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Cincinnati, Ohio 45226
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Terracon.com

September 5, 2025

Choice One Engineering
203 W. Loveland Avenue
Loveland, Ohio 45140

Attn: Mr. Troy Niese, P.E., SPESC, Project Manager
P: (513) 239-8554
E: tan@choiceoneengineering.com

Re: Geotechnical Design Services Letter
WAR-SR48-6.65
SR-48 between Sentry Hill Drive and Butterworth Road
Loveland, Warren County, Ohio
Terracon Project No. N1255021

Dear Mr. Niese:

Please find attached a copy of the shop drawings and supporting calculations for the two soldier pile and lagging walls along SR-48 between Sentry Hill Drive and Butterworth Road in in Loveland, Warren County, Ohio. These shop drawings were derived from the AutoCAD files provided by Choice One Engineering (JRJ) on July 21, August 18, and August 29, 2025.

Our shop drawings and calculations are based on:

- The referenced AutoCAD Plans
- The recent boring information collected in June 2025 and historic boring information gathered from the ODOT TIMS site for project WAR-48-0.37

Information regarding the preparer and checker of these documents is provided below:

- Preparer: Joseph D. Hauber, P.E. (JDH) with assistance from Neha Pillanagrovi (NP)
- Checker: David W. Westendorf, P.E. (DWW)

* * * * *

REVIEW COMPLETE

PM
BRIDGES
CONSTRUCT
DRAINAGE
ENVIRON
GEOTECH Casey Carriere, P.E. 9/25/2025
ITS
MOT
PAVEMENT
ROADWAY
R/W
SURVEY
TRAFFIC
UTILITIES
OTHER
OTHER

We appreciate the opportunity to be of service to you on this project. If you have any questions concerning the attached shop drawings or calculations, please contact us.

Sincerely,
Terracon

Joseph D. Hauber, P.E.
Senior Engineer | Principal

David W. Westendorf, P.E.
Group Manager | Principal

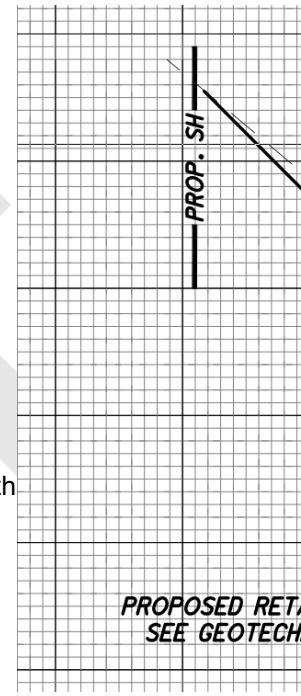
Attachments: Soldier Pile Wall Calculations
Soldier Pile & Lagging Wall Drawings

Attachments

Soldier Pile Wall Calculations

Soldier Pile & Lagging Wall Design Calculations
Project: WAR-SR48-6.65
Date: 9/2/2025
Case: Cross Section 1 (LPILE 1003)

Designed By: NP/JDH
Checked By: DWW



Lateral Forces

-Lateral Earth Pressure and LLS

$D_{ep} := 10.5\ ft$ Depth from top of wall to stable slope geometry below wall

$D_{frost} := 2.5\ ft$ Frost Depth

$H := D_{ep} + D_{frost} = 13\ ft$ Design Retained Height

$\beta := 0\ deg$ Slope behind wall ← 45 degree 1:1 slope shown behind wall.

$\gamma_m := 125\ \frac{lb}{ft^3}$ Moist unit weight of retained material

$\phi := 30\ deg$ Fully softened angle of internal friction of retained material

$k_a := \frac{\cos(\beta) - \sqrt[2]{(\cos(\beta)\cdot\cos(\beta)) - (\cos(\phi)\cdot\cos(\phi))}}{\cos(\beta) + \sqrt[2]{(\cos(\beta)\cdot\cos(\beta)) - (\cos(\phi)\cdot\cos(\phi))}} = 0.333$ Coefficient of active earth pressure

$q := 250\ \frac{lb}{ft^2}$ Surcharge pressure

$s := 8\ ft$ C-C spacing between shafts

$\gamma_S := 1.75$ Live load surcharge load factor (AASHTO recommends 1.75)

$\gamma_{EH} := 1.50$ Horizontal earth pressure load factor (AASHTO recommends 1.50)

$S_{unfactored} := k_a \cdot q \cdot s = 55.6\ \frac{lb}{in}$ unfactored surcharge lateral pressure

$EH_{unfactored} := k_a \cdot \gamma_m \cdot H \cdot s = 361.1\ \frac{lb}{in}$ unfactored lateral earth pressure

Unfactored Lateral Earth Pressures (service case):

$P_{top;factored} := S_{unfactored} = 55.6\ \frac{lb}{in}$ factored earth pressure at surface

$P_{bottom;factored} := S_{unfactored} + EH_{unfactored} = 416.7\ \frac{lb}{in}$ factored earth pressure at depth

Factored Lateral Earth Pressures (strength case):

$P_{top;factored} := \gamma_{EH} \cdot S_{unfactored} = 83.3\ \frac{lb}{in}$ factored earth pressure at surface

$P_{bottom;factored} := \gamma_{EH} \cdot S_{unfactored} + \gamma_{EH} \cdot EH_{unfactored} = 625\ \frac{lb}{in}$ factored earth pressure at depth

Wall Configuration

$b_s := 30\ in$ Structural pier diameter

$A := \pi \cdot \left(\frac{b_s}{2}\right)^2 = 706.9\ in^2$ Area of structural pier

$H = 13\ ft$ Retained height

-Shaft Embedment

$L := 20.5\ ft$ Structural pier total length

$L_{min;lem} := 25\ ft$ Minimum length from global stability

$L \geq L_{min;lem} = 0$ 1=true (OK), 0=false (Not OK)

$D := L - H = 7.5\ ft$ Embedment of drilled shaft below retained height

$D \geq 10\ ft = 0$ 1=true (OK), 0=false (Not OK) ODOT GDM Section 1501.7.7

$DL_{ratio} := \frac{D}{L} = 0.366$ Embedment-to-Length ratio. ODOT BDM Section 307.6 - Shall not be less than 0.5 for walls founded entirely in soil.

-Shaft Overlap- not needed

$s = 8\ ft$ C-C spacing of structural piers

$b_p := 24\ in$ Plug pier diameter

$s_c := s - b_s = 5.5\ ft$ Clear spacing between structural piers

$overlap := \frac{\left(\text{No. of Plug Shafts: 2} \cdot b_p - s_c\right)}{2} = -9\ in$ (≥3 in recommended)

-p-y Modification Factors for Group Action

$\beta_\alpha := \text{if}\left(\frac{s}{b_s} \geq 3.75, \text{return } 0.64 \cdot \left(\frac{s}{b_s}\right)^{0.34}, \text{return } 1\right) = 0.95$ Reese, Isenhower, and Wang, "Analysis and Design of Shallow and Deep Foundations (2006)

Steel Beam Design Checks

$SHAPE \equiv$ "HP14X73" select beam shape (including " " and **capital** X)

$F_y := 50 \frac{kip}{in^2}$ $E := 29000 \frac{kip}{in^2}$

-Check Horizontal Deflection (Service)

$d_{allow} := min(0.01 \cdot H, 2\ in) = 1.56\ in$ allowable deflection (ODOT GDM 1501.6)

$d_{max} := 1.45\ in$ maximum deflection from LPILE (Service)

$d_{max} \le d_{allow} = 1$ 1=true (OK), 0=false (Not OK) $CDR_{Deflection} := \frac{d_{allow}}{d_{max}} = 1.08$

-Check Geotechnical Overturning (Strength) (ODOT GDM Section 1501.7.9)

Does pile-head deflection at Strength Limit State:

Fail to Converge: $Over_{ftc} :=$ Criteria: No $= 1$
Show an infinite deflection: $Over_{id} :=$ Criteria: No $= 1$
Show a very large deflection: $Over_{vld} :=$ Criteria: No $= 1$
(GDM gives example of 100 inches)

$min(Over_{ftc}, Over_{id}, Over_{vld}) = 1$ 1=true (OK), 0=false (Not OK)

-Check Moment (Strength)

Section limited to doubly symmetric I-shaped member bending about their major axis

$\phi_b :=$ AISC $= 0.9$ moment resistance factor
$M_u := 3617\ in \cdot kip$ ultimate moment from LPILE (Strength)
$S_x = 107\ in^3$ section modulus
$I_x = 729\ in^3$ moment of inertia
$Z_x = 118\ in^3$ plastic modulus
$M_p := F_y \cdot Z_x = 5900\ in \cdot kip$ plastic moment

Yielding

$M_{n;y} := M_p = 5900\ in \cdot kip$ Nominal Moment Resistance - Limit State of Yielding (AISC Eq. F2-1)

Lateral Torsional Buckling

Assume full concrete embedment provides continuous lateral bracing and transverse stiffening; therefore, this flexural limit state does not apply — AISC Comm. I3 - Encased Composite Members

$M_{n;LTB} := M_p$

Flange Local Buckling

Assume full concrete embedment provides continuous lateral bracing and transverse stiffening; therefore, this flexural limit state does not apply — AISC Comm. I3 - Encased Composite Members

$M_{n;FLB} := M_p$

Compression/Tension Flange Yielding

Flange of selected member shape is compact. Provisions of AISC Sections F4 and F5 do not apply.

$M_{n;CFY} := M_p \quad M_{n;TFY} := M_p$

Nominal Flexural Strength

$M_n := min\left(M_{n;y}, M_{n;LTB}, M_{n;FLB}, M_{n;CFY}, M_{n;TFY}\right)$ Nominal Flexural Strength

$\phi_b \cdot M_n = 5310\ (in \cdot kip)$ Factored Flexural Strength

$\phi_b \cdot M_n > M_u = 1$ 1=true (OK), 0=false (Not OK) $CDR_{Flex} := \frac{\phi_b \cdot M_n}{M_u} = 1.47$

-Check Shear (Strength)

Section limited to webs of doubly symmetric I-shaped members subject to shear in the plane of the web.

$\phi_v :=$ AISC $= 0.9$ shear resistance factor

$V_u := 105\ kip$ ultimate shear from LPILE (Strength)

$t_w = 0.505\ in$ web thickness

$d = 13.6\ in$ beam depth

$A_w := t_w \cdot d = 6.868\ in^2$ area of web

$h := 18.9 \cdot t_w$ Look up compact section criteria from AISC Table 1

$$C_V := \left\| \begin{array}{l} \text{if } \left(\frac{h}{t_w}\right) \le 2.24 \cdot \sqrt{\frac{E}{F_y}} \\ \quad \text{return “Follow G2.1(b)”} \\ \text{return } 1.0 \end{array} \right| = 1$$

$V_n := 0.6 \cdot F_y \cdot A_w \cdot C_V = 206\ kip$ nominal shear strength (AISC Eq. G2-1)

$\phi_v \cdot V_n > V_u = 1$ 1=true (OK), 0=false (Not OK) $CDR_{Shear} := \frac{\phi_v \cdot V_n}{V_u} = 1.77$

-Check Concrete Cover

$b_s = 30\ in$ diameter of structural shaft

$d = 13.6\ in$ beam depth

$b = 14.625\ in$ beam width

$$cover_b := \frac{b_s}{2} - \sqrt{\left(\frac{b}{2}\right)^2 + \left(\frac{d}{2}\right)^2} = 5\ in$$

ODOT GDM Section 904.1 minimum cover:
≤4' dia: 3 inches
>4' dia: 6 inches

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                    LPile for Windows, Version 2022-12.010

                Analysis of Individual Piles and Drilled Shafts
               Subjected to Lateral Loading Using the p-y Method
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Cincinnati, Ohio


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--------------------------------------------------------------------------------
                            Files Used for Analysis
--------------------------------------------------------------------------------

Path to file locations:
\Users\jdhauber\OneDrive - Terracon Consultants Inc\JDH Projects\N1255021 War-SR48-6.65 - General\07 Working Files\02
Calculations\LPile\

Name of input data file:
WAR SR48-1003.lp12d

Name of output report file:
WAR SR48-1003.lp12o

Name of plot output file:
WAR SR48-1003.lp12p

Name of runtime message file:
WAR SR48-1003.lp12r



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

             Date:  September 2, 2025           Time:  10:49:27



--------------------------------------------------------------------------------
                                Problem Title
--------------------------------------------------------------------------------

Project Name: War-SR-48-6.65


Job Number: N1255021


Client: Choice One Engineering Corp
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Engineer: JB

Description:

Program Options and Settings

Computational Options:
- Conventional Analysis

Engineering Units Used for Data Input and Computations:
- US Customary System Units (pounds, feet, inches)

Analysis Control Options:
- Maximum number of iterations allowed = 500
- Deflection tolerance for convergence = 1.0000E-05 in
- Maximum allowable deflection = 100.0000 in
- Number of pile increments = 100

Loading Type and Number of Cycles of Loading:
- Static loading specified

- Analysis uses p-y modification factors for p-y curves
- Analysis uses layering correction (Method of Georgiadis)
- Analysis includes loading by multiple distributed lateral loads acting on pile
- Loading by lateral soil movements acting on pile not selected
- Input of shear resistance at the pile tip not selected
- Input of moment resistance at the pile tip not selected
- Computation of pile-head foundation stiffness matrix not selected
- Push-over analysis of pile not selected
- Buckling analysis of pile not selected

Output Options:
- Output files use decimal points to denote decimal symbols.
- Values of pile-head deflection, bending moment, shear force, and soil reaction are printed for full length of pile.
- Printing Increment (nodal spacing of output points) = 1
- No p-y curves to be computed and reported for user-specified depths
- Print using wide report formats

Pile Structural Properties and Geometry

Number of pile sections defined = 2
Total length of pile = 20.500 ft
Depth of ground surface below top of pile = 13.0000 ft

Pile diameters used for p-y curve computations are defined using 4 points.

p-y curves are computed using pile diameter values interpolated with depth over the length of the pile. A summary of values of pile diameter vs. depth follows.

Point No.	Depth Below Pile Head feet	Pile Diameter inches
1	0.000	14.4750
2	13.000	14.4750
3	13.000	30.0000

```
  4            20.500           30.0000


Input Structural Properties for Pile Sections:
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Pile Section No. 1:

   Section 1 is a H strong axis steel pile
   Length of section                                =    13.000000 ft
   Pile width                                       =    14.475000 in

Pile Section No. 2:

   Section 2 is a AISC strong axis steel pile
   Length of section                                =     7.500000 ft
   AISC Section Type                                = HP


   AISC Section Name                                = HP14X73


   Pile width                                       =    14.600000 in
   Eq. Diameter                                     =    30.000000 in



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                      Soil and Rock Layering Information
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The soil profile is modelled using 1 layers

Layer 1 is weak rock, p-y criteria by Reese, 1997

   Distance from top of pile to top of layer          =    13.000000 ft
   Distance from top of pile to bottom of layer       =    50.000000 ft
   Effective unit weight at top of layer              =   140.000000 pcf
   Effective unit weight at bottom of layer           =   140.000000 pcf
   Uniaxial compressive strength at top of layer      =   200.000000 psi
   Uniaxial compressive strength at bottom of layer   =   200.000000 psi
   Initial modulus of rock at top of layer            =        2000. psi
   Initial modulus of rock at bottom of layer         =        2000. psi
   RQD of rock at top of layer                        =    50.000000 %
   RQD of rock at bottom of layer                     =    50.000000 %
   k rm of rock at top of layer                       =    0.0005000
   k rm of rock at bottom of layer                    =    0.0005000


 (Depth of the lowest soil layer extends 29.500 ft below the pile tip)



--------------------------------------------------------------------------------
                      Summary of Input Soil Properties
--------------------------------------------------------------------------------

Layer         Soil Type          Layer      Effective    Uniaxial                    E50       Rock Mass
 Num.           Name             Depth       Unit Wt.       qu          RQD %        or        Modulus
          (p-y Curve Type)         ft           pcf          psi                     krm         psi
-----   -------------------   ----------   ----------   ----------   ----------   ----------   ----------
  1            Weak              13.0000     140.0000     200.0000      50.0000     5.00E-04        2000.
               Rock              50.0000     140.0000     200.0000      50.0000     5.00E-04        2000.


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                      Modification Factors for p-y Curves
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Distribution of p-y modifiers with depth defined using 2 points

Point No.	Depth X ft	p-mult	y-mult
1	13.000	0.9500	1.0000
2	50.000	0.9500	1.0000

Static Loading Type

Static loading criteria were used when computing p-y curves for all analyses.

Distributed Lateral Loading for Individual Load Cases

Distributed lateral load intensity for Load Case 1 defined using 2 points

Point No.	Depth X ft	Dist. Load lb/in
1	0.000	55.600
2	13.000	416.700

Distributed lateral load intensity for Load Case 2 defined using 2 points

Point No.	Depth X ft	Dist. Load lb/in
1	0.000	83.300
2	13.000	625.000

Pile-head Loading and Pile-head Fixity Conditions

Number of loads specified = 2

Load No.	Load Type	Condition 1	Condition 2	Axial Thrust Force, lbs	Compute Top y vs. Pile Length	Run Analysis
1	1	V = 0.0000 lbs	M = 0.0000 in-lbs	0.0000000	No	Yes
2	1	V = 0.0000 lbs	M = 0.0000 in-lbs	0.0000000	No	Yes

V = shear force applied normal to pile axis
M = bending moment applied to pile head
y = lateral deflection normal to pile axis
S = pile slope relative to original pile batter angle
R = rotational stiffness applied to pile head
Values of top y vs. pile lengths can be computed only for load types with
specified shear loading (Load Types 1, 2, and 3).
Thrust force is assumed to be acting axially for all pile batter angles.

Computations of Nominal Moment Capacity and Nonlinear Bending Stiffness

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Axial thrust force values were determined from pile-head loading conditions

Number of Pile Sections Analyzed = 2

Pile Section No. 1:

Dimensions and Properties of Steel H Strong Axis:

Length of Section	=	13.000000 ft
Flange Width	=	14.475000 in
Section Depth	=	13.475000 in
Flange Thickness	=	0.380000 in
Web Thickness	=	0.380000 in
Yield Stress of Pipe	=	50.000000 ksi
Elastic Modulus	=	29000. ksi
Cross-sectional Area	=	15.832700 sq. in.
Moment of Inertia	=	536.838139 in^4
Elastic Bending Stiffness	=	15568306. kip-in^2
Plastic Modulus, Z	=	87.387814in^3
Plastic Moment Capacity = Fy Z	=	4369.in-kip

Axial Structural Capacities:

Nom. Axial Structural Capacity = Fy As	=	791.635 kips
Nominal Axial Tensile Capacity	=	-791.635 kips

Number of Axial Thrust Force Values Determined from Pile-head Loadings = 1

Number	Axial Thrust Force kips
1	0.000

Definition of Run Messages:

Y = part of pipe section has yielded.

Axial Thrust Force = 0.000 kips

Bending Curvature rad/in.	Bending Moment in-kip	Bending Stiffness kip-in2	Depth to N Axis in	Max Total Stress ksi	Run Msg
0.00000506	78.7360980	15553621.	6.7375000	0.9792066	
0.00001012	157.4721959	15553621.	6.7375000	1.9584132	
0.00001519	236.2082939	15553621.	6.7375000	2.9376199	
0.00002025	314.9443919	15553621.	6.7375000	3.9168265	
0.00002531	393.6804898	15553621.	6.7375000	4.8960331	
0.00003037	472.4165878	15553621.	6.7375000	5.8752397	
0.00003544	551.1526857	15553621.	6.7375000	6.8544463	
0.00004050	629.8887837	15553621.	6.7375000	7.8336530	
0.00004556	708.6248817	15553621.	6.7375000	8.8128596	
0.00005062	787.3609796	15553621.	6.7375000	9.7920662	
0.00005568	866.0970776	15553621.	6.7375000	10.7712728	
0.00006075	944.8331756	15553621.	6.7375000	11.7504795	
0.00006581	1024.	15553621.	6.7375000	12.7296861	
0.00007087	1102.	15553621.	6.7375000	13.7088927	
0.00007593	1181.	15553621.	6.7375000	14.6880993	
0.00008100	1260.	15553621.	6.7375000	15.6673059	
0.00008606	1339.	15553621.	6.7375000	16.6465126	

0.00009112	1417.	15553621.	6.7375000	17.6257192	
0.00009618	1496.	15553621.	6.7375000	18.6049258	
0.0001012	1575.	15553621.	6.7375000	19.5841324	
0.0001063	1653.	15553621.	6.7375000	20.5633390	
0.0001114	1732.	15553621.	6.7375000	21.5425457	
0.0001164	1811.	15553621.	6.7375000	22.5217523	
0.0001215	1890.	15553621.	6.7375000	23.5009589	
0.0001266	1968.	15553621.	6.7375000	24.4801655	
0.0001316	2047.	15553621.	6.7375000	25.4593721	
0.0001367	2126.	15553621.	6.7375000	26.4385788	
0.0001417	2205.	15553621.	6.7375000	27.4177854	
0.0001468	2283.	15553621.	6.7375000	28.3969920	
0.0001519	2362.	15553621.	6.7375000	29.3761986	
0.0001569	2441.	15553621.	6.7375000	30.3554052	
0.0001620	2520.	15553621.	6.7375000	31.3346119	
0.0001671	2598.	15553621.	6.7375000	32.3138185	
0.0001721	2677.	15553621.	6.7375000	33.2930251	
0.0001772	2756.	15553621.	6.7375000	34.2722317	
0.0001822	2834.	15553621.	6.7375000	35.2514384	
0.0001873	2913.	15553621.	6.7375000	36.2306450	
0.0001924	2992.	15553621.	6.7375000	37.2098516	
0.0001974	3071.	15553621.	6.7375000	38.1890582	
0.0002076	3228.	15553621.	6.7375000	40.1474715	
0.0002177	3386.	15553621.	6.7375000	42.1058847	
0.0002278	3543.	15553621.	6.7375000	44.0642979	
0.0002379	3701.	15553621.	6.7375000	46.0227112	
0.0002480	3858.	15553621.	6.7375000	47.9811244	
0.0002582	4016.	15553621.	6.7375000	49.9395377	
0.0002683	4102.	15288831.	6.7375000	50.0000000	Y
0.0002784	4125.	14814078.	6.7375000	50.0000000	Y
0.0002885	4141.	14352455.	6.7375000	50.0000000	Y
0.0002987	4156.	13916281.	6.7375000	50.0000000	Y
0.0003088	4170.	13504277.	6.7375000	50.0000000	Y
0.0003189	4182.	13114063.	6.7375000	50.0000000	Y
0.0003290	4194.	12744636.	6.7375000	50.0000000	Y
0.0003392	4204.	12394414.	6.7375000	50.0000000	Y
0.0003493	4213.	12061983.	6.7375000	50.0000000	Y
0.0003594	4222.	11746080.	6.7375000	50.0000000	Y
0.0003695	4230.	11445565.	6.7375000	50.0000000	Y
0.0003797	4237.	11159411.	6.7375000	50.0000000	Y
0.0003898	4244.	10886684.	6.7375000	50.0000000	Y
0.0003999	4250.	10626536.	6.7375000	50.0000000	Y
0.0004100	4255.	10378190.	6.7375000	50.0000000	Y
0.0004202	4261.	10140935.	6.7375000	50.0000000	Y
0.0004303	4266.	9913741.	6.7375000	50.0000000	Y
0.0004404	4270.	9696281.	6.7375000	50.0000000	Y
0.0004505	4275.	9488082.	6.7375000	50.0000000	Y
0.0004607	4279.	9288222.	6.7375000	50.0000000	Y
0.0004708	4283.	9096481.	6.7375000	50.0000000	Y
0.0004809	4286.	8912422.	6.7375000	50.0000000	Y
0.0004910	4289.	8735321.	6.7375000	50.0000000	Y
0.0005012	4293.	8565230.	6.7375000	50.0000000	Y
0.0005113	4295.	8401222.	6.7375000	50.0000000	Y
0.0005214	4298.	8243543.	6.7375000	50.0000000	Y
0.0005315	4301.	8091306.	6.7375000	50.0000000	Y
0.0005417	4303.	7944709.	6.7375000	50.0000000	Y
0.0005518	4306.	7803097.	6.7375000	50.0000000	Y
0.0005619	4308.	7666440.	6.7375000	50.0000000	Y
0.0005720	4310.	7534459.	6.7375000	50.0000000	Y
0.0005822	4312.	7406752.	6.7375000	50.0000000	Y
0.0005923	4314.	7283411.	6.7375000	50.0000000	Y
0.0006024	4316.	7163914.	6.7375000	50.0000000	Y
0.0006429	4322.	6722463.	6.7375000	50.0000000	Y
0.0006834	4327.	6331794.	6.7375000	50.0000000	Y
0.0007239	4332.	5983638.	6.7375000	50.0000000	Y
0.0007644	4335.	5671455.	6.7375000	50.0000000	Y
0.0008049	4338.	5390002.	6.7375000	50.0000000	Y
0.0008454	4341.	5135017.	6.7375000	50.0000000	Y
0.0008859	4344.	4902999.	6.7375000	50.0000000	Y

0.0009264	4346.	4690813.	6.7375000	50.0000000	Y
0.0009669	4347.	4496209.	6.7375000	50.0000000	Y
0.0010074	4349.	4317042.	6.7375000	50.0000000	Y
0.0010479	4350.	4151529.	6.7375000	50.0000000	Y
0.0010884	4352.	3998207.	6.7375000	50.0000000	Y
0.0011289	4353.	3855783.	6.7375000	50.0000000	Y
0.0011694	4354.	3723076.	6.7375000	50.0000000	Y
0.0012099	4355.	3599254.	6.7375000	50.0000000	Y
0.0012504	4355.	3483301.	6.7375000	50.0000000	Y
0.0012909	4356.	3374583.	6.7375000	50.0000000	Y

Summary of Results for Nominal Moment Capacity for Section 1

Load No.	Axial Thrust kips	Nominal Moment Capacity in-kips
1	0.00000000	4356.

Note that the values in the above table are not factored by a strength reduction factor for LRFD.

The value of the strength reduction factor depends on the provisions of the LRFD code being followed.

The above values should be multiplied by the appropriate strength reduction factor to compute ultimate moment capacity according to the LRFD structural design standard being followed.

Pile Section No. 2:

Dimensions and Properties of Steel AISC Strong Axis:

Length of Section	=	7.500000 ft
Flange Width	=	14.600000 in
Section Depth	=	13.600000 in
Flange Thickness	=	0.505000 in
Web Thickness	=	0.505000 in
Yield Stress of Pipe	=	50.000000 ksi
Elastic Modulus	=	29000. ksi
Cross-sectional Area	=	21.400000 sq. in.
Moment of Inertia	=	729.000000 in^4
Elastic Bending Stiffness	=	21141000. kip-in^2
Plastic Modulus, Z	=	118.000000in^3
Plastic Moment Capacity = Fy Z	=	5900.in-kip

Axial Structural Capacities:

Nom. Axial Structural Capacity = Fy As	=	1070.000 kips
Nominal Axial Tensile Capacity	=	-1070.000 kips

Number of Axial Thrust Force Values Determined from Pile-head Loadings = 1

Number	Axial Thrust Force kips

1 0.000

Definition of Run Messages:

Y = part of pipe section has yielded.

Axial Thrust Force = 0.000 kips

Bending Curvature rad/in.	Bending Moment in-kip	Bending Stiffness kip-in2	Depth to N Axis in	Max Total Stress ksi	Run Msg
0.00000502	104.1755222	20756666.	6.8000000	0.9798288	
0.00001004	208.3510444	20756666.	6.8000000	1.9596576	
0.00001506	312.5265666	20756666.	6.8000000	2.9394863	
0.00002008	416.7020888	20756666.	6.8000000	3.9193151	
0.00002509	520.8776110	20756666.	6.8000000	4.8991439	
0.00003011	625.0531332	20756666.	6.8000000	5.8789727	
0.00003513	729.2286554	20756666.	6.8000000	6.8588015	
0.00004015	833.4041776	20756666.	6.8000000	7.8386303	
0.00004517	937.5796998	20756666.	6.8000000	8.8184590	
0.00005019	1042.	20756666.	6.8000000	9.7982878	
0.00005521	1146.	20756666.	6.8000000	10.7781166	
0.00006023	1250.	20756666.	6.8000000	11.7579454	
0.00006525	1354.	20756666.	6.8000000	12.7377742	
0.00007026	1458.	20756666.	6.8000000	13.7176029	
0.00007528	1563.	20756666.	6.8000000	14.6974317	
0.00008030	1667.	20756666.	6.8000000	15.6772605	
0.00008532	1771.	20756666.	6.8000000	16.6570893	
0.00009034	1875.	20756666.	6.8000000	17.6369181	
0.00009536	1979.	20756666.	6.8000000	18.6167469	
0.0001004	2084.	20756666.	6.8000000	19.5965756	
0.0001054	2188.	20756666.	6.8000000	20.5764044	
0.0001104	2292.	20756666.	6.8000000	21.5562332	
0.0001154	2396.	20756666.	6.8000000	22.5360620	
0.0001205	2500.	20756666.	6.8000000	23.5158908	
0.0001255	2604.	20756666.	6.8000000	24.4957195	
0.0001305	2709.	20756666.	6.8000000	25.4755483	
0.0001355	2813.	20756666.	6.8000000	26.4553771	
0.0001405	2917.	20756666.	6.8000000	27.4352059	
0.0001455	3021.	20756666.	6.8000000	28.4150347	
0.0001506	3125.	20756666.	6.8000000	29.3948635	
0.0001556	3229.	20756666.	6.8000000	30.3746922	
0.0001606	3334.	20756666.	6.8000000	31.3545210	
0.0001656	3438.	20756666.	6.8000000	32.3343498	
0.0001706	3542.	20756666.	6.8000000	33.3141786	
0.0001757	3646.	20756666.	6.8000000	34.2940074	
0.0001807	3750.	20756666.	6.8000000	35.2738361	
0.0001857	3854.	20756666.	6.8000000	36.2536649	
0.0001907	3959.	20756666.	6.8000000	37.2334937	
0.0001957	4063.	20756666.	6.8000000	38.2133225	
0.0002058	4271.	20756666.	6.8000000	40.1729800	
0.0002158	4480.	20756666.	6.8000000	42.1326376	
0.0002259	4688.	20756666.	6.8000000	44.0922952	
0.0002359	4896.	20756666.	6.8000000	46.0519527	
0.0002459	5105.	20756666.	6.8000000	48.0116103	
0.0002560	5313.	20756666.	6.8000000	49.9712679	
0.0002660	5447.	20475766.	6.8000000	50.0000000	Y
0.0002760	5497.	19913687.	6.8000000	50.0000000	Y
0.0002861	5520.	19294249.	6.8000000	50.0000000	Y
0.0002961	5540.	18708912.	6.8000000	50.0000000	Y
0.0003062	5558.	18155823.	6.8000000	50.0000000	Y
0.0003162	5575.	17631964.	6.8000000	50.0000000	Y
0.0003262	5590.	17135937.	6.8000000	50.0000000	Y
0.0003363	5604.	16665630.	6.8000000	50.0000000	Y
0.0003463	5617.	16219158.	6.8000000	50.0000000	Y
0.0003563	5628.	15794834.	6.8000000	50.0000000	Y
0.0003664	5639.	15391137.	6.8000000	50.0000000	Y

0.0003764	5649.	15006694.	6.8000000	50.0000000	Y
0.0003865	5658.	14640260.	6.8000000	50.0000000	Y
0.0003965	5666.	14290700.	6.8000000	50.0000000	Y
0.0004065	5674.	13956977.	6.8000000	50.0000000	Y
0.0004166	5681.	13638139.	6.8000000	50.0000000	Y
0.0004266	5688.	13332840.	6.8000000	50.0000000	Y
0.0004366	5694.	13040564.	6.8000000	50.0000000	Y
0.0004467	5700.	12760725.	6.8000000	50.0000000	Y
0.0004567	5705.	12492115.	6.8000000	50.0000000	Y
0.0004668	5710.	12234370.	6.8000000	50.0000000	Y
0.0004768	5715.	11986978.	6.8000000	50.0000000	Y
0.0004868	5720.	11748890.	6.8000000	50.0000000	Y
0.0004969	5724.	11520256.	6.8000000	50.0000000	Y
0.0005069	5728.	11299755.	6.8000000	50.0000000	Y
0.0005169	5732.	11087791.	6.8000000	50.0000000	Y
0.0005270	5735.	10883101.	6.8000000	50.0000000	Y
0.0005370	5739.	10686021.	6.8000000	50.0000000	Y
0.0005471	5742.	10495610.	6.8000000	50.0000000	Y
0.0005571	5745.	10311881.	6.8000000	50.0000000	Y
0.0005671	5748.	10134413.	6.8000000	50.0000000	Y
0.0005772	5750.	9962708.	6.8000000	50.0000000	Y
0.0005872	5753.	9796873.	6.8000000	50.0000000	Y
0.0005972	5755.	9636180.	6.8000000	50.0000000	Y
0.0006374	5764.	9042573.	6.8000000	50.0000000	Y
0.0006776	5771.	8517218.	6.8000000	50.0000000	Y
0.0007177	5777.	8049009.	6.8000000	50.0000000	Y
0.0007579	5782.	7629158.	6.8000000	50.0000000	Y
0.0007980	5786.	7250621.	6.8000000	50.0000000	Y
0.0008382	5790.	6907672.	6.8000000	50.0000000	Y
0.0008783	5793.	6595608.	6.8000000	50.0000000	Y
0.0009185	5796.	6310217.	6.8000000	50.0000000	Y
0.0009586	5798.	6048460.	6.8000000	50.0000000	Y
0.0009988	5800.	5807472.	6.8000000	50.0000000	Y
0.0010389	5802.	5584837.	6.8000000	50.0000000	Y
0.0010791	5804.	5378606.	6.8000000	50.0000000	Y
0.0011192	5805.	5187024.	6.8000000	50.0000000	Y
0.0011594	5807.	5008517.	6.8000000	50.0000000	Y
0.0011995	5808.	4841960.	6.8000000	50.0000000	Y
0.0012397	5809.	4685980.	6.8000000	50.0000000	Y
0.0012798	5810.	4539738.	6.8000000	50.0000000	Y

Summary of Results for Nominal Moment Capacity for Section 2

Load No.	Axial Thrust kips	Nominal Moment Capacity in-kips
1	0.00000000	5810.

Note that the values in the above table are not factored by a strength reduction factor for LRFD.

The value of the strength reduction factor depends on the provisions of the LRFD code being followed.

The above values should be multiplied by the appropriate strength reduction factor to compute ultimate moment capacity according to the LRFD structural design standard being followed.

Computed Values of Pile Loading and Deflection
for Lateral Loading for Load Case Number 1

Pile-head conditions are Shear and Moment (Loading Type 1)

Shear force at pile head = 0.0 lbs
Applied moment at pile head = 0.0 in-lbs
Axial thrust load on pile head = 0.0 lbs

Depth X feet	Deflect. y inches	Bending Moment in-lbs	Shear Force lbs	Slope S radians	Total Stress psi*	Bending Stiffness lb-in^2	Soil Res. p lb/inch	Soil Spr. Es*H lb/inch	Distrib. Lat. Load lb/inch
0.00	1.4507	-5.71E-07	1.16E-07	-0.01009	7.69E-09	1.56E+10	0.00	0.00	57.0236
0.2050	1.4259	172.5419	145.5309	-0.01009	2.3262	1.56E+10	0.00	0.00	61.2943
0.4100	1.4011	716.0122	303.3188	-0.01009	9.6531	1.56E+10	0.00	0.00	66.9885
0.6150	1.3763	1665.	475.1145	-0.01009	22.4453	1.56E+10	0.00	0.00	72.6828
0.8200	1.3514	3054.	660.9182	-0.01009	41.1674	1.56E+10	0.00	0.00	78.3771
1.0250	1.3266	4917.	860.7298	-0.01009	66.2840	1.56E+10	0.00	0.00	84.0713
1.2300	1.3018	7288.	1075.	-0.01009	98.2597	1.56E+10	0.00	0.00	89.7656
1.4350	1.2770	10203.	1302.	-0.01009	137.5590	1.56E+10	0.00	0.00	95.4599
1.6400	1.2522	13696.	1544.	-0.01009	184.6464	1.56E+10	0.00	0.00	101.1542
1.8450	1.2273	17801.	1800.	-0.01008	239.9866	1.56E+10	0.00	0.00	106.8484
2.0500	1.2025	22552.	2070.	-0.01008	304.0441	1.56E+10	0.00	0.00	112.5427
2.2550	1.1777	27985.	2354.	-0.01008	377.2836	1.56E+10	0.00	0.00	118.2370
2.4600	1.1530	34133.	2652.	-0.01007	460.1695	1.56E+10	0.00	0.00	123.9312
2.6650	1.1282	41031.	2964.	-0.01007	553.1665	1.56E+10	0.00	0.00	129.6255
2.8700	1.1034	48713.	3289.	-0.01006	656.7390	1.56E+10	0.00	0.00	135.3198
3.0750	1.0787	57215.	3629.	-0.01005	771.3518	1.56E+10	0.00	0.00	141.0140
3.2800	1.0540	66569.	3983.	-0.01004	897.4694	1.56E+10	0.00	0.00	146.7083
3.4850	1.0293	76812.	4351.	-0.01003	1036.	1.56E+10	0.00	0.00	152.4026
3.6900	1.0046	87977.	4733.	-0.01002	1186.	1.56E+10	0.00	0.00	158.0968
3.8950	0.9800	100098.	5129.	-0.01000	1349.	1.56E+10	0.00	0.00	163.7911
4.1000	0.9554	113211.	5539.	-0.00998	1526.	1.56E+10	0.00	0.00	169.4854
4.3050	0.9309	127349.	5963.	-0.00997	1717.	1.56E+10	0.00	0.00	175.1797
4.5100	0.9064	142548.	6401.	-0.00994	1922.	1.56E+10	0.00	0.00	180.8739
4.7150	0.8820	158841.	6853.	-0.00992	2141.	1.56E+10	0.00	0.00	186.5682
4.9200	0.8576	176263.	7319.	-0.00989	2376.	1.56E+10	0.00	0.00	192.2625
5.1250	0.8333	194849.	7799.	-0.00986	2627.	1.56E+10	0.00	0.00	197.9567
5.3300	0.8091	214632.	8293.	-0.00983	2894.	1.56E+10	0.00	0.00	203.6510
5.5350	0.7849	235648.	8801.	-0.00980	3177.	1.56E+10	0.00	0.00	209.3453
5.7400	0.7609	257931.	9323.	-0.00976	3477.	1.56E+10	0.00	0.00	215.0395
5.9450	0.7369	281515.	9859.	-0.00972	3795.	1.56E+10	0.00	0.00	220.7338
6.1500	0.7131	306435.	10409.	-0.00967	4131.	1.56E+10	0.00	0.00	226.4281
6.3550	0.6893	332726.	10973.	-0.00962	4486.	1.56E+10	0.00	0.00	232.1223
6.5600	0.6657	360421.	11551.	-0.00956	4859.	1.56E+10	0.00	0.00	237.8166
6.7650	0.6423	389555.	12143.	-0.00950	5252.	1.56E+10	0.00	0.00	243.5109
6.9700	0.6190	420163.	12749.	-0.00944	5665.	1.56E+10	0.00	0.00	249.2052
7.1750	0.5958	452278.	13369.	-0.00937	6097.	1.56E+10	0.00	0.00	254.8994
7.3800	0.5729	485937.	14003.	-0.00930	6551.	1.56E+10	0.00	0.00	260.5937
7.5850	0.5501	521172.	14651.	-0.00922	7026.	1.56E+10	0.00	0.00	266.2880
7.7900	0.5275	558019.	15313.	-0.00913	7523.	1.56E+10	0.00	0.00	271.9822
7.9950	0.5052	596512.	15989.	-0.00904	8042.	1.56E+10	0.00	0.00	277.6765
8.2000	0.4830	636685.	16679.	-0.00894	8584.	1.56E+10	0.00	0.00	283.3708
8.4050	0.4612	678573.	17383.	-0.00884	9148.	1.56E+10	0.00	0.00	289.0650
8.6100	0.4396	722210.	18101.	-0.00873	9737.	1.56E+10	0.00	0.00	294.7593
8.8150	0.4182	767632.	18833.	-0.00861	10349.	1.56E+10	0.00	0.00	300.4536
9.0200	0.3972	814871.	19580.	-0.00849	10986.	1.56E+10	0.00	0.00	306.1478
9.2250	0.3765	863963.	20340.	-0.00835	11648.	1.56E+10	0.00	0.00	311.8421
9.4300	0.3561	914942.	21114.	-0.00821	12335.	1.56E+10	0.00	0.00	317.5364
9.6350	0.3361	967843.	21902.	-0.00806	13048.	1.56E+10	0.00	0.00	323.2307
9.8400	0.3164	1022700.	22704.	-0.00791	13788.	1.56E+10	0.00	0.00	328.9249
10.0450	0.2972	1079547.	23520.	-0.00774	14554.	1.56E+10	0.00	0.00	334.6192
10.2500	0.2784	1138419.	24350.	-0.00756	15348.	1.56E+10	0.00	0.00	340.3135
10.4550	0.2600	1199351.	25195.	-0.00738	16169.	1.56E+10	0.00	0.00	346.0077
10.6600	0.2421	1262377.	26053.	-0.00718	17019.	1.56E+10	0.00	0.00	351.7020
10.8650	0.2246	1327531.	26925.	-0.00698	17897.	1.56E+10	0.00	0.00	357.3963
11.0700	0.2077	1394848.	27811.	-0.00676	18805.	1.56E+10	0.00	0.00	363.0905

11.2750	0.1913	1464362.	28711.	-0.00654	19742.	1.56E+10	0.00	0.00	368.7848
11.4800	0.1755	1536108.	29626.	-0.00630	20709.	1.56E+10	0.00	0.00	374.4791
11.6850	0.1603	1610120.	30554.	-0.00605	21707.	1.56E+10	0.00	0.00	380.1733
11.8900	0.1458	1686433.	31496.	-0.00579	22736.	1.56E+10	0.00	0.00	385.8676
12.0950	0.1319	1765080.	32452.	-0.00552	23796.	1.56E+10	0.00	0.00	391.5619
12.3000	0.1186	1846098.	33423.	-0.00523	24889.	1.56E+10	0.00	0.00	397.2562
12.5050	0.1061	1929519.	34407.	-0.00493	26013.	1.56E+10	0.00	0.00	402.9504
12.7100	0.09435	2015379.	35405.	-0.00462	27171.	1.56E+10	0.00	0.00	408.6447
12.9150	0.08337	2103712.	36374.	-0.00430	28362.	1.56E+10	0.00	0.00	378.7463
13.1200	0.07321	2194337.	33132.	-0.00400	45151.	2.08E+10	-3014.	101275.	0.00
13.3250	0.06369	2266723.	25460.	-0.00374	46640.	2.08E+10	-3224.	124523.	0.00
13.5300	0.05483	2319601.	17304.	-0.00346	47728.	2.08E+10	-3407.	152859.	0.00
13.7350	0.04665	2351861.	8733.	-0.00319	48392.	2.08E+10	-3562.	187835.	0.00
13.9400	0.03915	2362567.	-181.882	-0.00291	48612.	2.08E+10	-3686.	231636.	0.00
14.1450	0.03234	2350966.	-9364.	-0.00263	48374.	2.08E+10	-3779.	287430.	0.00
14.3500	0.02622	2316498.	-18730.	-0.00235	47665.	2.08E+10	-3836.	359967.	0.00
14.5550	0.02077	2258814.	-28191.	-0.00208	46478.	2.08E+10	-3856.	456705.	0.00
14.7600	0.01598	2177797.	-37648.	-0.00182	44811.	2.08E+10	-3833.	590038.	0.00
14.9650	0.01183	2073584.	-46988.	-0.00157	42666.	2.08E+10	-3761.	782252.	0.00
15.1700	0.00828	1946613.	-56006.	-0.00133	40054.	2.08E+10	-3571.	1061408.	0.00
15.3750	0.00529	1798032.	-63351.	-0.00111	36997.	2.08E+10	-2400.	1115200.	0.00
15.5800	0.00284	1634926.	-67962.	-9.02E-04	33640.	2.08E+10	-1348.	1168992.	0.00
15.7850	8.56E-04	1463661.	-70143.	-7.19E-04	30116.	2.08E+10	-425.348	1222784.	0.00
15.9900	-6.99E-04	1289823.	-70220.	-5.55E-04	26540.	2.08E+10	362.5666	1276576.	0.00
16.1950	-0.00188	1118178.	-68526.	-4.13E-04	23008.	2.08E+10	1015.	1330368.	0.00
16.4000	-0.00273	952677.	-65388.	-2.90E-04	19602.	2.08E+10	1536.	1384160.	0.00
16.6050	-0.00330	796469.	-61124.	-1.86E-04	16388.	2.08E+10	1931.	1437952.	0.00
16.8100	-0.00365	651948.	-56029.	-1.01E-04	13415.	2.08E+10	2211.	1491744.	0.00
17.0150	-0.00380	520808.	-50373.	-3.10E-05	10716.	2.08E+10	2387.	1545536.	0.00
17.2200	-0.00380	404111.	-44400.	2.38E-05	8315.	2.08E+10	2470.	1599328.	0.00
17.4250	-0.00368	302361.	-38319.	6.56E-05	6221.	2.08E+10	2474.	1653120.	0.00
17.6300	-0.00348	215583.	-32309.	9.63E-05	4436.	2.08E+10	2412.	1706912.	0.00
17.8350	-0.00321	143402.	-26518.	1.18E-04	2951.	2.08E+10	2296.	1760704.	0.00
18.0400	-0.00290	85115.	-21065.	1.31E-04	1751.	2.08E+10	2137.	1814496.	0.00
18.2450	-0.00256	39763.	-16042.	1.39E-04	818.1695	2.08E+10	1946.	1868288.	0.00
18.4500	-0.00222	6189.	-11518.	1.41E-04	127.3421	2.08E+10	1732.	1922080.	0.00
18.6550	-0.00187	-16907.	-7543.	1.41E-04	347.8770	2.08E+10	1500.	1975872.	0.00
18.8600	-0.00152	-30924.	-4151.	1.38E-04	636.2968	2.08E+10	1258.	2029664.	0.00
19.0650	-0.00119	-37330.	-1365.	1.34E-04	768.1170	2.08E+10	1008.	2083456.	0.00
19.2700	-8.66E-04	-37639.	800.4925	1.29E-04	774.4568	2.08E+10	752.6370	2137248.	0.00
19.4750	-5.54E-04	-33392.	2333.	1.25E-04	687.0795	2.08E+10	493.1734	2191040.	0.00
19.6800	-2.51E-04	-26161.	3221.	1.22E-04	538.2929	2.08E+10	228.9235	2244832.	0.00
19.8850	4.44E-05	-17545.	3452.	1.19E-04	361.0010	2.08E+10	-41.444	2298624.	0.00
20.0900	3.34E-04	-9179.	3007.	1.17E-04	188.8697	2.08E+10	-319.831	2352416.	0.00
20.2950	6.22E-04	-2749.	1866.	1.17E-04	56.5633	2.08E+10	-608.288	2406208.	0.00
20.5000	9.09E-04	0.00	0.00	1.17E-04	0.00	2.08E+10	-908.513	1230000.	0.00

* This analysis computed pile response using nonlinear moment-curvature relationships. Values of total stress due to combined axial and bending stresses are computed only for elastic sections only and do not equal the actual stresses in concrete and steel. Stresses in concrete and steel may be interpolated from the output for nonlinear bending properties relative to the magnitude of bending moment developed in the pile.

Output Summary for Load Case No. 1:

