

INTERSTATE 295 OVER  
VERANDA STREET  
BRIDGE REPLACEMENT

WIN 21745.00

City of Portland  
Cumberland County  
Maine

GEOTECHNICAL  
DESIGN  
CALCULATIONS  
PACKAGE

APRIL 2, 2020

PREPARED FOR

**Maine Department of  
Transportation**

16 State House Station  
Augusta, Maine 04333

PREPARED BY

**HNTB Corporation**  
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GEOTECHNICAL DESIGN CALCULATIONS PACKAGE  
INTERSTATE 295 #5933 OVER VERANDA STREET  
PORTLAND, MAINE  
WIN 21745.00

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|         |                                 |            |            |                |         |
|---------|---------------------------------|------------|------------|----------------|---------|
| For     | MEDOT I-295 over Veranda Street | Job no.    | 75297      | Sheet no.      | 1 of 92 |
| Made by | ACP                             | Checked by | JCJ        | Backchecked by | .       |
| Date    | 11/12/2019                      | Date       | 03/20/2020 | Date           | .       |



# MAINEDOT I-295 OVER VERANDA STREET

## FOUNDATION ANALYSIS FOR FINAL DESIGN

### ABUTMENT FB-MULTIPLIER PILE GROUP CALCULATIONS

# **ABUTMENT DESIGN LOAD COMBINATIONS**



|           |                               |         |          |                  |
|-----------|-------------------------------|---------|----------|------------------|
| Calc. for | Veranda Street Superstructure | Job No. | 75297    | Sheet No. 1 of 1 |
| Made by   | HJW                           | Date    | 09/05/19 |                  |
| Chkd by   | NMW                           | Date    | 09/06/19 |                  |



#### **UNFACTORED BEARING REACTION SUMMARY - ABUTMENT 1**

Note: Bearing reactions provided by Structural engineer, included for reference.

#### **DEAD LOAD REACTIONS**

|                                |       | <u>Southbound</u> |       |       |       |       |       |
|--------------------------------|-------|-------------------|-------|-------|-------|-------|-------|
| Girder #                       | Units | G01               | G02   | G03   | G04   | G05   | G06   |
| Unfactored Reactions           |       |                   |       |       |       |       |       |
| Vertical Forces                |       |                   |       |       |       |       |       |
| Dead Load, Bridge              | kip   | 48.20             | 55.40 | 55.60 | 54.60 | 49.80 | 54.20 |
| Dead Load, Approach Slab       | kip   | 29.29             | 29.29 | 29.29 | 29.29 | 29.29 | 29.29 |
| Total Dead Load                | kip   | 77.49             | 84.69 | 84.89 | 83.89 | 79.09 | 83.49 |
|                                |       |                   |       |       |       |       |       |
| Wearing Surface, Bridge        |       | 12.10             | 11.80 | 11.70 | 11.90 | 12.20 | 12.00 |
| Wearing Surface, Approach Slab | kip   | 8.66              | 8.66  | 8.66  | 8.66  | 8.66  | 8.66  |
| Wearing Surface, Total         | kip   | 20.76             | 20.46 | 20.36 | 20.56 | 20.86 | 20.66 |
|                                |       |                   |       |       |       |       |       |
| Earth Vertical Approach Slab   | kip   | 25.79             | 25.79 | 25.79 | 25.79 | 25.79 | 25.79 |
|                                |       |                   |       |       |       |       |       |
|                                |       | <u>Northbound</u> |       |       |       |       |       |
| Girder #                       | Units | G11               | G12   | G13   | G14   | G15   | G16   |
| Unfactored Reactions           |       |                   |       |       |       |       |       |
| Vertical Forces                |       |                   |       |       |       |       |       |
| Dead Load, Bridge              | kip   | 46.70             | 54.30 | 55.80 | 55.90 | 55.00 | 50.80 |
| Dead Load, Approach Slab       | kip   | 29.29             | 29.29 | 29.29 | 29.29 | 29.29 | 29.29 |
| Total Dead Load                | kip   | 75.99             | 83.59 | 85.09 | 85.19 | 84.29 | 80.09 |
|                                |       |                   |       |       |       |       |       |
| Wearing Surface                | kip   | 12.10             | 12.10 | 11.80 | 11.70 | 12.00 | 12.20 |
| Wearing Surface, Approach Slab | kip   | 8.66              | 8.66  | 8.66  | 8.66  | 8.66  | 8.66  |
| Wearing Surface, Total         | kip   | 20.76             | 20.76 | 20.46 | 20.36 | 20.66 | 20.86 |
|                                |       |                   |       |       |       |       |       |
| Earth Vertical Approach Slab   | kip   | 25.79             | 25.79 | 25.79 | 25.79 | 25.79 | 25.79 |

#### **LIVE LOAD REACTIONS**

##### 2-LANE LIVE LOAD REACTIONS FROM BDGS

|                         |     | <u>Southbound</u> |        |        |        |        |        |
|-------------------------|-----|-------------------|--------|--------|--------|--------|--------|
|                         |     | G01               | G02    | G03    | G04    | G05    | G06    |
| Max Truck, Bridge       | kip | 86.60             | 65.80  | 65.50  | 63.20  | 74.30  | 63.00  |
| Max Lane, Bridge        | kip | 17.00             | 17.40  | 17.20  | 17.60  | 19.30  | 17.20  |
| Max Lane, Approach Slab | kip | 6.72              | 6.72   | 6.72   | 6.72   | 6.72   | 6.72   |
| Live Load (no impact)   | kip | 110.32            | 89.92  | 89.42  | 87.52  | 100.32 | 86.92  |
| Live Load (impact)      | kip | 138.90            | 111.63 | 111.04 | 108.38 | 124.84 | 107.71 |
|                         |     |                   |        |        |        |        |        |
|                         |     | <u>Northbound</u> |        |        |        |        |        |
|                         |     | G11               | G12    | G13    | G14    | G15    | G16    |
| Max Truck               | kip | 65.90             | 63.50  | 69.60  | 64.50  | 65.30  | 73.30  |
| Max Lane                | kip | 16.80             | 17.70  | 17.20  | 17.00  | 17.60  | 20.10  |
| Max Lane, Approach Slab | kip | 6.72              | 6.72   | 6.72   | 6.72   | 6.72   | 6.72   |
| Live Load (no impact)   | kip | 89.42             | 87.92  | 93.52  | 88.22  | 89.62  | 100.12 |
| Live Load (impact)      | kip | 111.17            | 108.88 | 116.49 | 109.51 | 111.17 | 124.31 |

##### 3-LANE HORIZONTAL LIVE LOAD FORCES

|  |     |       |       |       |       |       |       |
|--|-----|-------|-------|-------|-------|-------|-------|
| Braking (Along Girders)                | kip | 9.56  | 9.56  | 9.56  | 9.56  | 9.56  | 9.56  |
| Centrifugal (Perpendicular to Girders) | kip | 10.84 | 10.84 | 10.84 | 10.84 | 10.84 | 10.84 |

#### **LIVE LOAD CASES**

CASE 1 - 3 Lanes Loaded, NB only loaded  
CASE 2 - 3 Lanes Loaded, SB only loaded  
CASE 3 - 6 Lanes Loaded, braking NB Only  
CASE 4 - 6 Lanes Loaded, braking SB Only

Note: Bearing reactions provided by Structural engineer, included for reference.

**CASE 1 DEMANDS** NB LOADED ONLY, 3 LANES

| <u>Southbound</u>                          |     | G01   | G02   | G03   | G04   | G05   | G06    |
|--|-----|-------|-------|-------|-------|-------|--------|
| Vertical Live Load (impact)                | kip | 0     | 0     | 0     | 0     | 0     | 0      |
| Vertical Live Load (no impact)             | kip | 0     | 0     | 0     | 0     | 0     | 0      |
| Braking (Abutment longitudinal)            | kip | 0     | 0     | 0     | 0     | 0     | 0      |
| Braking (Abutment transverse)              | kip | 0     | 0     | 0     | 0     | 0     | 0      |
| Centrifugal (Abutment longitudinal)        | kip | 0     | 0     | 0     | 0     | 0     | 0      |
| Centrifugal (Abutment transverse)          | kip | 0     | 0     | 0     | 0     | 0     | 0      |
| <u>Northbound</u>                          |     |       |       |       |       |       |        |
| Vertical Live Load (impact)                | kip | 94.49 | 92.54 | 99.01 | 93.08 | 94.49 | 105.66 |
| Vertical Live Load (no impact)             | kip | 76.01 | 74.73 | 79.49 | 74.99 | 76.18 | 85.10  |
| Braking (Abutment longitudinal)            | kip | 4.78  | 4.78  | 4.78  | 4.78  | 4.78  | 4.78   |
| Braking (Abutment transverse)              | kip | 8.28  | 8.28  | 8.28  | 8.28  | 8.28  | 8.28   |
| Centrifugal Only (Abutment longitudinal)   | kip | 9.39  | 9.39  | 9.39  | 9.39  | 9.39  | 9.39   |
| Centrifugal Only (Abutment transverse)     | kip | -5.42 | -5.42 | -5.42 | -5.42 | -5.42 | -5.42  |
| Braking + Centrifugal (Abut. Longitudinal) | kip | 14.17 | 14.17 | 14.17 | 14.17 | 14.17 | 14.17  |
| Braking + Centrifugal (Abut. Transverse)   | kip | 2.86  | 2.86  | 2.86  | 2.86  | 2.86  | 2.86   |

**CASE 3 DEMANDS** NB + SB LOADED, 6 LANES, BRAKING NB ONLY

| <u>Southbound</u>                          |     | G01   | G02   | G03   | G04   | G05   | G06   |
|--|-----|-------|-------|-------|-------|-------|-------|
| Vertical Live Load (impact)                | kip | 90.28 | 72.56 | 72.17 | 70.44 | 81.15 | 70.01 |
| Vertical Live Load (no impact)             | kip | 71.71 | 58.45 | 58.12 | 56.89 | 65.21 | 56.50 |
| Braking (Abutment longitudinal)            | kip | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  |
| Braking (Abutment transverse)              | kip | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  |
| Centrifugal (Abutment longitudinal)        | kip | 7.18  | 7.18  | 7.18  | 7.18  | 7.18  | 7.18  |
| Centrifugal (Abutment transverse)          | kip | -4.14 | -4.14 | -4.14 | -4.14 | -4.14 | -4.14 |
| Braking + Centrifugal (Abut. Longitudinal) | kip | 7.18  | 7.18  | 7.18  | 7.18  | 7.18  | 7.18  |
| Braking + Centrifugal (Abut. Transverse)   | kip | -4.14 | -4.14 | -4.14 | -4.14 | -4.14 | -4.14 |

| <u>Northbound</u>                          |     | G11   | G12   | G13   | G14   | G15   | G16   |
|--|-----|-------|-------|-------|-------|-------|-------|
| Vertical Live Load (impact)                | kip | 72.26 | 70.77 | 75.72 | 71.18 | 72.26 | 80.80 |
| Vertical Live Load (no impact)             | kip | 58.12 | 57.15 | 60.79 | 57.34 | 58.25 | 65.08 |
| Braking (Abutment longitudinal)            | kip | 3.66  | 3.66  | 3.66  | 3.66  | 3.66  | 3.66  |
| Braking (Abutment transverse)              | kip | 6.33  | 6.33  | 6.33  | 6.33  | 6.33  | 6.33  |
| Centrifugal Only (Abutment longitudinal)   | kip | 7.18  | 7.18  | 7.18  | 7.18  | 7.18  | 7.18  |
| Centrifugal Only (Abutment transverse)     | kip | -4.14 | -4.14 | -4.14 | -4.14 | -4.14 | -4.14 |
| Braking + Centrifugal (Abut. Longitudinal) | kip | 10.83 | 10.83 | 10.83 | 10.83 | 10.83 | 10.83 |
| Braking + Centrifugal (Abut. Transverse)   | kip | 2.19  | 2.19  | 2.19  | 2.19  | 2.19  | 2.19  |

**THERMAL FORCES AND MOMENTS**

Note: Thermal forces may be applied in either direction

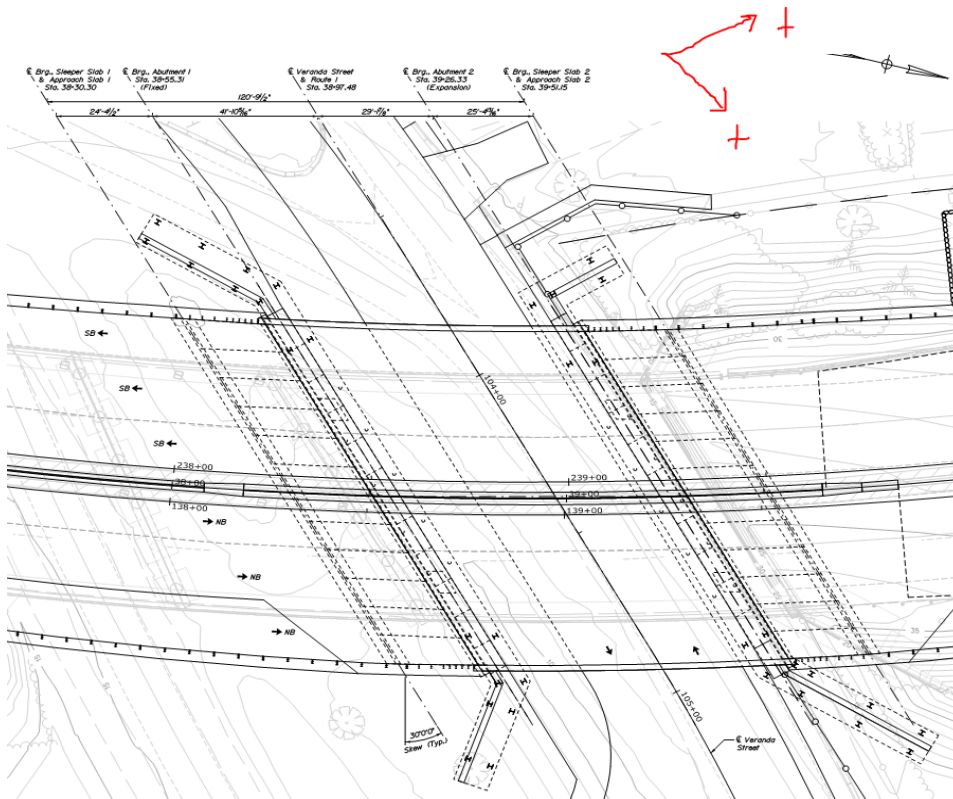
|                                    |        |       |       |       |       |       |       |
|------------------------------------|--------|-------|-------|-------|-------|-------|-------|
| Thermal Applied Moment             | kip-ft | 10.65 | 10.65 | 10.65 | 10.65 | 10.65 | 10.65 |
| Thermal Translation (Along Girder) | kip    | 7.04  | 7.04  | 7.04  | 7.04  | 7.04  | 7.04  |

| <u>Southbound</u>                           |        | G01  | G02  | G03  | G04  | G05  | G06  |
|---|--------|------|------|------|------|------|------|
| Thermal Moment (Abutment longitudinal)      | kip-ft | 5.33 | 5.33 | 5.33 | 5.33 | 5.33 | 5.33 |
| Thermal Moment (Abutment transverse)        | kip-ft | 9.22 | 9.22 | 9.22 | 9.22 | 9.22 | 9.22 |
| Thermal Translation (Abutment longitudinal) | kip    | 3.52 | 3.52 | 3.52 | 3.52 | 3.52 | 3.52 |
| Thermal Translation (Abutment transverse)   | kip    | 6.10 | 6.10 | 6.10 | 6.10 | 6.10 | 6.10 |

| <u>Northbound</u>                           |        | G11  | G12  | G13  | G14  | G15  | G16  |
|---|--------|------|------|------|------|------|------|
| Thermal Moment (Abutment longitudinal)      | kip-ft | 5.33 | 5.33 | 5.33 | 5.33 | 5.33 | 5.33 |
| Thermal Moment (Abutment transverse)        | kip-ft | 9.22 | 9.22 | 9.22 | 9.22 | 9.22 | 9.22 |
| Thermal Translation (Abutment longitudinal) | kip    | 3.52 | 3.52 | 3.52 | 3.52 | 3.52 | 3.52 |
| Thermal Translation (Abutment transverse)   | kip    | 6.10 | 6.10 | 6.10 | 6.10 | 6.10 | 6.10 |

Note on direction: the abutment longitudinal direction is along the length of the abutment breastwall (113' +/-), and the abutment transverse direction is through the width of the breastwall (4.5')

Note: Bearing reactions provided by Structural engineer, included for reference.



### Material Data

|            |        |     |  |
|------------|--------|-----|--|
| $\gamma_c$ | 150    | pcf | Unit weight of abutment concrete                             |
| $\gamma_f$ | 35     | pcf | Equivalent fluid pressure of lightweight concrete backfill   |
| $\gamma_s$ | 120    | pcf | Weight of soil backfill (for wingwalls, on top of LWC)       |
| $\Phi$     | 34     | deg | Friction angle of soil backfill                              |
| $k_a$      | 0.2827 | -   | Coefficient of active earth pressure for soil backfill       |
| $h_{c1}$   | 3      | ft  | Lightweight concrete fill lift thickness below slide surface |
| $h_{c2}$   | 3      | ft  | Lightweight concrete fill lift thickness above slide surface |

### Geometry Data

|            | Abutment | Wingwall |    |  |
|------------|----------|----------|----|--|
| El. A      | 7.61     | 7.61     | ft | Bottom of Footing Elevation                                |
| $t_f$      | 3        | 3        | ft | Thickness/Height of Footing                                |
| $w_f$      | 9        | 9        | ft | Width of Footing   |
| $w_{wall}$ | 4.5      | 1.5      | ft | Width of Abutment Wall                                     |
| El. B      | 10.61    | 10.61    | ft | Top of Footing Elevation                                   |
| El. C      | 24.07    | 24.07    | ft | Sliding Surface Elevation                                  |
| Mid El.    | 9.11     | 9.11     | ft | Mid-Height (Design) Elevation of Footing = El. A + $t_f/2$ |

## Wingwall Soil Loading Above LWC Fill

|                         | Low Side | High Side |      |
|-------------------------|----------|-----------|------|
| Soil fill height        | 2        | 7         | ft   |
| Lateral force from soil | 0.07     | 0.83      | k    |
| Moment arm              | 16.41    | 27.48     | ft   |
| Moment                  | 1.11     | 22.84     | k-ft |

#### Equivalent Fluid Pressure & Abutment Concrete Weight

|                   |                   |                 |  | Southbound   |        |        |        |        |        | Northbound |        |        |        |        |        | Wingwall |           |       |
|-------------------|-------------------|-----------------|--|--|--------|--------|--------|--------|--------|------------|--------|--------|--------|--------|--------|----------|-----------|-------|
| Bearing           |                   |                 |  | G01  | G02    | G03    | G04    | G05    | G06    | G11        | G12    | G13    | G14    | G15    | G16    | Low Side | High Side |       |
| Pre-Slide         | EL /              | ft              | Bearing "I" Elevation                                      | 28.69  | 29.32  | 29.96  | 30.59  | 31.22  | 31.86  | 31.46      | 32.09  | 32.73  | 33.37  | 34.01  | 34.65  | 23.35    | 32.76     |       |
|                   | $\Delta x_i$      | ft              | Bearing "I" Moment Arm above Mid EL = (EL /I) - (Mid EL)   | 19.58  | 20.21  | 20.85  | 21.48  | 22.12  | 22.75  | 22.35      | 22.98  | 23.62  | 24.26  | 24.9   | 25.54  | -        | -         |       |
|                   | $\Delta y_i$      | ft              | Bearing "I" Tributary Abutment Width (Per Bearing Spacing) | 17.58  | 9.81   | 9.81   | 9.81   | 9.81   | 7.66   | 7.66       | 9.81   | 9.81   | 9.81   | 9.81   | 24.81  | 14.78    | 1.00      | 1.00  |
|                   | H <sub>C1</sub>   | ft              | Total height of concrete to be placed up to slide EL       | 16.46  | 16.46  | 16.46  | 16.46  | 16.46  | 16.46  | 16.46      | 16.46  | 16.46  | 16.46  | 16.46  | 16.46  | 16.46    | 15.74     | 16.46 |
|                   | Z <sub>F</sub>    | k               | Total shear force from fluid pressure per girder segment   | 14.50  | 8.09   | 8.09   | 8.09   | 8.09   | 6.31   | 6.31       | 8.09   | 8.09   | 8.09   | 8.09   | 8.09   | 12.19    | 0.80      | 0.82  |
|                   | Z <sub>M</sub>    | k-k ft          | Total moment from fluid pressure per girder segment        | 107.07   | 59.76  | 59.76  | 59.76  | 59.76  | 46.63  | 46.63      | 59.76  | 59.76  | 59.76  | 59.76  | 59.76  | 90.01    | 5.66      | 6.09  |
|                   | V <sub>abut</sub> | k               | Weight of abutment wall per girder segment                 | 159.72   | 89.15  | 89.15  | 89.15  | 89.15  | 69.56  | 69.56      | 89.15  | 89.15  | 89.15  | 89.15  | 89.15  | 134.28   | 3.03      | 3.03  |
|                   | Post Slide        | H <sub>C2</sub> | ft   | Total height of concrete to be placed up to bearing EL   | 4.62   | 5.25   | 5.89   | 6.52   | 7.15   | 7.79       | 7.39   | 8.02   | 8.66   | 9.3    | 9.94   | 10.58    | 0         | 8.69  |
|                   |                   | Z <sub>F</sub>  | k  | Total shear force from fluid pressure per girder segment | 18.08  | 10.51  | 11.07  | 11.23  | 11.41  | 9.16       | 8.99   | 11.88  | 12.40  | 12.75  | 12.88  | 19.82    | 0.86      | 2.10  |
|                   |                   | Z <sub>M</sub>  | k-k ft   | Total moment from fluid pressure per girder segment      | 112.69 | 64.57  | 66.99  | 67.77  | 68.94  | 55.49      | 54.33  | 72.16  | 75.85  | 78.45  | 79.72  | 124.10   | 6.77      | 30.59 |
| V <sub>abut</sub> |                   | k               | Weight of abutment wall per girder segment                 | 214.55   | 123.92 | 128.16 | 132.34 | 136.51 | 109.87 | 107.75     | 142.27 | 146.51 | 150.75 | 154.99 | 239.84 | 9.95     | 19.68     |       |

### Pre-Slide Calculations

[illegible]

### Post-Slide Calculations

| Lift No. | Concrete Lift Height above Design Elevation, ft |      |      |      |      |      |      |      |      |      |      |       |      |      |      |      |
|----------|---|------|------|------|------|------|------|------|------|------|------|-------|------|------|------|------|
| 1        | 3.00  | 3.00 | 3.00 | 3.00 | 3.00 | 3.00 | 3.00 | 3.00 | 3.00 | 3.00 | 3.00 | 3.00  | 3.00 | 3.00 | 3.00 | 3.00 |
| 2        | 4.62  | 5.25 | 5.89 | 6.00 | 6.00 | 6.00 | 6.00 | 6.00 | 6.00 | 6.00 | 6.00 | 6.00  | 6.00 | 6.00 | 6.00 | 6.00 |
| 3        | 0.00  | 0.00 | 0.00 | 6.52 | 7.15 | 7.79 | 7.79 | 7.79 | 8.66 | 9.00 | 9.00 | 9.00  | 9.00 | 9.00 | 9.00 | 8.69 |
| 4        | 0.00  | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 9.30 | 9.94 | 10.58 | 0.00 | 0.00 | 0.00 | 0.00 |
| Lift No. | Concrete Lift Thickness, ft                     |      |      |      |      |      |      |      |      |      |      |       |      |      |      |      |
| 1        | 3.00  | 3.00 | 3.00 | 3.00 | 3.00 | 3.00 | 3.00 | 3.00 | 3.00 | 3.00 | 3.00 | 3.00  | 3.00 | 3.00 | 3.00 | 3.00 |
| 2        | 1.62  | 2.25 | 2.89 | 3.00 | 3.00 | 3.00 | 3.00 | 3.00 | 3.00 | 3.00 | 3.00 | 3.00  | 3.00 | 3.00 | 3.00 | 3.00 |
| 3        | 0.00  | 0.00 | 0.00 | 0.52 | 1.15 | 1.79 | 1.39 | 2.02 | 2.66 | 3.00 | 3.00 | 3.00  | 3.00 | 3.00 | 3.00 | 2.59 |
| 4        | 0.00  | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.30 | 0.94 | 1.58  | 0.00 | 0.00 | 0.00 | 0.00 |
| T        | 4.62  | 5.25 | 5.89 | 6.52 | 7.15 | 7.79 | 7.79 | 8.02 | 8.66 | 9.30 | 9.94 | 0.00  | 0.00 | 0.00 | 0.00 | 0.00 |
| Lift No. | Force per Concrete Lift, k/LF wall              |      |      |      |      |      |      |      |      |      |      |       |      |      |      |      |
| 1        | 0.16  | 0.16 | 0.16 | 0.16 | 0.16 | 0.16 | 0.16 | 0.16 | 0.16 | 0.16 | 0.16 | 0.16  | 0.16 | 0.16 | 0.16 | 0.16 |
| 2        | 0.05  | 0.09 | 0.15 | 0.16 | 0.16 | 0.16 | 0.16 | 0.16 | 0.16 | 0.16 | 0.16 | 0.16  | 0.16 | 0.16 | 0.16 | 0.16 |
| 3        | 0.00  | 0.00 | 0.00 | 0.00 | 0.02 | 0.06 | 0.03 | 0.07 | 0.12 | 0.16 | 0.16 | 0.16  | 0.16 | 0.16 | 0.16 | 0.13 |
| 4        | 0.00  | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.02 | 0.04  | 0.00 | 0.00 | 0.00 | 0.00 |
| T        | 0.20  | 0.25 | 0.30 | 0.32 | 0.34 | 0.37 | 0.35 | 0.39 | 0.44 | 0.47 | 0.49 | 0.52  | 0.00 | 0.00 | 0.00 | 0.44 |
| Lift No. | Concrete Lift Force Moment Arm, ft              |      |      |      |      |      |      |      |      |      |      |       |      |      |      |      |
| 1        | 1.00  | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00  | 1.00 | 1.00 | 1.00 | 1.00 |
| 2        | 3.54  | 3.75 | 3.96 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00  | 4.00 | 4.00 | 4.00 | 4.00 |
| 3        | 0.00  | 0.00 | 0.00 | 6.17 | 6.38 | 6.60 | 6.46 | 6.67 | 6.89 | 7.00 | 7.00 | 7.00  | 7.00 | 7.00 | 7.00 | 6.90 |
| 4        | 0.00  | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 9.10 | 9.31 | 9.53  | 0.00 | 0.00 | 0.00 | 0.00 |
| Lift No. | Moment, k-ft/LF wall                            |      |      |      |      |      |      |      |      |      |      |       |      |      |      |      |
| 1        | 0.16  | 0.16 | 0.16 | 0.16 | 0.16 | 0.16 | 0.16 | 0.16 | 0.16 | 0.16 | 0.16 | 0.16  | 0.16 | 0.16 | 0.16 | 0.16 |
| 2        | 0.16  | 0.33 | 0.58 | 0.63 | 0.63 | 0.63 | 0.63 | 0.63 | 0.63 | 0.63 | 0.63 | 0.63  | 0.63 | 0.63 | 0.63 | 0.63 |
| 3        | 0.00  | 0.00 | 0.00 | 0.03 | 0.15 | 0.37 | 0.22 | 0.48 | 0.85 | 1.10 | 1.10 | 1.10  | 1.10 | 1.10 | 1.10 | 0.87 |
| 4        | 0.00  | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.01 | 0.14 | 0.42  | 0.00 | 0.00 | 0.00 | 0.00 |
| T        | 0.32  | 0.49 | 0.74 | 0.82 | 0.94 | 1.16 | 1.01 | 1.26 | 1.64 | 1.90 | 2.03 | 2.31  | 0.00 | 0.00 | 0.00 | 1.66 |

**Abutment 1 - FB-Multiplier Design Loads**

Strength I

| Load Case | Load Factor | FBMP Case | Node | Fx     | Fy    | Fz     | Mx     | My     | Mz   |
|-----------|-------------|-----------|------|--------|-------|--------|--------|--------|------|
| 1         | Max         | 1         | 89   | -26.55 | 44.29 | 614.95 | 620.04 | 680.84 | 0.00 |
| 1         | Max         | 1         | 92   | -26.55 | 34.93 | 498.22 | 548.90 | 663.84 | 0.00 |
| 1         | Max         | 1         | 93   | -26.55 | 34.74 | 491.51 | 535.96 | 646.85 | 0.00 |
| 1         | Max         | 1         | 95   | -26.55 | 34.28 | 494.12 | 521.24 | 629.86 | 0.00 |
| 1         | Max         | 1         | 96   | -26.55 | 33.58 | 479.07 | 505.03 | 612.86 | 0.00 |
| 1         | Max         | 1         | 98   | -26.55 | 29.67 | 428.65 | 469.91 | 596.13 | 0.00 |
| 1         | Max         | 1         | 99   | -1.76  | 15.41 | 307.45 | 148.87 | 42.70  | 0.00 |
| 1         | Max         | 1         | 101  | -1.76  | 18.45 | 335.61 | 165.08 | 41.58  | 0.00 |
| 1         | Max         | 1         | 103  | -1.76  | 18.21 | 335.95 | 161.59 | 40.47  | 0.00 |
| 1         | Max         | 1         | 104  | -1.76  | 18.00 | 331.68 | 158.61 | 39.36  | 0.00 |
| 1         | Max         | 1         | 105  | -1.76  | 17.23 | 326.28 | 153.38 | 38.23  | 0.00 |
| 1         | Max         | 1         | 107  | -1.76  | 27.45 | 431.01 | 216.43 | 37.12  | 0.00 |
| 1         | Min         | 2         | 89   | -26.55 | 35.37 | 476.21 | 564.20 | 680.84 | 0.00 |
| 1         | Min         | 2         | 92   | -26.55 | 29.13 | 387.88 | 513.03 | 663.84 | 0.00 |
| 1         | Min         | 2         | 93   | -26.55 | 29.01 | 382.60 | 500.66 | 646.85 | 0.00 |
| 1         | Min         | 2         | 95   | -26.55 | 28.70 | 386.64 | 487.11 | 629.86 | 0.00 |
| 1         | Min         | 2         | 96   | -26.55 | 28.23 | 373.34 | 472.56 | 612.86 | 0.00 |
| 1         | Min         | 2         | 98   | -26.55 | 25.62 | 337.67 | 445.46 | 596.13 | 0.00 |
| 1         | Min         | 2         | 99   | -1.76  | 11.29 | 213.20 | 123.90 | 42.70  | 0.00 |
| 1         | Min         | 2         | 101  | -1.76  | 13.32 | 233.39 | 134.06 | 41.58  | 0.00 |
| 1         | Min         | 2         | 103  | -1.76  | 13.16 | 233.76 | 131.09 | 40.47  | 0.00 |
| 1         | Min         | 2         | 104  | -1.76  | 13.01 | 230.78 | 128.46 | 39.36  | 0.00 |
| 1         | Min         | 2         | 105  | -1.76  | 12.51 | 226.85 | 124.33 | 38.23  | 0.00 |
| 1         | Min         | 2         | 107  | -1.76  | 19.32 | 302.12 | 165.72 | 37.12  | 0.00 |
| 3         | Max         | 3         | 89   | -14.32 | 40.88 | 579.91 | 532.97 | 368.47 | 0.00 |
| 3         | Max         | 3         | 92   | -14.32 | 31.52 | 466.85 | 464.02 | 359.30 | 0.00 |
| 3         | Max         | 3         | 93   | -14.32 | 31.33 | 460.64 | 453.26 | 350.14 | 0.00 |
| 3         | Max         | 3         | 95   | -14.32 | 30.87 | 461.39 | 440.72 | 340.97 | 0.00 |
| 3         | Max         | 3         | 96   | -14.32 | 30.17 | 448.30 | 426.69 | 331.80 | 0.00 |
| 3         | Max         | 3         | 98   | -14.32 | 26.26 | 397.36 | 393.72 | 322.78 | 0.00 |
| 3         | Max         | 3         | 99   | -14.32 | 15.41 | 406.32 | 148.87 | 328.51 | 0.00 |
| 3         | Max         | 3         | 101  | -14.32 | 18.45 | 449.73 | 165.08 | 319.34 | 0.00 |
| 3         | Max         | 3         | 103  | -14.32 | 18.21 | 435.50 | 161.59 | 310.32 | 0.00 |
| 3         | Max         | 3         | 104  | -14.32 | 18.00 | 433.40 | 158.61 | 301.30 | 0.00 |
| 3         | Max         | 3         | 105  | -14.32 | 17.23 | 428.57 | 153.38 | 292.13 | 0.00 |
| 3         | Max         | 3         | 107  | -14.32 | 27.45 | 556.50 | 216.43 | 283.11 | 0.00 |
| 3         | Min         | 4         | 89   | -14.32 | 31.97 | 441.17 | 477.13 | 368.47 | 0.00 |
| 3         | Min         | 4         | 92   | -14.32 | 25.72 | 356.52 | 428.14 | 359.30 | 0.00 |
| 3         | Min         | 4         | 93   | -14.32 | 25.60 | 351.72 | 417.96 | 350.14 | 0.00 |
| 3         | Min         | 4         | 95   | -14.32 | 25.29 | 353.91 | 406.58 | 340.97 | 0.00 |
| 3         | Min         | 4         | 96   | -14.32 | 24.82 | 342.57 | 394.22 | 331.80 | 0.00 |
| 3         | Min         | 4         | 98   | -14.32 | 22.21 | 306.37 | 369.27 | 322.78 | 0.00 |
| 3         | Min         | 4         | 99   | -14.32 | 11.29 | 312.07 | 123.90 | 328.51 | 0.00 |
| 3         | Min         | 4         | 101  | -14.32 | 13.32 | 347.51 | 134.06 | 319.34 | 0.00 |
| 3         | Min         | 4         | 103  | -14.32 | 13.16 | 333.32 | 131.09 | 310.32 | 0.00 |
| 3         | Min         | 4         | 104  | -14.32 | 13.01 | 332.49 | 128.46 | 301.30 | 0.00 |
| 3         | Min         | 4         | 105  | -14.32 | 12.51 | 329.13 | 124.33 | 292.13 | 0.00 |
| 3         | Min         | 4         | 107  | -14.32 | 19.32 | 427.61 | 165.72 | 283.11 | 0.00 |

Strength IV

| Load Case | Load Factor | FBMP Case | Node | Fx    | Fy    | Fz     | Mx     | My    | Mz   |
|-----------|-------------|-----------|------|-------|-------|--------|--------|-------|------|
| 1/3       | Max         | 1         | 89   | -1.76 | 29.81 | 546.00 | 250.00 | 47.61 | 0.00 |
| 1/3       | Max         | 1         | 92   | -1.76 | 20.44 | 424.73 | 188.14 | 46.49 | 0.00 |
| 1/3       | Max         | 1         | 93   | -1.76 | 20.25 | 419.27 | 184.47 | 45.36 | 0.00 |
| 1/3       | Max         | 1         | 95   | -1.76 | 19.79 | 412.91 | 179.02 | 44.23 | 0.00 |
| 1/3       | Max         | 1         | 96   | -1.76 | 19.09 | 404.75 | 172.08 | 43.11 | 0.00 |
| 1/3       | Max         | 1         | 98   | -1.76 | 15.18 | 341.58 | 146.09 | 42.00 | 0.00 |
| 1/3       | Max         | 1         | 99   | -1.76 | 15.41 | 355.78 | 148.87 | 42.70 | 0.00 |
| 1/3       | Max         | 1         | 101  | -1.76 | 18.45 | 389.51 | 165.08 | 41.58 | 0.00 |
| 1/3       | Max         | 1         | 103  | -1.76 | 18.21 | 390.00 | 161.59 | 40.47 | 0.00 |
| 1/3       | Max         | 1         | 104  | -1.76 | 18.00 | 384.94 | 158.61 | 39.36 | 0.00 |
| 1/3       | Max         | 1         | 105  | -1.76 | 17.23 | 378.43 | 153.38 | 38.23 | 0.00 |
| 1/3       | Max         | 1         | 107  | -1.76 | 27.45 | 504.02 | 216.43 | 37.12 | 0.00 |
| 1/3       | Min         | 2         | 89   | -1.76 | 20.89 | 327.29 | 194.16 | 47.61 | 0.00 |
| 1/3       | Min         | 2         | 92   | -1.76 | 14.64 | 254.57 | 152.26 | 46.49 | 0.00 |
| 1/3       | Min         | 2         | 93   | -1.76 | 14.52 | 251.37 | 149.17 | 45.36 | 0.00 |
| 1/3       | Min         | 2         | 95   | -1.76 | 14.21 | 247.53 | 144.88 | 44.23 | 0.00 |
| 1/3       | Min         | 2         | 96   | -1.76 | 13.74 | 242.56 | 139.61 | 43.11 | 0.00 |
| 1/3       | Min         | 2         | 98   | -1.76 | 11.14 | 204.66 | 121.64 | 42.00 | 0.00 |
| 1/3       | Min         | 2         | 99   | -1.76 | 11.29 | 213.20 | 123.90 | 42.70 | 0.00 |
| 1/3       | Min         | 2         | 101  | -1.76 | 13.32 | 233.39 | 134.06 | 41.58 | 0.00 |
| 1/3       | Min         | 2         | 103  | -1.76 | 13.16 | 233.76 | 131.09 | 40.47 | 0.00 |
| 1/3       | Min         | 2         | 104  | -1.76 | 13.01 | 230.78 | 128.46 | 39.36 | 0.00 |
| 1/3       | Min         | 2         | 105  | -1.76 | 12.51 | 226.85 | 124.33 | 38.23 | 0.00 |
| 1/3       | Min         | 2         | 107  | -1.76 | 19.32 | 302.12 | 165.72 | 37.12 | 0.00 |

Service I

| Load Case | Load Factor | FBMP Case | Node | Fx     | Fy    | Fz     | Mx     | My     | Mz   |
|-----------|-------------|-----------|------|--------|-------|--------|--------|--------|------|
| 1         | 1.0         | 1         | 89   | -17.69 | 34.20 | 451.68 | 500.49 | 457.07 | 0.00 |
| 1         | 1.0         | 1         | 92   | -17.69 | 27.26 | 361.91 | 446.90 | 445.75 | 0.00 |
| 1         | 1.0         | 1         | 93   | -17.69 | 27.12 | 357.08 | 436.43 | 434.43 | 0.00 |
| 1         | 1.0         | 1         | 95   | -17.69 | 26.78 | 357.35 | 424.64 | 423.11 | 0.00 |
| 1         | 1.0         | 1         | 96   | -17.69 | 26.26 | 347.15 | 411.75 | 411.79 | 0.00 |
| 1         | 1.0         | 1         | 98   | -17.69 | 23.36 | 306.30 | 384.86 | 400.65 | 0.00 |
| 1         | 1.0         | 1         | 99   | -3.52  | 15.25 | 239.76 | 203.42 | 85.41  | 0.00 |
| 1         | 1.0         | 1         | 101  | -3.52  | 17.51 | 262.25 | 212.96 | 83.15  | 0.00 |
| 1         | 1.0         | 1         | 103  | -3.52  | 17.33 | 262.58 | 207.96 | 80.93  | 0.00 |
| 1         | 1.0         | 1         | 104  | -3.52  | 17.17 | 259.21 | 203.33 | 78.72  | 0.00 |
| 1         | 1.0         | 1         | 105  | -3.52  | 16.60 | 254.87 | 197.01 | 76.46  | 0.00 |
| 1         | 1.0         | 1         | 107  | -3.52  | 24.17 | 338.59 | 241.29 | 74.25  | 0.00 |
| 3         | 1.0         | 2         | 89   | -10.70 | 32.25 | 431.66 | 450.73 | 278.57 | 0.00 |
| 3         | 1.0         | 2         | 92   | -10.70 | 25.31 | 343.99 | 398.40 | 271.73 | 0.00 |
| 3         | 1.0         | 2         | 93   | -10.70 | 25.17 | 339.44 | 389.17 | 264.88 | 0.00 |
| 3         | 1.0         | 2         | 95   | -10.70 | 24.83 | 338.64 | 378.63 | 258.03 | 0.00 |
| 3         | 1.0         | 2         | 96   | -10.70 | 24.31 | 329.56 | 366.98 | 251.18 | 0.00 |
| 3         | 1.0         | 2         | 98   | -10.70 | 21.41 | 288.42 | 341.32 | 244.44 | 0.00 |
| 3         | 1.0         | 2         | 99   | -10.70 | 15.25 | 296.26 | 203.42 | 248.72 | 0.00 |
| 3         | 1.0         | 2         | 101  | -10.70 | 17.51 | 327.46 | 212.96 | 241.88 | 0.00 |
| 3         | 1.0         | 2         | 103  | -10.70 | 17.33 | 319.47 | 207.96 | 235.14 | 0.00 |
| 3         | 1.0         | 2         | 104  | -10.70 | 17.17 | 317.33 | 203.33 | 228.40 | 0.00 |
| 3         | 1.0         | 2         | 105  | -10.70 | 16.60 | 313.32 | 197.01 | 221.55 | 0.00 |
| 3         | 1.0         | 2         | 107  | -10.70 | 24.17 | 410.30 | 241.29 | 214.81 | 0.00 |

|           |                               |         |          |                  |
|-----------|-------------------------------|---------|----------|------------------|
| Calc. for | Veranda Street Superstructure | Job No. | 75297    | Sheet No. 1 of 1 |
| Made by   | HJW                           | Date    | 09/05/19 |                  |
| Chkd by   | NMW                           | Date    | 09/06/19 |                  |



#### **UNFACTORED BEARING REACTION SUMMARY - ABUTMENT 2**

Note: Bearing reactions provided by Structural engineer, included for reference.

#### **DEAD LOAD REACTIONS**

| Girder #                       | Units | Southbound |       |       |       |       |       |
|--------------------------------|-------|------------|-------|-------|-------|-------|-------|
|                                |       | G01        | G02   | G03   | G04   | G05   | G06   |
| Unfactored Reactions           |       |            |       |       |       |       |       |
| Vertical Forces                |       |            |       |       |       |       |       |
| Dead Load, Bridge              | kip   | 48.20      | 55.40 | 55.60 | 54.60 | 49.80 | 54.20 |
| Dead Load, Approach Slab       | kip   | 29.29      | 29.29 | 29.29 | 29.29 | 29.29 | 29.29 |
| Total Dead Load                | kip   | 77.49      | 84.69 | 84.89 | 83.89 | 79.09 | 83.49 |
| Wearing Surface, Bridge        |       | 12.10      | 11.80 | 11.70 | 11.90 | 12.20 | 12.00 |
| Wearing Surface, Approach Slab | kip   | 8.66       | 8.66  | 8.66  | 8.66  | 8.66  | 8.66  |
| Wearing Surface, Total         | kip   | 20.76      | 20.46 | 20.36 | 20.56 | 20.86 | 20.66 |
| Earth Vertical Approach Slab   | kip   | 25.79      | 25.79 | 25.79 | 25.79 | 25.79 | 25.79 |
| Girder #                       | Units | Northbound |       |       |       |       |       |
|                                |       | G11        | G12   | G13   | G14   | G15   | G16   |
| Unfactored Reactions           |       |            |       |       |       |       |       |
| Vertical Forces                |       |            |       |       |       |       |       |
| Dead Load, Bridge              | kip   | 46.70      | 54.30 | 55.80 | 55.90 | 55.00 | 50.80 |
| Dead Load, Approach Slab       | kip   | 29.29      | 29.29 | 29.29 | 29.29 | 29.29 | 29.29 |
| Total Dead Load                | kip   | 75.99      | 83.59 | 85.09 | 85.19 | 84.29 | 80.09 |
| Wearing Surface                | kip   | 12.10      | 12.10 | 11.80 | 11.70 | 12.00 | 12.20 |
| Wearing Surface, Approach Slab | kip   | 8.66       | 8.66  | 8.66  | 8.66  | 8.66  | 8.66  |
| Wearing Surface, Total         | kip   | 20.76      | 20.76 | 20.46 | 20.36 | 20.66 | 20.86 |
| Earth Vertical Approach Slab   | kip   | 25.79      | 25.79 | 25.79 | 25.79 | 25.79 | 25.79 |

#### **LIVE LOAD REACTIONS**

##### **2-LANE LIVE LOAD REACTIONS FROM BDGS**

| Southbound              |     | G01    | G02    | G03    | G04    | G05    | G06    |
|-------------------------|-----|--------|--------|--------|--------|--------|--------|
| Max Truck, Bridge       | kip | 86.60  | 65.80  | 65.50  | 63.20  | 74.30  | 63.00  |
| Max Lane, Bridge        | kip | 17.00  | 17.40  | 17.20  | 17.60  | 19.30  | 17.20  |
| Max Lane, Approach Slab | kip | 6.72   | 6.72   | 6.72   | 6.72   | 6.72   | 6.72   |
| Live Load (no impact)   | kip | 110.32 | 89.92  | 89.42  | 87.52  | 100.32 | 86.92  |
| Live Load (impact)      | kip | 138.90 | 111.63 | 111.04 | 108.38 | 124.84 | 107.71 |
| Northbound              |     | G11    | G12    | G13    | G14    | G15    | G16    |
| Max Truck               | kip | 65.90  | 63.50  | 69.60  | 64.50  | 65.30  | 73.30  |
| Max Lane                | kip | 16.80  | 17.70  | 17.20  | 17.00  | 17.60  | 20.10  |
| Max Lane, Approach Slab | kip | 6.72   | 6.72   | 6.72   | 6.72   | 6.72   | 6.72   |
| Live Load (no impact)   | kip | 89.42  | 87.92  | 93.52  | 88.22  | 89.62  | 100.12 |
| Live Load (impact)      | kip | 111.17 | 108.88 | 116.49 | 109.51 | 111.17 | 124.31 |

##### **3-LANE HORIZONTAL LIVE LOAD FORCES**

|  |     |       |       |       |       |       |       |
|--|-----|-------|-------|-------|-------|-------|-------|
| Braking (Along Girders)                | kip | 9.56  | 9.56  | 9.56  | 9.56  | 9.56  | 9.56  |
| Centrifugal (Perpendicular to Girders) | kip | 10.84 | 10.84 | 10.84 | 10.84 | 10.84 | 10.84 |

##### **LIVE LOAD CASES**

CASE 1 - 3 Lanes Loaded, NB only loaded  
CASE 2 - 3 Lanes Loaded, SB only loaded  
CASE 3 - 6 Lanes Loaded, braking NB Only  
CASE 4 - 6 Lanes Loaded, braking SB Only

Note: Bearing reactions provided by Structural engineer, included for reference.

