	19.9	1.55	0.15	6.56	10.3	D 19-42
20.0	169.4	48.8	120.5	26.7	1.58	0.19	6.71	9.8	D 19-42
21.0	174.3	53.8	120.5	27.5	1.58	0.19	6.72	9.8	D 19-42
22.0	179.4	58.9	120.5	28.3	1.59	0.18	6.74	9.7	D 19-42
23.0	184.7	64.2	120.5	29.2	1.59	0.17	6.76	9.7	D 19-42
24.0	190.1	69.5	120.5	30.2	1.59	0.16	6.78	9.7	D 19-42
25.0	195.6	75.1	120.5	31.2	1.60	0.15	6.80	9.7	D 19-42
26.0	185.8	79.7	106.1	29.0	1.59	0.17	6.75	9.7	D 19-42
27.0	191.0	82.8	108.2	30.1	1.60	0.16	6.77	9.6	D 19-42
28.0	196.2	85.9	110.2	31.1	1.60	0.15	6.79	9.7	D 19-42
29.0	201.4	89.1	112.3	32.1	1.61	0.13	6.82	9.7	D 19-42
30.0	206.7	92.4	114.4	33.1	1.62	0.11	6.84	9.7	D 19-42
31.0	212.1	95.7	116.4	34.2	1.62	0.09	6.86	9.6	D 19-42
32.0	217.5	99.1	118.5	35.0	1.63	0.09	6.88	9.6	D 19-42
33.0	223.0	102.5	120.5	36.0	1.63	0.08	6.90	9.6	D 19-42
34.0	228.6	106.0	122.6	37.0	1.63	0.07	6.93	9.6	D 19-42
35.0	388.4	109.6	278.8	74.6	1.90	0.26	7.42	9.3	D 19-42
36.0	396.9	113.1	283.8	77.7	1.91	0.26	7.44	9.3	D 19-42
37.0	405.6	116.8	288.8	81.2	1.91	0.27	7.47	9.3	D 19-42
38.0	414.3	120.5	293.8	84.5	1.92	0.27	7.49	9.3	D 19-42

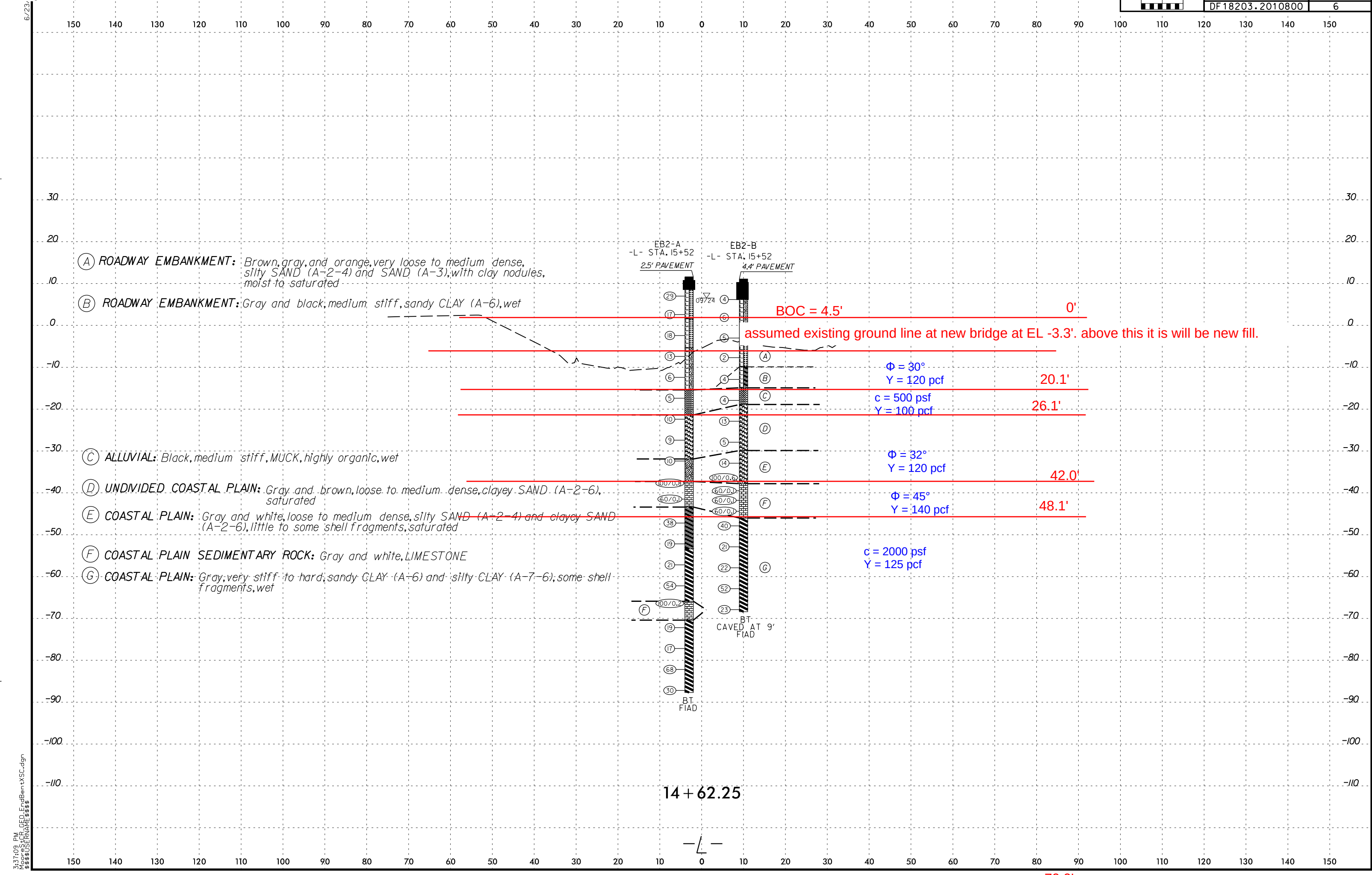
10/2/2024

9/10

GRLWEAP 14.1.20.1

E. Moore St Emergency Bridge - End Bent 1 + 16" PCP							HDR ENGINEERING		
39.0	423.0	124.3	298.8	87.1	1.94	0.26	7.51	9.3	D 19-42
40.0	431.9	128.1	303.7	93.0	1.93	0.24	7.55	9.2	D 19-42
40.8	439.0	131.2	307.7	96.2	1.94	0.23	7.56	9.2	D 19-42

END BENT 2



APILE ANALYSIS

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APILE for Windows, Version 2023.10.5

Serial Number : 226375647

A Program for Analyzing the Axial Capacity
and Short-term Settlement of Driven Piles
under Axial Loading.
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This program is licensed to :

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Path to file locations : C:\Users\skabra\OneDrive - HDR, Inc\Projects\Emergency
Bridge\Recs\Analysis\APILE\End Bent 2\
Name of input data file : End Bent 2.ap10d
Name of output file : End Bent 2.ap10o
Name of plot output file : End Bent 2.ap10p

Time and Date of Analysis

Date: October 02, 2024 Time: 13:58:22

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* INPUT INFORMATION *

PROJECT DESCRIPTION :
E. Moore St Emergency Bridge Repair
DESIGNER : S. Kabra
JOB NUMBER : U-

METHOD FOR UNIT LOAD TRANSFERS :
- FHWA (Federal Highway Administration)
Unfactored Unit Side Friction and Unit Side Resistance are used.

COMPUTATION METHOD(S) FOR PILE CAPACITY :
- FHWA (Federal Highway Administration)

TYPE OF LOADING :
- COMPRESSION

PILE TYPE :
Precast concrete pile (Square/Rectangular/Orthogonal)

AVERAGE DEPTH TO ESTIMATE TIP RESISTANCE:
- USE 1.5 DIAMETERS ABOVE AND BELOW TIP

DATA FOR AXIAL STIFFNESS :
- MODULUS OF ELASTICITY = 0.285E+08 PSI
- CROSS SECTION AREA = 256.00 IN2

NONCIRCULAR PILE PROPERTIES :
- TOTAL PILE LENGTH, TL = 45.00 FT.
- BATTER ANGLE = 0.00 DEG
- PILE STICKUP LENGTH, PSL = 11.20 FT.
- ZERO FRICTION LENGTH, ZFL = 5.00 FT.

- PERIMETER OF PILE = 64.00 IN.
 - TIP AREA OF PILE = 256.00 IN²
 - INCREMENT OF PILE LENGTH
 USED IN COMPUTATION = 1.00 FT.
 - PRINTING INCREMENT = 1

SOIL INFORMATIONS :

DEPTH FT.	SOIL TYPE	LATERAL EARTH PRESSURE	EFFECTIVE UNIT WEIGHT LB/FT ³	FRICTION ANGLE DEGREES	Nq FACTOR FHWA
0.00	SAND	0.80*	57.60	30.00	30.00**
12.10	SAND	0.80*	57.60	30.00	30.00**
12.10	CLAY	0.80*	37.60	0.00	4.80**
18.00	CLAY	0.80*	37.60	0.00	4.80**
18.00	SAND	0.80*	57.60	32.00	40.40**
33.80	SAND	0.80*	57.60	32.00	40.40**
33.80	SAND	0.80*	77.60	45.00	475.00**
40.00	SAND	0.80*	77.60	45.00	475.00**
40.00	CLAY	0.80*	62.60	0.00	4.80**
66.00	CLAY	0.80*	62.60	0.00	4.80**

* VALUE ASSUMED BY THE PROGRAM

** VALUE ESTIMATED BY THE PROGRAM BASED ON FRICTION ANGLE

MAXIMUM UNIT FRICTION KSF	MAXIMUM UNIT BEARING KSF	UNDISTURB SHEAR STRENGTH KSF	REMOLDED SHEAR STRENGTH KSF	BLOW COUNT	UNIT SKIN FRICTION KSF	UNIT END BEARING KSF
0.10E+08*	0.10E+08*	0.00	0.00	0.00	0.00	0.00
0.10E+08*	0.10E+08*	0.00	0.00	0.00	0.00	0.00
0.10E+08*	0.10E+08*	0.50	0.00	0.00	0.00	0.00
0.10E+08*	0.10E+08*	0.50	0.00	0.00	0.00	0.00
0.10E+08*	0.10E+08*	0.00	0.00	0.00	0.00	0.00
0.10E+08*	0.10E+08*	0.00	0.00	0.00	0.00	0.00
0.10E+08*	0.10E+08*	0.00	0.00	0.00	0.00	0.00
0.10E+08*	0.10E+08*	0.00	0.00	0.00	0.00	0.00
0.10E+08*	0.10E+08*	2.00	0.00	0.00	0.00	0.00
0.10E+08*	0.10E+08*	2.00	0.00	0.00	0.00	0.00

* MAXIMUM UNIT FRICTION AND/OR MAXIMUM UNIT BEARING
 WERE SET TO LARGE VALUES INDICATING THAT APILE
 USES THE LIMITS SPECIFIED BY EACH SELECTED
 CRITERIA (IF ANY).

DEPTH FT.	LRFD FACTOR ON UNIT FRICTION	LRFD FACTOR ON UNIT BEARING
0.00	1.000	1.000
12.10	1.000	1.000
12.10	1.000	1.000
18.00	1.000	1.000
18.00	1.000	1.000
33.80	1.000	1.000
33.80	1.000	1.000
40.00	1.000	1.000
40.00	1.000	1.000
66.00	1.000	1.000

DEPTH FT.	Z PEAK IN.	T RESIDUAL
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0.00	0.204 *	0.00
12.10	0.204 *	0.00
12.10	0.204 *	0.90 **
18.00	0.204 *	0.90 **
18.00	0.204 *	0.00
33.80	0.204 *	0.00
33.80	0.204 *	0.00
40.00	0.204 *	0.00
40.00	0.204 *	0.90 **
66.00	0.204 *	0.90 **

* DEFAULT VALUE = 0.01 D
** DEFAULT VALUE = 0.9

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* COMPUTATION RESULT *

* FED. HWY. METHOD *

PILE LENGTH BELOW GND. FT.	SKIN FRICTION KIP	END BEARING KIP	ULTIMATE CAPACITY KIP
0.00	0.0	1.1	1.1
1.00	0.0	2.2	2.2
2.00	0.0	3.6	3.6
3.00	0.0	5.3	5.3
4.00	0.0	7.1	7.1
5.00	0.4	8.9	9.3
6.00	1.3	10.7	12.0
7.00	2.4	12.5	14.9
8.00	3.6	14.3	17.9
9.00	5.0	16.0	21.0
10.00	6.6	17.8	24.4
11.00	8.3	17.9	26.2
12.00	10.2	16.4	26.5
13.00	12.2	14.4	26.7
14.00	14.6	12.2	26.8
15.00	17.3	9.6	26.9
16.00	20.0	11.7	31.7
17.00	22.6	19.0	41.6
18.00	25.3	26.7	52.0
19.00	28.5	34.9	63.4
20.00	32.2	43.7	75.9
21.00	36.2	49.9	86.0
22.00	40.3	52.4	92.7
23.00	44.7	54.6	99.4
24.00	49.3	56.4	105.7
25.00	54.1	57.6	111.7
26.00	59.1	58.4	117.5
27.00	64.3	58.6	123.0
28.00	69.8	58.7	128.4
29.00	75.4	58.7	134.1
30.00	81.3	58.7	139.9
31.00	87.3	58.7	146.0
32.00	93.6	188.6	282.2
33.00	100.1	432.9	533.1

NOTES:

Anticipated Pile Tip.
End Bearing on
limestone is greater
than the Required
Nominal
Resistance.

DRIVEABILITY ANALYSIS

DEPARTMENT OF TRANSPORTATION

SUBJECT: Prestressed Concrete Pile Driving Stress Analysis

GEOTECHNICAL ENGINEERING UNIT

1589 MAIL SERVICE CENTER

RALEIGH, NC 27699

PREPARED BY: SK DATE: 10/01/24 STATION: 14+33.62 -L-

CHECKED BY: PZ DATE: 10/03/24 STR. NO.: PAGE: OF

DISCLAIMER: The application of this spreadsheet is the responsibility of the user. It is imperative that the user understands the potential accuracy limitations and examines the reasonableness of the results with engineering knowledge and experience. There are no expressed or implied warranties.

Parameters for Prestressed Concrete PileResistance Factor during Pile Driving $\phi_{da} = 1.00$

resistance factor as specified in AASHTO LRFD 5.5.4.2.1 and Table 10.5.5.2.3-1

Concrete Pile Parameters

Pile Type: 16" Standard Prestressed Concrete Pile

Strand Size: 0.5 in

Concrete Area = 256 in²Compressive Strength of the Concrete, f'_c = 7.5 ksi

Number of Strands = 8

Strand Area = 0.153 in²Effective Prestressing Stress per Strand (after loss), f_{pe_strand} = 170 ksi

*** For Standard Piles see NCDOT
Structure Design Standard
Prestressed Concrete Pile Sheets
for details.

Effective Prestressing Stress in Concrete

$$f_{pe} = (f_{pe_strand}) \times (\text{strand area}) \times (\text{number of strand}) / (\text{concrete area})$$

NCDOT LRFD Pile Policy 2.2.2

 $f_{pe_strand} = 170$ ksiStrand Area = 0.153 in²

Number of Strands = 8

Concrete Area = 256 in²

$$f_{pe} = 0.813 \text{ ksi}$$

Driving Stress AnalysisDriving Stress, (σ_{dr}), In Compression (for both normal and severe corrosive environments)

$$\sigma_{dr} = \phi_{da} (0.85 f'_c - f_{pe}) = 5.6 \text{ ksi}$$

AASHTO LRFD Eq. 10.7.8-4

Driving Stress, (σ_{dr}), In Tension

For Normal Environments

$$\sigma_{dr} = \phi_{da} (0.095 \sqrt{f'_c} + f_{pe}) = 1.1 \text{ ksi}$$

AASHTO LRFD Eq. 10.7.8-5

For Severe Corrosive Environments

$$\sigma_{dr} = \phi_{da} f_{pe} = 0.8 \text{ ksi}$$

AASHTO LRFD Eq. 10.7.8-6

Project Description: E. Moore St Emergency Bridge - End Bent 2 Pile Name: 16" PCP

Hammer Information [9/7/2021]

Source: ALL ID: 1 Type: ALL Manufacturer: ALL

ID	Make	Model	Type	Ram Wt/Ecc. M.	Energy/Power	Stroke/Freq.
1	DELMAG	D 5	OED	1.1	10.505	9.55
2	DELMAG	D 8-22	OED	1.76	20.099	11.42
3	DELMAG	D 12	OED	2.75	22.605	8.22
4	DELMAG	D 15	OED	3.3	27.093	8.21
5	DELMAG	D 16-32	OED	3.52	40.198	11.42

Selected hammers: Add to Selected Hammers Remove from Selected Hammers

ID	Make	Model	Type	Ram Wt/Ecc. M.	Energy/Power	Stroke/Freq.
41	DELMAG	D 19-42	OED	4	43.24	10.81

Hammer Parameter

Efficiency 0.80
Pressure 1600.0 psi Fixed 100 %
Stroke 6.00 ft Variable

Pile Material

☒ Concrete ☐ Steel ☐ Timber

Cushion Information

	Hammer	Pile	
Area	415.000	256.000	in ²
E. Modulus	530.0	30.0	ksi
Thickness	2.0	9.0	in
C.O.R	0.80	0.50	
Stiffness	109976.01	853.34	kips/in
Helmet Weight	4.000		kips

Pile Information

Length	45.00	ft
Penetration	33.80	ft
Inclination	0	deg Ratio: x 1 : z 0
Section Area	256.000	in ² Segments Auto
E. Modulus	5000.0	ksi S-Length Auto
Spec. Weight	150.000	lb/ft ³ S-St. Wt Auto
End Bg. Area	256.000	in ² Splices 0
Perimeter	5.333	ft Pile Type
Pile Size	16.00	in Square