```
Pile-head deflection             =     1.45073984 inches
Computed slope at pile head      =     -0.0100922 radians
Maximum bending moment           =       2362567. inch-lbs
Maximum shear force              =        -70220. lbs
Depth of maximum bending moment  =    13.94000000 feet below pile head
Depth of maximum shear force     =    15.99000000 feet below pile head
Number of iterations             =             15
Number of zero deflection points =              2
Pile deflection at ground        =     0.07915459 inches
```

Computed Values of Pile Loading and Deflection
for Lateral Loading for Load Case Number 2

Pile-head conditions are Shear and Moment (Loading Type 1)

Shear force at pile head = 0.0 lbs
Applied moment at pile head = 0.0 in-lbs
Axial thrust load on pile head = 0.0 lbs

Depth X feet	Deflect. y inches	Bending Moment in-lbs	Shear Force lbs	Slope S radians	Total Stress psi*	Bending Stiffness lb-in^2	Soil Res. p lb/inch	Soil Spr. Es*H lb/inch	Distrib. Lat. Load lb/inch
0.00	2.3490	-1.03E-05	2.32E-07	-0.01602	1.38E-07	1.56E+10	0.00	0.00	85.4355
0.2050	2.3095	258.5109	218.0516	-0.01602	3.4852	1.56E+10	0.00	0.00	91.8422
0.4100	2.2701	1073.	454.4903	-0.01602	14.4634	1.56E+10	0.00	0.00	100.3844
0.6150	2.2307	2495.	711.9428	-0.01602	33.6315	1.56E+10	0.00	0.00	108.9266
0.8200	2.1913	4576.	990.4091	-0.01602	61.6866	1.56E+10	0.00	0.00	117.4688
1.0250	2.1519	7367.	1290.	-0.01602	99.3254	1.56E+10	0.00	0.00	126.0110
1.2300	2.1125	10922.	1610.	-0.01602	147.2450	1.56E+10	0.00	0.00	134.5532
1.4350	2.0730	15291.	1952.	-0.01602	206.1422	1.56E+10	0.00	0.00	143.0953
1.6400	2.0336	20525.	2314.	-0.01602	276.7140	1.56E+10	0.00	0.00	151.6375
1.8450	1.9942	26677.	2698.	-0.01601	359.6573	1.56E+10	0.00	0.00	160.1797
2.0500	1.9549	33799.	3102.	-0.01601	455.6690	1.56E+10	0.00	0.00	168.7219
2.2550	1.9155	41942.	3528.	-0.01600	565.4460	1.56E+10	0.00	0.00	177.2641
2.4600	1.8761	51157.	3975.	-0.01599	689.6853	1.56E+10	0.00	0.00	185.8063
2.6650	1.8368	61497.	4442.	-0.01599	829.0838	1.56E+10	0.00	0.00	194.3485
2.8700	1.7975	73013.	4931.	-0.01597	984.3384	1.56E+10	0.00	0.00	202.8907
3.0750	1.7582	85757.	5440.	-0.01596	1156.	1.56E+10	0.00	0.00	211.4329
3.2800	1.7189	99780.	5971.	-0.01595	1345.	1.56E+10	0.00	0.00	219.9751
3.4850	1.6797	115134.	6523.	-0.01593	1552.	1.56E+10	0.00	0.00	228.5173
3.6900	1.6406	131872.	7095.	-0.01591	1778.	1.56E+10	0.00	0.00	237.0595
3.8950	1.6015	150044.	7689.	-0.01589	2023.	1.56E+10	0.00	0.00	245.6017
4.1000	1.5624	169702.	8304.	-0.01586	2288.	1.56E+10	0.00	0.00	254.1438
4.3050	1.5234	190898.	8939.	-0.01583	2574.	1.56E+10	0.00	0.00	262.6860
4.5100	1.4845	213684.	9596.	-0.01580	2881.	1.56E+10	0.00	0.00	271.2282
4.7150	1.4457	238111.	10274.	-0.01577	3210.	1.56E+10	0.00	0.00	279.7704
4.9200	1.4069	264231.	10973.	-0.01573	3562.	1.56E+10	0.00	0.00	288.3126
5.1250	1.3683	292096.	11692.	-0.01568	3938.	1.56E+10	0.00	0.00	296.8548
5.3300	1.3298	321758.	12433.	-0.01563	4338.	1.56E+10	0.00	0.00	305.3970
5.5350	1.2914	353268.	13195.	-0.01558	4763.	1.56E+10	0.00	0.00	313.9392
5.7400	1.2531	386677.	13978.	-0.01552	5213.	1.56E+10	0.00	0.00	322.4814
5.9450	1.2150	422038.	14782.	-0.01546	5690.	1.56E+10	0.00	0.00	331.0236
6.1500	1.1770	459402.	15606.	-0.01539	6194.	1.56E+10	0.00	0.00	339.5658
6.3550	1.1393	498821.	16452.	-0.01531	6725.	1.56E+10	0.00	0.00	348.1080
6.5600	1.1017	540347.	17319.	-0.01523	7285.	1.56E+10	0.00	0.00	356.6502
6.7650	1.0643	584031.	18207.	-0.01514	7874.	1.56E+10	0.00	0.00	365.1923
6.9700	1.0272	629925.	19116.	-0.01505	8492.	1.56E+10	0.00	0.00	373.7345
7.1750	0.9903	678081.	20046.	-0.01494	9142.	1.56E+10	0.00	0.00	382.2767
7.3800	0.9537	728550.	20997.	-0.01483	9822.	1.56E+10	0.00	0.00	390.8189
7.5850	0.9173	781384.	21969.	-0.01471	10534.	1.56E+10	0.00	0.00	399.3611
7.7900	0.8813	836635.	22961.	-0.01458	11279.	1.56E+10	0.00	0.00	407.9033
7.9950	0.8456	894355.	23975.	-0.01445	12057.	1.56E+10	0.00	0.00	416.4455
8.2000	0.8102	954594.	25010.	-0.01430	12870.	1.56E+10	0.00	0.00	424.9877
8.4050	0.7752	1017406.	26066.	-0.01415	13716.	1.56E+10	0.00	0.00	433.5299
8.6100	0.7406	1082841.	27143.	-0.01398	14599.	1.56E+10	0.00	0.00	442.0721
8.8150	0.7064	1150951.	28241.	-0.01380	15517.	1.56E+10	0.00	0.00	450.6143
9.0200	0.6727	1221788.	29360.	-0.01362	16472.	1.56E+10	0.00	0.00	459.1565
9.2250	0.6394	1295404.	30500.	-0.01342	17464.	1.56E+10	0.00	0.00	467.6987
9.4300	0.6067	1371850.	31661.	-0.01321	18495.	1.56E+10	0.00	0.00	476.2408
9.6350	0.5745	1451178.	32844.	-0.01298	19564.	1.56E+10	0.00	0.00	484.7830
9.8400	0.5428	1533440.	34047.	-0.01275	20673.	1.56E+10	0.00	0.00	493.3252
10.0450	0.5118	1618688.	35271.	-0.01250	21823.	1.56E+10	0.00	0.00	501.8674
10.2500	0.4813	1706972.	36516.	-0.01223	23013.	1.56E+10	0.00	0.00	510.4096
10.4550	0.4516	1798345.	37782.	-0.01196	24245.	1.56E+10	0.00	0.00	518.9518
10.6600	0.4225	1892859.	39069.	-0.01166	25519.	1.56E+10	0.00	0.00	527.4940
10.8650	0.3942	1990565.	40377.	-0.01136	26836.	1.56E+10	0.00	0.00	536.0362

11.0700	0.3666	2091515.	41706.	-0.01103	28197.	1.56E+10	0.00	0.00	544.5784
11.2750	0.3399	2195760.	43056.	-0.01070	29603.	1.56E+10	0.00	0.00	553.1206
11.4800	0.3140	2303352.	44428.	-0.01034	31053.	1.56E+10	0.00	0.00	561.6628
11.6850	0.2890	2414344.	45820.	-0.00997	32550.	1.56E+10	0.00	0.00	570.2050
11.8900	0.2650	2528786.	47233.	-0.00958	34092.	1.56E+10	0.00	0.00	578.7472
12.0950	0.2419	2646731.	48667.	-0.00917	35682.	1.56E+10	0.00	0.00	587.2893
12.3000	0.2199	2768229.	50123.	-0.00874	37320.	1.56E+10	0.00	0.00	595.8315
12.5050	0.1989	2893333.	51599.	-0.00829	39007.	1.56E+10	0.00	0.00	604.3737
12.7100	0.1791	3022095.	53096.	-0.00782	40743.	1.56E+10	0.00	0.00	612.9159
12.9150	0.1604	3154566.	54549.	-0.00733	42529.	1.56E+10	0.00	0.00	568.0733
13.1200	0.1430	3290475.	50865.	-0.00689	67705.	2.08E+10	-3563.	61291.	0.00
13.3250	0.1265	3404821.	41775.	-0.00649	70058.	2.08E+10	-3827.	74409.	0.00
13.5300	0.1111	3496006.	32068.	-0.00608	71934.	2.08E+10	-4064.	90027.	0.00
13.7350	0.09660	3562594.	21813.	-0.00567	73304.	2.08E+10	-4273.	108802.	0.00
13.9400	0.08319	3603326.	11083.	-0.00524	74143.	2.08E+10	-4451.	131614.	0.00
14.1450	0.07082	3617125.	-44.513	-0.00481	74426.	2.08E+10	-4597.	159671.	0.00
14.3500	0.05950	3603107.	-11490.	-0.00439	74138.	2.08E+10	-4709.	194663.	0.00
14.5550	0.04924	3560594.	-23167.	-0.00396	73263.	2.08E+10	-4785.	239028.	0.00
14.7600	0.04002	3489126.	-34982.	-0.00354	71793.	2.08E+10	-4822.	296401.	0.00
14.9650	0.03181	3388480.	-46837.	-0.00314	69722.	2.08E+10	-4816.	372438.	0.00
15.1700	0.02459	3258690.	-58618.	-0.00274	67051.	2.08E+10	-4763.	476446.	0.00
15.3750	0.01832	3100079.	-70201.	-0.00236	63788.	2.08E+10	-4654.	624915.	0.00
15.5800	0.01296	2913302.	-81433.	-0.00201	59944.	2.08E+10	-4478.	850324.	0.00
15.7850	0.00844	2699426.	-92101.	-0.00168	55544.	2.08E+10	-4195.	1222784.	0.00
15.9900	0.00471	2460164.	-100267.	-0.00137	50621.	2.08E+10	-2444.	1276576.	0.00
16.1950	0.00170	2206111.	-104403.	-0.00109	45393.	2.08E+10	-918.307	1330368.	0.00
16.4000	-6.71E-04	1946500.	-105068.	-8.48E-04	40051.	2.08E+10	377.3793	1384160.	0.00
16.6050	-0.00247	1689174.	-102827.	-6.32E-04	34757.	2.08E+10	1445.	1437952.	0.00
16.8100	-0.00378	1440591.	-98230.	-4.47E-04	29642.	2.08E+10	2293.	1491744.	0.00
17.0150	-0.00467	1205883.	-91801.	-2.90E-04	24812.	2.08E+10	2934.	1545536.	0.00
17.2200	-0.00521	988928.	-84029.	-1.60E-04	20348.	2.08E+10	3385.	1599328.	0.00
17.4250	-0.00546	792458.	-75357.	-5.42E-05	16306.	2.08E+10	3666.	1653120.	0.00
17.6300	-0.00547	618174.	-66176.	2.94E-05	12720.	2.08E+10	3798.	1706912.	0.00
17.8350	-0.00531	466873.	-56829.	9.37E-05	9606.	2.08E+10	3801.	1760704.	0.00
18.0400	-0.00501	338575.	-47606.	1.41E-04	6967.	2.08E+10	3697.	1814496.	0.00
18.2450	-0.00462	232651.	-38747.	1.75E-04	4787.	2.08E+10	3505.	1868288.	0.00
18.4500	-0.00415	147939.	-30447.	1.98E-04	3044.	2.08E+10	3243.	1922080.	0.00
18.6550	-0.00364	82850.	-22861.	2.11E-04	1705.	2.08E+10	2925.	1975872.	0.00
18.8600	-0.00311	35463.	-16107.	2.19E-04	729.6981	2.08E+10	2566.	2029664.	0.00
19.0650	-0.00257	3603.	-10277.	2.21E-04	74.1398	2.08E+10	2174.	2083456.	0.00
19.2700	-0.00202	-15100.	-5441.	2.20E-04	310.7092	2.08E+10	1758.	2137248.	0.00
19.4750	-0.00148	-23167.	-1653.	2.18E-04	476.6816	2.08E+10	1322.	2191040.	0.00
19.6800	-9.51E-04	-23235.	1040.	2.15E-04	478.0827	2.08E+10	868.1163	2244832.	0.00
19.8850	-4.26E-04	-18049.	2597.	2.13E-04	371.3873	2.08E+10	397.6094	2298624.	0.00
20.0900	9.50E-05	-10458.	2974.	2.11E-04	215.1821	2.08E+10	-90.860	2352416.	0.00
20.2950	6.13E-04	-3416.	2126.	2.10E-04	70.2907	2.08E+10	-599.113	2406208.	0.00
20.5000	0.00113	0.00	0.00	2.10E-04	0.00	2.08E+10	-1129.	1230000.	0.00

* This analysis computed pile response using nonlinear moment-curvature relationships. Values of total stress due to combined axial and bending stresses are computed only for elastic sections only and do not equal the actual stresses in concrete and steel. Stresses in concrete and steel may be interpolated from the output for nonlinear bending properties relative to the magnitude of bending moment developed in the pile.

Output Summary for Load Case No. 2:

```
Pile-head deflection             =     2.34896324 inches
Computed slope at pile head      =     -0.0160245 radians
Maximum bending moment           =       3617125. inch-lbs
Maximum shear force              =       -105068. lbs
Depth of maximum bending moment  =    14.14500000 feet below pile head
Depth of maximum shear force     =    16.40000000 feet below pile head
Number of iterations             =             17
Number of zero deflection points =              2
Pile deflection at ground        =     0.15320826 inches
```

Summary of Pile-head Responses for Conventional Analyses

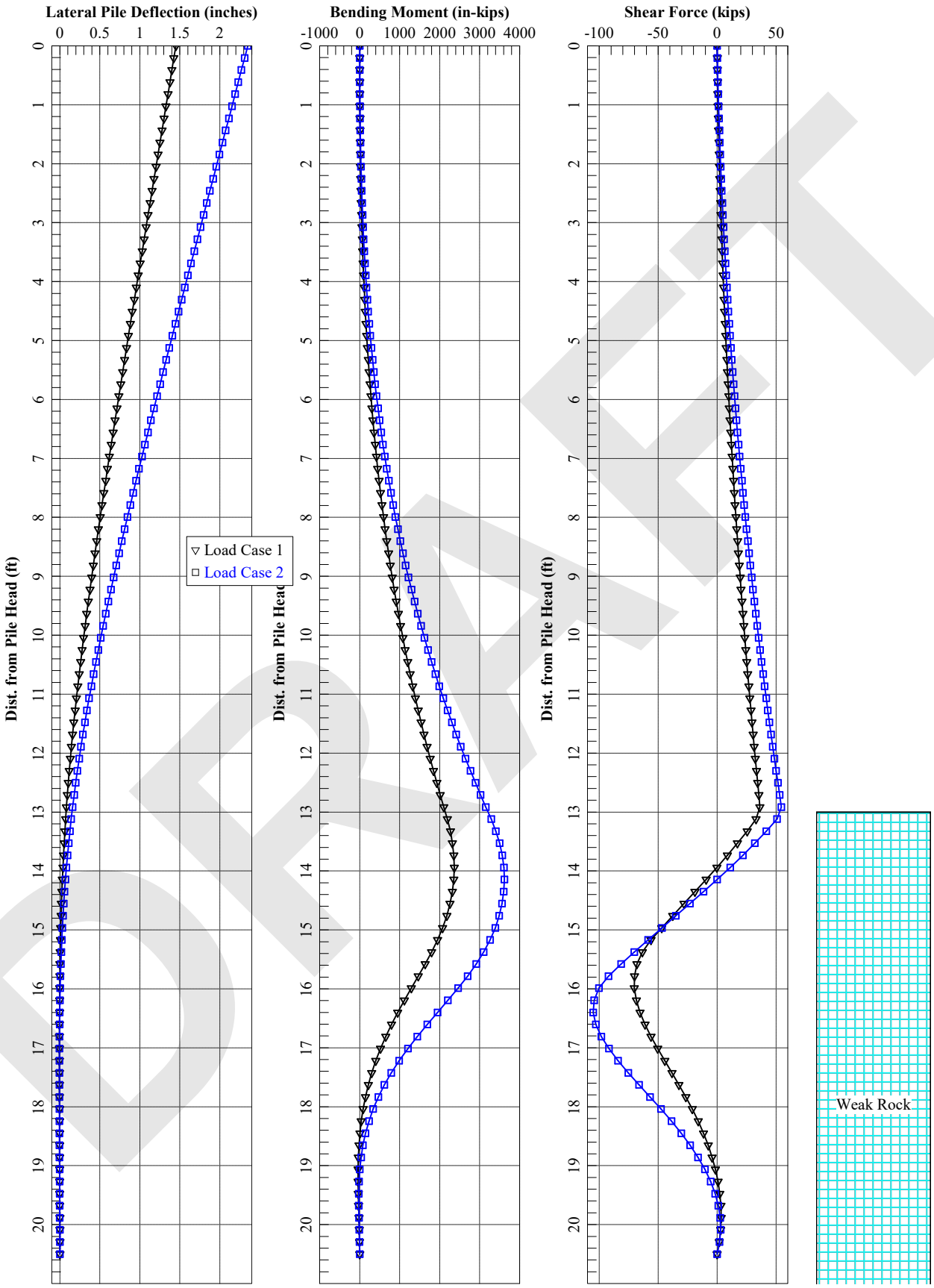
Definitions of Pile-head Loading Conditions:

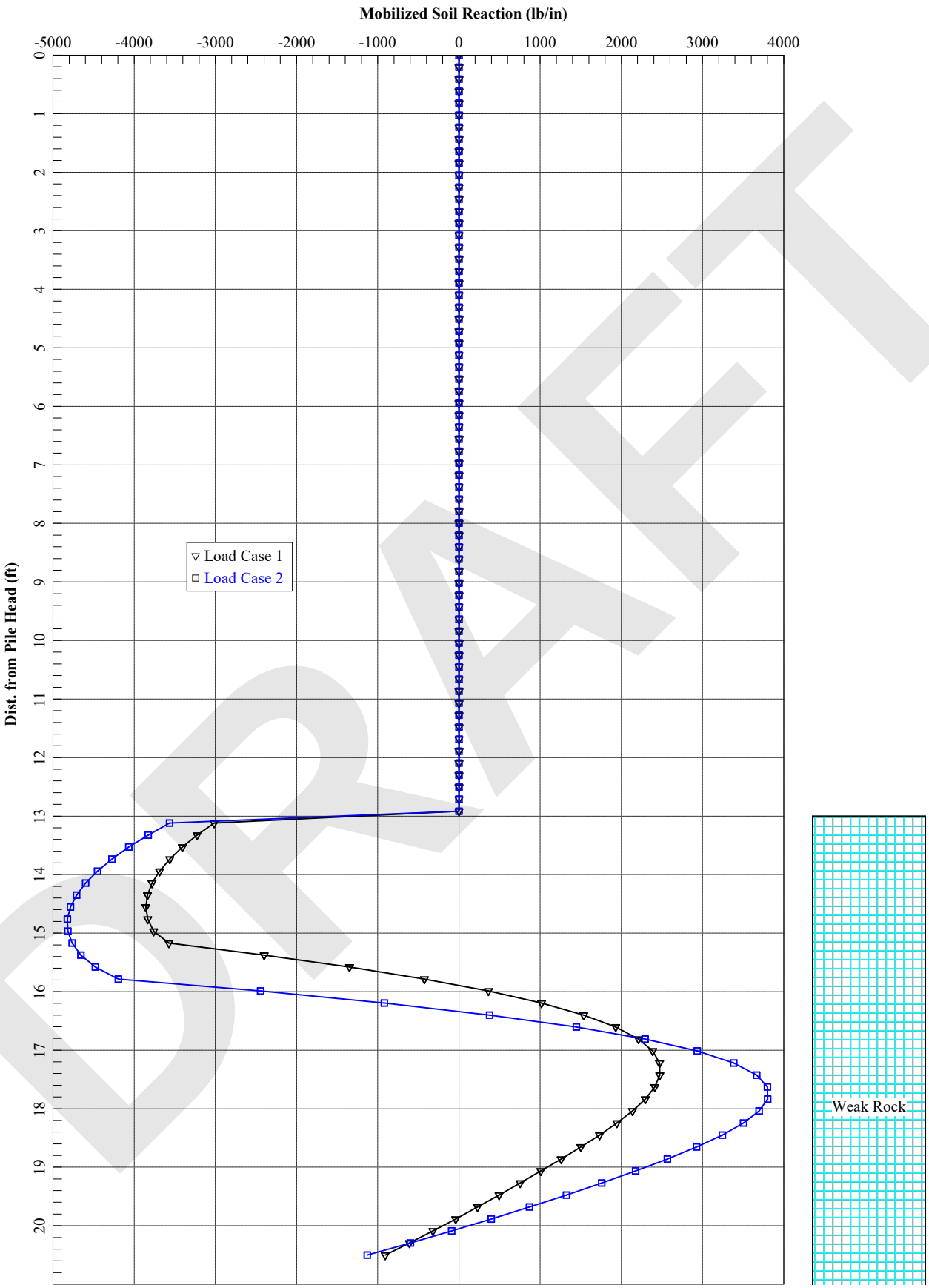
Load Type 1: Load 1 = Shear, V, lbs, and Load 2 = Moment, M, in-lbs
Load Type 2: Load 1 = Shear, V, lbs, and Load 2 = Slope, S, radians
Load Type 3: Load 1 = Shear, V, lbs, and Load 2 = Rot. Stiffness, R, in-lbs/rad.
Load Type 4: Load 1 = Top Deflection, y, inches, and Load 2 = Moment, M, in-lbs
Load Type 5: Load 1 = Top Deflection, y, inches, and Load 2 = Slope, S, radians

Load Case No.	Load Type 1	Pile-head Load 1	Load Type 2	Pile-head Load 2	Axial Loading lbs	Pile-head Deflection inches	Pile-head Rotation radians	Max Shear in Pile lbs	Max Moment in Pile in-lbs
1	V, lb	0.00	M, in-lb	0.00	0.00	1.4507	-0.01009	-70220.	2362567.
2	V, lb	0.00	M, in-lb	0.00	0.00	2.3490	-0.01602	-105068.	3617125.

Maximum pile-head deflection = 2.3489632374 inches
Maximum pile-head rotation = -0.0160244549 radians = -0.918134 deg.

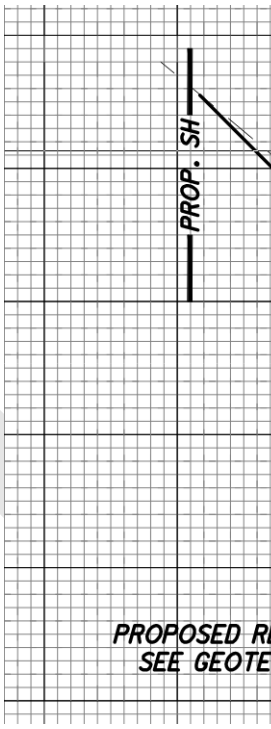
The analysis ended normally.


Lateral Pile Deflection (inches)
0
0.5
1
1.5
2
Bending Moment (in-kips)
-1000
0
1000
2000
3000
4000
Shear Force (kips)
-100
-50
0
50
Dist. from Pile Head (ft)
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
Load Case 1
Load Case 2
Weak Rock


Mobilized Soil Reaction (lb/in)
-5000
-4000
-3000
-2000
-1000
0
1000
2000
3000
4000
Dist. from Pile Head (ft)
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
Load Case 1
Load Case 2
Weak Rock

Soldier Pile & Lagging Wall Design Calculations
Project: WAR-SR48-6.65
Date: 9/2/2025
Case: Cross Section 1 (LPILE-1005)

Designed By: NP/JDH
Checked By: DWW



Lateral Forces

-Lateral Earth Pressure and LLS

$D_{ep} := 10.5\ ft$ Depth from top of wall to stable slope geometry below wall

$D_{frost} := 2.5\ ft$ Frost Depth

$H := D_{ep} + D_{frost} = 13\ ft$ Design Retained Height

$\beta := 0\ deg$ Slope behind wall ← 45 degree 1:1 slope shown on plans

$\gamma_m := 125\ \frac{lb}{ft^3}$ Moist unit weight of retained material

$\phi := 30\ deg$ Fully softened angle of internal friction of retained material

$$k_a := \frac{\cos(\beta) - \sqrt[2]{(\cos(\beta)\cdot\cos(\beta)) - (\cos(\phi)\cdot\cos(\phi))}}{\cos(\beta) + \sqrt[2]{(\cos(\beta)\cdot\cos(\beta)) - (\cos(\phi)\cdot\cos(\phi))}} = 0.333$$

Coefficient of active earth pressure

$q := 250\ \frac{lb}{ft^2}$ Surcharge pressure

$s := 8\ ft$ C-C spacing between shafts

$\gamma_S := 1.75$ Live load surcharge load factor (AASHTO recommends 1.75)

$\gamma_{EH} := 1.50$ Horizontal earth pressure load factor (AASHTO recommends 1.50)

$S_{unfactored} := k_a \cdot q \cdot s = 55.6\ \frac{lb}{in}$ unfactored surcharge lateral pressure

$EH_{unfactored} := k_a \cdot \gamma_m \cdot H \cdot s = 361.1\ \frac{lb}{in}$ unfactored lateral earth pressure

Unfactored Lateral Earth Pressures (service case):

$P_{top;factored} := S_{unfactored} = 55.6\ \frac{lb}{in}$ factored earth pressure at surface

$P_{bottom;factored} := S_{unfactored} + EH_{unfactored} = 416.7\ \frac{lb}{in}$ factored earth pressure at depth

Factored Lateral Earth Pressures (strength case):

$P_{top;factored} := \gamma_{EH} \cdot S_{unfactored} = 83.3\ \frac{lb}{in}$ factored earth pressure at surface

$P_{bottom;factored} := \gamma_{EH} \cdot S_{unfactored} + \gamma_{EH} \cdot EH_{unfactored} = 625\ \frac{lb}{in}$ factored earth pressure at depth

Wall Configuration

$b_s := 30\ in$ Structural pier diameter

$A := \pi \cdot \left(\frac{b_s}{2}\right)^2 = 706.9\ in^2$ Area of structural pier

$H = 13\ ft$ Retained height

-Shaft Embedment

$L := 24\ ft$ Structural pier total length

$L_{min;lem} := 25\ ft$ Minimum length from global stability

$L \geq L_{min;lem} = 0$ 1=true (OK), 0=false (Not OK)

$D_{ignored\_rock} := 3\ ft$ Length of bedrock socket ignored because of excavation for removal of existing storm sewer structure

$D := L - H - D_{ignored\_rock} = 8\ ft$ Embedment of drilled shaft below retained height

$D \geq 10\ ft = 0$ 1=true (OK), 0=false (Not OK) ODOT GDM Section 1501.7.7

$DL_{ratio} := \frac{D}{L} = 0.333$ Embedment-to-Length ratio. ODOT BDM Section 307.6 - Shall not be less than 0.5 for walls founded entirely in soil.

-Shaft Overlap- not needed

$s = 8\ ft$ C-C spacing of structural piers

$b_p := 24\ in$ Plug pier diameter

$s_c := s - b_s = 5.5\ ft$ Clear spacing between structural piers

$overlap := \frac{\left(\text{No. of Plug Shafts: 2} \cdot (b_p - s_c)\right)}{2} = -9\ in$ (≥3 in recommended)

-p-y Modification Factors for Group Action

$\beta_\alpha := \text{if } \left(\frac{s}{b_s}\right) \geq 3.75 \text{ return } 0.64 \cdot \left(\frac{s}{b_s}\right)^{0.34} \text{ else return } 1 = 0.95$ Reese, Isenhower, and Wang, "Analysis and Design of Shallow and Deep Foundations (2006)

Steel Beam Design Checks

$SHAPE \equiv$ "HP14X117" select beam shape (including " " and **capital** X)

$F_y := 50\ \frac{kip}{in^2}$ $E := 29000\ \frac{kip}{in^2}$

-Check Horizontal Deflection (Service)

$d_{allow} := min(0.01 \cdot H, 2\ in) = 1.56\ in$ allowable deflection (ODOT GDM 1501.6)

$d_{max} := 1.51\ in$ maximum deflection from LPILE (Service)

$d_{max} \le d_{allow} = 1$ 1=true (OK), 0=false (Not OK) $CDR_{Deflection} := \frac{d_{allow}}{d_{max}} = 1.03$

-Check Geotechnical Overturning (Strength) (ODOT GDM Section 1501.7.9)

Does pile-head deflection at Strength Limit State:

Fail to Converge: $Over_{ftc} :=$ Criteria: No $= 1$
Show an infinite deflection: $Over_{id} :=$ Criteria: No $= 1$
Show a very large deflection: $Over_{vld} :=$ Criteria: No $= 1$
(GDM gives example of 100 inches)

$min(Over_{ftc}, Over_{id}, Over_{vld}) = 1$ 1=true (OK), 0=false (Not OK)

-Check Moment (Strength)

Section limited to doubly symmetric I-shaped member bending about their major axis

$\phi_b :=$ AISC $= 0.9$ moment resistance factor
$M_u := 5372\ in \cdot kip$ ultimate moment from LPILE (Strength)
$S_x = 172\ in^3$ section modulus
$I_x = 1220\ in^3$ moment of inertia
$Z_x = 194\ in^3$ plastic modulus
$M_p := F_y \cdot Z_x = 9700\ in \cdot kip$ plastic moment

Yielding

$M_{n;y} := M_p = 9700\ in \cdot kip$ Nominal Moment Resistance - Limit State of Yielding (AISC Eq. F2-1)

Lateral Torsional Buckling

Assume full concrete embedment provides continuous lateral bracing and transverse stiffening; therefore, this flexural limit state does not apply — AISC Comm. I3 - Encased Composite Members

$M_{n;LTB} := M_p$

Flange Local Buckling

Assume full concrete embedment provides continuous lateral bracing and transverse stiffening; therefore, this flexural limit state does not apply — AISC Comm. I3 - Encased Composite Members

$M_{n;FLB} := M_p$

Compression/Tension Flange Yielding

Flange of selected member shape is compact. Provisions of AISC Sections F4 and F5 do not apply.

$M_{n;CFY} := M_p \quad M_{n;TFY} := M_p$

Nominal Flexural Strength

$M_n := min\left(M_{n;y}, M_{n;LTB}, M_{n;FLB}, M_{n;CFY}, M_{n;TFY}\right)$ Nominal Flexural Strength

$\phi_b \cdot M_n = 8730\ (in \cdot kip)$ Factored Flexural Strength

$\phi_b \cdot M_n > M_u = 1$ 1=true (OK), 0=false (Not OK) $CDR_{Flex} := \frac{\phi_b \cdot M_n}{M_u} = 1.63$

-Check Shear (Strength)

Section limited to webs of doubly symmetric I-shaped members subject to shear in the plane of the web.

$\phi_v :=$ AISC $= 0.9$ shear resistance factor

$V_u := 154\ kip$ ultimate shear from LPILE (Strength)

$t_w = 0.805\ in$ web thickness

$d = 14.2\ in$ beam depth

$A_w := t_w \cdot d = 11.431\ in^2$ area of web

$h := 18.9 \cdot t_w$ Look up compact section criteria from AISC Table 1

$$C_V := \left\| \begin{array}{l} \text{if } \left(\frac{h}{t_w}\right) \le 2.24 \cdot \sqrt{\frac{E}{F_y}} \\ \quad \text{return “Follow G2.1(b)”} \\ \text{return } 1.0 \end{array} \right| = 1$$

$V_n := 0.6 \cdot F_y \cdot A_w \cdot C_V = 343\ kip$ nominal shear strength (AISC Eq. G2-1)

$\phi_v \cdot V_n > V_u = 1$ 1=true (OK), 0=false (Not OK) $CDR_{Shear} := \frac{\phi_v \cdot V_n}{V_u} = 2$

-Check Concrete Cover

$b_s = 30\ in$ diameter of structural shaft

$d = 14.2\ in$ beam depth

$b = 14.875\ in$ beam width

$cover_b := \frac{b_s}{2} - \sqrt{\left(\frac{b}{2}\right)^2 + \left(\frac{d}{2}\right)^2} = 4.7\ in$

ODOT GDM Section 904.1 minimum cover:
≤4' dia: 3 inches
>4' dia: 6 inches

==========

LPile for Windows, Version 2022-12.010

Analysis of Individual Piles and Drilled Shafts
Subjected to Lateral Loading Using the p-y Method

==========

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Files Used for Analysis

Path to file locations:
\Users\jdhauber\OneDrive - Terracon Consultants Inc\JDH Projects\N1255021 War-SR48-6.65 - General\07 Working Files\02 Calculations\LPile\

Name of input data file:
WAR SR48-1005.lp12d

Name of output report file:
WAR SR48-1005.lp12o

Name of plot output file:
WAR SR48-1005.lp12p

Name of runtime message file:
WAR SR48-1005.lp12r

Date and Time of Analysis

Date: September 2, 2025 Time: 12:44:28

Problem Title

Project Name: War-SR-48-6.65

Job Number: N1255021

Client: Choice One Engineering Corp

Engineer: JB

Description:

Program Options and Settings

Computational Options:
- Conventional Analysis

Engineering Units Used for Data Input and Computations:
- US Customary System Units (pounds, feet, inches)

Analysis Control Options:
- Maximum number of iterations allowed = 500
- Deflection tolerance for convergence = 1.0000E-05 in
- Maximum allowable deflection = 100.0000 in
- Number of pile increments = 100

Loading Type and Number of Cycles of Loading:
- Static loading specified

- Analysis uses p-y modification factors for p-y curves
- Analysis uses layering correction (Method of Georgiadis)
- Analysis includes loading by multiple distributed lateral loads acting on pile
- Loading by lateral soil movements acting on pile not selected
- Input of shear resistance at the pile tip not selected
- Input of moment resistance at the pile tip not selected
- Computation of pile-head foundation stiffness matrix not selected
- Push-over analysis of pile not selected
- Buckling analysis of pile not selected

Output Options:
- Output files use decimal points to denote decimal symbols.
- Values of pile-head deflection, bending moment, shear force, and soil reaction are printed for full length of pile.
- Printing Increment (nodal spacing of output points) = 1
- No p-y curves to be computed and reported for user-specified depths
- Print using wide report formats

Pile Structural Properties and Geometry

Number of pile sections defined = 2
Total length of pile = 24.000 ft
Depth of ground surface below top of pile = 13.0000 ft

Pile diameters used for p-y curve computations are defined using 4 points.

p-y curves are computed using pile diameter values interpolated with depth over the length of the pile. A summary of values of pile diameter vs. depth follows.

Point No.	Depth Below Pile Head feet	Pile Diameter inches
1	0.000	14.7750
2	13.000	14.7750
3	13.000	30.0000

```
  4            24.000           30.0000


Input Structural Properties for Pile Sections:
----------------------------------------------

Pile Section No. 1:

   Section 1 is a H strong axis steel pile
   Length of section                                =    13.000000 ft
   Pile width                                       =    14.775000 in

Pile Section No. 2:

   Section 2 is a AISC strong axis steel pile
   Length of section                                =    11.000000 ft
   AISC Section Type                                = HP


   AISC Section Name                                = HP14X117


   Pile width                                       =    14.900000 in
   Eq. Diameter                                     =    30.000000 in



---------------------------------------------------------------------------
                      Soil and Rock Layering Information
---------------------------------------------------------------------------

The soil profile is modelled using 1 layers

Layer 1 is weak rock, p-y criteria by Reese, 1997

   Distance from top of pile to top of layer        =    13.000000 ft
   Distance from top of pile to bottom of layer     =    50.000000 ft
   Effective unit weight at top of layer            =   140.000000 pcf
   Effective unit weight at bottom of layer         =   140.000000 pcf
   Uniaxial compressive strength at top of layer    =   200.000000 psi
   Uniaxial compressive strength at bottom of layer =   200.000000 psi
   Initial modulus of rock at top of layer          =        2000. psi
   Initial modulus of rock at bottom of layer       =        2000. psi
   RQD of rock at top of layer                      =    50.000000 %
   RQD of rock at bottom of layer                   =    50.000000 %
   k rm of rock at top of layer                     =    0.0005000
   k rm of rock at bottom of layer                  =    0.0005000


 (Depth of the lowest soil layer extends 26.000 ft below the pile tip)



---------------------------------------------------------------------------
                      Summary of Input Soil Properties
---------------------------------------------------------------------------

Layer         Soil Type          Layer      Effective    Uniaxial                    E50       Rock Mass
 Num.           Name             Depth       Unit Wt.       qu          RQD %        or        Modulus
          (p-y Curve Type)         ft           pcf          psi                     krm         psi
-----   -------------------   ----------   ----------   ----------   ----------   ----------   ----------
  1            Weak              13.0000     140.0000     200.0000      50.0000     5.00E-04        2000.
               Rock              50.0000     140.0000     200.0000      50.0000     5.00E-04        2000.