**CASE 2 DEMANDS** SB LOADED ONLY, 3 LANES

| <u>Southbound</u>                          |     | G01    | G02    | G03    | G04    | G05    | G06    |
|--|-----|--------|--------|--------|--------|--------|--------|
| Vertical Live Load (impact)                | kip | 118.06 | 94.89  | 94.38  | 92.12  | 106.11 | 91.55  |
| Vertical Live Load (no impact)             | kip | 93.77  | 76.43  | 76.01  | 74.39  | 85.27  | 73.88  |
| Braking (Abutment longitudinal)            | kip | -4.78  | -4.78  | -4.78  | -4.78  | -4.78  | -4.78  |
| Braking (Abutment transverse)              | kip | -8.28  | -8.28  | -8.28  | -8.28  | -8.28  | -8.28  |
| Centrifugal (Abutment longitudinal)        | kip | 9.39   | 9.39   | 9.39   | 9.39   | 9.39   | 9.39   |
| Centrifugal (Abutment transverse)          | kip | -5.42  | -5.42  | -5.42  | -5.42  | -5.42  | -5.42  |
| Braking + Centrifugal (Abut. Longitudinal) | kip | 4.61   | 4.61   | 4.61   | 4.61   | 4.61   | 4.61   |
| Braking + Centrifugal (Abut. Transverse)   | kip | -13.70 | -13.70 | -13.70 | -13.70 | -13.70 | -13.70 |
| <u>Northbound</u>                          |     | G11    | G12    | G13    | G14    | G15    | G16    |
| Vertical Live Load (impact)                | kip | 0      | 0      | 0      | 0      | 0      | 0      |
| Vertical Live Load (no impact)             | kip | 0      | 0      | 0      | 0      | 0      | 0      |
| Braking (Abutment longitudinal)            | kip | 0      | 0      | 0      | 0      | 0      | 0      |
| Braking (Abutment transverse)              | kip | 0      | 0      | 0      | 0      | 0      | 0      |
| Centrifugal Only (Abutment longitudinal)   | kip | 0      | 0      | 0      | 0      | 0      | 0      |
| Centrifugal Only (Abutment transverse)     | kip | 0      | 0      | 0      | 0      | 0      | 0      |
| Braking + Centrifugal (Abut. Longitudinal) | kip | 0      | 0      | 0      | 0      | 0      | 0      |
| Braking + Centrifugal (Abut. Transverse)   | kip | 0      | 0      | 0      | 0      | 0      | 0      |

**CASE 4 DEMANDS** NB + SB LOADED, 6 LANES, BRAKING SB ONLY

| <u>Southbound</u>                          |     | G01    | G02    | G03    | G04    | G05    | G06    |
|--|-----|--------|--------|--------|--------|--------|--------|
| Vertical Live Load (impact)                | kip | 90.28  | 72.56  | 72.17  | 70.44  | 81.15  | 70.01  |
| Vertical Live Load (no impact)             | kip | 71.71  | 58.45  | 58.12  | 56.89  | 65.21  | 56.50  |
| Braking (Abutment longitudinal)            | kip | -3.66  | -3.66  | -3.66  | -3.66  | -3.66  | -3.66  |
| Braking (Abutment transverse)              | kip | -6.33  | -6.33  | -6.33  | -6.33  | -6.33  | -6.33  |
| Centrifugal (Abutment longitudinal)        | kip | 7.18   | 7.18   | 7.18   | 7.18   | 7.18   | 7.18   |
| Centrifugal (Abutment transverse)          | kip | -4.14  | -4.14  | -4.14  | -4.14  | -4.14  | -4.14  |
| Braking + Centrifugal (Abut. Longitudinal) | kip | 3.52   | 3.52   | 3.52   | 3.52   | 3.52   | 3.52   |
| Braking + Centrifugal (Abut. Transverse)   | kip | -10.48 | -10.48 | -10.48 | -10.48 | -10.48 | -10.48 |
| <u>Northbound</u>                          |     | G11    | G12    | G13    | G14    | G15    | G16    |
| Vertical Live Load (impact)                | kip | 72.26  | 70.77  | 75.72  | 71.18  | 72.26  | 80.80  |
| Vertical Live Load (no impact)             | kip | 58.12  | 57.15  | 60.79  | 57.34  | 58.25  | 65.08  |
| Braking (Abutment longitudinal)            | kip | 0.00   | 0.00   | 0.00   | 0.00   | 0.00   | 0.00   |
| Braking (Abutment transverse)              | kip | 0.00   | 0.00   | 0.00   | 0.00   | 0.00   | 0.00   |
| Centrifugal Only (Abutment longitudinal)   | kip | 7.18   | 7.18   | 7.18   | 7.18   | 7.18   | 7.18   |
| Centrifugal Only (Abutment transverse)     | kip | -4.14  | -4.14  | -4.14  | -4.14  | -4.14  | -4.14  |
| Braking + Centrifugal (Abut. Longitudinal) | kip | 7.18   | 7.18   | 7.18   | 7.18   | 7.18   | 7.18   |
| Braking + Centrifugal (Abut. Transverse)   | kip | -4.14  | -4.14  | -4.14  | -4.14  | -4.14  | -4.14  |

**THERMAL FORCES AND MOMENTS**

Note: Thermal forces may be applied in either direction

|                                    |        |       |       |       |       |       |       |
|------------------------------------|--------|-------|-------|-------|-------|-------|-------|
| Thermal Applied Moment             | kip-ft | 10.65 | 10.65 | 10.65 | 10.65 | 10.65 | 10.65 |
| Thermal Translation (Along Girder) | kip    | 7.04  | 7.04  | 7.04  | 7.04  | 7.04  | 7.04  |

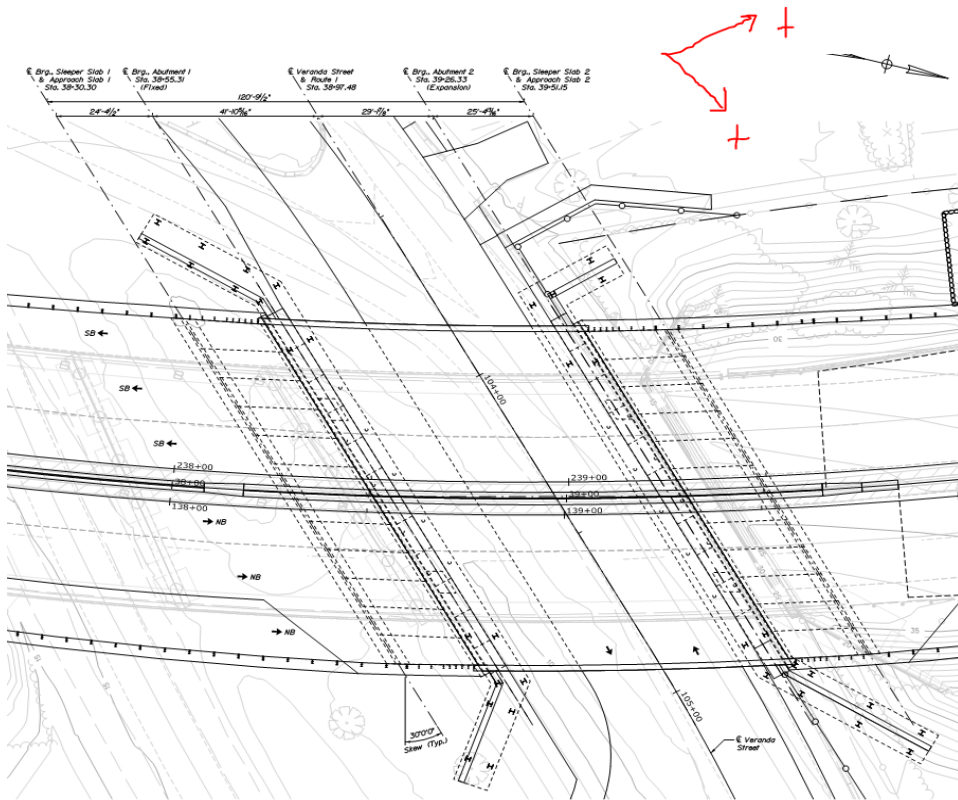
| <u>Southbound</u>                           |        | G01  | G02  | G03  | G04  | G05  | G06  |
|---|--------|------|------|------|------|------|------|
| Thermal Moment (Abutment longitudinal)      | kip-ft | 5.33 | 5.33 | 5.33 | 5.33 | 5.33 | 5.33 |
| Thermal Moment (Abutment transverse)        | kip-ft | 9.22 | 9.22 | 9.22 | 9.22 | 9.22 | 9.22 |
| Thermal Translation (Abutment longitudinal) | kip    | 3.52 | 3.52 | 3.52 | 3.52 | 3.52 | 3.52 |
| Thermal Translation (Abutment transverse)   | kip    | 6.10 | 6.10 | 6.10 | 6.10 | 6.10 | 6.10 |

| <u>Northbound</u>                           |        | G11  | G12  | G13  | G14  | G15  | G16  |
|---|--------|------|------|------|------|------|------|
| Thermal Moment (Abutment longitudinal)      | kip-ft | 5.33 | 5.33 | 5.33 | 5.33 | 5.33 | 5.33 |
| Thermal Moment (Abutment transverse)        | kip-ft | 9.22 | 9.22 | 9.22 | 9.22 | 9.22 | 9.22 |
| Thermal Translation (Abutment longitudinal) | kip    | 3.52 | 3.52 | 3.52 | 3.52 | 3.52 | 3.52 |
| Thermal Translation (Abutment transverse)   | kip    | 6.10 | 6.10 | 6.10 | 6.10 | 6.10 | 6.10 |

Note on direction: the abutment longitudinal direction is along the length of the abutment breastwall (113' +/-), and the abutment transverse direction is through the width of the breastwall (4.5')



Note: Bearing reactions provided by  
Structural engineer, included for reference.



ABUTMENT 2 (NORTH) SUBSTRUCTURE LOADING

Material Data

|            |        |     |  |    |
|------------|--------|-----|--|----|
| $\gamma_c$ | 150    | pcf | Unit weight of abutment concrete                           | 35 |
| $\gamma_f$ | 35     | pcf | Equivalent fluid pressure of lightweight concrete backfill |    |
| $\gamma_s$ | 120    | pcf | Weight of soil backfill (for wingwalls, on top of LWC)     |    |
| $\Phi$     | 34     | deg | Friction angle of soil backfill                            |    |
| $k_a$      | 0.2827 | -   | Coefficient of active earth pressure for soil backfill     |    |
| $h_{c1}$   | 3      | ft  |  |    |
| $h_{c2}$   | 3      | ft  |  |    |

Geometry Data

|            | Abutment | Wingwall |  |
|------------|----------|----------|--|
| EL A       | 8.33     | 8.33     | ft Bottom of Footing Elevation                               |
| $t_f$      | 3        | 3        | ft Thickness/Height of Footing                               |
| $W_f$      | 9        | 9        | ft Width of Footing  |
| $W_{wall}$ | 4.5      | 1.5      | ft Width of Abutment Wall                                    |
| EL B       | 11.33    | 11.33    | ft Top of Footing Elevation                                  |
| EL C       | 23.03    | 23.03    | ft Sliding Surface Elevation                                 |
| Mid El.    | 9.83     | 9.83     | ft Mid-Height (Design) Elevation of Footing = EL A + $t_f/2$ |

| Wingwall Soil Loading Above LWC Fill |          |           |      |
|--------------------------------------|----------|-----------|------|
|                                      | Low Side | High Side |      |
| Soil fill height                     | 2        | 7         | ft   |
| Lateral force from soil              | 0.07     | 0.83      | k    |
| Moment arm                           | 15.69    | 26.76     | ft   |
| Moment                               | 1.06     | 22.24     | k-ft |

Equivalent Fluid Pressure & Abutment Concrete Weight

| Bearing    |              | Southbound |  |     |     |     |     | Northbound |     |     |     |     |     | Wingwall |           |
|------------|--------------|------------|--|-----|-----|-----|-----|------------|-----|-----|-----|-----|-----|----------|-----------|
|            |              | G01        | G02  | G03 | G04 | G05 | G06 | G11        | G12 | G13 | G14 | G15 | G16 | Low Side | High Side |
| Pre-Slide  | EL I         | ft         | Bearing "I" Elevation                                      |     |     |     |     |            |     |     |     |     |     |          |           |
|            | $\Delta z_i$ | ft         | Bearing "I" Moment Arm above Mid El. = (EL I) - (Mid El.)  |     |     |     |     |            |     |     |     |     |     |          |           |
|            | $\Delta y_i$ | ft         | Bearing "I" Tributary Abutment Width (Per Bearing Spacing) |     |     |     |     |            |     |     |     |     |     |          |           |
|            | $H_{c1}$     | ft         | Total height of concrete to be placed up to slide El.      |     |     |     |     |            |     |     |     |     |     |          |           |
|            | 2F           | k          | Total shear force from fluid pressure per girder segment   |     |     |     |     |            |     |     |     |     |     |          |           |
| Post Slide | ZM           | k-ft       | Total moment from fluid pressure per girder segment        |     |     |     |     |            |     |     |     |     |     |          |           |
|            | $V_{wall}$   | k          | Weight of abutment wall per girder segment                 |     |     |     |     |            |     |     |     |     |     |          |           |
|            | $H_{c2}$     | ft         | Total height of concrete to be placed up to bearing El.    |     |     |     |     |            |     |     |     |     |     |          |           |
|            | 2F           | k          | Total shear force from fluid pressure per girder segment   |     |     |     |     |            |     |     |     |     |     |          |           |
|            | ZM           | k-ft       | Total moment from fluid pressure per girder segment        |     |     |     |     |            |     |     |     |     |     |          |           |
|            | $V_{wall}$   | k          | Weight of abutment wall per girder segment                 |     |     |     |     |            |     |     |     |     |     |          |           |

Pre-Slide Calculations

| Lift No. | Concrete Lift Height above Design Elevation, ft |       |       |       |       |       |       |       |       |       |       |       |       |       |
|----------|---|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| 1        | 3.00  | 3.00  | 3.00  | 3.00  | 3.00  | 3.00  | 3.00  | 3.00  | 3.00  | 3.00  | 3.00  | 3.00  | 3.00  | 3.00  |
| 2        | 6.00  | 6.00  | 6.00  | 6.00  | 6.00  | 6.00  | 6.00  | 6.00  | 6.00  | 6.00  | 6.00  | 6.00  | 6.00  | 6.00  |
| 3        | 9.00  | 9.00  | 9.00  | 9.00  | 9.00  | 9.00  | 9.00  | 9.00  | 9.00  | 9.00  | 9.00  | 9.00  | 9.00  | 9.00  |
| 4        | 12.00   | 12.00 | 12.00 | 12.00 | 12.00 | 12.00 | 12.00 | 12.00 | 12.00 | 12.00 | 12.00 | 12.00 | 12.00 | 12.00 |
| 5        | 14.70   | 14.70 | 14.70 | 14.70 | 14.70 | 14.70 | 14.70 | 14.70 | 14.70 | 14.70 | 14.70 | 14.70 | 14.70 | 14.70 |
| Lift No. | Concrete Lift Thickness, ft                     |       |       |       |       |       |       |       |       |       |       |       |       |       |
| 1        | 3.00  | 3.00  | 3.00  | 3.00  | 3.00  | 3.00  | 3.00  | 3.00  | 3.00  | 3.00  | 3.00  | 3.00  | 3.00  | 3.00  |
| 2        | 3.00  | 3.00  | 3.00  | 3.00  | 3.00  | 3.00  | 3.00  | 3.00  | 3.00  | 3.00  | 3.00  | 3.00  | 3.00  | 3.00  |
| 3        | 3.00  | 3.00  | 3.00  | 3.00  | 3.00  | 3.00  | 3.00  | 3.00  | 3.00  | 3.00  | 3.00  | 3.00  | 3.00  | 3.00  |
| 4        | 3.00  | 3.00  | 3.00  | 3.00  | 3.00  | 3.00  | 3.00  | 3.00  | 3.00  | 3.00  | 3.00  | 3.00  | 3.00  | 3.00  |
| 5        | 2.70  | 2.70  | 2.70  | 2.70  | 2.70  | 2.70  | 2.70  | 2.70  | 2.70  | 2.70  | 2.70  | 2.70  | 3.00  | 2.70  |
| Σ        | 14.70   | 14.70 | 14.70 | 14.70 | 14.70 | 14.70 | 14.70 | 14.70 | 14.70 | 14.70 | 14.70 | 14.70 | 15.02 | 14.70 |
| Lift No. | Force per Concrete Lift, k/ LF wall             |       |       |       |       |       |       |       |       |       |       |       |       |       |
| 1        | 0.16  | 0.16  | 0.16  | 0.16  | 0.16  | 0.16  | 0.16  | 0.16  | 0.16  | 0.16  | 0.16  | 0.16  | 0.16  | 0.16  |
| 2        | 0.16  | 0.16  | 0.16  | 0.16  | 0.16  | 0.16  | 0.16  | 0.16  | 0.16  | 0.16  | 0.16  | 0.16  | 0.16  | 0.16  |
| 3        | 0.16  | 0.16  | 0.16  | 0.16  | 0.16  | 0.16  | 0.16  | 0.16  | 0.16  | 0.16  | 0.16  | 0.16  | 0.16  | 0.16  |
| 4        | 0.16  | 0.16  | 0.16  | 0.16  | 0.16  | 0.16  | 0.16  | 0.16  | 0.16  | 0.16  | 0.16  | 0.16  | 0.16  | 0.16  |
| 5        | 0.13  | 0.13  | 0.13  | 0.13  | 0.13  | 0.13  | 0.13  | 0.13  | 0.13  | 0.13  | 0.13  | 0.13  | 0.16  | 0.13  |
| Σ        | 0.76  | 0.76  | 0.76  | 0.76  | 0.76  | 0.76  | 0.76  | 0.76  | 0.76  | 0.76  | 0.76  | 0.76  | 0.79  | 0.76  |
| Lift No. | Concrete Lift Force Moment Arm, ft              |       |       |       |       |       |       |       |       |       |       |       |       |       |
| 1        | 1.00  | 1.00  | 1.00  | 1.00  | 1.00  | 1.00  | 1.00  | 1.00  | 1.00  | 1.00  | 1.00  | 1.00  | 1.00  | 1.00  |
| 2        | 4.00  | 4.00  | 4.00  | 4.00  | 4.00  | 4.00  | 4.00  | 4.00  | 4.00  | 4.00  | 4.00  | 4.00  | 4.00  | 4.00  |
| 3        | 7.00  | 7.00  | 7.00  | 7.00  | 7.00  | 7.00  | 7.00  | 7.00  | 7.00  | 7.00  | 7.00  | 7.00  | 7.00  | 7.00  |
| 4        | 10.00   | 10.00 | 10.00 | 10.00 | 10.00 | 10.00 | 10.00 | 10.00 | 10.00 | 10.00 | 10.00 | 10.00 | 10.00 | 10.00 |
| 5        | 12.90   | 12.90 | 12.90 | 12.90 | 12.90 | 12.90 | 12.90 | 12.90 | 12.90 | 12.90 | 12.90 | 12.90 | 13.00 | 12.90 |
| Lift No. | Moment, k-ft/LF wall                            |       |       |       |       |       |       |       |       |       |       |       |       |       |
| 1        | 0.16  | 0.16  | 0.16  | 0.16  | 0.16  | 0.16  | 0.16  | 0.16  | 0.16  | 0.16  | 0.16  | 0.16  | 0.16  | 0.16  |
| 2        | 0.63  | 0.63  | 0.63  | 0.63  | 0.63  | 0.63  | 0.63  | 0.63  | 0.63  | 0.63  | 0.63  | 0.63  | 0.63  | 0.63  |
| 3        | 1.10  | 1.10  | 1.10  | 1.10  | 1.10  | 1.10  | 1.10  | 1.10  | 1.10  | 1.10  | 1.10  | 1.10  | 1.10  | 1.10  |
| 4        | 1.58  | 1.58  | 1.58  | 1.58  | 1.58  | 1.58  | 1.58  | 1.58  | 1.58  | 1.58  | 1.58  | 1.58  | 1.58  | 1.58  |
| 5        | 1.65  | 1.65  | 1.65  | 1.65  | 1.65  | 1.65  | 1.65  | 1.65  | 1.65  | 1.65  | 1.65  | 1.65  | 2.05  | 1.65  |
| Σ        | 5.11  | 5.11  | 5.11  | 5.11  | 5.11  | 5.11  | 5.11  | 5.11  | 5.11  | 5.11  | 5.11  | 5.11  | 5.51  | 5.11  |

Post-Slide Calculations

| Lift No. | Concrete Lift Height above Design Elevation, ft |      |      |      |      |      |      |      |      |      |       |       |  |      |
|----------|---|------|------|------|------|------|------|------|------|------|-------|-------|--|------|
| 1        | 3.00  | 3.00 | 3.00 | 3.00 | 3.00 | 3.00 | 3.00 | 3.00 | 3.00 | 3.00 | 3.00  | 3.00  |  | 3.00 |
| 2        | 4.87  | 5.49 | 6.00 | 6.00 | 6.00 | 6.00 | 6.00 | 6.00 | 6.00 | 6.00 | 6.00  | 6.00  |  | 6.00 |
| 3        | 0.00  | 0.00 | 6.11 | 6.73 | 7.35 | 7.97 | 7.75 | 8.39 | 9.00 | 9.00 | 9.00  | 9.00  |  | 9.00 |
| 4        | 0.00  | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 9.02 | 9.66 | 10.31 | 10.95 |  | 9.73 |
| Lift No. | Concrete Lift Thickness, ft                     |      |      |      |      |      |      |      |      |      |       |       |  |      |
| 1        | 3.00  | 3.00 | 3.00 | 3.00 | 3.00 | 3.00 | 3.00 | 3.00 | 3.00 | 3.00 | 3.00  | 3.00  |  | 3.00 |
| 2        | 1.87  | 2.49 | 3.00 | 3.00 | 3.00 | 3.00 | 3.00 | 3.00 | 3.00 | 3.00 | 3.00  | 3.00  |  | 3.00 |
| 3        | 0.00  | 0.00 | 0.11 | 0.73 | 1.35 | 1.97 | 1.75 | 2.39 | 3.00 | 3.00 | 3.00  | 3.00  |  | 3.00 |
| 4        | 0.00  | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.02 | 0.66 | 1.31  | 1.95  |  | 0.73 |
| Σ        | 4.87  | 5.49 | 6.11 | 6.73 | 7.35 | 7.97 | 7.75 | 8.39 | 9.02 | 9.66 | 10.31 | 0.00  |  | 0.00 |
| Lift No. | Force per Concrete Lift, k/ LF wall             |      |      |      |      |      |      |      |      |      |       |       |  |      |
| 1        | 0.16  | 0.16 | 0.16 | 0.16 | 0.16 | 0.16 | 0.16 | 0.16 | 0.16 | 0.16 | 0.16  | 0.16  |  | 0.16 |
| 2        | 0.06  | 0.11 | 0.16 | 0.16 | 0.16 | 0.16 | 0.16 | 0.16 | 0.16 | 0.16 | 0.16  | 0.16  |  | 0.16 |
| 3        | 0.00  | 0.00 | 0.00 | 0.01 | 0.03 | 0.07 | 0.05 | 0.10 | 0.16 | 0.16 | 0.16  | 0.16  |  | 0.16 |
| 4        | 0.00  | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.01 | 0.03  | 0.07  |  | 0.01 |
| Σ        | 0.22  | 0.27 | 0.32 | 0.32 | 0.35 | 0.38 | 0.37 | 0.41 | 0.47 | 0.48 | 0.50  | 0.54  |  | 0.48 |
| Lift No. | Concrete Lift Force Moment Arm, ft              |      |      |      |      |      |      |      |      |      |       |       |  |      |
| 1        | 1.00  | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00  | 1.00  |  | 1.00 |
| 2        | 3.62  | 3.83 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00  | 4.00  |  | 4.00 |
| 3        | 0.00  | 0.00 | 6.04 | 6.24 | 6.45 | 6.66 | 6.58 | 6.80 | 7.00 | 7.00 | 7.00  | 7.00  |  | 7.00 |
| 4        | 0.00  | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.01 | 0.92 | 9.44  | 9.65  |  | 9.24 |
| Lift No. | Moment, k-ft/LF wall                            |      |      |      |      |      |      |      |      |      |       |       |  |      |
| 1        | 0.16  | 0.16 | 0.16 | 0.16 | 0.16 | 0.16 | 0.16 | 0.16 | 0.16 | 0.16 | 0.16  | 0.16  |  | 0.16 |
| 2        | 0.22  | 0.42 | 0.63 | 0.63 | 0.63 | 0.63 | 0.63 | 0.63 | 0.63 | 0.63 | 0.63  | 0.63  |  | 0.63 |
| 3        | 0.00  | 0.00 | 0.00 | 0.06 | 0.21 | 0.45 | 0.35 | 0.68 | 1.10 | 1.10 | 1.10  | 1.10  |  | 1.10 |
| 4        | 0.00  | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.07 | 0.28  | 0.64  |  | 0.09 |
| Σ        | 0.38  | 0.57 | 0.79 | 0.85 | 0.99 | 1.24 | 1.14 | 1.47 | 1.89 | 1.96 | 2.17  | 2.53  |  | 1.98 |

**Abutment 2 - FB-Multiplier Design Loads**

Strength I

| Load Case | Load Factor | FBMP Case | Node | Fx     | Fy    | Fz     | Mx     | My     | Mz   |
|-----------|-------------|-----------|------|--------|-------|--------|--------|--------|------|
| 2         | Max         | 1         | 81   | -18.19 | 48.66 | 556.49 | 614.60 | 331.33 | 0.00 |
| 2         | Max         | 1         | 83   | -18.19 | 40.58 | 447.42 | 584.93 | 342.61 | 0.00 |
| 2         | Max         | 1         | 85   | -18.19 | 41.23 | 451.94 | 604.56 | 353.88 | 0.00 |
| 2         | Max         | 1         | 87   | -18.19 | 41.35 | 453.30 | 622.06 | 365.16 | 0.00 |
| 2         | Max         | 1         | 88   | -18.19 | 41.65 | 471.92 | 640.77 | 376.44 | 0.00 |
| 2         | Max         | 1         | 90   | -18.19 | 38.81 | 426.54 | 642.30 | 387.71 | 0.00 |
| 2         | Max         | 1         | 91   | -1.76  | 14.69 | 286.60 | 133.09 | 39.53  | 0.00 |
| 2         | Max         | 1         | 92   | -1.76  | 18.58 | 336.78 | 157.56 | 40.66  | 0.00 |
| 2         | Max         | 1         | 94   | -1.76  | 19.34 | 343.42 | 165.09 | 41.77  | 0.00 |
| 2         | Max         | 1         | 96   | -1.76  | 19.44 | 348.70 | 167.97 | 42.90  | 0.00 |
| 2         | Max         | 1         | 97   | -1.76  | 19.74 | 353.40 | 172.77 | 44.04  | 0.00 |
| 2         | Max         | 1         | 99   | -1.76  | 19.85 | 349.69 | 177.28 | 45.17  | 0.00 |
| 2         | Min         | 2         | 81   | -18.19 | 41.45 | 438.42 | 574.03 | 331.33 | 0.00 |
| 2         | Min         | 2         | 83   | -18.19 | 36.06 | 351.51 | 559.84 | 342.61 | 0.00 |
| 2         | Min         | 2         | 85   | -18.19 | 36.50 | 354.61 | 578.51 | 353.88 | 0.00 |
| 2         | Min         | 2         | 87   | -18.19 | 36.58 | 354.71 | 595.76 | 365.16 | 0.00 |
| 2         | Min         | 2         | 88   | -18.19 | 36.78 | 373.32 | 613.82 | 376.44 | 0.00 |
| 2         | Min         | 2         | 90   | -18.19 | 34.88 | 335.15 | 620.43 | 387.71 | 0.00 |
| 2         | Min         | 2         | 91   | -1.76  | 10.81 | 198.14 | 111.55 | 39.53  | 0.00 |
| 2         | Min         | 2         | 92   | -1.76  | 13.40 | 234.28 | 128.52 | 40.66  | 0.00 |
| 2         | Min         | 2         | 94   | -1.76  | 13.91 | 239.19 | 134.17 | 41.77  | 0.00 |
| 2         | Min         | 2         | 96   | -1.76  | 13.98 | 243.03 | 136.74 | 42.90  | 0.00 |
| 2         | Min         | 2         | 97   | -1.76  | 14.18 | 246.29 | 140.61 | 44.04  | 0.00 |
| 2         | Min         | 2         | 99   | -1.76  | 14.25 | 243.53 | 144.27 | 45.17  | 0.00 |
| 4         | Max         | 3         | 81   | -14.32 | 43.02 | 517.88 | 512.66 | 261.48 | 0.00 |
| 4         | Max         | 3         | 83   | -14.32 | 34.94 | 415.94 | 479.50 | 270.36 | 0.00 |
| 4         | Max         | 3         | 85   | -14.32 | 35.59 | 420.65 | 495.63 | 279.24 | 0.00 |
| 4         | Max         | 3         | 87   | -14.32 | 35.71 | 422.67 | 509.64 | 288.12 | 0.00 |
| 4         | Max         | 3         | 88   | -14.32 | 36.01 | 436.81 | 524.85 | 297.00 | 0.00 |
| 4         | Max         | 3         | 90   | -14.32 | 33.17 | 396.11 | 522.89 | 305.88 | 0.00 |
| 4         | Max         | 3         | 91   | -14.32 | 21.94 | 388.31 | 285.04 | 302.73 | 0.00 |
| 4         | Max         | 3         | 92   | -14.32 | 25.83 | 436.79 | 314.16 | 311.90 | 0.00 |
| 4         | Max         | 3         | 94   | -14.32 | 26.60 | 449.80 | 326.25 | 320.92 | 0.00 |
| 4         | Max         | 3         | 96   | -14.32 | 26.70 | 449.05 | 333.78 | 330.09 | 0.00 |
| 4         | Max         | 3         | 97   | -14.32 | 26.99 | 455.35 | 343.30 | 339.40 | 0.00 |
| 4         | Max         | 3         | 99   | -14.32 | 27.11 | 463.58 | 352.45 | 348.56 | 0.00 |
| 4         | Min         | 4         | 81   | -14.32 | 35.81 | 399.81 | 472.10 | 261.48 | 0.00 |
| 4         | Min         | 4         | 83   | -14.32 | 30.42 | 320.04 | 454.41 | 270.36 | 0.00 |
| 4         | Min         | 4         | 85   | -14.32 | 30.86 | 323.31 | 469.58 | 279.24 | 0.00 |
| 4         | Min         | 4         | 87   | -14.32 | 30.94 | 324.08 | 483.34 | 288.12 | 0.00 |
| 4         | Min         | 4         | 88   | -14.32 | 31.14 | 338.21 | 497.90 | 297.00 | 0.00 |
| 4         | Min         | 4         | 90   | -14.32 | 29.24 | 304.72 | 501.01 | 305.88 | 0.00 |
| 4         | Min         | 4         | 91   | -14.32 | 18.06 | 299.86 | 263.50 | 302.73 | 0.00 |
| 4         | Min         | 4         | 92   | -14.32 | 20.66 | 334.29 | 285.11 | 311.90 | 0.00 |
| 4         | Min         | 4         | 94   | -14.32 | 21.16 | 345.57 | 295.34 | 320.92 | 0.00 |
| 4         | Min         | 4         | 96   | -14.32 | 21.23 | 343.38 | 302.55 | 330.09 | 0.00 |
| 4         | Min         | 4         | 97   | -14.32 | 21.43 | 348.23 | 311.13 | 339.40 | 0.00 |
| 4         | Min         | 4         | 99   | -14.32 | 21.50 | 357.42 | 319.43 | 348.56 | 0.00 |

Strength IV

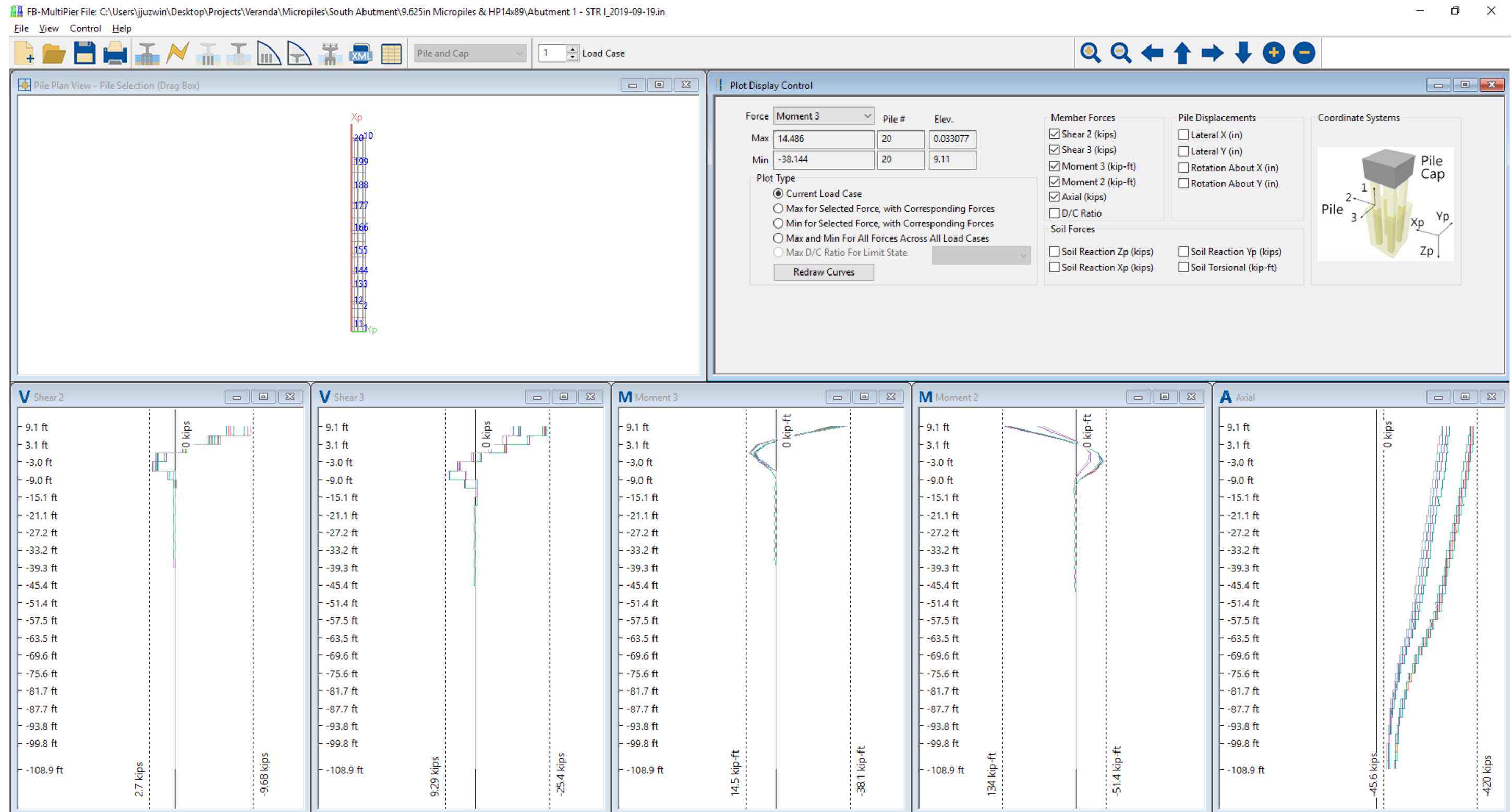
| Load Case | Load Factor | FBMP Case | Node | Fx    | Fy    | Fz     | Mx     | My    | Mz   |
|-----------|-------------|-----------|------|-------|-------|--------|--------|-------|------|
| 2/4       | Max         | 1         | 81   | -1.76 | 24.69 | 457.68 | 181.39 | 34.47 | 0.00 |
| 2/4       | Max         | 1         | 83   | -1.76 | 16.60 | 363.29 | 136.86 | 35.56 | 0.00 |
| 2/4       | Max         | 1         | 85   | -1.76 | 17.26 | 369.64 | 141.63 | 36.65 | 0.00 |
| 2/4       | Max         | 1         | 87   | -1.76 | 17.38 | 374.60 | 144.27 | 37.74 | 0.00 |
| 2/4       | Max         | 1         | 88   | -1.76 | 17.68 | 374.01 | 148.11 | 38.83 | 0.00 |
| 2/4       | Max         | 1         | 90   | -1.76 | 14.84 | 343.53 | 134.78 | 39.92 | 0.00 |
| 2/4       | Max         | 1         | 91   | -1.76 | 14.69 | 330.72 | 133.09 | 39.53 | 0.00 |
| 2/4       | Max         | 1         | 92   | -1.76 | 18.58 | 390.94 | 157.56 | 40.66 | 0.00 |
| 2/4       | Max         | 1         | 94   | -1.76 | 19.34 | 399.00 | 165.09 | 41.77 | 0.00 |
| 2/4       | Max         | 1         | 96   | -1.76 | 19.44 | 405.36 | 167.97 | 42.90 | 0.00 |
| 2/4       | Max         | 1         | 97   | -1.76 | 19.74 | 410.92 | 172.77 | 44.04 | 0.00 |
| 2/4       | Max         | 1         | 99   | -1.76 | 19.85 | 406.41 | 177.28 | 45.17 | 0.00 |
| 2/4       | Min         | 2         | 81   | -1.76 | 17.48 | 274.32 | 140.83 | 34.47 | 0.00 |
| 2/4       | Min         | 2         | 83   | -1.76 | 12.09 | 217.76 | 111.77 | 35.56 | 0.00 |
| 2/4       | Min         | 2         | 85   | -1.76 | 12.52 | 221.60 | 115.58 | 36.65 | 0.00 |
| 2/4       | Min         | 2         | 87   | -1.76 | 12.60 | 224.52 | 117.97 | 37.74 | 0.00 |
| 2/4       | Min         | 2         | 88   | -1.76 | 12.80 | 224.09 | 121.16 | 38.83 | 0.00 |
| 2/4       | Min         | 2         | 90   | -1.76 | 10.91 | 205.85 | 112.90 | 39.92 | 0.00 |
| 2/4       | Min         | 2         | 91   | -1.76 | 10.81 | 198.14 | 111.55 | 39.53 | 0.00 |
| 2/4       | Min         | 2         | 92   | -1.76 | 13.40 | 234.28 | 128.52 | 40.66 | 0.00 |
| 2/4       | Min         | 2         | 94   | -1.76 | 13.91 | 239.19 | 134.17 | 41.77 | 0.00 |
| 2/4       | Min         | 2         | 96   | -1.76 | 13.98 | 243.03 | 136.74 | 42.90 | 0.00 |
| 2/4       | Min         | 2         | 97   | -1.76 | 14.18 | 246.29 | 140.61 | 44.04 | 0.00 |
| 2/4       | Min         | 2         | 99   | -1.76 | 14.25 | 243.53 | 144.27 | 45.17 | 0.00 |

Service I

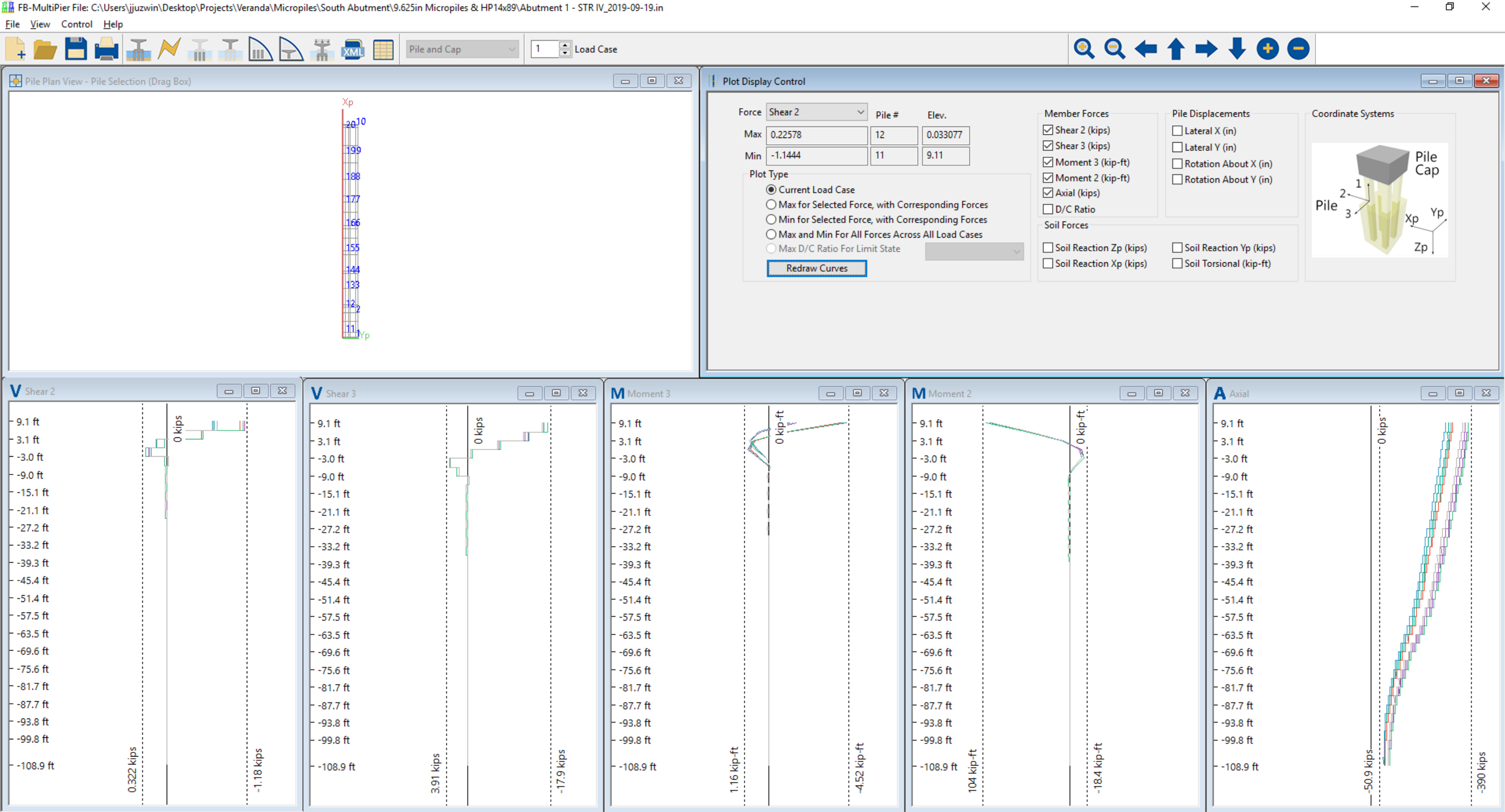
| Load Case | Load Factor | FBMP Case | Node | Fx     | Fy    | Fz     | Mx     | My     | Mz   |
|-----------|-------------|-----------|------|--------|-------|--------|--------|--------|------|
| 2         | 1.0         | 1         | 81   | -12.91 | 35.83 | 401.47 | 457.08 | 238.57 | 0.00 |
| 2         | 1.0         | 1         | 83   | -12.91 | 29.84 | 321.20 | 434.97 | 246.57 | 0.00 |
| 2         | 1.0         | 1         | 85   | -12.91 | 30.32 | 325.01 | 449.37 | 254.57 | 0.00 |
| 2         | 1.0         | 1         | 87   | -12.91 | 30.41 | 326.71 | 462.21 | 262.58 | 0.00 |
| 2         | 1.0         | 1         | 88   | -12.91 | 30.63 | 337.19 | 475.93 | 270.58 | 0.00 |
| 2         | 1.0         | 1         | 90   | -12.91 | 28.53 | 305.48 | 476.92 | 278.58 | 0.00 |
| 2         | 1.0         | 1         | 91   | -3.52  | 14.72 | 223.06 | 184.81 | 79.07  | 0.00 |
| 2         | 1.0         | 1         | 92   | -3.52  | 17.60 | 263.21 | 205.40 | 81.32  | 0.00 |
| 2         | 1.0         | 1         | 94   | -3.52  | 18.17 | 268.58 | 213.39 | 83.54  | 0.00 |
| 2         | 1.0         | 1         | 96   | -3.52  | 18.24 | 272.82 | 217.98 | 85.79  | 0.00 |
| 2         | 1.0         | 1         | 97   | -3.52  | 18.46 | 276.53 | 224.03 | 88.08  | 0.00 |
| 2         | 1.0         | 1         | 99   | -3.52  | 18.54 | 273.52 | 229.83 | 90.33  | 0.00 |
| 4         | 1.0         | 2         | 81   | -10.70 | 32.60 | 379.41 | 398.84 | 198.65 | 0.00 |
| 4         | 1.0         | 2         | 83   | -10.70 | 26.61 | 303.22 | 374.72 | 205.29 | 0.00 |
| 4         | 1.0         | 2         | 85   | -10.70 | 27.10 | 307.13 | 387.13 | 211.92 | 0.00 |
| 4         | 1.0         | 2         | 87   | -10.70 | 27.19 | 309.20 | 397.96 | 218.55 | 0.00 |
| 4         | 1.0         | 2         | 88   | -10.70 | 27.41 | 317.13 | 409.69 | 225.19 | 0.00 |
| 4         | 1.0         | 2         | 90   | -10.70 | 25.30 | 288.10 | 408.69 | 231.82 | 0.00 |
| 4         | 1.0         | 2         | 91   | -10.70 | 18.86 | 281.18 | 271.64 | 229.47 | 0.00 |
| 4         | 1.0         | 2         | 92   | -10.70 | 21.75 | 320.36 | 294.88 | 236.31 | 0.00 |
| 4         | 1.0         | 2         | 94   | -10.70 | 22.31 | 329.37 | 305.49 | 243.05 | 0.00 |
| 4         | 1.0         | 2         | 96   | -10.70 | 22.39 | 330.16 | 312.73 | 249.90 | 0.00 |
| 4         | 1.0         | 2         | 97   | -10.70 | 22.61 | 334.78 | 321.48 | 256.85 | 0.00 |
| 4         | 1.0         | 2         | 99   | -10.70 | 22.69 | 338.59 | 329.93 | 263.70 | 0.00 |