Resistance Gain/Loss Factors

Shaft		Toe	
1	1.000	1	1.000
2	0	2	0
3	0	3	0
4	0	4	0
5	0	5	0

Soil Parameters

2nd Toe - No

Quake
Shaft 0.100 in Const.
Toe 0.333 in

Damping
Shaft 0.050 s/ft Const.
Toe 0.149 s/ft Smith

Shaft Resistance

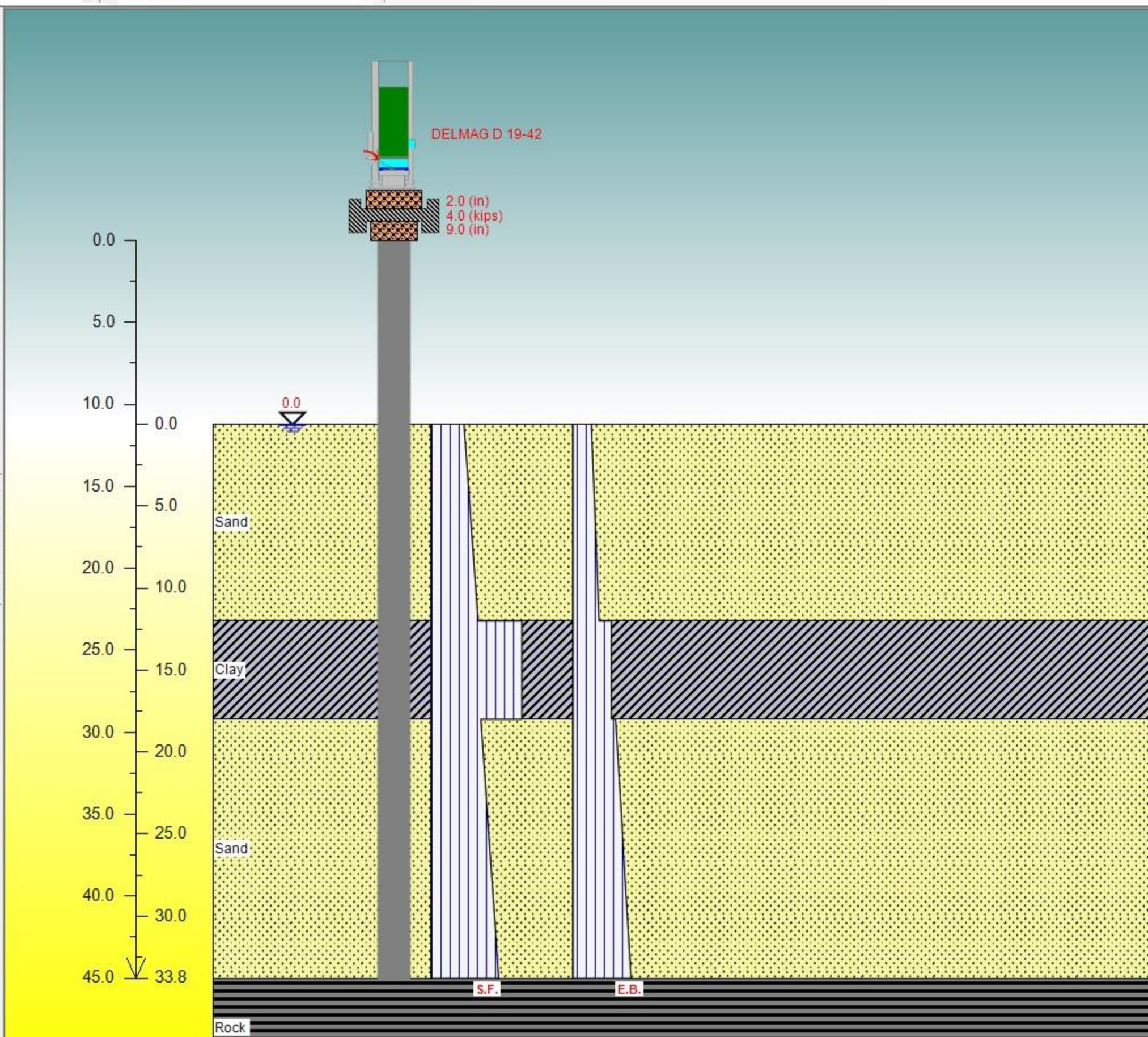
Percentage 35 %

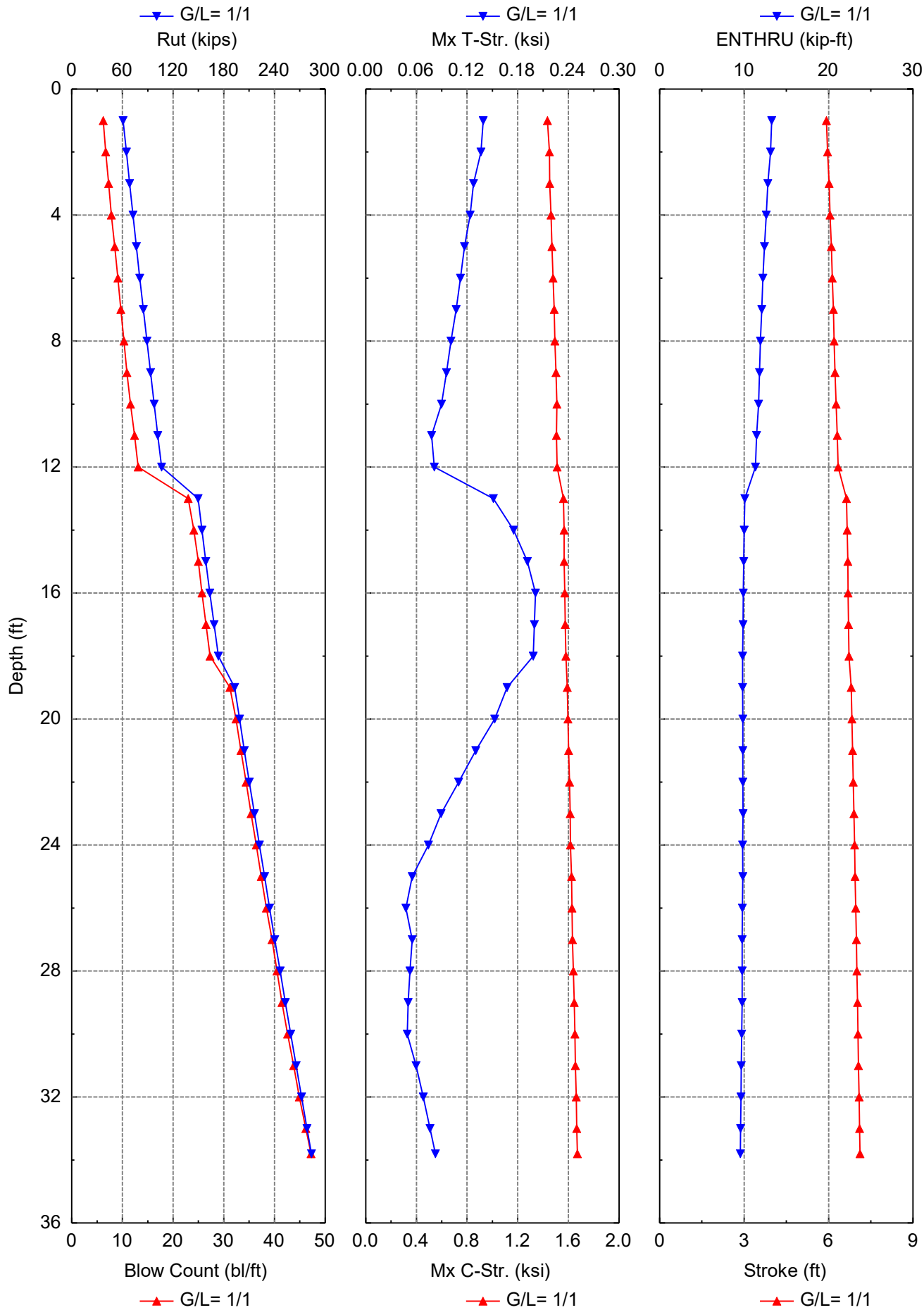
Residual Stress Analysis

No

Two Pile Model - Off

Converge Stroke with Fix Pressure





Gain/Loss Factor at Shaft/Toe = 1.000/1.000

Depth ft	Rut kips	Rshaft kips	Rtoe kips	Blow Ct bl/ft	Mx C-Str ksi	Mx T-Str ksi	Stroke ft	ENTHRU kip-ft	Hammer -
1.0	60.8	1.7	59.1	6.2	1.434	0.139	5.93	13.3	D 19-42
2.0	64.7	3.5	61.2	6.7	1.450	0.136	5.96	13.1	D 19-42
3.0	68.6	5.4	63.2	7.3	1.451	0.128	6.02	12.8	D 19-42
4.0	72.5	7.3	65.3	7.8	1.463	0.124	6.05	12.6	D 19-42
5.0	76.6	9.2	67.3	8.5	1.471	0.117	6.10	12.4	D 19-42
6.0	80.6	11.3	69.4	9.1	1.479	0.112	6.13	12.2	D 19-42
7.0	84.8	13.4	71.4	9.7	1.487	0.107	6.17	12.1	D 19-42
8.0	89.0	15.5	73.5	10.3	1.493	0.101	6.20	11.9	D 19-42
9.0	93.3	17.7	75.5	10.9	1.502	0.096	6.23	11.8	D 19-42
10.0	97.6	20.0	77.6	11.6	1.509	0.090	6.26	11.7	D 19-42
11.0	102.0	22.3	79.6	12.4	1.505	0.078	6.31	11.5	D 19-42
12.0	106.4	24.7	81.7	13.1	1.511	0.081	6.34	11.3	D 19-42
13.0	149.6	29.1	120.5	23.0	1.561	0.151	6.63	10.1	D 19-42
14.0	154.1	33.6	120.5	24.1	1.565	0.175	6.66	10.0	D 19-42
15.0	158.8	38.3	120.5	25.0	1.566	0.191	6.68	9.9	D 19-42
16.0	163.6	43.1	120.5	25.7	1.572	0.201	6.69	9.9	D 19-42
17.0	168.5	48.0	120.5	26.5	1.576	0.200	6.70	9.9	D 19-42
18.0	173.6	53.1	120.5	27.3	1.580	0.198	6.72	9.8	D 19-42
19.0	192.9	55.7	137.2	31.2	1.591	0.167	6.81	9.8	D 19-42
20.0	198.7	58.3	140.3	32.4	1.596	0.153	6.83	9.8	D 19-42
21.0	204.4	61.1	143.4	33.4	1.602	0.130	6.85	9.8	D 19-42
22.0	210.3	63.9	146.4	34.4	1.608	0.110	6.88	9.9	D 19-42
23.0	216.2	66.7	149.5	35.4	1.615	0.089	6.90	9.9	D 19-42
24.0	222.2	69.6	152.6	36.4	1.617	0.074	6.92	9.8	D 19-42
25.0	228.2	72.6	155.7	37.4	1.624	0.055	6.94	9.8	D 19-42
26.0	234.3	75.6	158.7	38.4	1.628	0.048	6.96	9.8	D 19-42
27.0	240.4	78.7	161.8	39.5	1.631	0.055	6.99	9.8	D 19-42
28.0	246.6	81.8	164.9	40.5	1.638	0.052	7.01	9.8	D 19-42
29.0	252.9	85.0	167.9	41.5	1.646	0.050	7.02	9.8	D 19-42
30.0	259.2	88.2	171.0	42.6	1.652	0.049	7.04	9.7	D 19-42
31.0	265.6	91.5	174.1	43.8	1.656	0.060	7.06	9.7	D 19-42
32.0	272.1	94.9	177.1	44.9	1.661	0.068	7.08	9.6	D 19-42
33.0	278.6	98.4	180.2	46.2	1.666	0.076	7.10	9.6	D 19-42
33.8	283.8	101.1	182.7	47.2	1.672	0.083	7.11	9.5	D 19-42

Total driving time: 19 minutes; Total Number of Blows: 854 (starting at penetration 1.0 ft)

GRLWEAP: Wave Equation Analysis of Pile Foundations

E. Moore St Emergency Bridge - End Bent 2 + 16" PCP

10/2/2024

HDR ENGINEERING

GRLWEAP 14.1.20.1

ABOUT THE WAVE EQUATION ANALYSIS RESULTS

The GRLWEAP program simulates the behavior of a preformed pile driven by either an impact hammer or a vibratory hammer. The program is based on mathematical models, which describe motion and forces of hammer, driving system, pile and soil under the hammer action. Under certain conditions, the models only crudely approximate, often complex, dynamic situations.

A wave equation analysis generally relies on input data, which represents normal situations. In particular, the hammer data file supplied with the program assumes that the hammer is in good working order. All of the input data selected by the user may be the best available information at the time when the analysis is performed. However, input data and therefore results may significantly differ from actual field conditions.

Therefore, the program authors recommend prudent use of the GRLWEAP results. Soil response and hammer performance should be verified by static and/or dynamic testing and measurements. Estimates of bending or other local stresses (e.g., helmet or clamp contact, uneven rock surfaces etc.), prestress effects and others must also be accounted for by the user.

The calculated capacity-blow count relationship, i.e. the bearing graph, should be used in conjunction with observed blow counts for the capacity assessment of a driven pile. Soil setup occurring after pile installation may produce bearing capacity values that differ substantially from those expected from a wave equation analysis due to soil setup or relaxation. This is particularly true for pile driven with vibratory hammers. The GRLWEAP user must estimate such effects and should also use proper care when applying blow counts from restrike because of the variability of hammer energy, soil resistance and blow count during early restriking.

Finally, the GRLWEAP capacities are ultimate values. They MUST be reduced by means of an appropriate factor of safety to yield a design or working load. The selection of a factor of safety should consider the quality of the construction control, the variability of the site conditions, uncertainties in the loads, the importance of structure and other factors.

E. Moore St Emergency Bridge - End Bent 2 + 16" PCP

HDR ENGINEERING

HAMMER DATA

Hammer Model:	D 19-42	Made By:	DELMAG
Hammer ID:	41	Hammer Type:	OED
Hammer Database Type:	PDI		
Hammer Database Name:			PDIHammer.gwh

Hammer and Drive System Segment Data

Segment	Weight	Stiffness	COR	C-Slack	Damping
-	kips	kips/in	-	in	kips/ft/s
1	0.800	140,084.4	1.000	0.000	
2	0.800	140,084.4	1.000	0.000	
3	0.800	140,084.4	1.000	0.000	
4	0.800	140,084.4	1.000	0.000	
5	0.800	70,754.7	0.900	0.120	
Imp Block	0.753	109,976.0	0.800	0.120	
Helmet	4.000				5.3

Ram Weight: (kips)	4.00	Ram Length: (ft)	10.76
Ram Area: (in ²)	124.69		
Maximum (Eq) Stroke: (ft)	10.81	Actual (Eq) Stroke: (ft)	6.00
Efficiency:	0.800	Rated Energy: (kip-ft)	43.24
Maximum Pressure: (psi)	1,600.00	Actual Pressure: (psi)	1,600.00
Combustion Delay: (ms)	2.00	Ignition Duration: (ms)	2.00
Expansion Exponent:	1.25		

Hammer Cushion

Pile Cushion

Cross Sect. Area: (in ²)	415.00	Cross Sect. Area: (in ²)	256.00
Elastic Modulus: (ksi)	530.0	Elastic Modulus: (ksi)	30.0
Thickness: (in)	2.00	Thickness: (in)	9.00
Coeff. of Restitution:	0.800	Coeff. of Restitution:	0.500
RoundOut: (in)	0.120	RoundOut: (in)	0.120
Stiffness: (kips/in)	109,976.0	Stiffness: (kips/in)	853.3
Helmet Weight: (kips)	4.000		

PILE INPUT

Uniform Pile		Pile Type:	Square
Pile Length: (ft)	45.000	Pile Penetration: (ft)	33.800
Pile Size: (ft)	1.33	Toe Area: (in ²)	256.00

E. Moore St Emergency Bridge - End Bent 2 + 16" PCP

HDR ENGINEERING

Table of Depths Analyzed with Driving System Modifiers

Depth ft	Temp Length ft	Wait Time Hr	Hammer -
1.00	45.0	0.0	DELMAG D 19-42
2.00	45.0	0.0	DELMAG D 19-42
3.00	45.0	0.0	DELMAG D 19-42
4.00	45.0	0.0	DELMAG D 19-42
5.00	45.0	0.0	DELMAG D 19-42
6.00	45.0	0.0	DELMAG D 19-42
7.00	45.0	0.0	DELMAG D 19-42
8.00	45.0	0.0	DELMAG D 19-42
9.00	45.0	0.0	DELMAG D 19-42
10.00	45.0	0.0	DELMAG D 19-42
11.00	45.0	0.0	DELMAG D 19-42
12.00	45.0	0.0	DELMAG D 19-42
13.00	45.0	0.0	DELMAG D 19-42
14.00	45.0	0.0	DELMAG D 19-42
15.00	45.0	0.0	DELMAG D 19-42
16.00	45.0	0.0	DELMAG D 19-42
17.00	45.0	0.0	DELMAG D 19-42
18.00	45.0	0.0	DELMAG D 19-42
19.00	45.0	0.0	DELMAG D 19-42
20.00	45.0	0.0	DELMAG D 19-42
21.00	45.0	0.0	DELMAG D 19-42
22.00	45.0	0.0	DELMAG D 19-42
23.00	45.0	0.0	DELMAG D 19-42
24.00	45.0	0.0	DELMAG D 19-42
25.00	45.0	0.0	DELMAG D 19-42
26.00	45.0	0.0	DELMAG D 19-42
27.00	45.0	0.0	DELMAG D 19-42
28.00	45.0	0.0	DELMAG D 19-42
29.00	45.0	0.0	DELMAG D 19-42
30.00	45.0	0.0	DELMAG D 19-42
31.00	45.0	0.0	DELMAG D 19-42
32.00	45.0	0.0	DELMAG D 19-42
33.00	45.0	0.0	DELMAG D 19-42
33.80	45.0	0.0	DELMAG D 19-42

Other Information for DELMAG D 19-42

Depth ft	Stroke ft	Diesel Pressure %	Efficiency -
1.00	6.0	100.0	0.80

E. Moore St Emergency Bridge - End Bent 2 + 16" PCP

HDR ENGINEERING

2.00	6.0	100.0	0.80
3.00	6.0	100.0	0.80
4.00	6.0	100.0	0.80
5.00	6.0	100.0	0.80
6.00	6.0	100.0	0.80
7.00	6.0	100.0	0.80
8.00	6.0	100.0	0.80
9.00	6.0	100.0	0.80
10.00	6.0	100.0	0.80
11.00	6.0	100.0	0.80
12.00	6.0	100.0	0.80
13.00	6.0	100.0	0.80
14.00	6.0	100.0	0.80
15.00	6.0	100.0	0.80
16.00	6.0	100.0	0.80
17.00	6.0	100.0	0.80
18.00	6.0	100.0	0.80
19.00	6.0	100.0	0.80
20.00	6.0	100.0	0.80
21.00	6.0	100.0	0.80
22.00	6.0	100.0	0.80
23.00	6.0	100.0	0.80
24.00	6.0	100.0	0.80
25.00	6.0	100.0	0.80
26.00	6.0	100.0	0.80
27.00	6.0	100.0	0.80
28.00	6.0	100.0	0.80
29.00	6.0	100.0	0.80
30.00	6.0	100.0	0.80
31.00	6.0	100.0	0.80
32.00	6.0	100.0	0.80
33.00	6.0	100.0	0.80
33.80	6.0	100.0	0.80

PILE, SOIL, ANALYSIS OPTIONS

Analysis type:	Driveability Analysis	Soil Damping Option:	Smith
Max No Analysis Iterations:	0	Time Increment/Critical:	160
Residual Stress Analysis:	0	Analysis Time-Input(ms):	0
Output Level:	Normal	Gravitational Acceleration (ft/s²):	32.169
Hammer Gravity (ft/s²):	32.169	Pile Gravity (ft/s²):	32.169

E. Moore St Emergency Bridge - End Bent 2 + 16" PCP

HDR ENGINEERING

DRIVEABILITY ANALYSIS

Analysis Depth (ft)	33.80	Standard Soil Setup	
Hammer Name	DELMAG D 19-42	Hammer ID	41
Diesel Pressure: (psi)	230.40	Stroke (ft)	6.00
Efficiency	0.80		
Pile C. Stiff. (kips/in)	853.34	Pile C. COR.	0.5
Shaft Gain/Loss Factor	1.000	Toe Gain/Loss Factor	1.000