---------------------------------------------------------------------------
                      Modification Factors for p-y Curves
---------------------------------------------------------------------------
```

Distribution of p-y modifiers with depth defined using 4 points

Point No.	Depth X ft	p-mult	y-mult
1	13.000	0.0000	1.0000
2	16.000	0.0000	1.0000
3	16.000	0.9500	1.0000
4	50.000	0.9500	1.0000

Static Loading Type

Static loading criteria were used when computing p-y curves for all analyses.

Distributed Lateral Loading for Individual Load Cases

Distributed lateral load intensity for Load Case 1 defined using 2 points

Point No.	Depth X ft	Dist. Load lb/in
1	0.000	55.600
2	13.000	416.700

Distributed lateral load intensity for Load Case 2 defined using 2 points

Point No.	Depth X ft	Dist. Load lb/in
1	0.000	83.300
2	13.000	625.000

Pile-head Loading and Pile-head Fixity Conditions

Number of loads specified = 2

Load No.	Load Type	Condition 1	Condition 2	Axial Thrust Force, lbs	Compute Top y vs. Pile Length	Run Analysis
1	1	V = 0.0000 lbs	M = 0.0000 in-lbs	0.0000000	No	Yes
2	1	V = 0.0000 lbs	M = 0.0000 in-lbs	0.0000000	No	Yes

V = shear force applied normal to pile axis
M = bending moment applied to pile head
y = lateral deflection normal to pile axis
S = pile slope relative to original pile batter angle
R = rotational stiffness applied to pile head
Values of top y vs. pile lengths can be computed only for load types with
specified shear loading (Load Types 1, 2, and 3).
Thrust force is assumed to be acting axially for all pile batter angles.

Computations of Nominal Moment Capacity and Nonlinear Bending Stiffness

---

Axial thrust force values were determined from pile-head loading conditions

Number of Pile Sections Analyzed = 2

Pile Section No. 1:

Dimensions and Properties of Steel H Strong Axis:

Length of Section	=	13.000000 ft
Flange Width	=	14.775000 in
Section Depth	=	14.075000 in
Flange Thickness	=	0.680000 in
Web Thickness	=	0.680000 in
Yield Stress of Pipe	=	50.000000 ksi
Elastic Modulus	=	29000. ksi
Cross-sectional Area	=	28.740200 sq. in.
Moment of Inertia	=	1019. in^4
Elastic Bending Stiffness	=	29539624. kip-in^2
Plastic Modulus, Z	=	162.063673in^3
Plastic Moment Capacity = Fy Z	=	8103.in-kip

Axial Structural Capacities:

Nom. Axial Structural Capacity = Fy As	=	1437.010 kips
Nominal Axial Tensile Capacity	=	-1437.010 kips

Number of Axial Thrust Force Values Determined from Pile-head Loadings = 1

Number	Axial Thrust Force kips
1	0.000

Definition of Run Messages:

Y = part of pipe section has yielded.

Axial Thrust Force = 0.000 kips

Bending Curvature rad/in.	Bending Moment in-kip	Bending Stiffness kip-in2	Depth to N Axis in	Max Total Stress ksi	Run Msg
0.00000496	146.4214680	29523736.	7.0375000	1.0020400	
0.00000992	292.8429361	29523736.	7.0375000	2.0040800	
0.00001488	439.2644041	29523736.	7.0375000	3.0061200	
0.00001984	585.6858721	29523736.	7.0375000	4.0081600	
0.00002480	732.1073402	29523736.	7.0375000	5.0101999	
0.00002976	878.5288082	29523736.	7.0375000	6.0122399	
0.00003472	1025.	29523736.	7.0375000	7.0142799	
0.00003968	1171.	29523736.	7.0375000	8.0163199	
0.00004464	1318.	29523736.	7.0375000	9.0183599	
0.00004959	1464.	29523736.	7.0375000	10.0203999	
0.00005455	1611.	29523736.	7.0375000	11.0224399	
0.00005951	1757.	29523736.	7.0375000	12.0244799	
0.00006447	1903.	29523736.	7.0375000	13.0265199	
0.00006943	2050.	29523736.	7.0375000	14.0285598	
0.00007439	2196.	29523736.	7.0375000	15.0305998	

0.00007935	2343.	29523736.	7.0375000	16.0326398	
0.00008431	2489.	29523736.	7.0375000	17.0346798	
0.00008927	2636.	29523736.	7.0375000	18.0367198	
0.00009423	2782.	29523736.	7.0375000	19.0387598	
0.00009919	2928.	29523736.	7.0375000	20.0407998	
0.0001041	3075.	29523736.	7.0375000	21.0428398	
0.0001091	3221.	29523736.	7.0375000	22.0448798	
0.0001141	3368.	29523736.	7.0375000	23.0469197	
0.0001190	3514.	29523736.	7.0375000	24.0489597	
0.0001240	3661.	29523736.	7.0375000	25.0509997	
0.0001289	3807.	29523736.	7.0375000	26.0530397	
0.0001339	3953.	29523736.	7.0375000	27.0550797	
0.0001389	4100.	29523736.	7.0375000	28.0571197	
0.0001438	4246.	29523736.	7.0375000	29.0591597	
0.0001488	4393.	29523736.	7.0375000	30.0611997	
0.0001537	4539.	29523736.	7.0375000	31.0632397	
0.0001587	4685.	29523736.	7.0375000	32.0652796	
0.0001637	4832.	29523736.	7.0375000	33.0673196	
0.0001686	4978.	29523736.	7.0375000	34.0693596	
0.0001736	5125.	29523736.	7.0375000	35.0713996	
0.0001785	5271.	29523736.	7.0375000	36.0734396	
0.0001835	5418.	29523736.	7.0375000	37.0754796	
0.0001885	5564.	29523736.	7.0375000	38.0775196	
0.0001934	5710.	29523736.	7.0375000	39.0795596	
0.0002033	6003.	29523736.	7.0375000	41.0836395	
0.0002133	6296.	29523736.	7.0375000	43.0877195	
0.0002232	6589.	29523736.	7.0375000	45.0917995	
0.0002331	6882.	29523736.	7.0375000	47.0958795	
0.0002430	7175.	29523736.	7.0375000	49.0999595	
0.0002529	7433.	29389209.	7.0375000	50.0000000	Y
0.0002629	7586.	28859448.	7.0375000	50.0000000	Y
0.0002728	7648.	28039460.	7.0375000	50.0000000	Y
0.0002827	7680.	27166299.	7.0375000	50.0000000	Y
0.0002926	7708.	26341218.	7.0375000	50.0000000	Y
0.0003025	7733.	25561960.	7.0375000	50.0000000	Y
0.0003124	7756.	24823658.	7.0375000	50.0000000	Y
0.0003224	7777.	24124629.	7.0375000	50.0000000	Y
0.0003323	7796.	23461906.	7.0375000	50.0000000	Y
0.0003422	7813.	22832838.	7.0375000	50.0000000	Y
0.0003521	7829.	22235048.	7.0375000	50.0000000	Y
0.0003620	7844.	21666397.	7.0375000	50.0000000	Y
0.0003720	7858.	21124949.	7.0375000	50.0000000	Y
0.0003819	7870.	20608948.	7.0375000	50.0000000	Y
0.0003918	7882.	20116792.	7.0375000	50.0000000	Y
0.0004017	7893.	19647016.	7.0375000	50.0000000	Y
0.0004116	7902.	19197437.	7.0375000	50.0000000	Y
0.0004216	7912.	18767581.	7.0375000	50.0000000	Y
0.0004315	7920.	18356346.	7.0375000	50.0000000	Y
0.0004414	7928.	17961921.	7.0375000	50.0000000	Y
0.0004513	7936.	17583752.	7.0375000	50.0000000	Y
0.0004612	7943.	17221118.	7.0375000	50.0000000	Y
0.0004711	7949.	16872295.	7.0375000	50.0000000	Y
0.0004811	7956.	16537590.	7.0375000	50.0000000	Y
0.0004910	7961.	16215063.	7.0375000	50.0000000	Y
0.0005009	7967.	15905189.	7.0375000	50.0000000	Y
0.0005108	7972.	15606186.	7.0375000	50.0000000	Y
0.0005207	7977.	15318574.	7.0375000	50.0000000	Y
0.0005307	7981.	15040638.	7.0375000	50.0000000	Y
0.0005406	7986.	14772842.	7.0375000	50.0000000	Y
0.0005505	7990.	14514084.	7.0375000	50.0000000	Y
0.0005604	7994.	14264102.	7.0375000	50.0000000	Y
0.0005703	7998.	14022763.	7.0375000	50.0000000	Y
0.0005803	8001.	13788858.	7.0375000	50.0000000	Y
0.0005902	8004.	13562815.	7.0375000	50.0000000	Y
0.0006299	8016.	12727356.	7.0375000	50.0000000	Y
0.0006695	8026.	11987617.	7.0375000	50.0000000	Y
0.0007092	8034.	11328494.	7.0375000	50.0000000	Y
0.0007489	8041.	10737583.	7.0375000	50.0000000	Y
0.0007886	8047.	10204874.	7.0375000	50.0000000	Y

0.0008282	8052.	9721994.	7.0375000	50.0000000	Y
0.0008679	8056.	9282594.	7.0375000	50.0000000	Y
0.0009076	8060.	8881185.	7.0375000	50.0000000	Y
0.0009473	8064.	8512566.	7.0375000	50.0000000	Y
0.0009869	8067.	8173464.	7.0375000	50.0000000	Y
0.0010266	8069.	7860025.	7.0375000	50.0000000	Y
0.0010663	8072.	7569897.	7.0375000	50.0000000	Y
0.0011060	8074.	7300078.	7.0375000	50.0000000	Y
0.0011456	8076.	7048948.	7.0375000	50.0000000	Y
0.0011853	8077.	6814439.	7.0375000	50.0000000	Y
0.0012250	8079.	6594912.	7.0375000	50.0000000	Y

Summary of Results for Nominal Moment Capacity for Section 1

Load No.	Axial Thrust kips	Nominal Moment Capacity in-kips
1	0.00000000	8079.

Note that the values in the above table are not factored by a strength reduction factor for LRFD.

The value of the strength reduction factor depends on the provisions of the LRFD code being followed.

The above values should be multiplied by the appropriate strength reduction factor to compute ultimate moment capacity according to the LRFD structural design standard being followed.

Pile Section No. 2:

Dimensions and Properties of Steel AISC Strong Axis:

Length of Section	=	11.000000 ft
Flange Width	=	14.900000 in
Section Depth	=	14.200000 in
Flange Thickness	=	0.805000 in
Web Thickness	=	0.805000 in
Yield Stress of Pipe	=	50.000000 ksi
Elastic Modulus	=	29000. ksi
Cross-sectional Area	=	34.400000 sq. in.
Moment of Inertia	=	1220. in^4
Elastic Bending Stiffness	=	35380000. kip-in^2
Plastic Modulus, Z	=	194.000000in^3
Plastic Moment Capacity = Fy Z	=	9700.in-kip

Axial Structural Capacities:

Nom. Axial Structural Capacity = Fy As	=	1720.000 kips
Nominal Axial Tensile Capacity	=	-1720.000 kips

Number of Axial Thrust Force Values Determined from Pile-head Loadings = 1

Number	Axial Thrust Force kips

1	0.000

Definition of Run Messages:

Y = part of pipe section has yielded.

Axial Thrust Force = 0.000 kips

Bending Curvature rad/in.	Bending Moment in-kip	Bending Stiffness kip-in2	Depth to N Axis in	Max Total Stress ksi	Run Msg
0.00000492	172.6211845	35100995.	7.1000000	1.0024581	
0.00000984	345.2423689	35100995.	7.1000000	2.0049161	
0.00001475	517.8635534	35100995.	7.1000000	3.0073742	
0.00001967	690.4847378	35100995.	7.1000000	4.0098323	
0.00002459	863.1059223	35100995.	7.1000000	5.0122903	
0.00002951	1036.	35100995.	7.1000000	6.0147484	
0.00003442	1208.	35100995.	7.1000000	7.0172065	
0.00003934	1381.	35100995.	7.1000000	8.0196645	
0.00004426	1554.	35100995.	7.1000000	9.0221226	
0.00004918	1726.	35100995.	7.1000000	10.0245807	
0.00005410	1899.	35100995.	7.1000000	11.0270387	
0.00005901	2071.	35100995.	7.1000000	12.0294968	
0.00006393	2244.	35100995.	7.1000000	13.0319549	
0.00006885	2417.	35100995.	7.1000000	14.0344130	
0.00007377	2589.	35100995.	7.1000000	15.0368710	
0.00007869	2762.	35100995.	7.1000000	16.0393291	
0.00008360	2935.	35100995.	7.1000000	17.0417872	
0.00008852	3107.	35100995.	7.1000000	18.0442452	
0.00009344	3280.	35100995.	7.1000000	19.0467033	
0.00009836	3452.	35100995.	7.1000000	20.0491614	
0.0001033	3625.	35100995.	7.1000000	21.0516194	
0.0001082	3798.	35100995.	7.1000000	22.0540775	
0.0001131	3970.	35100995.	7.1000000	23.0565356	
0.0001180	4143.	35100995.	7.1000000	24.0589936	
0.0001229	4316.	35100995.	7.1000000	25.0614517	
0.0001279	4488.	35100995.	7.1000000	26.0639098	
0.0001328	4661.	35100995.	7.1000000	27.0663678	
0.0001377	4833.	35100995.	7.1000000	28.0688259	
0.0001426	5006.	35100995.	7.1000000	29.0712840	
0.0001475	5179.	35100995.	7.1000000	30.0737420	
0.0001525	5351.	35100995.	7.1000000	31.0762001	
0.0001574	5524.	35100995.	7.1000000	32.0786582	
0.0001623	5696.	35100995.	7.1000000	33.0811162	
0.0001672	5869.	35100995.	7.1000000	34.0835743	
0.0001721	6042.	35100995.	7.1000000	35.0860324	
0.0001770	6214.	35100995.	7.1000000	36.0884904	
0.0001820	6387.	35100995.	7.1000000	37.0909485	
0.0001869	6560.	35100995.	7.1000000	38.0934066	
0.0001918	6732.	35100995.	7.1000000	39.0958647	
0.0002016	7077.	35100995.	7.1000000	41.1007808	
0.0002115	7423.	35100995.	7.1000000	43.1056969	
0.0002213	7768.	35100995.	7.1000000	45.1106131	
0.0002311	8113.	35100995.	7.1000000	47.1155292	
0.0002410	8458.	35100995.	7.1000000	49.1204453	
0.0002508	8768.	34956786.	7.1000000	50.0000000	Y
0.0002606	8968.	34406082.	7.1000000	50.0000000	Y
0.0002705	9073.	33542198.	7.1000000	50.0000000	Y
0.0002803	9118.	32525814.	7.1000000	50.0000000	Y
0.0002902	9151.	31539616.	7.1000000	50.0000000	Y
0.0003000	9182.	30607932.	7.1000000	50.0000000	Y
0.0003098	9210.	29725136.	7.1000000	50.0000000	Y
0.0003197	9235.	28889181.	7.1000000	50.0000000	Y
0.0003295	9258.	28096536.	7.1000000	50.0000000	Y
0.0003393	9279.	27344053.	7.1000000	50.0000000	Y
0.0003492	9298.	26628906.	7.1000000	50.0000000	Y

0.0003590	9316.	25948550.	7.1000000	50.0000000	Y
0.0003688	9332.	25300683.	7.1000000	50.0000000	Y
0.0003787	9347.	24683214.	7.1000000	50.0000000	Y
0.0003885	9361.	24094238.	7.1000000	50.0000000	Y
0.0003983	9374.	23532010.	7.1000000	50.0000000	Y
0.0004082	9386.	22993958.	7.1000000	50.0000000	Y
0.0004180	9397.	22479436.	7.1000000	50.0000000	Y
0.0004279	9407.	21987182.	7.1000000	50.0000000	Y
0.0004377	9417.	21515064.	7.1000000	50.0000000	Y
0.0004475	9426.	21062342.	7.1000000	50.0000000	Y
0.0004574	9435.	20628245.	7.1000000	50.0000000	Y
0.0004672	9442.	20210614.	7.1000000	50.0000000	Y
0.0004770	9450.	19809883.	7.1000000	50.0000000	Y
0.0004869	9457.	19423744.	7.1000000	50.0000000	Y
0.0004967	9464.	19052717.	7.1000000	50.0000000	Y
0.0005065	9470.	18694718.	7.1000000	50.0000000	Y
0.0005164	9476.	18350357.	7.1000000	50.0000000	Y
0.0005262	9481.	18017531.	7.1000000	50.0000000	Y
0.0005360	9486.	17696878.	7.1000000	50.0000000	Y
0.0005459	9491.	17387006.	7.1000000	50.0000000	Y
0.0005557	9496.	17087665.	7.1000000	50.0000000	Y
0.0005656	9501.	16798647.	7.1000000	50.0000000	Y
0.0005754	9505.	16518541.	7.1000000	50.0000000	Y
0.0005852	9509.	16247851.	7.1000000	50.0000000	Y
0.0006246	9523.	15247286.	7.1000000	50.0000000	Y
0.0006639	9535.	14361320.	7.1000000	50.0000000	Y
0.0007033	9544.	13571868.	7.1000000	50.0000000	Y
0.0007426	9553.	12864088.	7.1000000	50.0000000	Y
0.0007819	9560.	12226014.	7.1000000	50.0000000	Y
0.0008213	9566.	11647588.	7.1000000	50.0000000	Y
0.0008606	9571.	11121235.	7.1000000	50.0000000	Y
0.0009000	9576.	10640384.	7.1000000	50.0000000	Y
0.0009393	9580.	10198808.	7.1000000	50.0000000	Y
0.0009787	9584.	9792580.	7.1000000	50.0000000	Y
0.0010180	9587.	9417093.	7.1000000	50.0000000	Y
0.0010573	9590.	9069525.	7.1000000	50.0000000	Y
0.0010967	9592.	8746284.	7.1000000	50.0000000	Y
0.0011360	9594.	8445432.	7.1000000	50.0000000	Y
0.0011754	9596.	8164483.	7.1000000	50.0000000	Y
0.0012147	9598.	7901486.	7.1000000	50.0000000	Y

Summary of Results for Nominal Moment Capacity for Section 2

Load No.	Axial Thrust kips	Nominal Moment Capacity in-kips
1	0.00000000	9598.

Note that the values in the above table are not factored by a strength reduction factor for LRFD.

The value of the strength reduction factor depends on the provisions of the LRFD code being followed.

The above values should be multiplied by the appropriate strength reduction factor to compute ultimate moment capacity according to the LRFD structural design standard being followed.

Computed Values of Pile Loading and Deflection
for Lateral Loading for Load Case Number 1

Pile-head conditions are Shear and Moment (Loading Type 1)

Shear force at pile head = 0.0 lbs
Applied moment at pile head = 0.0 in-lbs
Axial thrust load on pile head = 0.0 lbs

Depth X feet	Deflect. y inches	Bending Moment in-lbs	Shear Force lbs	Slope S radians	Total Stress psi*	Bending Stiffness lb-in^2	Soil Res. p lb/inch	Soil Spr. Es*H lb/inch	Distrib. Lat. Load lb/inch
0.00	1.5115	-5.53E-06	0.00	-0.00902	4.01E-08	2.95E+10	0.00	0.00	57.2666
0.2400	1.4855	237.4961	172.1276	-0.00902	1.7225	2.95E+10	0.00	0.00	62.2665
0.4800	1.4595	991.4551	361.0547	-0.00902	7.1906	2.95E+10	0.00	0.00	68.9329
0.7200	1.4335	2317.	569.1813	-0.00902	16.8054	2.95E+10	0.00	0.00	75.5994
0.9600	1.4075	4270.	796.5072	-0.00902	30.9679	2.95E+10	0.00	0.00	82.2658
1.2000	1.3816	6905.	1043.	-0.00902	50.0792	2.95E+10	0.00	0.00	88.9323
1.4400	1.3556	10278.	1309.	-0.00902	74.5403	2.95E+10	0.00	0.00	95.5988
1.6800	1.3296	14443.	1594.	-0.00902	104.7521	2.95E+10	0.00	0.00	102.2652
1.9200	1.3036	19457.	1898.	-0.00902	141.1158	2.95E+10	0.00	0.00	108.9317
2.1600	1.2776	25375.	2221.	-0.00902	184.0323	2.95E+10	0.00	0.00	115.5982
2.4000	1.2517	32251.	2564.	-0.00901	233.9027	2.95E+10	0.00	0.00	122.2646
2.6400	1.2257	40141.	2925.	-0.00901	291.1279	2.95E+10	0.00	0.00	128.9311
2.8800	1.1998	49101.	3306.	-0.00901	356.1091	2.95E+10	0.00	0.00	135.5975
3.1200	1.1738	59186.	3706.	-0.00900	429.2472	2.95E+10	0.00	0.00	142.2640
3.3600	1.1479	70450.	4126.	-0.00899	510.9433	2.95E+10	0.00	0.00	148.9305
3.6000	1.1220	82950.	4564.	-0.00899	601.5984	2.95E+10	0.00	0.00	155.5969
3.8400	1.0961	96740.	5022.	-0.00898	701.6135	2.95E+10	0.00	0.00	162.2634
4.0800	1.0703	111877.	5499.	-0.00897	811.3896	2.95E+10	0.00	0.00	168.9298
4.3200	1.0445	128414.	5995.	-0.00896	931.3278	2.95E+10	0.00	0.00	175.5963
4.5600	1.0187	146408.	6510.	-0.00894	1062.	2.95E+10	0.00	0.00	182.2628
4.8000	0.9930	165913.	7045.	-0.00893	1203.	2.95E+10	0.00	0.00	188.9292
5.0400	0.9673	186986.	7599.	-0.00891	1356.	2.95E+10	0.00	0.00	195.5957
5.2800	0.9416	209681.	8171.	-0.00889	1521.	2.95E+10	0.00	0.00	202.2622
5.5200	0.9161	234054.	8764.	-0.00887	1697.	2.95E+10	0.00	0.00	208.9286
5.7600	0.8906	260159.	9375.	-0.00885	1887.	2.95E+10	0.00	0.00	215.5951
6.0000	0.8651	288053.	10005.	-0.00882	2089.	2.95E+10	0.00	0.00	222.2615
6.2400	0.8398	317791.	10655.	-0.00879	2305.	2.95E+10	0.00	0.00	228.9280
6.4800	0.8145	349427.	11324.	-0.00876	2534.	2.95E+10	0.00	0.00	235.5945
6.7200	0.7893	383017.	12012.	-0.00872	2778.	2.95E+10	0.00	0.00	242.2609
6.9600	0.7643	418617.	12719.	-0.00868	3036.	2.95E+10	0.00	0.00	248.9274
7.2000	0.7393	456281.	13446.	-0.00864	3309.	2.95E+10	0.00	0.00	255.5938
7.4400	0.7145	496066.	14192.	-0.00859	3598.	2.95E+10	0.00	0.00	262.2603
7.6800	0.6898	538025.	14957.	-0.00854	3902.	2.95E+10	0.00	0.00	268.9268
7.9200	0.6653	582215.	15741.	-0.00849	4223.	2.95E+10	0.00	0.00	275.5932
8.1600	0.6409	628692.	16544.	-0.00843	4560.	2.95E+10	0.00	0.00	282.2597
8.4000	0.6167	677509.	17367.	-0.00837	4914.	2.95E+10	0.00	0.00	288.9262
8.6400	0.5927	728723.	18208.	-0.00830	5285.	2.95E+10	0.00	0.00	295.5926
8.8800	0.5689	782388.	19069.	-0.00822	5674.	2.95E+10	0.00	0.00	302.2591
9.1200	0.5454	838561.	19949.	-0.00814	6082.	2.95E+10	0.00	0.00	308.9255
9.3600	0.5220	897296.	20849.	-0.00806	6508.	2.95E+10	0.00	0.00	315.5920
9.6000	0.4989	958649.	21767.	-0.00797	6953.	2.95E+10	0.00	0.00	322.2585
9.8400	0.4761	1022674.	22705.	-0.00787	7417.	2.95E+10	0.00	0.00	328.9249
10.0800	0.4536	1089428.	23662.	-0.00777	7901.	2.95E+10	0.00	0.00	335.5914
10.3200	0.4314	1158965.	24638.	-0.00766	8405.	2.95E+10	0.00	0.00	342.2578
10.5600	0.4095	1231341.	25633.	-0.00754	8930.	2.95E+10	0.00	0.00	348.9243
10.8000	0.3879	1306612.	26648.	-0.00742	9476.	2.95E+10	0.00	0.00	355.5908
11.0400	0.3668	1384831.	27681.	-0.00729	10044.	2.95E+10	0.00	0.00	362.2572
11.2800	0.3460	1466056.	28734.	-0.00715	10633.	2.95E+10	0.00	0.00	368.9237
11.5200	0.3256	1550340.	29806.	-0.00700	11244.	2.95E+10	0.00	0.00	375.5902
11.7600	0.3056	1637740.	30898.	-0.00685	11878.	2.95E+10	0.00	0.00	382.2566
12.0000	0.2861	1728310.	32008.	-0.00668	12535.	2.95E+10	0.00	0.00	388.9231
12.2400	0.2671	1822106.	33138.	-0.00651	13215.	2.95E+10	0.00	0.00	395.5895
12.4800	0.2487	1919184.	34287.	-0.00633	13919.	2.95E+10	0.00	0.00	402.2560
12.7200	0.2307	2019597.	35455.	-0.00613	14647.	2.95E+10	0.00	0.00	408.9225
12.9600	0.2133	2123403.	36442.	-0.00593	15400.	2.95E+10	0.00	0.00	276.3186

13.2000	0.1965	2229501.	36839.	-0.00574	27412.	3.51E+10	0.00	0.00	0.00
13.4400	0.1803	2335598.	36839.	-0.00555	28716.	3.51E+10	0.00	0.00	0.00
13.6800	0.1646	2441695.	36839.	-0.00535	30021.	3.51E+10	0.00	0.00	0.00
13.9200	0.1494	2547793.	36839.	-0.00515	31325.	3.51E+10	0.00	0.00	0.00
14.1600	0.1349	2653890.	36839.	-0.00494	32630.	3.51E+10	0.00	0.00	0.00
14.4000	0.1210	2759988.	36839.	-0.00471	33934.	3.51E+10	0.00	0.00	0.00
14.6400	0.1078	2866085.	36839.	-0.00448	35239.	3.51E+10	0.00	0.00	0.00
14.8800	0.09518	2972183.	36839.	-0.00424	36543.	3.51E+10	0.00	0.00	0.00
15.1200	0.08332	3078280.	36839.	-0.00400	37848.	3.51E+10	0.00	0.00	0.00
15.3600	0.07217	3184378.	36839.	-0.00374	39152.	3.51E+10	0.00	0.00	0.00
15.6000	0.06178	3290475.	36839.	-0.00347	40457.	3.51E+10	0.00	0.00	0.00
15.8400	0.05217	3396573.	36839.	-0.00320	41761.	3.51E+10	0.00	0.00	0.00
16.0800	0.04336	3502670.	27118.	-0.00292	43066.	3.51E+10	-6751.	448365.	0.00
16.3200	0.03538	3552775.	7703.	-0.00263	43682.	3.51E+10	-6732.	548029.	0.00
16.5600	0.02824	3547037.	-11586.	-0.00233	43611.	3.51E+10	-6663.	679515.	0.00
16.8000	0.02193	3486038.	-30592.	-0.00205	42861.	3.51E+10	-6536.	858147.	0.00
17.0400	0.01645	3370830.	-49138.	-0.00176	41445.	3.51E+10	-6344.	1110391.	0.00
17.2800	0.01177	3203005.	-67020.	-0.00149	39381.	3.51E+10	-6074.	1486381.	0.00
17.5200	0.00784	2984796.	-83471.	-0.00124	36698.	3.51E+10	-5350.	1964544.	0.00
17.7600	0.00462	2722213.	-95884.	-0.00101	33470.	3.51E+10	-3271.	2038272.	0.00
18.0000	0.00204	2432503.	-102751.	-7.95E-04	29908.	3.51E+10	-1498.	2112000.	0.00
18.2400	3.93E-05	2130368.	-104951.	-6.08E-04	26193.	3.51E+10	-29.793	2185728.	0.00
18.4800	-0.00146	1827985.	-103344.	-4.46E-04	22475.	3.51E+10	1146.	2259456.	0.00
18.7200	-0.00253	1535108.	-98743.	-3.08E-04	18874.	3.51E+10	2049.	2333184.	0.00
18.9600	-0.00323	1259226.	-91900.	-1.93E-04	15482.	3.51E+10	2703.	2406912.	0.00
19.2000	-0.00364	1005766.	-83489.	-1.00E-04	12366.	3.51E+10	3137.	2480640.	0.00
19.4400	-0.00381	778328.	-74102.	-2.72E-05	9570.	3.51E+10	3382.	2554368.	0.00
19.6800	-0.00380	578939.	-64240.	2.85E-05	7118.	3.51E+10	3467.	2628096.	0.00
19.9200	-0.00365	408304.	-54319.	6.90E-05	5020.	3.51E+10	3423.	2701824.	0.00
20.1600	-0.00340	266059.	-44670.	9.67E-05	3271.	3.51E+10	3278.	2775552.	0.00
20.4000	-0.00309	151005.	-35545.	1.14E-04	1857.	3.51E+10	3059.	2849280.	0.00
20.6400	-0.00275	61321.	-27186.	1.22E-04	753.9420	3.51E+10	2746.	2880000.	0.00
20.8800	-0.00239	-5586.	-19795.	1.25E-04	68.6758	3.51E+10	2386.	2880000.	0.00
21.1200	-0.00203	-52700.	-13440.	1.22E-04	647.9519	3.51E+10	2027.	2880000.	0.00
21.3600	-0.00168	-82998.	-8099.	1.17E-04	1020.	3.51E+10	1681.	2880000.	0.00
21.6000	-0.00135	-99351.	-3728.	1.09E-04	1222.	3.51E+10	1355.	2880000.	0.00
21.8400	-0.00105	-104468.	-262.826	1.01E-04	1284.	3.51E+10	1051.	2880000.	0.00
22.0800	-7.73E-04	-100865.	2364.	9.26E-05	1240.	3.51E+10	772.9785	2880000.	0.00
22.3200	-5.18E-04	-90850.	4224.	8.47E-05	1117.	3.51E+10	518.3466	2880000.	0.00
22.5600	-2.85E-04	-76535.	5381.	7.78E-05	941.0098	3.51E+10	285.1826	2880000.	0.00
22.8000	-7.01E-05	-59856.	5893.	7.22E-05	735.9303	3.51E+10	70.1040	2880000.	0.00
23.0400	1.31E-04	-42594.	5805.	6.80E-05	523.7016	3.51E+10	-130.831	2880000.	0.00
23.2800	3.22E-04	-26418.	5153.	6.52E-05	324.8150	3.51E+10	-321.700	2880000.	0.00
23.5200	5.06E-04	-12910.	3961.	6.36E-05	158.7356	3.51E+10	-506.327	2880000.	0.00
23.7600	6.88E-04	-3602.	2241.	6.29E-05	44.2915	3.51E+10	-687.903	2880000.	0.00
24.0000	8.69E-04	0.00	0.00	6.28E-05	0.00	3.51E+10	-868.628	1440000.	0.00

* This analysis computed pile response using nonlinear moment-curvature relationships. Values of total stress due to combined axial and bending stresses are computed only for elastic sections only and do not equal the actual stresses in concrete and steel. Stresses in concrete and steel may be interpolated from the output for nonlinear bending properties relative to the magnitude of bending moment developed in the pile.

Output Summary for Load Case No. 1:

```
Pile-head deflection             =     1.51149645 inches
Computed slope at pile head      =     -0.0090243 radians
Maximum bending moment           =       3552775. inch-lbs
Maximum shear force              =       -104951. lbs
Depth of maximum bending moment  =    16.32000000 feet below pile head
Depth of maximum shear force     =    18.24000000 feet below pile head
Number of iterations             =             16
Number of zero deflection points =              2
Pile deflection at ground        =     0.21052112 inches
```

Computed Values of Pile Loading and Deflection
for Lateral Loading for Load Case Number 2

Pile-head conditions are Shear and Moment (Loading Type 1)

Shear force at pile head = 0.0 lbs
Applied moment at pile head = 0.0 in-lbs
Axial thrust load on pile head = 0.0 lbs

Depth X feet	Deflect. y inches	Bending Moment in-lbs	Shear Force lbs	Slope S radians	Total Stress psi*	Bending Stiffness lb-in^2	Soil Res. p lb/inch	Soil Spr. Es*H lb/inch	Distrib. Lat. Load lb/inch
0.00	2.3994	-3.64E-05	0.00	-0.01412	2.64E-07	2.95E+10	0.00	0.00	85.8002
0.2400	2.3587	355.8304	257.9051	-0.01412	2.5807	2.95E+10	0.00	0.00	93.3006
0.4800	2.3180	1486.	541.0118	-0.01412	10.7739	2.95E+10	0.00	0.00	103.3012
0.7200	2.2774	3472.	852.9202	-0.01412	25.1813	2.95E+10	0.00	0.00	113.3018
0.9600	2.2367	6398.	1194.	-0.01412	46.4044	2.95E+10	0.00	0.00	123.3025
1.2000	2.1960	10347.	1563.	-0.01412	75.0448	2.95E+10	0.00	0.00	133.3031
1.4400	2.1554	15402.	1961.	-0.01412	111.7041	2.95E+10	0.00	0.00	143.3037
1.6800	2.1147	21645.	2389.	-0.01412	156.9840	2.95E+10	0.00	0.00	153.3043
1.9200	2.0740	29160.	2844.	-0.01412	211.4859	2.95E+10	0.00	0.00	163.3049
2.1600	2.0334	38030.	3329.	-0.01411	275.8115	2.95E+10	0.00	0.00	173.3055
2.4000	1.9928	48336.	3843.	-0.01411	350.5625	2.95E+10	0.00	0.00	183.3062
2.6400	1.9521	60164.	4385.	-0.01410	436.3403	2.95E+10	0.00	0.00	193.3068
2.8800	1.9115	73594.	4956.	-0.01410	533.7465	2.95E+10	0.00	0.00	203.3074
3.1200	1.8709	88711.	5556.	-0.01409	643.3829	2.95E+10	0.00	0.00	213.3080
3.3600	1.8304	105598.	6185.	-0.01408	765.8508	2.95E+10	0.00	0.00	223.3086
3.6000	1.7898	124336.	6842.	-0.01407	901.7521	2.95E+10	0.00	0.00	233.3092
3.8400	1.7493	145009.	7529.	-0.01405	1052.	2.95E+10	0.00	0.00	243.3098
4.0800	1.7089	167701.	8244.	-0.01404	1216.	2.95E+10	0.00	0.00	253.3105
4.3200	1.6685	192494.	8988.	-0.01402	1396.	2.95E+10	0.00	0.00	263.3111
4.5600	1.6281	219471.	9760.	-0.01400	1592.	2.95E+10	0.00	0.00	273.3117
4.8000	1.5878	248714.	10562.	-0.01398	1804.	2.95E+10	0.00	0.00	283.3123
5.0400	1.5476	280308.	11392.	-0.01395	2033.	2.95E+10	0.00	0.00	293.3129
5.2800	1.5075	314334.	12252.	-0.01392	2280.	2.95E+10	0.00	0.00	303.3135
5.5200	1.4674	350877.	13139.	-0.01389	2545.	2.95E+10	0.00	0.00	313.3142
5.7600	1.4274	390018.	14056.	-0.01386	2829.	2.95E+10	0.00	0.00	323.3148
6.0000	1.3876	431840.	15002.	-0.01382	3132.	2.95E+10	0.00	0.00	333.3154
6.2400	1.3479	476428.	15976.	-0.01377	3455.	2.95E+10	0.00	0.00	343.3160
6.4800	1.3083	523863.	16979.	-0.01372	3799.	2.95E+10	0.00	0.00	353.3166
6.7200	1.2688	574228.	18011.	-0.01367	4165.	2.95E+10	0.00	0.00	363.3172
6.9600	1.2295	627607.	19072.	-0.01361	4552.	2.95E+10	0.00	0.00	373.3178
7.2000	1.1904	684083.	20162.	-0.01355	4961.	2.95E+10	0.00	0.00	383.3185
7.4400	1.1515	743738.	21280.	-0.01348	5394.	2.95E+10	0.00	0.00	393.3191
7.6800	1.1128	806655.	22427.	-0.01340	5850.	2.95E+10	0.00	0.00	403.3197
7.9200	1.0743	872917.	23603.	-0.01332	6331.	2.95E+10	0.00	0.00	413.3203
8.1600	1.0361	942608.	24808.	-0.01323	6836.	2.95E+10	0.00	0.00	423.3209
8.4000	0.9981	1015810.	26041.	-0.01313	7367.	2.95E+10	0.00	0.00	433.3215
8.6400	0.9604	1092606.	27304.	-0.01303	7924.	2.95E+10	0.00	0.00	443.3222
8.8800	0.9231	1173079.	28595.	-0.01292	8508.	2.95E+10	0.00	0.00	453.3228
9.1200	0.8860	1257313.	29915.	-0.01280	9119.	2.95E+10	0.00	0.00	463.3234
9.3600	0.8493	1345389.	31264.	-0.01268	9757.	2.95E+10	0.00	0.00	473.3240
9.6000	0.8130	1437391.	32641.	-0.01254	10425.	2.95E+10	0.00	0.00	483.3246
9.8400	0.7771	1533402.	34048.	-0.01240	11121.	2.95E+10	0.00	0.00	493.3252
10.0800	0.7416	1633505.	35483.	-0.01224	11847.	2.95E+10	0.00	0.00	503.3258
10.3200	0.7066	1737783.	36947.	-0.01208	12603.	2.95E+10	0.00	0.00	513.3265
10.5600	0.6720	1846318.	38439.	-0.01190	13391.	2.95E+10	0.00	0.00	523.3271
10.8000	0.6380	1959194.	39961.	-0.01172	14209.	2.95E+10	0.00	0.00	533.3277
11.0400	0.6046	2076494.	41511.	-0.01152	15060.	2.95E+10	0.00	0.00	543.3283
11.2800	0.5717	2198300.	43091.	-0.01131	15943.	2.95E+10	0.00	0.00	553.3289
11.5200	0.5394	2324696.	44699.	-0.01109	16860.	2.95E+10	0.00	0.00	563.3295
11.7600	0.5078	2455764.	46335.	-0.01086	17811.	2.95E+10	0.00	0.00	573.3302
12.0000	0.4769	2591588.	48001.	-0.01061	18796.	2.95E+10	0.00	0.00	583.3308
12.2400	0.4467	2732250.	49695.	-0.01035	19816.	2.95E+10	0.00	0.00	593.3314
12.4800	0.4172	2877833.	51419.	-0.01008	20872.	2.95E+10	0.00	0.00	603.3320
12.7200	0.3886	3028421.	53171.	-0.00979	21964.	2.95E+10	0.00	0.00	613.3326

12.9600	0.3609	3184096.	54651.	-0.00949	23093.	2.95E+10	0.00	0.00	414.4443
13.2000	0.3340	3343209.	55247.	-0.00919	41105.	3.51E+10	0.00	0.00	0.00
13.4400	0.3079	3502321.	55247.	-0.00891	43061.	3.51E+10	0.00	0.00	0.00
13.6800	0.2826	3661434.	55247.	-0.00862	45018.	3.51E+10	0.00	0.00	0.00
13.9200	0.2583	3820546.	55247.	-0.00831	46974.	3.51E+10	0.00	0.00	0.00
14.1600	0.2348	3979659.	55247.	-0.00799	48930.	3.51E+10	0.00	0.00	0.00
14.4000	0.2122	4138771.	55247.	-0.00766	50887.	3.51E+10	0.00	0.00	0.00
14.6400	0.1907	4297884.	55247.	-0.00731	52843.	3.51E+10	0.00	0.00	0.00
14.8800	0.1701	4456996.	55247.	-0.00695	54799.	3.51E+10	0.00	0.00	0.00
15.1200	0.1506	4616109.	55247.	-0.00658	56755.	3.51E+10	0.00	0.00	0.00
15.3600	0.1322	4775221.	55247.	-0.00620	58712.	3.51E+10	0.00	0.00	0.00
15.6000	0.1149	4934334.	55247.	-0.00580	60668.	3.51E+10	0.00	0.00	0.00
15.8400	0.09879	5093446.	55247.	-0.00539	62624.	3.51E+10	0.00	0.00	0.00
16.0800	0.08388	5252559.	43783.	-0.00496	64581.	3.51E+10	-7961.	273350.	0.00
16.3200	0.07021	5345637.	20813.	-0.00453	65725.	3.51E+10	-7991.	327777.	0.00
16.5600	0.05780	5372439.	-2169.	-0.00409	66055.	3.51E+10	-7969.	397071.	0.00
16.8000	0.04666	5333142.	-25011.	-0.00365	65571.	3.51E+10	-7893.	487151.	0.00
17.0400	0.03679	5228376.	-47547.	-0.00322	64283.	3.51E+10	-7757.	607309.	0.00
17.2800	0.02814	5059271.	-69594.	-0.00279	62204.	3.51E+10	-7554.	772986.	0.00
17.5200	0.02070	4827514.	-90942.	-0.00239	59355.	3.51E+10	-7272.	1011895.	0.00
17.7600	0.01439	4535443.	-111339.	-0.00200	55764.	3.51E+10	-6893.	1379527.	0.00
18.0000	0.00916	4186201.	-130933.	-0.00165	51470.	3.51E+10	-6714.	2112000.	0.00
18.2400	0.00491	3781269.	-145968.	-0.00132	46491.	3.51E+10	-3727.	2185728.	0.00
18.4800	0.00156	3345425.	-153096.	-0.00103	41132.	3.51E+10	-1223.	2259456.	0.00
18.7200	-0.00100	2899438.	-153687.	-7.70E-04	35649.	3.51E+10	811.9800	2333184.	0.00
18.9600	-0.00288	2460186.	-149054.	-5.50E-04	30248.	3.51E+10	2405.	2406912.	0.00
19.2000	-0.00417	2040886.	-140415.	-3.66E-04	25093.	3.51E+10	3594.	2480640.	0.00
19.4400	-0.00499	1651398.	-128872.	-2.14E-04	20304.	3.51E+10	4422.	2554368.	0.00
19.6800	-0.00541	1298584.	-115399.	-9.33E-05	15966.	3.51E+10	4934.	2628096.	0.00
19.9200	-0.00552	986698.	-100833.	4.50E-07	12132.	3.51E+10	5181.	2701824.	0.00
20.1600	-0.00540	717786.	-85872.	7.04E-05	8825.	3.51E+10	5209.	2775552.	0.00
20.4000	-0.00512	492077.	-71081.	1.20E-04	6050.	3.51E+10	5063.	2849280.	0.00
20.6400	-0.00471	308361.	-57003.	1.53E-04	3791.	3.51E+10	4714.	2880000.	0.00
20.8800	-0.00424	163741.	-44114.	1.72E-04	2013.	3.51E+10	4237.	2880000.	0.00
21.1200	-0.00372	54263.	-32654.	1.81E-04	667.1707	3.51E+10	3722.	2880000.	0.00
21.3600	-0.00319	-24346.	-22696.	1.82E-04	299.3360	3.51E+10	3193.	2880000.	0.00
21.6000	-0.00267	-76468.	-14251.	1.78E-04	940.1744	3.51E+10	2671.	2880000.	0.00
21.8400	-0.00217	-106434.	-7285.	1.71E-04	1309.	3.51E+10	2167.	2880000.	0.00
22.0800	-0.00169	-118429.	-1735.	1.62E-04	1456.	3.51E+10	1688.	2880000.	0.00
22.3200	-0.00124	-116427.	2476.	1.52E-04	1431.	3.51E+10	1236.	2880000.	0.00
22.5600	-8.13E-04	-104170.	5426.	1.43E-04	1281.	3.51E+10	812.6855	2880000.	0.00
22.8000	-4.14E-04	-85172.	7192.	1.35E-04	1047.	3.51E+10	413.6239	2880000.	0.00
23.0400	-3.47E-05	-62744.	7838.	1.29E-04	771.4406	3.51E+10	34.6886	2880000.	0.00
23.2800	3.29E-04	-40028.	7413.	1.25E-04	492.1422	3.51E+10	-329.420	2880000.	0.00
23.5200	6.84E-04	-20044.	5954.	1.22E-04	246.4383	3.51E+10	-684.071	2880000.	0.00
23.7600	0.00103	-5734.	3480.	1.21E-04	70.4961	3.51E+10	-1034.	2880000.	0.00
24.0000	0.00138	0.00	0.00	1.21E-04	0.00	3.51E+10	-1383.	1440000.	0.00

* This analysis computed pile response using nonlinear moment-curvature relationships. Values of total stress due to combined axial and bending stresses are computed only for elastic sections only and do not equal the actual stresses in concrete and steel. Stresses in concrete and steel may be interpolated from the output for nonlinear bending properties relative to the magnitude of bending moment developed in the pile.

Output Summary for Load Case No. 2:

```
Pile-head deflection             =     2.39939352 inches
Computed slope at pile head      =     -0.0141228 radians
Maximum bending moment           =       5372439. inch-lbs
Maximum shear force              =       -153687. lbs
Depth of maximum bending moment  =    16.56000000 feet below pile head
Depth of maximum shear force     =    18.72000000 feet below pile head
Number of iterations             =             18
Number of zero deflection points =              2
Pile deflection at ground        =     0.35638214 inches
```

Summary of Pile-head Responses for Conventional Analyses

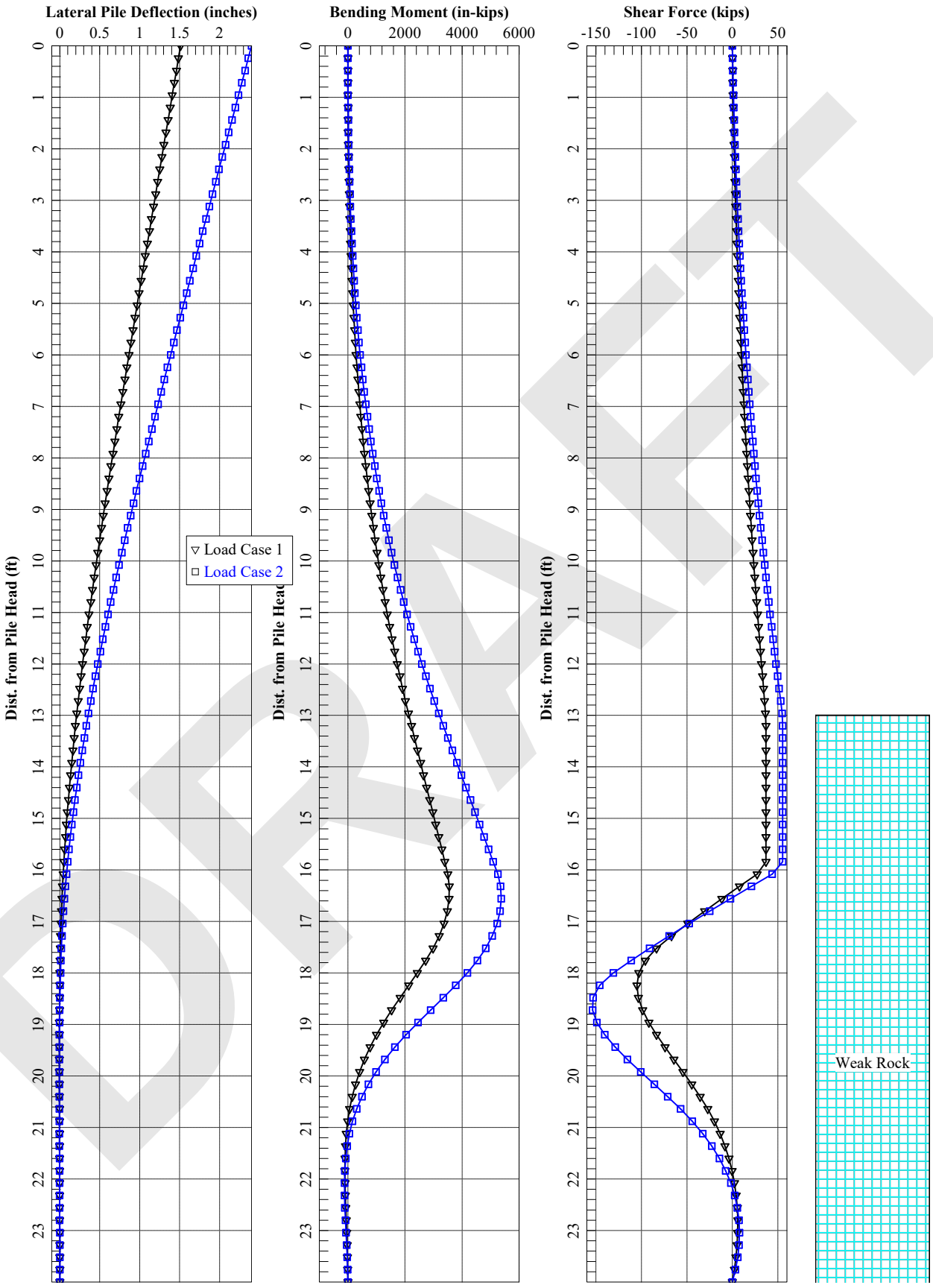
Definitions of Pile-head Loading Conditions:

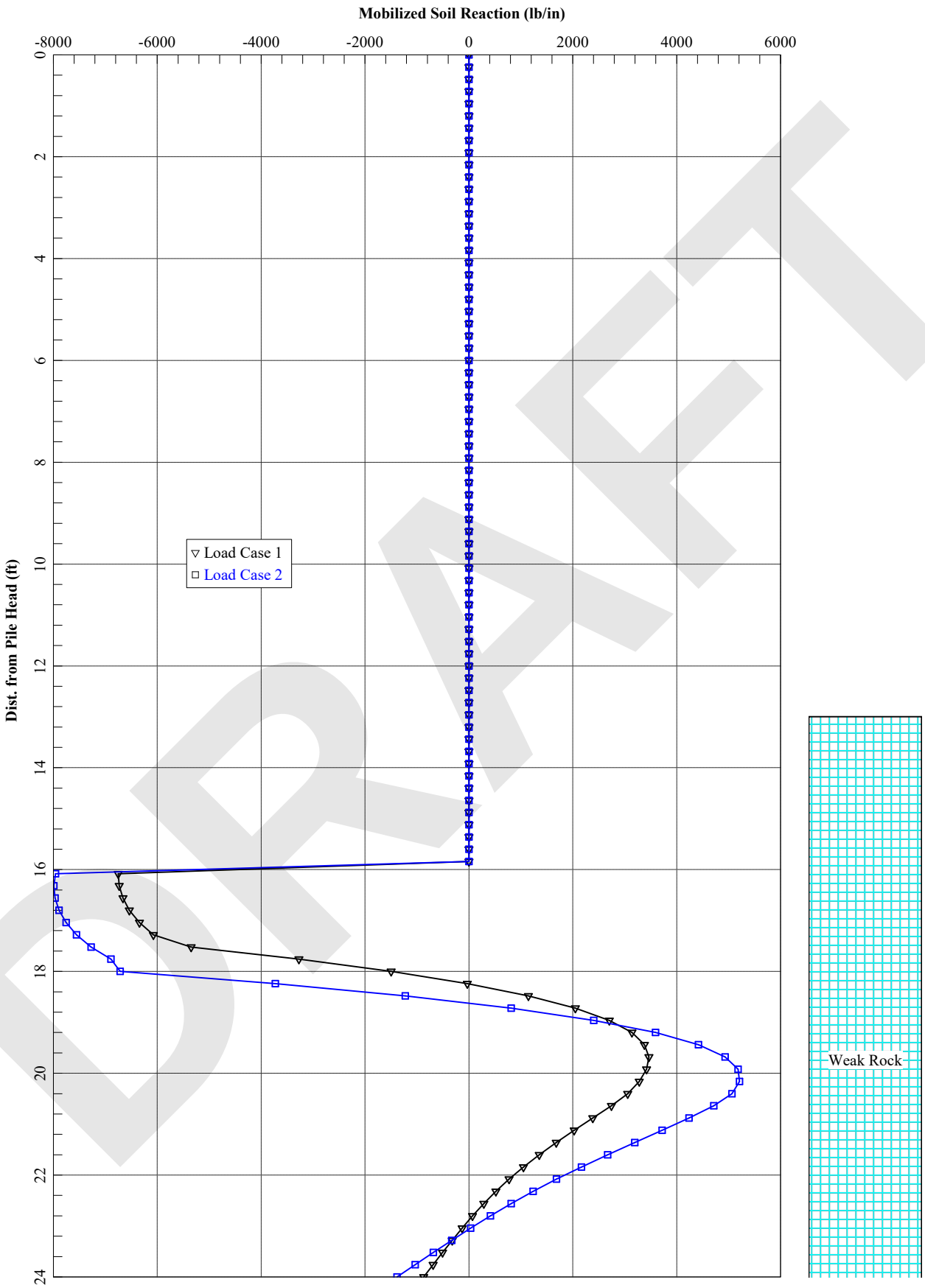
Load Type 1: Load 1 = Shear, V, lbs, and Load 2 = Moment, M, in-lbs
Load Type 2: Load 1 = Shear, V, lbs, and Load 2 = Slope, S, radians
Load Type 3: Load 1 = Shear, V, lbs, and Load 2 = Rot. Stiffness, R, in-lbs/rad.
Load Type 4: Load 1 = Top Deflection, y, inches, and Load 2 = Moment, M, in-lbs
Load Type 5: Load 1 = Top Deflection, y, inches, and Load 2 = Slope, S, radians

Load Case No.	Load Type 1	Pile-head Load 1	Load Type 2	Pile-head Load 2	Axial Loading lbs	Pile-head Deflection inches	Pile-head Rotation radians	Max Shear in Pile lbs	Max Moment in Pile in-lbs
1	V, lb	0.00	M, in-lb	0.00	0.00	1.5115	-0.00902	-104951.	3552775.
2	V, lb	0.00	M, in-lb	0.00	0.00	2.3994	-0.01412	-153687.	5372439.

Maximum pile-head deflection = 2.3993935230 inches
Maximum pile-head rotation = -0.0141227661 radians = -0.809175 deg.

The analysis ended normally.


Lateral Pile Deflection (inches)
0
0.5
1
1.5
2
Bending Moment (in-kips)
0
2000
4000
6000
Shear Force (kips)
-150
-100
-50
0
50
Dist. from Pile Head (ft)
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
Load Case 1
Load Case 2
Weak Rock


Mobilized Soil Reaction (lb/in)
-8000
-6000
-4000
-2000
0
2000
4000
6000
Dist. from Pile Head (ft)
0
2
4
6
8
10
12
14
16
18
20
22
24
Load Case 1
Load Case 2
Weak Rock

References

- ACI (2019). *Building Code Requirements for Structural Concrete* (ACI 318-19).
- AASTHO (2024). *LRFD Bridge Design Specifications, 10th Ed.*

Precast Panel

Unit weight: $\gamma_r := 125$ ***pcf***

Internal angle of friction: $\phi_r := 30$ ***deg***

Slope behind lagging wall: $\beta := 0$ ***deg***

Depth to bottom of lagging from top of soldier pile wall: $z_{lagging} := 13$ ***ft***

Lagging span length: $L := 7$ ***ft***

Lagging panel width: $B := 2$ ***ft***

Lagging panel thickness: $H := 6$ ***in***

A soil surcharge of was applied above the soldier pile wall:

Height of soil surcharge: $h_{eq} := 2$ ***ft***

Soil surcharge: $q := \gamma_r \cdot h_{eq} = 250$ ***psf***

Lateral Loading

Rankine active earth pressure coefficient (inclined at $\beta = 0$ ***deg***):

$$k_a := \cos(\beta)\frac{\cos(\beta) - \sqrt[2]{\cos(\beta)^2 - \cos(\phi_r)^2}}{\cos(\beta) + \sqrt[2]{\cos(\beta)^2 - \cos(\phi_r)^2}} = 0.333$$

Horizontal component of Rankine active earth pressure coefficient:

$k_{a\_h} := k_a \cdot \cos(\beta) = 0.333$

Equivalent fluid weight (horizontal component):

$EFW_h := k_{a\_h} \cdot \gamma_r = 41.7$ ***pcf***

Earth Pressures

Horizontal earth pressure load factor from AASHTO Table 3.4.1.2: $\gamma_{EH} := 1.50$

Unfactored surcharge lateral loading at midpoint of panel:

$\sigma_{surcharge} := k_a \cdot q = 83.3$ ***psf***

Unfactored soil lateral loading at $H = 0.5$ ***ft***:

$$\sigma_{soil} := EFW_h \cdot \left(z_{lagging} - \frac{B}{2}\right) = 500 \text{ } \textbf{\textit{psf}}$$

Unfactored distributed load acting on precast panel:

$w := \left(\sigma_{surcharge} + \sigma_{soil}\right) \cdot B = 1166.7$ ***plf***

Service Load Case:

Maximum unfactored moment for simple span:

$$M_{max} := \frac{w \cdot L^2}{8} = 7145.8 \text{ } \textbf{\textit{lbf} \cdot \textit{ft}} \text{ or } M_{max} = 85.75 \text{ } \textbf{\textit{in} \cdot \textit{kip}}$$

Maximum unfactored shear for simple span:

$$V_{max} := \frac{w \cdot L}{2} = 4083.3 \text{ } \textbf{\textit{lbf}} \text{ or } V_{max} = 4.1 \text{ } \textbf{\textit{kip}}$$

Strength Load Case:

Maximum factored moment for simple span:

$M_u := \gamma_{EH} \cdot M_{max} = 10718.8$ ***lbf*** $\cdot$ ***ft*** or $M_u = 10.7$ ***ft*** $\cdot$ ***kip***

Maximum factored shear for simple span:

$V_u := \gamma_{EH} \cdot V_{max} = 6125$ ***lbf*** or $V_u = 6.1$ ***kip***

Reinforced Concrete Calculations

Refer to attached Excel spreadsheet based on ACI 318-19.

Flexural Resistance

Ultimate moment: $M_u = 10.7$ ***ft•kip***

Factored flexural strength from Excel: $\phi_b M_n := 13.9$ ***ft • kip***

$\phi_b M_n > M_u = 1$ 1 = True (OK), 0 = False (Not OK)

$$CDR_{Flex} := \frac{\phi_b M_n}{M_u} = 1.3$$

Shear Resistance

Ultimate moment: $V_u = 6.1$ ***kip***

Factored shear strength from Excel: $\phi_v V_n := 33.7$ ***kip***

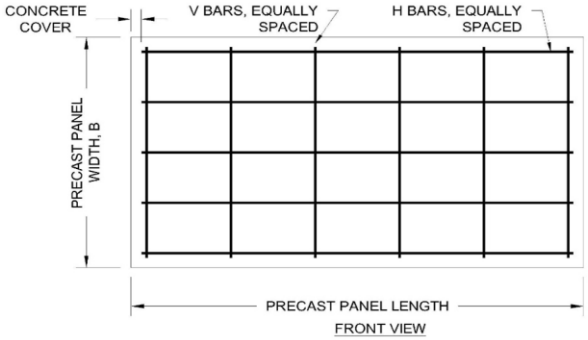
$\phi_v V_n > V_u = 1$ 1 = True (OK), 0 = False (Not OK)

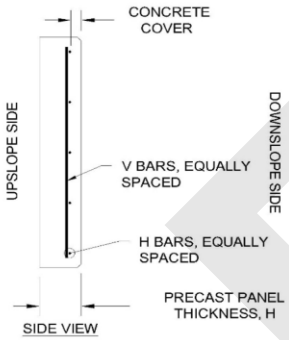
$$CDR_{Shear} := \frac{\phi_v V_n}{V_u} = 5.5$$

PROJECT NO.: N1255021
CLIENT: Choice One Engineering
PROJECT: WAR-SR48-6.65
LOCATION: Loveland, Ohio
DESCRIPTION: Precast Panels w/ 7' Span

Terracon
Date Printed: 9/4/2025
Time Printed: 6:24 PM

REINFORCED CONCRETE DESIGN FOR PRECAST LAGGING (COMPRESSION & FLEXURE)





Bar No.	Bar Diameter (in.)	Bar Area (in.^{2})
3	0.375	0.110
4	0.500	0.196
5	0.625	0.307
6	0.750	0.442
7	0.875	0.601
8	1.000	0.785
9	1.128	1.000
10	1.269	1.266
11	1.410	1.563
14	1.693	2.250
18	2.257	4.000

Width of precast panel, B (in.):	24	
Thickness of precast panel, H (in.):	6	
Length of precast panel, L (in.):	96	
Unit weight of concrete, w_c (pcf):	145	
Concrete strength, f'_c (psi):	4,000	
Maximum compressive concrete strain, ε_c:	0.003	
Modulus of elasticity of concrete, E_c (ksi):	3,644	
Modulus of elasticity of steel, E_s (ksi):	29,000	
Concrete clear cover, c_c (in.):	2	
Yield strength, f_y (ksi):	60,000	
Average lateral stress on precast panel, σ_h (psf):	583	
Uniform load acting on precast panel, w (plf):	1,167	
Lagging clear span length, L_{span} (ft.):	7	
Maximum shear, V_{max} (k):	4.08	
Maximum moment, M_{max} (k-ft.):	7.15	
Load factor, γ_{EH}:	1.50	AASHTO Table 3.4.1.2
Factored shear, V_u (k):	6.13	
Factored moment, M_u (k-ft.):	10.72	

	Longitudinal	Transverse
Bar no.:	5	4
No. of bars:	3	6
Bar spacing (in.):	9.7	18.3
Bar diameter (in.):	0.625	0.5
Cumulative bar area (in.^{2}):	0.920	1.178
Reinforcing steel ratio, ρ:	0.00639	0.00205
Min. reinforcing steel ratio, ρ_{min}:	0.00100	0.00100
Depth of reinforcement from c_c, $d_{e,cc}$ (in.):	3.688	3.125
Depth of reinforcement override, $d_{e,or}$ (in.):	3	2.44
Basis for depth of reinforcement:	Clear cover	
Depth of reinforcement, d_e (in.):	3.688	3.125

Shear Capacity

Gross area of concrete, A_{cv} (in.^{2}):	144.00	
Limiting shear force per ACI 11.5.4.2, V_{lim} (k):	72.9	
ACI 11.5.4.3 coefficient, α_c:	3.0	
Lightweight modification factor, λ:	1	
Nominal shear capacity, V_n (k):	45.0	
Strength reduction factor, ϕ_v:	0.75	ACI 318-19 §21.2.1
Design shear capacity, ϕV_n (k):	**33.7**	OK
Factored shear, V_u (k):	***6.1***	

Flexural Capacity

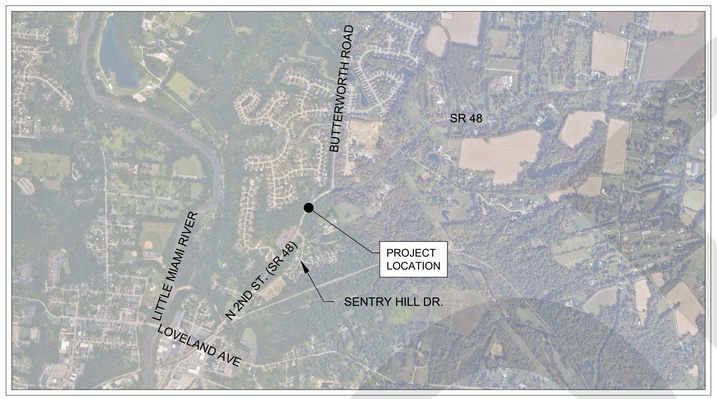
Effective depth of extreme tensile bar, d_t (in.):	3.69	
Depth to neutral axis, c (in.):	0.80	
Min. area of flexural reinf., $A_{s,mln}$ (in.^{2}):	0.30	
Extreme tensile strain, ε_t:	0.011	
Nominal moment capacity, M_n (k-ft.):	15.4	
Strength reduction factor, ϕ_f:	0.900	ACI 318-19 §21.2.2
Design moment capacity, ϕM_n (k-ft.):	**13.9**	OK
Factored moment, M_u (k-ft.):	***10.7***	

Soldier Pile & Lagging Wall Drawings

SOLDIER PILE & LAGGING WALL
WAR-SR48-6.65

CHOICE ONE ENGINEERING CORP
SR-48 AND BUTTERWORTH ROAD
LOVELAND, OHIO

SITE VICINITY MAP



SHEET INDEX

GENERAL DRAWING NOTES

1. THESE PLANS ARE SIZED FOR 34 INCHES BY 22 INCHES PAPER.
2. THESE PLANS ARE INTENDED TO BE PRINTED IN COLOR.
3. THE BID DRAWINGS ARE TO AN APPROXIMATE SCALE BASED ON SITE TOPOGRAPHIC MAPPING. WHILE REASONABLE ATTEMPTS WERE MADE TO PROVIDE THE BIDDERS WITH ACCURATE SCALED PLANS THAT REFLECT CURRENT CONDITIONS, MINOR ERRORS ARE EVIDENT. THE BIDDERS SHOULD VERIFY QUANTITIES BY PERFORMING A THOROUGH SITE VISIT AND OBTAINING HIS OWN TAKE OFF OF REQUIRED QUANTITIES FOR THE WORK ON THE PROJECT. TERRACON WILL NOT BE RESPONSIBLE FOR ADDITIONAL COSTS RESULTING FROM THE BIDDER NOT PERFORMING A THOROUGH SITE VISIT.

REV.	DATE	BY	DESCRIPTION

COVER & TITLE SHEET
WAR-SR48-6.65
CHOICE ONE ENGINEERING CORP
SR-48 AND BUTTERWORTH ROAD
LOVELAND, OHIO

Terracon
Explore with us
611 LUNKEN PARK DRIVE CINCINNATI, OHIO 45226
PH. (513) 321-5816 FAX. (513) 321-4540

SHEET 1

DESIGNED BY:	JDH
DRAWN BY:	RLC
APPVD. BY:	DWW
SCALE:	AS NOTED
DATE:	9/5/2025
JOB NO.	N1255021
SHEET NO.:	1 OF 12

SOLDIER PILE & LAGGING WALL
SPL1 ALIGNMENT

Grading behind wall, 1:1.
Calculations assume level grades.

0+00.00

1+43.22

B-001-0-25

B-002-0-25

16+90, 10'R

B-003-0-25

STATE ROUTE 48

B-004-0-25

19+42, 74'L

SOLDIER PILE & LAGGING WALL
SPL2 ALIGNMENT

19+75, 47'L

1+00.00

19+50, 9'L

19+50, 8'R

grading behind wall is 1:1.
Calculations assume level grading.

B-005-0-25

2+00.00

21+50, 70'L

B-006-0-25

3+00.00

21+80, 32'L

22+05, 6'R

4+00.00

B-007-0-25

5+00.00

24+00, 50'L

23+90, 12'R

5+64.56

B-008-0-25

14+00, 4'R

26+00, 6'R

SENTRY HILL DRIVE

HUNTING FIELDS LANE

HOUNDS RUN

BUTTERWORTH ROAD

LEGEND

INDICATES TEST BORING LOCATIONS

INDICATES PREVIOUSLY DRILLED TEST BORING LOCATIONS

0 25 50 100
SCALE: 1" = 50'

NOTE: BASE MAP DERIVED FROM AUTOCAD FILES PROVIDED BY CHOICE ONE ENGINEERING ON 7/21/2025, 8/18/2025, AND 8/29/2025.

REV.	DATE	BY	DESCRIPTION

OVERALL SITE PLAN

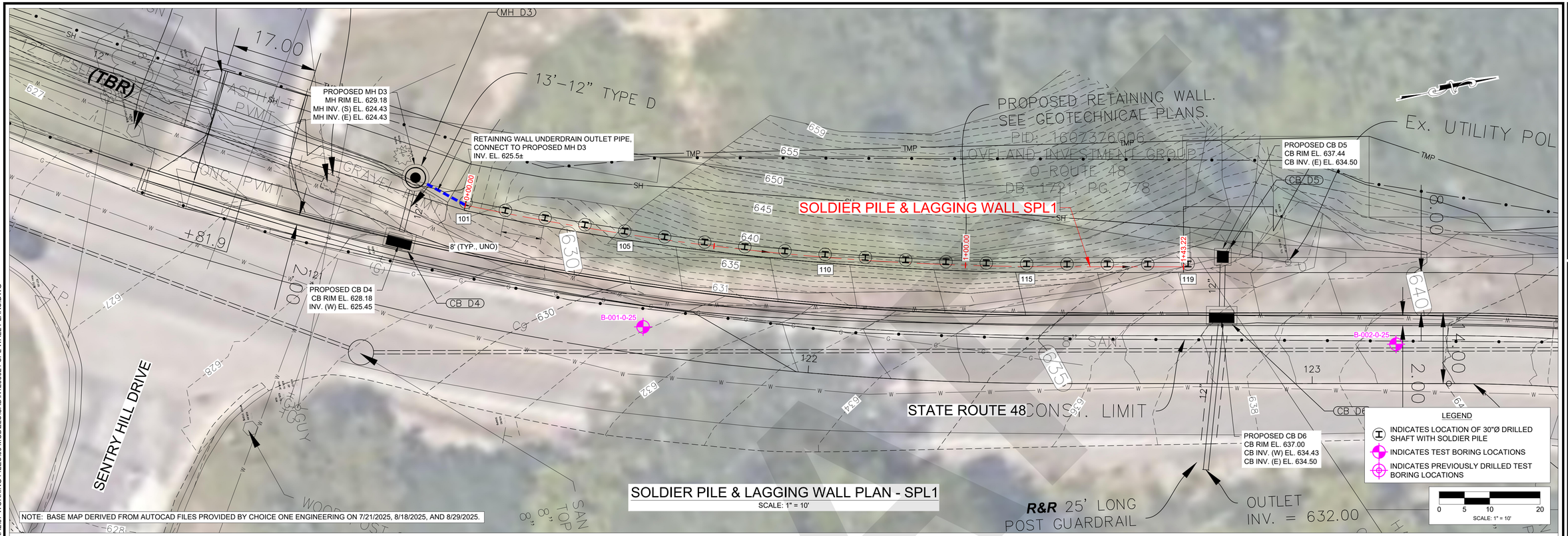
WAR-SR48-6.65

CHOICE ONE ENGINEERING CORP
SR-48 AND BUTTERWORTH ROAD
LOVELAND, OHIO

Terracon
Explore with us
611 LUNKEN PARK DRIVE CINCINNATI, OHIO 45226
PH: (513) 321-5816 FAX: (513) 321-4540

SHEET 2

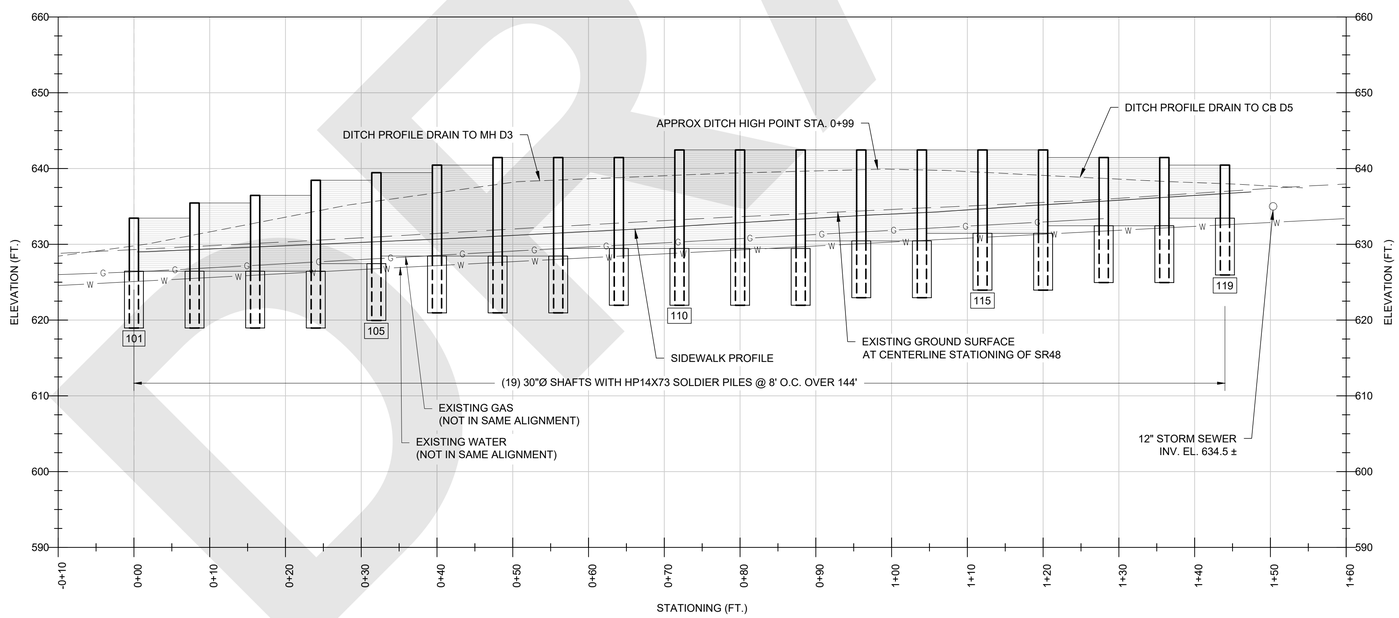
DESIGNED BY:	JDH
DRAWN BY:	RLC
APP'VD. BY:	DWW
SCALE:	AS NOTED
DATE:	9/5/2025
JOB NO.	N1255021
SHEET NO.:	2 OF 12



SOLDIER PILE & LAGGING WALL PLAN - SPL1

SCALE: 1" = 10'

NOTE: BASE MAP DERIVED FROM AUTOCAD FILES PROVIDED BY CHOICE ONE ENGINEERING ON 7/21/2025, 8/18/2025, AND 8/29/2025.



SOLDIER PILE & LAGGING WALL PROFILE - SPL1

SCALE: 1" = 10'

VERTICAL SCALE: 1" = 10'
HORIZONTAL SCALE: 1" = 10'

REV.	DATE	BY	DESCRIPTION

SOLDIER PILE & LAGGING WALL PLAN & PROFILE - SPL1

WAR-SR48-6.65

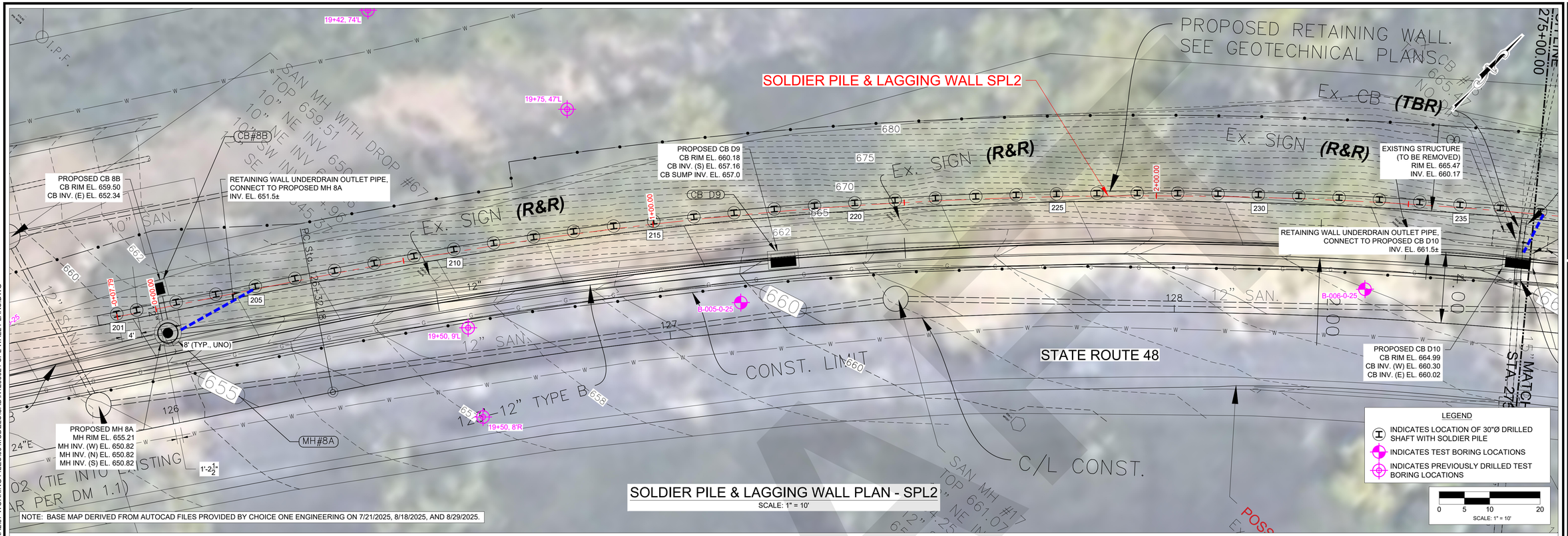
CHOICE ONE ENGINEERING CORP

SR-48 AND BUTTERWORTH ROAD
LOVELAND, OHIO

Terracon
Explore with us
611 LUNKEN PARK DRIVE CINCINNATI, OHIO 45226
PH. (513) 321-5816 FAX. (513) 321-4540

SHEET 3

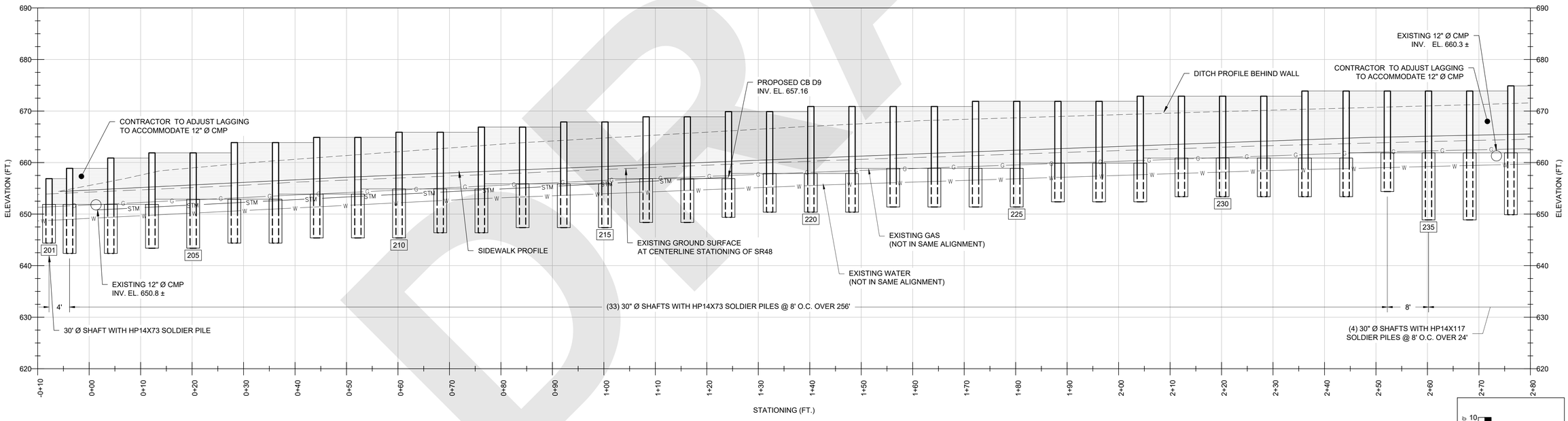
DESIGNED BY:	JDH
DRAWN BY:	RLC
APPVD. BY:	DWW
SCALE:	AS NOTED
DATE:	9/5/2025
JOB NO.	N1255021
SHEET NO.:	3 OF 12



SOLDIER PILE & LAGGING WALL PLAN - SPL2

SCALE: 1" = 10'

NOTE: BASE MAP DERIVED FROM AUTOCAD FILES PROVIDED BY CHOICE ONE ENGINEERING ON 7/21/2025, 8/18/2025, AND 8/29/2025.



SOLDIER PILE & LAGGING WALL PROFILE - SPL2

SCALE: 1" = 10'

REV.	DATE	BY	DESCRIPTION

SOLDIER PILE & LAGGING WALL PLAN & PROFILE - SPL2

WAR-SR48-6.65

SR-48 AND BUTTERWORTH ROAD

LOVELAND, OHIO

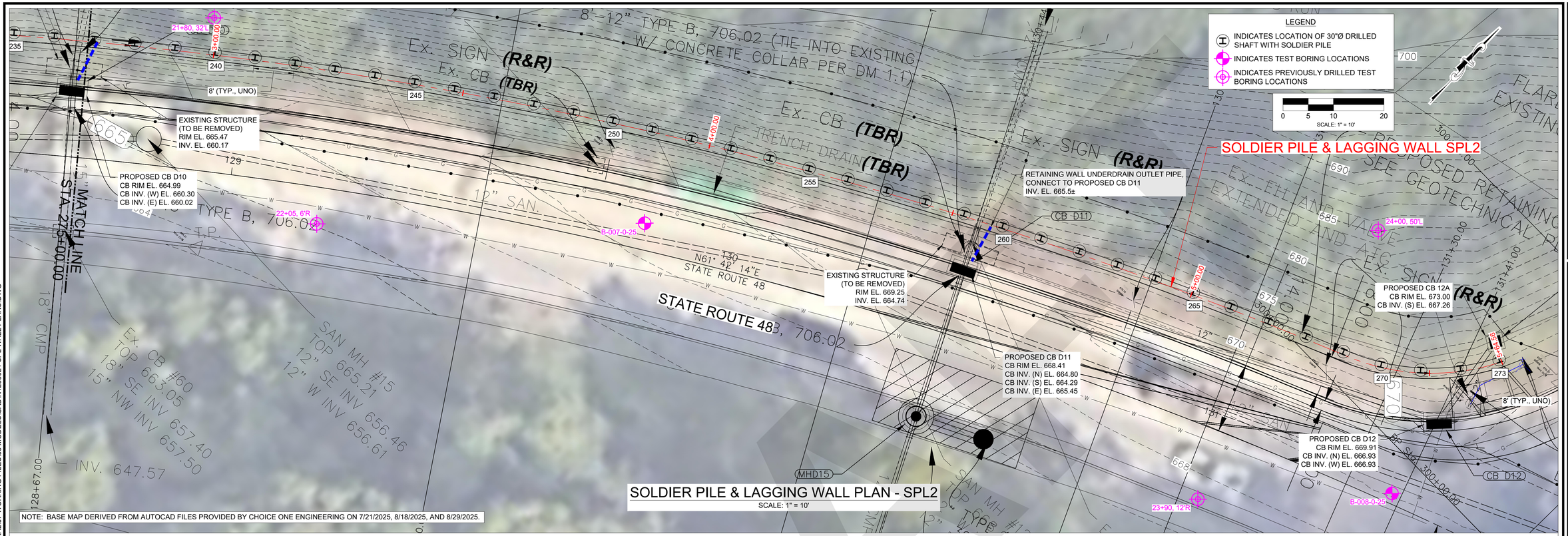
CHOICE ONE ENGINEERING CORP

terracon Explore with us

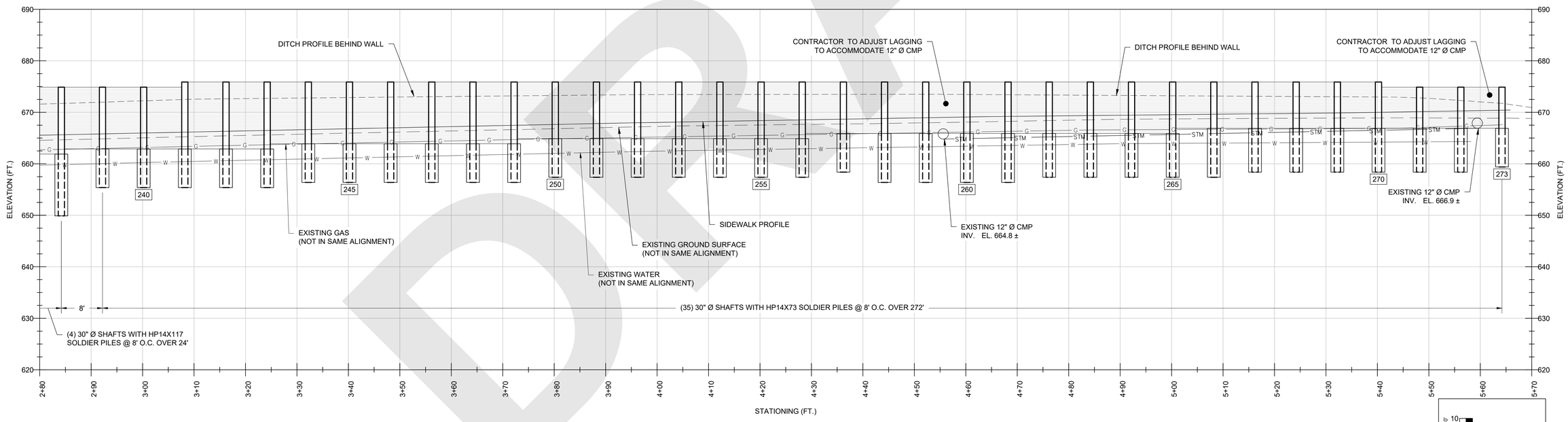
611 LUNKEN PARK DRIVE CINCINNATI, OHIO 45226

PH. (513) 321-5816 FAX. (513) 321-4540

SHEET 4	
DESIGNED BY:	JDH
DRAWN BY:	RLC
APP'VD. BY:	DWW
SCALE:	AS NOTED
DATE:	9/5/2025
JOB NO.	N1255021
SHEET NO.:	4 OF 12



NOTE: BASE MAP DERIVED FROM AUTOCAD FILES PROVIDED BY CHOICE ONE ENGINEERING ON 7/21/2025, 8/18/2025, AND 8/29/2025.



SOLDIER PILE & LAGGING WALL PROFILE - SPL2
SCALE: 1" = 10'

REV.	DATE	BY	DESCRIPTION

SOLDIER PILE & LAGGING WALL PLAN & PROFILE - SPL2

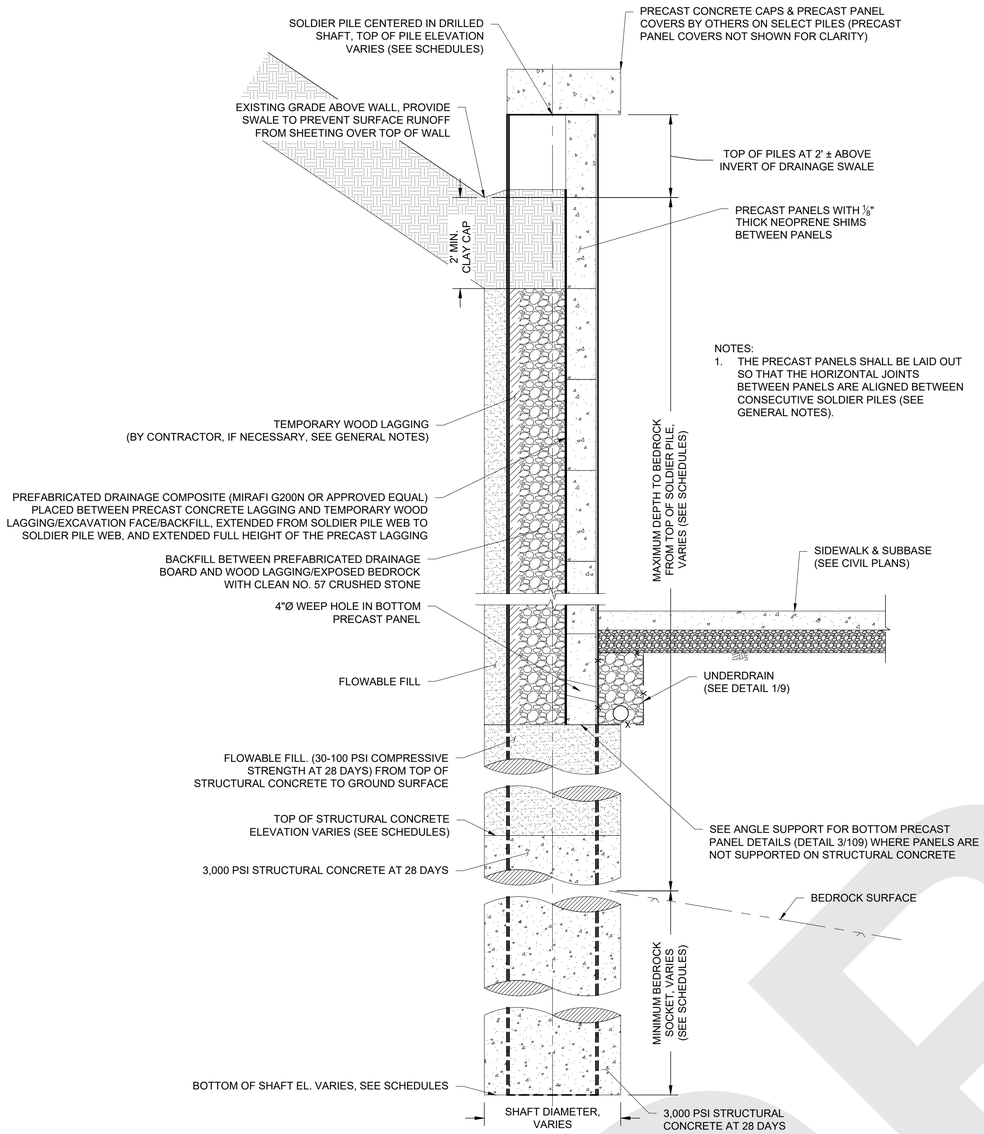
CHOICE ONE ENGINEERING CORP
WAR-SR48-6.65
SR-48 AND BUTTERWORTH ROAD
LOVELAND, OHIO

Terracon Explore with us
611 LUNKEN PARK DRIVE CINCINNATI, OHIO 45226
PH. (513) 321-5816 FAX. (513) 321-4540

SHEET 5

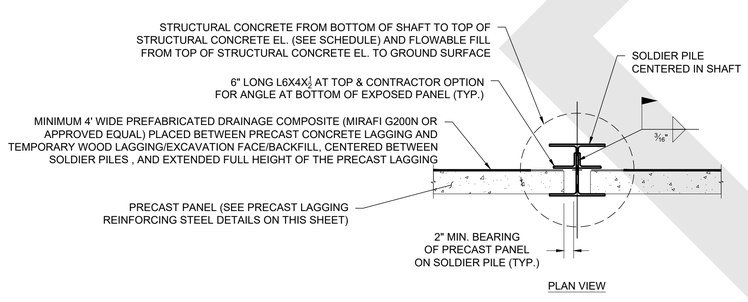
DESIGNED BY:	JDH
DRAWN BY:	RLC
APP'VD. BY:	DWW
SCALE:	AS NOTED
DATE:	9/5/2025
JOB NO.	N1255021
SHEET NO.:	5 OF 12

Date:9/5/2025 12:48 PM File Path: C:\USERS\JDHAUBER\ONEDRIVE - TERRACON CONSULTANTS INC\JDH PROJECTS\N1255021 WAR-SR48-6.65 - GENERAL\07 WORKING FILES\03 MODELS\CAD\N1255021 SPL WALL PLANS.DWG



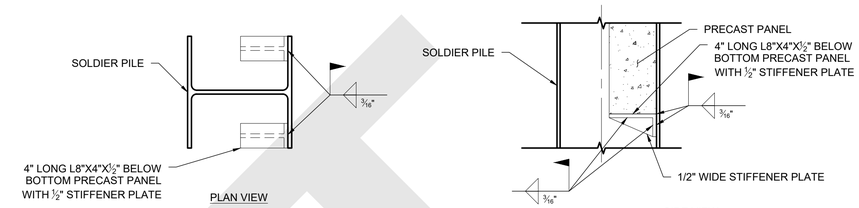
1/6 DRILLED SHAFT/SOLDIER PILE LAGGING DETAIL

NOT TO SCALE



2/6 ANGLE CONNECTION FOR ABOVE-GRADE PRECAST PANELS DETAIL

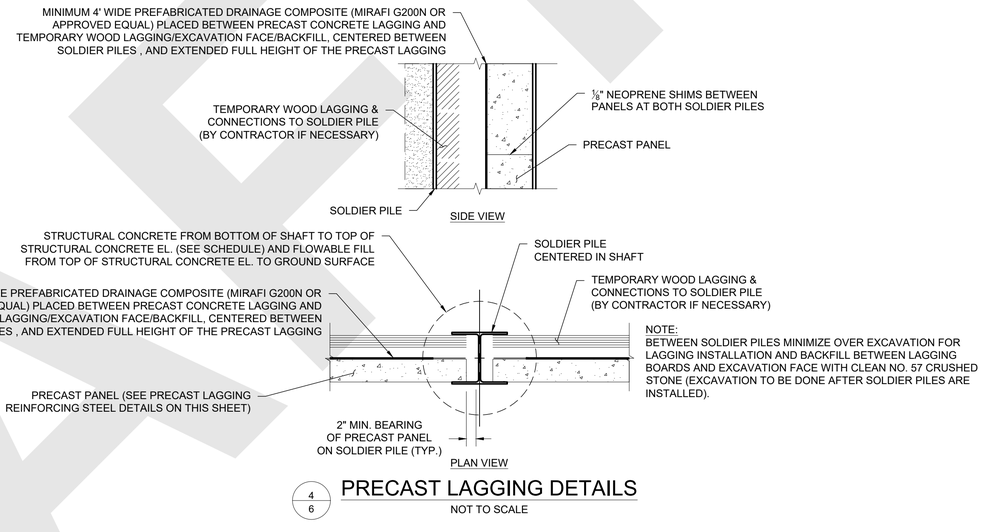
NOT TO SCALE



NOTE: CONTRACTOR OPTION TO USE SEAT ANGLE OR SUPPORT PRECAST PANELS ON FLOWABLE FILL OR STRUCTURAL CONCRETE BACKFILL OF DRILLED SHAFT

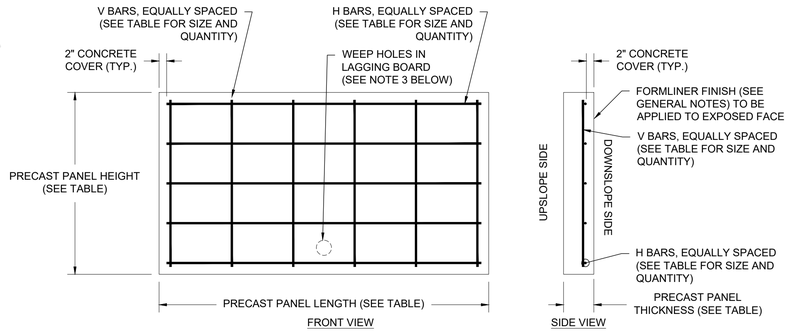
3/6 ANGLE SUPPORT FOR BOTTOM PRECAST PANEL DETAILS

NOT TO SCALE



4/6 PRECAST LAGGING DETAILS

NOT TO SCALE



SOLDIER PILE C-C SPACING	PRECAST PANEL LENGTH	PRECAST PANEL HEIGHT	PRECAST PANEL THICKNESS*	MIN. H BARS** (QTY. & SIZE)	MIN. V BARS** (QTY. & SIZE)
8'-0"	7'-8"	VARIES	6"	#5 @ 10" O.C.	#4 @ 16" O.C.
4'-0"	3'-8"	VARIES	6"	#5 @ 10" O.C.	#4 @ 16" O.C.

* PRECAST PANEL THICKNESS EXCLUDES THE RELIEF FROM THE FORMLINER
** ADDITIONAL REINFORCING STEEL FOR PRECASTING BY OTHERS

NOTES:
1. REINFORCING STEEL SHALL BE EPOXY COATED.
2. HORIZONTAL REINFORCING STEEL SHALL BE 2 INCHES CLEAR OF THE RELIEF ON THE FORMLINER FOR THE PRECAST PANELS.
3. ONE 4-INCH-DIAMETER WEEP HOLE SHALL BE CAST 6 INCHES CLEAR OF THE BOTTOM OF THE BOTTOM LAGGING PANEL BETWEEN EACH SET OF SOLDIER PILES. AT LEAST 2 INCHES OF CONCRETE CLEAR COVER SHALL BE PROVIDED BETWEEN THE WEEPHOLE AND ADJACENT REINFORCING STEEL. THE WEEPHOLE SHALL BE CAST NEAR THE MID-LENGTH OF THE PANEL.