## FB-MULTIPLIER ANALYSIS AND RESULTS

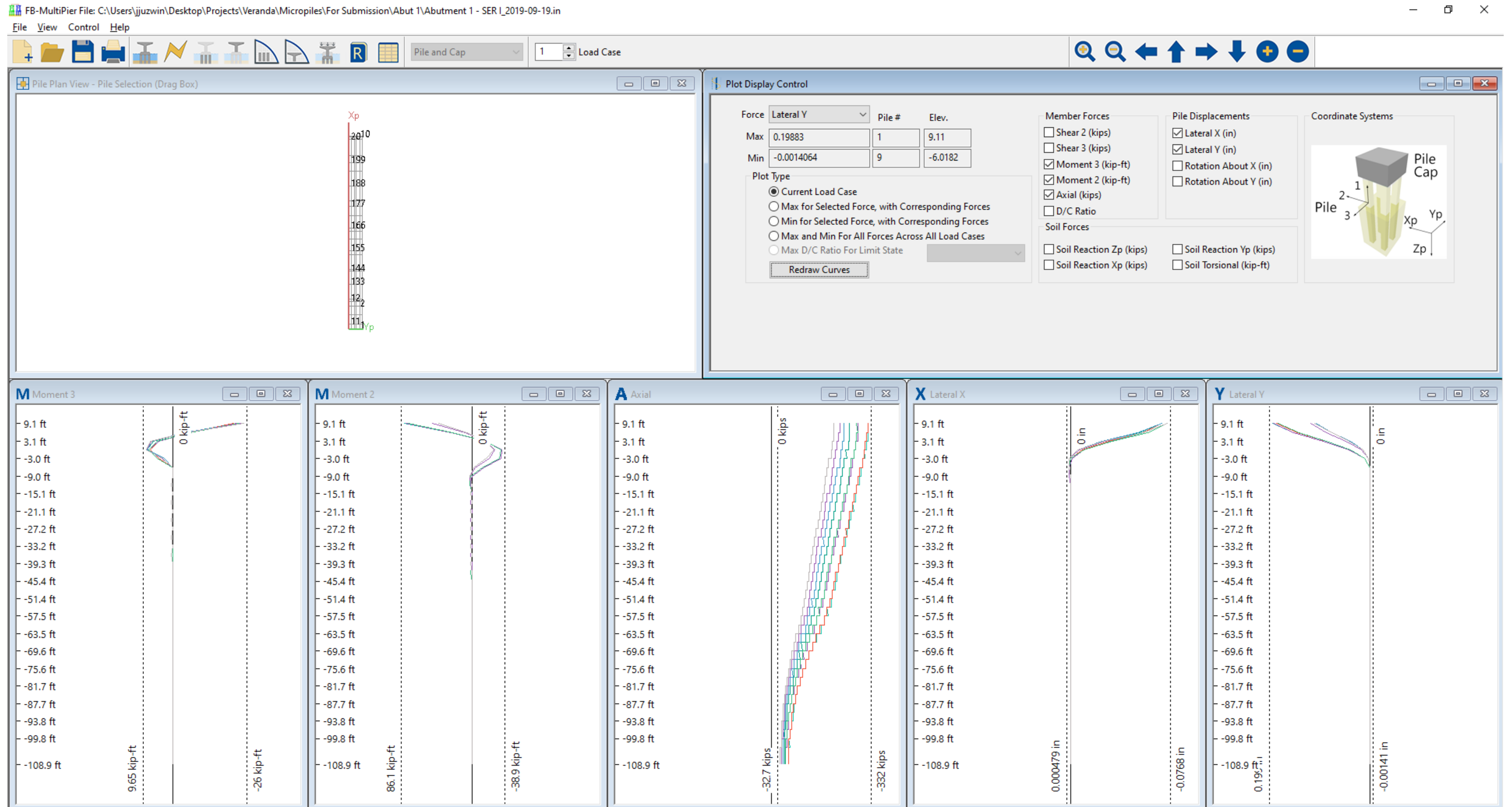
- Note:
- Axial Compression is Negative
  - Shear 2 is Parallel to Abutment Centerline
  - Shear 3 is Perpendicular to Abutment Centerline
  - Moment 2 is Applied About Centerline of Abutment (about 2-axis)
  - Moment 3 is Applied About Line Perpendicular to Abutment (about 3-axis)



Abutment 1 (South Abutment) – Strength-I Load Case – HP14x89

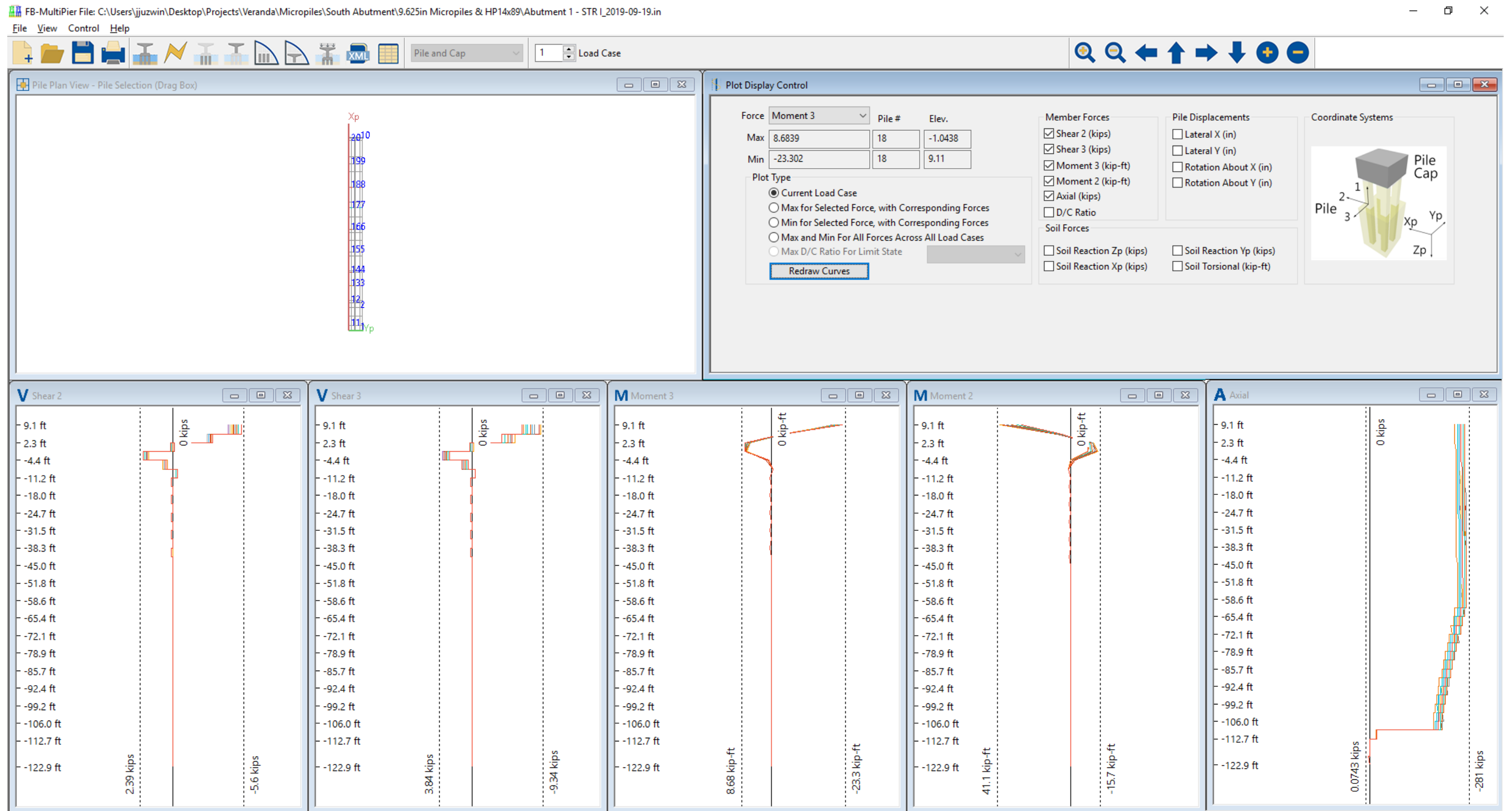


Abutment 1 (South Abutment) – Strength-IV Load Case – HP14x89

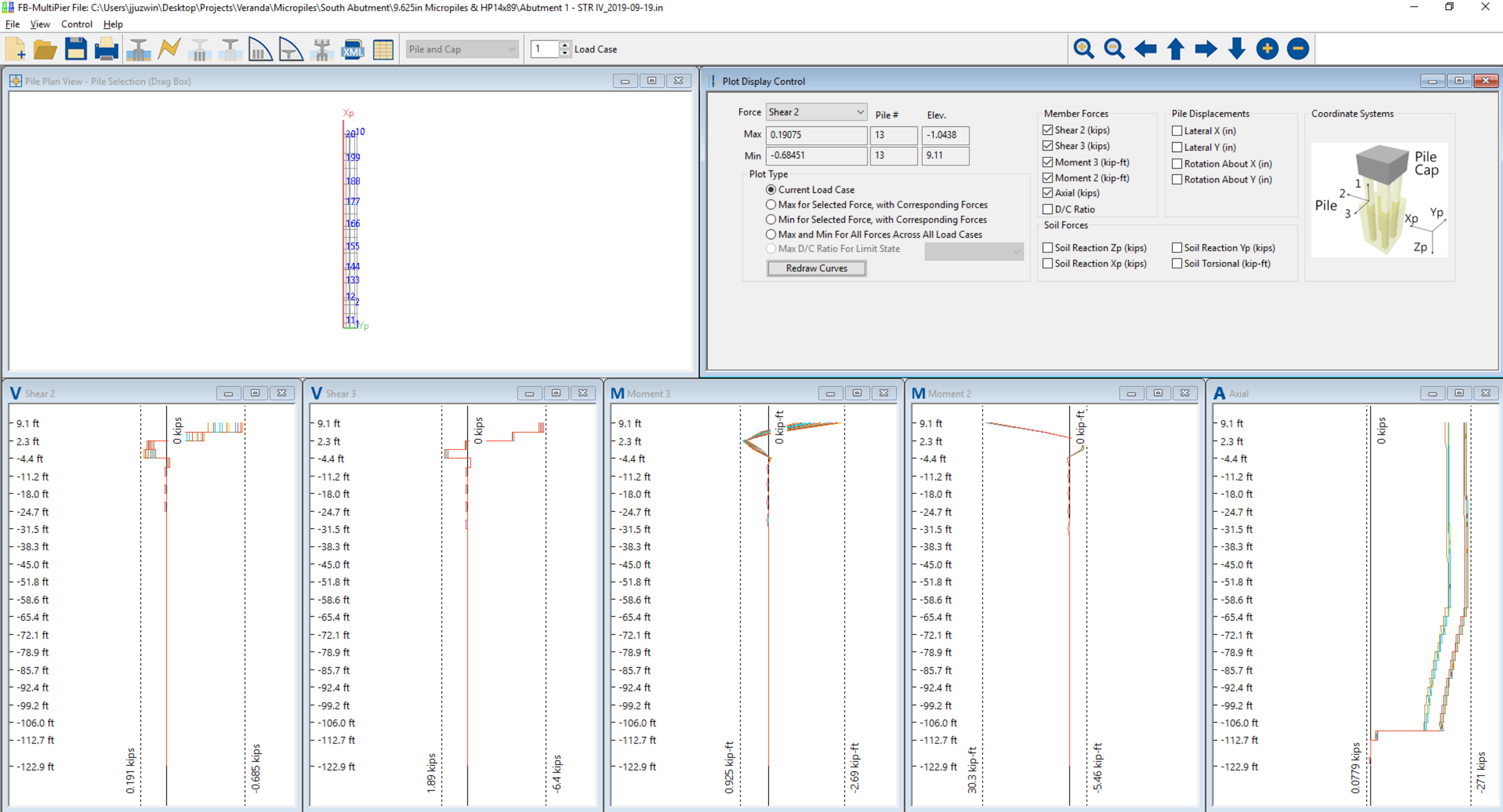


Abutment 1 (South Abutment) – Service-I Load Case – HP14x89

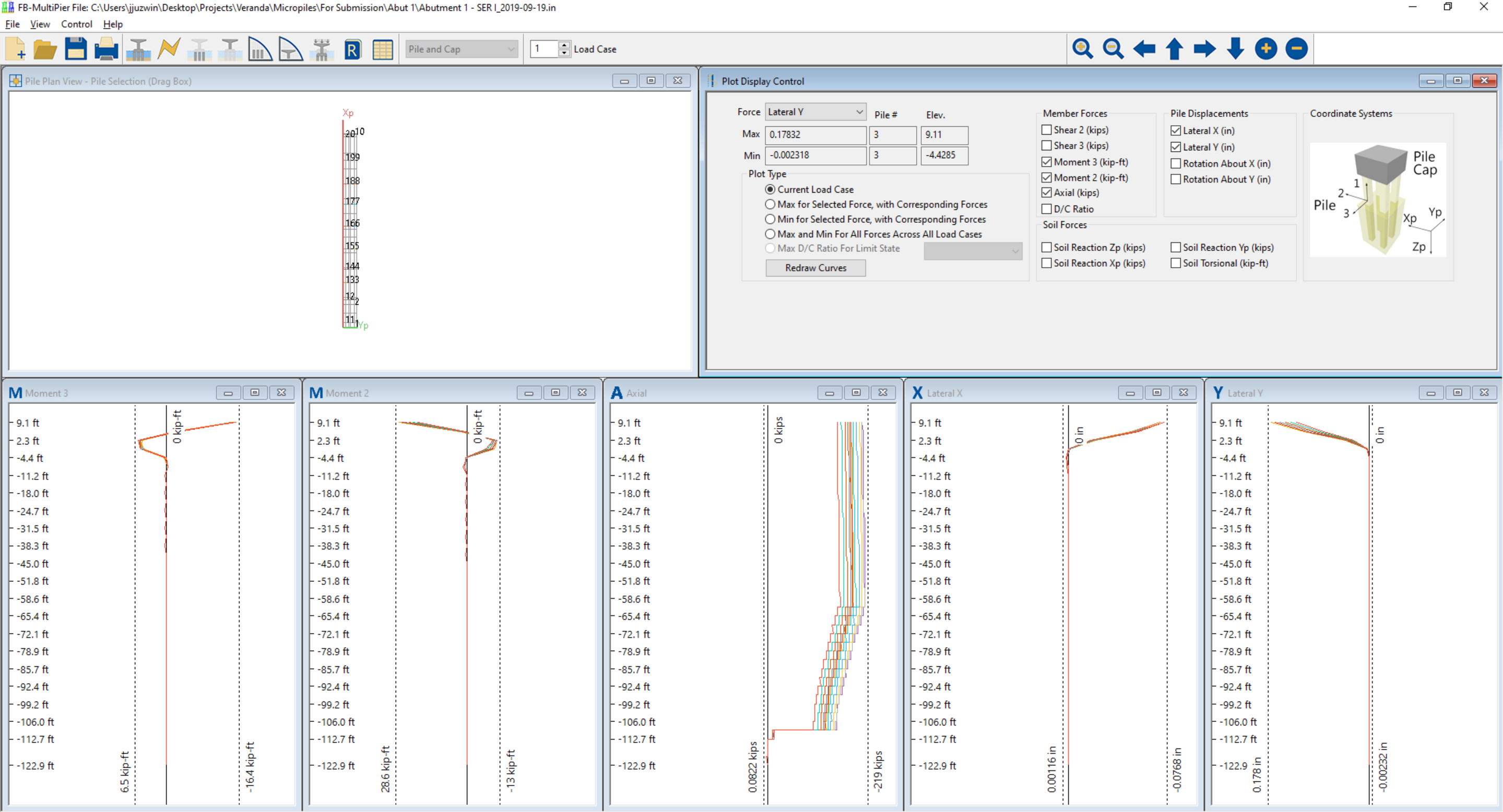




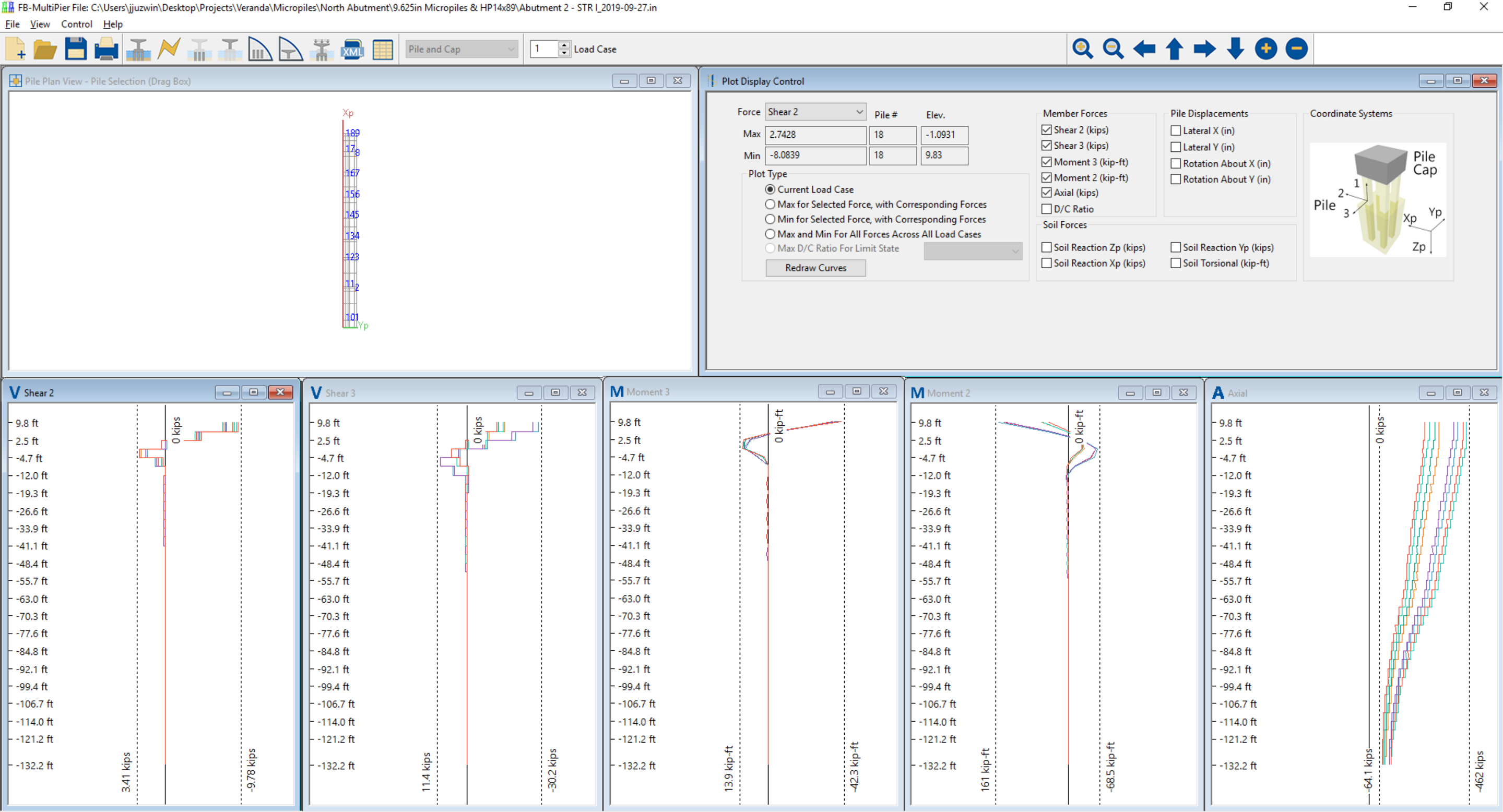
Abutment 1 (South Abutment) – Strength-I Load Case – 9.625” OD Micropile



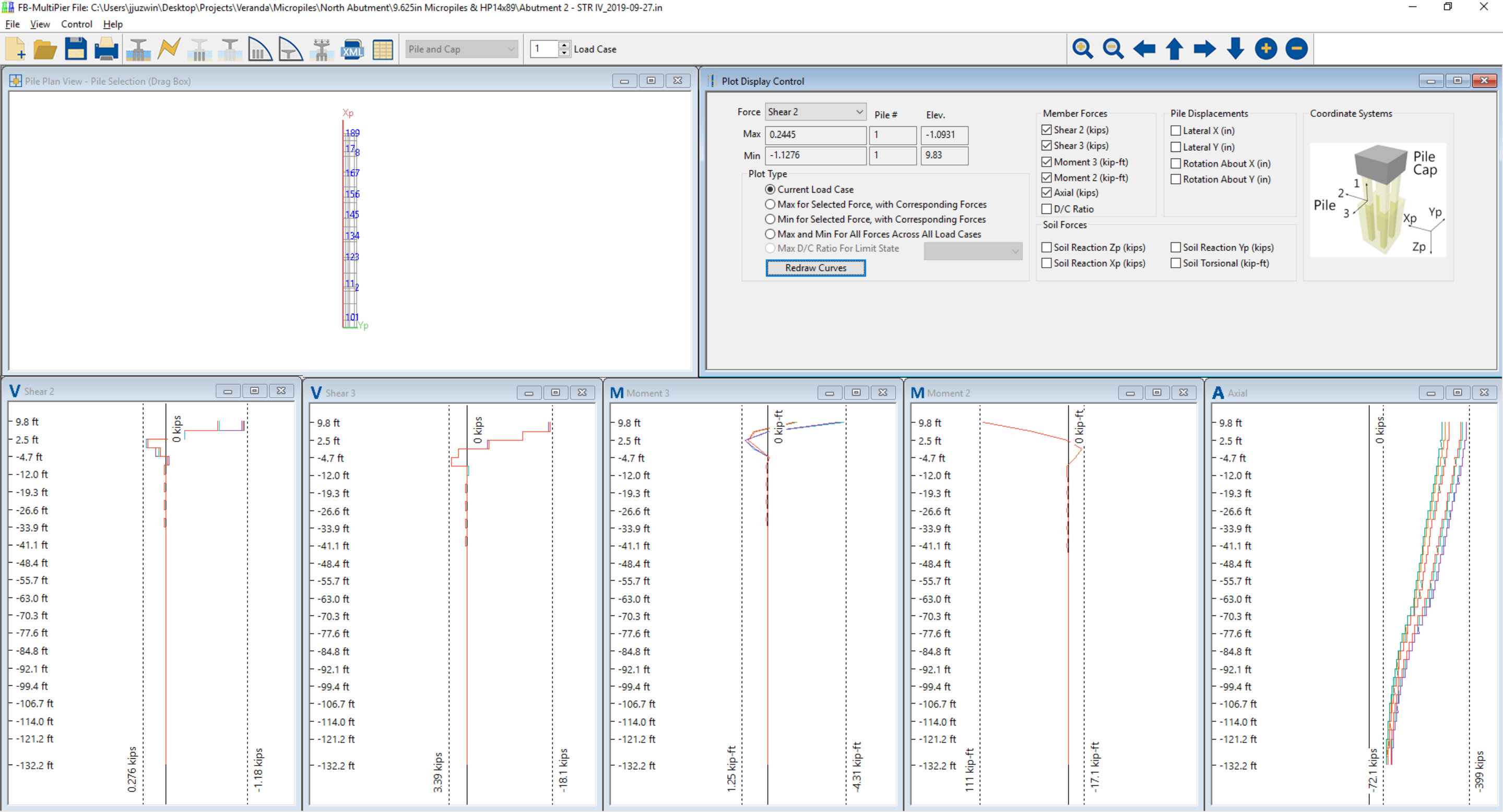
Abutment 1 (South Abutment) – Strength-IV Load Case – 9.625” OD Micropile



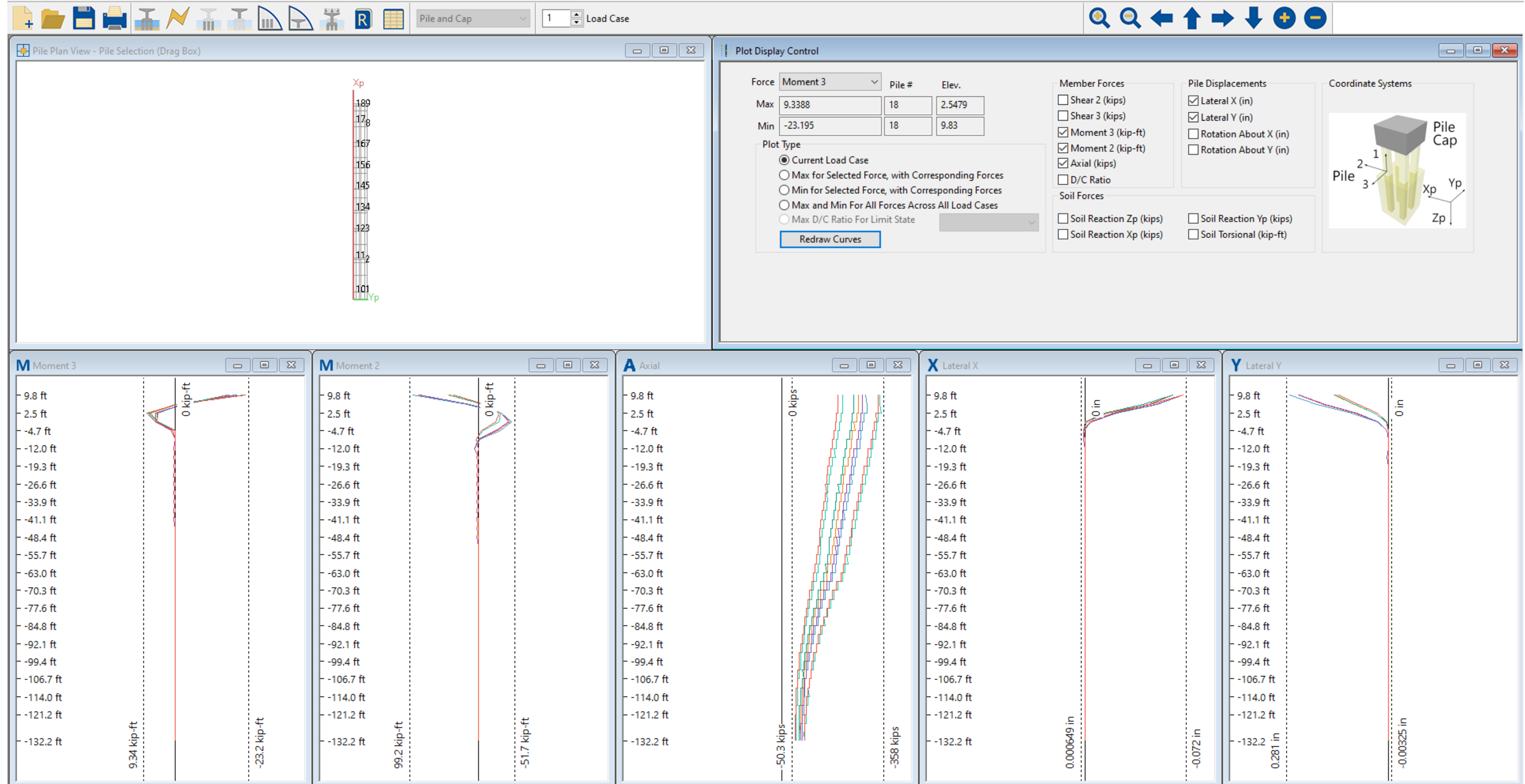
Abutment 1 (South Abutment) – Service-I Load Case – 9.625" OD Micropile



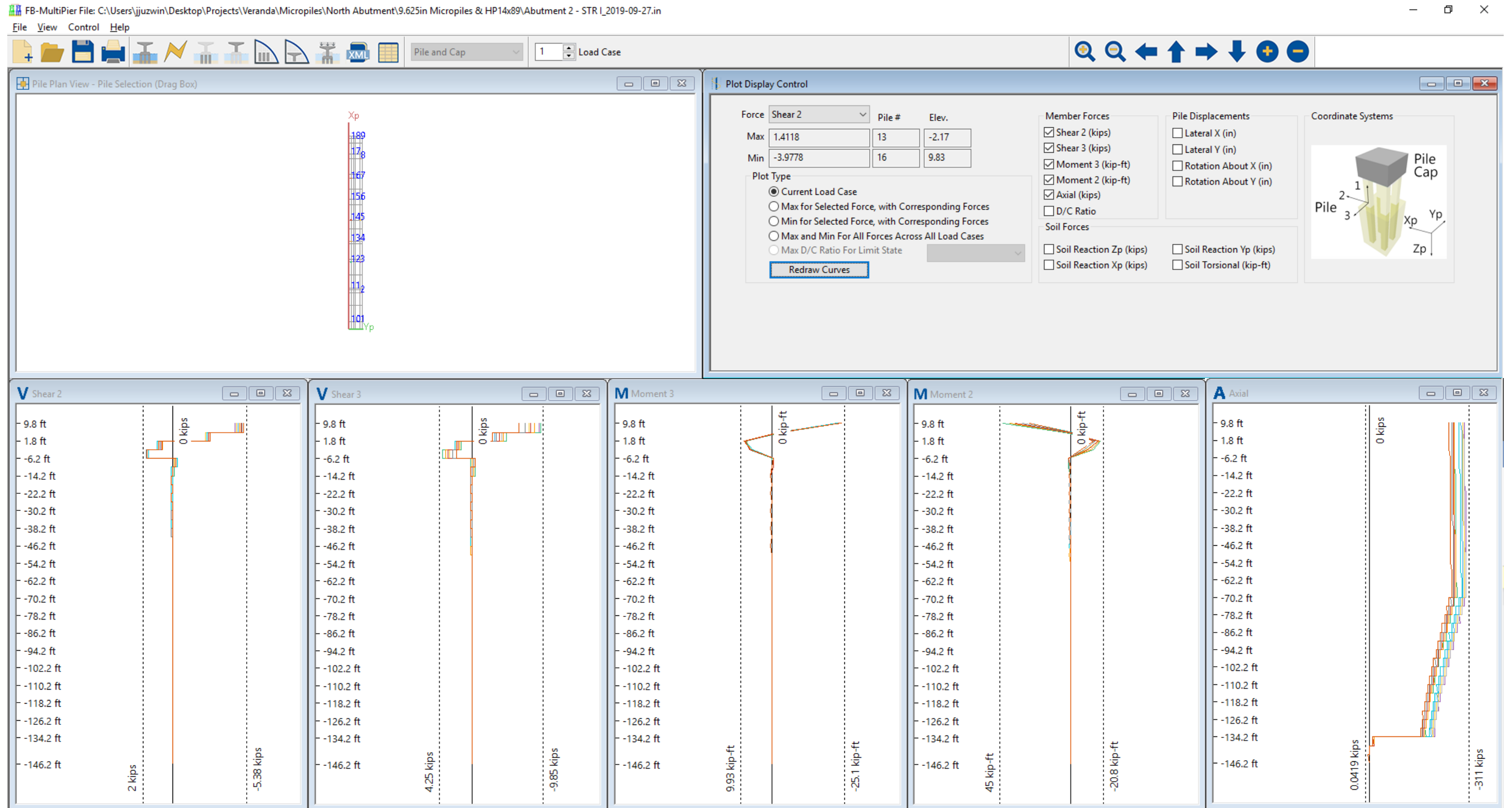
Abutment 2 (North Abutment) – Strength-I Load Case – HP14x89



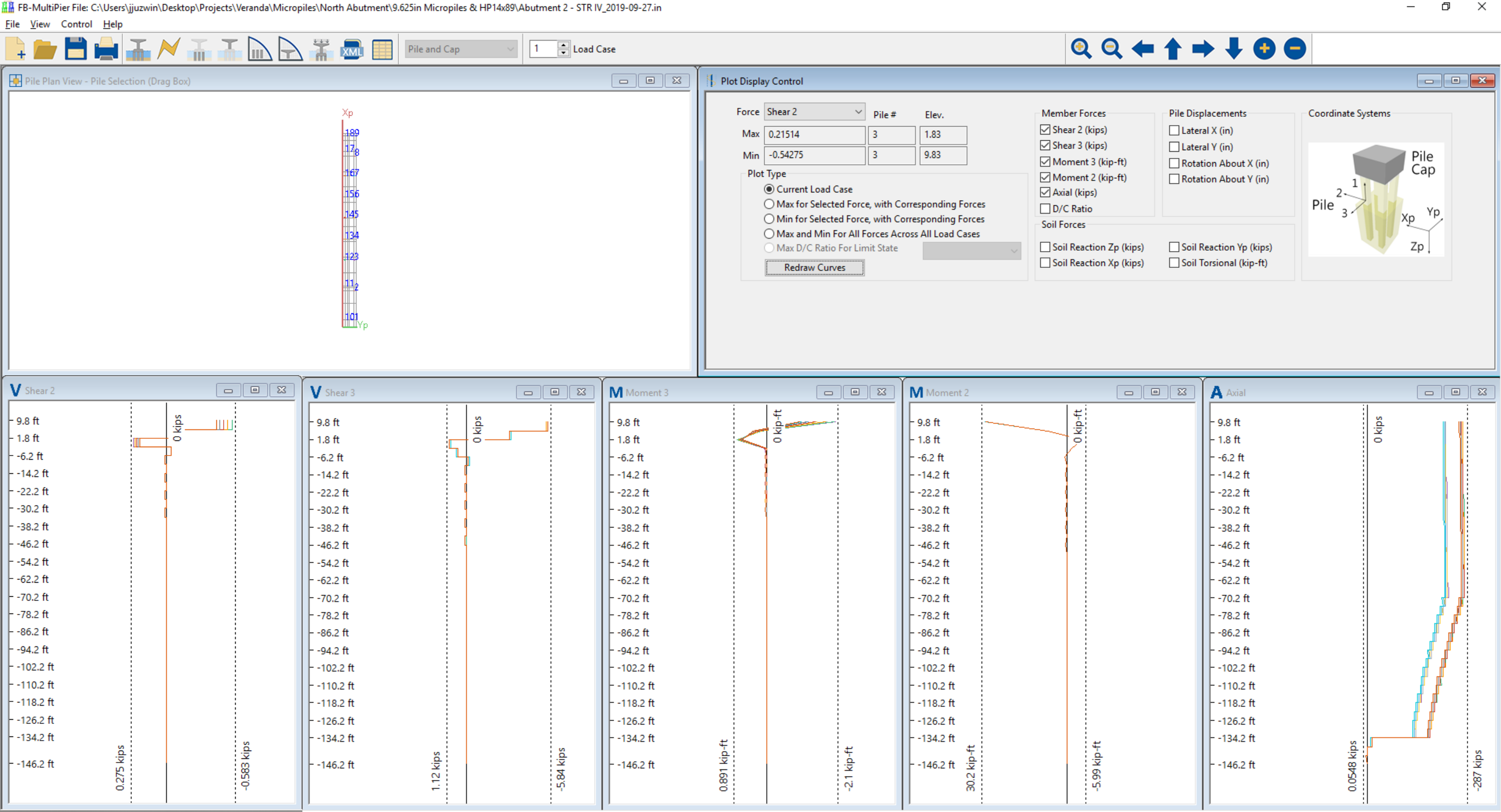
Abutment 2 (North Abutment) – Strength-IV Load Case – HP14x89



Abutment 2 (North Abutment) – Service-I Load Case – HP14x89

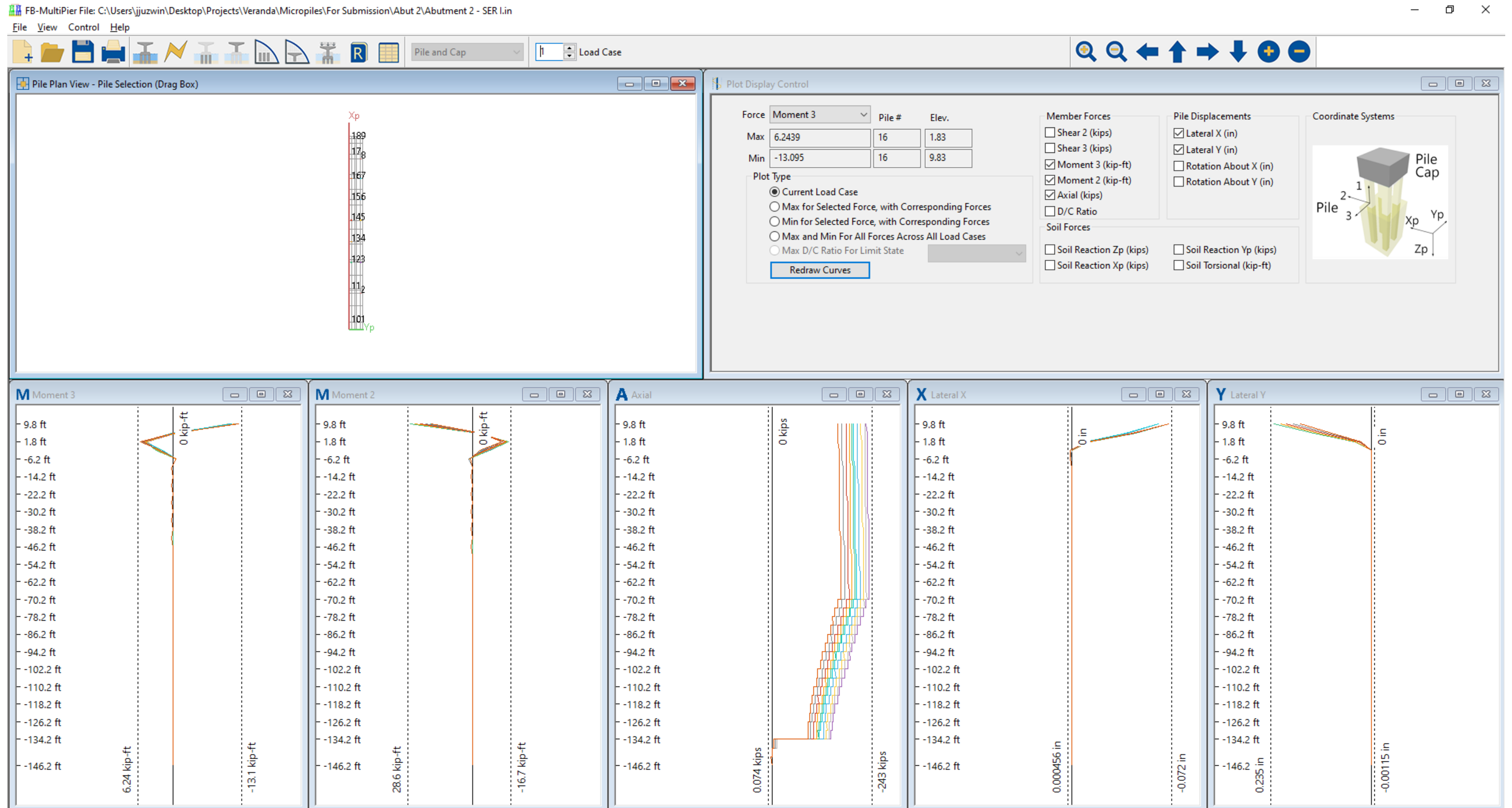


Abutment 2 (North Abutment) – Strength-I Load Case – 9.625” OD Micropile

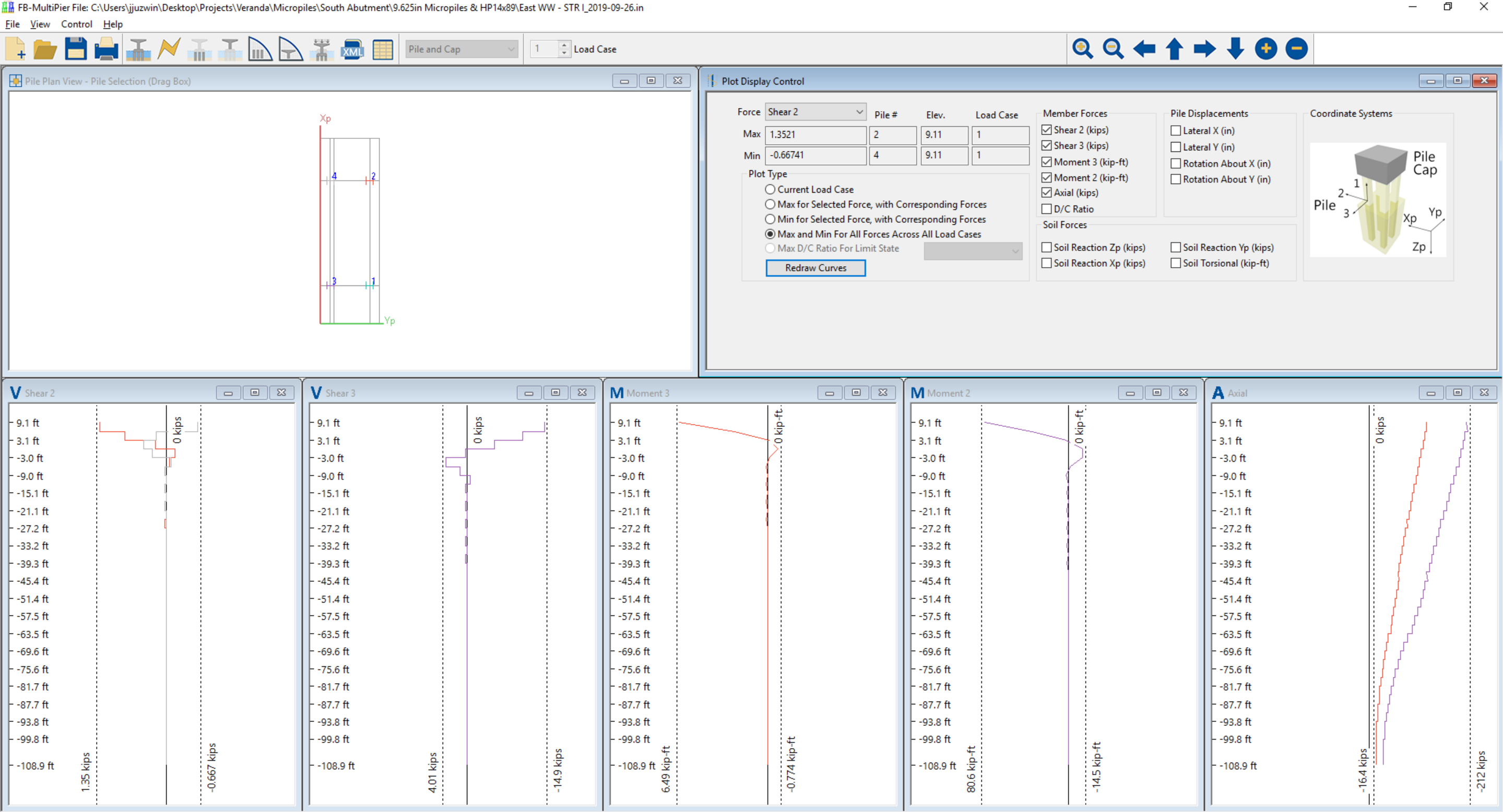


Abutment 2 (North Abutment) – Strength-IV Load Case – 9.625” OD Micropile





Abutment 2 (North Abutment) – Service-I Load Case – 9.625" OD Micropile



Wingwall – Strength-I Load Case – HP14x89

## FB-Multiplier Output – Abutment 1 (South) – Service-I

```

*****
*
*   The University of Florida, Florida Department of
*   Transportation, Marc Hoyt, Mike McVay, Cliff Hays,
*   Mark Williams, Petros Christou, Jae Chung,
*   Gary Consolazio, and Michael Davidson
*   disclaim any warranty, expressed or implied,
*   including but not limited to, any implied
*   warranty of fitness for a particular purpose
*   or accuracy of the FB-Multiplier software. The
*   developers shall not be liable for any damages
*   incurred through the use of FB-Multiplier.
*
*
*   ::: F B - M U L T I P L I E R :::
*   v5.6.0
*
*   Written by Marc Hoyt, Mike McVay, Cliff Hays,
*   Mark Williams, Petros Christou, Jae Chung,
*   Gary Consolazio, and Michael Davidson.
*
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*   Unauthorized reproduction or distribution
*   of this program, or any portion of it, may
*   result in severe civil and criminal penalties,
*   and will be prosecuted to the maximum extent
*   possible under the law.
*
*   © 2019 Bridge Software Institute
*   All rights reserved.
*
*   FB-Multiplier calculates the response of
*   bridge-pier-pile-soil structures.
*
*   FB-Multiplier analysis types include preload,
*   static, pushover, modal, and transient dynamic.
*
*   FB-Multiplier accounts for linear and nonlinear
*   pile and pier structural members, linear pile caps
*   and superstructure, and nonlinear soil behavior.
*
*   Contact the Bridge Software Institute for support
*   https://bsi.ce.ufl.edu
*
*****