SOIL RESISTANCE PARAMETERS

Depth	Unit Rs	Unit Rt	Qs	Qt	Js	Jt	Setup F.	Limit D.	Setup TEB	Area
ft	ksf	ksf	in	in	s/ft	s/ft	-	ft	Hours	in ²
0.00	0.3	32.1	0.10	0.100	0.050	0.1	1.2	6.56	1.0	256.00
1.71	0.3	34.1	0.10	0.100	0.050	0.1	1.2	6.56	1.0	256.00
3.43	0.4	36.1	0.10	0.100	0.050	0.1	1.2	6.56	1.0	256.00
5.14	0.4	38.0	0.10	0.100	0.050	0.1	1.2	6.56	1.0	256.00
6.86	0.4	40.0	0.10	0.100	0.050	0.1	1.2	6.56	1.0	256.00
8.57	0.4	42.0	0.10	0.100	0.050	0.1	1.2	6.56	1.0	256.00
10.29	0.4	44.0	0.10	0.100	0.050	0.1	1.2	6.56	1.0	256.00
12.00	0.5	45.9	0.10	0.100	0.050	0.1	1.2	6.56	1.0	256.00
12.00	0.9	67.8	0.10	0.100	0.050	0.1	1.2	6.56	1.0	256.00
18.00	0.9	67.8	0.10	0.100	0.050	0.1	1.2	6.56	1.0	256.00
18.00	0.5	75.5	0.10	0.100	0.050	0.1	1.2	6.56	1.0	256.00
19.76	0.5	78.5	0.10	0.100	0.050	0.1	1.2	6.56	1.0	256.00
21.51	0.5	81.5	0.10	0.100	0.050	0.1	1.2	6.56	1.0	256.00
23.27	0.5	84.6	0.10	0.100	0.050	0.1	1.2	6.56	1.0	256.00
25.02	0.6	87.6	0.10	0.100	0.050	0.1	1.2	6.56	1.0	256.00
26.78	0.6	90.6	0.10	0.100	0.050	0.1	1.2	6.56	1.0	256.00
28.53	0.6	93.7	0.10	0.100	0.050	0.1	1.2	6.56	1.0	256.00
30.29	0.6	96.7	0.10	0.100	0.050	0.1	1.2	6.56	1.0	256.00
32.04	0.6	99.7	0.10	0.100	0.050	0.1	1.2	6.56	1.0	256.00
33.80	0.7	102.7	0.10	0.100	0.050	0.1	1.2	6.56	1.0	256.00

PILE PROFILE

Lb Top	X-Area	E-Mod	Spec. Wt	Perim.	C-Index	Wave Sp	Impedance
ft	in ²	ksi	lb/ft ³	ft	-	ft/s	kips/ft/s
0.00	256.0	5,000	150.00	5.333	0	12,426.2	103.0
45.00	256.0	5,000	150.00	5.333	0	12,426.2	103.0

PILE AND SOIL MODEL

Total Capacity Rut (kips):

283.796

Seg.	Weight	Stiffn.	C-Slk	T-Slk	COR	Ru	Js/Jt	Qs/Qt	LbTop	Perim.	X-Area
-	kips	kips/in	in	in	-	kips	s/ft	in	ft	ft	in ²
1	0.86	33,185	0.12	0.00	1.00	0.0	0.000	0.10	3.21	5.33	256.0

E. Moore St Emergency Bridge - End Bent 2 + 16" PCP										HDR ENGINEERING	
2	0.86	33,185	0.00	0.00	1.00	0.0	0.000	0.10	6.43	5.33	256.0
3	0.86	33,185	0.00	0.00	1.00	0.0	0.000	0.10	9.64	5.33	256.0
4	0.86	33,185	0.00	0.00	1.00	2.9	0.050	0.10	12.86	5.33	256.0
5	0.86	33,185	0.00	0.00	1.00	6.1	0.050	0.10	16.07	5.33	256.0
6	0.86	33,185	0.00	0.00	1.00	6.7	0.050	0.10	19.29	5.33	256.0
7	0.86	33,185	0.00	0.00	1.00	7.3	0.050	0.10	22.50	5.33	256.0
8	0.86	33,185	0.00	0.00	1.00	13.6	0.050	0.10	25.71	5.33	256.0
9	0.86	33,185	0.00	0.00	1.00	15.2	0.050	0.10	28.93	5.33	256.0
10	0.86	33,185	0.00	0.00	1.00	9.1	0.050	0.10	32.14	5.33	256.0
11	0.86	33,185	0.00	0.00	1.00	9.1	0.050	0.10	35.36	5.33	256.0
12	0.86	33,185	0.00	0.00	1.00	9.8	0.050	0.10	38.57	5.33	256.0
13	0.86	33,185	0.00	0.00	1.00	10.4	0.050	0.10	41.79	5.33	256.0
14	0.86	33,185	0.00	0.00	1.00	11.0	0.050	0.10	45.00	5.33	256.0
Toe						182.7	0.149	0.10	45.00		

12.000 kips total unreduced pile weight (g = 32.169 ft/s²)

12.000 kips total reduced pile weight (g = 32.169 ft/s²)

OTHER OPTIONS

Pile Damping (%):	3	Pile Damping Fact. (kips/ft/s):	6.181
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E. Moore St Emergency Bridge - End Bent 2 + 16" PCP

HDR ENGINEERING

EXTREMA TABLE at 33.8 FT; HAMMER: D 19-42

Shaft/Toe Gain/Loss Factor = 1.000/1.000							
Rut = 283.8 kips		Rtoe = 182.7 kips				Time Inc. = 0.054 ms	
Hammer		DELMAG D 19-42 Efficiency				0.800	
Lb Top	Mx.T-For.	Mx.C-For	Mx.T-Str.	Mx.C-Str.	Mx Vel.	Mx Dis.	ENTHRU
ft	kips	kips	ksi	ksi	ft/s	in	kip-ft
3.2	0.0	417.2	0.00	1.63	3.70	0.391	9.54
6.4	9.6	427.2	0.04	1.67	3.80	0.390	9.75
9.6	16.1	428.0	0.06	1.67	3.81	0.389	9.77
12.9	19.7	422.8	0.08	1.65	3.90	0.387	9.75
16.1	21.2	415.1	0.08	1.62	3.99	0.385	9.63
19.3	20.7	403.7	0.08	1.58	4.00	0.383	9.44
22.5	19.0	400.2	0.07	1.56	3.94	0.380	9.24
25.7	21.0	401.7	0.08	1.57	3.90	0.378	8.93
28.9	20.6	395.2	0.08	1.54	3.83	0.375	8.49
32.1	17.7	378.0	0.07	1.48	3.70	0.371	8.13
35.4	13.8	362.9	0.05	1.42	3.70	0.368	7.85
38.6	7.0	348.6	0.03	1.36	3.73	0.364	7.57
41.8	0.0	329.8	0.00	1.29	3.76	0.359	7.26
45.0	0.0	303.0	0.00	1.18	3.78	0.354	7.09

Converged Stroke (ft)7.11Fixed Combustion Pressure (psi)1,600.0

(Eq) Strokes Analyzed and Last Return (ft)

6.007.327.087.11

SUMMARY TABLE at 33.8 FT; HAMMER: D 19-42

Rut	Bl Ct	Stk Dn	Stk Up	Mx T-Str	LOp	Mx C-Str	LOp	ENTHRU	Bl Rt	ActRes
kips	b/ft	ft	ft	ksi	ft	ksi	ft	kip-ft	b/min	kips
283.8	47.2	7.11	0.00	0.08	16.1	1.67	9.6	9.5	44.3	283.8

E. Moore St Emergency Bridge - End Bent 2 + 16" PCP

HDR ENGINEERING

SUMMARY OVER DEPTHS

G/L at Shaft and Toe: 1.000/1.000									
Depth ft	Rut kips	Rshaft kips	Rtoe kips	BI Ct b/ft	Mx C-Str ksi	Mx T-Str ksi	Stroke ft	ENTHRU kip-ft	Hammer -
1.0	60.8	1.7	59.1	6.2	1.43	0.14	5.93	13.3	D 19-42
2.0	64.7	3.5	61.2	6.7	1.45	0.14	5.96	13.1	D 19-42
3.0	68.6	5.4	63.2	7.3	1.45	0.13	6.02	12.8	D 19-42
4.0	72.5	7.3	65.3	7.8	1.46	0.12	6.05	12.6	D 19-42
5.0	76.6	9.2	67.3	8.5	1.47	0.12	6.10	12.4	D 19-42
6.0	80.6	11.3	69.4	9.1	1.48	0.11	6.13	12.2	D 19-42
7.0	84.8	13.4	71.4	9.7	1.49	0.11	6.17	12.1	D 19-42
8.0	89.0	15.5	73.5	10.3	1.49	0.10	6.20	11.9	D 19-42
9.0	93.3	17.7	75.5	10.9	1.50	0.10	6.23	11.8	D 19-42
10.0	97.6	20.0	77.6	11.6	1.51	0.09	6.26	11.7	D 19-42
11.0	102.0	22.3	79.6	12.4	1.51	0.08	6.31	11.5	D 19-42
12.0	106.4	24.7	81.7	13.1	1.51	0.08	6.34	11.3	D 19-42
13.0	149.6	29.1	120.5	23.0	1.56	0.15	6.63	10.1	D 19-42
14.0	154.1	33.6	120.5	24.1	1.57	0.18	6.66	10.0	D 19-42
15.0	158.8	38.3	120.5	25.0	1.57	0.19	6.68	9.9	D 19-42
16.0	163.6	43.1	120.5	25.7	1.57	0.20	6.69	9.9	D 19-42
17.0	168.5	48.0	120.5	26.5	1.58	0.20	6.70	9.9	D 19-42
18.0	173.6	53.1	120.5	27.3	1.58	0.20	6.72	9.8	D 19-42
19.0	192.9	55.7	137.2	31.2	1.59	0.17	6.81	9.8	D 19-42
20.0	198.7	58.3	140.3	32.4	1.60	0.15	6.83	9.8	D 19-42
21.0	204.4	61.1	143.4	33.4	1.60	0.13	6.85	9.8	D 19-42
22.0	210.3	63.9	146.4	34.4	1.61	0.11	6.88	9.9	D 19-42
23.0	216.2	66.7	149.5	35.4	1.61	0.09	6.90	9.9	D 19-42
24.0	222.2	69.6	152.6	36.4	1.62	0.07	6.92	9.8	D 19-42
25.0	228.2	72.6	155.7	37.4	1.62	0.06	6.94	9.8	D 19-42
26.0	234.3	75.6	158.7	38.4	1.63	0.05	6.96	9.8	D 19-42
27.0	240.4	78.7	161.8	39.5	1.63	0.06	6.99	9.8	D 19-42
28.0	246.6	81.8	164.9	40.5	1.64	0.05	7.01	9.8	D 19-42
29.0	252.9	85.0	167.9	41.5	1.65	0.05	7.02	9.8	D 19-42
30.0	259.2	88.2	171.0	42.6	1.65	0.05	7.04	9.7	D 19-42
31.0	265.6	91.5	174.1	43.8	1.66	0.06	7.06	9.7	D 19-42
32.0	272.1	94.9	177.1	44.9	1.66	0.07	7.08	9.6	D 19-42
33.0	278.6	98.4	180.2	46.2	1.67	0.08	7.10	9.6	D 19-42
33.8	283.8	101.1	182.7	47.2	1.67	0.08	7.11	9.5	D 19-42

SHORING ANALYSIS



Shoring Analysis

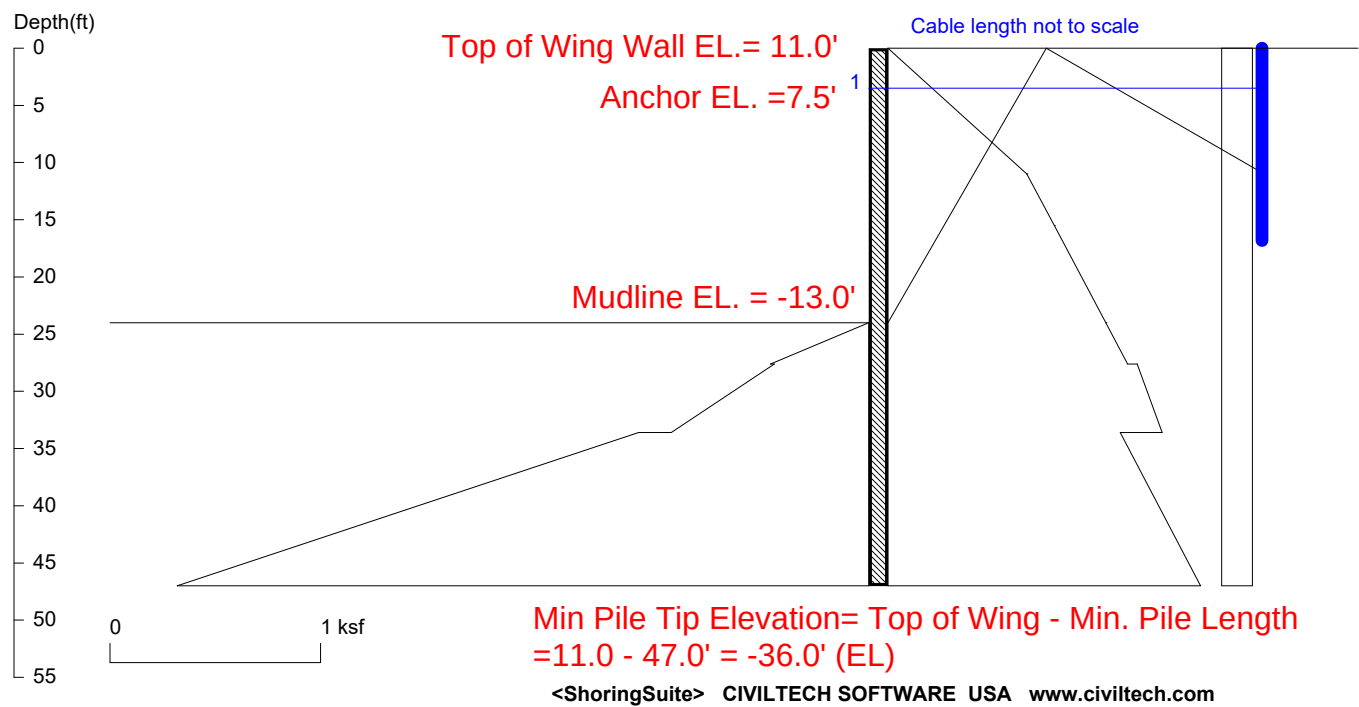
Shoring Analysis was performed using Shoring Suite version 8.20b software. The sections showing the greatest heights of sheet pile walls were analyzed. The wall length was 24.0 feet based on the top of the coping to the design scour elevation. The design scour elevation is at -13.0 feet. The top of the wall coping is at an elevation of 10.89 feet. Based on the discussion with the Structure and Hydro engineer, a PZ35 sheet pile wall section was analyzed. An anchor is analyzed at an elevation of 3.5 feet from the top of the coping. The intent here is to connect the opposite end of the wing walls using the anchor. Unit weight, effective cohesion for cohesive soils, and effective friction angle were determined using the average N or $N_{1(60)}$ value for each soil type using the empirical correlations described below:

$$\phi = 27.1 + 0.3 * N_{1(60)} - 0.00054 * (N_{1(60)})^2$$

Peck, Hanson, Thorburn (1974)

$$S_u = 100 * N$$

Based on the analysis, the minimum embedment depth is 22.99 feet, and the minimum pile length required will be 46.99 feet. Therefore, the minimum tip elevation for the sheet pile wall will be at an elevation of -36.0 feet. The minimum required section modulus is 42.6 in³/ft. PZ35 has a section modulus of 48.5 in³/ft. Therefore, PZ35 is selected for the sheet pile wall.



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Wall Height=24.0 Pile Diameter=1.0 Pile Spacing=1.0 Wall Type: 1. Sheet Pile

PILE LENGTH: Min. Embedment=22.99 Min. Pile Length=46.99
MOMENT IN PILE: Max. Moment=159.67 per Pile Spacing=1.0 at Depth=22.06

PILE SELECTION:
Request Min. Section Modulus = 42.6 in3/ft=2288.98 cm3/m, Fy= 50 ksi = 345 MPa, Fb/Fy=0.9
PZ35 has Section Modulus = 48.5 in3/ft=2607.36 cm3/m. It is greater than Min. Requirements!
Top Deflection = -1.16(in) based on E (ksi)=29000.00 and I (in4)/foot=361.2

BRACE FORCE: Strut, Tieback, Plate Anchor, Deadman, Sheet Pile as Anchor

No. & Type	Depth	Angle	Space	Total F.	Horiz. F.	Vert. F.	L_free	Sheet Length
1. Sheet Pile	3.5	0.0	4.0	63.7	63.7	0.0	43.0	16.8

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

DRIVING PRESSURES (ACTIVE, WATER, & SURCHARGE):

Z1	P1	Z2	P2	Slope
*	Above	Base		
0.000	0.000	11.000	0.660	0.060000
11.000	0.660	15.500	0.790	0.028800
15.500	0.790	24.000	1.034	0.028800
*	Below	Base		
24.000	1.034	27.600	1.138	0.028800
27.600	1.184	33.600	1.302	0.019566
33.600	1.103	49.500	1.555	0.028452
*	Sur-	charge		
0.000	0.146	1.200	0.146	0.000000
1.200	0.146	2.400	0.146	0.000000
2.400	0.146	3.600	0.146	0.000000
3.600	0.146	4.800	0.146	0.000000

4.800	0.146	6.000	0.146	0.000000
6.000	0.146	7.200	0.146	0.000000
7.200	0.146	8.400	0.146	0.000000
8.400	0.146	9.600	0.146	0.000000
9.600	0.146	10.800	0.146	0.000000
10.800	0.146	12.000	0.146	0.000000
12.000	0.146	13.200	0.146	0.000000
13.200	0.146	14.400	0.146	0.000000
14.400	0.146	15.600	0.146	0.000000
15.600	0.146	16.800	0.146	0.000000
16.800	0.146	18.000	0.146	0.000000
18.000	0.146	19.200	0.146	0.000000
19.200	0.146	20.400	0.146	0.000000
20.400	0.146	21.600	0.146	0.000000
21.600	0.146	22.800	0.146	0.000000
22.800	0.146	24.000	0.146	0.000000
24.000	0.146	26.400	0.146	0.000000
26.400	0.146	28.800	0.146	0.000000
28.800	0.146	31.200	0.146	0.000000
31.200	0.146	33.600	0.146	0.000000
33.600	0.146	36.000	0.146	0.000000
36.000	0.146	38.400	0.146	0.000000
38.400	0.146	40.800	0.146	0.000000
40.800	0.146	43.200	0.146	0.000000
43.200	0.146	45.600	0.146	0.000000
45.600	0.146	48.000	0.146	0.000000

PASSIVE PRESSURES:

Z1	P1	Z2	P2	Slope
*	Below	Base		
24.000	0.000	27.600	0.467	0.129600
27.600	0.448	33.600	0.936	0.081347
33.600	1.091	49.500	3.692	0.163560