4. THE PRECAST PANELS SHALL BE LAID OUT SO THAT THE HORIZONTAL JOINTS BETWEEN PANELS ARE ALIGNED BETWEEN CONSECUTIVE SOLDIER PILES (SEE GENERAL NOTES).
5. WHERE STORM PIPES CROSS BETWEEN SOLDIER PILES (E.G., BETWEEN SOLDIER PILES 202 AND 203, 236 AND 237, 259 AND 260, AND 272 AND 273), THE CONTRACTOR SHALL FIELD LOCATE THE EXISTING SEWER AND PREPARE SHOP DRAWINGS FOR REVIEW AND APPROVAL BY THE DESIGN ENGINEER THAT DETAIL THE PRECAST PANEL AROUND THE STORM SEWER PIPES.

5/6 PRECAST LAGGING REINFORCING STEEL DETAILS

NOT TO SCALE

REV.	DATE	BY	DESCRIPTION

SOLIDER PILE & LAGGING WALL DETAILS

WAR-SR48-6.65
CHOICE ONE ENGINEERING CORP
SR-48 AND BUTTERWORTH ROAD
LOVELAND, OHIO

Terracon Explore with us
611 LUNKEN PARK DRIVE
CINCINNATI, OHIO 45226
PH. (513) 321-5816
FAX. (513) 321-4540

SHEET 6	
DESIGNED BY:	JDH
DRAWN BY:	RLC
APPVD. BY:	DWW
SCALE:	AS NOTED
DATE:	9/5/2025
JOB NO.	N1255021
SHEET NO.:	6 OF 12

DRILLED SHAFT/ PILE NO.	DRILLED SHAFT DIAMETER (IN.)	PILE SIZE	NORTHING (FT.)*	EASTING (FT.)*	STATION**	OFFSET**	APPROX. EXISTING GROUND SURFACE EL. (FT.)	ESTIMATED BEDROCK SURFACE EL. (FT.)***	MINIMUM BEDROCK SOCKET LENGTH BELOW BOTTOM OF LAGGING (FT.)***	MAXIMUM DEPTH TO BEDROCK FROM TOP OF PILE (FT.)***	ESTIMATED BOTTOM OF SHAFT/PILE EL. (FT.)****	TOP OF PILE EL. (FT.)	APPROX. PILE LENGTH (FT.)****	TOP OF STRUCTURAL CONCRETE EL. IN SHAFT (FT.)	TOP OF LAGGING EL. (FT.)*****	BOTTOM OF LAGGING EL. (FT.)*****	DRILLED SHAFT/ PILE NO.
101	30	HP14X73	282,063.93	135,450.86	0+00.00	0.0	629.3	627.3	7.5	13	618.9	633.4	14.5	626.4	633.4	626.4	101
102	30	HP14X73	282,071.24	135,454.11	0+08.00	0.0	629.7	627.7	7.5	13	618.9	635.4	16.5	626.4	635.4	626.4	102
103	30	HP14X73	282,078.59	135,457.26	0+16.00	0.0	630.1	628.1	7.5	13	618.9	636.4	17.5	626.4	636.4	626.4	103
104	30	HP14X73	282,085.99	135,460.31	0+24.00	0.0	630.5	628.5	7.5	13	618.9	638.4	19.5	626.4	638.4	627.4	104
105	30	HP14X73	282,093.43	135,463.26	0+32.00	0.0	631.0	629.0	7.5	13	619.9	639.4	19.5	627.4	639.4	628.4	105
106	30	HP14X73	282,100.91	135,466.10	0+40.00	0.0	631.4	629.4	7.5	13	620.9	640.4	19.5	628.4	640.4	628.4	106
107	30	HP14X73	282,108.42	135,468.84	0+48.00	0.0	631.9	629.9	7.5	13	620.9	641.4	20.5	628.4	641.4	628.4	107
108	30	HP14X73	282,115.98	135,471.47	0+56.00	0.0	632.4	630.4	7.5	13	620.9	641.4	20.5	628.4	641.4	629.4	108
109	30	HP14X73	282,123.57	135,474.00	0+64.00	0.0	632.8	630.8	7.5	13	621.9	641.4	19.5	629.4	641.4	629.4	109
110	30	HP14X73	282,131.19	135,476.42	0+72.00	0.0	633.2	631.2	7.5	13	621.9	642.4	20.5	629.4	642.4	629.4	110
111	30	HP14X73	282,138.85	135,478.74	0+80.00	0.0	633.6	631.6	7.5	13	621.9	642.4	20.5	629.4	642.4	629.4	111
112	30	HP14X73	282,146.54	135,480.95	0+88.00	0.0	634.0	632.0	7.5	13	621.9	642.4	20.5	629.4	642.4	630.4	112
113	30	HP14X73	282,154.26	135,483.05	0+96.00	0.0	634.4	632.4	7.5	13	622.9	642.4	19.5	630.4	642.4	630.4	113
114	30	HP14X73	282,162.01	135,485.04	1+04.00	0.0	634.8	632.8	7.5	13	622.9	642.4	19.5	630.4	642.4	631.4	114
115	30	HP14X73	282,169.78	135,486.93	1+12.00	0.0	635.1	633.1	7.5	13	623.9	642.4	18.5	631.4	642.4	631.4	115
116	30	HP14X73	282,177.58	135,488.70	1+20.00	0.0	635.5	633.5	7.5	13	623.9	642.4	18.5	631.4	641.4	632.4	116
117	30	HP14X73	282,185.39	135,490.44	1+28.00	0.0	635.9	633.9	7.5	13	624.9	641.4	16.5	632.4	641.4	632.4	117
118	30	HP14X73	282,193.20	135,492.18	1+36.00	0.0	636.5	634.5	7.5	13	624.9	641.4	16.5	632.4	640.4	633.4	118
119	30	HP14X73	282,201.00	135,493.93	1+44.00	0.0	637.0	635.0	7.5	13	625.9	640.4	14.5	633.4	-	-	119

* THE DRILLED SHAFT COORDINATES ARE PROVIDED AS NORTHINGS AND EASTINGS BASED ON THE OHIO SOUTH STATE PLANE COORDINATE SYSTEM (NAD 83).

** THE SPL RETAINING WALL STATIONING BASELINE IS ALONG THE FACING OF THE WALL.

*** IF THE ACTUAL BEDROCK SURFACE ELEVATION ENCOUNTERED IN THE FIELD IS LOWER THAN THE TABULATED DESIGN VALUE SUCH THAT THE MAXIMUM DEPTH TO BEDROCK FROM THE TOP OF THE PILE IS EXCEEDED, THE DESIGN ENGINEER SHALL BE NOTIFIED TO REVIEW AND EVALUATE WHETHER THE SHAFT/PILE CONSTRUCTION CAN BE COMPLETED AS DETAILED WITH THE SCHEDULED MINIMUM BEDROCK SOCKET AND SOLDIER PILE.

****THE BOTTOM OF THE SHAFT/PILE ELEVATIONS ARE APPROXIMATIONS BASED ON THE SUBSURFACE INFORMATION OBTAINED FROM THE BORINGS. THE MINIMUM BEDROCK SOCKET LENGTHS SHALL DICTATE THE ACTUAL BOTTOM OF SHAFT ELEVATIONS AND TOTAL SHAFT LENGTHS. HOWEVER, THE BOTTOMS OF PILES SHALL EXTEND DOWN TO AT LEAST THE MINIMUM BOTTOM OF SHAFT/PILE ELEVATION THAT IS TABULATED.

*****THE TOP AND BOTTOM OF LAGGING ELEVATIONS ARE FOR THE SECTIONS TO THE RIGHT OF THE DESIGNATED SHAFT/PILE NO.

REV.	DATE	BY	DESCRIPTION

SOLDIER PILE & LAGGING WALL SCHEDULE - SPL1

CHOICE ONE ENGINEERING CORP

WAR-SR48-6.65
SR-48 AND BUTTERWORTH ROAD
LOVELAND, OHIO

Terracon Explore with us
611 LUNKEN PARK DRIVE
CINCINNATI, OHIO 45226
PH. (513) 321-5816
FAX. (513) 321-4540

SHEET 7

DESIGNED BY:	JDH
DRAWN BY:	RLC
APPVD. BY:	DWW
SCALE:	AS NOTED
DATE:	9/5/2025
JOB NO.	N1255021
SHEET NO.:	7 OF 12

DRILLED SHAFT/ PILE NO.	DRILLED SHAFT DIAMETER (IN.)	PILE SIZE	NORTHING (FT.)*	EASTING (FT.)*	STATION**	OFFSET**	APPROX. EXISTING GROUND SURFACE EL. (FT.)	ESTIMATED BEDROCK SURFACE EL. (FT.)***	MINIMUM BEDROCK SOCKET LENGTH BELOW BOTTOM OF LAGGING (FT.)***	MAXIMUM DEPTH TO BEDROCK FROM TOP OF PILE (FT.)***	ESTIMATED BOTTOM OF SHAFT/PILE EL. (FT.)****	TOP OF PILE EL. (FT.)	APPROX. PILE LENGTH (FT.)****	TOP OF STRUCTURAL CONCRETE EL. IN SHAFT (FT.)	TOP OF LAGGING EL. (FT.)*****	BOTTOM OF LAGGING EL. (FT.)*****	DRILLED SHAFT/ PILE NO.
201	30	HP14X73	282,489.26	135,639.90	-0+07.79	0.0	653.9	651.9	7.5	13	644.4	656.9	12.5	651.9	656.9	651.9	201
202	30	HP14X73	282,492.50	135,642.25	-0+03.79	0.0	654.1	652.1	9.5	13	642.4	658.9	16.5	651.9	658.9	651.9	202
203	30	HP14X73	282,498.97	135,646.95	0+04.21	0.0	654.4	652.4	9.5	13	642.4	660.9	18.5	651.9	660.9	651.9	203
204	30	HP14X73	282,505.45	135,651.64	0+12.21	0.0	654.8	652.8	8.5	13	643.4	661.9	18.5	651.9	661.9	652.9	204
205	30	HP14X73	282,511.92	135,656.34	0+20.21	0.0	655.2	653.2	9.5	13	643.4	661.9	18.5	652.9	661.9	652.9	205
206	30	HP14X73	282,518.40	135,661.04	0+28.21	0.0	655.5	653.5	8.5	13	644.4	663.9	19.5	652.9	663.9	652.9	206
207	30	HP14X73	282,524.87	135,665.75	0+36.21	0.0	656.0	654.0	8.5	13	644.4	663.9	19.5	652.9	663.9	653.9	207
208	30	HP14X73	282,531.30	135,670.52	0+44.21	0.0	656.4	654.4	8.5	13	645.4	664.9	19.5	653.9	664.9	653.9	208
209	30	HP14X73	282,537.68	135,675.35	0+52.21	0.0	656.7	654.7	8.5	13	645.4	664.9	19.5	653.9	664.9	654.9	209
210	30	HP14X73	282,544.02	135,680.24	0+60.21	0.0	657.0	655.0	9.5	13	645.4	665.9	20.5	654.9	665.9	654.9	210
211	30	HP14X73	282,550.31	135,685.19	0+68.21	0.0	657.3	655.3	8.5	13	646.4	665.9	19.5	654.9	665.9	654.9	211
212	30	HP14X73	282,556.56	135,690.20	0+76.21	0.0	657.6	655.6	8.5	13	646.4	666.9	20.5	654.9	666.9	655.9	212
213	30	HP14X73	282,562.75	135,695.27	0+84.21	0.0	658.0	656.0	8.5	13	647.4	666.9	19.5	655.9	666.9	655.9	213
214	30	HP14X73	282,568.90	135,700.40	0+92.21	0.0	658.3	656.3	8.5	13	647.4	667.9	20.5	655.9	667.9	655.9	214
215	30	HP14X73	282,575.00	135,705.58	1+00.21	0.0	658.7	656.7	8.5	13	647.4	667.9	20.5	655.9	667.9	656.9	215
216	30	HP14X73	282,581.05	135,710.83	1+08.21	0.0	659.0	657.0	8.5	13	648.4	668.9	20.5	656.9	668.9	656.9	216
217	30	HP14X73	282,587.05	135,716.13	1+16.21	0.0	659.3	657.3	8.5	13	648.4	668.9	20.5	656.9	668.9	656.9	217
218	30	HP14X73	282,593.00	135,721.48	1+24.21	0.0	659.7	657.7	7.5	13	649.4	669.9	20.5	656.9	669.9	657.9	218
219	30	HP14X73	282,598.89	135,726.90	1+32.21	0.0	660.0	658.0	7.5	13	650.4	669.9	19.5	657.9	669.9	657.9	219
220	30	HP14X73	282,604.74	135,732.36	1+40.21	0.0	660.3	658.3	7.5	13	650.4	670.9	20.5	657.9	670.9	657.9	220
221	30	HP14X73	282,610.53	135,737.89	1+48.21	0.0	660.6	658.6	7.5	13	650.4	670.9	20.5	657.9	670.9	658.9	221
222	30	HP14X73	282,616.27	135,743.47	1+56.21	0.0	660.8	658.8	7.5	13	651.4	670.9	19.5	658.9	670.9	658.9	222
223	30	HP14X73	282,621.96	135,749.10	1+64.21	0.0	661.1	659.1	7.5	13	651.4	670.9	19.5	658.9	670.9	658.9	223
224	30	HP14X73	282,627.60	135,754.79	1+72.21	0.0	661.4	659.4	7.5	13	651.4	671.9	20.5	658.9	671.9	658.9	224
225	30	HP14X73	282,633.18	135,760.53	1+80.21	0.0	661.6	659.6	7.5	13	651.4	671.9	20.5	658.9	671.9	659.9	225
226	30	HP14X73	282,638.70	135,766.32	1+88.21	0.0	661.9	659.9	7.5	13	652.4	671.9	19.5	659.9	671.9	659.9	226
227	30	HP14X73	282,644.17	135,772.16	1+96.21	0.0	662.2	660.2	7.5	13	652.4	671.9	19.5	659.9	671.9	659.9	227
228	30	HP14X73	282,649.59	135,778.06	2+04.21	0.0	662.5	660.5	7.5	13	652.4	672.9	20.5	659.9	672.9	660.9	228
229	30	HP14X73	282,654.95	135,784.01	2+12.21	0.0	662.7	660.7	7.5	13	653.4	672.9	19.5	660.9	672.9	660.9	229
230	30	HP14X73	282,660.25	135,790.01	2+20.21	0.0	663.0	661.0	7.5	13	653.4	672.9	19.5	660.9	672.9	660.9	230
231	30	HP14X73	282,665.49	135,796.05	2+28.21	0.0	663.3	661.3	7.5	13	653.4	672.9	19.5	660.9	672.9	660.9	231
232	30	HP14X73	282,670.68	135,802.15	2+36.21	0.0	663.5	661.5	7.5	13	653.4	673.9	20.5	660.9	673.9	660.9	232
233	30	HP14X73	282,675.81	135,808.30	2+44.21	0.0	663.7	661.7	7.5	13	653.4	673.9	20.5	660.9	673.9	661.9	233
234	30	HP14X73	282,680.88	135,814.49	2+52.21	0.0	663.9	661.9	7.5	13	654.4	673.9	19.5	661.9	673.9	661.9	234
235	30	HP14X117	282,685.89	135,820.74	2+60.21	0.0	664.1	662.1	13.0	13	648.9	673.9	25.0	661.9	673.9	661.9	235
236	30	HP14X117	282,690.84	135,827.02	2+68.21	0.0	664.3	662.3	13.0	13	648.9	673.9	25.0	661.9	673.9	661.9	236
237	30	HP14X117	282,695.74	135,833.36	2+76.21	0.0	664.5	662.5	12.0	13	649.9	674.9	25.0	661.9	674.9	661.9	237

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DRILLED SHAFT/ PILE NO.	DRILLED SHAFT DIAMETER (IN.)	PILE SIZE	NORTHING (FT.)*	EASTING (FT.)*	STATION**	OFFSET**	APPROX. EXISTING GROUND SURFACE EL. (FT.)	ESTIMATED BEDROCK SURFACE EL. (FT.)***	MINIMUM BEDROCK SOCKET LENGTH BELOW BOTTOM OF LAGGING (FT.)***	MAXIMUM DEPTH TO BEDROCK FROM TOP OF PILE (FT.)***	ESTIMATED BOTTOM OF SHAFT/PILE EL. (FT.)****	TOP OF PILE EL. (FT.)	APPROX. PILE LENGTH (FT.)****	TOP OF STRUCTURAL CONCRETE EL. IN SHAFT (FT.)	TOP OF LAGGING EL. (FT.)*****	BOTTOM OF LAGGING EL. (FT.)*****	DRILLED SHAFT/ PILE NO.
238	30	HP14X117	282,700.57	135,839.74	2+84.21	0.0	664.7	662.7	12.0	13	649.9	674.9	25.0	661.9	674.9	662.9	238
239	30	HP14X73	282,705.34	135,846.17	2+92.21	0.0	664.8	662.8	7.5	13	655.4	674.9	19.5	662.9	674.9	662.9	239
240	30	HP14X73	282,710.05	135,852.64	3+00.21	0.0	665.0	663.0	7.5	13	655.4	674.9	19.5	662.9	674.9	662.9	240
241	30	HP14X73	282,714.70	135,859.16	3+08.21	0.0	665.3	663.3	7.5	13	655.4	675.9	20.5	662.9	675.9	662.9	241
242	30	HP14X73	282,719.29	135,865.72	3+16.21	0.0	665.4	663.4	7.5	13	655.4	675.9	20.5	662.9	675.9	662.9	242
243	30	HP14X73	282,723.81	135,872.33	3+24.21	0.0	665.6	663.6	7.5	13	655.4	675.9	20.5	662.9	675.9	663.9	243
244	30	HP14X73	282,728.27	135,878.98	3+32.21	0.0	665.8	663.8	7.5	13	656.4	675.9	19.5	663.9	675.9	663.9	244
245	30	HP14X73	282,732.67	135,885.66	3+40.21	0.0	666.0	664.0	7.5	13	656.4	675.9	19.5	663.9	675.9	663.9	245
246	30	HP14X73	282,737.00	135,892.39	3+48.21	0.0	666.1	664.1	7.5	13	656.4	675.9	19.5	663.9	675.9	663.9	246
247	30	HP14X73	282,741.27	135,899.17	3+56.21	0.0	666.3	664.3	7.5	13	656.4	675.9	19.5	663.9	675.9	663.9	247
248	30	HP14X73	282,745.48	135,905.98	3+64.21	0.0	666.5	664.5	7.5	13	656.4	675.9	19.5	663.9	675.9	663.9	248
249	30	HP14X73	282,749.62	135,912.83	3+72.21	0.0	666.6	664.6	7.5	13	656.4	675.9	19.5	663.9	675.9	664.9	249
250	30	HP14X73	282,753.70	135,919.72	3+80.21	0.0	666.8	664.8	7.5	13	657.4	675.9	18.5	664.9	675.9	664.9	250
251	30	HP14X73	282,757.71	135,926.65	3+88.21	0.0	667.0	665.0	7.5	13	657.4	675.9	18.5	664.9	675.9	664.9	251
252	30	HP14X73	282,761.65	135,933.61	3+96.21	0.0	667.2	665.2	7.5	13	657.4	675.9	18.5	664.9	675.9	664.9	252
253	30	HP14X73	282,765.53	135,940.62	4+04.21	0.0	667.3	665.3	7.5	13	657.4	675.9	18.5	664.9	675.9	664.9	253
254	30	HP14X73	282,769.34	135,947.66	4+12.21	0.0	667.4	665.4	7.5	13	657.4	675.9	18.5	664.9	675.9	664.9	254
255	30	HP14X73	282,773.09	135,954.73	4+20.21	0.0	667.5	665.5	7.5	13	657.4	675.9	18.5	664.9	675.9	664.9	255
256	30	HP14X73	282,776.76	135,961.84	4+28.21	0.0	667.6	665.6	7.5	13	657.4	675.9	18.5	664.9	675.9	665.9	256
257	30	HP14X73	282,780.37	135,968.99	4+36.21	0.0	667.7	665.7	7.5	13	658.4	675.9	17.5	665.9	675.9	665.9	257
258	30	HP14X73	282,783.91	135,976.17	4+44.21	0.0	667.8	665.8	9.5	13	656.4	675.9	19.5	665.9	675.9	665.9	258
259	30	HP14X73	282,787.39	135,983.38	4+52.21	0.0	668.0	666.0	9.5	13	656.4	675.9	19.5	665.9	675.9	665.9	259
260	30	HP14X73	282,790.79	135,990.62	4+60.21	0.0	668.1	666.1	9.5	13	656.4	675.9	19.5	665.9	675.9	665.9	260
261	30	HP14X73	282,794.13	135,997.90	4+68.21	0.0	668.2	666.2	9.5	13	656.4	675.9	19.5	665.9	675.9	665.9	261
262	30	HP14X73	282,797.40	136,005.21	4+76.21	0.0	668.4	666.4	8.5	13	657.4	675.9	18.5	665.9	675.9	665.9	262
263	30	HP14X73	282,800.59	136,012.55	4+84.21	0.0	668.5	666.5	8.5	13	657.4	675.9	18.5	665.9	675.9	665.9	263
264	30	HP14X73	282,803.72	136,019.92	4+92.21	0.0	668.7	666.7	8.5	13	657.4	675.9	18.5	665.9	675.9	665.9	264
265	30	HP14X73	282,806.78	136,027.32	5+00.21	0.0	668.7	666.7	8.5	13	657.4	675.9	18.5	665.9	675.9	666.9	265
266	30	HP14X73	282,809.77	136,034.74	5+08.21	0.0	668.8	666.8	9.5	13	657.4	675.9	18.5	666.9	675.9	666.9	266
267	30	HP14X73	282,812.68	136,042.20	5+16.21	0.0	668.8	666.8	8.5	13	658.4	675.9	17.5	666.9	675.9	666.9	267
268	30	HP14X73	282,815.53	136,049.68	5+24.21	0.0	668.8	666.8	8.5	13	658.4	675.9	17.5	666.9	675.9	666.9	268
269	30	HP14X73	282,818.31	136,057.19	5+32.21	0.0	668.9	666.9	8.5	13	658.4	675.9	17.5	666.9	675.9	666.9	269
270	30	HP14X73	282,821.53	136,064.40	5+40.21	0.0	668.9	666.9	8.5	13	658.4	675.9	17.5	666.9	674.9	666.9	270