```

Analysis Start = 10:20pm  
 Analysis End = 10:20pm  
 Analysis Duration = 7 second(s)

Input Data File Name = Abutment 1 - SER I.in  
 Analysis Date = 4- 2-2020  
 License ID Number = 432000000

```

*****
*   OUTPUT STAGE 1 OF 2: INTERPRETATION OF INPUT FILE
*   *****

```

```

*****
*   PROJECT DATA
*   *****

```

Project client = MaineDOT  
 Project name = Veranda Street Bridge Replacement  
 Project manager = T. Cote  
 Computed by = A. Piccolino  
 Project description = 75297 - Abutment 1 (South) - Service I

```

*****
*   SELECTIVE PRINT OUTPUT CONTROL
*   *****

```

| Print Flag                                 | State |
|--|-------|
| Pile displacements                         | Off   |
| Pile element forces                        | Off   |
| Pile ID numbers                            | Off   |
| Pile cap stresses                          | Off   |
| Substructure coordinates                   | Off   |
| Substructure interaction diagrams          | Off   |
| Substructure material stress-strain curves | Off   |
| Substructure member section properties     | Off   |
| Pier columns and pier cap displacements    | Off   |
| Pier columns and pier cap forces           | On    |
| Soil response forces                       | Off   |
| Soil data per layer                        | On    |
| Soil curve data per pile node              | Off   |
| Soil resistance curves                     | Off   |
| Bridge span properties                     | Off   |
| Bridge span temperature data               | Off   |
| Bridge span displacements                  | Off   |
| Bridge span element forces                 | Off   |
| Discrete spring forces                     | Off   |
| Out of balance forces                      | Off   |
| XML output                                 | Off   |
| Eigenvectors                               | Off   |

```

*****
*   ANALYSIS CONTROL INFORMATION
*   *****

```

Memory specified for solution = 1024 MB

Number of cores = 1

Type of analysis = Static

-----  
 - Linear / Nonlinear analysis settings -  
 -----

Soil stiffness = Nonlinear  
 Pile stiffness = Nonlinear

-----  
 - Miscellaneous analysis settings -  
 -----

Units = English (kips & ft; lbs & in)

Convergence tolerance = 0.10 kips  
 Maximum number of iterations = 100

Number of substructures = 1

# FB-Multiplier Output – Abutment 1 (South) – Service-I

\*\*\*\*\*  
 \* SOIL BEHAVIOR \*  
 \*\*\*\*\*

Springs are defined at the following DOF for embedded nodes:  
 X-TRANSLATION Y-TRANSLATION Z-TRANSLATION  
 Z-ROTATION

\*\*\*\*\*  
 \* LOAD FACTORS FOR SELF WEIGHT AND BUOYANCY \*  
 \*\*\*\*\*

| LOAD CASE NO. | SELF WEIGHT FACTOR | BUOYANCY FACTOR |
|---------------|--------------------|-----------------|
| 1             | 1.00               | 1.00            |
| 2             | 1.00               | 1.00            |

\*\*\*\*\*  
 \* PILE CAP DATA \*  
 \*\*\*\*\*

NOTE: Xp-Grid: Distance between axes along Xp axis  
 Yp-Grid: Distance between axes along Yp axis

Number of Grid Points in Xp direction (NPX) = 25  
 Number of Grid Points in Yp direction (NPY) = 6

Grid Spacing in the Xp direction (in):

|        |       |        |        |        |       |        |
|--------|-------|--------|--------|--------|-------|--------|
| 8.20   | 33.40 | 76.90  | 61.70  | 40.30  | 15.80 | 117.80 |
| 105.20 | 12.60 | 117.80 | 28.80  | 89.10  | 65.90 | 22.30  |
| 95.60  | 72.30 | 45.30  | 114.00 | 121.80 | 61.70 | 56.20  |
| 127.60 | 19.50 | 5.10   |        |        |       |        |

Grid Spacing in the Yp direction (in):

|       |       |       |       |       |
|-------|-------|-------|-------|-------|
| 18.00 | 36.00 | 12.00 | 24.00 | 18.00 |
|-------|-------|-------|-------|-------|

\*\*\*\*\*  
 \* PILE TO PILE CAP CONNECTION \*  
 \*\*\*\*\*

PILE head fixity = FIXED

\*\*\*\*\*  
 \* INPUT SOIL LAYER DATA \*  
 \*\*\*\*\*

P-Y SOIL LAYER DATA

-----  
 - SOIL SET # 1 -  
 -----

| SET | LAYER | MODEL | PHI<br>deg | RK<br>lbs/in^3 | GAMMA<br>pcf |
|-----|-------|-------|------------|----------------|--------------|
| 1   | 1     | 2     | 0.3200E+02 | 0.9000E+02     | 0.1100E+03   |
|     |       |       | 0.3200E+02 | 0.9000E+02     | 0.1100E+03   |

| SET | LAYER | MODEL | GAMMA<br>pcf | CU<br>psf  | E50        |
|-----|-------|-------|--------------|------------|------------|
| 1   | 2     | 4     | 0.1050E+03   | 0.3500E+03 | 0.1000E-01 |
|     |       |       | 0.1050E+03   | 0.3500E+03 | 0.1000E-01 |

| SET | LAYER | MODEL | GAMMA<br>pcf | CU<br>psf  | E50        | Cavg<br>psf |
|-----|-------|-------|--------------|------------|------------|-------------|
| 1   | 3     | 6     | 0.1150E+03   | 0.5000E+03 | 0.5000E-02 | 0.5000E+03  |
|     |       |       | 0.1150E+03   | 0.1500E+04 | 0.5000E-02 | 0.1500E+04  |

| SET | LAYER | MODEL | PHI<br>deg | RK<br>lbs/in^3 | GAMMA<br>pcf |
|-----|-------|-------|------------|----------------|--------------|
| 1   | 4     | 2     | 0.3000E+02 | 0.3000E+02     | 0.1050E+03   |
|     |       |       | 0.3400E+02 | 0.6000E+02     | 0.1150E+03   |

| SET | LAYER | MODEL | PHI<br>deg | RK<br>lbs/in^3 | GAMMA<br>pcf |
|-----|-------|-------|------------|----------------|--------------|
| 1   | 5     | 2     | 0.3600E+02 | 0.7000E+02     | 0.1200E+03   |
|     |       |       | 0.3600E+02 | 0.7000E+02     | 0.1200E+03   |

| SET | LAYER | MODEL | Qu<br>psf  |
|-----|-------|-------|------------|
| 1   | 6     | 8     | 0.5040E+06 |

-----  
 - SOIL SET # 2 -  
 -----

| SET | LAYER | MODEL | PHI<br>deg | RK<br>lbs/in^3 | GAMMA<br>pcf |
|-----|-------|-------|------------|----------------|--------------|
| 2   | 1     | 2     | 0.3200E+02 | 0.9000E+02     | 0.1100E+03   |
|     |       |       | 0.3200E+02 | 0.9000E+02     | 0.1100E+03   |

| SET | LAYER | MODEL | GAMMA<br>pcf | CU<br>psf  | E50        | Cavg<br>psf |
|-----|-------|-------|--------------|------------|------------|-------------|
| 2   | 2     | 6     | 0.1150E+03   | 0.5000E+03 | 0.1000E-01 | 0.5000E+03  |
|     |       |       | 0.1150E+03   | 0.5000E+03 | 0.1000E-01 | 0.5000E+03  |

| SET | LAYER | MODEL | GAMMA<br>pcf | CU<br>psf  | E50        | Cavg<br>psf |
|-----|-------|-------|--------------|------------|------------|-------------|
| 2   | 3     | 6     | 0.1150E+03   | 0.5000E+03 | 0.5000E-02 | 0.5000E+03  |
|     |       |       | 0.1150E+03   | 0.1500E+04 | 0.5000E-02 | 0.1500E+04  |

| SET | LAYER | MODEL | PHI<br>deg | RK<br>lbs/in^3 | GAMMA<br>pcf |
|-----|-------|-------|------------|----------------|--------------|
| 2   | 4     | 2     | 0.3000E+02 | 0.3000E+02     | 0.1050E+03   |
|     |       |       | 0.3400E+02 | 0.6000E+02     | 0.1150E+03   |

| SET | LAYER | MODEL | PHI<br>deg | RK<br>lbs/in^3 | GAMMA<br>pcf |
|-----|-------|-------|------------|----------------|--------------|
| 2   | 5     | 2     | 0.3600E+02 | 0.7000E+02     | 0.1200E+03   |
|     |       |       | 0.3600E+02 | 0.7000E+02     | 0.1200E+03   |

| SET | LAYER | MODEL | Qu<br>psf  |
|-----|-------|-------|------------|
| 2   | 6     | 8     | 0.5040E+06 |

T-Z SOIL LAYER DATA

-----  
 - SOIL SET # 1 -  
 -----

| SET | LAYER | MODEL | G<br>ksi   | POISSON    | TAU MAX<br>psf | ELEVATION<br>ft | ELEV. PIEZ.<br>ft |
|-----|-------|-------|------------|------------|----------------|-----------------|-------------------|
| 1   | 1     | 1     | 0.9700E+00 | 0.3000E+00 | 0.1000E+00     | 0.1200E+02      | 0.5000E+01        |
|     |       |       | 0.9700E+00 | 0.3000E+00 | 0.1000E+00     | 0.8200E+01      | 0.5000E+01        |

| SET | LAYER | MODEL | G<br>ksi | POISSON | TAU MAX<br>psf | ELEVATION<br>ft | ELEV. PIEZ.<br>ft |
|-----|-------|-------|----------|---------|----------------|-----------------|-------------------|
|-----|-------|-------|----------|---------|----------------|-----------------|-------------------|

# FB-Multiplier Output – Abutment 1 (South) – Service-I

|     |       |       |                          |                          |                          |                            |                          |
|-----|-------|-------|--------------------------|--------------------------|--------------------------|----------------------------|--------------------------|
| 1   | 2     | 1     | 0.6900E+00<br>0.6900E+00 | 0.4000E+00<br>0.4000E+00 | 0.1000E+00<br>0.1000E+00 | 0.8200E+01<br>0.5000E+01   | 0.5000E+01<br>0.5000E+01 |
| SET | LAYER | MODEL | G<br>ksi                 | POISSON                  | TAU MAX<br>psf           | ELEVATION<br>ft            | ELEV. PIEZ.<br>ft        |
| 1   | 3     | 1     | 0.6900E+00<br>0.6900E+00 | 0.4500E+00<br>0.5000E+00 | 0.1000E+00<br>0.1000E+00 | 0.5000E+01<br>-0.4960E+02  | 0.5000E+01<br>0.5000E+01 |
| SET | LAYER | MODEL | G<br>ksi                 | POISSON                  | TAU MAX<br>psf           | ELEVATION<br>ft            | ELEV. PIEZ.<br>ft        |
| 1   | 4     | 1     | 0.6900E+00<br>0.1460E+01 | 0.3000E+00<br>0.4000E+00 | 0.1000E+00<br>0.1000E+00 | -0.4960E+02<br>-0.6090E+02 | 0.5000E+01<br>0.5000E+01 |
| SET | LAYER | MODEL | G<br>ksi                 | POISSON                  | TAU MAX<br>psf           | ELEVATION<br>ft            | ELEV. PIEZ.<br>ft        |
| 1   | 5     | 1     | 0.2010E+01<br>0.2010E+01 | 0.2500E+00<br>0.2500E+00 | 0.8270E+03<br>0.8270E+03 | -0.6090E+02<br>-0.1079E+03 | 0.5000E+01<br>0.5000E+01 |
| SET | LAYER | MODEL | G<br>ksi                 | POISSON                  | TAU MAX<br>psf           | ELEVATION<br>ft            | ELEV. PIEZ.<br>ft        |
| 1   | 6     | 1     | 0.5200E+03<br>0.5200E+03 | 0.2500E+00<br>0.2500E+00 | 0.5040E+06<br>0.5040E+06 | -0.1079E+03<br>-0.1300E+03 | 0.5000E+01<br>0.5000E+01 |

-----  
- SOIL SET # 2 -  
-----

|     |       |       |                          |                          |                          |                            |                          |
|-----|-------|-------|--------------------------|--------------------------|--------------------------|----------------------------|--------------------------|
| SET | LAYER | MODEL | G<br>ksi                 | POISSON                  | TAU MAX<br>psf           | ELEVATION<br>ft            | ELEV. PIEZ.<br>ft        |
| 2   | 1     | 1     | 0.9700E+00<br>0.9700E+00 | 0.3000E+00<br>0.3000E+00 | 0.1000E+00<br>0.1000E+00 | 0.1200E+02<br>0.8200E+01   | 0.5000E+01<br>0.5000E+01 |
| SET | LAYER | MODEL | G<br>ksi                 | POISSON                  | TAU MAX<br>psf           | ELEVATION<br>ft            | ELEV. PIEZ.<br>ft        |
| 2   | 2     | 1     | 0.6900E+00<br>0.6900E+00 | 0.4500E+00<br>0.4500E+00 | 0.1000E+00<br>0.4200E+03 | 0.8200E+01<br>0.5000E+01   | 0.5000E+01<br>0.5000E+01 |
| SET | LAYER | MODEL | G<br>ksi                 | POISSON                  | TAU MAX<br>psf           | ELEVATION<br>ft            | ELEV. PIEZ.<br>ft        |
| 2   | 3     | 1     | 0.6900E+00<br>0.6900E+00 | 0.4500E+00<br>0.5000E+00 | 0.4200E+03<br>0.1040E+04 | 0.5000E+01<br>-0.4960E+02  | 0.5000E+01<br>0.5000E+01 |
| SET | LAYER | MODEL | G<br>ksi                 | POISSON                  | TAU MAX<br>psf           | ELEVATION<br>ft            | ELEV. PIEZ.<br>ft        |
| 2   | 4     | 1     | 0.6900E+00<br>0.1460E+01 | 0.3000E+00<br>0.4000E+00 | 0.1840E+04<br>0.3250E+04 | -0.4960E+02<br>-0.6090E+02 | 0.5000E+01<br>0.5000E+01 |
| SET | LAYER | MODEL | G<br>ksi                 | POISSON                  | TAU MAX<br>psf           | ELEVATION<br>ft            | ELEV. PIEZ.<br>ft        |
| 2   | 5     | 1     | 0.2010E+01<br>0.2010E+01 | 0.2500E+00<br>0.2500E+00 | 0.4200E+04<br>0.7240E+04 | -0.6090E+02<br>-0.1079E+03 | 0.5000E+01<br>0.5000E+01 |
| SET | LAYER | MODEL | G<br>ksi                 | POISSON                  | TAU MAX<br>psf           | ELEVATION<br>ft            | ELEV. PIEZ.<br>ft        |
| 2   | 6     | 1     | 0.5200E+03<br>0.5200E+03 | 0.2500E+00<br>0.2500E+00 | 0.5040E+06<br>0.5040E+06 | -0.1079E+03<br>-0.1300E+03 | 0.5000E+01<br>0.5000E+01 |

T-THETA SOIL LAYER DATA

-----  
- SOIL SET # 1 -  
-----

|     |       |       |          |                |
|-----|-------|-------|----------|----------------|
| SET | LAYER | MODEL | G<br>ksi | TAU MAX<br>psf |
|-----|-------|-------|----------|----------------|

|     |       |       |                          |                          |
|-----|-------|-------|--------------------------|--------------------------|
| 1   | 1     | 1     | 0.9700E+00<br>0.9700E+00 | 0.1000E+00<br>0.1000E+00 |
| SET | LAYER | MODEL | G<br>ksi                 | TAU MAX<br>psf           |
| 1   | 2     | 1     | 0.6900E+00<br>0.6900E+00 | 0.1000E+00<br>0.1000E+00 |
| SET | LAYER | MODEL | G<br>ksi                 | TAU MAX<br>psf           |
| 1   | 3     | 1     | 0.6900E+00<br>0.6900E+00 | 0.1000E+00<br>0.1000E+00 |
| SET | LAYER | MODEL | G<br>ksi                 | TAU MAX<br>psf           |
| 1   | 4     | 1     | 0.6900E+00<br>0.1460E+01 | 0.1000E+00<br>0.1000E+00 |
| SET | LAYER | MODEL | G<br>ksi                 | TAU MAX<br>psf           |
| 1   | 5     | 1     | 0.2010E+01<br>0.2010E+01 | 0.8270E+03<br>0.8270E+03 |
| SET | LAYER | MODEL | G<br>ksi                 | TAU MAX<br>psf           |
| 1   | 6     | 1     | 0.5200E+03<br>0.5200E+03 | 0.5040E+06<br>0.5040E+06 |

-----  
- SOIL SET # 2 -  
-----

|     |       |       |                          |                          |
|-----|-------|-------|--------------------------|--------------------------|
| SET | LAYER | MODEL | G<br>ksi                 | TAU MAX<br>psf           |
| 2   | 1     | 1     | 0.9700E+00<br>0.9700E+00 | 0.1000E+00<br>0.1000E+00 |
| SET | LAYER | MODEL | G<br>ksi                 | TAU MAX<br>psf           |
| 2   | 2     | 1     | 0.6900E+00<br>0.6900E+00 | 0.1000E+00<br>0.4200E+03 |
| SET | LAYER | MODEL | G<br>ksi                 | TAU MAX<br>psf           |
| 2   | 3     | 1     | 0.6900E+00<br>0.6900E+00 | 0.4200E+03<br>0.1040E+04 |
| SET | LAYER | MODEL | G<br>ksi                 | TAU MAX<br>psf           |
| 2   | 4     | 1     | 0.6900E+00<br>0.1460E+01 | 0.1840E+04<br>0.3250E+04 |
| SET | LAYER | MODEL | G<br>ksi                 | TAU MAX<br>psf           |
| 2   | 5     | 1     | 0.2010E+01<br>0.2010E+01 | 0.4200E+04<br>0.7240E+04 |
| SET | LAYER | MODEL | G<br>ksi                 | TAU MAX<br>psf           |
| 2   | 6     | 1     | 0.5200E+03<br>0.5200E+03 | 0.5040E+06<br>0.5040E+06 |

Q-Z SOIL LAYER DATA

-----  
- SOIL SET # 1 -  
-----

## FB-Multiplier Output – Abutment 1 (South) – Service-I

```

-----
Driven Pile (McVay)
Shear Modulus           =      520.0000 ksi
Poisson's Ratio         =      0.2000
Nominal Tip Resistance   =     200.0000 kips

-----
- SOIL SET # 2 -
-----

Driven Pile (McVay)
Shear Modulus           =      520.0000 ksi
Poisson's Ratio         =      0.2000
Nominal Tip Resistance   =     200.0000 kips

*****
*                PILE SECTION DATA                *
*****

NOTE: Pile sets consist of pile segments based on user input.
      The program groups all segments from every pile set and
      assigns a unique section number to each segment.

Number of pile sections      =      3

-----
-                INPUT DATA FOR SECTION : 1        -
-----

File Set Number             =      1
File Set Segment            =      1

Section Length (L)          =     117.00000 ft

-----
Section Nonlinear Properties
-----

- Concrete Stress Strain Properties -
-----

Concrete Strength (FPC)      = 0.5000E+01 ksi
Modulus of Elasticity (EC)   = 0.4287E+04 ksi

No. Gauss Integ. points in the concrete = 60

-----
- Steel Stress Strain Properties -
-----

Mild Steel Yield Stress (FY) = 0.7500E+02 ksi
Modulus of Elasticity (ES)   = 0.2900E+05 ksi

Steel Casing Yield Stress (FY) = 0.8000E+02 ksi
Modulus of Elasticity (ES)   = 0.2900E+05 ksi

- Shape of Section : CIRCULAR

- Reinforcement and Confinement Data

Number of Reinforcement Layers = 1
Diameter                       = 9.6250 in
Tied/Spiral Reinforcement Flag = 1
(Spiral = 1;
Tied = 2)
Confinement Flag               = 0
(Unconfined = 0;
Confined: Tied/Spiral = 1;
Confined: Tied/Spiral w/ Casing = 2;
Confined: Tied/Spiral w/ Confine-Only Casing = 3)

- Total Area of Steel Reinforcement = 4.0000 in^2

WARNING : The number of bars is changed to a multiple of 4.
This is to ensure a symmetric section for the
analysis. The area is changed to result in the
same total area of reinforcement.

```

```

Confinement Flag           = 0
(Unconfined = 0;
Confined: Tied/Spiral = 1;
Confined: Tied/Spiral w/ Casing = 2;
Confined: Tied/Spiral w/ Confine-Only Casing = 3)
Outer Shell Thickness       = 0.5450E+00 in

- Total Area of Steel Reinforcement = 4.0000 in^2

WARNING : The number of bars is changed to a multiple of 4.
This is to ensure a symmetric section for the
analysis. The area is changed to result in the
same total area of reinforcement.

Layer # Bars/Strands Area Layer Dia. Prestressing
      in^2 in ksi
1      4      1.00 0.00 0.00

-----
-                INPUT DATA FOR SECTION : 2        -
-----

File Set Number             =      1
File Set Segment            =      2

Section Length (L)          =     15.00000 ft

-----
Section Nonlinear Properties
-----

- Concrete Stress Strain Properties -
-----

Concrete Strength (FPC)      = 0.5000E+01 ksi
Modulus of Elasticity (EC)   = 0.4287E+04 ksi

No. Gauss Integ. points in the concrete = 60

-----
- Steel Stress Strain Properties -
-----

Mild Steel Yield Stress (FY) = 0.7500E+02 ksi
Modulus of Elasticity (ES)   = 0.2900E+05 ksi

- Shape of Section : CIRCULAR

- Reinforcement and Confinement Data

Number of Reinforcement Layers = 1
Diameter                       = 9.6250 in
Tied/Spiral Reinforcement Flag = 1
(Spiral = 1;
Tied = 2)
Confinement Flag               = 0
(Unconfined = 0;
Confined: Tied/Spiral = 1;
Confined: Tied/Spiral w/ Casing = 2;
Confined: Tied/Spiral w/ Confine-Only Casing = 3)

- Total Area of Steel Reinforcement = 4.0000 in^2

WARNING : The number of bars is changed to a multiple of 4.
This is to ensure a symmetric section for the
analysis. The area is changed to result in the
same total area of reinforcement.

```

# FB-Multiplier Output – Abutment 1 (South) – Service-I

| Layer | # Bars/Strands | Area<br>in^2 | Layer Dia.<br>in | Prestressing<br>ksi |
|-------|----------------|--------------|------------------|---------------------|
| 1     | 4              | 1.00         | 0.00             | 0.00                |

-----  
INPUT DATA FOR SECTION : 3  
-----

File Set Number = 2  
File Set Segment = 1  
  
Section Length (L) = 118.00000 ft

## Section Nonlinear Properties

-----  
- Steel Stress Strain Properties -  
-----

H-Pile Yield Stress (FY) = 0.5000E+02 ksi  
Modulus of Elasticity (ES) = 0.2900E+05 ksi

- Shape of Section : USER DEFINED H-PILE

Units are in in  
Orientation : OR = 2 Web along 2 axis  
OR = 3 Web along 3 axis

| Depth | Width | Web Width | Flange Width | Orientation |
|-------|-------|-----------|--------------|-------------|
| 13.8  | 14.7  | 0.615     | 0.615        | 3           |

\*\*\*\*\*  
\* PILE SET DATA \*  
\*\*\*\*\*

NOTE : Piles are organized into pile sets. Each pile set is  
composed of pile segments, as specified by the user.

## List of Pile Sets and Piles

| Pile Set | Piles Assigned to the Pile Set           |
|----------|--|
| 1        | 3, 4, 5, 6, 7, 8, 13, 14, 15, 16, 17, 18 |
| 2        | 1, 2, 9, 10, 11, 12, 19, 20              |

## Total length for each Pile Set

| Pile Set | Length<br>in |
|----------|--------------|
| 1        | 1584.00      |
| 2        | 1416.00      |

\*\*\*\*\*  
\* EXTERNAL LOADS APPLIED TO SUBSTRUCTURE \*  
\*\*\*\*\*

-----  
SUBSTRUCTURE # 1  
-----

| NODE | CASE | FXp<br>kips | FYp<br>kips | FZp<br>kips | MXp<br>kip-ft | MYp<br>kip-ft | MZp<br>kip-ft |
|------|------|-------------|-------------|-------------|---------------|---------------|---------------|
|------|------|-------------|-------------|-------------|---------------|---------------|---------------|

|     |   |        |       |        |        |        |      |
|-----|---|--------|-------|--------|--------|--------|------|
| 89  | 1 | -17.69 | 34.20 | 451.68 | 500.49 | 457.07 | 0.00 |
| 92  | 1 | -17.69 | 27.26 | 361.91 | 446.90 | 445.75 | 0.00 |
| 93  | 1 | -17.69 | 27.12 | 357.08 | 436.43 | 434.43 | 0.00 |
| 95  | 1 | -17.69 | 26.78 | 357.35 | 424.64 | 423.11 | 0.00 |
| 96  | 1 | -17.69 | 26.26 | 347.15 | 411.75 | 411.79 | 0.00 |
| 98  | 1 | -17.69 | 23.36 | 306.30 | 384.86 | 400.65 | 0.00 |
| 99  | 1 | -3.52  | 15.25 | 239.76 | 203.42 | 85.41  | 0.00 |
| 101 | 1 | -3.52  | 17.51 | 262.25 | 212.96 | 83.15  | 0.00 |
| 103 | 1 | -3.52  | 17.33 | 262.58 | 207.96 | 80.93  | 0.00 |
| 104 | 1 | -3.52  | 17.17 | 259.21 | 203.33 | 78.72  | 0.00 |
| 105 | 1 | -3.52  | 16.60 | 254.87 | 197.01 | 76.46  | 0.00 |
| 107 | 1 | -3.52  | 24.17 | 338.59 | 241.29 | 74.25  | 0.00 |
| 89  | 2 | -10.70 | 32.25 | 431.66 | 450.73 | 278.57 | 0.00 |
| 92  | 2 | -10.70 | 25.31 | 343.99 | 398.40 | 271.73 | 0.00 |
| 93  | 2 | -10.70 | 25.17 | 339.44 | 389.17 | 264.88 | 0.00 |
| 95  | 2 | -10.70 | 24.83 | 338.64 | 378.63 | 258.03 | 0.00 |
| 96  | 2 | -10.70 | 24.31 | 329.56 | 366.98 | 251.18 | 0.00 |
| 98  | 2 | -10.70 | 21.41 | 288.42 | 341.32 | 244.44 | 0.00 |
| 99  | 2 | -10.70 | 15.25 | 296.26 | 203.42 | 248.72 | 0.00 |
| 101 | 2 | -10.70 | 17.51 | 327.46 | 212.96 | 241.88 | 0.00 |
| 103 | 2 | -10.70 | 17.33 | 319.47 | 207.96 | 235.14 | 0.00 |
| 104 | 2 | -10.70 | 17.17 | 317.33 | 203.33 | 228.40 | 0.00 |
| 105 | 2 | -10.70 | 16.60 | 313.32 | 197.01 | 221.55 | 0.00 |
| 107 | 2 | -10.70 | 24.17 | 410.30 | 241.29 | 214.81 | 0.00 |

\*\*\*\*\*  
\* OUTPUT STAGE 2 OF 2: ANALYSIS RESULTS \*  
\*\*\*\*\*

\*\*\*\*\*  
\* RESULTS FOR LOAD CASE 1 \*  
\*\*\*\*\*

\*\*\*\*\*  
\* CONVERGENCE REPORT \*  
\*\*\*\*\*

The solution converged in 18 iterations

## Summary of Maximum Out-Of-Balance Forces (Absolute Values)

FZ = 0.000 kips  
FX = 0.000 kips  
FY = 0.036 kips  
MXX = 0.000 kip-ft  
MYY = 0.000 kip-ft  
MZZ = 0.008 kip-ft

## Summary of Displacements at Pile Heads

| NODE | X<br>in    | Y<br>in    | Z<br>in    |
|------|------------|------------|------------|
| 1    | -.7254E-01 | 0.1988E+00 | 0.3715E+00 |
| 2    | -.7254E-01 | 0.1886E+00 | 0.3672E+00 |
| 3    | -.7253E-01 | 0.1783E+00 | 0.3618E+00 |
| 4    | -.7253E-01 | 0.1721E+00 | 0.3576E+00 |
| 5    | -.7253E-01 | 0.1626E+00 | 0.3496E+00 |
| 6    | -.7252E-01 | 0.1520E+00 | 0.3378E+00 |
| 7    | -.7251E-01 | 0.1420E+00 | 0.3238E+00 |
| 8    | -.7251E-01 | 0.1324E+00 | 0.3081E+00 |
| 9    | -.7250E-01 | 0.1214E+00 | 0.2879E+00 |

## FB-Multiplier Output – Abutment 1 (South) – Service-I

|    |            |            |            |
|----|------------|------------|------------|
| 10 | -.7250E-01 | 0.1091E+00 | 0.2640E+00 |
| 11 | -.7680E-01 | 0.1969E+00 | 0.3249E+00 |
| 12 | -.7681E-01 | 0.1862E+00 | 0.3203E+00 |
| 13 | -.7681E-01 | 0.1783E+00 | 0.3160E+00 |
| 14 | -.7681E-01 | 0.1721E+00 | 0.3119E+00 |
| 15 | -.7682E-01 | 0.1626E+00 | 0.3039E+00 |
| 16 | -.7682E-01 | 0.1520E+00 | 0.2922E+00 |
| 17 | -.7683E-01 | 0.1420E+00 | 0.2781E+00 |
| 18 | -.7683E-01 | 0.1324E+00 | 0.2625E+00 |
| 19 | -.7683E-01 | 0.1214E+00 | 0.2423E+00 |
| 20 | -.7683E-01 | 0.1103E+00 | 0.2207E+00 |

---

Sum of Total Soil Spring Forces for Piles

|                   |   |           |      |
|-------------------|---|-----------|------|
| Xp Direction      | = | -127.4512 | kips |
| Yp Direction      | = | 273.0810  | kips |
| Zp Direction      | = | 4676.4939 | kips |
| Sum of Tip Forces | = | 132.0693  | kips |

---

Summary of Pile Forces for Load CASE 1

### 1. Axial Force (kips)

| Pile # | Maximum Force | Minimum Force |
|--------|---------------|---------------|
| 1      | -0.59964E+02  | -0.33249E+03  |
| 2      | -0.59129E+02  | -0.32930E+03  |
| 3      | 0.77493E-01   | -0.21908E+03  |
| 4      | 0.77697E-01   | -0.21674E+03  |
| 5      | 0.78089E-01   | -0.21223E+03  |
| 6      | 0.78666E-01   | -0.20555E+03  |
| 7      | 0.79349E-01   | -0.19755E+03  |
| 8      | 0.80102E-01   | -0.18864E+03  |
| 9      | -0.44323E+02  | -0.26912E+03  |
| 10     | -0.40084E+02  | -0.25038E+03  |
| 11     | -0.51106E+02  | -0.29760E+03  |
| 12     | -0.50243E+02  | -0.29407E+03  |
| 13     | 0.79723E-01   | -0.19314E+03  |
| 14     | 0.79921E-01   | -0.19079E+03  |
| 15     | 0.80301E-01   | -0.18626E+03  |
| 16     | 0.80860E-01   | -0.17954E+03  |
| 17     | 0.81520E-01   | -0.17149E+03  |
| 18     | 0.82246E-01   | -0.16251E+03  |
| 19     | -0.36327E+02  | -0.23307E+03  |
| 20     | -0.32687E+02  | -0.21556E+03  |

### 2. Pile Shear Force in 2 Direction (kips)

| Pile # | Maximum Shear | Minimum Shear |
|--------|---------------|---------------|
| 1      | 0.17111E+01   | -0.52638E+01  |
| 2      | 0.17034E+01   | -0.53876E+01  |
| 3      | 0.15412E+01   | -0.35835E+01  |
| 4      | 0.15611E+01   | -0.36208E+01  |
| 5      | 0.15871E+01   | -0.36735E+01  |
| 6      | 0.16107E+01   | -0.37327E+01  |
| 7      | 0.16318E+01   | -0.37996E+01  |
| 8      | 0.16494E+01   | -0.38757E+01  |
| 9      | 0.18561E+01   | -0.62771E+01  |
| 10     | 0.20931E+01   | -0.65657E+01  |
| 11     | 0.18071E+01   | -0.56084E+01  |
| 12     | 0.17975E+01   | -0.57419E+01  |

|    |             |              |
|----|-------------|--------------|
| 13 | 0.16213E+01 | -0.38119E+01 |
| 14 | 0.16446E+01 | -0.38521E+01 |
| 15 | 0.16764E+01 | -0.39098E+01 |
| 16 | 0.17065E+01 | -0.39751E+01 |
| 17 | 0.17309E+01 | -0.40446E+01 |
| 18 | 0.17498E+01 | -0.41204E+01 |
| 19 | 0.19279E+01 | -0.66553E+01 |
| 20 | 0.21475E+01 | -0.69216E+01 |

### 3. Pile Shear Force in 3 Direction (kips)

| Pile # | Maximum Shear | Minimum Shear |
|--------|---------------|---------------|
| 1      | 0.71465E+01   | -0.19298E+02  |
| 2      | 0.71698E+01   | -0.18604E+02  |
| 3      | 0.33506E+01   | -0.73911E+01  |
| 4      | 0.32595E+01   | -0.71938E+01  |
| 5      | 0.31119E+01   | -0.68870E+01  |
| 6      | 0.29327E+01   | -0.65318E+01  |
| 7      | 0.27447E+01   | -0.61774E+01  |
| 8      | 0.25503E+01   | -0.58209E+01  |
| 9      | 0.60843E+01   | -0.13271E+02  |
| 10     | 0.55178E+01   | -0.12018E+02  |
| 11     | 0.70980E+01   | -0.19149E+02  |
| 12     | 0.71173E+01   | -0.18418E+02  |
| 13     | 0.33443E+01   | -0.74216E+01  |
| 14     | 0.32562E+01   | -0.72218E+01  |
| 15     | 0.31123E+01   | -0.69100E+01  |
| 16     | 0.29356E+01   | -0.65467E+01  |
| 17     | 0.27493E+01   | -0.61840E+01  |
| 18     | 0.25547E+01   | -0.58192E+01  |
| 19     | 0.60702E+01   | -0.13202E+02  |
| 20     | 0.55800E+01   | -0.12061E+02  |

### 4. Bending Moment About 2 Axis (kip-ft and ft)

| Pile | Node | Depth Below Cap | Maximum Moment | Node | Depth Below Cap | Minimum Moment |
|------|------|-----------------|----------------|------|-----------------|----------------|
| 1    | 1    | 0.00000E+00     | 0.8615E+02     | 542  | 0.1180E+02      | -0.38940E+02   |
| 2    | 2    | 0.00000E+00     | 0.8174E+02     | 581  | 0.1180E+02      | -0.37958E+02   |
| 3    | 3    | 0.00000E+00     | 0.2860E+02     | 619  | 0.9900E+01      | -0.13046E+02   |
| 4    | 4    | 0.00000E+00     | 0.2760E+02     | 658  | 0.9900E+01      | -0.12809E+02   |
| 5    | 5    | 0.00000E+00     | 0.2605E+02     | 697  | 0.9900E+01      | -0.12432E+02   |
| 6    | 6    | 0.00000E+00     | 0.2427E+02     | 736  | 0.9900E+01      | -0.11980E+02   |
| 7    | 7    | 0.00000E+00     | 0.2253E+02     | 775  | 0.9900E+01      | -0.11510E+02   |
| 8    | 8    | 0.00000E+00     | 0.2079E+02     | 814  | 0.9900E+01      | -0.11026E+02   |
| 9    | 9    | 0.00000E+00     | 0.4990E+02     | 854  | 0.1180E+02      | -0.29484E+02   |
| 10   | 10   | 0.00000E+00     | 0.4296E+02     | 893  | 0.1180E+02      | -0.27250E+02   |
| 11   | 11   | 0.00000E+00     | 0.8510E+02     | 932  | 0.1180E+02      | -0.38633E+02   |
| 12   | 12   | 0.00000E+00     | 0.8051E+02     | 971  | 0.1180E+02      | -0.37597E+02   |
| 13   | 13   | 0.00000E+00     | 0.2861E+02     | 1009 | 0.9900E+01      | -0.13004E+02   |
| 14   | 14   | 0.00000E+00     | 0.2761E+02     | 1048 | 0.9900E+01      | -0.12763E+02   |
| 15   | 15   | 0.00000E+00     | 0.2605E+02     | 1087 | 0.9900E+01      | -0.12378E+02   |
| 16   | 16   | 0.00000E+00     | 0.2426E+02     | 1126 | 0.9900E+01      | -0.11916E+02   |
| 17   | 17   | 0.00000E+00     | 0.2249E+02     | 1165 | 0.9900E+01      | -0.11435E+02   |
| 18   | 18   | 0.00000E+00     | 0.2073E+02     | 1204 | 0.9900E+01      | -0.10934E+02   |
| 19   | 19   | 0.00000E+00     | 0.4960E+02     | 1244 | 0.1180E+02      | -0.29352E+02   |
| 20   | 20   | 0.00000E+00     | 0.4332E+02     | 1283 | 0.1180E+02      | -0.27348E+02   |

### 5. Bending Moment About 3 Axis (kip-ft and ft)

| Pile | Node | Depth Below Cap | Maximum Moment | Node | Depth Below Cap | Minimum Moment |
|------|------|-----------------|----------------|------|-----------------|----------------|
| 1    | 542  | 0.11800E+02     | 0.7932E+01     | 1    | 0.0000E+00      | -0.22273E+02   |
| 2    | 581  | 0.11800E+02     | 0.8065E+01     | 2    | 0.0000E+00      | -0.22593E+02   |
| 3    | 620  | 0.13200E+02     | 0.5433E+01     | 3    | 0.0000E+00      | -0.15083E+02   |



## FB-Multiplier Output – Abutment 1 (South) – Service-I

|    |      |             |            |    |            |              |
|----|------|-------------|------------|----|------------|--------------|
| 4  | 658  | 0.99000E+01 | 0.5447E+01 | 4  | 0.0000E+00 | -0.15138E+02 |
| 5  | 697  | 0.99000E+01 | 0.5612E+01 | 5  | 0.0000E+00 | -0.15184E+02 |
| 6  | 736  | 0.99000E+01 | 0.5802E+01 | 6  | 0.0000E+00 | -0.15213E+02 |
| 7  | 775  | 0.99000E+01 | 0.5996E+01 | 7  | 0.0000E+00 | -0.15274E+02 |
| 8  | 814  | 0.99000E+01 | 0.6186E+01 | 8  | 0.0000E+00 | -0.15383E+02 |
| 9  | 854  | 0.11800E+02 | 0.8909E+01 | 9  | 0.0000E+00 | -0.23881E+02 |
| 10 | 893  | 0.11800E+02 | 0.9134E+01 | 10 | 0.0000E+00 | -0.24570E+02 |
| 11 | 932  | 0.11800E+02 | 0.8406E+01 | 11 | 0.0000E+00 | -0.23651E+02 |
| 12 | 971  | 0.11800E+02 | 0.8551E+01 | 12 | 0.0000E+00 | -0.23983E+02 |
| 13 | 1010 | 0.13200E+02 | 0.5791E+01 | 13 | 0.0000E+00 | -0.16025E+02 |
| 14 | 1049 | 0.13200E+02 | 0.5799E+01 | 14 | 0.0000E+00 | -0.16089E+02 |
| 15 | 1087 | 0.99000E+01 | 0.5908E+01 | 15 | 0.0000E+00 | -0.16151E+02 |
| 16 | 1126 | 0.99000E+01 | 0.6108E+01 | 16 | 0.0000E+00 | -0.16201E+02 |
| 17 | 1165 | 0.99000E+01 | 0.6305E+01 | 17 | 0.0000E+00 | -0.16267E+02 |
| 18 | 1204 | 0.99000E+01 | 0.6495E+01 | 18 | 0.0000E+00 | -0.16368E+02 |
| 19 | 1244 | 0.11800E+02 | 0.9436E+01 | 19 | 0.0000E+00 | -0.25362E+02 |
| 20 | 1283 | 0.11800E+02 | 0.9652E+01 | 20 | 0.0000E+00 | -0.25996E+02 |

\*\*\*\*\*  
 \* RESULTS FOR LOAD CASE 2 \*  
 \*\*\*\*\*

\*\*\*\*\*  
 \* CONVERGENCE REPORT \*  
 \*\*\*\*\*

The solution converged in 19 iterations

### Summary of Maximum Out-Of-Balance Forces (Absolute Values)

FZ = 0.000 kips  
 FX = 0.000 kips  
 FY = 0.012 kips  
 MXX = 0.000 kip-ft  
 MYY = 0.000 kip-ft  
 MZZ = 0.007 kip-ft