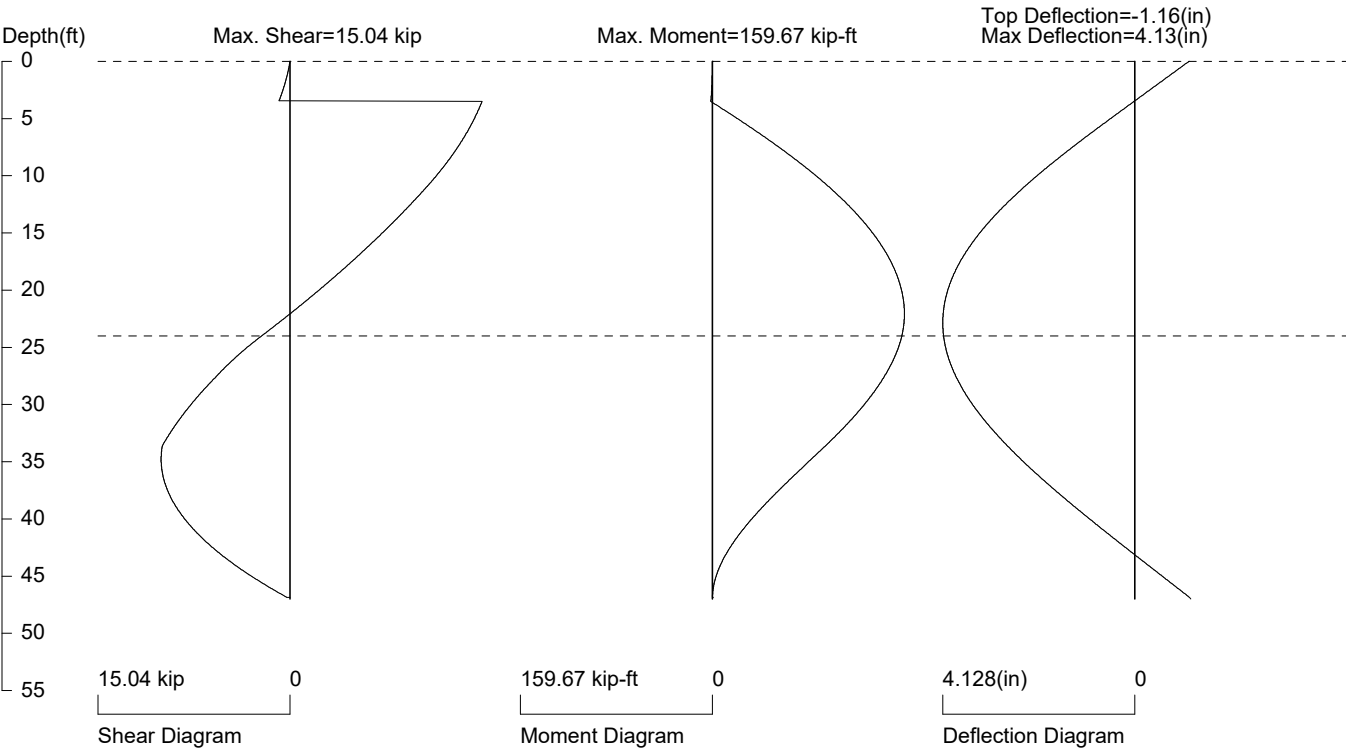
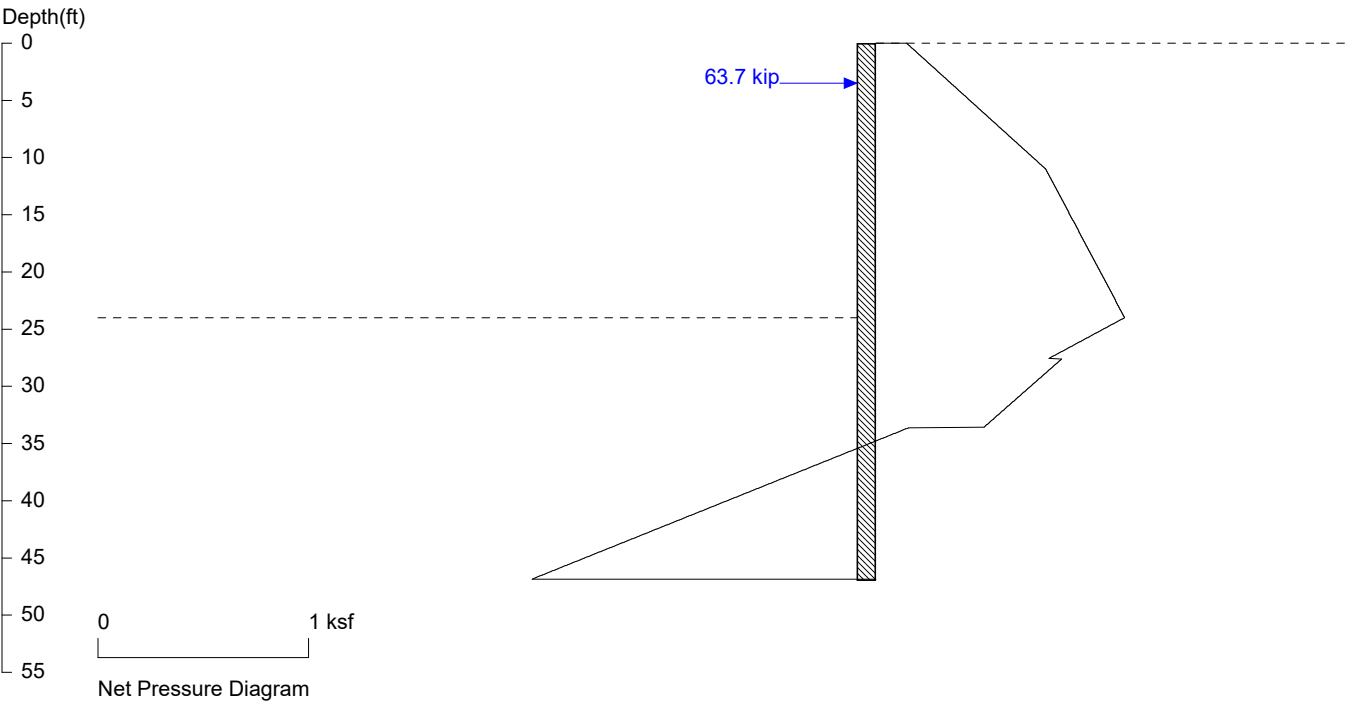
ACTIVE SPACING:

No.	Z depth	Spacing
1	0.00	1.00
2	24.00	1.00

PASSIVE SPACING:

No.	Z depth	Spacing
1	0.00	1.00

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



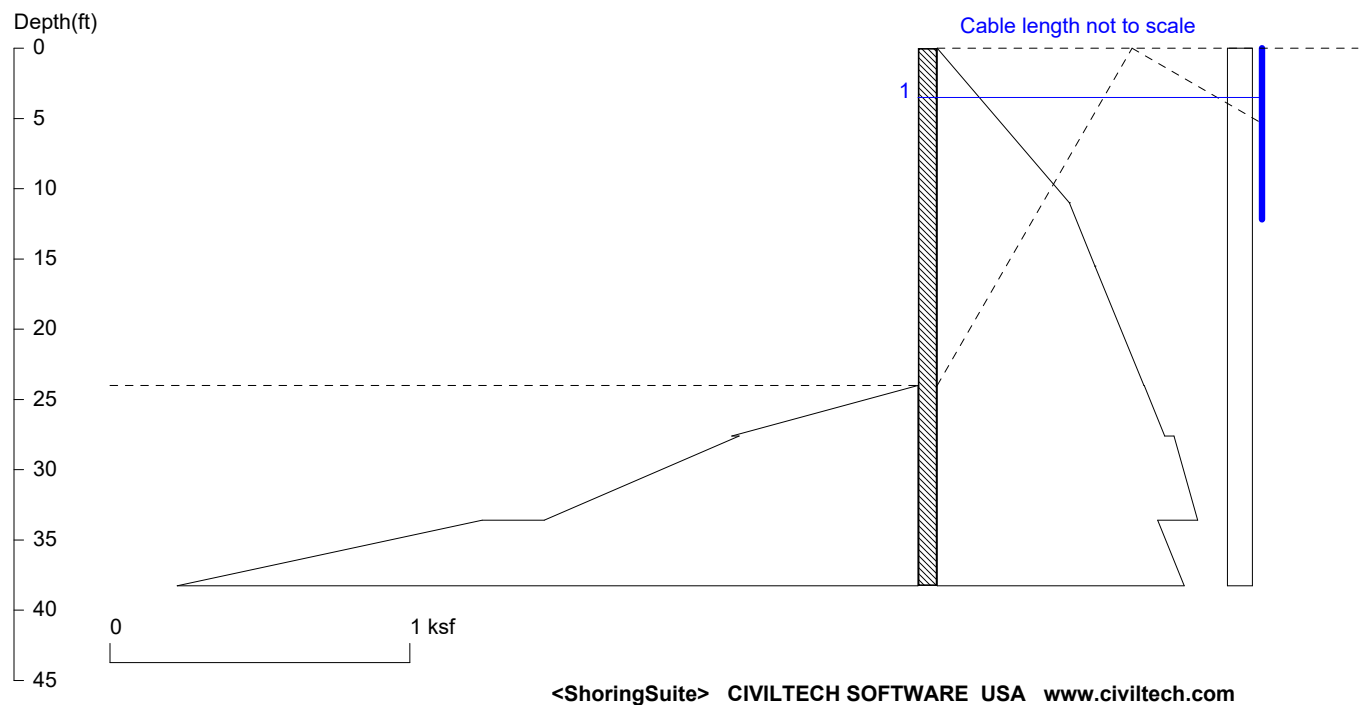
PRESSURE, SHEAR, MOMENT, AND DEFLECTION DIAGRAMS

Based on pile spacing: 1.0 foot or meter

User Input Pile, PZ35: E (ksi)=29000.0, I (in4)/foot=361.2

File: UNTITLED

Service Limit Analysis for Deflection



<ShoringSuite> CIVILTECH SOFTWARE USA www.civiltech.com
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File: UNTITLED

Wall Height=24.0 Pile Diameter=1.0 Pile Spacing=1.0 Wall Type: 1. Sheet Pile

PILE LENGTH: Min. Embedment=14.27 Min. Pile Length=38.27
MOMENT IN PILE: Max. Moment=70.35 per Pile Spacing=1.0 at Depth=19.33

PILE SELECTION:
Request Min. Section Modulus = 18.8 in³/ft=1008.50 cm³/m, F_y= 50 ksi = 345 MPa, F_b/F_y=0.9
PZ35 has Section Modulus = 48.5 in³/ft=2607.36 cm³/m. It is greater than Min. Requirements!
Top Deflection = -0.41(in) based on E (ksi)=29000.00 and I (in⁴)/foot=361.2

BRACE FORCE: Strut, Tieback, Plate Anchor, Deadman, Sheet Pile as Anchor

No. & Type	Depth	Angle	Space	Total F.	Horiz. F.	Vert. F.	L_free	Sheet Length
1. Sheet Pile	3.5	0.0	4.0	33.4	33.4	0.0	34.9	12.2

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

DRIVING PRESSURES (ACTIVE, WATER, & SURCHARGE):

Z1	P1	Z2	P2	Slope
*	Above	Base		
0.000	0.000	11.000	0.440	0.040000
11.000	0.440	15.500	0.526	0.019200
15.500	0.526	24.000	0.690	0.019200
*	Below	Base		
24.000	0.690	27.600	0.759	0.019200
27.600	0.790	33.600	0.868	0.013044
33.600	0.735	49.500	1.037	0.018968
*	Sur-	charge		
0.000	0.083	1.200	0.083	0.000000
1.200	0.083	2.400	0.083	0.000000
2.400	0.083	3.600	0.083	0.000000
3.600	0.083	4.800	0.083	0.000000

4.800	0.083	6.000	0.083	0.000000
6.000	0.083	7.200	0.083	0.000000
7.200	0.083	8.400	0.083	0.000000
8.400	0.083	9.600	0.083	0.000000
9.600	0.083	10.800	0.083	0.000000
10.800	0.083	12.000	0.083	0.000000
12.000	0.083	13.200	0.083	0.000000
13.200	0.083	14.400	0.083	0.000000
14.400	0.083	15.600	0.083	0.000000
15.600	0.083	16.800	0.083	0.000000
16.800	0.083	18.000	0.083	0.000000
18.000	0.083	19.200	0.083	0.000000
19.200	0.083	20.400	0.083	0.000000
20.400	0.083	21.600	0.083	0.000000
21.600	0.083	22.800	0.083	0.000000
22.800	0.083	24.000	0.083	0.000000
24.000	0.083	26.400	0.083	0.000000
26.400	0.083	28.800	0.083	0.000000
28.800	0.083	31.200	0.083	0.000000
31.200	0.083	33.600	0.083	0.000000
33.600	0.083	36.000	0.083	0.000000
36.000	0.083	38.400	0.083	0.000000

PASSIVE PRESSURES:

Z1	P1	Z2	P2	Slope
*	Below	Base		
24.000	0.000	27.600	0.622	0.172800
27.600	0.597	33.600	1.248	0.108462
33.600	1.455	49.500	4.922	0.218079

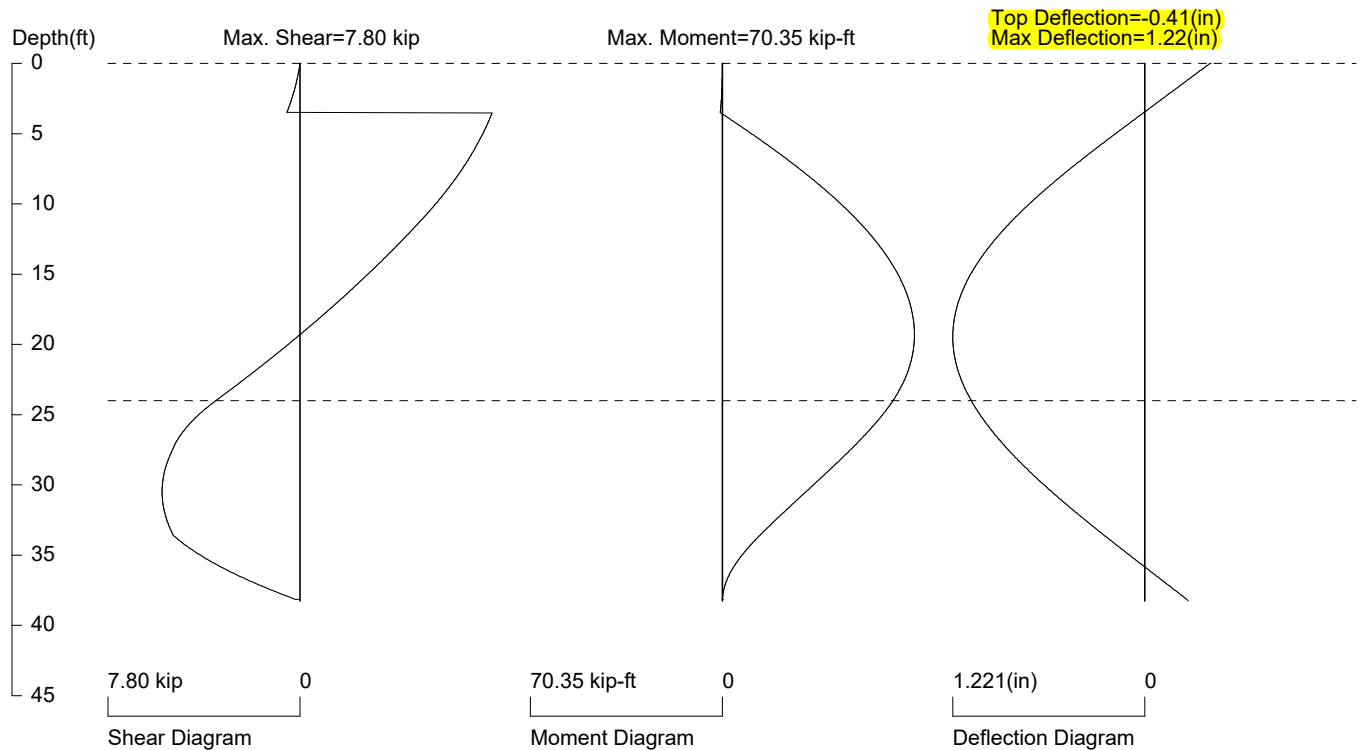
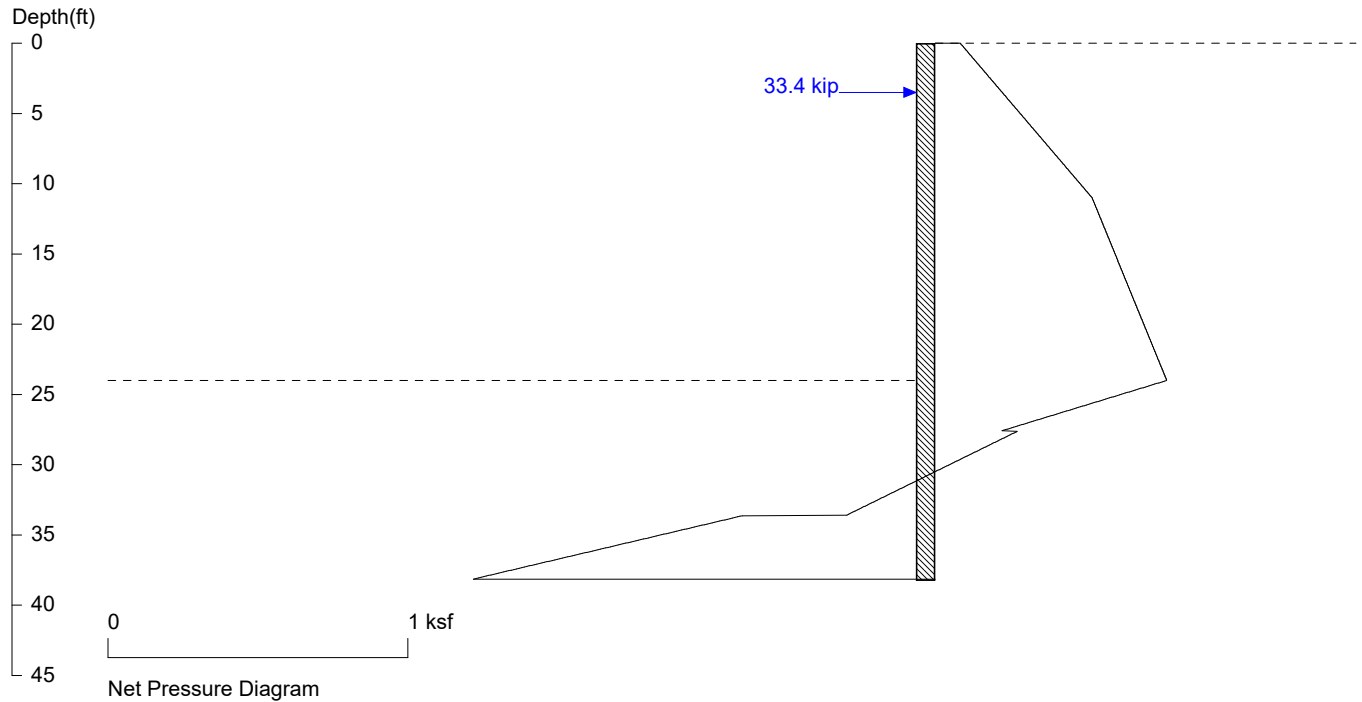
ACTIVE SPACING:

No.	Z depth	Spacing
1	0.00	1.00
2	24.00	1.00

PASSIVE SPACING:

No.	Z depth	Spacing
1	0.00	1.00

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



PRESSURE, SHEAR, MOMENT, AND DEFLECTION DIAGRAMS

Based on pile spacing: 1.0 foot or meter

User Input Pile, PZ35: E (ksi)=29000.0, I (in⁴)/foot=361.2

File: UNTITLED

REPORT

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

ShoringSuite Software is developed by CivilTech Software, Bellevue, WA, USA.
The calculation method is based on the following references:
1. FHWA 98-011, FHWA-RD-97-130, FHWA SA 96-069, FHWA-IF-99-015
2. STEEL SHEET PILING DESIGN MANUAL by Pile Buck Inc., 1987
3. DESIGN MANUAL DM-7 (NAVFAC), Department of the Navy, May 1982
4. TRENCHING AND SHORING MANUAL Revision 12, California Department of Transportation, January 2000
5. EARTH SUPPORT SYSTEM & RETAINING STRUCTURES, Pile Buck Inc. 2002
6. DESIGN OF SHEET PILE WALLS, EM 1110-2-2504, U.S. Army Corps of Engineers, 31 March 1994
7. EARTH RETENTION SYSTEMS HANDBOOK, Alan Macnab, McGraw-Hill. 2002
8. Temporary Structures in Construction, Robert T. Ratay (Co-author of Chapter 7: John J. Peirce), McGraw-Hill. 2012
9. AASHTO HB-17, American Association of State and Highway Transportation Officials, 2 September 2002