271	30	HP14X73	282,826.01	136,070.89	5+48.21	0.0	668.9	666.9	8.5	13	658.4	674.9	16.5	666.9	674.9	666.9	271
272	30	HP14X73	282,831.59	136,076.45	5+56.21	0.0	668.9	666.9	8.5	13	658.4	674.9	16.5	666.9	674.9	666.9	272
273	30	HP14X73	282,838.10	136,080.90	5+64.21	0.0	668.9	666.9	7.5	13	659.4	674.9	15.5	666.9	-	-	273

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REV.	DATE	BY	DESCRIPTION

SOLDIER PILE & LAGGING WALL SCHEDULE - SPL2

WAR-SR48-6.65

CHOICE ONE ENGINEERING CORP

SR-48 AND BUTTERWORTH ROAD
LOVELAND, OHIO

terracon Explore with us
611 LUNKEN PARK DRIVE CINCINNATI, OHIO 45226
PH: (513) 321-5816 FAX: (513) 321-4540

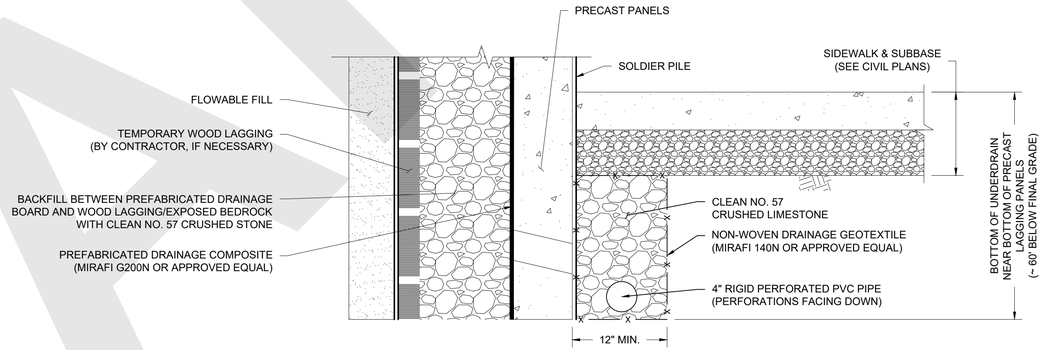
SHEET 8

DESIGNED BY:	JDH
DRAWN BY:	RLC
APPVD. BY:	DWW
SCALE:	AS NOTED
DATE:	9/5/2025
JOB NO.	N1255021
SHEET NO.:	8 OF 12

GENERAL NOTES

IN THE FOLLOWING NOTES, THE ENGINEER SHALL BE HELD TO MEAN THE DESIGN ENGINEER FROM TERRACON. THE OWNER SHALL BE HELD TO MEAN THE CITY OF LOVELAND. THE PROJECT PLANS SHALL BE HELD TO MEAN THESE PLANS PREPARED BY TERRACON. ODOT CMS SHALL BE HELD TO MEAN THE STATE OF OHIO DEPARTMENT OF TRANSPORTATION CONSTRUCTION AND MATERIALS SPECIFICATIONS, CURRENT EDITION.

1. THE CONTRACTOR SHALL REFER TO THE PROJECT PLANS AND THESE GENERAL NOTES, AND SHALL SATISFY THE REQUIREMENTS OF BOTH. ANY DISCREPANCIES BETWEEN THE PROJECT PLANS AND THESE GENERAL NOTES SHALL BE BROUGHT TO THE ATTENTION OF THE ENGINEER IN WRITING. THE RESOLUTION OF ANY DISCREPANCY SHALL BE AT THE SOLE DISCRETION OF THE ENGINEER.
2. THE CONTRACTOR SHALL OBTAIN ANY NECESSARY PERMITS THAT ARE REQUIRED FOR THIS WORK PRIOR TO PERFORMANCE OF THIS WORK.
3. THE CONTRACTOR SHALL COORDINATE A STAGING AREA, ACCEPTABLE TO THE ENGINEER AND OWNER, FOR STOCKPILING MATERIALS, INCLUDING DRILLING AND EXCAVATION SPOILS.
4. THE CONTRACTOR SHALL DEVELOP A MAINTENANCE OF TRAFFIC CONTROL (MOT) PLAN AND ESTABLISH THE WORK ZONE WITHIN THE LIMITS OF THE ROADWAY IN ACCORDANCE WITH THE OHIO MANUAL OF UNIFORM TRAFFIC CONTROL DEVICES (OMUTCD). THESE SHALL BE COORDINATED WITH THE OWNER PRIOR TO CONSTRUCTION.
5. THE CONTRACTOR SHALL COORDINATE WITH THE OWNER, OH 811, AND ALL UTILITY COMPANIES TO CHECK FOR UNDERGROUND UTILITIES WITHIN THE WORK AREA BEFORE THE SHAFTS ARE DRILLED. THE ENGINEER SHALL BE NOTIFIED OF ANY EXISTING UTILITIES, STRUCTURES, OR OTHER INFRASTRUCTURE WITHIN THE PROPOSED DRILLED SHAFT LOCATIONS THAT DEVIATE FROM THE LOCATIONS SHOWN ON THE PROJECT PLANS OR ARE NOT SHOWN ON THE PROJECT PLANS BEFORE WORK BEGINS. SHOULD THE PRESENCE OF UNDERGROUND FEATURES NEGATIVELY IMPACT THE DESIGN OF THE SOLDIER PILE AND LAGGING WALL, A REASONABLE ALLOTMENT OF TIME SHALL BE PROVIDED IN THE CONSTRUCTION SCHEDULE TO MAKE DESIGN REVISIONS WHERE APPROPRIATE.
6. OVERHEAD UTILITIES SHALL BE PROTECTED AND/OR RELOCATED AS NECESSARY FOR CONSTRUCTION.
7. THE CONTRACTOR SHALL COORDINATE THE PROJECT PLANS AND THE FIELD CONDITIONS. THE ENGINEER SHALL APPROVE OF THE ADJUSTMENTS AND ADJUST THE REINFORCEMENT DESIGN AND/OR BEDROCK SOCKET LENGTH, IF NECESSARY.
8. STAKING OF THE DRILLED SHAFTS SHALL BE THE RESPONSIBILITY OF THE CONTRACTOR.
9. ALL DRILLED SHAFT EXCAVATIONS SHALL BE REVIEWED BY THE ENGINEER, OR A REPRESENTATIVE THEREOF, DURING DRILLING AND PRIOR TO PLACING SOLDIER PILES AND CONCRETE. FINAL INTERPRETATION OF THE SOLDIER PILE AND LAGGING WALL PLANS AND THE GENERAL NOTES SHALL BE AT THE DISCRETION OF THE ENGINEER. MATERIAL TESTING AND SPECIAL INSPECTIONS OF THE SOLDIER PILE AND LAGGING WALL SHALL BE CONTRACTED SEPARATED BY THE OWNER; HOWEVER, THE CONTRACTOR SHALL BE FAMILIAR WITH THE REQUIRED SPECIAL INSPECTIONS AND THEIR FREQUENCY, SHALL SCHEDULE THE ENGINEER, OR A REPRESENTATIVE THEREOF, AND SHALL PROVIDE SAFE ACCESS FOR THE REQUIRED TESTING AND REVIEWS.
10. THE DRILLED SHAFTS SHALL BE DRILLED WITH DRY DRILLING METHODS AND SHALL BE DRILLED SO THAT THEY DO NOT COLLAPSE DURING DRILLING, PLACEMENT OF SOLDIER PILES, AND/OR CONCRETING. CASING OF THE DRILLED SHAFTS SHALL BE PROVIDED, AS NECESSARY, TO CONTROL CAVING SOILS AND/OR EXCESSIVE GROUNDWATER SEEPAGE.
11. THE DRILLED SHAFTS SHALL BE EXCAVATED PLUMB, AND THE BOTTOMS SHALL BE RELATIVELY LEVEL AND REASONABLY FREE OF LOOSE AND DISTURBED MATERIAL PRIOR TO PLACING CONCRETE. THE OUT-OF-PLUMB TOLERANCE SHALL BE 1.5 PERCENT OF THE SHAFT LENGTH. THE DRILLED SHAFT EXCAVATIONS WILL EXTEND INTO THE INTERBEDDED SHALE AND LIMESTONE BEDROCK, AND THE CONTRACTOR SHALL BE PREPARED TO DRILL THROUGH THE BEDROCK WITH THE PROPER EQUIPMENT.
12. THE SOLDIER PILE WALL WILL DERIVE ITS LATERAL RESISTANCE FROM BEDROCK SOCKETS. DISTURBANCE OF BEDROCK WITHIN 8 FEET HORIZONTALLY OF THE DRILLED SHAFTS SHALL BE PROHIBITED UNLESS REVIEWED BY THE ENGINEER, INCLUDING FOR NEW STORM SEWERS AND REMOVAL OF OLD STORM SEWERS. CONSEQUENTLY, THE CONTRACTOR SHALL EMPLOY CARE WHEN COMPLETING EXCAVATIONS, INCLUDING TRENCH EXCAVATIONS FOR UTILITIES TO AVOID OVERBREAK OF THE BEDROCK THAT MAY COMPROMISE THE BEDROCK SOCKETS FOR THE SOLDIERS. EXCAVATIONS WITHIN THE NOTED LIMITS SHALL BE BACKFILLED WITH FLOWABLE FILL THAT HAS A MINIMUM COMPRESSIVE STRENGTH OF 100 PSI, UNLESS OTHERWISE APPROVED BY THE ENGINEER.
13. THE DRILLED SHAFTS SHALL BE REINFORCED AND FILLED WITH CONCRETE THE SAME DAY THAT THE ENTIRE BEDROCK SOCKET (TOP TO BOTTOM) IS DRILLED. IF CONCRETE CANNOT BE PLACED THE SAME DAY AS THE BEDROCK SOCKET IS DRILLED, THE CONTRACTOR SHALL NOTIFY THE ENGINEER FOR DIRECTION, WHICH MAY INVOLVE EXTENDING THE DRILLED SHAFT DEEPER AND/OR REDRILLING THE SHAFT WITH A LARGER DIAMETER AUGER, ETC. THE CONTRACTOR SHALL BE RESPONSIBLE FOR ANY ADDITIONAL COSTS ASSOCIATED WITH NOT FILLING THE DRILLED SHAFT WITH CONCRETE THE SAME DAY THAT THE BEDROCK SOCKET IS DRILLED.
14. DRILLING AND EXCAVATION SPOILS SHALL BE WASTED OFF SITE OR MAY BE USED FOR FILL (IF ACCEPTABLE MATERIAL) WHERE INDICATED ON THE CIVIL PLANS.
15. CONCRETE:
    A. CONCRETE FOR THE DRILLED SHAFTS SHALL HAVE A MINIMUM 28-DAY COMPRESSIVE STRENGTH (F'_C) OF 3,000 PSI, SHALL HAVE A MAXIMUM AGGREGATE SIZE OF 1.5 INCHES, AND SHALL BE PLACED AT A SLUMP OF 5 TO 7 INCHES.
    B. CONCRETE SHALL NOT BE PLACED THROUGH MORE THAN 3 INCHES OF STANDING WATER THAT MAY ACCUMULATE AT THE BOTTOM OF ANY DRILLED SHAFT EXCAVATION. CONCRETE PLACEMENT FOR ANY GIVEN DRILLED SHAFT SHALL BE CONTINUOUS. IF CASING IS REQUIRED DURING THE DRILLED SHAFT EXCAVATIONS, THE TEMPORARY CASING SHALL BE EXTRACTED AT SUCH A RATE AND IN SUCH A MANNER THAT THE OVERBURDEN SOILS DO NOT CAVE INTO THE SHAFT DURING CONCRETE PLACEMENT AND THAT POCKETS OF AIR AND SOIL ARE NOT INTRODUCED INTO THE CONCRETE. THE TOP 6 FEET OF CONCRETE IN THE DRILLED SHAFTS SHALL BE VIBRATED WITH A CONCRETE VIBRATOR.
    C. CONCRETE FOR THE PRECAST LAGGING PANELS SHALL HAVE A MINIMUM 28-DAY COMPRESSIVE STRENGTH (F'_C) OF 4,000 PSI, A MAXIMUM AGGREGATE SIZE OF 3/4 INCHES, AND SHALL CONTAIN 4 TO 6 PERCENT ENTRAINED AIR.
    D. THE CONTRACTOR SHALL FOLLOW THE GUIDELINES WITHIN ACI 301, "STANDARD SPECIFICATIONS FOR STRUCTURAL CONCRETE," AND, WHEN NECESSARY, SHALL IMPLEMENT THE PRACTICES OUTLINED WITHIN ACI 305, "HOT WEATHER CONCRETING," OR ACI 306, "COLD WEATHER CONCRETING."
16. FLOWABLE FILL, WHERE USED, SHALL HAVE A 28-DAY COMPRESSIVE STRENGTH BETWEEN 20 AND 100 PSI, UNLESS NOTED OTHERWISE IN THESE PROJECT PLANS.
17. THE REINFORCING STEEL BARS FOR THE PRECAST LAGGING PANELS SHALL CONFORM TO ASTM A615, GRADE 60 AND SHALL HAVE A MINIMUM YIELD STRENGTH (F_Y) OF 60,000 PSI (60 KSI), UNLESS NOTED OTHERWISE. ALL REINFORCING STEEL CONSTRUCTION AND PLACEMENT SHALL BE IN CONFORMANCE WITH ACI 318-19. ALL REINFORCING STEEL SHALL BE RELATIVELY CLEAN OF RUST, SOIL, AND OTHER DEBRIS IMMEDIATELY PRIOR TO THE PLACEMENT OF CONCRETE. UNLESS NOTED OTHERWISE, ALL REINFORCING STEEL SHALL HAVE MINIMUM CLEAR COVER OF 3 INCHES WHERE THE CONCRETE IS CAST AGAINST SOIL OR BEDROCK AND 2 INCHES WHERE THE CONCRETE IS CAST AGAINST FORMS.
18. LAP SPLICES MAY BE USED FOR THE NO. 10 AND SMALLER BARS PER ACI 318-19.
19. THE SOLDIER PILES SHALL BE ROLLED STEEL HP-SHAPED MEMBERS AS SHOWN ON THE DRAWINGS. THE HP-SHAPES SHALL CONFORM TO ASTM A572, GRADE 50 (F_Y = 50 KSI). PROVIDE PILES FREE OF CAMBER OR TWIST THAT WOULD AFFECT THEIR STRUCTURAL CAPACITY. SPLICING OF THE SOLDIER PILES SHALL NOT BE PERMITTED WITHOUT REVIEW AND WRITTEN PERMISSION BY THE ENGINEER.
20. EXPOSED PORTIONS OF THE SOLDIER PILES SHALL BE PAINTED USING A COLOR APPROVED BY THE OWNER. THE PAINT SHALL CONFORM TO SECTION 708 OF THE ODOT CMS, AND SHALL BE APPLIED IN ACCORDANCE WITH SECTION 514 OF THE ODOT CMS.
21. PRECAST PANELS SHALL BE PROVIDED WITH AN ARCHITECTURAL FINISH SIMILAR TO CUSTOMROCK FORMLINER PATTERN #2001 - FLAT RANDOM STONE, OR EQUAL TO BE APPROVED BY THE OWNER.
22. PRECAST PANELS SHALL BE LAID OUT SO THAT THE HORIZONTAL JOINTS BETWEEN PANELS ARE ALIGNED BETWEEN CONSECUTIVE SOLDIER PILES. THE CONTRACTOR SHALL PREPARE SHOP DRAWINGS FOR REVIEW AND APPROVAL BY THE ENGINEER AND OWNER THAT ILLUSTRATE THE PANEL SIZES AND LAYOUT OF HORIZONTAL JOINTS.
23. PRECAST CAPS SHALL BE PROVIDED OVER THE TOPS OF THE SOLDIER PILES AND PRECAST LAGGING PANELS. PRECAST PANEL COVERS SHALL BE PROVIDED TO COVER EXPOSED FLANGES OF SOLDIER PILES. THE CONTRACTOR SHALL PREPARE SHOP DRAWINGS FOR THE PRECAST CAPS AND PANEL COVERS THAT ILLUSTRATE THEIR DIMENSIONS AND MEANS OF CONNECTION TO THE SOLDIER PILES FOR REVIEW AND APPROVAL OF THE DESIGN ENGINEER AND OWNER.
24. AN ANTI-GRAFFITI COATING SHALL BE APPLIED TO THE PRECAST PANELS AND SHALL CONSIST OF MONOCHEM PERMASHIELD® PREMIUM, OR EQUAL TO BE APPROVED BY THE OWNER AND DESIGN ENGINEER.
25. TEMPORARY WOOD LAGGING SHALL CONSIST OF 3" WIDE BY 8" HIGH, ROUGH CUT, NO. 2 OR BETTER SOUTHERN YELLOW PINE OR MIXED HARDWOOD LAGGING, UNLESS NOTED OTHERWISE. TEMPORARY LAGGING SHALL BE INSTALLED INCREMENTALLY AS THE EXCAVATION PROCEEDS IN ACCORDANCE WITH OSHA CRITERIA.
26. EXCAVATION AND DISTURBANCE OF THE BEDROCK BELOW THE PRECAST CONCRETE LAGGING AND HORIZONTAL BEDROCK EXCAVATION BETWEEN THE SOLDIER PILES SHALL BE MINIMIZED.
27. PREFABRICATED DRAINAGE COMPOSITE (MIRAFI G200N OR APPROVED EQUAL) SHALL BE PROVIDED BETWEEN THE PRECAST CONCRETE LAGGING AND TEMPORARY WOOD LAGGING/BEDROCK EXCAVATION/BACKFILL.
28. PLATE STEEL, STEEL ANGLES, THREADED RODS, AND PLATE WASHERS FOR CLAMPING WOOD LAGGING TO SOLDIER PILES SHALL CONFORM TO ASTM A36 (F_Y = 36 KSI).
29. ALL WELDING MATERIALS AND PROCEDURES SHALL CONFORM TO AWS D1.1 "STRUCTURAL WELDING CODE". ALL WELDING ELECTRODES SHALL HAVE A MINIMUM TENSILE STRENGTH OF 70 KSI. ALL FIELD WELDS SHALL BE VISUALLY REVIEWED BY A CERTIFIED WELDING INSPECTOR, OR A QUALIFIED REPRESENTATIVE THEREOF, EXCLUSIVE OF TACK WELDING.
30. ANY VOIDS BEHIND THE LAGGING SHALL BE FILLED WITH CLEAN NO. 57 STONE.
31. CLAY BACKFILL SHALL CONSIST OF CLEAN LEAN CLAY SOILS, CLASSIFYING AS CL ACCORDING TO THE UNIFIED SOIL CLASSIFICATION SYSTEM (USCS) WITH A MAXIMUM LIQUID LIMIT OF 45% AND A MAXIMUM PLASTICITY INDEX OF 24%. CLAY BACKFILL SHALL BE COMPACTED TO AT LEAST 98 PERCENT OF THE STANDARD PROCTOR MAXIMUM DRY DENSITY (ASTM D698). BEDROCK SHALL BE EXCLUDED FROM CLAY BACKFILL.
32. WALK-BEHIND COMPACTORS SHALL BE USED FOR COMPACTION WITHIN THE LIMITING HORIZONTAL DISTANCE BEHIND THE BACK OF THE WALL, WHERE THE LIMITING HORIZONTAL DISTANCE IS DEFINED AS THE GREATER OF 5 FEET AND 50 PERCENT OF THE EXPOSED WALL HEIGHT. HEAVY EQUIPMENT SHALL ALSO NOT BE PERMITTED OR OPERATED WITHIN THIS LIMITING HORIZONTAL DISTANCE.
33. NON-WOVEN DRAINAGE GEOTEXTILE SHALL CONSIST OF MIRAFI 140N OR AN APPROVED EQUIVALENT.
34. DISTURBED AREAS SHALL BE SEEDED AND COVERED WITH A TEMPORARY EROSION CONTROL MAT, CONFORMING TO ODOT CMS ITEM 712.11, UNLESS OTHERWISE NOTED ON THE CIVIL PLANS.
35. REFER TO THE CIVIL PLANS FOR RESTORATION OF ANY PAVEMENT DAMAGED BY THE SOLDIER PILE AND LAGGING WALL CONSTRUCTION.
36. REFER TO THE BORING LOGS ON SHEET 10 OF THESE PROJECT PLANS FOR SUBSURFACE INFORMATION, AS WELL AS THE HISTORIC BORING INFORMATION ON SHEETS 11 AND 12.
37. TERRACON HAS DESIGNED THE SOLDIER PILE AND LAGGING WALL TO SUPPORT THE LATERAL EARTH PRESSURES GENERATED FROM THE THE PROPOSED GRADES SHOWN ON THE PROJECT PLANS PLUS ADDITIONAL MATERIAL THAT MAY ACCUMULATE UP TO THE THE TOP OF THE WALL FROM FUTURE UPSLOPE INSTABILITY AND A 2-FOOT-TALL TOE BULGE THAT MAY DEVELOP ABOVE THE TOP OF THE WALL. THE OWNER IS RESPONSIBLE FOR REGULAR SITE VISITS TO EVALUATE IF MATERIAL IS BEGINNING TO BUILD UP BEHIND THE WALL AND EXTEND ABOVE. ONCE MATERIAL BEGINS TO BUILD ABOVE THE WALL, THE OWNER SHALL BE RESPONSIBLE FOR SCHEDULING MAINTENANCE TO REMOVE THE ACCUMULATED MATERIAL BACK TO THE PROPOSED DESIGN GRADES ABOVE THE WALL.
38. TERRACON ASSUMES NO RESPONSIBILITY FOR, BUT NOT LIMITED TO, THE FOLLOWING ITEMS:
    A. LOCATION AND PROTECTION OF EXISTING UNDERGROUND OR ABOVE GROUND UTILITIES.
    B. COORDINATION AND VERIFICATION OF DIMENSIONS AND DETAILS WITH EXISTING ON-SITE CONDITIONS.
    C. CONDITIONS OF THE JOB SITE, INCLUDING SAFETY OF PERSONS AND PROPERTY DURING CONSTRUCTION.
    D. TRAFFIC CONTROL
    E. SLOPE MOVEMENT UPSLOPE AND BEYOND THE LIMITS OF THE PROPOSED RETAINING WALL.



NOTES

1. TRENCHED UNDERDRAIN SHALL BE EXCAVATED AFTER THE NEW COMPACTED AND TESTED FILL HAS BEEN PLACED TO THE TOP OF SUBGRADE ON THE LOW SIDE OF THE WALL, AND SHALL EXPOSE THE WEEPHOLES IN THE BOTTOM PRECAST CONCRETE LAGGING PANELS OF THE SOLDIER PILE AND LAGGING WALL.
2. WEEPHOLES SHALL BE CLEANED AND CLEARED OF ANY DEBRIS PRIOR TO INSTALLING UNDERDRAIN MATERIALS.
3. THE BOTTOM OF THE EXCAVATION FOR THE TRENCHED UNDERDRAIN SHALL BE TRIMMED SMOOTH AND SLOPED TO DRAIN AT A MINIMUM OF 1 PERCENT.
4. THE CLEAN NO. 57 CRUSHED LIMESTONE SHALL CONTAIN LESS THAN 5 PERCENT FINES AND BE COMPACTED TO 75 PERCENT RELATIVE DENSITY, AS DETERMINED BY ASTM D4253 AND D4254.