### Summary of Displacements at Pile Heads

| NODE | X<br>in    | Y<br>in    | Z<br>in    |
|------|------------|------------|------------|
| 1    | -.6734E-01 | 0.1594E+00 | 0.3397E+00 |
| 2    | -.6734E-01 | 0.1517E+00 | 0.3448E+00 |
| 3    | -.6733E-01 | 0.1438E+00 | 0.3490E+00 |
| 4    | -.6733E-01 | 0.1390E+00 | 0.3506E+00 |
| 5    | -.6733E-01 | 0.1317E+00 | 0.3513E+00 |
| 6    | -.6732E-01 | 0.1236E+00 | 0.3490E+00 |
| 7    | -.6731E-01 | 0.1159E+00 | 0.3434E+00 |
| 8    | -.6731E-01 | 0.1086E+00 | 0.3354E+00 |
| 9    | -.6731E-01 | 0.1002E+00 | 0.3235E+00 |
| 10   | -.6731E-01 | 0.9077E-01 | 0.3085E+00 |
| 11   | -.7060E-01 | 0.1579E+00 | 0.3203E+00 |
| 12   | -.7060E-01 | 0.1498E+00 | 0.3255E+00 |
| 13   | -.7060E-01 | 0.1438E+00 | 0.3286E+00 |
| 14   | -.7060E-01 | 0.1390E+00 | 0.3302E+00 |
| 15   | -.7061E-01 | 0.1317E+00 | 0.3310E+00 |
| 16   | -.7062E-01 | 0.1236E+00 | 0.3286E+00 |
| 17   | -.7062E-01 | 0.1159E+00 | 0.3231E+00 |
| 18   | -.7063E-01 | 0.1086E+00 | 0.3151E+00 |
| 19   | -.7063E-01 | 0.1002E+00 | 0.3032E+00 |
| 20   | -.7063E-01 | 0.9167E-01 | 0.2897E+00 |

### Sum of Total Soil Spring Forces for Piles

|                   |   |           |      |
|-------------------|---|-----------|------|
| Xp Direction      | = | -128.4873 | kips |
| Yp Direction      | = | 261.3958  | kips |
| Zp Direction      | = | 4933.6139 | kips |
| Sum of Tip Forces | = | 140.9763  | kips |

### Summary of Pile Forces for Load CASE 2

#### 1. Axial Force (kips)

| Pile # | Maximum Force | Minimum Force |
|--------|---------------|---------------|
| 1      | -0.53870E+02  | -0.30874E+03  |
| 2      | -0.54842E+02  | -0.31260E+03  |
| 3      | 0.78122E-01   | -0.21186E+03  |
| 4      | 0.78041E-01   | -0.21279E+03  |
| 5      | 0.78006E-01   | -0.21320E+03  |
| 6      | 0.78121E-01   | -0.21186E+03  |
| 7      | 0.78394E-01   | -0.20871E+03  |
| 8      | 0.78786E-01   | -0.20416E+03  |
| 9      | -0.50831E+02  | -0.29648E+03  |
| 10     | -0.48057E+02  | -0.28501E+03  |
| 11     | -0.50244E+02  | -0.29407E+03  |
| 12     | -0.51208E+02  | -0.29802E+03  |
| 13     | 0.79117E-01   | -0.20028E+03  |
| 14     | 0.79037E-01   | -0.20123E+03  |
| 15     | 0.79000E-01   | -0.20165E+03  |
| 16     | 0.79113E-01   | -0.20033E+03  |
| 17     | 0.79381E-01   | -0.19718E+03  |
| 18     | 0.79767E-01   | -0.19262E+03  |
| 19     | -0.47094E+02  | -0.28097E+03  |
| 20     | -0.44642E+02  | -0.27050E+03  |

#### 2. Pile Shear Force in 2 Direction (kips)

| Pile # | Maximum Shear | Minimum Shear |
|--------|---------------|---------------|
| 1      | 0.16404E+01   | -0.54778E+01  |
| 2      | 0.16213E+01   | -0.55844E+01  |
| 3      | 0.15292E+01   | -0.36729E+01  |
| 4      | 0.15401E+01   | -0.36976E+01  |
| 5      | 0.15511E+01   | -0.37286E+01  |
| 6      | 0.15570E+01   | -0.37596E+01  |
| 7      | 0.15593E+01   | -0.37952E+01  |
| 8      | 0.15601E+01   | -0.38407E+01  |
| 9      | 0.17969E+01   | -0.62246E+01  |
| 10     | 0.19762E+01   | -0.64501E+01  |
| 11     | 0.17143E+01   | -0.57515E+01  |
| 12     | 0.16923E+01   | -0.58641E+01  |
| 13     | 0.15967E+01   | -0.38454E+01  |
| 14     | 0.16094E+01   | -0.38719E+01  |
| 15     | 0.16237E+01   | -0.39059E+01  |
| 16     | 0.16335E+01   | -0.39405E+01  |
| 17     | 0.16387E+01   | -0.39794E+01  |
| 18     | 0.16419E+01   | -0.40274E+01  |
| 19     | 0.18623E+01   | -0.65141E+01  |
| 20     | 0.20287E+01   | -0.67206E+01  |

#### 3. Pile Shear Force in 3 Direction (kips)

# FB-Multiplier Output – Abutment 1 (South) – Service-I

| Pile # | Maximum Shear | Minimum Shear |
|--------|---------------|---------------|
| 1      | 0.65625E+01   | -0.18453E+02  |
| 2      | 0.65488E+01   | -0.17875E+02  |
| 3      | 0.29838E+01   | -0.69683E+01  |
| 4      | 0.29040E+01   | -0.67976E+01  |
| 5      | 0.27767E+01   | -0.65350E+01  |
| 6      | 0.26253E+01   | -0.62354E+01  |
| 7      | 0.24717E+01   | -0.59423E+01  |
| 8      | 0.23174E+01   | -0.56529E+01  |
| 9      | 0.56370E+01   | -0.13534E+02  |
| 10     | 0.52474E+01   | -0.12555E+02  |
| 11     | 0.65325E+01   | -0.18306E+02  |
| 12     | 0.65135E+01   | -0.17699E+02  |
| 13     | 0.29798E+01   | -0.69653E+01  |
| 14     | 0.29019E+01   | -0.67943E+01  |
| 15     | 0.27773E+01   | -0.65309E+01  |
| 16     | 0.26287E+01   | -0.62293E+01  |
| 17     | 0.24777E+01   | -0.59329E+01  |
| 18     | 0.23245E+01   | -0.56392E+01  |
| 19     | 0.56269E+01   | -0.13465E+02  |
| 20     | 0.52831E+01   | -0.12573E+02  |

## 4. Bending Moment About 2 Axis (kip-ft and ft)

| Pile | Node | Depth Below Cap | Maximum Moment | Node | Depth Below Cap | Minimum Moment |
|------|------|-----------------|----------------|------|-----------------|----------------|
| 1    | 1    | 0.00000E+00     | 0.8579E+02     | 542  | 0.1180E+02      | -0.33527E+02   |
| 2    | 2    | 0.00000E+00     | 0.8230E+02     | 581  | 0.1180E+02      | -0.32708E+02   |
| 3    | 3    | 0.00000E+00     | 0.2774E+02     | 619  | 0.9900E+01      | -0.11268E+02   |
| 4    | 4    | 0.00000E+00     | 0.2693E+02     | 658  | 0.9900E+01      | -0.11058E+02   |
| 5    | 5    | 0.00000E+00     | 0.2567E+02     | 697  | 0.9900E+01      | -0.10728E+02   |
| 6    | 6    | 0.00000E+00     | 0.2424E+02     | 736  | 0.9900E+01      | -0.10342E+02   |
| 7    | 7    | 0.00000E+00     | 0.2285E+02     | 775  | 0.9900E+01      | -0.99509E+01   |
| 8    | 8    | 0.00000E+00     | 0.2149E+02     | 814  | 0.9900E+01      | -0.95553E+01   |
| 9    | 9    | 0.00000E+00     | 0.5721E+02     | 854  | 0.1180E+02      | -0.25903E+02   |
| 10   | 10   | 0.00000E+00     | 0.5190E+02     | 893  | 0.1180E+02      | -0.24227E+02   |
| 11   | 11   | 0.00000E+00     | 0.8496E+02     | 932  | 0.1180E+02      | -0.33294E+02   |
| 12   | 12   | 0.00000E+00     | 0.8132E+02     | 971  | 0.1180E+02      | -0.32431E+02   |
| 13   | 13   | 0.00000E+00     | 0.2772E+02     | 1009 | 0.9900E+01      | -0.11221E+02   |
| 14   | 14   | 0.00000E+00     | 0.2691E+02     | 1048 | 0.9900E+01      | -0.11011E+02   |
| 15   | 15   | 0.00000E+00     | 0.2565E+02     | 1087 | 0.9900E+01      | -0.10679E+02   |
| 16   | 16   | 0.00000E+00     | 0.2422E+02     | 1126 | 0.9900E+01      | -0.10289E+02   |
| 17   | 17   | 0.00000E+00     | 0.2282E+02     | 1165 | 0.9900E+01      | -0.98956E+01   |
| 18   | 18   | 0.00000E+00     | 0.2145E+02     | 1204 | 0.9900E+01      | -0.94962E+01   |
| 19   | 19   | 0.00000E+00     | 0.5700E+02     | 1244 | 0.1180E+02      | -0.25812E+02   |
| 20   | 20   | 0.00000E+00     | 0.5217E+02     | 1283 | 0.1180E+02      | -0.24303E+02   |

## 5. Bending Moment About 3 Axis (kip-ft and ft)

| Pile | Node | Depth Below Cap | Maximum Moment | Node | Depth Below Cap | Minimum Moment |
|------|------|-----------------|----------------|------|-----------------|----------------|
| 1    | 542  | 0.1180E+02      | 0.7783E+01     | 1    | 0.0000E+00      | -0.22988E+02   |
| 2    | 581  | 0.1180E+02      | 0.7889E+01     | 2    | 0.0000E+00      | -0.23260E+02   |
| 3    | 619  | 0.9900E+01      | 0.5330E+01     | 3    | 0.0000E+00      | -0.15403E+02   |
| 4    | 658  | 0.9900E+01      | 0.5417E+01     | 4    | 0.0000E+00      | -0.15416E+02   |
| 5    | 697  | 0.9900E+01      | 0.5551E+01     | 5    | 0.0000E+00      | -0.15385E+02   |
| 6    | 736  | 0.9900E+01      | 0.5705E+01     | 6    | 0.0000E+00      | -0.15309E+02   |
| 7    | 775  | 0.9900E+01      | 0.5859E+01     | 7    | 0.0000E+00      | -0.15251E+02   |
| 8    | 814  | 0.9900E+01      | 0.6012E+01     | 8    | 0.0000E+00      | -0.15247E+02   |
| 9    | 854  | 0.1180E+02      | 0.8450E+01     | 9    | 0.0000E+00      | -0.23718E+02   |
| 10   | 893  | 0.1180E+02      | 0.8609E+01     | 10   | 0.0000E+00      | -0.24234E+02   |
| 11   | 932  | 0.1180E+02      | 0.8164E+01     | 11   | 0.0000E+00      | -0.24088E+02   |
| 12   | 971  | 0.1180E+02      | 0.8279E+01     | 12   | 0.0000E+00      | -0.24363E+02   |
| 13   | 1009 | 0.9900E+01      | 0.5558E+01     | 13   | 0.0000E+00      | -0.16123E+02   |
| 14   | 1048 | 0.9900E+01      | 0.5648E+01     | 14   | 0.0000E+00      | -0.16143E+02   |
| 15   | 1087 | 0.9900E+01      | 0.5789E+01     | 15   | 0.0000E+00      | -0.16121E+02   |

|    |      |             |            |    |            |              |
|----|------|-------------|------------|----|------------|--------------|
| 16 | 1126 | 0.99000E+01 | 0.5952E+01 | 16 | 0.0000E+00 | -0.16057E+02 |
| 17 | 1165 | 0.99000E+01 | 0.6110E+01 | 17 | 0.0000E+00 | -0.16012E+02 |
| 18 | 1204 | 0.99000E+01 | 0.6265E+01 | 18 | 0.0000E+00 | -0.16018E+02 |
| 19 | 1244 | 0.11800E+02 | 0.8863E+01 | 19 | 0.0000E+00 | -0.24875E+02 |
| 20 | 1283 | 0.11800E+02 | 0.9015E+01 | 20 | 0.0000E+00 | -0.25345E+02 |

\*\*\*\*\*  
\* SUBSTRUCTURE 1 MAX/MIN RESPONSES FOR ALL LOAD CASES \*  
\*\*\*\*\*

## Pile demands

| Demand type                    | Value       | Unit   | Load case | Load comb. | Pile |
|--------------------------------|-------------|--------|-----------|------------|------|
| Max axial force (tension is +) | 0.8225E-01  | kips   | 1         | 0          | 18   |
| Min axial force                | -0.3325E+03 | kips   | 1         | 0          | 1    |
| Max shear in 2 direction       | 0.2147E+01  | kips   | 1         | 0          | 20   |
| Min shear in 2 direction       | -0.6922E+01 | kips   | 1         | 0          | 20   |
| Max shear in 3 direction       | 0.7170E+01  | kips   | 1         | 0          | 2    |
| Min shear in 3 direction       | -0.1930E+02 | kips   | 1         | 0          | 1    |
| Max moment about 2 axis        | 0.8615E+02  | kip-ft | 1         | 0          | 1    |
| Min moment about 2 axis        | -0.3894E+02 | kip-ft | 1         | 0          | 1    |
| Max moment about 3 axis        | 0.9652E+01  | kip-ft | 1         | 0          | 20   |
| Min moment about 3 axis        | -0.2600E+02 | kip-ft | 1         | 0          | 20   |
| Max torsional force            | 0.2959E-01  | kip-ft | 1         | 0          | 8    |
| Min torsional force            | 0.1713E-64  | kip-ft | 2         | 0          | 1    |
| Max demand/capacity ratio      | 0.4856E+00  |        | 1         | 0          | 1    |

## Soil demands

| Demand type              | Value       | Unit   | Load case | Load comb. | Pile |
|--------------------------|-------------|--------|-----------|------------|------|
| Max Zp soil force        | 0.1376E+03  | kips   | 1         | 0          | 3    |
| Min Zp soil force        | 0.4264E-03  | kips   | 1         | 0          | 18   |
| Max Xp soil force        | 0.1760E+01  | kips   | 1         | 0          | 11   |
| Min Xp soil force        | -0.3514E+01 | kips   | 1         | 0          | 20   |
| Max Yp soil force        | 0.7635E+01  | kips   | 1         | 0          | 1    |
| Min Yp soil force        | -0.3993E+01 | kips   | 1         | 0          | 1    |
| Max torsional soil force | -0.1713E-64 | kip-ft | 2         | 0          | 1    |

## Pile head displacements

| Displacement type  | Value       | Unit | Load case | Load comb. | Pile |
|--------------------|-------------|------|-----------|------------|------|
| Max Z displacement | 0.3715E+00  | in   | 1         | 0          | 1    |
| Min Z displacement | 0.2207E+00  | in   | 1         | 0          | 20   |
| Max X displacement | -0.6731E-01 | in   | 2         | 0          | 10   |
| Min X displacement | -0.7683E-01 | in   | 1         | 0          | 20   |
| Max Y displacement | 0.1988E+00  | in   | 1         | 0          | 1    |
| Min Y displacement | 0.9077E-01  | in   | 2         | 0          | 10   |

## FB-Multiplier Output – Abutment 1 (South) – Strength-I

```

*****
*
*   The University of Florida, Florida Department of
*   Transportation, Marc Hoyt, Mike McVay, Cliff Hays,
*   Mark Williams, Petros Christou, Jae Chung,
*   Gary Consolazio, and Michael Davidson
*   disclaim any warranty, expressed or implied,
*   including but not limited to, any implied
*   warranty of fitness for a particular purpose
*   or accuracy of the FB-Multiplier software. The
*   developers shall not be liable for any damages
*   incurred through the use of FB-Multiplier.
*
*
*   ::: F B - M U L T I P L I E R :::
*   v5.6.0
*
*   Written by Marc Hoyt, Mike McVay, Cliff Hays,
*   Mark Williams, Petros Christou, Jae Chung,
*   Gary Consolazio, and Michael Davidson.
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*
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*
*   FB-Multiplier calculates the response of
*   bridge-pier-pile-soil structures.
*
*   FB-Multiplier analysis types include preload,
*   static, pushover, modal, and transient dynamic.
*
*   FB-Multiplier accounts for linear and nonlinear
*   pile and pier structural members, linear pile caps
*   and superstructure, and nonlinear soil behavior.
*
*   Contact the Bridge Software Institute for support
*   https://bsi.ce.ufl.edu
*
*****

```

Analysis Start = 10:27pm  
 Analysis End = 10:27pm  
 Analysis Duration = 10 second(s)

Input Data File Name = Abutment 1 - STR I.in  
 Analysis Date = 4- 2-2020  
 License ID Number = 432000000

```

*****
*   OUTPUT STAGE 1 OF 2: INTERPRETATION OF INPUT FILE
*   *****

```

```

*****
*   PROJECT DATA
*   *****

```

Project client = MaineDOT  
 Project name = Veranda Street Bridge Replacement  
 Project manager = T. Cote  
 Computed by = A. Piccolino  
 Project description = 75297 - Abutment 1 (South) - Strength I

```

*****
*   SELECTIVE PRINT OUTPUT CONTROL
*   *****

```

| Print Flag                                 | State |
|--|-------|
| Pile displacements                         | Off   |
| Pile element forces                        | Off   |
| Pile ID numbers                            | Off   |
| Pile cap stresses                          | Off   |
| Substructure coordinates                   | Off   |
| Substructure interaction diagrams          | Off   |
| Substructure material stress-strain curves | Off   |
| Substructure member section properties     | Off   |
| Pier columns and pier cap displacements    | Off   |
| Pier columns and pier cap forces           | On    |
| Soil response forces                       | Off   |
| Soil data per layer                        | On    |
| Soil curve data per pile node              | Off   |
| Soil resistance curves                     | Off   |
| Bridge span properties                     | Off   |
| Bridge span temperature data               | Off   |
| Bridge span displacements                  | Off   |
| Bridge span element forces                 | Off   |
| Discrete spring forces                     | Off   |
| Out of balance forces                      | Off   |
| XML output                                 | Off   |
| Eigenvectors                               | Off   |

```

*****
*   ANALYSIS CONTROL INFORMATION
*   *****

```

Memory specified for solution = 1024 MB

Number of cores = 1

Type of analysis = Static

-----  
 - Linear / Nonlinear analysis settings -  
 -----

Soil stiffness = Nonlinear  
 Pile stiffness = Nonlinear

-----  
 - Miscellaneous analysis settings -  
 -----

Units = English (kips & ft; lbs & in)

Convergence tolerance = 0.10 kips  
 Maximum number of iterations = 100

Number of substructures = 1

# FB-Multiplier Output – Abutment 1 (South) – Strength-I

\*\*\*\*\*  
 \* SOIL BEHAVIOR \*  
 \*\*\*\*\*

Springs are defined at the following DOF for embedded nodes:  
 X-TRANSLATION Y-TRANSLATION Z-TRANSLATION  
 Z-ROTATION

\*\*\*\*\*  
 \* LOAD FACTORS FOR SELF WEIGHT AND BUOYANCY \*  
 \*\*\*\*\*

| LOAD CASE NO. | SELF WEIGHT FACTOR | BUOYANCY FACTOR |
|---------------|--------------------|-----------------|
| 1             | 1.00               | 1.00            |
| 2             | 1.00               | 1.00            |
| 3             | 1.00               | 1.00            |
| 4             | 1.00               | 1.00            |

\*\*\*\*\*  
 \* PILE CAP DATA \*  
 \*\*\*\*\*

NOTE: Xp-Grid: Distance between axes along Xp axis  
 Yp-Grid: Distance between axes along Yp axis

Number of Grid Points in Xp direction (NPX) = 25  
 Number of Grid Points in Yp direction (NPY) = 6

Grid Spacing in the Xp direction (in):  
 8.20 33.40 76.90 61.70 40.30 15.80 117.80  
 105.20 12.60 117.80 28.80 89.10 65.90 22.30  
 95.60 72.30 45.30 114.00 121.80 61.70 56.20  
 127.60 19.50 5.10

Grid Spacing in the Yp direction (in):  
 18.00 36.00 12.00 24.00 18.00

\*\*\*\*\*  
 \* PILE TO PILE CAP CONNECTION \*  
 \*\*\*\*\*

Pile head fixity = FIXED

\*\*\*\*\*  
 \* INPUT SOIL LAYER DATA \*  
 \*\*\*\*\*

P-Y SOIL LAYER DATA

-----  
 - SOIL SET # 1 -  
 -----

| SET | LAYER | MODEL | PHI<br>deg               | RK<br>lbs/in^3           | GAMMA<br>pcf             |
|-----|-------|-------|--------------------------|--------------------------|--------------------------|
| 1   | 1     | 2     | 0.3200E+02<br>0.3200E+02 | 0.9000E+02<br>0.9000E+02 | 0.1100E+03<br>0.1100E+03 |

| SET | LAYER | MODEL | GAMMA<br>pcf | CU<br>psf  | E50        |
|-----|-------|-------|--------------|------------|------------|
| 1   | 2     | 4     | 0.1050E+03   | 0.3500E+03 | 0.1000E-01 |

0.1050E+03 0.3500E+03 0.1000E-01

| SET | LAYER | MODEL | GAMMA<br>pcf             | CU<br>psf                | E50                      | Cavg<br>psf              |
|-----|-------|-------|--------------------------|--------------------------|--------------------------|--------------------------|
| 1   | 3     | 6     | 0.1150E+03<br>0.1150E+03 | 0.5000E+03<br>0.1500E+04 | 0.5000E-02<br>0.5000E-02 | 0.5000E+03<br>0.1500E+04 |

| SET | LAYER | MODEL | PHI<br>deg               | RK<br>lbs/in^3           | GAMMA<br>pcf             |
|-----|-------|-------|--------------------------|--------------------------|--------------------------|
| 1   | 4     | 2     | 0.3000E+02<br>0.3400E+02 | 0.3000E+02<br>0.6000E+02 | 0.1050E+03<br>0.1150E+03 |

| SET | LAYER | MODEL | PHI<br>deg               | RK<br>lbs/in^3           | GAMMA<br>pcf             |
|-----|-------|-------|--------------------------|--------------------------|--------------------------|
| 1   | 5     | 2     | 0.3600E+02<br>0.3600E+02 | 0.7000E+02<br>0.7000E+02 | 0.1200E+03<br>0.1200E+03 |

| SET | LAYER | MODEL | Qu<br>psf  |
|-----|-------|-------|------------|
| 1   | 6     | 8     | 0.5040E+06 |

-----  
 - SOIL SET # 2 -  
 -----

| SET | LAYER | MODEL | PHI<br>deg               | RK<br>lbs/in^3           | GAMMA<br>pcf             |
|-----|-------|-------|--------------------------|--------------------------|--------------------------|
| 2   | 1     | 2     | 0.3200E+02<br>0.3200E+02 | 0.9000E+02<br>0.9000E+02 | 0.1100E+03<br>0.1100E+03 |

| SET | LAYER | MODEL | GAMMA<br>pcf             | CU<br>psf                | E50                      | Cavg<br>psf              |
|-----|-------|-------|--------------------------|--------------------------|--------------------------|--------------------------|
| 2   | 2     | 6     | 0.1150E+03<br>0.1150E+03 | 0.5000E+03<br>0.5000E+03 | 0.1000E-01<br>0.1000E-01 | 0.5000E+03<br>0.5000E+03 |

| SET | LAYER | MODEL | GAMMA<br>pcf             | CU<br>psf                | E50                      | Cavg<br>psf              |
|-----|-------|-------|--------------------------|--------------------------|--------------------------|--------------------------|
| 2   | 3     | 6     | 0.1150E+03<br>0.1150E+03 | 0.5000E+03<br>0.1500E+04 | 0.5000E-02<br>0.5000E-02 | 0.5000E+03<br>0.1500E+04 |

| SET | LAYER | MODEL | PHI<br>deg               | RK<br>lbs/in^3           | GAMMA<br>pcf             |
|-----|-------|-------|--------------------------|--------------------------|--------------------------|
| 2   | 4     | 2     | 0.3000E+02<br>0.3400E+02 | 0.3000E+02<br>0.6000E+02 | 0.1050E+03<br>0.1150E+03 |

| SET | LAYER | MODEL | PHI<br>deg               | RK<br>lbs/in^3           | GAMMA<br>pcf             |
|-----|-------|-------|--------------------------|--------------------------|--------------------------|
| 2   | 5     | 2     | 0.3600E+02<br>0.3600E+02 | 0.7000E+02<br>0.7000E+02 | 0.1200E+03<br>0.1200E+03 |

| SET | LAYER | MODEL | Qu<br>psf  |
|-----|-------|-------|------------|
| 2   | 6     | 8     | 0.5040E+06 |

T-Z SOIL LAYER DATA

-----  
 - SOIL SET # 1 -  
 -----

| SET | LAYER | MODEL | G<br>ksi                 | POISSON                  | TAU MAX<br>psf           | ELEVATION<br>ft          | ELEV. PIEZ.<br>ft        |
|-----|-------|-------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|
| 1   | 1     | 1     | 0.9700E+00<br>0.9700E+00 | 0.3000E+00<br>0.3000E+00 | 0.1000E+00<br>0.1000E+00 | 0.1200E+02<br>0.8200E+01 | 0.5000E+01<br>0.5000E+01 |

# FB-Multiplier Output – Abutment 1 (South) – Strength-I

| SET | LAYER | MODEL | G<br>ksi                 | POISSON                  | TAU MAX<br>psf           | ELEVATION<br>ft            | ELEV. PIEZ.<br>ft        |
|-----|-------|-------|--------------------------|--------------------------|--------------------------|----------------------------|--------------------------|
| 1   | 2     | 1     | 0.6900E+00<br>0.6900E+00 | 0.4000E+00<br>0.4000E+00 | 0.1000E+00<br>0.1000E+00 | 0.8200E+01<br>0.5000E+01   | 0.5000E+01<br>0.5000E+01 |
| SET | LAYER | MODEL | G<br>ksi                 | POISSON                  | TAU MAX<br>psf           | ELEVATION<br>ft            | ELEV. PIEZ.<br>ft        |
| 1   | 3     | 1     | 0.6900E+00<br>0.6900E+00 | 0.4500E+00<br>0.5000E+00 | 0.1000E+00<br>0.1000E+00 | 0.8200E+01<br>-0.4960E+02  | 0.5000E+01<br>0.5000E+01 |
| SET | LAYER | MODEL | G<br>ksi                 | POISSON                  | TAU MAX<br>psf           | ELEVATION<br>ft            | ELEV. PIEZ.<br>ft        |
| 1   | 4     | 1     | 0.6900E+00<br>0.1460E+01 | 0.3000E+00<br>0.4000E+00 | 0.1000E+00<br>0.1000E+00 | -0.4960E+02<br>-0.6090E+02 | 0.5000E+01<br>0.5000E+01 |
| SET | LAYER | MODEL | G<br>ksi                 | POISSON                  | TAU MAX<br>psf           | ELEVATION<br>ft            | ELEV. PIEZ.<br>ft        |
| 1   | 5     | 1     | 0.2010E+01<br>0.2010E+01 | 0.2500E+00<br>0.2500E+00 | 0.8270E+03<br>0.8270E+03 | -0.6090E+02<br>-0.1079E+03 | 0.5000E+01<br>0.5000E+01 |
| SET | LAYER | MODEL | G<br>ksi                 | POISSON                  | TAU MAX<br>psf           | ELEVATION<br>ft            | ELEV. PIEZ.<br>ft        |
| 1   | 6     | 1     | 0.5200E+03<br>0.5200E+03 | 0.2500E+00<br>0.2500E+00 | 0.5040E+06<br>0.5040E+06 | -0.1079E+03<br>-0.1300E+03 | 0.5000E+01<br>0.5000E+01 |

-----  
- SOIL SET # 2 -  
-----

| SET | LAYER | MODEL | G<br>ksi                 | POISSON                  | TAU MAX<br>psf           | ELEVATION<br>ft            | ELEV. PIEZ.<br>ft        |
|-----|-------|-------|--------------------------|--------------------------|--------------------------|----------------------------|--------------------------|
| 2   | 1     | 1     | 0.9700E+00<br>0.9700E+00 | 0.3000E+00<br>0.3000E+00 | 0.1000E+00<br>0.1000E+00 | 0.1200E+02<br>0.5000E+01   | 0.5000E+01<br>0.5000E+01 |
| SET | LAYER | MODEL | G<br>ksi                 | POISSON                  | TAU MAX<br>psf           | ELEVATION<br>ft            | ELEV. PIEZ.<br>ft        |
| 2   | 2     | 1     | 0.6900E+00<br>0.6900E+00 | 0.4500E+00<br>0.4500E+00 | 0.1000E+00<br>0.4200E+03 | 0.8200E+01<br>0.5000E+01   | 0.5000E+01<br>0.5000E+01 |
| SET | LAYER | MODEL | G<br>ksi                 | POISSON                  | TAU MAX<br>psf           | ELEVATION<br>ft            | ELEV. PIEZ.<br>ft        |
| 2   | 3     | 1     | 0.6900E+00<br>0.6900E+00 | 0.4500E+00<br>0.5000E+00 | 0.4200E+03<br>0.1040E+04 | 0.5000E+01<br>-0.4960E+02  | 0.5000E+01<br>0.5000E+01 |
| SET | LAYER | MODEL | G<br>ksi                 | POISSON                  | TAU MAX<br>psf           | ELEVATION<br>ft            | ELEV. PIEZ.<br>ft        |
| 2   | 4     | 1     | 0.6900E+00<br>0.1460E+01 | 0.3000E+00<br>0.4000E+00 | 0.1840E+04<br>0.3250E+04 | -0.4960E+02<br>-0.6090E+02 | 0.5000E+01<br>0.5000E+01 |
| SET | LAYER | MODEL | G<br>ksi                 | POISSON                  | TAU MAX<br>psf           | ELEVATION<br>ft            | ELEV. PIEZ.<br>ft        |
| 2   | 5     | 1     | 0.2010E+01<br>0.2010E+01 | 0.2500E+00<br>0.2500E+00 | 0.4200E+04<br>0.7240E+04 | -0.6090E+02<br>-0.1079E+03 | 0.5000E+01<br>0.5000E+01 |
| SET | LAYER | MODEL | G<br>ksi                 | POISSON                  | TAU MAX<br>psf           | ELEVATION<br>ft            | ELEV. PIEZ.<br>ft        |
| 2   | 6     | 1     | 0.5200E+03<br>0.5200E+03 | 0.2500E+00<br>0.2500E+00 | 0.5040E+06<br>0.5040E+06 | -0.1079E+03<br>-0.1300E+03 | 0.5000E+01<br>0.5000E+01 |

T-THETA SOIL LAYER DATA

-----  
- SOIL SET # 1 -  
-----

| SET | LAYER | MODEL | G<br>ksi                 | TAU MAX<br>psf           |
|-----|-------|-------|--------------------------|--------------------------|
| 1   | 1     | 1     | 0.9700E+00<br>0.9700E+00 | 0.1000E+00<br>0.1000E+00 |
| SET | LAYER | MODEL | G<br>ksi                 | TAU MAX<br>psf           |
| 1   | 2     | 1     | 0.6900E+00<br>0.6900E+00 | 0.1000E+00<br>0.1000E+00 |
| SET | LAYER | MODEL | G<br>ksi                 | TAU MAX<br>psf           |
| 1   | 3     | 1     | 0.6900E+00<br>0.6900E+00 | 0.1000E+00<br>0.1000E+00 |
| SET | LAYER | MODEL | G<br>ksi                 | TAU MAX<br>psf           |
| 1   | 4     | 1     | 0.6900E+00<br>0.1460E+01 | 0.1000E+00<br>0.1000E+00 |
| SET | LAYER | MODEL | G<br>ksi                 | TAU MAX<br>psf           |
| 1   | 5     | 1     | 0.2010E+01<br>0.2010E+01 | 0.8270E+03<br>0.8270E+03 |
| SET | LAYER | MODEL | G<br>ksi                 | TAU MAX<br>psf           |
| 1   | 6     | 1     | 0.5200E+03<br>0.5200E+03 | 0.5040E+06<br>0.5040E+06 |

-----  
- SOIL SET # 2 -  
-----

| SET | LAYER | MODEL | G<br>ksi                 | TAU MAX<br>psf           |
|-----|-------|-------|--------------------------|--------------------------|
| 2   | 1     | 1     | 0.9700E+00<br>0.9700E+00 | 0.1000E+00<br>0.1000E+00 |
| SET | LAYER | MODEL | G<br>ksi                 | TAU MAX<br>psf           |
| 2   | 2     | 1     | 0.6900E+00<br>0.6900E+00 | 0.1000E+00<br>0.4200E+03 |
| SET | LAYER | MODEL | G<br>ksi                 | TAU MAX<br>psf           |
| 2   | 3     | 1     | 0.6900E+00<br>0.6900E+00 | 0.4200E+03<br>0.1040E+04 |
| SET | LAYER | MODEL | G<br>ksi                 | TAU MAX<br>psf           |
| 2   | 4     | 1     | 0.6900E+00<br>0.1460E+01 | 0.1840E+04<br>0.3250E+04 |
| SET | LAYER | MODEL | G<br>ksi                 | TAU MAX<br>psf           |
| 2   | 5     | 1     | 0.2010E+01<br>0.2010E+01 | 0.4200E+04<br>0.7240E+04 |
| SET | LAYER | MODEL | G<br>ksi                 | TAU MAX<br>psf           |
| 2   | 6     | 1     | 0.5200E+03<br>0.5200E+03 | 0.5040E+06<br>0.5040E+06 |

Q-Z SOIL LAYER DATA

## FB-Multiplier Output – Abutment 1 (South) – Strength-I

```

-----
- SOIL SET # 1 -
-----

Driven Pile (McVay)
Shear Modulus           =      520.0000 ksi
Poisson's Ratio         =      0.2000
Nominal Tip Resistance   =     200.0000 kips

-----
- SOIL SET # 2 -
-----

Driven Pile (McVay)
Shear Modulus           =      520.0000 ksi
Poisson's Ratio         =      0.2000
Nominal Tip Resistance   =     200.0000 kips

*****
*                PILE SECTION DATA                *
*****

NOTE: Pile sets consist of pile segments based on user input.
      The program groups all segments from every pile set and
      assigns a unique section number to each segment.

Number of pile sections      =      3

-----
-                INPUT DATA FOR SECTION : 1        -
-----

Pile Set Number           =      1
Pile Set Segment          =      1

Section Length (L)        =     117.00000 ft

-----
Section Nonlinear Properties
-----

- Concrete Stress Strain Properties -
-----

Concrete Strength (FPC)    = 0.5000E+01 ksi
Modulus of Elasticity (EC) = 0.4287E+04 ksi

No. Gauss Integ. points in the concrete = 60

-----
- Steel Stress Strain Properties -
-----

Mild Steel Yield Stress (FY) = 0.7500E+02 ksi
Modulus of Elasticity (ES)  = 0.2900E+05 ksi

Steel Casing Yield Stress (FY) = 0.8000E+02 ksi
Modulus of Elasticity (ES)    = 0.2900E+05 ksi

- Shape of Section : CIRCULAR

- Reinforcement and Confinement Data

Number of Reinforcement Layers = 1
Diameter                      = 9.6250 in
Tied/Spiral Reinforcement Flag = 1

```

```

(Spiral = 1;
Tied = 2)
Confinement Flag           = 0
(Unconfined = 0;
Confined: Tied/Spiral = 1;
Confined: Tied/Spiral w/ Casing = 2;
Confined: Tied/Spiral w/ Confine-Only Casing = 3)
Outer Shell Thickness       = 0.5450E+00 in

- Total Area of Steel Reinforcement = 4.0000 in^2

WARNING : The number of bars is changed to a multiple of 4.
This is to ensure a symmetric section for the
analysis. The area is changed to result in the
same total area of reinforcement.

Layer # Bars/Strands Area Layer Dia. Prestressing
      in^2 in ksi
1      4      1.00    0.00    0.00

-----
-                INPUT DATA FOR SECTION : 2        -
-----

Pile Set Number           =      1
Pile Set Segment          =      2

Section Length (L)        =     15.000000 ft

-----
Section Nonlinear Properties
-----

- Concrete Stress Strain Properties -
-----

Concrete Strength (FPC)    = 0.5000E+01 ksi
Modulus of Elasticity (EC) = 0.4287E+04 ksi

No. Gauss Integ. points in the concrete = 60

-----
- Steel Stress Strain Properties -
-----

Mild Steel Yield Stress (FY) = 0.7500E+02 ksi
Modulus of Elasticity (ES)  = 0.2900E+05 ksi

- Shape of Section : CIRCULAR

- Reinforcement and Confinement Data

Number of Reinforcement Layers = 1
Diameter                      = 9.6250 in
Tied/Spiral Reinforcement Flag = 1
(Spiral = 1;
Tied = 2)
Confinement Flag           = 0
(Unconfined = 0;
Confined: Tied/Spiral = 1;
Confined: Tied/Spiral w/ Casing = 2;
Confined: Tied/Spiral w/ Confine-Only Casing = 3)

- Total Area of Steel Reinforcement = 4.0000 in^2

WARNING : The number of bars is changed to a multiple of 4.
This is to ensure a symmetric section for the

```

## FB-Multiplier Output – Abutment 1 (South) – Strength-I

analysis. The area is changed to result in the same total area of reinforcement.

| Layer | # Bars/Strands | Area<br>in^2 | Layer Dia.<br>in | Prestressing<br>ksi |
|-------|----------------|--------------|------------------|---------------------|
| 1     | 4              | 1.00         | 0.00             | 0.00                |

-----  
INPUT DATA FOR SECTION : 3  
-----

Pile Set Number = 2  
Pile Set Segment = 1

Section Length (L) = 118.00000 ft

---

Section Nonlinear Properties

-----  
- Steel Stress Strain Properties -  
-----

H-Pile Yield Stress (FY) = 0.5000E+02 ksi  
Modulus of Elasticity (ES) = 0.2900E+05 ksi

- Shape of Section : USER DEFINED H-PILE  
Units are in in  
Orientation : OR = 2 Web along 2 axis  
OR = 3 Web along 3 axis

| Depth | Width | Web Width | Flange Width | Orientation |
|-------|-------|-----------|--------------|-------------|
| 13.8  | 14.7  | 0.615     | 0.615        | 3           |

\*\*\*\*\*  
\* PILE SET DATA \*  
\*\*\*\*\*

NOTE : Piles are organized into pile sets. Each pile set is composed of pile segments, as specified by the user.

---

List of Pile Sets and Piles

| Pile Set | Piles Assigned to the Pile Set           |
|----------|--|
| 1        | 3, 4, 5, 6, 7, 8, 13, 14, 15, 16, 17, 18 |
| 2        | 1, 2, 9, 10, 11, 12, 19, 20              |

---

Total length for each Pile Set

| Pile Set | Length<br>in |
|----------|--------------|
| 1        | 1584.00      |
| 2        | 1416.00      |

\*\*\*\*\*  
\* EXTERNAL LOADS APPLIED TO SUBSTRUCTURE \*  
\*\*\*\*\*

-----  
SUBSTRUCTURE # 1  
-----

| NODE | CASE | FXp<br>kips | FYp<br>kips | FZp<br>kips | MXp<br>kip-ft | MYp<br>kip-ft | MZp<br>kip-ft |
|------|------|-------------|-------------|-------------|---------------|---------------|---------------|
| 89   | 1    | -26.55      | 44.29       | 614.95      | 620.04        | 680.84        | 0.00          |
| 92   | 1    | -26.55      | 34.93       | 498.22      | 548.90        | 663.84        | 0.00          |
| 93   | 1    | -26.55      | 34.74       | 491.51      | 535.96        | 646.85        | 0.00          |
| 95   | 1    | -26.55      | 34.28       | 494.12      | 521.24        | 629.86        | 0.00          |
| 96   | 1    | -26.55      | 33.58       | 479.07      | 505.03        | 612.86        | 0.00          |
| 98   | 1    | -26.55      | 29.67       | 428.65      | 469.91        | 596.13        | 0.00          |
| 99   | 1    | -1.76       | 15.41       | 307.45      | 148.87        | 42.70         | 0.00          |
| 101  | 1    | -1.76       | 18.45       | 335.61      | 165.08        | 41.58         | 0.00          |
| 103  | 1    | -1.76       | 18.21       | 335.95      | 161.59        | 40.47         | 0.00          |
| 104  | 1    | -1.76       | 18.00       | 331.68      | 158.61        | 39.36         | 0.00          |
| 105  | 1    | -1.76       | 17.23       | 326.28      | 153.38        | 38.23         | 0.00          |
| 107  | 1    | -1.76       | 27.45       | 431.01      | 216.43        | 37.12         | 0.00          |
| 89   | 2    | -26.55      | 35.37       | 476.21      | 564.20        | 680.84        | 0.00          |
| 92   | 2    | -26.55      | 29.13       | 387.88      | 513.03        | 663.84        | 0.00          |
| 93   | 2    | -26.55      | 29.01       | 382.60      | 500.66        | 646.85        | 0.00          |
| 95   | 2    | -26.55      | 28.70       | 386.64      | 487.11        | 629.86        | 0.00          |
| 96   | 2    | -26.55      | 28.23       | 373.34      | 472.56        | 612.86        | 0.00          |
| 98   | 2    | -26.55      | 25.62       | 337.67      | 445.46        | 596.13        | 0.00          |
| 99   | 2    | -1.76       | 11.29       | 213.20      | 123.90        | 42.70         | 0.00          |
| 101  | 2    | -1.76       | 13.32       | 233.39      | 134.06        | 41.58         | 0.00          |
| 103  | 2    | -1.76       | 13.16       | 233.76      | 131.09        | 40.47         | 0.00          |
| 104  | 2    | -1.76       | 13.01       | 230.78      | 128.46        | 39.36         | 0.00          |
| 105  | 2    | -1.76       | 12.51       | 226.85      | 124.33        | 38.23         | 0.00          |
| 107  | 2    | -1.76       | 19.32       | 302.12      | 165.72        | 37.12         | 0.00          |
| 89   | 3    | -14.32      | 40.88       | 579.91      | 532.97        | 368.47        | 0.00          |
| 92   | 3    | -14.32      | 31.52       | 466.85      | 464.02        | 359.30        | 0.00          |
| 93   | 3    | -14.32      | 31.33       | 460.64      | 453.26        | 350.14        | 0.00          |
| 95   | 3    | -14.32      | 30.87       | 461.39      | 440.72        | 340.97        | 0.00          |
| 96   | 3    | -14.32      | 30.17       | 448.30      | 426.69        | 331.80        | 0.00          |
| 98   | 3    | -14.32      | 26.26       | 397.36      | 393.72        | 322.78        | 0.00          |
| 99   | 3    | -14.32      | 15.41       | 406.32      | 148.87        | 328.51        | 0.00          |
| 101  | 3    | -14.32      | 18.45       | 449.73      | 165.08        | 319.34        | 0.00          |
| 103  | 3    | -14.32      | 18.21       | 435.50      | 161.59        | 310.32        | 0.00          |
| 104  | 3    | -14.32      | 18.00       | 433.40      | 158.61        | 301.30        | 0.00          |
| 105  | 3    | -14.32      | 17.23       | 428.57      | 153.38        | 292.13        | 0.00          |
| 107  | 3    | -14.32      | 27.45       | 556.50      | 216.43        | 283.11        | 0.00          |
| 89   | 4    | -14.32      | 31.97       | 441.17      | 477.13        | 368.47        | 0.00          |
| 92   | 4    | -14.32      | 25.72       | 356.52      | 428.14        | 359.30        | 0.00          |
| 93   | 4    | -14.32      | 25.60       | 351.72      | 417.96        | 350.14        | 0.00          |
| 95   | 4    | -14.32      | 25.29       | 353.91      | 406.58        | 340.97        | 0.00          |
| 96   | 4    | -14.32      | 24.82       | 342.57      | 394.22        | 331.80        | 0.00          |
| 98   | 4    | -14.32      | 22.21       | 306.37      | 369.27        | 322.78        | 0.00          |
| 99   | 4    | -14.32      | 11.29       | 312.07      | 123.90        | 328.51        | 0.00          |
| 101  | 4    | -14.32      | 13.32       | 347.51      | 134.06        | 319.34        | 0.00          |
| 103  | 4    | -14.32      | 13.16       | 333.32      | 131.09        | 310.32        | 0.00          |
| 104  | 4    | -14.32      | 13.01       | 332.49      | 128.46        | 301.30        | 0.00          |
| 105  | 4    | -14.32      | 12.51       | 329.13      | 124.33        | 292.13        | 0.00          |
| 107  | 4    | -14.32      | 19.32       | 427.61      | 165.72        | 283.11        | 0.00          |

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\* OUTPUT STAGE 2 OF 2: ANALYSIS RESULTS \*  
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\* RESULTS FOR LOAD CASE 1 \*  
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\* CONVERGENCE REPORT \*  
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The solution converged in 15 iterations

## FB-Multiplier Output – Abutment 1 (South) – Strength-I

### Summary of Maximum Out-Of-Balance Forces (Absolute Values)

FZ = 0.002 kips  
 FX = 0.001 kips  
 FY = 0.054 kips  
 MXX = 0.000 kip-ft  
 MYY = 0.000 kip-ft  
 MZZ = 0.007 kip-ft