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

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Date: 10/15/2024 File: C:\Users\skabra\OneDrive - HDR, Inc\Projects\Emergency Bridge\Recs\Analysis\End Bent 2\Shoring Design\Shoring\PZ35 Section\PZ-35.sh8

Title: E. More St Bridge Replacement
Subtitle: PZ 35 Sheet Pile

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

Wall Type: 1. Sheet Pile
Wall Height: 24.00
Pile Diameter: 1.00
Pile Spacing: 1.00
Factor of Safety (F.S.): 1.00
Lateral Support Type (Braces): 7. Sheet Pile
Top Brace Increase (Multi-Bracing): Add 15%
Brace Position (One Brace Case): Normal Brace*
No-Load Zone:
Vertical Depth for No-Load Zone: 24.00
H-Distance (Input H/V ratio) for No-Load Zone: 0.25
Angle from H. Line for No-Load Zone: 60.00
Embedment Option: 1. Yes
Friction at Pile Tip: No
Pile Properties:
Steel Strength, Fy: 50 ksi = 345 MPa
Allowable Fb/Fy: 0.9
Elastic Module, E: 29000.00
Moment of Inertia, I: 361.20
User Input Pile: PZ35

* DRIVING PRESSURE (ACTIVE, WATER, & SURCHARGE) *					
No.	Z1 top	Top Pres.	Z2 bottom	Bottom Pres.	Slope
1	*	Above	Base		
2	0.000	0.000	11.000	0.660	0.060000
3	11.000	0.660	15.500	0.790	0.028800
4	15.500	0.790	24.000	1.034	0.028800
5	*	Below	Base		
6	24.000	1.034	27.600	1.138	0.028800
7	27.600	1.184	33.600	1.302	0.019566
8	33.600	1.103	49.500	1.555	0.028452
9	49.500	0.833	55.600	0.982	0.024504
10	55.600	1.765	192.000	5.625	0.028294
11	*	Sur-	charge		
12	0.000	0.146	1.200	0.146	0.000000

13	1.200	0.146	2.400	0.146	0.000000
14	2.400	0.146	3.600	0.146	0.000000
15	3.600	0.146	4.800	0.146	0.000000
16	4.800	0.146	6.000	0.146	0.000000
17	6.000	0.146	7.200	0.146	0.000000
18	7.200	0.146	8.400	0.146	0.000000
19	8.400	0.146	9.600	0.146	0.000000
20	9.600	0.146	10.800	0.146	0.000000
21	10.800	0.146	12.000	0.146	0.000000
22	12.000	0.146	13.200	0.146	0.000000
23	13.200	0.146	14.400	0.146	0.000000
24	14.400	0.146	15.600	0.146	0.000000
25	15.600	0.146	16.800	0.146	0.000000
26	16.800	0.146	18.000	0.146	0.000000
27	18.000	0.146	19.200	0.146	0.000000
28	19.200	0.146	20.400	0.146	0.000000
29	20.400	0.146	21.600	0.146	0.000000
30	21.600	0.146	22.800	0.146	0.000000
31	22.800	0.146	24.000	0.146	0.000000
32	24.000	0.146	26.400	0.146	0.000000
33	26.400	0.146	28.800	0.146	0.000000
34	28.800	0.146	31.200	0.146	0.000000
35	31.200	0.146	33.600	0.146	0.000000
36	33.600	0.146	36.000	0.146	0.000000
37	36.000	0.146	38.400	0.146	0.000000
38	38.400	0.146	40.800	0.146	0.000000
39	40.800	0.146	43.200	0.146	0.000000
40	43.200	0.146	45.600	0.146	0.000000
41	45.600	0.146	48.000	0.146	0.000000
42	48.000	0.146	52.800	0.146	0.000000
43	52.800	0.146	57.600	0.146	0.000000
44	57.600	0.146	62.400	0.146	0.000000
45	62.400	0.146	67.200	0.146	0.000000
46	67.200	0.146	72.000	0.146	0.000000
47	72.000	0.146	76.800	0.146	0.000000
48	76.800	0.146	81.600	0.146	0.000000
49	81.600	0.146	86.400	0.146	0.000000
50	86.400	0.146	91.200	0.146	0.000000
51	91.200	0.146	96.000	0.000	-0.030382

* PASSIVE PRESSURE *

No.	Z1 top	Top Pres.	Z2 bottom	Bottom Pres.	Slope
1	*	Below	Base		
2	24.000	0.000	27.600	0.467	0.129600
3	27.600	0.448	33.600	0.936	0.081347
4	33.600	1.091	49.500	3.692	0.163560
5	49.500	5.555	55.600	7.944	0.391707
6	55.600	4.863	192.000	27.119	0.163164

* ACTIVE SPACE *

No.	Z depth	Spacing
1	0.00	1.00
2	24.00	1.00

* PASSIVE SPACE *

No.	Z depth	Spacing
1	0.00	1.00

* BRACE: STRUT, TIEBACK, ANCHOR PLATE, DEADMAN, OR SHEET PILE AS ANCHOR*

No.	Z brace	Angle	Spacing	Input1*	Input2*	Type
1	3.50	0.0	4.00	1.90	0.30	Sheet Pile

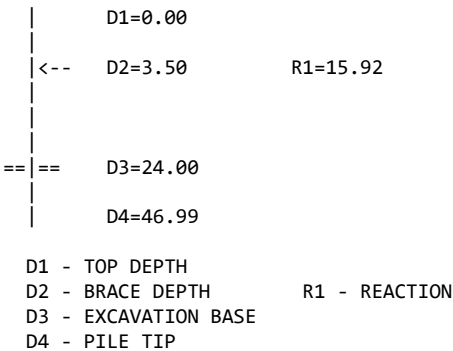
*For Tieback: Input1 = Diameter; Input2 = Bond Strength
*For Plate: Input1 = Diameter; Input2 = Allowable Pressure
*For Deadman: Input1 = Horz. Width; Input2 = Passive Pressure;
*For Sheet Pile Anchor: Input1 = Horz. Width; Input2 = Passive Slope;

*****CALCULATION*****

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

Top Pressures start at depth = 0.00

NUMBER OF BRACE LEVEL = 1



TOTAL REACTION: R1 = 15.92
TOTAL PRESSURES ACTING ON WALL = 15.92
Total Reactions = Total Pressures, OK!

BRACE NO.1 AT DEPTH = 3.50
R1 = Brace Load = 15.92

*****RESULTS*****

* EMBEDMENT *
MINIMUM EMBEDMENT = 22.99, TOTAL MINIMUM PILE LENGTH = 46.99

* MOMENT IN PILE (per pile spacing)*
Pile Spacing: sheet piles are one foot or one meter; soldier piles are one pile.

No.	Depth	M @ Brace	Mmax in Span	Depth of Mmax
1	3.50	1.28	159.67	22.06

Overall Maximum Moment = 159.67 at 22.06
Maximum Shear = 15.04
Moment and Shear are per pile spacing: 1.0 foot or meter

* BRACE: STRUT, TIEBACK, ANCHOR PLATE, DEADMAN, OR SHEET PILE AS ANCHOR*
The calculated brace force are per brace spacing.

No.	DEPTH	Tangle	SPACING	HORIZONTAL	VERTICAL	TOTAL LOAD
1	3.50	0.0	4.00	63.69	0.00	63.69

No.	DEPTH	Free length	Brace Type
1	3.50	39.75	Sheet Pile Length = 14.95

* VERTICAL LOADING *
Vertical Loading from Braces = 0.00
Vertical Loading from External Load = 0.00
Total Vertical Loading = 0.00

*****SPECIFIED PILE *****

Overall Maximum Moment = 159.67 at 22.06
The pile selection is based on the magnitude of the moment only. Axial force is neglected.

Request Min. Section Modulus = 42.58 in3/ft = 2288.98 cm3/m, Fy= 50 ksi = 345 MPa, Fb/Fy=0.9

PZ35 has been found in Sheet Pile list!
PZ35(English): Sx= 48.50 in3/ft Ix= 361.20 in4/ft Weight= 35.00 lb/ft
PZ35(Metrics): Sx= 2607.36 cm3/m Ix= 493.25 x100cm4/m Weight= 0.511 kN/m

* Note: All the pile dimensions are in English Units per one foot width.

PZ35 is capable to support the shoring!
I (in4)/foot=361.20
Top deflection = -1.163(in)
Max. deflection = 4.128(in)

*****PRESSURE, LOAD, SHEAR, MOMENT, AND DEFLECTION v.s. DEPTH*****

The shear and moment are per single soldier pile (secant/tangent pile) or one foot of sheet pile (concrete wall). The deflection is based on users input pile below:

User Input Pile: PZ35
Elastic Module, E (ksi)= 29000.00
Moment of Inertia, I (in4)/foot= 361.2

PRESS. - Sum of all pressures (Net pressure). (Active) direction is positive
LOAD - Liner load (force per unit depth) = Pressures multiply by acting space

No	DEPTH ft	PRESS. ksf	LOAD kip/ft	SHEAR kip	MOMENT kip-ft	DEFLECTION in
1	0.00	0.15	0.15	0.00	0.00	-1.163
2	0.05	0.15	0.15	0.01	0.00	-1.146
3	0.10	0.15	0.15	0.02	0.00	-1.128
4	0.16	0.16	0.16	0.02	0.00	-1.111
5	0.21	0.16	0.16	0.03	0.00	-1.093
6	0.26	0.16	0.16	0.04	0.01	-1.075
7	0.31	0.16	0.16	0.05	0.01	-1.058
8	0.37	0.17	0.17	0.06	0.01	-1.040
9	0.42	0.17	0.17	0.07	0.01	-1.022
10	0.47	0.17	0.17	0.08	0.02	-1.005
11	0.52	0.18	0.18	0.08	0.02	-0.987
12	0.58	0.18	0.18	0.09	0.03	-0.970
13	0.63	0.18	0.18	0.10	0.03	-0.952
14	0.68	0.19	0.19	0.11	0.04	-0.934
15	0.73	0.19	0.19	0.12	0.04	-0.917
16	0.78	0.19	0.19	0.13	0.05	-0.899
17	0.84	0.20	0.20	0.14	0.06	-0.881
18	0.89	0.20	0.20	0.15	0.06	-0.864
19	0.94	0.20	0.20	0.16	0.07	-0.846
20	0.99	0.21	0.21	0.17	0.08	-0.829
21	1.05	0.21	0.21	0.19	0.09	-0.811
22	1.10	0.21	0.21	0.20	0.10	-0.793
23	1.15	0.22	0.22	0.21	0.11	-0.776
24	1.20	0.22	0.22	0.22	0.12	-0.758
25	1.25	0.22	0.22	0.23	0.13	-0.740
26	1.31	0.22	0.22	0.24	0.15	-0.723
27	1.36	0.23	0.23	0.25	0.16	-0.705
28	1.41	0.23	0.23	0.27	0.17	-0.688
29	1.46	0.23	0.23	0.28	0.19	-0.670
30	1.52	0.24	0.24	0.29	0.20	-0.652

31	1.57	0.24	0.24	0.30	0.22	-0.635
32	1.62	0.24	0.24	0.32	0.23	-0.617
33	1.67	0.25	0.25	0.33	0.25	-0.599
34	1.73	0.25	0.25	0.34	0.27	-0.582
35	1.78	0.25	0.25	0.35	0.29	-0.564
36	1.83	0.26	0.26	0.37	0.31	-0.547
37	1.88	0.26	0.26	0.38	0.33	-0.529
38	1.93	0.26	0.26	0.39	0.35	-0.511
39	1.99	0.27	0.27	0.41	0.37	-0.494
40	2.04	0.27	0.27	0.42	0.39	-0.476
41	2.09	0.27	0.27	0.44	0.41	-0.458
42	2.14	0.27	0.27	0.45	0.43	-0.441
43	2.20	0.28	0.28	0.47	0.46	-0.423
44	2.25	0.28	0.28	0.48	0.48	-0.406
45	2.30	0.28	0.28	0.49	0.51	-0.388
46	2.35	0.29	0.29	0.51	0.53	-0.370
47	2.40	0.29	0.29	0.52	0.56	-0.353
48	2.46	0.29	0.29	0.54	0.59	-0.335
49	2.51	0.30	0.30	0.56	0.62	-0.317
50	2.56	0.30	0.30	0.57	0.65	-0.300
51	2.61	0.30	0.30	0.59	0.68	-0.282
52	2.67	0.31	0.31	0.60	0.71	-0.264
53	2.72	0.31	0.31	0.62	0.74	-0.247
54	2.77	0.31	0.31	0.63	0.77	-0.229
55	2.82	0.32	0.32	0.65	0.81	-0.212
56	2.88	0.32	0.32	0.67	0.84	-0.194
57	2.93	0.32	0.32	0.68	0.88	-0.176
58	2.98	0.32	0.32	0.70	0.91	-0.159
59	3.03	0.33	0.33	0.72	0.95	-0.141
60	3.08	0.33	0.33	0.74	0.99	-0.123
61	3.14	0.33	0.33	0.75	1.03	-0.106
62	3.19	0.34	0.34	0.77	1.07	-0.088
63	3.24	0.34	0.34	0.79	1.11	-0.071
64	3.29	0.34	0.34	0.81	1.15	-0.053
65	3.35	0.35	0.35	0.82	1.19	-0.035
66	3.40	0.35	0.35	0.84	1.24	-0.018
67	3.45	0.35	0.35	0.86	1.28	0.000
68	3.50	0.36	0.36	-15.04	1.28	0.018
69	3.56	0.36	0.36	-15.02	0.50	0.035
70	3.61	0.36	0.36	-15.01	-0.29	0.053
71	3.66	0.37	0.37	-14.99	-1.07	0.071
72	3.71	0.37	0.37	-14.97	-1.86	0.088
73	3.76	0.37	0.37	-14.95	-2.64	0.106
74	3.82	0.37	0.37	-14.93	-3.42	0.123
75	3.87	0.38	0.38	-14.91	-4.20	0.141
76	3.92	0.38	0.38	-14.89	-4.98	0.159
77	3.97	0.38	0.38	-14.87	-5.76	0.176
78	4.03	0.39	0.39	-14.85	-6.53	0.194
79	4.08	0.39	0.39	-14.83	-7.31	0.212
80	4.13	0.39	0.39	-14.81	-8.08	0.229
81	4.18	0.40	0.40	-14.79	-8.86	0.247
82	4.23	0.40	0.40	-14.77	-9.63	0.264
83	4.29	0.40	0.40	-14.75	-10.40	0.282
84	4.34	0.41	0.41	-14.72	-11.17	0.300
85	4.39	0.41	0.41	-14.70	-11.94	0.317
86	4.44	0.41	0.41	-14.68	-12.71	0.335
87	4.50	0.42	0.42	-14.66	-13.47	0.352
88	4.55	0.42	0.42	-14.64	-14.24	0.370
89	4.60	0.42	0.42	-14.62	-15.01	0.388
90	4.65	0.43	0.43	-14.59	-15.77	0.405
91	4.71	0.43	0.43	-14.57	-16.53	0.423
92	4.76	0.43	0.43	-14.55	-17.29	0.440
93	4.81	0.43	0.43	-14.53	-18.05	0.458
94	4.86	0.44	0.44	-14.50	-18.81	0.475
95	4.91	0.44	0.44	-14.48	-19.57	0.493
96	4.97	0.44	0.44	-14.46	-20.33	0.510
97	5.02	0.45	0.45	-14.43	-21.08	0.528
98	5.07	0.45	0.45	-14.41	-21.83	0.545
99	5.12	0.45	0.45	-14.39	-22.59	0.563

100	5.18	0.46	0.46	-14.36	-23.34	0.580
101	5.23	0.46	0.46	-14.34	-24.09	0.598
102	5.28	0.46	0.46	-14.32	-24.84	0.615
103	5.33	0.47	0.47	-14.29	-25.59	0.633
104	5.38	0.47	0.47	-14.27	-26.33	0.650
105	5.44	0.47	0.47	-14.24	-27.08	0.667
106	5.49	0.48	0.48	-14.22	-27.82	0.685
107	5.54	0.48	0.48	-14.19	-28.56	0.702
108	5.59	0.48	0.48	-14.17	-29.31	0.720
109	5.65	0.48	0.48	-14.14	-30.05	0.737
110	5.70	0.49	0.49	-14.12	-30.78	0.754
111	5.75	0.49	0.49	-14.09	-31.52	0.772
112	5.80	0.49	0.49	-14.06	-32.26	0.789
113	5.86	0.50	0.50	-14.04	-32.99	0.806
114	5.91	0.50	0.50	-14.01	-33.72	0.824
115	5.96	0.50	0.50	-13.99	-34.46	0.841
116	6.01	0.51	0.51	-13.96	-35.19	0.858
117	6.06	0.51	0.51	-13.93	-35.92	0.875
118	6.12	0.51	0.51	-13.91	-36.64	0.893
119	6.17	0.52	0.52	-13.88	-37.37	0.910
120	6.22	0.52	0.52	-13.85	-38.10	0.927
121	6.27	0.52	0.52	-13.83	-38.82	0.944
122	6.33	0.53	0.53	-13.80	-39.54	0.961
123	6.38	0.53	0.53	-13.77	-40.26	0.978
124	6.43	0.53	0.53	-13.74	-40.98	0.996
125	6.48	0.53	0.53	-13.72	-41.70	1.013
126	6.53	0.54	0.54	-13.69	-42.42	1.030
127	6.59	0.54	0.54	-13.66	-43.13	1.047
128	6.64	0.54	0.54	-13.63	-43.84	1.064
129	6.69	0.55	0.55	-13.60	-44.56	1.081
130	6.74	0.55	0.55	-13.57	-45.27	1.098
131	6.80	0.55	0.55	-13.54	-45.97	1.115
132	6.85	0.56	0.56	-13.52	-46.68	1.132
133	6.90	0.56	0.56	-13.49	-47.39	1.149
134	6.95	0.56	0.56	-13.46	-48.09	1.166
135	7.01	0.57	0.57	-13.43	-48.79	1.182
136	7.06	0.57	0.57	-13.40	-49.50	1.199
137	7.11	0.57	0.57	-13.37	-50.20	1.216
138	7.16	0.58	0.58	-13.34	-50.89	1.233
139	7.21	0.58	0.58	-13.31	-51.59	1.250
140	7.27	0.58	0.58	-13.28	-52.28	1.267
141	7.32	0.59	0.59	-13.25	-52.98	1.283
142	7.37	0.59	0.59	-13.22	-53.67	1.300
143	7.42	0.59	0.59	-13.19	-54.36	1.317
144	7.48	0.59	0.59	-13.15	-55.05	1.334
145	7.53	0.60	0.60	-13.12	-55.74	1.350
146	7.58	0.60	0.60	-13.09	-56.42	1.367
147	7.63	0.60	0.60	-13.06	-57.10	1.383
148	7.69	0.61	0.61	-13.03	-57.79	1.400
149	7.74	0.61	0.61	-13.00	-58.47	1.417
150	7.79	0.61	0.61	-12.96	-59.14	1.433
151	7.84	0.62	0.62	-12.93	-59.82	1.450
152	7.89	0.62	0.62	-12.90	-60.50	1.466
153	7.95	0.62	0.62	-12.87	-61.17	1.482
154	8.00	0.63	0.63	-12.84	-61.84	1.499
155	8.05	0.63	0.63	-12.80	-62.51	1.515
156	8.10	0.63	0.63	-12.77	-63.18	1.532
157	8.16	0.64	0.64	-12.74	-63.85	1.548
158	8.21	0.64	0.64	-12.70	-64.51	1.564
159	8.26	0.64	0.64	-12.67	-65.18	1.581
160	8.31	0.64	0.64	-12.64	-65.84	1.597
161	8.36	0.65	0.65	-12.60	-66.50	1.613
162	8.42	0.65	0.65	-12.57	-67.16	1.629
163	8.47	0.65	0.65	-12.53	-67.81	1.645
164	8.52	0.66	0.66	-12.50	-68.47	1.661
165	8.57	0.66	0.66	-12.47	-69.12	1.678
166	8.63	0.66	0.66	-12.43	-69.77	1.694
167	8.68	0.67	0.67	-12.40	-70.42	1.710
168	8.73	0.67	0.67	-12.36	-71.07	1.726