5. THE CLEAN NO. 57 CRUSHED LIMESTONE SHALL BE WRAPPED WITH AN APPROVED NON-WOVEN GEOTEXTILE (E.G., MIRAFI 140N), AND SHALL BE LAPPED A MINIMUM OF 6 INCHES.
6. THE WRAPPED NO. 57 STONE SHALL BE IN CONTACT WITH EACH WEEPHOLE.
7. THE 4-INCH DIAMETER RIGID PERFORATED PVC PIPE SHALL BE SLOPED TO DRAIN AT A MINIMUM OF 1 PERCENT AND SHALL BE CONNECTED TO SOLID 6-INCH DIAMETER RIGID PVC OUTLET PIPE (OUTLET PIPE) THAT IS SLOPED TO DRAIN AT A MINIMUM OF 1 PERCENT TOWARD PROPOSED/EXISTING STORM SEWER SYSTEM. THE OUTLET PIPES SHALL BE LOCATED AT LEAST 1 FOOT ABOVE THE OUTLET INVERT OF THE STORM SEWER STRUCTURES THAT THEY CONNECT TO.
8. THE PERFORATED AND SOLID PVC PIPES SHALL BE SDR 35 OR BETTER.

1/9 SOLDIER PILE WALL UNDERDRAIN DETAIL
NOT TO SCALE

REV.	DATE	BY	DESCRIPTION

GENERAL NOTES & SOLDIER PILE WALL UNDERDRAIN DETAIL

CHOICE ONE ENGINEERING CORP
WAR-SR48-6.65
SR-48 AND BUTTERWORTH ROAD
LOVELAND, OHIO

terracon Explore with us
611 LUNKEN PARK DRIVE CINCINNATI, OHIO 45226
PH. (513) 321-5816 FAX. (513) 321-4540

SHEET 9	
DESIGNED BY:	JDH
DRAWN BY:	RLC
APPVD. BY:	DWW
SCALE:	N.T.S.
DATE:	9/5/2025
JOB NO.	N1255021
SHEET NO.:	9 OF 12

Date: 9/5/2025 12:48 PM File Path: C:\USERS\JDHAUBER\ONEDRIVE - TERRACON CONSULTANTS INC\JDH PROJECTS\N1255021 WAR-SR48-6 65 - GENERAL\07 WORKING FILES\03 MODELS\CADIN1255021 SPL WALL PLANS.DWG

PROJECT:	WAR-SR48-6.65	DRILLING FIRM / OPERATOR:	TERRACON / C.K.	DRILL RIG:	CME-55 TRACK	STATION / OFFSET:	121+66, 5' LT.	EXPLORATION ID
TYPE:	RETAINING WALL	SAMPLING FIRM / LOGGER:	TERRACON / J.F.	HAMMER:	CME AUTOMATIC	ALIGNMENT:	SR-48	B-001-0-25
PID:	121899 SFN	DRILLING METHOD:	3.25" HSA / NQ2	CALIBRATION DATE:	12/6/24	ELEVATION:	631.6 (MSL) EOB: 10.0 ft.	PAGE
START:	6/12/25 END: 6/12/25	SAMPLING METHOD:	SPT / NQ2	ENERGY RATIO (%):	88.8	LAT / LONG:	39.273698, -84.250873	1 OF 1

MATERIAL DESCRIPTION AND NOTES	ELEV.	DEPTHS	SPT/ RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%) GR	CS	FS	SI	CL	ATTERBERG LL	PL	PI	WC	ODOT CLASS (GI)	BACK FILL
ASPHALT (11 INCHES)	630.7																	
AGGREGATE BASE (7 INCHES)	630.1																	
VERY STIFF, BROWNISH GRAY, **SILTY CLAY**, LITTLE GRAVEL, TRACE SAND			3 5 7	18	61	SS-1	4.00	18	5	1	36	40	37	20	17	18	A-6b (11)	
	627.1	TR																
SHALE WITH INTERBEDDED LIMESTONE, BROWN TO GRAY, HIGHLY TO MODERATELY WEATHERED, VERY WEAK.	626.1		3 6 22	41	44	SS-2	-	-	-	-	-	-	-	-	-	9	A-6b (V)	
INTERBEDDED SHALE (75%) AND LIMESTONE (25%); **SHALE**, GRAY, MODERATELY TO SLIGHTLY WEATHERED, WEAK, THIN TO MEDIUM BEDDED; **LIMESTONE**, GRAY, SLIGHTLY WEATHERED, MODERATELY STRONG, VERY THIN TO THIN BEDDED.			15		100	NQ2-1										6	CORE	
	621.6	EOB																

NOTES: NONE

ABANDONMENT METHODS, MATERIALS, QUANTITIES: AUGER CUTTINGS MIXED WITH BENTONITE CHIPS

PROJECT:	WAR-SR48-6.65	DRILLING FIRM / OPERATOR:	TERRACON / C.K.	DRILL RIG:	CME-55 TRACK	STATION / OFFSET:	123+17, 8' LT.	EXPLORATION ID
TYPE:	RETAINING WALL	SAMPLING FIRM / LOGGER:	TERRACON / J.F.	HAMMER:	CME AUTOMATIC	ALIGNMENT:	SR-48	B-002-0-25
PID:	121899 SFN	DRILLING METHOD:	3.25" HSA	CALIBRATION DATE:	12/6/24	ELEVATION:	640.0 (MSL) EOB: 10.0 ft.	PAGE
START:	6/12/25 END: 6/12/25	SAMPLING METHOD:	SPT	ENERGY RATIO (%):	88.8	LAT / LONG:	39.274096, -84.250747	1 OF 1

MATERIAL DESCRIPTION AND NOTES	ELEV.	DEPTHS	SPT/ RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%) GR	CS	FS	SI	CL	ATTERBERG LL	PL	PI	WC	ODOT CLASS (GI)	BACK FILL
ASPHALT (9 INCHES)	639.3																	
AGGREGATE BASE (3 INCHES)	639.0																	
LOOSE, BROWN, **GRAVEL WITH SAND**, LITTLE GRAVEL, TRACE SILT, TRACE CLAY (FILL)			14 14 21	52	67	SS-1	-	15	59	17	7	2	NP	NP	NP	13	A-1-b (0)	
	635.0	TR																
SOFT, BROWN, **SILT AND CLAY**, SOME GRAVEL, SOME SAND			9 3 4	10	100	SS-2	-	-	-	-	-	-	-	-	-	11	A-1-b (V)	
			2 1 2	4	61	SS-3	0.25	33	22	6	26	13	27	16	11	26	A-6a (1)	
SHALE WITH INTERBEDDED LIMESTONE, GRAY, MODERATELY WEATHERED, VERY WEAK.	631.0		50 50/4"	-	44	SS-4	-	-	-	-	-	-	-	-	-	5	Rock (V)	
	630.0	EOB																

NOTES: NONE

ABANDONMENT METHODS, MATERIALS, QUANTITIES: AUGER CUTTINGS MIXED WITH BENTONITE CHIPS

PROJECT:	WAR-SR48-6.65	DRILLING FIRM / OPERATOR:	TERRACON / C.K.	DRILL RIG:	CME-55 TRACK	STATION / OFFSET:	124+34, 22' LT.	EXPLORATION ID
TYPE:	RETAINING WALL	SAMPLING FIRM / LOGGER:	TERRACON / J.F.	HAMMER:	CME AUTOMATIC	ALIGNMENT:	SR-48	B-003-0-25
PID:	121899 SFN	DRILLING METHOD:	3.25" HSA / NQ2	CALIBRATION DATE:	12/6/24	ELEVATION:	646.9 (MSL) EOB: 10.3 ft.	PAGE
START:	6/12/25 END: 6/12/25	SAMPLING METHOD:	SPT / NQ2	ENERGY RATIO (%):	88.8	LAT / LONG:	39.274421, -84.250642	1 OF 1

MATERIAL DESCRIPTION AND NOTES	ELEV.	DEPTHS	SPT/ RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%) GR	CS	FS	SI	CL	ATTERBERG LL	PL	PI	WC	ODOT CLASS (GI)	BACK FILL
TOPSOIL (3 INCHES)	646.7																	
VERY STIFF, OLIVE BROWN, **SILTY CLAY**, SOME GRAVEL, SOME SAND			3 2 3	7	83	SS-1	2.75	21	14	6	29	30	38	22	16	20	A-6b (7)	
	640.9	TR	3 3 4	10	11	SS-2	3.25	-	-	-	-	-	-	-	-	9	A-6b (V)	
SHALE WITH INTERBEDDED LIMESTONE, BROWN TO GRAY, HIGHLY TO MODERATELY WEATHERED, VERY WEAK.	639.6		17 50/4"	-	100	SS-3	-	-	-	-	-	-	-	-	-	14	Rock (V)	
INTERBEDDED SHALE (70%) AND LIMESTONE (30%); **SHALE**, GRAY, MODERATELY TO SLIGHTLY WEATHERED, WEAK, THIN TO MEDIUM BEDDED; **LIMESTONE**, GRAY, SLIGHTLY WEATHERED, MODERATELY STRONG, VERY THIN TO THIN BEDDED.			11		100	NQ2-1										6	CORE	
	636.6	EOB																

NOTES: NONE

ABANDONMENT METHODS, MATERIALS, QUANTITIES: AUGER CUTTINGS MIXED WITH BENTONITE CHIPS

PROJECT:	WAR-SR48-6.65	DRILLING FIRM / OPERATOR:	TERRACON / C.K.	DRILL RIG:	CME-55 TRACK	STATION / OFFSET:	125+69, 28' LT.	EXPLORATION ID
TYPE:	RETAINING WALL	SAMPLING FIRM / LOGGER:	TERRACON / J.F.	HAMMER:	CME AUTOMATIC	ALIGNMENT:	SR-48	B-004-0-25
PID:	121899 SFN	DRILLING METHOD:	3.25" HSA	CALIBRATION DATE:	12/6/24	ELEVATION:	659.0 (MSL) EOB: 10.0 ft.	PAGE
START:	6/12/25 END: 6/12/25	SAMPLING METHOD:	SPT	ENERGY RATIO (%):	88.8	LAT / LONG:	39.274740, -84.250381	1 OF 1

MATERIAL DESCRIPTION AND NOTES	ELEV.	DEPTHS	SPT/ RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%) GR	CS	FS	SI	CL	ATTERBERG LL	PL	PI	WC	ODOT CLASS (GI)	BACK FILL
TOPSOIL (2 INCHES)	658.8																	
VERY STIFF, BROWN, **SILTY CLAY**, SOME SAND, TRACE GRAVEL			4 5 5	15	83	SS-1	3.00	2	12	15	38	33	34	17	17	16	A-6b (10)	
	653.0	TR	3 4 5	13	50	SS-2	3.50	-	-	-	-	-	-	-	-	24	A-6b (V)	
SHALE WITH INTERBEDDED LIMESTONE, BROWN TO GRAY, HIGHLY TO MODERATELY WEATHERED, VERY WEAK TO WEAK.			9 11 19	44	83	SS-3	-	-	-	-	-	-	-	-	-	18	Rock (V)	
	649.0	EOB	28 50/3"	-	100	SS-4	-	-	-	-	-	-	-	-	-	16	Rock (V)	

NOTES: NONE

ABANDONMENT METHODS, MATERIALS, QUANTITIES: AUGER CUTTINGS MIXED WITH BENTONITE CHIPS

PROJECT:	WAR-SR48-6.65	DRILLING FIRM / OPERATOR:	TERRACON / C.K.	DRILL RIG:	CME-55 TRACK	STATION / OFFSET:	127+14, 14' LT.	EXPLORATION ID
TYPE:	RETAINING WALL	SAMPLING FIRM / LOGGER:	TERRACON / J.F.	HAMMER:	CME AUTOMATIC	ALIGNMENT:	SR-48	B-005-0-25
PID:	121899 SFN	DRILLING METHOD:	3.25" HSA / NQ2	CALIBRATION DATE:	12/6/24	ELEVATION:	660.8 (MSL) EOB: 10.0 ft.	PAGE
START:	6/12/25 END: 6/12/25	SAMPLING METHOD:	SPT / NQ2	ENERGY RATIO (%):	88.8	LAT / LONG:	39.275037, -84.250026	1 OF 1

MATERIAL DESCRIPTION AND NOTES	ELEV.	DEPTHS	SPT/ RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%) GR	CS	FS	SI	CL	ATTERBERG LL	PL	PI	WC	ODOT CLASS (GI)	BACK FILL
ASPHALT (10 INCHES)	660.0																	
AGGREGATE BASE (8 INCHES)	659.3																	
VERY STIFF, OLIVE GRAY, **SILT AND CLAY**, SOME GRAVEL, LITTLE SAND	658.3	TR	11 50/4"	-	94	SS-1	4.00	25	10	4	34	27	30	17	13	15	A-6a (6)	
SHALE WITH INTERBEDDED LIMESTONE, BROWNISH GRAY TO GRAY, HIGHLY TO MODERATELY WEATHERED, VERY WEAK.	656.2		35 50/1"	-	100	SS-2	-	-	-	-	-	-	-	-	-	10	Rock (V)	
INTERBEDDED SHALE (80%) AND LIMESTONE (20%); **SHALE**, GRAY, MODERATELY TO SLIGHTLY WEATHERED, WEAK, THIN TO MEDIUM BEDDED; **LIMESTONE**, GRAY, SLIGHTLY WEATHERED, MODERATELY STRONG, VERY THIN TO THIN BEDDED.			0		80	NQ2-1										5	CORE	
			68		100	NQ2-2										8	CORE	
	650.8	EOB																

NOTES: NONE

ABANDONMENT METHODS, MATERIALS, QUANTITIES: AUGER CUTTINGS MIXED WITH BENTONITE CHIPS

PROJECT:	WAR-SR48-6.65	DRILLING FIRM / OPERATOR:	TERRACON / C.K.	DRILL RIG:	CME-55 TRACK	STATION / OFFSET:	128+37, 13' LT.	EXPLORATION ID
TYPE:	RETAINING WALL	SAMPLING FIRM / LOGGER:	TERRACON / J.F.	HAMMER:	CME AUTOMATIC	ALIGNMENT:	SR-48	B-006-0-25
PID:	121899 SFN	DRILLING METHOD:	3.25" HSA / NQ2	CALIBRATION DATE:	12/6/24	ELEVATION:	665.1 (MSL) EOB: 16.2 ft.	PAGE
START:	6/11/25 END: 6/11/25	SAMPLING METHOD:	SPT / NQ2	ENERGY RATIO (%):	88.8	LAT / LONG:	39.275273, -84.249708	1 OF 1

MATERIAL DESCRIPTION AND NOTES	ELEV.	DEPTHS	SPT/ RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%) GR	CS	FS	SI	CL	ATTERBERG LL	PL	PI	WC	ODOT CLASS (GI)	BACK FILL
ASPHALT (7 INCHES)	664.5																	
AGGREGATE BASE (6 INCHES)	664.0																	
DENSE TO VERY DENSE, BROWNISH GRAY, **GRAVEL WITH SAND**, TRACE SILT, TRACE CLAY (FILL)			12 28 9	55	78	SS-1	-	16	55	20	7	2	NP	NP	NP	5	A-1-b (0)	
	660.6	TR	7 6 25	46	78	SS-2	-	-	-	-	-	-	-	-	-	11	A-1-b (V)	
SHALE WITH INTERBEDDED LIMESTONE, GRAY, MODERATELY WEATHERED, VERY WEAK.	658.9		50/2"	-	100	SS-3	-	-	-	-	-	-	-	-	-	4	Rock (V)	
INTERBEDDED SHALE (55%) AND LIMESTONE (45%); **SHALE**, GRAY, MODERATELY TO SLIGHTLY WEATHERED, WEAK, THIN TO MEDIUM BEDDED; **LIMESTONE**, GRAY, SLIGHTLY WEATHERED, MODERATELY STRONG, VERY THIN TO THIN BEDDED.			48		100	NQ2-1										6	CORE	
			17		100	NQ2-2										6	CORE	
			0		100	NQ2-3										5	CORE	
	648.9	EOB																

NOTES: NONE

ABANDONMENT METHODS, MATERIALS, QUANTITIES: AUGER CUTTINGS MIXED WITH BENTONITE CHIPS

PROJECT:	WAR-SR48-6.65	DRILLING FIRM / OPERATOR:	TERRACON / C.K.	DRILL RIG:	CME-55 TRACK	STATION / OFFSET:	129+82, 12' LT.	EXPLORATION ID
TYPE:	RETAINING WALL	SAMPLING FIRM / LOGGER:	TERRACON / J.F.	HAMMER:	CME AUTOMATIC	ALIGNMENT:	SR-48	B-007-0-25
PID:	121899 SFN	DRILLING METHOD:	3.25" HSA / NQ2	CALIBRATION DATE:	12/6/24	ELEVATION:	668.4 (MSL) EOB: 12.3 ft.	PAGE
START:	6/11/25 END: 6/11/25	SAMPLING METHOD:	SPT / NQ2	ENERGY RATIO (%):	88.8	LAT / LONG:	39.275501, -84.249279	1 OF 1

MATERIAL DESCRIPTION AND NOTES	ELEV.	DEPTHS	SPT/ RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%) GR	CS	FS	SI	CL	ATTERBERG LL	PL	PI	WC	ODOT CLASS (GI)	BACK FILL
ASPHALT (9 INCHES)	667.7																	
AGGREGATE BASE (6 INCHES)	667.4																	
VERY STIFF, GRAY, **SILT AND CLAY**, SOME GRAVEL, SOME SAND	666.5	TR	4 8 50/3"	-	100	SS-1	4.00	28	20	4	21	27	31	16	15	13	A-6a (4)	
SHALE WITH INTERBEDDED LIMESTONE, GRAY, MODERATELY WEATHERED, VERY WEAK.	666.1		45		100	NQ2-1										7	CORE	
INTERBEDDED SHALE (70%) AND LIMESTONE (30%); **SHALE**, GRAY, MODERATELY TO SLIGHTLY WEATHERED, WEAK, THIN TO MEDIUM BEDDED; **LIMESTONE**, GRAY, SLIGHTLY WEATHERED, MODERATELY STRONG, VERY THIN TO THIN BEDDED.			70		100	NQ2-2										5	CORE	
			58		94	NQ2-3										5	CORE	
	656.1	EOB																

NOTES: NONE

ABANDONMENT METHODS, MATERIALS, QUANTITIES: AUGER CUTTINGS MIXED WITH BENTONITE CHIPS

PROJECT:	WAR-SR48-6.65	DRILLING FIRM / OPERATOR:	TERRACON / C.K.	DRILL RIG:	CME-55 TRACK	STATION / OFFSET:	131+37, 14' LT.	EXPLORATION ID
TYPE:	RETAINING WALL	SAMPLING FIRM / LOGGER:	TERRACON / J.F.	HAMMER:	CME AUTOMATIC	ALIGNMENT:	SR-48	B-008-0-25
PID:	121899 SFN	DRILLING METHOD:	3.25" HSA / NQ2	CALIBRATION DATE:	12/6/24	ELEVATION:	670.3 (MSL) EOB: 14.3 ft.	PAGE
START:	6/11/25 END: 6/11/25	SAMPLING METHOD:	SPT / NQ2	ENERGY RATIO (%):	88.8	LAT / LONG:	39.275682, -84.248775	1 OF 1

MATERIAL DESCRIPTION AND NOTES	ELEV.	DEPTHS	SPT/ RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%) GR	CS	FS	SI	CL	ATTERBERG LL	PL	PI	WC	ODOT CLASS (GI)	BACK FILL
ASPHALT (10 INCHES)	669.5																	
AGGREGATE BASE (10 INCHES)	668.6																	
SHALE WITH INTERBEDDED LIMESTONE, GRAY, MODERATELY WEATHERED, VERY WEAK.			12 16 28	65	100	SS-1	-	-	-	-	-	-	-	-	-	9	Rock (V)	
	666.0	TR	36 50/3"	-	22	SS-2	-	-	-	-	-	-	-	-	-	4	Rock (V)	
INTERBEDDED SHALE (70%) AND LIMESTONE (30%); **SHALE**, GRAY, MODERATELY TO SLIGHTLY WEATHERED, WEAK, THIN TO MEDIUM BEDDED; **LIMESTONE**, GRAY, SLIGHTLY WEATHERED, MODERATELY STRONG, VERY THIN TO THIN BEDDED.			30		88	NQ2-1										0	CORE	
			10		80	NQ2-2										7	CORE	
	656.0	EOB																

NOTES: NONE

ABANDONMENT METHODS, MATERIALS, QUANTITIES: AUGER CUTTINGS MIXED WITH BENTONITE CHIPS

REV.	DATE	BY	DESCRIPTION

2025 BORING LOGS

WAR-SR48-6.65

CHOICE ONE ENGINEERING CORP

SR-48 AND BUTTERWORTH ROAD

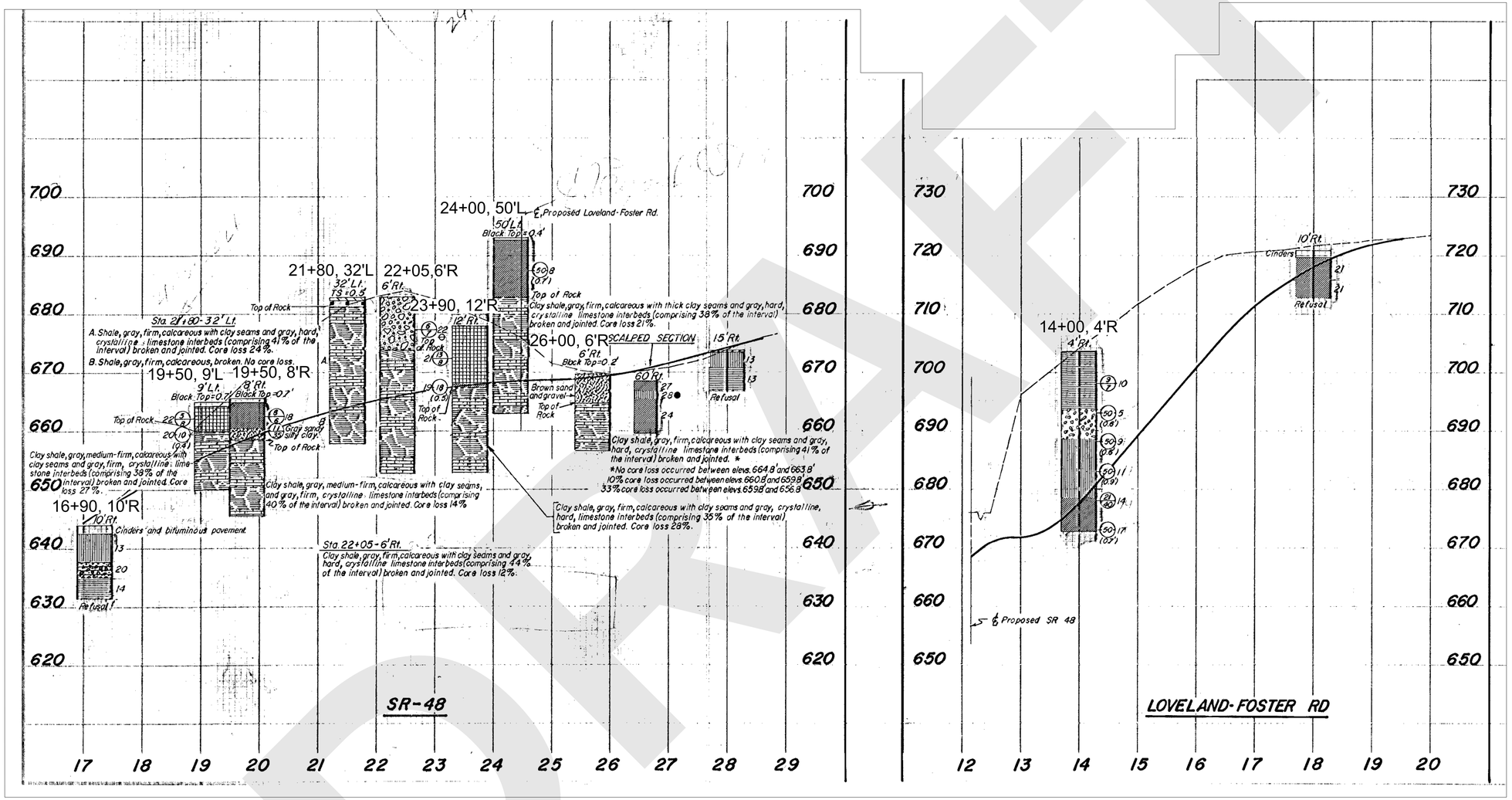
LOVELAND, OHIO

Terracon Explore with us

611 LUNKEN PARK DRIVE CINCINNATI, OHIO 45226

PH. (513) 321-5816 FAX. (513) 321-4540

SHEET 10	
DESIGNED BY:	JDH
DRAWN BY:	RLC
APPVD. BY:	DWW
SCALE:	N.T.S.
DATE:	9/5/2025
JOB NO.	N1255021
SHEET NO.:	10 OF 12



REV.	DATE	BY	DESCRIPTION

HISTORIC BORING INFORMATION

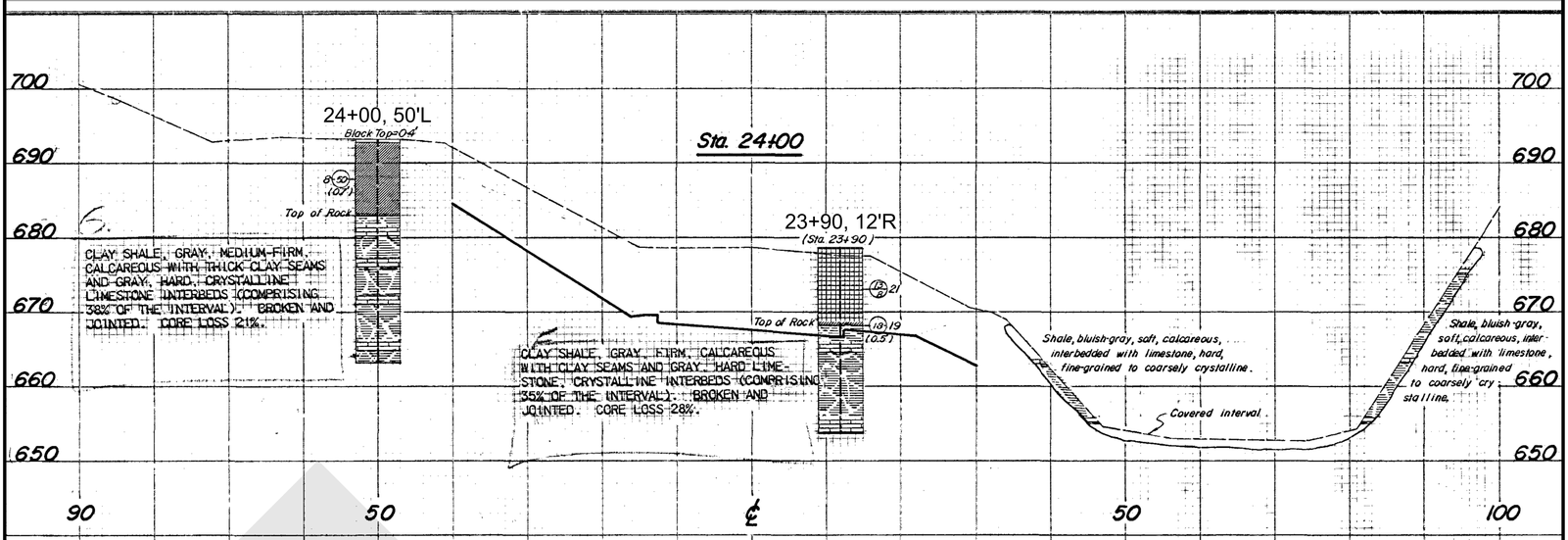
WAR-SR48-6.65

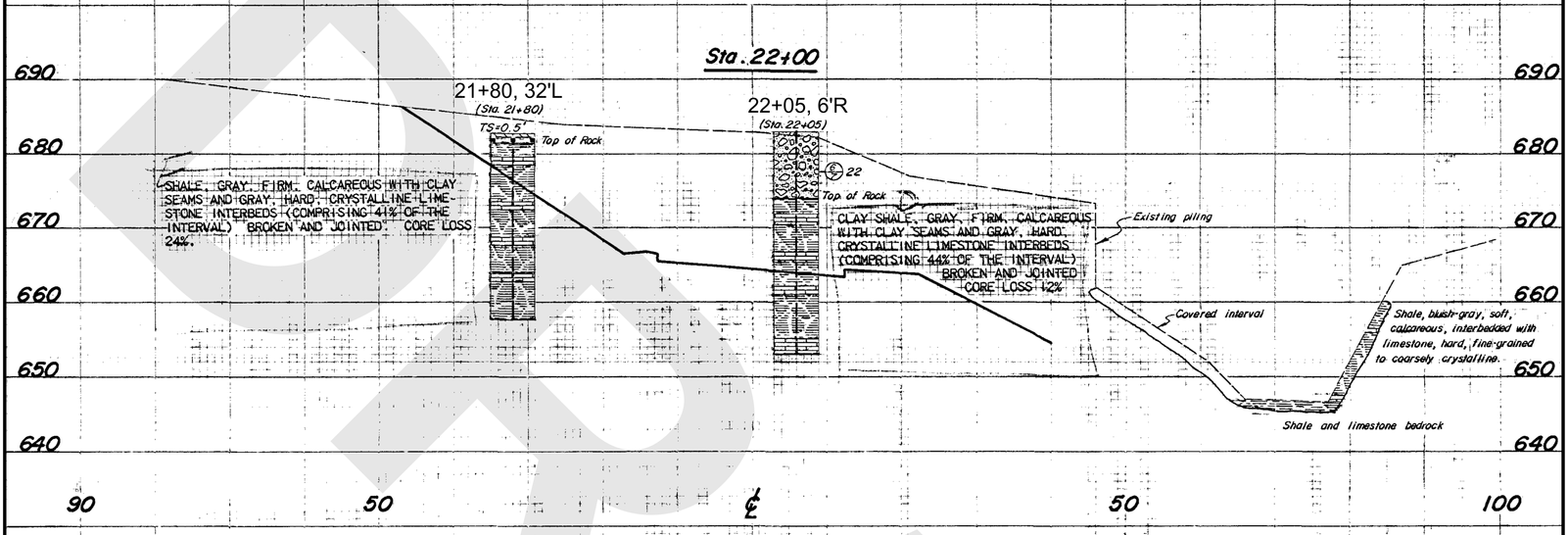
CHOICE ONE ENGINEERING CORP

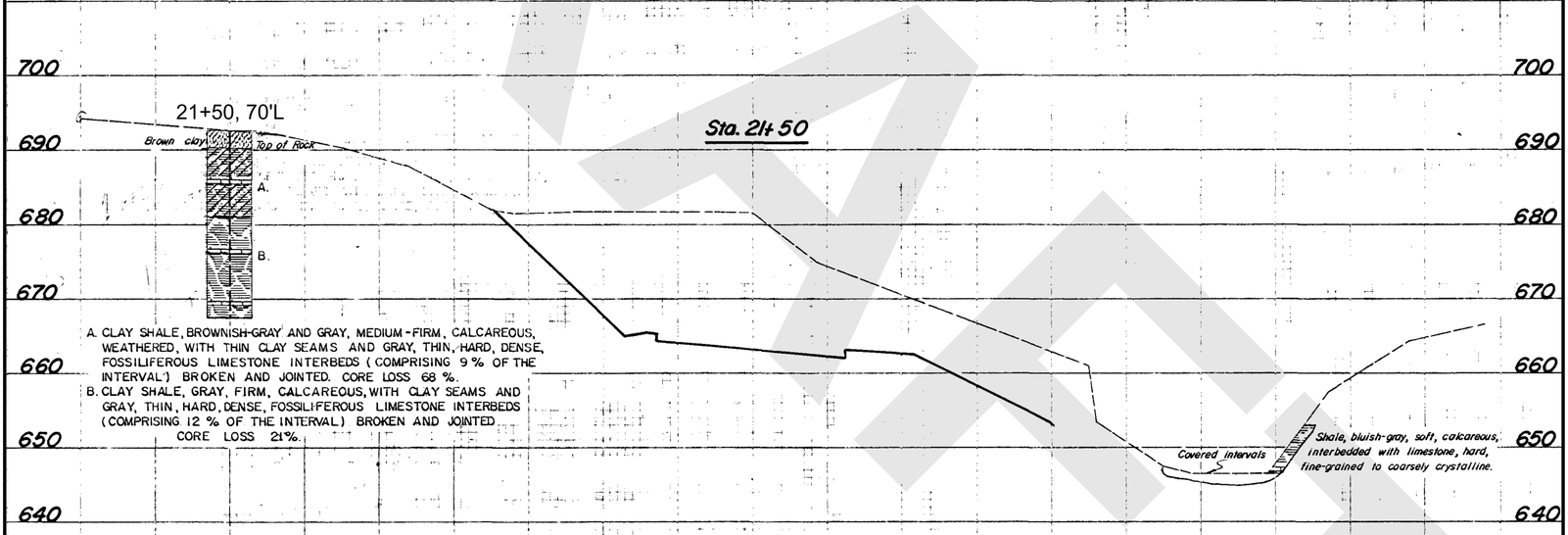
SR-48 AND BUTTERWORTH ROAD
LOVELAND, OHIO

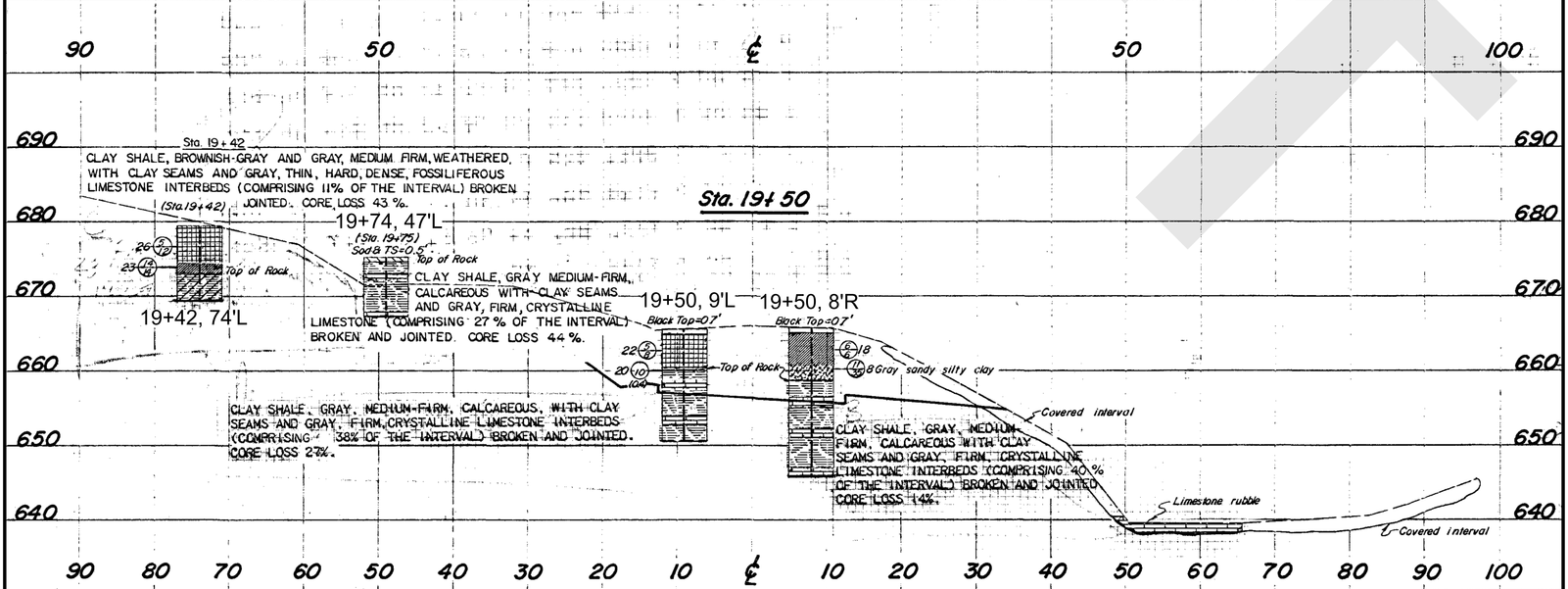
Terracon
Explore with us
611 LUNKEN PARK DRIVE
CINCINNATI, OHIO 45226
PH. (513) 321-5816
FAX. (513) 321-4540

SHEET 11	
DESIGNED BY:	JDH
DRAWN BY:	RLC
APPVD. BY:	DWW
SCALE:	N.T.S.
DATE:	9/5/2025
JOB NO.	N1255021
SHEET NO.:	11 OF 12









DESIGNED BY:	JDH
DRAWN BY:	RLC
APPVD BY:	DMW
SCALE:	N.T.S.
DATE:	9/5/2025
JOB NO.	N1255021
SHEET NO.	12 OF 12

SHEET 12

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HISTORIC BORING INFORMATION

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SR-48 AND BUTTERWORTH ROAD
LOVELAND, OHIO

REV.	DATE	BY	DESCRIPTION