### Summary of Displacements at Pile Heads

| NODE | X<br>in    | Y<br>in    | Z<br>in    |
|------|------------|------------|------------|
| 1    | -.1151E+00 | 0.2781E+00 | 0.4931E+00 |
| 2    | -.1151E+00 | 0.2588E+00 | 0.4820E+00 |
| 3    | -.1151E+00 | 0.2393E+00 | 0.4695E+00 |
| 4    | -.1150E+00 | 0.2276E+00 | 0.4608E+00 |
| 5    | -.1150E+00 | 0.2097E+00 | 0.4454E+00 |
| 6    | -.1150E+00 | 0.1898E+00 | 0.4247E+00 |
| 7    | -.1150E+00 | 0.1709E+00 | 0.4015E+00 |
| 8    | -.1150E+00 | 0.1529E+00 | 0.3768E+00 |
| 9    | -.1150E+00 | 0.1322E+00 | 0.3457E+00 |
| 10   | -.1150E+00 | 0.1093E+00 | 0.3094E+00 |
| 11   | -.1231E+00 | 0.2743E+00 | 0.4728E+00 |
| 12   | -.1231E+00 | 0.2543E+00 | 0.4611E+00 |
| 13   | -.1231E+00 | 0.2393E+00 | 0.4513E+00 |
| 14   | -.1231E+00 | 0.2276E+00 | 0.4426E+00 |
| 15   | -.1231E+00 | 0.2097E+00 | 0.4273E+00 |
| 16   | -.1231E+00 | 0.1898E+00 | 0.4066E+00 |
| 17   | -.1231E+00 | 0.1709E+00 | 0.3835E+00 |
| 18   | -.1231E+00 | 0.1529E+00 | 0.3587E+00 |
| 19   | -.1231E+00 | 0.1322E+00 | 0.3277E+00 |
| 20   | -.1231E+00 | 0.1115E+00 | 0.2949E+00 |

### Sum of Total Soil Spring Forces for Piles

Xp Direction = -170.0506 kips  
 Yp Direction = 327.0254 kips  
 Zp Direction = 5952.2822 kips  
 Sum of Tip Forces = 177.7519 kips

### Summary of Pile Forces for Load CASE 1

#### 1. Axial Force (kips)

| Pile # | Maximum Force | Minimum Force |
|--------|---------------|---------------|
| 1      | -0.84834E+02  | -0.42024E+03  |
| 2      | -0.82473E+02  | -0.41242E+03  |
| 3      | 0.72281E-01   | -0.27685E+03  |
| 4      | 0.72704E-01   | -0.27228E+03  |
| 5      | 0.73470E-01   | -0.26421E+03  |
| 6      | 0.74449E-01   | -0.25322E+03  |
| 7      | 0.75564E-01   | -0.24087E+03  |
| 8      | 0.76751E-01   | -0.22753E+03  |
| 9      | -0.55009E+02  | -0.31326E+03  |
| 10     | -0.48232E+02  | -0.28574E+03  |
| 11     | -0.80516E+02  | -0.40588E+03  |
| 12     | -0.78054E+02  | -0.39755E+03  |

|    |              |              |
|----|--------------|--------------|
| 13 | 0.73166E-01  | -0.26727E+03 |
| 14 | 0.73586E-01  | -0.26269E+03 |
| 15 | 0.74326E-01  | -0.25458E+03 |
| 16 | 0.75322E-01  | -0.24357E+03 |
| 17 | 0.76430E-01  | -0.23115E+03 |
| 18 | 0.77643E-01  | -0.21736E+03 |
| 19 | -0.51610E+02 | -0.29965E+03 |
| 20 | -0.45587E+02 | -0.27456E+03 |

#### 2. Pile Shear Force in 2 Direction (kips)

| Pile # | Maximum Shear | Minimum Shear |
|--------|---------------|---------------|
| 1      | 0.21332E+01   | -0.66277E+01  |
| 2      | 0.22619E+01   | -0.68409E+01  |
| 3      | 0.18624E+01   | -0.45845E+01  |
| 4      | 0.19160E+01   | -0.46626E+01  |
| 5      | 0.19970E+01   | -0.47826E+01  |
| 6      | 0.20873E+01   | -0.49271E+01  |
| 7      | 0.21749E+01   | -0.50857E+01  |
| 8      | 0.22563E+01   | -0.52569E+01  |
| 9      | 0.24958E+01   | -0.86268E+01  |
| 10     | 0.24482E+01   | -0.91785E+01  |
| 11     | 0.22950E+01   | -0.71325E+01  |
| 12     | 0.24353E+01   | -0.73660E+01  |
| 13     | 0.19683E+01   | -0.48992E+01  |
| 14     | 0.20251E+01   | -0.49816E+01  |
| 15     | 0.21110E+01   | -0.51085E+01  |
| 16     | 0.22085E+01   | -0.52622E+01  |
| 17     | 0.22995E+01   | -0.54270E+01  |
| 18     | 0.23866E+01   | -0.56035E+01  |
| 19     | 0.26976E+01   | -0.91820E+01  |
| 20     | 0.25537E+01   | -0.96809E+01  |

#### 3. Pile Shear Force in 3 Direction (kips)

| Pile # | Maximum Shear | Minimum Shear |
|--------|---------------|---------------|
| 1      | 0.92922E+01   | -0.25405E+02  |
| 2      | 0.86962E+01   | -0.24336E+02  |
| 3      | 0.38389E+01   | -0.93371E+01  |
| 4      | 0.37551E+01   | -0.90426E+01  |
| 5      | 0.36103E+01   | -0.85781E+01  |
| 6      | 0.34200E+01   | -0.80290E+01  |
| 7      | 0.32070E+01   | -0.74710E+01  |
| 8      | 0.29756E+01   | -0.69009E+01  |
| 9      | 0.61222E+01   | -0.15679E+02  |
| 10     | 0.57192E+01   | -0.13552E+02  |
| 11     | 0.91810E+01   | -0.25130E+02  |
| 12     | 0.85552E+01   | -0.23999E+02  |
| 13     | 0.37884E+01   | -0.93008E+01  |
| 14     | 0.37053E+01   | -0.90034E+01  |
| 15     | 0.35617E+01   | -0.85343E+01  |
| 16     | 0.33725E+01   | -0.79796E+01  |
| 17     | 0.31629E+01   | -0.74172E+01  |
| 18     | 0.29349E+01   | -0.68416E+01  |
| 19     | 0.60577E+01   | -0.15509E+02  |
| 20     | 0.57118E+01   | -0.13579E+02  |

#### 4. Bending Moment About 2 Axis (kip-ft and ft)

| Pile | Node | Depth Below Cap | Maximum Moment | Node | Depth Below Cap | Minimum Moment |
|------|------|-----------------|----------------|------|-----------------|----------------|
| 1    | 1    | 0.00000E+00     | 0.1343E+03     | 543  | 0.1475E+02      | -0.51425E+02   |
| 2    | 2    | 0.00000E+00     | 0.1270E+03     | 582  | 0.1475E+02      | -0.48649E+02   |



## FB-Multiplier Output – Abutment 1 (South) – Strength-I

|    |    |             |            |      |            |              |
|----|----|-------------|------------|------|------------|--------------|
| 3  | 3  | 0.00000E+00 | 0.4109E+02 | 620  | 0.1320E+02 | -0.15697E+02 |
| 4  | 4  | 0.00000E+00 | 0.3949E+02 | 659  | 0.1320E+02 | -0.15059E+02 |
| 5  | 5  | 0.00000E+00 | 0.3701E+02 | 698  | 0.1320E+02 | -0.14064E+02 |
| 6  | 6  | 0.00000E+00 | 0.3412E+02 | 737  | 0.1320E+02 | -0.12911E+02 |
| 7  | 7  | 0.00000E+00 | 0.3126E+02 | 776  | 0.1320E+02 | -0.11769E+02 |
| 8  | 8  | 0.00000E+00 | 0.2842E+02 | 814  | 0.9900E+01 | -0.10812E+02 |
| 9  | 9  | 0.00000E+00 | 0.7238E+02 | 854  | 0.1180E+02 | -0.29427E+02 |
| 10 | 10 | 0.00000E+00 | 0.6057E+02 | 893  | 0.1180E+02 | -0.26162E+02 |
| 11 | 11 | 0.00000E+00 | 0.1326E+03 | 933  | 0.1475E+02 | -0.50839E+02 |
| 12 | 12 | 0.00000E+00 | 0.1249E+03 | 972  | 0.1475E+02 | -0.47928E+02 |
| 13 | 13 | 0.00000E+00 | 0.4094E+02 | 1010 | 0.1320E+02 | -0.15658E+02 |
| 14 | 14 | 0.00000E+00 | 0.3934E+02 | 1049 | 0.1320E+02 | -0.15024E+02 |
| 15 | 15 | 0.00000E+00 | 0.3684E+02 | 1088 | 0.1320E+02 | -0.14038E+02 |
| 16 | 16 | 0.00000E+00 | 0.3395E+02 | 1127 | 0.1320E+02 | -0.12895E+02 |
| 17 | 17 | 0.00000E+00 | 0.3108E+02 | 1166 | 0.1320E+02 | -0.11772E+02 |
| 18 | 18 | 0.00000E+00 | 0.2823E+02 | 1205 | 0.1320E+02 | -0.10659E+02 |
| 19 | 19 | 0.00000E+00 | 0.7184E+02 | 1244 | 0.1180E+02 | -0.29180E+02 |
| 20 | 20 | 0.00000E+00 | 0.6115E+02 | 1283 | 0.1180E+02 | -0.26239E+02 |

### 5. Bending Moment About 3 Axis (kip-ft and ft)

| Pile | Node | Depth Below Cap | Maximum Moment | Node | Depth Below Cap | Minimum Moment |
|------|------|-----------------|----------------|------|-----------------|----------------|
| 1    | 542  | 0.11800E+02     | 0.1060E+02     | 1    | 0.0000E+00      | -0.30028E+02   |
| 2    | 581  | 0.11800E+02     | 0.1091E+02     | 2    | 0.0000E+00      | -0.30611E+02   |
| 3    | 620  | 0.13200E+02     | 0.7649E+01     | 3    | 0.0000E+00      | -0.20353E+02   |
| 4    | 659  | 0.13200E+02     | 0.7713E+01     | 4    | 0.0000E+00      | -0.20531E+02   |
| 5    | 698  | 0.13200E+02     | 0.7801E+01     | 5    | 0.0000E+00      | -0.20773E+02   |
| 6    | 737  | 0.13200E+02     | 0.7893E+01     | 6    | 0.0000E+00      | -0.21052E+02   |
| 7    | 776  | 0.13200E+02     | 0.7992E+01     | 7    | 0.0000E+00      | -0.21384E+02   |
| 8    | 814  | 0.99000E+01     | 0.8132E+01     | 8    | 0.0000E+00      | -0.21776E+02   |
| 9    | 854  | 0.11800E+02     | 0.1308E+02     | 9    | 0.0000E+00      | -0.34398E+02   |
| 10   | 893  | 0.11800E+02     | 0.1362E+02     | 10   | 0.0000E+00      | -0.35853E+02   |
| 11   | 932  | 0.11800E+02     | 0.1138E+02     | 11   | 0.0000E+00      | -0.32275E+02   |
| 12   | 971  | 0.11800E+02     | 0.1172E+02     | 12   | 0.0000E+00      | -0.32900E+02   |
| 13   | 1010 | 0.13200E+02     | 0.8179E+01     | 13   | 0.0000E+00      | -0.21779E+02   |
| 14   | 1049 | 0.13200E+02     | 0.8249E+01     | 14   | 0.0000E+00      | -0.21971E+02   |
| 15   | 1088 | 0.13200E+02     | 0.8348E+01     | 15   | 0.0000E+00      | -0.22235E+02   |
| 16   | 1127 | 0.13200E+02     | 0.8465E+01     | 16   | 0.0000E+00      | -0.22543E+02   |
| 17   | 1166 | 0.13200E+02     | 0.8576E+01     | 17   | 0.0000E+00      | -0.22898E+02   |
| 18   | 1205 | 0.13200E+02     | 0.8684E+01     | 18   | 0.0000E+00      | -0.23302E+02   |
| 19   | 1244 | 0.11800E+02     | 0.1398E+02     | 19   | 0.0000E+00      | -0.36822E+02   |
| 20   | 1283 | 0.11800E+02     | 0.1449E+02     | 20   | 0.0000E+00      | -0.38144E+02   |

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 \* RESULTS FOR LOAD CASE 2 \*  
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 \* CONVERGENCE REPORT \*  
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The solution converged in 18 iterations

### Summary of Maximum Out-Of-Balance Forces (Absolute Values)

FZ = 0.000 kips  
 FX = 0.000 kips  
 FY = 0.030 kips  
 MXX = 0.000 kip-ft  
 MYY = 0.000 kip-ft  
 MZZ = 0.007 kip-ft

### Summary of Displacements at Pile Heads

| NODE | X<br>in    | Y<br>in    | Z<br>in    |
|------|------------|------------|------------|
| 1    | -.1006E+00 | 0.2160E+00 | 0.3981E+00 |
| 2    | -.1006E+00 | 0.2012E+00 | 0.3868E+00 |
| 3    | -.1006E+00 | 0.1862E+00 | 0.3742E+00 |
| 4    | -.1006E+00 | 0.1771E+00 | 0.3657E+00 |
| 5    | -.1006E+00 | 0.1634E+00 | 0.3512E+00 |
| 6    | -.1006E+00 | 0.1481E+00 | 0.3321E+00 |
| 7    | -.1006E+00 | 0.1335E+00 | 0.3113E+00 |
| 8    | -.1006E+00 | 0.1197E+00 | 0.2895E+00 |
| 9    | -.1006E+00 | 0.1038E+00 | 0.2624E+00 |
| 10   | -.1006E+00 | 0.8611E-01 | 0.2311E+00 |
| 11   | -.1068E+00 | 0.2131E+00 | 0.3547E+00 |
| 12   | -.1068E+00 | 0.1977E+00 | 0.3428E+00 |
| 13   | -.1068E+00 | 0.1862E+00 | 0.3330E+00 |
| 14   | -.1068E+00 | 0.1771E+00 | 0.3245E+00 |
| 15   | -.1068E+00 | 0.1634E+00 | 0.3100E+00 |
| 16   | -.1068E+00 | 0.1481E+00 | 0.2910E+00 |
| 17   | -.1068E+00 | 0.1335E+00 | 0.2702E+00 |
| 18   | -.1068E+00 | 0.1197E+00 | 0.2484E+00 |
| 19   | -.1068E+00 | 0.1038E+00 | 0.2214E+00 |
| 20   | -.1068E+00 | 0.8780E-01 | 0.1931E+00 |

### Sum of Total Soil Spring Forces for Piles

Xp Direction = -169.9554 kips  
 Yp Direction = 258.4820 kips  
 Zp Direction = 4662.2041 kips  
 Sum of Tip Forces = 131.7540 kips

### Summary of Pile Forces for Load CASE 2

#### 1. Axial Force (kips)

| Pile # | Maximum Force | Minimum Force |
|--------|---------------|---------------|
| 1      | -0.65198E+02  | -0.35208E+03  |
| 2      | -0.62957E+02  | -0.34377E+03  |
| 3      | 0.76877E-01   | -0.22609E+03  |
| 4      | 0.77297E-01   | -0.22132E+03  |
| 5      | 0.78015E-01   | -0.21309E+03  |
| 6      | 0.78947E-01   | -0.20228E+03  |
| 7      | 0.79949E-01   | -0.19046E+03  |
| 8      | 0.80986E-01   | -0.17801E+03  |
| 9      | -0.39812E+02  | -0.24916E+03  |
| 10     | -0.34433E+02  | -0.22405E+03  |
| 11     | -0.56728E+02  | -0.32001E+03  |
| 12     | -0.54450E+02  | -0.31106E+03  |
| 13     | 0.78904E-01   | -0.20277E+03  |
| 14     | 0.79314E-01   | -0.19797E+03  |
| 15     | 0.80012E-01   | -0.18971E+03  |
| 16     | 0.80917E-01   | -0.17884E+03  |
| 17     | 0.81888E-01   | -0.16696E+03  |
| 18     | 0.82888E-01   | -0.15442E+03  |
| 19     | -0.32802E+02  | -0.21612E+03  |
| 20     | -0.28170E+02  | -0.19265E+03  |

#### 2. Pile Shear Force in 2 Direction (kips)

## FB-Multiplier Output – Abutment 1 (South) – Strength-I

| Pile # | Maximum Shear | Minimum Shear |
|--------|---------------|---------------|
| 1      | 0.23021E+01   | -0.67289E+01  |
| 2      | 0.23255E+01   | -0.69403E+01  |
| 3      | 0.19759E+01   | -0.46360E+01  |
| 4      | 0.20173E+01   | -0.47122E+01  |
| 5      | 0.20769E+01   | -0.48283E+01  |
| 6      | 0.21424E+01   | -0.49680E+01  |
| 7      | 0.21980E+01   | -0.51132E+01  |
| 8      | 0.22429E+01   | -0.52618E+01  |
| 9      | 0.26954E+01   | -0.87363E+01  |
| 10     | 0.31246E+01   | -0.92289E+01  |
| 11     | 0.24390E+01   | -0.71918E+01  |
| 12     | 0.24608E+01   | -0.74214E+01  |
| 13     | 0.20732E+01   | -0.49312E+01  |
| 14     | 0.21195E+01   | -0.50116E+01  |
| 15     | 0.21862E+01   | -0.51338E+01  |
| 16     | 0.22556E+01   | -0.52757E+01  |
| 17     | 0.23159E+01   | -0.54212E+01  |
| 18     | 0.23653E+01   | -0.55696E+01  |
| 19     | 0.27716E+01   | -0.92158E+01  |
| 20     | 0.31615E+01   | -0.96550E+01  |

### 3. Pile Shear Force in 3 Direction (kips)

| Pile # | Maximum Shear | Minimum Shear |
|--------|---------------|---------------|
| 1      | 0.67679E+01   | -0.20384E+02  |
| 2      | 0.68687E+01   | -0.19393E+02  |
| 3      | 0.33698E+01   | -0.75110E+01  |
| 4      | 0.32532E+01   | -0.72297E+01  |
| 5      | 0.30596E+01   | -0.67841E+01  |
| 6      | 0.28155E+01   | -0.62512E+01  |
| 7      | 0.25563E+01   | -0.57067E+01  |
| 8      | 0.22808E+01   | -0.51463E+01  |
| 9      | 0.53567E+01   | -0.11150E+02  |
| 10     | 0.43363E+01   | -0.89835E+01  |
| 11     | 0.67157E+01   | -0.20143E+02  |
| 12     | 0.68108E+01   | -0.19095E+02  |
| 13     | 0.33381E+01   | -0.75125E+01  |
| 14     | 0.32243E+01   | -0.72260E+01  |
| 15     | 0.30355E+01   | -0.67715E+01  |
| 16     | 0.27978E+01   | -0.62309E+01  |
| 17     | 0.25411E+01   | -0.56766E+01  |
| 18     | 0.22681E+01   | -0.51059E+01  |
| 19     | 0.53473E+01   | -0.11008E+02  |
| 20     | 0.44715E+01   | -0.90514E+01  |

### 4. Bending Moment About 2 Axis (kip-ft and ft)

| Pile | Node | Depth Below Cap | Maximum Moment | Node | Depth Below Cap | Minimum Moment |
|------|------|-----------------|----------------|------|-----------------|----------------|
| 1    | 1    | 0.00000E+00     | 0.9536E+02     | 543  | 0.1475E+02      | -0.40185E+02   |
| 2    | 2    | 0.00000E+00     | 0.8900E+02     | 581  | 0.1180E+02      | -0.38433E+02   |
| 3    | 3    | 0.00000E+00     | 0.2994E+02     | 619  | 0.9900E+01      | -0.12786E+02   |
| 4    | 4    | 0.00000E+00     | 0.2851E+02     | 658  | 0.9900E+01      | -0.12449E+02   |
| 5    | 5    | 0.00000E+00     | 0.2628E+02     | 697  | 0.9900E+01      | -0.11898E+02   |
| 6    | 6    | 0.00000E+00     | 0.2368E+02     | 736  | 0.9900E+01      | -0.11207E+02   |
| 7    | 7    | 0.00000E+00     | 0.2107E+02     | 775  | 0.9900E+01      | -0.10475E+02   |
| 8    | 8    | 0.00000E+00     | 0.1846E+02     | 814  | 0.9900E+01      | -0.96920E+01   |
| 9    | 9    | 0.00000E+00     | 0.4123E+02     | 854  | 0.1180E+02      | -0.25557E+02   |
| 10   | 10   | 0.00000E+00     | 0.3003E+02     | 893  | 0.1180E+02      | -0.21714E+02   |
| 11   | 11   | 0.00000E+00     | 0.9384E+02     | 933  | 0.1475E+02      | -0.39671E+02   |
| 12   | 12   | 0.00000E+00     | 0.8719E+02     | 971  | 0.1180E+02      | -0.37929E+02   |
| 13   | 13   | 0.00000E+00     | 0.2986E+02     | 1009 | 0.9900E+01      | -0.12694E+02   |
| 14   | 14   | 0.00000E+00     | 0.2843E+02     | 1048 | 0.9900E+01      | -0.12348E+02   |

|    |    |             |            |      |            |              |
|----|----|-------------|------------|------|------------|--------------|
| 15 | 15 | 0.00000E+00 | 0.2618E+02 | 1087 | 0.9900E+01 | -0.11784E+02 |
| 16 | 16 | 0.00000E+00 | 0.2356E+02 | 1126 | 0.9900E+01 | -0.11085E+02 |
| 17 | 17 | 0.00000E+00 | 0.2093E+02 | 1165 | 0.9900E+01 | -0.10336E+02 |
| 18 | 18 | 0.00000E+00 | 0.1830E+02 | 1204 | 0.9900E+01 | -0.95405E+01 |
| 19 | 19 | 0.00000E+00 | 0.4074E+02 | 1244 | 0.1180E+02 | -0.25345E+02 |
| 20 | 20 | 0.00000E+00 | 0.3064E+02 | 1283 | 0.1180E+02 | -0.21903E+02 |

### 5. Bending Moment About 3 Axis (kip-ft and ft)

| Pile | Node | Depth Below Cap | Maximum Moment | Node | Depth Below Cap | Minimum Moment |
|------|------|-----------------|----------------|------|-----------------|----------------|
| 1    | 542  | 0.11800E+02     | 0.1049E+02     | 1    | 0.0000E+00      | -0.28863E+02   |
| 2    | 581  | 0.11800E+02     | 0.1073E+02     | 2    | 0.0000E+00      | -0.29440E+02   |
| 3    | 620  | 0.13200E+02     | 0.7270E+01     | 3    | 0.0000E+00      | -0.19684E+02   |
| 4    | 659  | 0.13200E+02     | 0.7312E+01     | 4    | 0.0000E+00      | -0.19856E+02   |
| 5    | 698  | 0.13200E+02     | 0.7358E+01     | 5    | 0.0000E+00      | -0.20092E+02   |
| 6    | 736  | 0.99000E+01     | 0.7680E+01     | 6    | 0.0000E+00      | -0.20372E+02   |
| 7    | 775  | 0.99000E+01     | 0.8001E+01     | 7    | 0.0000E+00      | -0.20678E+02   |
| 8    | 814  | 0.99000E+01     | 0.8309E+01     | 8    | 0.0000E+00      | -0.21002E+02   |
| 9    | 854  | 0.11800E+02     | 0.1258E+02     | 9    | 0.0000E+00      | -0.33347E+02   |
| 10   | 893  | 0.11800E+02     | 0.1304E+02     | 10   | 0.0000E+00      | -0.34591E+02   |
| 11   | 932  | 0.11800E+02     | 0.1115E+02     | 11   | 0.0000E+00      | -0.30770E+02   |
| 12   | 971  | 0.11800E+02     | 0.1142E+02     | 12   | 0.0000E+00      | -0.31385E+02   |
| 13   | 1010 | 0.13200E+02     | 0.7762E+01     | 13   | 0.0000E+00      | -0.20927E+02   |
| 14   | 1049 | 0.13200E+02     | 0.7812E+01     | 14   | 0.0000E+00      | -0.21116E+02   |
| 15   | 1088 | 0.13200E+02     | 0.7868E+01     | 15   | 0.0000E+00      | -0.21379E+02   |
| 16   | 1126 | 0.99000E+01     | 0.8049E+01     | 16   | 0.0000E+00      | -0.21665E+02   |
| 17   | 1165 | 0.99000E+01     | 0.8369E+01     | 17   | 0.0000E+00      | -0.21969E+02   |
| 18   | 1204 | 0.99000E+01     | 0.8672E+01     | 18   | 0.0000E+00      | -0.22292E+02   |
| 19   | 1244 | 0.11800E+02     | 0.1332E+02     | 19   | 0.0000E+00      | -0.35322E+02   |
| 20   | 1283 | 0.11800E+02     | 0.1375E+02     | 20   | 0.0000E+00      | -0.36429E+02   |

\*\*\*\*\*  
 \* RESULTS FOR LOAD CASE 3 \*  
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 \* CONVERGENCE REPORT \*  
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The solution converged in 16 iterations

### Summary of Maximum Out-Of-Balance Forces (Absolute Values)

FZ = 0.001 kips  
 FX = 0.017 kips  
 FY = 0.030 kips  
 MXX = 0.000 kip-ft  
 MYY = 0.000 kip-ft  
 MZZ = 0.006 kip-ft

### Summary of Displacements at Pile Heads

| NODE | X in       | Y in       | Z in       |
|------|------------|------------|------------|
| 1    | -.1040E+00 | 0.1983E+00 | 0.4345E+00 |
| 2    | -.1040E+00 | 0.1844E+00 | 0.4408E+00 |
| 3    | -.1040E+00 | 0.1703E+00 | 0.4458E+00 |
| 4    | -.1040E+00 | 0.1618E+00 | 0.4477E+00 |
| 5    | -.1040E+00 | 0.1489E+00 | 0.4484E+00 |
| 6    | -.1040E+00 | 0.1345E+00 | 0.4451E+00 |
| 7    | -.1040E+00 | 0.1208E+00 | 0.4376E+00 |

## FB-Multiplier Output – Abutment 1 (South) – Strength-I

|    |            |            |            |
|----|------------|------------|------------|
| 8  | -.1040E+00 | 0.1078E+00 | 0.4270E+00 |
| 9  | -.1040E+00 | 0.9284E-01 | 0.4113E+00 |
| 10 | -.1040E+00 | 0.7621E-01 | 0.3915E+00 |
| 11 | -.1099E+00 | 0.1956E+00 | 0.4650E+00 |
| 12 | -.1099E+00 | 0.1811E+00 | 0.4714E+00 |
| 13 | -.1099E+00 | 0.1703E+00 | 0.4751E+00 |
| 14 | -.1099E+00 | 0.1618E+00 | 0.4771E+00 |
| 15 | -.1099E+00 | 0.1489E+00 | 0.4778E+00 |
| 16 | -.1099E+00 | 0.1345E+00 | 0.4745E+00 |
| 17 | -.1099E+00 | 0.1208E+00 | 0.4671E+00 |
| 18 | -.1099E+00 | 0.1078E+00 | 0.4565E+00 |
| 19 | -.1099E+00 | 0.9284E-01 | 0.4408E+00 |
| 20 | -.1099E+00 | 0.7781E-01 | 0.4230E+00 |

### Sum of Total Soil Spring Forces for Piles

|                   |   |           |      |
|-------------------|---|-----------|------|
| Xp Direction      | = | -172.1323 | kips |
| Yp Direction      | = | 306.2512  | kips |
| Zp Direction      | = | 6402.2541 | kips |
| Sum of Tip Forces | = | 194.6700  | kips |

### Summary of Pile Forces for Load CASE 3

#### 1. Axial Force (kips)

| Pile # | Maximum Force | Minimum Force |
|--------|---------------|---------------|
| 1      | -0.72547E+02  | -0.37848E+03  |
| 2      | -0.73841E+02  | -0.38302E+03  |
| 3      | 0.73463E-01   | -0.26442E+03  |
| 4      | 0.73335E-01   | -0.26543E+03  |
| 5      | 0.73303E-01   | -0.26578E+03  |
| 6      | 0.73477E-01   | -0.26403E+03  |
| 7      | 0.73825E-01   | -0.26008E+03  |
| 8      | 0.74338E-01   | -0.25445E+03  |
| 9      | -0.67844E+02  | -0.36173E+03  |
| 10     | -0.63902E+02  | -0.34729E+03  |
| 11     | -0.78885E+02  | -0.40038E+03  |
| 12     | -0.80223E+02  | -0.40490E+03  |
| 13     | 0.72005E-01   | -0.27983E+03  |
| 14     | 0.71910E-01   | -0.28086E+03  |
| 15     | 0.71875E-01   | -0.28123E+03  |
| 16     | 0.72034E-01   | -0.27952E+03  |
| 17     | 0.72395E-01   | -0.27563E+03  |
| 18     | 0.72910E-01   | -0.27005E+03  |
| 19     | -0.73851E+02  | -0.38306E+03  |
| 20     | -0.69979E+02  | -0.37071E+03  |

#### 2. Pile Shear Force in 2 Direction (kips)

| Pile # | Maximum Shear | Minimum Shear |
|--------|---------------|---------------|
| 1      | 0.21589E+01   | -0.70120E+01  |
| 2      | 0.22527E+01   | -0.71929E+01  |
| 3      | 0.18991E+01   | -0.47528E+01  |
| 4      | 0.19376E+01   | -0.48081E+01  |
| 5      | 0.19923E+01   | -0.48876E+01  |
| 6      | 0.20479E+01   | -0.49761E+01  |
| 7      | 0.20967E+01   | -0.50708E+01  |
| 8      | 0.21409E+01   | -0.51772E+01  |
| 9      | 0.23638E+01   | -0.84952E+01  |
| 10     | 0.22814E+01   | -0.89019E+01  |

|    |             |              |
|----|-------------|--------------|
| 11 | 0.22976E+01 | -0.73858E+01 |
| 12 | 0.23973E+01 | -0.75789E+01 |
| 13 | 0.19929E+01 | -0.49640E+01 |
| 14 | 0.20328E+01 | -0.50212E+01 |
| 15 | 0.20895E+01 | -0.51031E+01 |
| 16 | 0.21474E+01 | -0.51944E+01 |
| 17 | 0.21978E+01 | -0.52908E+01 |
| 18 | 0.22422E+01 | -0.53969E+01 |
| 19 | 0.25029E+01 | -0.88798E+01 |
| 20 | 0.24076E+01 | -0.92445E+01 |

#### 3. Pile Shear Force in 3 Direction (kips)

| Pile # | Maximum Shear | Minimum Shear |
|--------|---------------|---------------|
| 1      | 0.78577E+01   | -0.23988E+02  |
| 2      | 0.73674E+01   | -0.23109E+02  |
| 3      | 0.32936E+01   | -0.86592E+01  |
| 4      | 0.32202E+01   | -0.84072E+01  |
| 5      | 0.30965E+01   | -0.80145E+01  |
| 6      | 0.29398E+01   | -0.75577E+01  |
| 7      | 0.27712E+01   | -0.71008E+01  |
| 8      | 0.25916E+01   | -0.66398E+01  |
| 9      | 0.50664E+01   | -0.16259E+02  |
| 10     | 0.48482E+01   | -0.14654E+02  |
| 11     | 0.77691E+01   | -0.23712E+02  |
| 12     | 0.72464E+01   | -0.22788E+02  |
| 13     | 0.32734E+01   | -0.85737E+01  |
| 14     | 0.31984E+01   | -0.83215E+01  |
| 15     | 0.30728E+01   | -0.79284E+01  |
| 16     | 0.29143E+01   | -0.74708E+01  |
| 17     | 0.27442E+01   | -0.70124E+01  |
| 18     | 0.25638E+01   | -0.65495E+01  |
| 19     | 0.50311E+01   | -0.16108E+02  |
| 20     | 0.48382E+01   | -0.14653E+02  |

#### 4. Bending Moment About 2 Axis (kip-ft and ft)

| Pile | Node | Depth Below Cap | Maximum Moment | Node | Depth Below Cap | Minimum Moment |
|------|------|-----------------|----------------|------|-----------------|----------------|
| 1    | 1    | 0.00000E+00     | 0.1331E+03     | 543  | 0.1475E+02      | -0.42163E+02   |
| 2    | 2    | 0.00000E+00     | 0.1275E+03     | 582  | 0.1475E+02      | -0.40033E+02   |
| 3    | 3    | 0.00000E+00     | 0.3957E+02     | 620  | 0.1320E+02      | -0.12893E+02   |
| 4    | 4    | 0.00000E+00     | 0.3831E+02     | 659  | 0.1320E+02      | -0.12395E+02   |
| 5    | 5    | 0.00000E+00     | 0.3635E+02     | 698  | 0.1320E+02      | -0.11625E+02   |
| 6    | 6    | 0.00000E+00     | 0.3411E+02     | 737  | 0.1320E+02      | -0.10739E+02   |
| 7    | 7    | 0.00000E+00     | 0.3190E+02     | 776  | 0.1320E+02      | -0.98711E+01   |
| 8    | 8    | 0.00000E+00     | 0.2971E+02     | 815  | 0.1320E+02      | -0.90208E+01   |
| 9    | 9    | 0.00000E+00     | 0.8636E+02     | 855  | 0.1475E+02      | -0.24270E+02   |
| 10   | 10   | 0.00000E+00     | 0.7768E+02     | 894  | 0.1475E+02      | -0.21139E+02   |
| 11   | 11   | 0.00000E+00     | 0.1318E+03     | 933  | 0.1475E+02      | -0.41753E+02   |
| 12   | 12   | 0.00000E+00     | 0.1259E+03     | 972  | 0.1475E+02      | -0.39519E+02   |
| 13   | 13   | 0.00000E+00     | 0.3933E+02     | 1010 | 0.1320E+02      | -0.12833E+02   |
| 14   | 14   | 0.00000E+00     | 0.3806E+02     | 1049 | 0.1320E+02      | -0.12337E+02   |
| 15   | 15   | 0.00000E+00     | 0.3611E+02     | 1088 | 0.1320E+02      | -0.11568E+02   |
| 16   | 16   | 0.00000E+00     | 0.3386E+02     | 1127 | 0.1320E+02      | -0.10685E+02   |
| 17   | 17   | 0.00000E+00     | 0.3165E+02     | 1166 | 0.1320E+02      | -0.98176E+01   |
| 18   | 18   | 0.00000E+00     | 0.2946E+02     | 1205 | 0.1320E+02      | -0.89674E+01   |
| 19   | 19   | 0.00000E+00     | 0.8596E+02     | 1245 | 0.1475E+02      | -0.24308E+02   |
| 20   | 20   | 0.00000E+00     | 0.7808E+02     | 1284 | 0.1475E+02      | -0.21489E+02   |

#### 5. Bending Moment About 3 Axis (kip-ft and ft)

| Pile | Node | Depth Below Cap | Maximum Moment | Node | Depth Below Cap | Minimum Moment |
|------|------|-----------------|----------------|------|-----------------|----------------|
| 1    | 542  | 0.11800E+02     | 0.1040E+02     | 1    | 0.0000E+00      | -0.31194E+02   |

## FB-Multiplier Output – Abutment 1 (South) – Strength-I

|    |      |             |            |    |            |              |
|----|------|-------------|------------|----|------------|--------------|
| 2  | 581  | 0.11800E+02 | 0.1065E+02 | 2  | 0.0000E+00 | -0.31692E+02 |
| 3  | 620  | 0.13200E+02 | 0.7302E+01 | 3  | 0.0000E+00 | -0.20895E+02 |
| 4  | 659  | 0.13200E+02 | 0.7325E+01 | 4  | 0.0000E+00 | -0.21001E+02 |
| 5  | 698  | 0.13200E+02 | 0.7345E+01 | 5  | 0.0000E+00 | -0.21111E+02 |
| 6  | 737  | 0.13200E+02 | 0.7345E+01 | 6  | 0.0000E+00 | -0.21192E+02 |
| 7  | 775  | 0.99000E+01 | 0.7505E+01 | 7  | 0.0000E+00 | -0.21293E+02 |
| 8  | 814  | 0.99000E+01 | 0.7791E+01 | 8  | 0.0000E+00 | -0.21454E+02 |
| 9  | 854  | 0.11800E+02 | 0.1219E+02 | 9  | 0.0000E+00 | -0.33870E+02 |
| 10 | 893  | 0.11800E+02 | 0.1255E+02 | 10 | 0.0000E+00 | -0.34909E+02 |
| 11 | 932  | 0.11800E+02 | 0.1102E+02 | 11 | 0.0000E+00 | -0.32908E+02 |
| 12 | 971  | 0.11800E+02 | 0.1129E+02 | 12 | 0.0000E+00 | -0.33425E+02 |
| 13 | 1010 | 0.13200E+02 | 0.7672E+01 | 13 | 0.0000E+00 | -0.21908E+02 |
| 14 | 1049 | 0.13200E+02 | 0.7699E+01 | 14 | 0.0000E+00 | -0.22021E+02 |
| 15 | 1088 | 0.13200E+02 | 0.7723E+01 | 15 | 0.0000E+00 | -0.22137E+02 |
| 16 | 1127 | 0.13200E+02 | 0.7728E+01 | 16 | 0.0000E+00 | -0.22230E+02 |
| 17 | 1165 | 0.99000E+01 | 0.7834E+01 | 17 | 0.0000E+00 | -0.22341E+02 |
| 18 | 1204 | 0.99000E+01 | 0.8117E+01 | 18 | 0.0000E+00 | -0.22503E+02 |
| 19 | 1244 | 0.11800E+02 | 0.1287E+02 | 19 | 0.0000E+00 | -0.35656E+02 |
| 20 | 1283 | 0.11800E+02 | 0.1321E+02 | 20 | 0.0000E+00 | -0.36592E+02 |

\*\*\*\*\*  
 \* RESULTS FOR LOAD CASE 4 \*  
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\*\*\*\*\*  
 \* CONVERGENCE REPORT \*  
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The solution converged in 22 iterations

### Summary of Maximum Out-Of-Balance Forces (Absolute Values)

FZ = 0.000 kips  
 FX = 0.000 kips  
 FY = 0.010 kips  
 MXX = 0.000 kip-ft  
 MYY = 0.000 kip-ft  
 MZZ = 0.008 kip-ft

### Summary of Displacements at Pile Heads

| NODE | X<br>in    | Y<br>in    | Z<br>in    |
|------|------------|------------|------------|
| 1    | -.9002E-01 | 0.1481E+00 | 0.3425E+00 |
| 2    | -.9002E-01 | 0.1377E+00 | 0.3477E+00 |
| 3    | -.9002E-01 | 0.1272E+00 | 0.3519E+00 |
| 4    | -.9002E-01 | 0.1208E+00 | 0.3535E+00 |
| 5    | -.9001E-01 | 0.1111E+00 | 0.3541E+00 |
| 6    | -.9000E-01 | 0.1004E+00 | 0.3515E+00 |
| 7    | -.9000E-01 | 0.9012E-01 | 0.3456E+00 |
| 8    | -.9000E-01 | 0.8039E-01 | 0.3371E+00 |
| 9    | -.8999E-01 | 0.6916E-01 | 0.3246E+00 |
| 10   | -.8999E-01 | 0.5671E-01 | 0.3087E+00 |
| 11   | -.9437E-01 | 0.1461E+00 | 0.3465E+00 |
| 12   | -.9437E-01 | 0.1353E+00 | 0.3517E+00 |
| 13   | -.9438E-01 | 0.1272E+00 | 0.3548E+00 |
| 14   | -.9438E-01 | 0.1208E+00 | 0.3565E+00 |
| 15   | -.9438E-01 | 0.1111E+00 | 0.3571E+00 |
| 16   | -.9439E-01 | 0.1004E+00 | 0.3546E+00 |
| 17   | -.9440E-01 | 0.9012E-01 | 0.3487E+00 |
| 18   | -.9440E-01 | 0.8039E-01 | 0.3402E+00 |
| 19   | -.9440E-01 | 0.6916E-01 | 0.3277E+00 |

20 -.9440E-01 0.5790E-01 0.3134E+00

### Sum of Total Soil Spring Forces for Piles

|                   |   |           |      |
|-------------------|---|-----------|------|
| Xp Direction      | = | -171.8721 | kips |
| Yp Direction      | = | 238.0697  | kips |
| Zp Direction      | = | 5112.1538 | kips |
| Sum of Tip Forces | = | 147.2220  | kips |

### Summary of Pile Forces for Load CASE 4

#### 1. Axial Force (kips)

| Pile # | Maximum Force | Minimum Force |
|--------|---------------|---------------|
| 1      | -0.54412E+02  | -0.31090E+03  |
| 2      | -0.55395E+02  | -0.31479E+03  |
| 3      | 0.77979E-01   | -0.21350E+03  |
| 4      | 0.77899E-01   | -0.21443E+03  |
| 5      | 0.77868E-01   | -0.21478E+03  |
| 6      | 0.77995E-01   | -0.21332E+03  |
| 7      | 0.78285E-01   | -0.20997E+03  |
| 8      | 0.78701E-01   | -0.20515E+03  |
| 9      | -0.51035E+02  | -0.29731E+03  |
| 10     | -0.48109E+02  | -0.28523E+03  |
| 11     | -0.55159E+02  | -0.31386E+03  |
| 12     | -0.56155E+02  | -0.31777E+03  |
| 13     | 0.77836E-01   | -0.21515E+03  |
| 14     | 0.77755E-01   | -0.21608E+03  |
| 15     | 0.77722E-01   | -0.21646E+03  |
| 16     | 0.77846E-01   | -0.21503E+03  |
| 17     | 0.78135E-01   | -0.21170E+03  |
| 18     | 0.78550E-01   | -0.20690E+03  |
| 19     | -0.51612E+02  | -0.29966E+03  |
| 20     | -0.48965E+02  | -0.28879E+03  |

#### 2. Pile Shear Force in 2 Direction (kips)

| Pile # | Maximum Shear | Minimum Shear |
|--------|---------------|---------------|
| 1      | 0.21958E+01   | -0.71196E+01  |
| 2      | 0.21882E+01   | -0.72983E+01  |
| 3      | 0.19604E+01   | -0.47881E+01  |
| 4      | 0.19833E+01   | -0.48383E+01  |
| 5      | 0.20121E+01   | -0.49097E+01  |
| 6      | 0.20366E+01   | -0.49878E+01  |
| 7      | 0.20540E+01   | -0.50698E+01  |
| 8      | 0.20663E+01   | -0.51587E+01  |
| 9      | 0.25583E+01   | -0.85822E+01  |
| 10     | 0.28666E+01   | -0.89395E+01  |
| 11     | 0.22961E+01   | -0.74567E+01  |
| 12     | 0.22852E+01   | -0.76459E+01  |
| 13     | 0.20392E+01   | -0.49790E+01  |
| 14     | 0.20635E+01   | -0.50304E+01  |
| 15     | 0.20948E+01   | -0.51032E+01  |
| 16     | 0.21224E+01   | -0.51831E+01  |
| 17     | 0.21431E+01   | -0.52661E+01  |
| 18     | 0.21590E+01   | -0.53552E+01  |
| 19     | 0.26404E+01   | -0.89059E+01  |
| 20     | 0.29206E+01   | -0.92231E+01  |

## FB-Multiplier Output – Abutment 1 (South) – Strength-I

### 3. Pile Shear Force in 3 Direction (kips)

| Pile # | Maximum Shear | Minimum Shear |
|--------|---------------|---------------|
| 1      | 0.58386E+01   | -0.18977E+02  |
| 2      | 0.58596E+01   | -0.18176E+02  |
| 3      | 0.27815E+01   | -0.68020E+01  |
| 4      | 0.26837E+01   | -0.65633E+01  |
| 5      | 0.25256E+01   | -0.61907E+01  |
| 6      | 0.23351E+01   | -0.57567E+01  |
| 7      | 0.21405E+01   | -0.53226E+01  |
| 8      | 0.19434E+01   | -0.48863E+01  |
| 9      | 0.46725E+01   | -0.11727E+02  |
| 10     | 0.40768E+01   | -0.10141E+02  |
| 11     | 0.58168E+01   | -0.18742E+02  |
| 12     | 0.58291E+01   | -0.17898E+02  |
| 13     | 0.27615E+01   | -0.67523E+01  |
| 14     | 0.26645E+01   | -0.65131E+01  |
| 15     | 0.25081E+01   | -0.61398E+01  |
| 16     | 0.23197E+01   | -0.57047E+01  |
| 17     | 0.21276E+01   | -0.52693E+01  |
| 18     | 0.19331E+01   | -0.48321E+01  |
| 19     | 0.46580E+01   | -0.11603E+02  |
| 20     | 0.41355E+01   | -0.10169E+02  |