169	8.78	0.67	0.67	-12.33	-71.71	1.742
170	8.84	0.68	0.68	-12.29	-72.35	1.758
171	8.89	0.68	0.68	-12.26	-73.00	1.773
172	8.94	0.68	0.68	-12.22	-73.64	1.789
173	8.99	0.69	0.69	-12.18	-74.27	1.805
174	9.04	0.69	0.69	-12.15	-74.91	1.821
175	9.10	0.69	0.69	-12.11	-75.54	1.837
176	9.15	0.69	0.69	-12.08	-76.18	1.852
177	9.20	0.70	0.70	-12.04	-76.81	1.868
178	9.25	0.70	0.70	-12.00	-77.43	1.884
179	9.31	0.70	0.70	-11.97	-78.06	1.899
180	9.36	0.71	0.71	-11.93	-78.69	1.915
181	9.41	0.71	0.71	-11.89	-79.31	1.931
182	9.46	0.71	0.71	-11.85	-79.93	1.946
183	9.51	0.72	0.72	-11.82	-80.55	1.962
184	9.57	0.72	0.72	-11.78	-81.16	1.977
185	9.62	0.72	0.72	-11.74	-81.78	1.992
186	9.67	0.73	0.73	-11.70	-82.39	2.008
187	9.72	0.73	0.73	-11.67	-83.00	2.023
188	9.78	0.73	0.73	-11.63	-83.61	2.038
189	9.83	0.74	0.74	-11.59	-84.22	2.054
190	9.88	0.74	0.74	-11.55	-84.82	2.069
191	9.93	0.74	0.74	-11.51	-85.43	2.084
192	9.99	0.75	0.75	-11.47	-86.03	2.099
193	10.04	0.75	0.75	-11.43	-86.63	2.114
194	10.09	0.75	0.75	-11.40	-87.22	2.129
195	10.14	0.75	0.75	-11.36	-87.82	2.144
196	10.19	0.76	0.76	-11.32	-88.41	2.159
197	10.25	0.76	0.76	-11.28	-89.00	2.174
198	10.30	0.76	0.76	-11.24	-89.59	2.189
199	10.35	0.77	0.77	-11.20	-90.18	2.204
200	10.40	0.77	0.77	-11.16	-90.76	2.219
201	10.46	0.77	0.77	-11.12	-91.34	2.234
202	10.51	0.78	0.78	-11.08	-91.92	2.248
203	10.56	0.78	0.78	-11.03	-92.50	2.263
204	10.61	0.78	0.78	-10.99	-93.08	2.278
205	10.67	0.79	0.79	-10.95	-93.65	2.292
206	10.72	0.79	0.79	-10.91	-94.22	2.307
207	10.77	0.79	0.79	-10.87	-94.79	2.321
208	10.82	0.80	0.80	-10.83	-95.36	2.336
209	10.87	0.80	0.80	-10.79	-95.92	2.350
210	10.93	0.80	0.80	-10.75	-96.49	2.365
211	10.98	0.80	0.80	-10.70	-97.05	2.379
212	11.03	0.81	0.81	-10.66	-97.61	2.393
213	11.08	0.81	0.81	-10.62	-98.16	2.408
214	11.14	0.81	0.81	-10.58	-98.72	2.422
215	11.19	0.81	0.81	-10.53	-99.27	2.436
216	11.24	0.81	0.81	-10.49	-99.82	2.450
217	11.29	0.81	0.81	-10.45	-100.36	2.464
218	11.34	0.82	0.82	-10.41	-100.91	2.478
219	11.40	0.82	0.82	-10.36	-101.45	2.492
220	11.45	0.82	0.82	-10.32	-101.99	2.506
221	11.50	0.82	0.82	-10.28	-102.53	2.520
222	11.55	0.82	0.82	-10.24	-103.07	2.534
223	11.61	0.82	0.82	-10.19	-103.60	2.548
224	11.66	0.82	0.82	-10.15	-104.13	2.562
225	11.71	0.83	0.83	-10.11	-104.66	2.575
226	11.76	0.83	0.83	-10.06	-105.19	2.589
227	11.82	0.83	0.83	-10.02	-105.72	2.603
228	11.87	0.83	0.83	-9.98	-106.24	2.616
229	11.92	0.83	0.83	-9.93	-106.76	2.630
230	11.97	0.83	0.83	-9.89	-107.28	2.643
231	12.02	0.84	0.84	-9.85	-107.79	2.657
232	12.08	0.84	0.84	-9.80	-108.31	2.670
233	12.13	0.84	0.84	-9.76	-108.82	2.683
234	12.18	0.84	0.84	-9.71	-109.33	2.697
235	12.23	0.84	0.84	-9.67	-109.83	2.710
236	12.29	0.84	0.84	-9.63	-110.34	2.723
237	12.34	0.84	0.84	-9.58	-110.84	2.736

238	12.39	0.85	0.85	-9.54	-111.34	2.749
239	12.44	0.85	0.85	-9.49	-111.84	2.762
240	12.49	0.85	0.85	-9.45	-112.33	2.775
241	12.55	0.85	0.85	-9.40	-112.82	2.788
242	12.60	0.85	0.85	-9.36	-113.32	2.801
243	12.65	0.85	0.85	-9.32	-113.80	2.814
244	12.70	0.86	0.86	-9.27	-114.29	2.827
245	12.76	0.86	0.86	-9.23	-114.77	2.839
246	12.81	0.86	0.86	-9.18	-115.25	2.852
247	12.86	0.86	0.86	-9.14	-115.73	2.865
248	12.91	0.86	0.86	-9.09	-116.21	2.877
249	12.97	0.86	0.86	-9.05	-116.68	2.890
250	13.02	0.86	0.86	-9.00	-117.16	2.902
251	13.07	0.87	0.87	-8.96	-117.62	2.915
252	13.12	0.87	0.87	-8.91	-118.09	2.927
253	13.17	0.87	0.87	-8.87	-118.56	2.939
254	13.23	0.87	0.87	-8.82	-119.02	2.951
255	13.28	0.87	0.87	-8.77	-119.48	2.964
256	13.33	0.87	0.87	-8.73	-119.94	2.976
257	13.38	0.87	0.87	-8.68	-120.39	2.988
258	13.44	0.88	0.88	-8.64	-120.84	3.000
259	13.49	0.88	0.88	-8.59	-121.29	3.012
260	13.54	0.88	0.88	-8.55	-121.74	3.024
261	13.59	0.88	0.88	-8.50	-122.19	3.036
262	13.64	0.88	0.88	-8.45	-122.63	3.047
263	13.70	0.88	0.88	-8.41	-123.07	3.059
264	13.75	0.89	0.89	-8.36	-123.51	3.071
265	13.80	0.89	0.89	-8.32	-123.95	3.083
266	13.85	0.89	0.89	-8.27	-124.38	3.094
267	13.91	0.89	0.89	-8.22	-124.81	3.106
268	13.96	0.89	0.89	-8.18	-125.24	3.117
269	14.01	0.89	0.89	-8.13	-125.67	3.129
270	14.06	0.89	0.89	-8.08	-126.09	3.140
271	14.12	0.90	0.90	-8.04	-126.51	3.151
272	14.17	0.90	0.90	-7.99	-126.93	3.163
273	14.22	0.90	0.90	-7.94	-127.35	3.174
274	14.27	0.90	0.90	-7.89	-127.76	3.185
275	14.32	0.90	0.90	-7.85	-128.17	3.196
276	14.38	0.90	0.90	-7.80	-128.58	3.207
277	14.43	0.90	0.90	-7.75	-128.99	3.218
278	14.48	0.91	0.91	-7.71	-129.39	3.229
279	14.53	0.91	0.91	-7.66	-129.79	3.240
280	14.59	0.91	0.91	-7.61	-130.19	3.250
281	14.64	0.91	0.91	-7.56	-130.59	3.261
282	14.69	0.91	0.91	-7.52	-130.98	3.272
283	14.74	0.91	0.91	-7.47	-131.37	3.282
284	14.80	0.92	0.92	-7.42	-131.76	3.293
285	14.85	0.92	0.92	-7.37	-132.15	3.303
286	14.90	0.92	0.92	-7.32	-132.53	3.314
287	14.95	0.92	0.92	-7.28	-132.92	3.324
288	15.00	0.92	0.92	-7.23	-133.30	3.335
289	15.06	0.92	0.92	-7.18	-133.67	3.345
290	15.11	0.92	0.92	-7.13	-134.05	3.355
291	15.16	0.93	0.93	-7.08	-134.42	3.365
292	15.21	0.93	0.93	-7.03	-134.79	3.375
293	15.27	0.93	0.93	-6.99	-135.15	3.385
294	15.32	0.93	0.93	-6.94	-135.52	3.395
295	15.37	0.93	0.93	-6.89	-135.88	3.405
296	15.42	0.93	0.93	-6.84	-136.24	3.415
297	15.47	0.93	0.93	-6.79	-136.59	3.425
298	15.53	0.94	0.94	-6.74	-136.95	3.434
299	15.58	0.94	0.94	-6.69	-137.30	3.444
300	15.63	0.94	0.94	-6.64	-137.65	3.453
301	15.68	0.94	0.94	-6.60	-137.99	3.463
302	15.74	0.94	0.94	-6.55	-138.34	3.472
303	15.79	0.94	0.94	-6.50	-138.68	3.482
304	15.84	0.95	0.95	-6.45	-139.02	3.491
305	15.89	0.95	0.95	-6.40	-139.35	3.500
306	15.95	0.95	0.95	-6.35	-139.69	3.510

307	16.00	0.95	0.95	-6.30	-140.02	3.519
308	16.05	0.95	0.95	-6.25	-140.34	3.528
309	16.10	0.95	0.95	-6.20	-140.67	3.537
310	16.15	0.95	0.95	-6.15	-140.99	3.546
311	16.21	0.96	0.96	-6.10	-141.31	3.555
312	16.26	0.96	0.96	-6.05	-141.63	3.563
313	16.31	0.96	0.96	-6.00	-141.94	3.572
314	16.36	0.96	0.96	-5.95	-142.26	3.581
315	16.42	0.96	0.96	-5.90	-142.57	3.589
316	16.47	0.96	0.96	-5.85	-142.87	3.598
317	16.52	0.97	0.97	-5.80	-143.18	3.607
318	16.57	0.97	0.97	-5.75	-143.48	3.615
319	16.62	0.97	0.97	-5.70	-143.78	3.623
320	16.68	0.97	0.97	-5.65	-144.08	3.632
321	16.73	0.97	0.97	-5.60	-144.37	3.640
322	16.78	0.97	0.97	-5.54	-144.66	3.648
323	16.83	0.97	0.97	-5.49	-144.95	3.656
324	16.89	0.98	0.98	-5.44	-145.23	3.664
325	16.94	0.98	0.98	-5.39	-145.52	3.672
326	16.99	0.98	0.98	-5.34	-145.80	3.680
327	17.04	0.98	0.98	-5.29	-146.08	3.688
328	17.10	0.98	0.98	-5.24	-146.35	3.696
329	17.15	0.98	0.98	-5.19	-146.62	3.703
330	17.20	0.98	0.98	-5.13	-146.89	3.711
331	17.25	0.99	0.99	-5.08	-147.16	3.719
332	17.30	0.99	0.99	-5.03	-147.43	3.726
333	17.36	0.99	0.99	-4.98	-147.69	3.734
334	17.41	0.99	0.99	-4.93	-147.95	3.741
335	17.46	0.99	0.99	-4.88	-148.20	3.748
336	17.51	0.99	0.99	-4.82	-148.46	3.755
337	17.57	1.00	1.00	-4.77	-148.71	3.763
338	17.62	1.00	1.00	-4.72	-148.96	3.770
339	17.67	1.00	1.00	-4.67	-149.20	3.777
340	17.72	1.00	1.00	-4.62	-149.44	3.784
341	17.78	1.00	1.00	-4.56	-149.68	3.791
342	17.83	1.00	1.00	-4.51	-149.92	3.798
343	17.88	1.00	1.00	-4.46	-150.15	3.804
344	17.93	1.01	1.01	-4.41	-150.39	3.811
345	17.98	1.01	1.01	-4.35	-150.62	3.818
346	18.04	1.01	1.01	-4.30	-150.84	3.824
347	18.09	1.01	1.01	-4.25	-151.07	3.831
348	18.14	1.01	1.01	-4.20	-151.29	3.837
349	18.19	1.01	1.01	-4.14	-151.50	3.844
350	18.25	1.02	1.02	-4.09	-151.72	3.850
351	18.30	1.02	1.02	-4.04	-151.93	3.856
352	18.35	1.02	1.02	-3.98	-152.14	3.862
353	18.40	1.02	1.02	-3.93	-152.35	3.868
354	18.45	1.02	1.02	-3.88	-152.55	3.874
355	18.51	1.02	1.02	-3.82	-152.75	3.880
356	18.56	1.02	1.02	-3.77	-152.95	3.886
357	18.61	1.03	1.03	-3.72	-153.15	3.892
358	18.66	1.03	1.03	-3.66	-153.34	3.898
359	18.72	1.03	1.03	-3.61	-153.53	3.903
360	18.77	1.03	1.03	-3.55	-153.72	3.909
361	18.82	1.03	1.03	-3.50	-153.90	3.914
362	18.87	1.03	1.03	-3.45	-154.08	3.920
363	18.93	1.03	1.03	-3.39	-154.26	3.925
364	18.98	1.04	1.04	-3.34	-154.44	3.931
365	19.03	1.04	1.04	-3.28	-154.61	3.936
366	19.08	1.04	1.04	-3.23	-154.78	3.941
367	19.13	1.04	1.04	-3.18	-154.95	3.946
368	19.19	1.04	1.04	-3.12	-155.11	3.951
369	19.24	1.04	1.04	-3.07	-155.28	3.956
370	19.29	1.05	1.05	-3.01	-155.43	3.961
371	19.34	1.05	1.05	-2.96	-155.59	3.966
372	19.40	1.05	1.05	-2.90	-155.74	3.971
373	19.45	1.05	1.05	-2.85	-155.89	3.975
374	19.50	1.05	1.05	-2.79	-156.04	3.980
375	19.55	1.05	1.05	-2.74	-156.19	3.985

376	19.60	1.05	1.05	-2.68	-156.33	3.989
377	19.66	1.06	1.06	-2.63	-156.47	3.994
378	19.71	1.06	1.06	-2.57	-156.60	3.998
379	19.76	1.06	1.06	-2.52	-156.74	4.002
380	19.81	1.06	1.06	-2.46	-156.87	4.006
381	19.87	1.06	1.06	-2.41	-156.99	4.011
382	19.92	1.06	1.06	-2.35	-157.12	4.015
383	19.97	1.06	1.06	-2.30	-157.24	4.019
384	20.02	1.07	1.07	-2.24	-157.36	4.023
385	20.08	1.07	1.07	-2.18	-157.47	4.026
386	20.13	1.07	1.07	-2.13	-157.59	4.030
387	20.18	1.07	1.07	-2.07	-157.70	4.034
388	20.23	1.07	1.07	-2.02	-157.80	4.037
389	20.28	1.07	1.07	-1.96	-157.91	4.041
390	20.34	1.08	1.08	-1.90	-158.01	4.045
391	20.39	1.08	1.08	-1.85	-158.11	4.048
392	20.44	1.08	1.08	-1.79	-158.20	4.051
393	20.49	1.08	1.08	-1.73	-158.29	4.055
394	20.55	1.08	1.08	-1.68	-158.38	4.058
395	20.60	1.08	1.08	-1.62	-158.47	4.061
396	20.65	1.08	1.08	-1.56	-158.55	4.064
397	20.70	1.09	1.09	-1.51	-158.63	4.067
398	20.76	1.09	1.09	-1.45	-158.71	4.070
399	20.81	1.09	1.09	-1.39	-158.78	4.073
400	20.86	1.09	1.09	-1.34	-158.85	4.076
401	20.91	1.09	1.09	-1.28	-158.92	4.078
402	20.96	1.09	1.09	-1.22	-158.99	4.081
403	21.02	1.09	1.09	-1.17	-159.05	4.083
404	21.07	1.10	1.10	-1.11	-159.11	4.086
405	21.12	1.10	1.10	-1.05	-159.17	4.088
406	21.17	1.10	1.10	-0.99	-159.22	4.091
407	21.23	1.10	1.10	-0.94	-159.27	4.093
408	21.28	1.10	1.10	-0.88	-159.32	4.095
409	21.33	1.10	1.10	-0.82	-159.36	4.097
410	21.38	1.11	1.11	-0.76	-159.40	4.099
411	21.43	1.11	1.11	-0.71	-159.44	4.101
412	21.49	1.11	1.11	-0.65	-159.48	4.103
413	21.54	1.11	1.11	-0.59	-159.51	4.105
414	21.59	1.11	1.11	-0.53	-159.54	4.107
415	21.64	1.11	1.11	-0.47	-159.57	4.109
416	21.70	1.11	1.11	-0.42	-159.59	4.110
417	21.75	1.12	1.12	-0.36	-159.61	4.112
418	21.80	1.12	1.12	-0.30	-159.63	4.113
419	21.85	1.12	1.12	-0.24	-159.64	4.115
420	21.91	1.12	1.12	-0.18	-159.65	4.116
421	21.96	1.12	1.12	-0.12	-159.66	4.117
422	22.01	1.12	1.12	-0.06	-159.66	4.119
423	22.06	1.12	1.12	-0.01	-159.67	4.120
424	22.11	1.13	1.13	0.05	-159.67	4.121
425	22.17	1.13	1.13	0.11	-159.66	4.122
426	22.22	1.13	1.13	0.17	-159.65	4.123
427	22.27	1.13	1.13	0.23	-159.64	4.123
428	22.32	1.13	1.13	0.29	-159.63	4.124
429	22.38	1.13	1.13	0.35	-159.61	4.125
430	22.43	1.14	1.14	0.41	-159.59	4.125
431	22.48	1.14	1.14	0.47	-159.57	4.126
432	22.53	1.14	1.14	0.53	-159.54	4.127
433	22.58	1.14	1.14	0.59	-159.52	4.127
434	22.64	1.14	1.14	0.65	-159.48	4.127
435	22.69	1.14	1.14	0.71	-159.45	4.128
436	22.74	1.14	1.14	0.77	-159.41	4.128
437	22.79	1.15	1.15	0.83	-159.37	4.128
438	22.85	1.15	1.15	0.89	-159.32	4.128
439	22.90	1.15	1.15	0.95	-159.27	4.128
440	22.95	1.15	1.15	1.01	-159.22	4.128
441	23.00	1.15	1.15	1.07	-159.17	4.128
442	23.06	1.15	1.15	1.13	-159.11	4.127
443	23.11	1.16	1.16	1.19	-159.05	4.127
444	23.16	1.16	1.16	1.25	-158.99	4.127