### 4. Bending Moment About 2 Axis (kip-ft and ft)

| Pile | Node | Depth Below Cap | Maximum Moment | Node | Depth Below Cap | Minimum Moment |
|------|------|-----------------|----------------|------|-----------------|----------------|
| 1    | 1    | 0.00000E+00     | 0.9516E+02     | 543  | 0.1475E+02      | -0.31900E+02   |
| 2    | 2    | 0.00000E+00     | 0.9039E+02     | 582  | 0.1475E+02      | -0.30059E+02   |
| 3    | 3    | 0.00000E+00     | 0.2866E+02     | 619  | 0.9900E+01      | -0.97321E+01   |
| 4    | 4    | 0.00000E+00     | 0.2754E+02     | 658  | 0.9900E+01      | -0.94330E+01   |
| 5    | 5    | 0.00000E+00     | 0.2582E+02     | 697  | 0.9900E+01      | -0.89548E+01   |
| 6    | 6    | 0.00000E+00     | 0.2383E+02     | 736  | 0.9900E+01      | -0.83809E+01   |
| 7    | 7    | 0.00000E+00     | 0.2188E+02     | 775  | 0.9900E+01      | -0.77912E+01   |
| 8    | 8    | 0.00000E+00     | 0.1995E+02     | 814  | 0.9900E+01      | -0.71816E+01   |
| 9    | 9    | 0.00000E+00     | 0.5503E+02     | 854  | 0.1180E+02      | -0.19767E+02   |
| 10   | 10   | 0.00000E+00     | 0.4712E+02     | 893  | 0.1180E+02      | -0.17169E+02   |
| 11   | 11   | 0.00000E+00     | 0.9400E+02     | 933  | 0.1475E+02      | -0.31551E+02   |
| 12   | 12   | 0.00000E+00     | 0.8903E+02     | 972  | 0.1475E+02      | -0.29637E+02   |
| 13   | 13   | 0.00000E+00     | 0.2852E+02     | 1010 | 0.1320E+02      | -0.96436E+01   |
| 14   | 14   | 0.00000E+00     | 0.2740E+02     | 1048 | 0.9900E+01      | -0.93359E+01   |
| 15   | 15   | 0.00000E+00     | 0.2568E+02     | 1087 | 0.9900E+01      | -0.88547E+01   |
| 16   | 16   | 0.00000E+00     | 0.2370E+02     | 1126 | 0.9900E+01      | -0.82787E+01   |
| 17   | 17   | 0.00000E+00     | 0.2174E+02     | 1165 | 0.9900E+01      | -0.76877E+01   |
| 18   | 18   | 0.00000E+00     | 0.1980E+02     | 1204 | 0.9900E+01      | -0.70785E+01   |
| 19   | 19   | 0.00000E+00     | 0.5469E+02     | 1244 | 0.1180E+02      | -0.19629E+02   |
| 20   | 20   | 0.00000E+00     | 0.4753E+02     | 1283 | 0.1180E+02      | -0.17291E+02   |

### 5. Bending Moment About 3 Axis (kip-ft and ft)

| Pile | Node | Depth Below Cap | Maximum Moment | Node | Depth Below Cap | Minimum Moment |
|------|------|-----------------|----------------|------|-----------------|----------------|
| 1    | 542  | 0.11800E+02     | 0.1020E+02     | 1    | 0.0000E+00      | -0.29995E+02   |
| 2    | 581  | 0.11800E+02     | 0.1038E+02     | 2    | 0.0000E+00      | -0.30480E+02   |
| 3    | 619  | 0.99000E+01     | 0.6886E+01     | 3    | 0.0000E+00      | -0.20126E+02   |
| 4    | 658  | 0.99000E+01     | 0.7023E+01     | 4    | 0.0000E+00      | -0.20214E+02   |
| 5    | 697  | 0.99000E+01     | 0.7237E+01     | 5    | 0.0000E+00      | -0.20300E+02   |
| 6    | 736  | 0.99000E+01     | 0.7486E+01     | 6    | 0.0000E+00      | -0.20357E+02   |
| 7    | 775  | 0.99000E+01     | 0.7728E+01     | 7    | 0.0000E+00      | -0.20431E+02   |
| 8    | 814  | 0.99000E+01     | 0.7961E+01     | 8    | 0.0000E+00      | -0.20546E+02   |
| 9    | 854  | 0.11800E+02     | 0.1159E+02     | 9    | 0.0000E+00      | -0.32725E+02   |
| 10   | 893  | 0.11800E+02     | 0.1190E+02     | 10   | 0.0000E+00      | -0.33607E+02   |
| 11   | 932  | 0.11800E+02     | 0.1071E+02     | 11   | 0.0000E+00      | -0.31418E+02   |
| 12   | 971  | 0.11800E+02     | 0.1091E+02     | 12   | 0.0000E+00      | -0.31921E+02   |
| 13   | 1009 | 0.99000E+01     | 0.7148E+01     | 13   | 0.0000E+00      | -0.20974E+02   |

|    |      |             |            |    |            |              |
|----|------|-------------|------------|----|------------|--------------|
| 14 | 1048 | 0.99000E+01 | 0.7287E+01 | 14 | 0.0000E+00 | -0.21067E+02 |
| 15 | 1087 | 0.99000E+01 | 0.7505E+01 | 15 | 0.0000E+00 | -0.21159E+02 |
| 16 | 1126 | 0.99000E+01 | 0.7756E+01 | 16 | 0.0000E+00 | -0.21225E+02 |
| 17 | 1165 | 0.99000E+01 | 0.8000E+01 | 17 | 0.0000E+00 | -0.21305E+02 |
| 18 | 1204 | 0.99000E+01 | 0.8235E+01 | 18 | 0.0000E+00 | -0.21423E+02 |
| 19 | 1244 | 0.11800E+02 | 0.1214E+02 | 19 | 0.0000E+00 | -0.34142E+02 |
| 20 | 1283 | 0.11800E+02 | 0.1242E+02 | 20 | 0.0000E+00 | -0.34924E+02 |

\*\*\*\*\*  
\* SUBSTRUCTURE 1 MAX/MIN RESPONSES FOR ALL LOAD CASES \*  
\*\*\*\*\*

#### Pile demands

| Demand type                    | Value       | Unit   | Load case | Load comb. | Pile |
|--------------------------------|-------------|--------|-----------|------------|------|
| Max axial force (tension is +) | 0.8289E-01  | kips   | 2         | 0          | 18   |
| Min axial force                | -0.4202E+03 | kips   | 1         | 0          | 1    |
| Max shear in 2 direction       | 0.3162E+01  | kips   | 2         | 0          | 20   |
| Min shear in 2 direction       | -0.9681E+01 | kips   | 1         | 0          | 20   |
| Max shear in 3 direction       | 0.9292E+01  | kips   | 1         | 0          | 1    |
| Min shear in 3 direction       | -0.2540E+02 | kips   | 1         | 0          | 1    |
| Max moment about 2 axis        | 0.1343E+03  | kip-ft | 1         | 0          | 1    |
| Min moment about 2 axis        | -0.5142E+02 | kip-ft | 1         | 0          | 1    |
| Max moment about 3 axis        | 0.1449E+02  | kip-ft | 1         | 0          | 20   |
| Min moment about 3 axis        | -0.3814E+02 | kip-ft | 1         | 0          | 20   |
| Max torsional force            | 0.5242E-01  | kip-ft | 1         | 0          | 8    |
| Min torsional force            | 0.2287E-64  | kip-ft | 4         | 0          | 1    |
| Max demand/capacity ratio      | 0.6506E+00  |        | 1         | 0          | 1    |

#### Soil demands

| Demand type              | Value       | Unit   | Load case | Load comb. | Pile |
|--------------------------|-------------|--------|-----------|------------|------|
| Max Zp soil force        | 0.1882E+03  | kips   | 3         | 0          | 15   |
| Min Zp soil force        | 0.4264E-03  | kips   | 2         | 0          | 18   |
| Max Xp soil force        | 0.2664E+01  | kips   | 3         | 0          | 19   |
| Min Xp soil force        | -0.4908E+01 | kips   | 2         | 0          | 20   |
| Max Yp soil force        | 0.8953E+01  | kips   | 1         | 0          | 1    |
| Min Yp soil force        | -0.5350E+01 | kips   | 1         | 0          | 1    |
| Max torsional soil force | -0.2287E-64 | kip-ft | 4         | 0          | 1    |

#### Pile head displacements

| Displacement type  | Value       | Unit | Load case | Load comb. | Pile |
|--------------------|-------------|------|-----------|------------|------|
| Max Z displacement | 0.4931E+00  | in   | 1         | 0          | 1    |
| Min Z displacement | 0.1931E+00  | in   | 2         | 0          | 20   |
| Max X displacement | -0.8999E-01 | in   | 4         | 0          | 10   |
| Min X displacement | -0.1231E+00 | in   | 1         | 0          | 20   |
| Max Y displacement | 0.2781E+00  | in   | 1         | 0          | 1    |
| Min Y displacement | 0.5671E-01  | in   | 4         | 0          | 10   |

## FB-Multiplier Output – Abutment 1 (South) – Strength-IV

```

*****
*
*   The University of Florida, Florida Department of
*   Transportation, Marc Hoyt, Mike McVay, Cliff Hays,
*   Mark Williams, Petros Christou, Jae Chung,
*   Gary Consolazio, and Michael Davidson
*   disclaim any warranty, expressed or implied,
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*
*
*   :::: F B - M U L T I P L I E R ::::
*   v5.6.0
*
*   Written by Marc Hoyt, Mike McVay, Cliff Hays,
*   Mark Williams, Petros Christou, Jae Chung,
*   Gary Consolazio, and Michael Davidson.
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*
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*
*   FB-Multiplier calculates the response of
*   bridge-pier-pile-soil structures.
*
*   FB-Multiplier analysis types include preload,
*   static, pushover, modal, and transient dynamic.
*
*   FB-Multiplier accounts for linear and nonlinear
*   pile and pier structural members, linear pile caps
*   and superstructure, and nonlinear soil behavior.
*
*   Contact the Bridge Software Institute for support
*   https://bsi.ce.ufl.edu
*
*****

```

Analysis Start = 10:29pm  
 Analysis End = 10:30pm  
 Analysis Duration = 1 minute(s), 6 second(s)

Input Data File Name = Abutment 1 - STR IV.in  
 Analysis Date = 4- 2-2020  
 License ID Number = 432000000

```

*****
*   OUTPUT STAGE 1 OF 2: INTERPRETATION OF INPUT FILE
*   *****

```

```

*****
*   PROJECT DATA
*   *****

```

Project client = MaineDOT  
 Project name = Veranda Street Bridge Replacement  
 Project manager = T. Cote  
 Computed by = A. Piccolino  
 Project description = 75297 - Abutment 1 (South) - Strength-IV

```

*****
*   SELECTIVE PRINT OUTPUT CONTROL
*   *****

```

| Print Flag                                 | State |
|--|-------|
| Pile displacements                         | Off   |
| Pile element forces                        | Off   |
| Pile ID numbers                            | Off   |
| Pile cap stresses                          | Off   |
| Substructure coordinates                   | Off   |
| Substructure interaction diagrams          | Off   |
| Substructure material stress-strain curves | Off   |
| Substructure member section properties     | Off   |
| Pier columns and pier cap displacements    | Off   |
| Pier columns and pier cap forces           | On    |
| Soil response forces                       | Off   |
| Soil data per layer                        | On    |
| Soil curve data per pile node              | Off   |
| Soil resistance curves                     | Off   |
| Bridge span properties                     | Off   |
| Bridge span temperature data               | Off   |
| Bridge span displacements                  | Off   |
| Bridge span element forces                 | Off   |
| Discrete spring forces                     | Off   |
| Out of balance forces                      | Off   |
| XML output                                 | Off   |
| Eigenvectors                               | Off   |

```

*****
*   ANALYSIS CONTROL INFORMATION
*   *****

```

Memory specified for solution = 1024 MB

Number of cores = 1

Type of analysis = Static

-----  
 - Linear / Nonlinear analysis settings -  
 -----

Soil stiffness = Nonlinear  
 Pile stiffness = Nonlinear

-----  
 - Miscellaneous analysis settings -  
 -----

Units = English (kips & ft; lbs & in)

Convergence tolerance = 0.10 kips  
 Maximum number of iterations = 100

Number of substructures = 1

# FB-Multiplier Output – Abutment 1 (South) – Strength-IV

\*\*\*\*\*  
 \* SOIL BEHAVIOR \*  
 \*\*\*\*\*

Springs are defined at the following DOF for embedded nodes:  
 X-TRANSLATION Y-TRANSLATION Z-TRANSLATION  
 Z-ROTATION

\*\*\*\*\*  
 \* LOAD FACTORS FOR SELF WEIGHT AND BUOYANCY \*  
 \*\*\*\*\*

| LOAD CASE NO. | SELF WEIGHT FACTOR | BUOYANCY FACTOR |
|---------------|--------------------|-----------------|
| 1             | 1.00               | 1.00            |
| 2             | 1.00               | 1.00            |

\*\*\*\*\*  
 \* PILE CAP DATA \*  
 \*\*\*\*\*

NOTE: Xp-Grid: Distance between axes along Xp axis  
 Yp-Grid: Distance between axes along Yp axis

Number of Grid Points in Xp direction (NPX) = 25  
 Number of Grid Points in Yp direction (NPY) = 6

Grid Spacing in the Xp direction (in):

|        |       |        |        |        |       |        |
|--------|-------|--------|--------|--------|-------|--------|
| 8.20   | 33.40 | 76.90  | 61.70  | 40.30  | 15.80 | 117.80 |
| 105.20 | 12.60 | 117.80 | 28.80  | 89.10  | 65.90 | 22.30  |
| 95.60  | 72.30 | 45.30  | 114.00 | 121.80 | 61.70 | 56.20  |
| 127.60 | 19.50 | 5.10   |        |        |       |        |

Grid Spacing in the Yp direction (in):

|       |       |       |       |       |
|-------|-------|-------|-------|-------|
| 18.00 | 36.00 | 12.00 | 24.00 | 18.00 |
|-------|-------|-------|-------|-------|

\*\*\*\*\*  
 \* PILE TO PILE CAP CONNECTION \*  
 \*\*\*\*\*

PILE head fixity = FIXED

\*\*\*\*\*  
 \* INPUT SOIL LAYER DATA \*  
 \*\*\*\*\*

P-Y SOIL LAYER DATA

-----  
 - SOIL SET # 1 -  
 -----

| SET | LAYER | MODEL | PHI<br>deg               | RK<br>lbs/in^3           | GAMMA<br>pcf             |
|-----|-------|-------|--------------------------|--------------------------|--------------------------|
| 1   | 1     | 2     | 0.3200E+02<br>0.3200E+02 | 0.9000E+02<br>0.9000E+02 | 0.1100E+03<br>0.1100E+03 |

| SET | LAYER | MODEL | GAMMA<br>pcf             | CU<br>psf                | E50                      |
|-----|-------|-------|--------------------------|--------------------------|--------------------------|
| 1   | 2     | 4     | 0.1050E+03<br>0.1050E+03 | 0.3500E+03<br>0.3500E+03 | 0.1000E-01<br>0.1000E-01 |

| SET | LAYER | MODEL | GAMMA<br>pcf             | CU<br>psf                | E50                      | Cavg<br>psf              |
|-----|-------|-------|--------------------------|--------------------------|--------------------------|--------------------------|
| 1   | 3     | 6     | 0.1150E+03<br>0.1150E+03 | 0.5000E+03<br>0.1500E+04 | 0.5000E-02<br>0.5000E-02 | 0.5000E+03<br>0.1500E+04 |

| SET | LAYER | MODEL | PHI<br>deg               | RK<br>lbs/in^3           | GAMMA<br>pcf             |
|-----|-------|-------|--------------------------|--------------------------|--------------------------|
| 1   | 4     | 2     | 0.3000E+02<br>0.3400E+02 | 0.3000E+02<br>0.6000E+02 | 0.1050E+03<br>0.1150E+03 |

| SET | LAYER | MODEL | PHI<br>deg               | RK<br>lbs/in^3           | GAMMA<br>pcf             |
|-----|-------|-------|--------------------------|--------------------------|--------------------------|
| 1   | 5     | 2     | 0.3600E+02<br>0.3600E+02 | 0.7000E+02<br>0.7000E+02 | 0.1200E+03<br>0.1200E+03 |

| SET | LAYER | MODEL | Qu<br>psf  |
|-----|-------|-------|------------|
| 1   | 6     | 8     | 0.5040E+06 |

-----  
 - SOIL SET # 2 -  
 -----

| SET | LAYER | MODEL | PHI<br>deg               | RK<br>lbs/in^3           | GAMMA<br>pcf             |
|-----|-------|-------|--------------------------|--------------------------|--------------------------|
| 2   | 1     | 2     | 0.3200E+02<br>0.3200E+02 | 0.9000E+02<br>0.9000E+02 | 0.1100E+03<br>0.1100E+03 |

| SET | LAYER | MODEL | GAMMA<br>pcf             | CU<br>psf                | E50                      | Cavg<br>psf              |
|-----|-------|-------|--------------------------|--------------------------|--------------------------|--------------------------|
| 2   | 2     | 6     | 0.1150E+03<br>0.1150E+03 | 0.5000E+03<br>0.5000E+03 | 0.1000E-01<br>0.1000E-01 | 0.5000E+03<br>0.5000E+03 |

| SET | LAYER | MODEL | GAMMA<br>pcf             | CU<br>psf                | E50                      | Cavg<br>psf              |
|-----|-------|-------|--------------------------|--------------------------|--------------------------|--------------------------|
| 2   | 3     | 6     | 0.1150E+03<br>0.1150E+03 | 0.5000E+03<br>0.1500E+04 | 0.5000E-02<br>0.5000E-02 | 0.5000E+03<br>0.1500E+04 |

| SET | LAYER | MODEL | PHI<br>deg               | RK<br>lbs/in^3           | GAMMA<br>pcf             |
|-----|-------|-------|--------------------------|--------------------------|--------------------------|
| 2   | 4     | 2     | 0.3000E+02<br>0.3400E+02 | 0.3000E+02<br>0.6000E+02 | 0.1050E+03<br>0.1150E+03 |

| SET | LAYER | MODEL | PHI<br>deg               | RK<br>lbs/in^3           | GAMMA<br>pcf             |
|-----|-------|-------|--------------------------|--------------------------|--------------------------|
| 2   | 5     | 2     | 0.3600E+02<br>0.3600E+02 | 0.7000E+02<br>0.7000E+02 | 0.1200E+03<br>0.1200E+03 |

| SET | LAYER | MODEL | Qu<br>psf  |
|-----|-------|-------|------------|
| 2   | 6     | 8     | 0.5040E+06 |

T-Z SOIL LAYER DATA

-----  
 - SOIL SET # 1 -  
 -----

| SET | LAYER | MODEL | G<br>ksi                 | POISSON                  | TAU MAX<br>psf           | ELEVATION<br>ft          | ELEV. PIEZ.<br>ft        |
|-----|-------|-------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|
| 1   | 1     | 1     | 0.9700E+00<br>0.9700E+00 | 0.3000E+00<br>0.3000E+00 | 0.1000E+00<br>0.1000E+00 | 0.1200E+02<br>0.8200E+01 | 0.5000E+01<br>0.5000E+01 |

| SET | LAYER | MODEL | G<br>ksi | POISSON | TAU MAX<br>psf | ELEVATION<br>ft | ELEV. PIEZ.<br>ft |
|-----|-------|-------|----------|---------|----------------|-----------------|-------------------|
|-----|-------|-------|----------|---------|----------------|-----------------|-------------------|

# FB-Multiplier Output – Abutment 1 (South) – Strength-IV

|     |       |       |                          |                          |                          |                            |                          |
|-----|-------|-------|--------------------------|--------------------------|--------------------------|----------------------------|--------------------------|
| 1   | 2     | 1     | 0.6900E+00<br>0.6900E+00 | 0.4000E+00<br>0.4000E+00 | 0.1000E+00<br>0.1000E+00 | 0.8200E+01<br>0.5000E+01   | 0.5000E+01<br>0.5000E+01 |
| SET | LAYER | MODEL | G<br>ksi                 | POISSON                  | TAU MAX<br>psf           | ELEVATION<br>ft            | ELEV. PIEZ.<br>ft        |
| 1   | 3     | 1     | 0.6900E+00<br>0.6900E+00 | 0.4500E+00<br>0.5000E+00 | 0.1000E+00<br>0.1000E+00 | 0.5000E+01<br>-0.4960E+02  | 0.5000E+01<br>0.5000E+01 |
| SET | LAYER | MODEL | G<br>ksi                 | POISSON                  | TAU MAX<br>psf           | ELEVATION<br>ft            | ELEV. PIEZ.<br>ft        |
| 1   | 4     | 1     | 0.6900E+00<br>0.1460E+01 | 0.3000E+00<br>0.4000E+00 | 0.1000E+00<br>0.1000E+00 | -0.4960E+02<br>-0.6090E+02 | 0.5000E+01<br>0.5000E+01 |
| SET | LAYER | MODEL | G<br>ksi                 | POISSON                  | TAU MAX<br>psf           | ELEVATION<br>ft            | ELEV. PIEZ.<br>ft        |
| 1   | 5     | 1     | 0.2010E+01<br>0.2010E+01 | 0.2500E+00<br>0.2500E+00 | 0.8270E+03<br>0.8270E+03 | -0.6090E+02<br>-0.1079E+03 | 0.5000E+01<br>0.5000E+01 |
| SET | LAYER | MODEL | G<br>ksi                 | POISSON                  | TAU MAX<br>psf           | ELEVATION<br>ft            | ELEV. PIEZ.<br>ft        |
| 1   | 6     | 1     | 0.5200E+03<br>0.5200E+03 | 0.2500E+00<br>0.2500E+00 | 0.5040E+06<br>0.5040E+06 | -0.1079E+03<br>-0.1300E+03 | 0.5000E+01<br>0.5000E+01 |

-----  
- SOIL SET # 2 -  
-----

|     |       |       |                          |                          |                          |                            |                          |
|-----|-------|-------|--------------------------|--------------------------|--------------------------|----------------------------|--------------------------|
| SET | LAYER | MODEL | G<br>ksi                 | POISSON                  | TAU MAX<br>psf           | ELEVATION<br>ft            | ELEV. PIEZ.<br>ft        |
| 2   | 1     | 1     | 0.9700E+00<br>0.9700E+00 | 0.3000E+00<br>0.3000E+00 | 0.1000E+00<br>0.1000E+00 | 0.1200E+02<br>0.8200E+01   | 0.5000E+01<br>0.5000E+01 |
| SET | LAYER | MODEL | G<br>ksi                 | POISSON                  | TAU MAX<br>psf           | ELEVATION<br>ft            | ELEV. PIEZ.<br>ft        |
| 2   | 2     | 1     | 0.6900E+00<br>0.6900E+00 | 0.4500E+00<br>0.4500E+00 | 0.1000E+00<br>0.4200E+03 | 0.8200E+01<br>0.5000E+01   | 0.5000E+01<br>0.5000E+01 |
| SET | LAYER | MODEL | G<br>ksi                 | POISSON                  | TAU MAX<br>psf           | ELEVATION<br>ft            | ELEV. PIEZ.<br>ft        |
| 2   | 3     | 1     | 0.6900E+00<br>0.6900E+00 | 0.4500E+00<br>0.5000E+00 | 0.4200E+03<br>0.1040E+04 | 0.5000E+01<br>-0.4960E+02  | 0.5000E+01<br>0.5000E+01 |
| SET | LAYER | MODEL | G<br>ksi                 | POISSON                  | TAU MAX<br>psf           | ELEVATION<br>ft            | ELEV. PIEZ.<br>ft        |
| 2   | 4     | 1     | 0.6900E+00<br>0.1460E+01 | 0.3000E+00<br>0.4000E+00 | 0.1840E+04<br>0.3250E+04 | -0.4960E+02<br>-0.6090E+02 | 0.5000E+01<br>0.5000E+01 |
| SET | LAYER | MODEL | G<br>ksi                 | POISSON                  | TAU MAX<br>psf           | ELEVATION<br>ft            | ELEV. PIEZ.<br>ft        |
| 2   | 5     | 1     | 0.2010E+01<br>0.2010E+01 | 0.2500E+00<br>0.2500E+00 | 0.4200E+04<br>0.7240E+04 | -0.6090E+02<br>-0.1079E+03 | 0.5000E+01<br>0.5000E+01 |
| SET | LAYER | MODEL | G<br>ksi                 | POISSON                  | TAU MAX<br>psf           | ELEVATION<br>ft            | ELEV. PIEZ.<br>ft        |
| 2   | 6     | 1     | 0.5200E+03<br>0.5200E+03 | 0.2500E+00<br>0.2500E+00 | 0.5040E+06<br>0.5040E+06 | -0.1079E+03<br>-0.1300E+03 | 0.5000E+01<br>0.5000E+01 |

T-THETA SOIL LAYER DATA

-----  
- SOIL SET # 1 -  
-----

|     |       |       |          |                |
|-----|-------|-------|----------|----------------|
| SET | LAYER | MODEL | G<br>ksi | TAU MAX<br>psf |
|-----|-------|-------|----------|----------------|

|     |       |       |                          |                          |
|-----|-------|-------|--------------------------|--------------------------|
| 1   | 1     | 1     | 0.9700E+00<br>0.9700E+00 | 0.1000E+00<br>0.1000E+00 |
| SET | LAYER | MODEL | G<br>ksi                 | TAU MAX<br>psf           |
| 1   | 2     | 1     | 0.6900E+00<br>0.6900E+00 | 0.1000E+00<br>0.1000E+00 |
| SET | LAYER | MODEL | G<br>ksi                 | TAU MAX<br>psf           |
| 1   | 3     | 1     | 0.6900E+00<br>0.6900E+00 | 0.1000E+00<br>0.1000E+00 |
| SET | LAYER | MODEL | G<br>ksi                 | TAU MAX<br>psf           |
| 1   | 4     | 1     | 0.6900E+00<br>0.1460E+01 | 0.1000E+00<br>0.1000E+00 |
| SET | LAYER | MODEL | G<br>ksi                 | TAU MAX<br>psf           |
| 1   | 5     | 1     | 0.2010E+01<br>0.2010E+01 | 0.8270E+03<br>0.8270E+03 |
| SET | LAYER | MODEL | G<br>ksi                 | TAU MAX<br>psf           |
| 1   | 6     | 1     | 0.5200E+03<br>0.5200E+03 | 0.5040E+06<br>0.5040E+06 |

-----  
- SOIL SET # 2 -  
-----

|     |       |       |                          |                          |
|-----|-------|-------|--------------------------|--------------------------|
| SET | LAYER | MODEL | G<br>ksi                 | TAU MAX<br>psf           |
| 2   | 1     | 1     | 0.9700E+00<br>0.9700E+00 | 0.1000E+00<br>0.1000E+00 |
| SET | LAYER | MODEL | G<br>ksi                 | TAU MAX<br>psf           |
| 2   | 2     | 1     | 0.6900E+00<br>0.6900E+00 | 0.1000E+00<br>0.4200E+03 |
| SET | LAYER | MODEL | G<br>ksi                 | TAU MAX<br>psf           |
| 2   | 3     | 1     | 0.6900E+00<br>0.6900E+00 | 0.4200E+03<br>0.1040E+04 |
| SET | LAYER | MODEL | G<br>ksi                 | TAU MAX<br>psf           |
| 2   | 4     | 1     | 0.6900E+00<br>0.1460E+01 | 0.1840E+04<br>0.3250E+04 |
| SET | LAYER | MODEL | G<br>ksi                 | TAU MAX<br>psf           |
| 2   | 5     | 1     | 0.2010E+01<br>0.2010E+01 | 0.4200E+04<br>0.7240E+04 |
| SET | LAYER | MODEL | G<br>ksi                 | TAU MAX<br>psf           |
| 2   | 6     | 1     | 0.5200E+03<br>0.5200E+03 | 0.5040E+06<br>0.5040E+06 |

Q-Z SOIL LAYER DATA

-----  
- SOIL SET # 1 -  
-----



## FB-Multiplier Output – Abutment 1 (South) – Strength-IV

```

-----
Driven Pile (McVay)
Shear Modulus           =      520.0000 ksi
Poisson's Ratio         =      0.2000
Nominal Tip Resistance   =     200.0000 kips

-----
- SOIL SET # 2 -
-----

Driven Pile (McVay)
Shear Modulus           =      520.0000 ksi
Poisson's Ratio         =      0.2000
Nominal Tip Resistance   =     200.0000 kips

*****
*                PILE SECTION DATA                *
*****

NOTE: Pile sets consist of pile segments based on user input.
      The program groups all segments from every pile set and
      assigns a unique section number to each segment.

Number of pile sections      =      3

-----
-                INPUT DATA FOR SECTION : 1        -
-----

File Set Number            =      1
File Set Segment           =      1

Section Length (L)         =     117.00000 ft

-----
Section Nonlinear Properties
-----

- Concrete Stress Strain Properties -
-----

Concrete Strength (FPC)    = 0.5000E+01 ksi
Modulus of Elasticity (EC) = 0.4287E+04 ksi

No. Gauss Integ. points in the concrete = 60

-----
- Steel Stress Strain Properties -
-----

Mild Steel Yield Stress (FY) = 0.7500E+02 ksi
Modulus of Elasticity (ES)  = 0.2900E+05 ksi

Steel Casing Yield Stress (FY) = 0.8000E+02 ksi
Modulus of Elasticity (ES)  = 0.2900E+05 ksi

- Shape of Section : CIRCULAR

- Reinforcement and Confinement Data

Number of Reinforcement Layers = 1
Diameter                       = 9.6250 in
Tied/Spiral Reinforcement Flag = 1
(Spiral = 1;
Tied = 2)
Confinement Flag               = 0
(Unconfined = 0;
Confined: Tied/Spiral = 1;
Confined: Tied/Spiral w/ Casing = 2;
Confined: Tied/Spiral w/ Confine-Only Casing = 3)

- Total Area of Steel Reinforcement = 4.0000 in^2

WARNING : The number of bars is changed to a multiple of 4.
          This is to ensure a symmetric section for the
          analysis. The area is changed to result in the
          same total area of reinforcement.

```

```

Confinement Flag           = 0
(Unconfined = 0;
Confined: Tied/Spiral = 1;
Confined: Tied/Spiral w/ Casing = 2;
Confined: Tied/Spiral w/ Confine-Only Casing = 3)
Outer Shell Thickness       = 0.5450E+00 in

- Total Area of Steel Reinforcement = 4.0000 in^2

WARNING : The number of bars is changed to a multiple of 4.
          This is to ensure a symmetric section for the
          analysis. The area is changed to result in the
          same total area of reinforcement.

Layer # Bars/Strands Area Layer Dia. Prestressing
      in^2 in ksi
1      4      1.00 0.00 0.00

-----
-                INPUT DATA FOR SECTION : 2        -
-----

File Set Number            =      1
File Set Segment           =      2

Section Length (L)         =     15.00000 ft

-----
Section Nonlinear Properties
-----

- Concrete Stress Strain Properties -
-----

Concrete Strength (FPC)    = 0.5000E+01 ksi
Modulus of Elasticity (EC) = 0.4287E+04 ksi

No. Gauss Integ. points in the concrete = 60

-----
- Steel Stress Strain Properties -
-----

Mild Steel Yield Stress (FY) = 0.7500E+02 ksi
Modulus of Elasticity (ES)  = 0.2900E+05 ksi

- Shape of Section : CIRCULAR

- Reinforcement and Confinement Data

Number of Reinforcement Layers = 1
Diameter                       = 9.6250 in
Tied/Spiral Reinforcement Flag = 1
(Spiral = 1;
Tied = 2)
Confinement Flag               = 0
(Unconfined = 0;
Confined: Tied/Spiral = 1;
Confined: Tied/Spiral w/ Casing = 2;
Confined: Tied/Spiral w/ Confine-Only Casing = 3)

- Total Area of Steel Reinforcement = 4.0000 in^2

WARNING : The number of bars is changed to a multiple of 4.
          This is to ensure a symmetric section for the
          analysis. The area is changed to result in the
          same total area of reinforcement.

```

## FB-Multiplier Output – Abutment 1 (South) – Strength-IV

| Layer | # Bars/Strands | Area<br>in^2 | Layer Dia.<br>in | Prestressing<br>ksi |
|-------|----------------|--------------|------------------|---------------------|
| 1     | 4              | 1.00         | 0.00             | 0.00                |

-----  
INPUT DATA FOR SECTION : 3  
-----

File Set Number = 2  
File Set Segment = 1  
  
Section Length (L) = 118.00000 ft

### Section Nonlinear Properties

-----  
- Steel Stress Strain Properties -  
-----

H-Pile Yield Stress (FY) = 0.5000E+02 ksi  
Modulus of Elasticity (ES) = 0.2900E+05 ksi

- Shape of Section : USER DEFINED H-PILE

Units are in in

Orientation : OR = 2 Web along 2 axis

OR = 3 Web along 3 axis

| Depth | Width | Web Width | Flange Width | Orientation |
|-------|-------|-----------|--------------|-------------|
| 13.8  | 14.7  | 0.615     | 0.615        | 3           |

\*\*\*\*\*  
\* PILE SET DATA \*  
\*\*\*\*\*

NOTE : Piles are organized into pile sets. Each pile set is  
composed of pile segments, as specified by the user.

### List of Pile Sets and Piles

| Pile Set | Piles Assigned to the Pile Set           |
|----------|--|
| 1        | 3, 4, 5, 6, 7, 8, 13, 14, 15, 16, 17, 18 |
| 2        | 1, 2, 9, 10, 11, 12, 19, 20              |

### Total length for each Pile Set

| Pile Set | Length<br>in |
|----------|--------------|
| 1        | 1584.00      |
| 2        | 1416.00      |

\*\*\*\*\*  
\* EXTERNAL LOADS APPLIED TO SUBSTRUCTURE \*  
\*\*\*\*\*

-----  
SUBSTRUCTURE # 1  
-----

| NODE | CASE | FXp<br>kips | FYp<br>kips | FZp<br>kips | MXp<br>kip-ft | MYp<br>kip-ft | MZp<br>kip-ft |
|------|------|-------------|-------------|-------------|---------------|---------------|---------------|
|------|------|-------------|-------------|-------------|---------------|---------------|---------------|

|     |   |       |       |        |        |       |      |
|-----|---|-------|-------|--------|--------|-------|------|
| 89  | 1 | -1.76 | 29.81 | 546.00 | 250.00 | 47.61 | 0.00 |
| 92  | 1 | -1.76 | 20.44 | 424.73 | 188.14 | 46.49 | 0.00 |
| 93  | 1 | -1.76 | 20.25 | 419.27 | 184.47 | 45.36 | 0.00 |
| 95  | 1 | -1.76 | 19.79 | 412.91 | 179.02 | 44.23 | 0.00 |
| 96  | 1 | -1.76 | 19.09 | 404.75 | 172.08 | 43.11 | 0.00 |
| 98  | 1 | -1.76 | 15.18 | 341.58 | 146.09 | 42.00 | 0.00 |
| 99  | 1 | -1.76 | 15.41 | 355.78 | 148.87 | 42.70 | 0.00 |
| 101 | 1 | -1.76 | 18.45 | 389.51 | 165.08 | 41.58 | 0.00 |
| 103 | 1 | -1.76 | 18.21 | 390.00 | 161.59 | 40.47 | 0.00 |
| 104 | 1 | -1.76 | 18.00 | 384.94 | 158.61 | 39.36 | 0.00 |
| 105 | 1 | -1.76 | 17.23 | 378.43 | 153.38 | 38.23 | 0.00 |
| 107 | 1 | -1.76 | 27.45 | 504.02 | 216.43 | 37.12 | 0.00 |
| 89  | 2 | -1.76 | 20.89 | 327.29 | 194.16 | 47.61 | 0.00 |
| 92  | 2 | -1.76 | 14.64 | 254.57 | 152.26 | 46.49 | 0.00 |
| 93  | 2 | -1.76 | 14.52 | 251.37 | 149.17 | 45.36 | 0.00 |
| 95  | 2 | -1.76 | 14.21 | 247.53 | 144.88 | 44.23 | 0.00 |
| 96  | 2 | -1.76 | 13.74 | 242.56 | 139.61 | 43.11 | 0.00 |
| 98  | 2 | -1.76 | 11.14 | 204.66 | 121.64 | 42.00 | 0.00 |
| 99  | 2 | -1.76 | 11.29 | 213.20 | 123.90 | 42.70 | 0.00 |
| 101 | 2 | -1.76 | 13.32 | 233.39 | 134.06 | 41.58 | 0.00 |
| 103 | 2 | -1.76 | 13.16 | 233.76 | 131.09 | 40.47 | 0.00 |
| 104 | 2 | -1.76 | 13.01 | 230.78 | 128.46 | 39.36 | 0.00 |
| 105 | 2 | -1.76 | 12.51 | 226.85 | 124.33 | 38.23 | 0.00 |
| 107 | 2 | -1.76 | 19.32 | 302.12 | 165.72 | 37.12 | 0.00 |

\*\*\*\*\*  
\* OUTPUT STAGE 2 OF 2: ANALYSIS RESULTS \*  
\*\*\*\*\*

\*\*\*\*\*  
\* RESULTS FOR LOAD CASE 1 \*  
\*\*\*\*\*

\*\*\*\*\*  
\* CONVERGENCE REPORT \*  
\*\*\*\*\*

The solution converged in 24 iterations

### Summary of Maximum Out-Of-Balance Forces (Absolute Values)

FZ = 0.000 kips  
FX = 0.000 kips  
FY = 0.013 kips  
MXX = 0.000 kip-ft  
MYX = 0.000 kip-ft  
MZZ = 0.006 kip-ft

### Summary of Displacements at Pile Heads

| NODE | X<br>in    | Y<br>in    | Z<br>in    |
|------|------------|------------|------------|
| 1    | -.7563E-02 | 0.3412E-01 | 0.3532E+00 |
| 2    | -.7562E-02 | 0.3250E-01 | 0.3599E+00 |
| 3    | -.7559E-02 | 0.3084E-01 | 0.3653E+00 |
| 4    | -.7557E-02 | 0.2984E-01 | 0.3676E+00 |
| 5    | -.7552E-02 | 0.2830E-01 | 0.3691E+00 |
| 6    | -.7546E-02 | 0.2656E-01 | 0.3671E+00 |
| 7    | -.7541E-02 | 0.2488E-01 | 0.3614E+00 |
| 8    | -.7537E-02 | 0.2327E-01 | 0.3529E+00 |
| 9    | -.7533E-02 | 0.2139E-01 | 0.3401E+00 |

## FB-Multiplier Output – Abutment 1 (South) – Strength-IV

|    |            |            |            |
|----|------------|------------|------------|
| 10 | -.7532E-02 | 0.1930E-01 | 0.3238E+00 |
| 11 | -.8243E-02 | 0.3381E-01 | 0.4444E+00 |
| 12 | -.8244E-02 | 0.3212E-01 | 0.4511E+00 |
| 13 | -.8246E-02 | 0.3084E-01 | 0.4552E+00 |
| 14 | -.8249E-02 | 0.2984E-01 | 0.4575E+00 |
| 15 | -.8253E-02 | 0.2830E-01 | 0.4589E+00 |
| 16 | -.8259E-02 | 0.2656E-01 | 0.4570E+00 |
| 17 | -.8265E-02 | 0.2488E-01 | 0.4513E+00 |
| 18 | -.8269E-02 | 0.2327E-01 | 0.4427E+00 |
| 19 | -.8272E-02 | 0.2139E-01 | 0.4299E+00 |
| 20 | -.8274E-02 | 0.1950E-01 | 0.4152E+00 |

---

Sum of Total Soil Spring Forces for Piles

|                   |   |           |      |
|-------------------|---|-----------|------|
| Xp Direction      | = | -21.1496  | kips |
| Yp Direction      | = | 239.4924  | kips |
| Zp Direction      | = | 5829.6838 | kips |
| Sum of Tip Forces | = | 173.7081  | kips |

---

Summary of Pile Forces for Load CASE 1

### 1. Axial Force (kips)

| Pile # | Maximum Force | Minimum Force |
|--------|---------------|---------------|
| 1      | -0.56450E+02  | -0.31893E+03  |
| 2      | -0.57719E+02  | -0.32386E+03  |
| 3      | 0.77312E-01   | -0.22115E+03  |
| 4      | 0.77197E-01   | -0.22245E+03  |
| 5      | 0.77125E-01   | -0.22328E+03  |
| 6      | 0.77223E-01   | -0.22216E+03  |
| 7      | 0.77504E-01   | -0.21895E+03  |
| 8      | 0.77924E-01   | -0.21413E+03  |
| 9      | -0.53952E+02  | -0.30907E+03  |
| 10     | -0.50889E+02  | -0.29672E+03  |
| 11     | -0.74584E+02  | -0.38561E+03  |
| 12     | -0.75972E+02  | -0.39041E+03  |
| 13     | 0.72972E-01   | -0.26938E+03  |
| 14     | 0.72860E-01   | -0.27060E+03  |
| 15     | 0.72789E-01   | -0.27137E+03  |
| 16     | 0.72885E-01   | -0.27033E+03  |
| 17     | 0.73160E-01   | -0.26734E+03  |
| 18     | 0.73572E-01   | -0.26284E+03  |
| 19     | -0.71614E+02  | -0.37520E+03  |
| 20     | -0.68622E+02  | -0.36453E+03  |

### 2. Pile Shear Force in 2 Direction (kips)

| Pile # | Maximum Shear | Minimum Shear |
|--------|---------------|---------------|
| 1      | 0.20631E+00   | -0.10707E+01  |
| 2      | 0.20520E+00   | -0.10622E+01  |
| 3      | 0.18586E+00   | -0.64481E+00  |
| 4      | 0.17576E+00   | -0.61967E+00  |
| 5      | 0.15668E+00   | -0.56786E+00  |
| 6      | 0.13794E+00   | -0.49758E+00  |
| 7      | 0.14851E+00   | -0.43155E+00  |
| 8      | 0.15713E+00   | -0.37720E+00  |
| 9      | 0.18535E+00   | -0.54995E+00  |
| 10     | 0.18489E+00   | -0.53021E+00  |
| 11     | 0.22332E+00   | -0.11444E+01  |
| 12     | 0.22578E+00   | -0.11300E+01  |

|    |             |              |
|----|-------------|--------------|
| 13 | 0.19075E+00 | -0.68451E+00 |
| 14 | 0.18111E+00 | -0.66022E+00 |
| 15 | 0.16235E+00 | -0.60979E+00 |
| 16 | 0.15506E+00 | -0.54138E+00 |
| 17 | 0.16532E+00 | -0.47751E+00 |
| 18 | 0.17369E+00 | -0.42522E+00 |
| 19 | 0.20780E+00 | -0.63796E+00 |
| 20 | 0.20764E+00 | -0.62019E+00 |

### 3. Pile Shear Force in 3 Direction (kips)

| Pile # | Maximum Shear | Minimum Shear |
|--------|---------------|---------------|
| 1      | 0.38899E+01   | -0.17926E+02  |
| 2      | 0.38768E+01   | -0.17781E+02  |
| 3      | 0.18852E+01   | -0.63995E+01  |
| 4      | 0.18597E+01   | -0.63552E+01  |
| 5      | 0.18215E+01   | -0.62896E+01  |
| 6      | 0.17803E+01   | -0.62192E+01  |
| 7      | 0.17428E+01   | -0.61545E+01  |
| 8      | 0.17074E+01   | -0.60937E+01  |
| 9      | 0.37294E+01   | -0.16789E+02  |
| 10     | 0.36897E+01   | -0.16593E+02  |
| 11     | 0.39083E+01   | -0.17871E+02  |
| 12     | 0.38927E+01   | -0.17723E+02  |
| 13     | 0.18335E+01   | -0.63117E+01  |
| 14     | 0.18091E+01   | -0.62698E+01  |
| 15     | 0.17711E+01   | -0.62067E+01  |
| 16     | 0.17273E+01   | -0.61364E+01  |
| 17     | 0.16844E+01   | -0.60692E+01  |
| 18     | 0.16424E+01   | -0.60048E+01  |
| 19     | 0.37449E+01   | -0.16771E+02  |
| 20     | 0.37090E+01   | -0.16591E+02  |