445	23.21	1.16	1.16	1.31	-158.92	4.126
446	23.26	1.16	1.16	1.37	-158.85	4.126
447	23.32	1.16	1.16	1.43	-158.78	4.125
448	23.37	1.16	1.16	1.49	-158.70	4.124
449	23.42	1.16	1.16	1.55	-158.62	4.124
450	23.47	1.17	1.17	1.61	-158.54	4.123
451	23.53	1.17	1.17	1.67	-158.45	4.122
452	23.58	1.17	1.17	1.73	-158.37	4.121
453	23.63	1.17	1.17	1.79	-158.27	4.120
454	23.68	1.17	1.17	1.86	-158.18	4.119
455	23.74	1.17	1.17	1.92	-158.08	4.118
456	23.79	1.17	1.17	1.98	-157.98	4.116
457	23.84	1.18	1.18	2.04	-157.87	4.115
458	23.89	1.18	1.18	2.10	-157.76	4.114
459	23.94	1.18	1.18	2.16	-157.65	4.112
460	24.00	1.18	1.18	2.22	-157.54	4.111
461	24.05	1.18	1.18	2.29	-157.42	4.109
462	24.10	1.17	1.17	2.35	-157.30	4.108
463	24.15	1.16	1.16	2.41	-157.17	4.106
464	24.21	1.16	1.16	2.47	-157.05	4.104
465	24.26	1.15	1.15	2.53	-156.92	4.102
466	24.31	1.15	1.15	2.59	-156.78	4.100
467	24.36	1.14	1.14	2.65	-156.65	4.098
468	24.41	1.14	1.14	2.71	-156.51	4.096
469	24.47	1.13	1.13	2.77	-156.36	4.094
470	24.52	1.13	1.13	2.83	-156.22	4.092
471	24.57	1.12	1.12	2.89	-156.07	4.089
472	24.62	1.12	1.12	2.95	-155.91	4.087
473	24.68	1.11	1.11	3.00	-155.76	4.085
474	24.73	1.11	1.11	3.06	-155.60	4.082
475	24.78	1.10	1.10	3.12	-155.44	4.079
476	24.83	1.10	1.10	3.18	-155.27	4.077
477	24.89	1.09	1.09	3.23	-155.11	4.074
478	24.94	1.09	1.09	3.29	-154.94	4.071
479	24.99	1.08	1.08	3.35	-154.76	4.068
480	25.04	1.07	1.07	3.40	-154.59	4.065
481	25.09	1.07	1.07	3.46	-154.41	4.062
482	25.15	1.06	1.06	3.52	-154.22	4.059
483	25.20	1.06	1.06	3.57	-154.04	4.056
484	25.25	1.05	1.05	3.63	-153.85	4.053
485	25.30	1.05	1.05	3.68	-153.66	4.050
486	25.36	1.04	1.04	3.74	-153.47	4.046
487	25.41	1.04	1.04	3.79	-153.27	4.043
488	25.46	1.03	1.03	3.84	-153.07	4.039
489	25.51	1.03	1.03	3.90	-152.87	4.036
490	25.56	1.02	1.02	3.95	-152.66	4.032
491	25.62	1.02	1.02	4.01	-152.45	4.029
492	25.67	1.01	1.01	4.06	-152.24	4.025
493	25.72	1.01	1.01	4.11	-152.03	4.021
494	25.77	1.00	1.00	4.16	-151.81	4.017
495	25.83	1.00	1.00	4.22	-151.59	4.013
496	25.88	0.99	0.99	4.27	-151.37	4.009
497	25.93	0.99	0.99	4.32	-151.15	4.005
498	25.98	0.98	0.98	4.37	-150.92	4.001
499	26.04	0.97	0.97	4.42	-150.69	3.997
500	26.09	0.97	0.97	4.47	-150.46	3.992
501	26.14	0.96	0.96	4.52	-150.22	3.988
502	26.19	0.96	0.96	4.57	-149.99	3.983
503	26.24	0.95	0.95	4.62	-149.75	3.979
504	26.30	0.95	0.95	4.67	-149.50	3.974
505	26.35	0.94	0.94	4.72	-149.26	3.970
506	26.40	0.94	0.94	4.77	-149.01	3.965
507	26.45	0.93	0.93	4.82	-148.76	3.960
508	26.51	0.93	0.93	4.87	-148.50	3.955
509	26.56	0.92	0.92	4.92	-148.25	3.950
510	26.61	0.92	0.92	4.97	-147.99	3.945
511	26.66	0.91	0.91	5.01	-147.73	3.940
512	26.72	0.91	0.91	5.06	-147.47	3.935
513	26.77	0.90	0.90	5.11	-147.20	3.930

514	26.82	0.90	0.90	5.16	-146.93	3.925
515	26.87	0.89	0.89	5.20	-146.66	3.920
516	26.92	0.89	0.89	5.25	-146.39	3.914
517	26.98	0.88	0.88	5.29	-146.11	3.909
518	27.03	0.87	0.87	5.34	-145.83	3.903
519	27.08	0.87	0.87	5.39	-145.55	3.898
520	27.13	0.86	0.86	5.43	-145.27	3.892
521	27.19	0.86	0.86	5.48	-144.99	3.886
522	27.24	0.85	0.85	5.52	-144.70	3.881
523	27.29	0.85	0.85	5.57	-144.41	3.875
524	27.34	0.84	0.84	5.61	-144.12	3.869
525	27.39	0.84	0.84	5.65	-143.82	3.863
526	27.45	0.83	0.83	5.70	-143.53	3.857
527	27.50	0.83	0.83	5.74	-143.23	3.851
528	27.55	0.82	0.82	5.78	-142.93	3.845
529	27.60	0.88	0.88	5.83	-142.62	3.838
530	27.66	0.88	0.88	5.87	-142.32	3.832
531	27.71	0.88	0.88	5.92	-142.01	3.826
532	27.76	0.87	0.87	5.96	-141.70	3.819
533	27.81	0.87	0.87	6.01	-141.38	3.813
534	27.87	0.87	0.87	6.06	-141.07	3.806
535	27.92	0.86	0.86	6.10	-140.75	3.800
536	27.97	0.86	0.86	6.15	-140.43	3.793
537	28.02	0.86	0.86	6.19	-140.11	3.786
538	28.07	0.85	0.85	6.23	-139.78	3.779
539	28.13	0.85	0.85	6.28	-139.46	3.773
540	28.18	0.85	0.85	6.32	-139.13	3.766
541	28.23	0.84	0.84	6.37	-138.80	3.759
542	28.28	0.84	0.84	6.41	-138.46	3.752
543	28.34	0.84	0.84	6.46	-138.13	3.745
544	28.39	0.83	0.83	6.50	-137.79	3.737
545	28.44	0.83	0.83	6.54	-137.45	3.730
546	28.49	0.83	0.83	6.59	-137.10	3.723
547	28.54	0.82	0.82	6.63	-136.76	3.715
548	28.60	0.82	0.82	6.67	-136.41	3.708
549	28.65	0.82	0.82	6.71	-136.06	3.701
550	28.70	0.81	0.81	6.76	-135.71	3.693
551	28.75	0.81	0.81	6.80	-135.35	3.685
552	28.81	0.81	0.81	6.84	-135.00	3.678
553	28.86	0.80	0.80	6.88	-134.64	3.670
554	28.91	0.80	0.80	6.93	-134.28	3.662
555	28.96	0.80	0.80	6.97	-133.91	3.654
556	29.02	0.79	0.79	7.01	-133.55	3.646
557	29.07	0.79	0.79	7.05	-133.18	3.639
558	29.12	0.79	0.79	7.09	-132.81	3.630
559	29.17	0.78	0.78	7.13	-132.44	3.622
560	29.22	0.78	0.78	7.17	-132.06	3.614
561	29.28	0.78	0.78	7.22	-131.69	3.606
562	29.33	0.78	0.78	7.26	-131.31	3.598
563	29.38	0.77	0.77	7.30	-130.93	3.589
564	29.43	0.77	0.77	7.34	-130.55	3.581
565	29.49	0.77	0.77	7.38	-130.16	3.573
566	29.54	0.76	0.76	7.42	-129.78	3.564
567	29.59	0.76	0.76	7.46	-129.39	3.556
568	29.64	0.76	0.76	7.50	-129.00	3.547
569	29.69	0.75	0.75	7.54	-128.60	3.538
570	29.75	0.75	0.75	7.57	-128.21	3.530
571	29.80	0.75	0.75	7.61	-127.81	3.521
572	29.85	0.74	0.74	7.65	-127.41	3.512
573	29.90	0.74	0.74	7.69	-127.01	3.503
574	29.96	0.74	0.74	7.73	-126.61	3.494
575	30.01	0.73	0.73	7.77	-126.20	3.485
576	30.06	0.73	0.73	7.81	-125.80	3.476
577	30.11	0.73	0.73	7.85	-125.39	3.467
578	30.17	0.72	0.72	7.88	-124.98	3.458
579	30.22	0.72	0.72	7.92	-124.56	3.448
580	30.27	0.72	0.72	7.96	-124.15	3.439
581	30.32	0.71	0.71	8.00	-123.73	3.430
582	30.37	0.71	0.71	8.03	-123.31	3.420

583	30.43	0.71	0.71	8.07	-122.89	3.411
584	30.48	0.70	0.70	8.11	-122.47	3.401
585	30.53	0.70	0.70	8.14	-122.04	3.392
586	30.58	0.70	0.70	8.18	-121.62	3.382
587	30.64	0.69	0.69	8.22	-121.19	3.372
588	30.69	0.69	0.69	8.25	-120.76	3.363
589	30.74	0.69	0.69	8.29	-120.32	3.353
590	30.79	0.68	0.68	8.32	-119.89	3.343
591	30.85	0.68	0.68	8.36	-119.45	3.333
592	30.90	0.68	0.68	8.40	-119.02	3.323
593	30.95	0.68	0.68	8.43	-118.58	3.313
594	31.00	0.67	0.67	8.47	-118.13	3.303
595	31.05	0.67	0.67	8.50	-117.69	3.293
596	31.11	0.67	0.67	8.54	-117.25	3.283
597	31.16	0.66	0.66	8.57	-116.80	3.273
598	31.21	0.66	0.66	8.61	-116.35	3.262
599	31.26	0.66	0.66	8.64	-115.90	3.252
600	31.32	0.65	0.65	8.67	-115.45	3.242
601	31.37	0.65	0.65	8.71	-114.99	3.231
602	31.42	0.65	0.65	8.74	-114.54	3.221
603	31.47	0.64	0.64	8.78	-114.08	3.210
604	31.52	0.64	0.64	8.81	-113.62	3.200
605	31.58	0.64	0.64	8.84	-113.16	3.189
606	31.63	0.63	0.63	8.88	-112.69	3.178
607	31.68	0.63	0.63	8.91	-112.23	3.168
608	31.73	0.63	0.63	8.94	-111.76	3.157
609	31.79	0.62	0.62	8.97	-111.29	3.146
610	31.84	0.62	0.62	9.01	-110.82	3.135
611	31.89	0.62	0.62	9.04	-110.35	3.124
612	31.94	0.61	0.61	9.07	-109.88	3.113
613	32.00	0.61	0.61	9.10	-109.40	3.102
614	32.05	0.61	0.61	9.14	-108.93	3.091
615	32.10	0.60	0.60	9.17	-108.45	3.080
616	32.15	0.60	0.60	9.20	-107.97	3.069
617	32.20	0.60	0.60	9.23	-107.49	3.057
618	32.26	0.59	0.59	9.26	-107.00	3.046
619	32.31	0.59	0.59	9.29	-106.52	3.035
620	32.36	0.59	0.59	9.32	-106.03	3.023
621	32.41	0.58	0.58	9.35	-105.54	3.012
622	32.47	0.58	0.58	9.38	-105.05	3.001
623	32.52	0.58	0.58	9.41	-104.56	2.989
624	32.57	0.57	0.57	9.44	-104.07	2.978
625	32.62	0.57	0.57	9.47	-103.57	2.966
626	32.67	0.57	0.57	9.50	-103.08	2.954
627	32.73	0.57	0.57	9.53	-102.58	2.943
628	32.78	0.56	0.56	9.56	-102.08	2.931
629	32.83	0.56	0.56	9.59	-101.58	2.919
630	32.88	0.56	0.56	9.62	-101.08	2.907
631	32.94	0.55	0.55	9.65	-100.57	2.895
632	32.99	0.55	0.55	9.68	-100.07	2.883
633	33.04	0.55	0.55	9.71	-99.56	2.871
634	33.09	0.54	0.54	9.74	-99.05	2.859
635	33.15	0.54	0.54	9.76	-98.54	2.847
636	33.20	0.54	0.54	9.79	-98.03	2.835
637	33.25	0.53	0.53	9.82	-97.52	2.823
638	33.30	0.53	0.53	9.85	-97.01	2.811
639	33.35	0.53	0.53	9.88	-96.49	2.799
640	33.41	0.52	0.52	9.90	-95.97	2.786
641	33.46	0.52	0.52	9.93	-95.46	2.774
642	33.51	0.52	0.52	9.96	-94.94	2.762
643	33.56	0.51	0.51	9.98	-94.41	2.749
644	33.62	0.16	0.16	10.01	-93.89	2.737
645	33.67	0.15	0.15	10.01	-93.37	2.724
646	33.72	0.14	0.14	10.02	-92.84	2.712
647	33.77	0.13	0.13	10.03	-92.32	2.699
648	33.83	0.13	0.13	10.04	-91.80	2.687
649	33.88	0.12	0.12	10.04	-91.27	2.674
650	33.93	0.11	0.11	10.05	-90.75	2.661
651	33.98	0.11	0.11	10.05	-90.22	2.648

652	34.03	0.10	0.10	10.06	-89.69	2.636
653	34.09	0.09	0.09	10.06	-89.17	2.623
654	34.14	0.09	0.09	10.07	-88.64	2.610
655	34.19	0.08	0.08	10.07	-88.12	2.597
656	34.24	0.07	0.07	10.08	-87.59	2.584
657	34.30	0.06	0.06	10.08	-87.06	2.571
658	34.35	0.06	0.06	10.08	-86.53	2.558
659	34.40	0.05	0.05	10.09	-86.01	2.545
660	34.45	0.04	0.04	10.09	-85.48	2.532
661	34.50	0.04	0.04	10.09	-84.95	2.519
662	34.56	0.03	0.03	10.09	-84.43	2.506
663	34.61	0.02	0.02	10.09	-83.90	2.492
664	34.66	0.01	0.01	10.10	-83.37	2.479
665	34.71	0.01	0.01	10.10	-82.84	2.466
666	34.77	0.00	0.00	10.10	-82.31	2.453
667	34.82	-0.01	-0.01	10.10	-81.79	2.439
668	34.87	-0.01	-0.01	10.10	-81.26	2.426
669	34.92	-0.02	-0.02	10.09	-80.73	2.412
670	34.98	-0.03	-0.03	10.09	-80.20	2.399
671	35.03	-0.03	-0.03	10.09	-79.68	2.385
672	35.08	-0.04	-0.04	10.09	-79.15	2.372
673	35.13	-0.05	-0.05	10.09	-78.62	2.358
674	35.18	-0.06	-0.06	10.08	-78.09	2.345
675	35.24	-0.06	-0.06	10.08	-77.57	2.331
676	35.29	-0.07	-0.07	10.08	-77.04	2.317
677	35.34	-0.08	-0.08	10.07	-76.51	2.304
678	35.39	-0.08	-0.08	10.07	-75.99	2.290
679	35.45	-0.09	-0.09	10.06	-75.46	2.276
680	35.50	-0.10	-0.10	10.06	-74.93	2.262
681	35.55	-0.11	-0.11	10.05	-74.41	2.248
682	35.60	-0.11	-0.11	10.05	-73.88	2.234
683	35.65	-0.12	-0.12	10.04	-73.36	2.221
684	35.71	-0.13	-0.13	10.04	-72.83	2.207
685	35.76	-0.13	-0.13	10.03	-72.31	2.193
686	35.81	-0.14	-0.14	10.02	-71.78	2.179
687	35.86	-0.15	-0.15	10.01	-71.26	2.165
688	35.92	-0.15	-0.15	10.01	-70.74	2.150
689	35.97	-0.16	-0.16	10.00	-70.21	2.136
690	36.02	-0.17	-0.17	9.99	-69.69	2.122
691	36.07	-0.18	-0.18	9.98	-69.17	2.108
692	36.13	-0.18	-0.18	9.97	-68.65	2.094
693	36.18	-0.19	-0.19	9.96	-68.13	2.080
694	36.23	-0.20	-0.20	9.95	-67.61	2.065
695	36.28	-0.20	-0.20	9.94	-67.09	2.051
696	36.33	-0.21	-0.21	9.93	-66.57	2.037
697	36.39	-0.22	-0.22	9.92	-66.05	2.022
698	36.44	-0.23	-0.23	9.91	-65.53	2.008
699	36.49	-0.23	-0.23	9.90	-65.01	1.993
700	36.54	-0.24	-0.24	9.88	-64.49	1.979
701	36.60	-0.25	-0.25	9.87	-63.98	1.965
702	36.65	-0.25	-0.25	9.86	-63.46	1.950
703	36.70	-0.26	-0.26	9.84	-62.95	1.936
704	36.75	-0.27	-0.27	9.83	-62.43	1.921
705	36.81	-0.28	-0.28	9.82	-61.92	1.906
706	36.86	-0.28	-0.28	9.80	-61.41	1.892
707	36.91	-0.29	-0.29	9.79	-60.89	1.877
708	36.96	-0.30	-0.30	9.77	-60.38	1.862
709	37.01	-0.30	-0.30	9.76	-59.87	1.848
710	37.07	-0.31	-0.31	9.74	-59.36	1.833
711	37.12	-0.32	-0.32	9.72	-58.85	1.818
712	37.17	-0.32	-0.32	9.71	-58.35	1.803
713	37.22	-0.33	-0.33	9.69	-57.84	1.789
714	37.28	-0.34	-0.34	9.67	-57.33	1.774
715	37.33	-0.35	-0.35	9.65	-56.83	1.759
716	37.38	-0.35	-0.35	9.64	-56.32	1.744
717	37.43	-0.36	-0.36	9.62	-55.82	1.729
718	37.48	-0.37	-0.37	9.60	-55.32	1.714
719	37.54	-0.37	-0.37	9.58	-54.82	1.699
720	37.59	-0.38	-0.38	9.56	-54.32	1.684

721	37.64	-0.39	-0.39	9.54	-53.82	1.669
722	37.69	-0.40	-0.40	9.52	-53.32	1.654
723	37.75	-0.40	-0.40	9.50	-52.82	1.639
724	37.80	-0.41	-0.41	9.48	-52.33	1.624
725	37.85	-0.42	-0.42	9.45	-51.83	1.609
726	37.90	-0.42	-0.42	9.43	-51.34	1.594
727	37.96	-0.43	-0.43	9.41	-50.85	1.579
728	38.01	-0.44	-0.44	9.39	-50.35	1.564
729	38.06	-0.44	-0.44	9.36	-49.86	1.548
730	38.11	-0.45	-0.45	9.34	-49.38	1.533
731	38.16	-0.46	-0.46	9.32	-48.89	1.518
732	38.22	-0.47	-0.47	9.29	-48.40	1.503
733	38.27	-0.47	-0.47	9.27	-47.92	1.487
734	38.32	-0.48	-0.48	9.24	-47.43	1.472
735	38.37	-0.49	-0.49	9.22	-46.95	1.457
736	38.43	-0.49	-0.49	9.19	-46.47	1.442
737	38.48	-0.50	-0.50	9.17	-45.99	1.426
738	38.53	-0.51	-0.51	9.14	-45.51	1.411
739	38.58	-0.52	-0.52	9.11	-45.03	1.395
740	38.63	-0.52	-0.52	9.09	-44.56	1.380
741	38.69	-0.53	-0.53	9.06	-44.08	1.365
742	38.74	-0.54	-0.54	9.03	-43.61	1.349
743	38.79	-0.54	-0.54	9.00	-43.14	1.334
744	38.84	-0.55	-0.55	8.97	-42.67	1.318
745	38.90	-0.56	-0.56	8.95	-42.20	1.303
746	38.95	-0.56	-0.56	8.92	-41.73	1.287
747	39.00	-0.57	-0.57	8.89	-41.27	1.271
748	39.05	-0.58	-0.58	8.86	-40.80	1.256
749	39.11	-0.59	-0.59	8.83	-40.34	1.240
750	39.16	-0.59	-0.59	8.79	-39.88	1.225
751	39.21	-0.60	-0.60	8.76	-39.42	1.209
752	39.26	-0.61	-0.61	8.73	-38.96	1.193
753	39.31	-0.61	-0.61	8.70	-38.51	1.178
754	39.37	-0.62	-0.62	8.67	-38.05	1.162
755	39.42	-0.63	-0.63	8.64	-37.60	1.146
756	39.47	-0.64	-0.64	8.60	-37.15	1.131
757	39.52	-0.64	-0.64	8.57	-36.70	1.115
758	39.58	-0.65	-0.65	8.54	-36.26	1.099
759	39.63	-0.66	-0.66	8.50	-35.81	1.083
760	39.68	-0.66	-0.66	8.47	-35.37	1.068
761	39.73	-0.67	-0.67	8.43	-34.93	1.052
762	39.79	-0.68	-0.68	8.40	-34.49	1.036
763	39.84	-0.68	-0.68	8.36	-34.05	1.020
764	39.89	-0.69	-0.69	8.32	-33.61	1.004
765	39.94	-0.70	-0.70	8.29	-33.18	0.988
766	39.99	-0.71	-0.71	8.25	-32.74	0.973
767	40.05	-0.71	-0.71	8.21	-32.31	0.957
768	40.10	-0.72	-0.72	8.18	-31.89	0.941
769	40.15	-0.73	-0.73	8.14	-31.46	0.925
770	40.20	-0.73	-0.73	8.10	-31.03	0.909
771	40.26	-0.74	-0.74	8.06	-30.61	0.893
772	40.31	-0.75	-0.75	8.02	-30.19	0.877
773	40.36	-0.76	-0.76	7.98	-29.77	0.861
774	40.41	-0.76	-0.76	7.94	-29.36	0.845
775	40.46	-0.77	-0.77	7.90	-28.94	0.829
776	40.52	-0.78	-0.78	7.86	-28.53	0.813
777	40.57	-0.78	-0.78	7.82	-28.12	0.797
778	40.62	-0.79	-0.79	7.78	-27.71	0.781
779	40.67	-0.80	-0.80	7.74	-27.31	0.765
780	40.73	-0.80	-0.80	7.70	-26.90	0.749
781	40.78	-0.81	-0.81	7.66	-26.50	0.733
782	40.83	-0.82	-0.82	7.61	-26.10	0.717
783	40.88	-0.83	-0.83	7.57	-25.71	0.701
784	40.94	-0.83	-0.83	7.53	-25.31	0.685
785	40.99	-0.84	-0.84	7.48	-24.92	0.668
786	41.04	-0.85	-0.85	7.44	-24.53	0.652
787	41.09	-0.85	-0.85	7.40	-24.14	0.636
788	41.14	-0.86	-0.86	7.35	-23.75	0.620
789	41.20	-0.87	-0.87	7.31	-23.37	0.604

790	41.25	-0.88	-0.88	7.26	-22.99	0.588
791	41.30	-0.88	-0.88	7.21	-22.61	0.572
792	41.35	-0.89	-0.89	7.17	-22.24	0.555
793	41.41	-0.90	-0.90	7.12	-21.86	0.539
794	41.46	-0.90	-0.90	7.07	-21.49	0.523
795	41.51	-0.91	-0.91	7.03	-21.12	0.507
796	41.56	-0.92	-0.92	6.98	-20.76	0.490
797	41.61	-0.92	-0.92	6.93	-20.39	0.474
798	41.67	-0.93	-0.93	6.88	-20.03	0.458
799	41.72	-0.94	-0.94	6.83	-19.67	0.442
800	41.77	-0.95	-0.95	6.78	-19.32	0.425
801	41.82	-0.95	-0.95	6.73	-18.97	0.409
802	41.88	-0.96	-0.96	6.68	-18.61	0.393
803	41.93	-0.97	-0.97	6.63	-18.27	0.377
804	41.98	-0.97	-0.97	6.58	-17.92	0.360
805	42.03	-0.98	-0.98	6.53	-17.58	0.344
806	42.09	-0.99	-0.99	6.48	-17.24	0.328
807	42.14	-1.00	-1.00	6.43	-16.90	0.311
808	42.19	-1.00	-1.00	6.38	-16.57	0.295
809	42.24	-1.01	-1.01	6.32	-16.23	0.279
810	42.29	-1.02	-1.02	6.27	-15.90	0.262
811	42.35	-1.02	-1.02	6.22	-15.58	0.246
812	42.40	-1.03	-1.03	6.16	-15.25	0.230
813	42.45	-1.04	-1.04	6.11	-14.93	0.213
814	42.50	-1.04	-1.04	6.05	-14.62	0.197
815	42.56	-1.05	-1.05	6.00	-14.30	0.181
816	42.61	-1.06	-1.06	5.94	-13.99	0.164
817	42.66	-1.07	-1.07	5.89	-13.68	0.148
818	42.71	-1.07	-1.07	5.83	-13.37	0.131
819	42.77	-1.08	-1.08	5.78	-13.07	0.115
820	42.82	-1.09	-1.09	5.72	-12.77	0.099
821	42.87	-1.09	-1.09	5.66	-12.47	0.082
822	42.92	-1.10	-1.10	5.61	-12.18	0.066
823	42.97	-1.11	-1.11	5.55	-11.88	0.049
824	43.03	-1.12	-1.12	5.49	-11.60	0.033
825	43.08	-1.12	-1.12	5.43	-11.31	0.016
826	43.13	-1.13	-1.13	5.37	-11.03	0.000
827	43.18	-1.14	-1.14	5.31	-10.75	-0.016
828	43.24	-1.14	-1.14	5.25	-10.47	-0.033
829	43.29	-1.15	-1.15	5.19	-10.20	-0.049
830	43.34	-1.16	-1.16	5.13	-9.93	-0.066
831	43.39	-1.17	-1.17	5.07	-9.66	-0.082
832	43.44	-1.17	-1.17	5.01	-9.40	-0.099
833	43.50	-1.18	-1.18	4.95	-9.14	-0.115
834	43.55	-1.19	-1.19	4.89	-8.88	-0.132
835	43.60	-1.19	-1.19	4.83	-8.63	-0.148
836	43.65	-1.20	-1.20	4.76	-8.38	-0.165
837	43.71	-1.21	-1.21	4.70	-8.13	-0.181
838	43.76	-1.21	-1.21	4.64	-7.89	-0.198
839	43.81	-1.22	-1.22	4.57	-7.64	-0.214
840	43.86	-1.23	-1.23	4.51	-7.41	-0.231
841	43.92	-1.24	-1.24	4.45	-7.17	-0.247
842	43.97	-1.24	-1.24	4.38	-6.94	-0.264
843	44.02	-1.25	-1.25	4.32	-6.72	-0.280
844	44.07	-1.26	-1.26	4.25	-6.49	-0.297
845	44.12	-1.26	-1.26	4.18	-6.27	-0.313
846	44.18	-1.27	-1.27	4.12	-6.05	-0.330
847	44.23	-1.28	-1.28	4.05	-5.84	-0.346
848	44.28	-1.29	-1.29	3.98	-5.63	-0.363
849	44.33	-1.29	-1.29	3.92	-5.42	-0.379
850	44.39	-1.30	-1.30	3.85	-5.22	-0.396
851	44.44	-1.31	-1.31	3.78	-5.02	-0.412
852	44.49	-1.31	-1.31	3.71	-4.83	-0.429
853	44.54	-1.32	-1.32	3.64	-4.63	-0.445
854	44.59	-1.33	-1.33	3.57	-4.44	-0.462
855	44.65	-1.33	-1.33	3.50	-4.26	-0.478
856	44.70	-1.34	-1.34	3.43	-4.08	-0.495
857	44.75	-1.35	-1.35	3.36	-3.90	-0.511
858	44.80	-1.36	-1.36	3.29	-3.73	-0.528

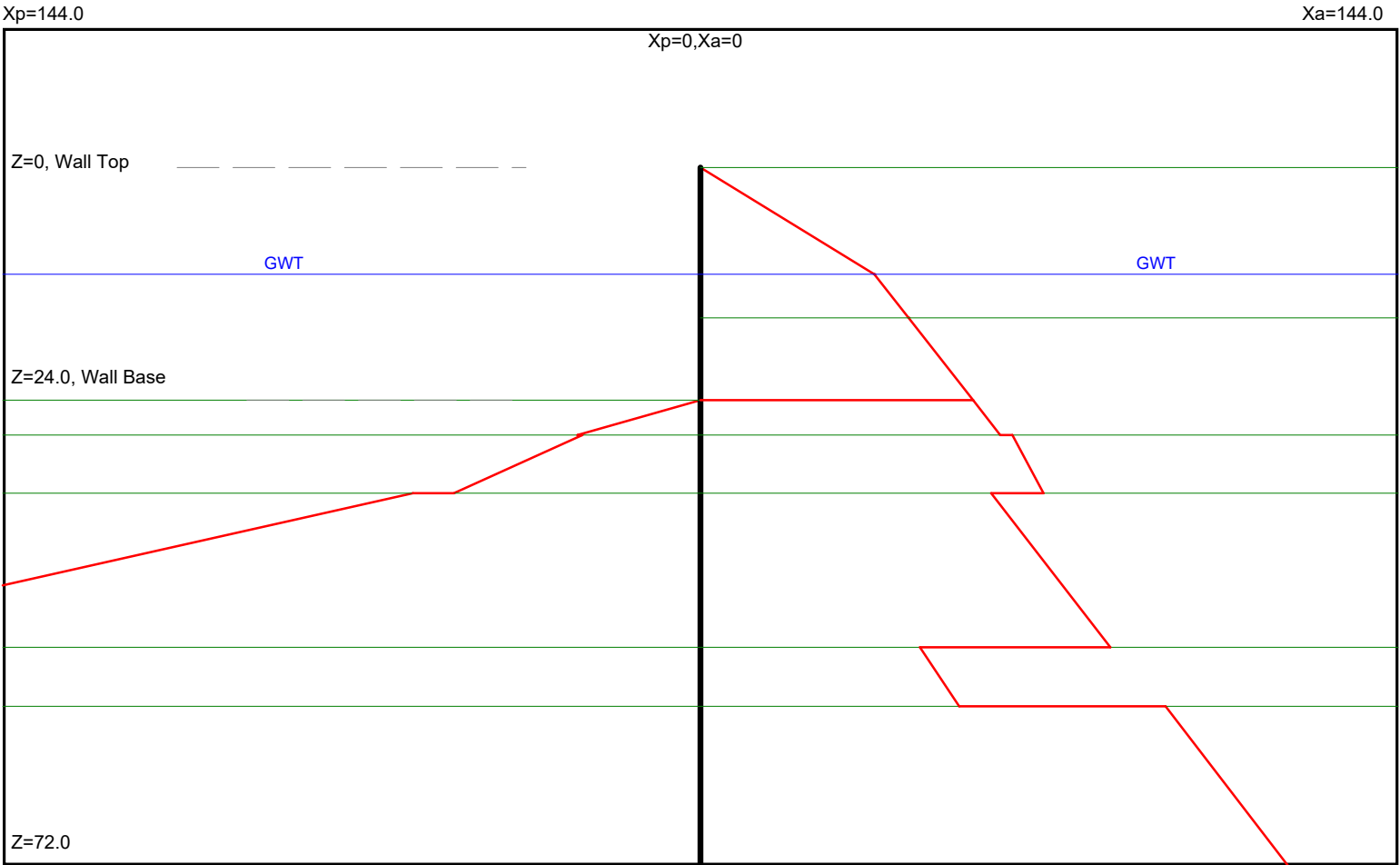
859	44.86	-1.36	-1.36	3.22	-3.56	-0.545
860	44.91	-1.37	-1.37	3.15	-3.39	-0.561
861	44.96	-1.38	-1.38	3.08	-3.23	-0.578
862	45.01	-1.38	-1.38	3.01	-3.07	-0.594
863	45.07	-1.39	-1.39	2.93	-2.91	-0.611
864	45.12	-1.40	-1.40	2.86	-2.76	-0.627
865	45.17	-1.41	-1.41	2.79	-2.61	-0.644
866	45.22	-1.41	-1.41	2.71	-2.47	-0.660
867	45.27	-1.42	-1.42	2.64	-2.33	-0.677
868	45.33	-1.43	-1.43	2.57	-2.19	-0.693
869	45.38	-1.43	-1.43	2.49	-2.06	-0.710
870	45.43	-1.44	-1.44	2.42	-1.93	-0.727
871	45.48	-1.45	-1.45	2.34	-1.81	-0.743
872	45.54	-1.45	-1.45	2.27	-1.69	-0.760
873	45.59	-1.46	-1.46	2.19	-1.57	-0.776
874	45.64	-1.47	-1.47	2.11	-1.46	-0.793
875	45.69	-1.48	-1.48	2.04	-1.35	-0.809
876	45.75	-1.48	-1.48	1.96	-1.25	-0.826
877	45.80	-1.49	-1.49	1.88	-1.15	-0.842
878	45.85	-1.50	-1.50	1.80	-1.05	-0.859
879	45.90	-1.50	-1.50	1.72	-0.96	-0.876
880	45.95	-1.51	-1.51	1.64	-0.87	-0.892
881	46.01	-1.52	-1.52	1.57	-0.79	-0.909
882	46.06	-1.53	-1.53	1.49	-0.71	-0.925
883	46.11	-1.53	-1.53	1.41	-0.63	-0.942
884	46.16	-1.54	-1.54	1.33	-0.56	-0.958
885	46.22	-1.55	-1.55	1.25	-0.49	-0.975
886	46.27	-1.55	-1.55	1.16	-0.43	-0.992
887	46.32	-1.56	-1.56	1.08	-0.37	-1.008
888	46.37	-1.57	-1.57	1.00	-0.32	-1.025
889	46.42	-1.57	-1.57	0.92	-0.27	-1.041
890	46.48	-1.58	-1.58	0.84	-0.22	-1.058
891	46.53	-1.59	-1.59	0.75	-0.18	-1.074
892	46.58	-1.60	-1.60	0.67	-0.14	-1.091
893	46.63	-1.60	-1.60	0.59	-0.11	-1.107
894	46.69	-1.61	-1.61	0.50	-0.08	-1.124
895	46.74	-1.62	-1.62	0.42	-0.06	-1.141
896	46.79	-1.62	-1.62	0.33	-0.04	-1.157
897	46.84	-1.63	-1.63	0.25	-0.02	-1.174
898	46.90	-1.64	-1.64	0.16	-0.01	-1.190
899	46.95	-1.65	-1.65	0.00	0.00	-1.207

The above data can be selected using mouse, then copy and paste into Excel to create graphics

LATERAL PRESSURE CALCS

E. More St Bridge Replacement

PZ 35 Sheet Pile



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UNITS: DEPTH/DISTANCE: ft, UNIT WEIGHT: pcf, FORCE: kip/ft, PRESSURE: ksf, SLOPE: kcf

Date: 10/15/2024 File: C:\Users\skabra\OneDrive - HDR, Inc\Projects\Emergency Bridge\Recs\Analysis\End Bent 2\Shoring Design\Eath Pressure.ep8

* INPUT DATA *

Wall Height=24.0		Total Soil Types= 5					
Soil No.	Weight	Saturate	Phi	Cohesion	Nspt	Type	Description
1	120.0	120.0	30.00	0.0	6	4	New Fill
2	120.0	120.0	30.00	0.0	6	4	Alluvial: Sa
3	100.0	100.0	0.00	0.5	4	1	Alluvial : M
4	114.9	126.4	33.00	0.0	10	4	CP: Sand
5	140.0	140.0	44.95	0.0	60	4	CPR: Limesto

Ground Surface at Active Side:						
Line	Z1	Xa1	Z2	Xa2	Soil No.	Description
1	0.0	0.0	0.0	800.0	1	New Fill
2	15.5	0.0	15.5	800.0	2	Alluvial: Sa
3	27.6	0.0	27.6	800.0	3	Alluvial : M
4	33.6	0.0	33.6	800.0	4	CP: Sand
5	49.5	0.0	49.5	800.0	5	CPR: Limesto
6	55.6	0.0	55.6	800.0	4	CP: Sand

Water Table at Active Side:		
Point	Z-water	X-water
1	11.0	0.0
2	11.0	800.0

Ground Surface at Passive Side:

Line	Z1	Xp1	Z2	Xp2	Soil No.	Description
1	24.0	0.0	24.0	800.0	2	Alluvial: Sa
2	27.6	0.0	27.6	800.0	3	Alluvial : M
3	33.6	0.0	33.6	800.0	4	CP: Sand
4	49.5	0.0	49.5	800.0	5	CPR: Limesto
5	55.6	0.0	55.6	800.0	4	CP: Sand

Water Table at Passive Side:

Point	Z-water	X-water
1	11.0	0.0
2	11.0	800.0

← assumed water will be at EL.0

Wall Friction Options: 1.* No wall friction

Wall Batter Angle = 0

Apparent Pressure Conversion: 1.* Default (Terzaghi and Peck)*

Water Density = 62.4

Water Pressure: 1.* No seepage at wall tip

* OUTPUT RESULTS *

Total Force above Base= 14.64 per one linear foot (or meter) width along wall height

Total Static Force above Base= 14.64

Driving Pressure above Base - Output to Shoring - Multiplier of Pressure = 1.5

Z1	Pa1	Z2	Pa2	Slope	Coef.
0.00	0.00	11.00	0.66	0.0600	0.5000
11.00	0.66	15.50	0.79	0.0288	0.5000
15.50	0.79	24.00	1.03	0.0288	0.5000

Driving Pressure below Base - Output to Shoring - Multiplier of Pressure = 1.5

Z1	Pa1	Z2	Pa2	Slope	Ka or Ko
24.00	1.03	27.60	1.14	0.0288	0.5000
27.60	1.18	33.60	1.30	0.0196	0.5204
33.60	1.10	49.50	1.56	0.0285	0.4446
49.50	0.83	55.60	0.98	0.0245	0.3158
55.60	1.77	72.00	2.23	0.0283	0.4421

Passive Pressure below Base - Output to Shoring - Multiplier of Pressure = 0.75

Z1	Pp1	Z2	Pp2	Slope	Kp
24.00	0.00	27.60	0.47	0.130	2.2500
27.60	0.45	33.60	0.94	0.081	2.1635
33.60	1.09	49.50	3.69	0.164	2.5556
49.50	5.55	55.60	7.94	0.392	5.0478
55.60	4.80	72.00	7.55	0.167	2.6168

UNITS: DEPTH/DISTANCE: ft, UNIT WEIGHT: pcf, FORCE: kip/ft, PRESSURE: ksf, SLOPE: kcf

Date: 10/15/2024 File Name: C:\Users\skabra\OneDrive - HDR, Inc\Projects\Emergency Bridge\Recs\Analysis\End Bent 2\Shoring Design\Eath Pressure.e