### 4. Bending Moment About 2 Axis (kip-ft and ft)

| Pile | Node | Depth Below Cap | Maximum Moment | Node | Depth Below Cap | Minimum Moment |
|------|------|-----------------|----------------|------|-----------------|----------------|
| 1    | 1    | 0.00000E+00     | 0.1044E+03     | 543  | 0.1475E+02      | -0.18391E+02   |
| 2    | 2    | 0.00000E+00     | 0.1036E+03     | 582  | 0.1475E+02      | -0.18071E+02   |
| 3    | 3    | 0.00000E+00     | 0.3028E+02     | 620  | 0.1320E+02      | -0.54559E+01   |
| 4    | 4    | 0.00000E+00     | 0.3007E+02     | 659  | 0.1320E+02      | -0.53594E+01   |
| 5    | 5    | 0.00000E+00     | 0.2977E+02     | 698  | 0.1320E+02      | -0.52178E+01   |
| 6    | 6    | 0.00000E+00     | 0.2945E+02     | 737  | 0.1320E+02      | -0.50696E+01   |
| 7    | 7    | 0.00000E+00     | 0.2916E+02     | 775  | 0.9900E+01      | -0.49456E+01   |
| 8    | 8    | 0.00000E+00     | 0.2890E+02     | 814  | 0.9900E+01      | -0.48555E+01   |
| 9    | 9    | 0.00000E+00     | 0.9800E+02     | 855  | 0.1475E+02      | -0.15841E+02   |
| 10   | 10   | 0.00000E+00     | 0.9693E+02     | 894  | 0.1475E+02      | -0.15411E+02   |
| 11   | 11   | 0.00000E+00     | 0.1041E+03     | 933  | 0.1475E+02      | -0.18353E+02   |
| 12   | 12   | 0.00000E+00     | 0.1033E+03     | 972  | 0.1475E+02      | -0.18023E+02   |
| 13   | 13   | 0.00000E+00     | 0.2979E+02     | 1010 | 0.1320E+02      | -0.52314E+01   |
| 14   | 14   | 0.00000E+00     | 0.2960E+02     | 1048 | 0.9900E+01      | -0.51775E+01   |
| 15   | 15   | 0.00000E+00     | 0.2930E+02     | 1087 | 0.9900E+01      | -0.50949E+01   |
| 16   | 16   | 0.00000E+00     | 0.2898E+02     | 1126 | 0.9900E+01      | -0.49990E+01   |
| 17   | 17   | 0.00000E+00     | 0.2867E+02     | 1165 | 0.9900E+01      | -0.49033E+01   |
| 18   | 18   | 0.00000E+00     | 0.2839E+02     | 1204 | 0.9900E+01      | -0.48067E+01   |
| 19   | 19   | 0.00000E+00     | 0.9788E+02     | 1245 | 0.1475E+02      | -0.15867E+02   |
| 20   | 20   | 0.00000E+00     | 0.9688E+02     | 1284 | 0.1475E+02      | -0.15473E+02   |

### 5. Bending Moment About 3 Axis (kip-ft and ft)

| Pile | Node | Depth Below Cap | Maximum Moment | Node | Depth Below Cap | Minimum Moment |
|------|------|-----------------|----------------|------|-----------------|----------------|
| 1    | 542  | 0.11800E+02     | 0.1076E+01     | 1    | 0.0000E+00      | -0.42404E+01   |
| 2    | 581  | 0.11800E+02     | 0.1066E+01     | 2    | 0.0000E+00      | -0.41631E+01   |
| 3    | 619  | 0.99000E+01     | 0.8673E+00     | 3    | 0.0000E+00      | -0.25304E+01   |

## FB-Multiplier Output – Abutment 1 (South) – Strength-IV

|    |      |             |            |    |            |              |
|----|------|-------------|------------|----|------------|--------------|
| 4  | 658  | 0.99000E+01 | 0.8586E+00 | 4  | 0.0000E+00 | -0.23879E+01 |
| 5  | 697  | 0.99000E+01 | 0.8389E+00 | 5  | 0.0000E+00 | -0.20992E+01 |
| 6  | 736  | 0.99000E+01 | 0.8118E+00 | 6  | 0.0000E+00 | -0.17108E+01 |
| 7  | 775  | 0.99000E+01 | 0.7865E+00 | 7  | 0.0000E+00 | -0.13451E+01 |
| 8  | 814  | 0.99000E+01 | 0.7627E+00 | 8  | 0.0000E+00 | -0.10445E+01 |
| 9  | 853  | 0.88500E+01 | 0.1016E+01 | 9  | 0.0000E+00 | -0.12345E+01 |
| 10 | 892  | 0.88500E+01 | 0.1032E+01 | 10 | 0.0000E+00 | -0.10894E+01 |
| 11 | 932  | 0.11800E+02 | 0.1163E+01 | 11 | 0.0000E+00 | -0.45172E+01 |
| 12 | 971  | 0.11800E+02 | 0.1148E+01 | 12 | 0.0000E+00 | -0.44044E+01 |
| 13 | 1009 | 0.99000E+01 | 0.9249E+00 | 13 | 0.0000E+00 | -0.26904E+01 |
| 14 | 1048 | 0.99000E+01 | 0.9180E+00 | 14 | 0.0000E+00 | -0.25511E+01 |
| 15 | 1087 | 0.99000E+01 | 0.9001E+00 | 15 | 0.0000E+00 | -0.22688E+01 |
| 16 | 1126 | 0.99000E+01 | 0.8729E+00 | 16 | 0.0000E+00 | -0.18910E+01 |
| 17 | 1165 | 0.99000E+01 | 0.8460E+00 | 17 | 0.0000E+00 | -0.15391E+01 |
| 18 | 1204 | 0.99000E+01 | 0.8233E+00 | 18 | 0.0000E+00 | -0.12492E+01 |
| 19 | 1243 | 0.88500E+01 | 0.1111E+01 | 19 | 0.0000E+00 | -0.15653E+01 |
| 20 | 1282 | 0.88500E+01 | 0.1128E+01 | 20 | 0.0000E+00 | -0.14296E+01 |

\*\*\*\*\*  
 \* RESULTS FOR LOAD CASE 2 \*  
 \*\*\*\*\*

\*\*\*\*\*  
 \* CONVERGENCE REPORT \*  
 \*\*\*\*\*

The solution converged in 16 iterations

### Summary of Maximum Out-Of-Balance Forces (Absolute Values)

FZ = 0.000 kips  
 FX = 0.000 kips  
 FY = 0.028 kips  
 MXX = 0.000 kip-ft  
 MYY = 0.000 kip-ft  
 MZZ = 0.005 kip-ft

### Summary of Displacements at Pile Heads

| NODE | X<br>in    | Y<br>in    | Z<br>in    |
|------|------------|------------|------------|
| 1    | -.6404E-02 | 0.3173E-01 | 0.2275E+00 |
| 2    | -.6404E-02 | 0.3085E-01 | 0.2324E+00 |
| 3    | -.6402E-02 | 0.2996E-01 | 0.2366E+00 |
| 4    | -.6400E-02 | 0.2941E-01 | 0.2384E+00 |
| 5    | -.6397E-02 | 0.2857E-01 | 0.2398E+00 |
| 6    | -.6393E-02 | 0.2762E-01 | 0.2390E+00 |
| 7    | -.6389E-02 | 0.2670E-01 | 0.2356E+00 |
| 8    | -.6386E-02 | 0.2581E-01 | 0.2302E+00 |
| 9    | -.6383E-02 | 0.2477E-01 | 0.2220E+00 |
| 10   | -.6382E-02 | 0.2361E-01 | 0.2116E+00 |
| 11   | -.6772E-02 | 0.3156E-01 | 0.2582E+00 |
| 12   | -.6773E-02 | 0.3064E-01 | 0.2632E+00 |
| 13   | -.6775E-02 | 0.2996E-01 | 0.2663E+00 |
| 14   | -.6776E-02 | 0.2941E-01 | 0.2682E+00 |
| 15   | -.6780E-02 | 0.2857E-01 | 0.2696E+00 |
| 16   | -.6784E-02 | 0.2762E-01 | 0.2687E+00 |
| 17   | -.6788E-02 | 0.2670E-01 | 0.2653E+00 |
| 18   | -.6791E-02 | 0.2581E-01 | 0.2600E+00 |
| 19   | -.6793E-02 | 0.2477E-01 | 0.2518E+00 |
| 20   | -.6794E-02 | 0.2372E-01 | 0.2423E+00 |

### Sum of Total Soil Spring Forces for Piles

|                   |   |           |      |
|-------------------|---|-----------|------|
| Xp Direction      | = | -21.2526  | kips |
| Yp Direction      | = | 172.5185  | kips |
| Zp Direction      | = | 3845.8468 | kips |
| Sum of Tip Forces | = | 103.9411  | kips |

### Summary of Pile Forces for Load CASE 2

#### 1. Axial Force (kips)

| Pile # | Maximum Force | Minimum Force |
|--------|---------------|---------------|
| 1      | -0.33823E+02  | -0.22111E+03  |
| 2      | -0.34653E+02  | -0.22511E+03  |
| 3      | 0.83422E-01   | -0.14760E+03  |
| 4      | 0.83339E-01   | -0.14867E+03  |
| 5      | 0.83276E-01   | -0.14948E+03  |
| 6      | 0.83315E-01   | -0.14897E+03  |
| 7      | 0.83468E-01   | -0.14701E+03  |
| 8      | 0.83707E-01   | -0.14391E+03  |
| 9      | -0.32914E+02  | -0.21667E+03  |
| 10     | -0.31179E+02  | -0.20807E+03  |
| 11     | -0.39073E+02  | -0.24580E+03  |
| 12     | -0.39948E+02  | -0.24977E+03  |
| 13     | 0.82067E-01   | -0.16474E+03  |
| 14     | 0.81981E-01   | -0.16580E+03  |
| 15     | 0.81916E-01   | -0.16661E+03  |
| 16     | 0.81956E-01   | -0.16611E+03  |
| 17     | 0.82114E-01   | -0.16416E+03  |
| 18     | 0.82360E-01   | -0.16108E+03  |
| 19     | -0.37960E+02  | -0.24069E+03  |
| 20     | -0.36339E+02  | -0.23313E+03  |

#### 2. Pile Shear Force in 2 Direction (kips)

| Pile # | Maximum Shear | Minimum Shear |
|--------|---------------|---------------|
| 1      | 0.30464E+00   | -0.11230E+01  |
| 2      | 0.30595E+00   | -0.11178E+01  |
| 3      | 0.20126E+00   | -0.66651E+00  |
| 4      | 0.20374E+00   | -0.64703E+00  |
| 5      | 0.20677E+00   | -0.60657E+00  |
| 6      | 0.20907E+00   | -0.55155E+00  |
| 7      | 0.21046E+00   | -0.49979E+00  |
| 8      | 0.21157E+00   | -0.45785E+00  |
| 9      | 0.24192E+00   | -0.71759E+00  |
| 10     | 0.23865E+00   | -0.70485E+00  |
| 11     | 0.32179E+00   | -0.11761E+01  |
| 12     | 0.32242E+00   | -0.11662E+01  |
| 13     | 0.21363E+00   | -0.69816E+00  |
| 14     | 0.21633E+00   | -0.67914E+00  |
| 15     | 0.21975E+00   | -0.63947E+00  |
| 16     | 0.22256E+00   | -0.58572E+00  |
| 17     | 0.22452E+00   | -0.53544E+00  |
| 18     | 0.22606E+00   | -0.49489E+00  |
| 19     | 0.26122E+00   | -0.78093E+00  |
| 20     | 0.25828E+00   | -0.76926E+00  |

#### 3. Pile Shear Force in 3 Direction (kips)

## FB-Multiplier Output – Abutment 1 (South) – Strength-IV

| Pile # | Maximum Shear | Minimum Shear |
|--------|---------------|---------------|
| 1      | 0.33594E+01   | -0.12188E+02  |
| 2      | 0.32915E+01   | -0.12078E+02  |
| 3      | 0.98278E+00   | -0.43411E+01  |
| 4      | 0.98699E+00   | -0.43119E+01  |
| 5      | 0.99337E+00   | -0.42676E+01  |
| 6      | 0.10001E+01   | -0.42179E+01  |
| 7      | 0.10054E+01   | -0.41699E+01  |
| 8      | 0.10093E+01   | -0.41233E+01  |
| 9      | 0.27842E+01   | -0.11322E+02  |
| 10     | 0.26858E+01   | -0.11172E+02  |
| 11     | 0.33467E+01   | -0.12155E+02  |
| 12     | 0.32766E+01   | -0.12043E+02  |
| 13     | 0.98709E+00   | -0.43314E+01  |
| 14     | 0.99099E+00   | -0.43027E+01  |
| 15     | 0.99693E+00   | -0.42594E+01  |
| 16     | 0.10033E+01   | -0.42105E+01  |
| 17     | 0.10084E+01   | -0.41630E+01  |
| 18     | 0.10120E+01   | -0.41166E+01  |
| 19     | 0.27859E+01   | -0.11315E+02  |
| 20     | 0.26955E+01   | -0.11176E+02  |

#### 4. Bending Moment About 2 Axis (kip-ft and ft)

| Pile | Node | Depth Below Cap | Maximum Moment | Node | Depth Below Cap | Minimum Moment |
|------|------|-----------------|----------------|------|-----------------|----------------|
| 1    | 1    | 0.00000E+00     | 0.5880E+02     | 542  | 0.1180E+02      | -0.14234E+02   |
| 2    | 2    | 0.00000E+00     | 0.5822E+02     | 581  | 0.1180E+02      | -0.14031E+02   |
| 3    | 3    | 0.00000E+00     | 0.1758E+02     | 619  | 0.9900E+01      | -0.52660E+01   |
| 4    | 4    | 0.00000E+00     | 0.1745E+02     | 658  | 0.9900E+01      | -0.52243E+01   |
| 5    | 5    | 0.00000E+00     | 0.1726E+02     | 697  | 0.9900E+01      | -0.51607E+01   |
| 6    | 6    | 0.00000E+00     | 0.1705E+02     | 736  | 0.9900E+01      | -0.50878E+01   |
| 7    | 7    | 0.00000E+00     | 0.1684E+02     | 775  | 0.9900E+01      | -0.50158E+01   |
| 8    | 8    | 0.00000E+00     | 0.1665E+02     | 814  | 0.9900E+01      | -0.49444E+01   |
| 9    | 9    | 0.00000E+00     | 0.5428E+02     | 854  | 0.1180E+02      | -0.12573E+02   |
| 10   | 10   | 0.00000E+00     | 0.5352E+02     | 893  | 0.1180E+02      | -0.12283E+02   |
| 11   | 11   | 0.00000E+00     | 0.5866E+02     | 932  | 0.1180E+02      | -0.14198E+02   |
| 12   | 12   | 0.00000E+00     | 0.5808E+02     | 971  | 0.1180E+02      | -0.13988E+02   |
| 13   | 13   | 0.00000E+00     | 0.1755E+02     | 1009 | 0.9900E+01      | -0.52666E+01   |
| 14   | 14   | 0.00000E+00     | 0.1743E+02     | 1048 | 0.9900E+01      | -0.52250E+01   |
| 15   | 15   | 0.00000E+00     | 0.1725E+02     | 1087 | 0.9900E+01      | -0.51614E+01   |
| 16   | 16   | 0.00000E+00     | 0.1704E+02     | 1126 | 0.9900E+01      | -0.50886E+01   |
| 17   | 17   | 0.00000E+00     | 0.1683E+02     | 1165 | 0.9900E+01      | -0.50165E+01   |
| 18   | 18   | 0.00000E+00     | 0.1663E+02     | 1204 | 0.9900E+01      | -0.49450E+01   |
| 19   | 19   | 0.00000E+00     | 0.5428E+02     | 1244 | 0.1180E+02      | -0.12578E+02   |
| 20   | 20   | 0.00000E+00     | 0.5356E+02     | 1283 | 0.1180E+02      | -0.12314E+02   |

#### 5. Bending Moment About 3 Axis (kip-ft and ft)

| Pile | Node | Depth Below Cap | Maximum Moment | Node | Depth Below Cap | Minimum Moment |
|------|------|-----------------|----------------|------|-----------------|----------------|
| 1    | 541  | 0.88500E+01     | 0.1026E+01     | 1    | 0.0000E+00      | -0.40782E+01   |
| 2    | 580  | 0.88500E+01     | 0.1037E+01     | 2    | 0.0000E+00      | -0.40259E+01   |
| 3    | 619  | 0.99000E+01     | 0.9463E+00     | 3    | 0.0000E+00      | -0.24500E+01   |
| 4    | 658  | 0.99000E+01     | 0.9357E+00     | 4    | 0.0000E+00      | -0.23438E+01   |
| 5    | 697  | 0.99000E+01     | 0.9117E+00     | 5    | 0.0000E+00      | -0.21286E+01   |
| 6    | 736  | 0.99000E+01     | 0.8771E+00     | 6    | 0.0000E+00      | -0.18397E+01   |
| 7    | 775  | 0.99000E+01     | 0.8435E+00     | 7    | 0.0000E+00      | -0.15686E+01   |
| 8    | 814  | 0.99000E+01     | 0.8159E+00     | 8    | 0.0000E+00      | -0.13475E+01   |
| 9    | 853  | 0.88500E+01     | 0.1064E+01     | 9    | 0.0000E+00      | -0.18689E+01   |
| 10   | 892  | 0.88500E+01     | 0.1071E+01     | 10   | 0.0000E+00      | -0.17713E+01   |
| 11   | 931  | 0.88500E+01     | 0.1087E+01     | 11   | 0.0000E+00      | -0.42585E+01   |
| 12   | 970  | 0.88500E+01     | 0.1099E+01     | 12   | 0.0000E+00      | -0.41798E+01   |
| 13   | 1009 | 0.99000E+01     | 0.9980E+00     | 13   | 0.0000E+00      | -0.25624E+01   |
| 14   | 1048 | 0.99000E+01     | 0.9881E+00     | 14   | 0.0000E+00      | -0.24578E+01   |
| 15   | 1087 | 0.99000E+01     | 0.9653E+00     | 15   | 0.0000E+00      | -0.22451E+01   |

|    |      |             |            |    |            |              |
|----|------|-------------|------------|----|------------|--------------|
| 16 | 1126 | 0.99000E+01 | 0.9324E+00 | 16 | 0.0000E+00 | -0.19609E+01 |
| 17 | 1165 | 0.99000E+01 | 0.9006E+00 | 17 | 0.0000E+00 | -0.16954E+01 |
| 18 | 1204 | 0.99000E+01 | 0.8746E+00 | 18 | 0.0000E+00 | -0.14796E+01 |
| 19 | 1243 | 0.88500E+01 | 0.1135E+01 | 19 | 0.0000E+00 | -0.20833E+01 |
| 20 | 1282 | 0.88500E+01 | 0.1143E+01 | 20 | 0.0000E+00 | -0.19913E+01 |

\*\*\*\*\*  
 \* SUBSTRUCTURE 1 MAX/MIN RESPONSES FOR ALL LOAD CASES \*  
 \*\*\*\*\*

#### Pile demands

| Demand type                    | Value       | Unit   | Load case | Load comb. | Pile |
|--------------------------------|-------------|--------|-----------|------------|------|
| Max axial force (tension is +) | 0.8371E-01  | kips   | 2         | 0          | 8    |
| Min axial force                | -0.3904E+03 | kips   | 1         | 0          | 12   |
| Max shear in 2 direction       | 0.3224E+00  | kips   | 2         | 0          | 12   |
| Min shear in 2 direction       | -0.1176E+01 | kips   | 2         | 0          | 11   |
| Max shear in 3 direction       | 0.3908E+01  | kips   | 1         | 0          | 11   |
| Min shear in 3 direction       | -0.1793E+02 | kips   | 1         | 0          | 1    |
| Max moment about 2 axis        | 0.1044E+03  | kip-ft | 1         | 0          | 1    |
| Min moment about 2 axis        | -0.1839E+02 | kip-ft | 1         | 0          | 1    |
| Max moment about 3 axis        | 0.1163E+01  | kip-ft | 1         | 0          | 11   |
| Min moment about 3 axis        | -0.4517E+01 | kip-ft | 1         | 0          | 11   |
| Max torsional force            | 0.7673E-02  | kip-ft | 1         | 0          | 8    |
| Min torsional force            | 0.1931E-65  | kip-ft | 2         | 0          | 1    |
| Max demand/capacity ratio      | 0.5729E+00  |        | 1         | 0          | 12   |

#### Soil demands

| Demand type              | Value       | Unit   | Load case | Load comb. | Pile |
|--------------------------|-------------|--------|-----------|------------|------|
| Max Zp soil force        | 0.1800E+03  | kips   | 1         | 0          | 15   |
| Min Zp soil force        | 0.4264E-03  | kips   | 2         | 0          | 8    |
| Max Xp soil force        | 0.3101E+00  | kips   | 2         | 0          | 20   |
| Min Xp soil force        | -0.6190E+00 | kips   | 2         | 0          | 12   |
| Max Yp soil force        | 0.6396E+01  | kips   | 1         | 0          | 1    |
| Min Yp soil force        | -0.3010E+01 | kips   | 2         | 0          | 1    |
| Max torsional soil force | -0.1931E-65 | kip-ft | 2         | 0          | 1    |

#### Pile head displacements

| Displacement type  | Value       | Unit | Load case | Load comb. | Pile |
|--------------------|-------------|------|-----------|------------|------|
| Max Z displacement | 0.4589E+00  | in   | 1         | 0          | 15   |
| Min Z displacement | 0.2116E+00  | in   | 2         | 0          | 10   |
| Max X displacement | -0.6382E-02 | in   | 2         | 0          | 10   |
| Min X displacement | -0.8274E-02 | in   | 1         | 0          | 20   |
| Max Y displacement | 0.3412E-01  | in   | 1         | 0          | 1    |
| Min Y displacement | 0.1930E-01  | in   | 1         | 0          | 10   |

## FB-Multiplier Output – Abutment 2 (North) – Service-I

```

*****
*
*   The University of Florida, Florida Department of
*   Transportation, Marc Hoyt, Mike McVay, Cliff Hays,
*   Mark Williams, Petros Christou, Jae Chung,
*   Gary Consolazio, and Michael Davidson
*   disclaim any warranty, expressed or implied,
*   including but not limited to, any implied
*   warranty of fitness for a particular purpose
*   or accuracy of the FB-Multiplier software. The
*   developers shall not be liable for any damages
*   incurred through the use of FB-Multiplier.
*
*
*   ::: F B - M U L T I P L I E R :::
*   v5.6.0
*
*   Written by Marc Hoyt, Mike McVay, Cliff Hays,
*   Mark Williams, Petros Christou, Jae Chung,
*   Gary Consolazio, and Michael Davidson.
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*
*   FB-Multiplier calculates the response of
*   bridge-pier-pile-soil structures.
*
*   FB-Multiplier analysis types include preload,
*   static, pushover, modal, and transient dynamic.
*
*   FB-Multiplier accounts for linear and nonlinear
*   pile and pier structural members, linear pile caps
*   and superstructure, and nonlinear soil behavior.
*
*   Contact the Bridge Software Institute for support
*   https://bsi.ce.ufl.edu
*
*****

```

Analysis Start = 10:34pm  
 Analysis End = 10:34pm  
 Analysis Duration = 6 second(s)

Input Data File Name = Abutment 2 - SER I.in  
 Analysis Date = 4- 2-2020  
 License ID Number = 432000000

```

*****
*   OUTPUT STAGE 1 OF 2: INTERPRETATION OF INPUT FILE
*   *****

```

```

*****
*   PROJECT DATA
*   *****

```

Project client = MaineDOT  
 Project name = Veranda Street Bridge Replacement  
 Project manager = T. Cote  
 Computed by = A. Piccolino  
 Project description = 75297 - Abutment 2 (North) - Service-I

```

*****
*   SELECTIVE PRINT OUTPUT CONTROL
*   *****

```

| Print Flag                                 | State |
|--|-------|
| Pile displacements                         | Off   |
| Pile element forces                        | Off   |
| Pile ID numbers                            | Off   |
| Pile cap stresses                          | Off   |
| Substructure coordinates                   | Off   |
| Substructure interaction diagrams          | Off   |
| Substructure material stress-strain curves | Off   |
| Substructure member section properties     | Off   |
| Pier columns and pier cap displacements    | Off   |
| Pier columns and pier cap forces           | On    |
| Soil response forces                       | Off   |
| Soil data per layer                        | On    |
| Soil curve data per pile node              | Off   |
| Soil resistance curves                     | Off   |
| Bridge span properties                     | Off   |
| Bridge span temperature data               | Off   |
| Bridge span displacements                  | Off   |
| Bridge span element forces                 | Off   |
| Discrete spring forces                     | Off   |
| Out of balance forces                      | Off   |
| XML output                                 | Off   |
| Eigenvectors                               | Off   |

```

*****
*   ANALYSIS CONTROL INFORMATION
*   *****

```

Memory specified for solution = 1024 MB

Number of cores = 1

Type of analysis = Static

-----  
 - Linear / Nonlinear analysis settings -  
 -----

Soil stiffness = Nonlinear  
 Pile stiffness = Nonlinear

-----  
 - Miscellaneous analysis settings -  
 -----

Units = English (kips & ft; lbs & in)

Convergence tolerance = 0.10 kips  
 Maximum number of iterations = 100

Number of substructures = 1

# FB-Multiplier Output – Abutment 2 (North) – Service-I

\*\*\*\*\*  
 \* SOIL BEHAVIOR \*  
 \*\*\*\*\*

Springs are defined at the following DOF for embedded nodes:  
 X-TRANSLATION Y-TRANSLATION Z-TRANSLATION  
 Z-ROTATION

\*\*\*\*\*  
 \* LOAD FACTORS FOR SELF WEIGHT AND BUOYANCY \*  
 \*\*\*\*\*

| LOAD CASE NO. | SELF WEIGHT FACTOR | BUOYANCY FACTOR |
|---------------|--------------------|-----------------|
| 1             | 1.00               | 1.00            |
| 2             | 1.00               | 1.00            |

\*\*\*\*\*  
 \* PILE CAP DATA \*  
 \*\*\*\*\*

NOTE: Xp-Grid: Distance between axes along Xp axis  
 Yp-Grid: Distance between axes along Yp axis

Number of Grid Points in Xp direction (NPX) = 23  
 Number of Grid Points in Yp direction (NPY) = 6

Grid Spacing in the Xp direction (in):

|       |        |       |        |       |        |       |
|-------|--------|-------|--------|-------|--------|-------|
| 57.08 | 129.47 | 95.28 | 22.54  | 11.09 | 106.88 | 96.55 |
| 21.01 | 117.97 | 21.82 | 96.22  | 67.07 | 117.71 | 41.46 |
| 76.44 | 84.03  | 33.93 | 117.97 | 34.57 | 83.15  | 37.82 |
| 18.00 |        |       |        |       |        |       |

Grid Spacing in the Yp direction (in):

|       |       |       |       |       |
|-------|-------|-------|-------|-------|
| 18.00 | 36.00 | 12.00 | 24.00 | 18.00 |
|-------|-------|-------|-------|-------|

\*\*\*\*\*  
 \* PILE TO PILE CAP CONNECTION \*  
 \*\*\*\*\*

PILE head fixity = FIXED

\*\*\*\*\*  
 \* INPUT SOIL LAYER DATA \*  
 \*\*\*\*\*

P-Y SOIL LAYER DATA

-----  
 - SOIL SET # 1 -  
 -----

| SET | LAYER | MODEL | PHI<br>deg               | RK<br>lbs/in^3           | GAMMA<br>pcf             |
|-----|-------|-------|--------------------------|--------------------------|--------------------------|
| 1   | 1     | 2     | 0.3200E+02<br>0.3200E+02 | 0.9000E+02<br>0.9000E+02 | 0.1100E+03<br>0.1100E+03 |

| SET | LAYER | MODEL | GAMMA<br>pcf             | CU<br>psf                | E50                      |
|-----|-------|-------|--------------------------|--------------------------|--------------------------|
| 1   | 2     | 4     | 0.1050E+03<br>0.1050E+03 | 0.3500E+03<br>0.3500E+03 | 0.1000E-01<br>0.1000E-01 |

| SET | LAYER | MODEL | GAMMA<br>pcf             | CU<br>psf                | E50                      | Cavg<br>psf              |
|-----|-------|-------|--------------------------|--------------------------|--------------------------|--------------------------|
| 1   | 3     | 6     | 0.1150E+03<br>0.1150E+03 | 0.5000E+03<br>0.1500E+04 | 0.5000E-02<br>0.5000E-02 | 0.5000E+03<br>0.1500E+04 |

| SET | LAYER | MODEL | PHI<br>deg               | RK<br>lbs/in^3           | GAMMA<br>pcf             |
|-----|-------|-------|--------------------------|--------------------------|--------------------------|
| 1   | 4     | 2     | 0.3000E+02<br>0.3400E+02 | 0.3000E+02<br>0.6000E+02 | 0.1050E+03<br>0.1150E+03 |

| SET | LAYER | MODEL | PHI<br>deg               | RK<br>lbs/in^3           | GAMMA<br>pcf             |
|-----|-------|-------|--------------------------|--------------------------|--------------------------|
| 1   | 5     | 2     | 0.3600E+02<br>0.3600E+02 | 0.7000E+02<br>0.7000E+02 | 0.1200E+03<br>0.1200E+03 |

| SET | LAYER | MODEL | Qu<br>psf  |
|-----|-------|-------|------------|
| 1   | 6     | 8     | 0.5040E+06 |

-----  
 - SOIL SET # 2 -  
 -----

| SET | LAYER | MODEL | PHI<br>deg               | RK<br>lbs/in^3           | GAMMA<br>pcf             |
|-----|-------|-------|--------------------------|--------------------------|--------------------------|
| 2   | 1     | 2     | 0.3200E+02<br>0.3200E+02 | 0.9000E+02<br>0.9000E+02 | 0.1100E+03<br>0.1100E+03 |

| SET | LAYER | MODEL | GAMMA<br>pcf             | CU<br>psf                | E50                      | Cavg<br>psf              |
|-----|-------|-------|--------------------------|--------------------------|--------------------------|--------------------------|
| 2   | 2     | 6     | 0.1150E+03<br>0.1150E+03 | 0.5000E+03<br>0.5000E+03 | 0.1000E-01<br>0.1000E-01 | 0.5000E+03<br>0.5000E+03 |

| SET | LAYER | MODEL | GAMMA<br>pcf             | CU<br>psf                | E50                      | Cavg<br>psf              |
|-----|-------|-------|--------------------------|--------------------------|--------------------------|--------------------------|
| 2   | 3     | 6     | 0.1150E+03<br>0.1150E+03 | 0.5000E+03<br>0.1500E+04 | 0.5000E-02<br>0.5000E-02 | 0.5000E+03<br>0.1500E+04 |

| SET | LAYER | MODEL | PHI<br>deg               | RK<br>lbs/in^3           | GAMMA<br>pcf             |
|-----|-------|-------|--------------------------|--------------------------|--------------------------|
| 2   | 4     | 2     | 0.3000E+02<br>0.3400E+02 | 0.3000E+02<br>0.6000E+02 | 0.1050E+03<br>0.1150E+03 |

| SET | LAYER | MODEL | PHI<br>deg               | RK<br>lbs/in^3           | GAMMA<br>pcf             |
|-----|-------|-------|--------------------------|--------------------------|--------------------------|
| 2   | 5     | 2     | 0.3600E+02<br>0.3600E+02 | 0.7000E+02<br>0.7000E+02 | 0.1200E+03<br>0.1200E+03 |

| SET | LAYER | MODEL | Qu<br>psf  |
|-----|-------|-------|------------|
| 2   | 6     | 8     | 0.5040E+06 |

T-Z SOIL LAYER DATA

-----  
 - SOIL SET # 1 -  
 -----

| SET | LAYER | MODEL | G<br>ksi                 | POISSON                  | TAU MAX<br>psf           | ELEVATION<br>ft          | ELEV. PIEZ.<br>ft        |
|-----|-------|-------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|
| 1   | 1     | 1     | 0.9700E+00<br>0.9700E+00 | 0.3000E+00<br>0.3000E+00 | 0.1000E+00<br>0.1000E+00 | 0.1300E+02<br>0.7200E+01 | 0.5000E+01<br>0.5000E+01 |

| SET | LAYER | MODEL | G<br>ksi | POISSON | TAU MAX<br>psf | ELEVATION<br>ft | ELEV. PIEZ.<br>ft |
|-----|-------|-------|----------|---------|----------------|-----------------|-------------------|
|-----|-------|-------|----------|---------|----------------|-----------------|-------------------|

# FB-Multiplier Output – Abutment 2 (North) – Service-I

|     |       |       |                          |                          |                          |                            |                          |
|-----|-------|-------|--------------------------|--------------------------|--------------------------|----------------------------|--------------------------|
| 1   | 2     | 1     | 0.6900E+00<br>0.6900E+00 | 0.4000E+00<br>0.4000E+00 | 0.1000E+00<br>0.1000E+00 | 0.7200E+01<br>0.3800E+01   | 0.5000E+01<br>0.5000E+01 |
| SET | LAYER | MODEL | G<br>ksi                 | POISSON                  | TAU MAX<br>psf           | ELEVATION<br>ft            | ELEV. PIEZ.<br>ft        |
| 1   | 3     | 1     | 0.6900E+00<br>0.6900E+00 | 0.4500E+00<br>0.5000E+00 | 0.1000E+00<br>0.1000E+00 | 0.3800E+01<br>-0.5470E+02  | 0.5000E+01<br>0.5000E+01 |
| SET | LAYER | MODEL | G<br>ksi                 | POISSON                  | TAU MAX<br>psf           | ELEVATION<br>ft            | ELEV. PIEZ.<br>ft        |
| 1   | 4     | 1     | 0.6900E+00<br>0.1460E+01 | 0.3000E+00<br>0.4000E+00 | 0.1000E+00<br>0.1000E+00 | -0.5470E+02<br>-0.6630E+02 | 0.5000E+01<br>0.5000E+01 |
| SET | LAYER | MODEL | G<br>ksi                 | POISSON                  | TAU MAX<br>psf           | ELEVATION<br>ft            | ELEV. PIEZ.<br>ft        |
| 1   | 5     | 1     | 0.2010E+01<br>0.2010E+01 | 0.2500E+00<br>0.2500E+00 | 0.8270E+03<br>0.8270E+03 | -0.6630E+02<br>-0.1322E+03 | 0.5000E+01<br>0.5000E+01 |
| SET | LAYER | MODEL | G<br>ksi                 | POISSON                  | TAU MAX<br>psf           | ELEVATION<br>ft            | ELEV. PIEZ.<br>ft        |
| 1   | 6     | 1     | 0.5200E+03<br>0.5200E+03 | 0.2500E+00<br>0.2500E+00 | 0.5040E+06<br>0.5040E+06 | -0.1322E+03<br>-0.1500E+03 | 0.5000E+01<br>0.5000E+01 |

-----  
- SOIL SET # 2 -  
-----

|     |       |       |                          |                          |                          |                            |                          |
|-----|-------|-------|--------------------------|--------------------------|--------------------------|----------------------------|--------------------------|
| SET | LAYER | MODEL | G<br>ksi                 | POISSON                  | TAU MAX<br>psf           | ELEVATION<br>ft            | ELEV. PIEZ.<br>ft        |
| 2   | 1     | 1     | 0.9700E+00<br>0.9700E+00 | 0.3000E+00<br>0.3000E+00 | 0.1000E+00<br>0.1000E+00 | 0.1300E+02<br>0.7200E+01   | 0.5000E+01<br>0.5000E+01 |
| SET | LAYER | MODEL | G<br>ksi                 | POISSON                  | TAU MAX<br>psf           | ELEVATION<br>ft            | ELEV. PIEZ.<br>ft        |
| 2   | 2     | 1     | 0.6900E+00<br>0.6900E+00 | 0.4500E+00<br>0.4500E+00 | 0.1000E+00<br>0.1000E+00 | 0.7200E+01<br>0.3800E+01   | 0.5000E+01<br>0.5000E+01 |
| SET | LAYER | MODEL | G<br>ksi                 | POISSON                  | TAU MAX<br>psf           | ELEVATION<br>ft            | ELEV. PIEZ.<br>ft        |
| 2   | 3     | 1     | 0.6900E+00<br>0.6900E+00 | 0.4500E+00<br>0.5000E+00 | 0.4000E+03<br>0.1000E+04 | 0.3800E+01<br>-0.5470E+02  | 0.5000E+01<br>0.5000E+01 |
| SET | LAYER | MODEL | G<br>ksi                 | POISSON                  | TAU MAX<br>psf           | ELEVATION<br>ft            | ELEV. PIEZ.<br>ft        |
| 2   | 4     | 1     | 0.6900E+00<br>0.1460E+01 | 0.3000E+00<br>0.4000E+00 | 0.2000E+04<br>0.3500E+04 | -0.5470E+02<br>-0.6630E+02 | 0.5000E+01<br>0.5000E+01 |
| SET | LAYER | MODEL | G<br>ksi                 | POISSON                  | TAU MAX<br>psf           | ELEVATION<br>ft            | ELEV. PIEZ.<br>ft        |
| 2   | 5     | 1     | 0.2010E+01<br>0.2010E+01 | 0.2500E+00<br>0.2500E+00 | 0.4600E+04<br>0.8900E+04 | -0.6630E+02<br>-0.1322E+03 | 0.5000E+01<br>0.5000E+01 |
| SET | LAYER | MODEL | G<br>ksi                 | POISSON                  | TAU MAX<br>psf           | ELEVATION<br>ft            | ELEV. PIEZ.<br>ft        |
| 2   | 6     | 1     | 0.5200E+03<br>0.5200E+03 | 0.2500E+00<br>0.2500E+00 | 0.5040E+06<br>0.5040E+06 | -0.1322E+03<br>-0.1500E+03 | 0.5000E+01<br>0.5000E+01 |

T-THETA SOIL LAYER DATA

-----  
- SOIL SET # 1 -  
-----

|     |       |       |          |                |
|-----|-------|-------|----------|----------------|
| SET | LAYER | MODEL | G<br>ksi | TAU MAX<br>psf |
|-----|-------|-------|----------|----------------|

|     |       |       |                          |                          |
|-----|-------|-------|--------------------------|--------------------------|
| 1   | 1     | 1     | 0.9700E+00<br>0.9700E+00 | 0.1000E+00<br>0.1000E+00 |
| SET | LAYER | MODEL | G<br>ksi                 | TAU MAX<br>psf           |
| 1   | 2     | 1     | 0.6900E+00<br>0.6900E+00 | 0.1000E+00<br>0.1000E+00 |
| SET | LAYER | MODEL | G<br>ksi                 | TAU MAX<br>psf           |
| 1   | 3     | 1     | 0.6900E+00<br>0.6900E+00 | 0.1000E+00<br>0.1000E+00 |
| SET | LAYER | MODEL | G<br>ksi                 | TAU MAX<br>psf           |
| 1   | 4     | 1     | 0.6900E+00<br>0.1460E+01 | 0.1000E+00<br>0.1000E+00 |
| SET | LAYER | MODEL | G<br>ksi                 | TAU MAX<br>psf           |
| 1   | 5     | 1     | 0.2010E+01<br>0.2010E+01 | 0.8270E+03<br>0.8270E+03 |
| SET | LAYER | MODEL | G<br>ksi                 | TAU MAX<br>psf           |
| 1   | 6     | 1     | 0.5200E+03<br>0.5200E+03 | 0.5040E+06<br>0.5040E+06 |

-----  
- SOIL SET # 2 -  
-----

|     |       |       |                          |                          |
|-----|-------|-------|--------------------------|--------------------------|
| SET | LAYER | MODEL | G<br>ksi                 | TAU MAX<br>psf           |
| 2   | 1     | 1     | 0.9700E+00<br>0.9700E+00 | 0.1000E+00<br>0.1000E+00 |
| SET | LAYER | MODEL | G<br>ksi                 | TAU MAX<br>psf           |
| 2   | 2     | 1     | 0.6900E+00<br>0.6900E+00 | 0.1000E+00<br>0.1000E+00 |
| SET | LAYER | MODEL | G<br>ksi                 | TAU MAX<br>psf           |
| 2   | 3     | 1     | 0.6900E+00<br>0.6900E+00 | 0.4000E+03<br>0.1000E+04 |
| SET | LAYER | MODEL | G<br>ksi                 | TAU MAX<br>psf           |
| 2   | 4     | 1     | 0.6900E+00<br>0.1460E+01 | 0.2000E+04<br>0.3500E+04 |
| SET | LAYER | MODEL | G<br>ksi                 | TAU MAX<br>psf           |
| 2   | 5     | 1     | 0.2010E+01<br>0.2010E+01 | 0.4600E+04<br>0.8900E+04 |
| SET | LAYER | MODEL | G<br>ksi                 | TAU MAX<br>psf           |
| 2   | 6     | 1     | 0.5200E+03<br>0.5200E+03 | 0.5040E+06<br>0.5040E+06 |

Q-Z SOIL LAYER DATA

-----  
- SOIL SET # 1 -  
-----



## FB-Multiplier Output – Abutment 2 (North) – Service-I

```

-----
Driven Pile (McVay)
Shear Modulus           =      520.0000 ksi
Poisson's Ratio         =      0.2000
Nominal Tip Resistance   =     200.0000 kips

-----
- SOIL SET # 2 -
-----

Driven Pile (McVay)
Shear Modulus           =      520.0000 ksi
Poisson's Ratio         =      0.2000
Nominal Tip Resistance   =     200.0000 kips

*****
*                PILE SECTION DATA                *
*****

NOTE: Pile sets consist of pile segments based on user input.
      The program groups all segments from every pile set and
      assigns a unique section number to each segment.

Number of pile sections      =      3

-----
-                INPUT DATA FOR SECTION : 1        -
-----

File Set Number             =      1
File Set Segment            =      1

Section Length (L)          =     142.00000 ft

-----
Section Nonlinear Properties
-----

- Concrete Stress Strain Properties -
-----

Concrete Strength (FPC)      = 0.5000E+01 ksi
Modulus of Elasticity (EC)   = 0.4287E+04 ksi

No. Gauss Integ. points in the concrete = 60

-----
- Steel Stress Strain Properties -
-----

Mild Steel Yield Stress (FY) = 0.7500E+02 ksi
Modulus of Elasticity (ES)   = 0.2900E+05 ksi

Steel Casing Yield Stress (FY) = 0.8000E+02 ksi
Modulus of Elasticity (ES)   = 0.2900E+05 ksi

- Shape of Section : CIRCULAR

- Reinforcement and Confinement Data

Number of Reinforcement Layers = 1
Diameter                       = 9.6250 in
Tied/Spiral Reinforcement Flag = 1
(Spiral = 1;
Tied = 2)
Confinement Flag               = 0
(Unconfined = 0;
Confined: Tied/Spiral = 1;
Confined: Tied/Spiral w/ Casing = 2;
Confined: Tied/Spiral w/ Confine-Only Casing = 3)

- Total Area of Steel Reinforcement = 4.0000 in^2

WARNING : The number of bars is changed to a multiple of 4.
This is to ensure a symmetric section for the
analysis. The area is changed to result in the
same total area of reinforcement.

```

```

Confinement Flag           = 0
(Unconfined = 0;
Confined: Tied/Spiral = 1;
Confined: Tied/Spiral w/ Casing = 2;
Confined: Tied/Spiral w/ Confine-Only Casing = 3)
Outer Shell Thickness       = 0.5450E+00 in

- Total Area of Steel Reinforcement = 4.0000 in^2

WARNING : The number of bars is changed to a multiple of 4.
This is to ensure a symmetric section for the
analysis. The area is changed to result in the
same total area of reinforcement.

Layer # Bars/Strands Area Layer Dia. Prestressing
      in^2 in ksi
1      4      1.00 0.00 0.00

-----
-                INPUT DATA FOR SECTION : 2        -
-----

File Set Number             =      1
File Set Segment            =      2

Section Length (L)          =     14.000000 ft

-----
Section Nonlinear Properties
-----

- Concrete Stress Strain Properties -
-----

Concrete Strength (FPC)      = 0.5000E+01 ksi
Modulus of Elasticity (EC)   = 0.4287E+04 ksi

No. Gauss Integ. points in the concrete = 60

-----
- Steel Stress Strain Properties -
-----

Mild Steel Yield Stress (FY) = 0.7500E+02 ksi
Modulus of Elasticity (ES)   = 0.2900E+05 ksi

- Shape of Section : CIRCULAR

- Reinforcement and Confinement Data

Number of Reinforcement Layers = 1
Diameter                       = 9.6250 in
Tied/Spiral Reinforcement Flag = 1
(Spiral = 1;
Tied = 2)
Confinement Flag               = 0
(Unconfined = 0;
Confined: Tied/Spiral = 1;
Confined: Tied/Spiral w/ Casing = 2;
Confined: Tied/Spiral w/ Confine-Only Casing = 3)

- Total Area of Steel Reinforcement = 4.0000 in^2

WARNING : The number of bars is changed to a multiple of 4.
This is to ensure a symmetric section for the
analysis. The area is changed to result in the
same total area of reinforcement.

```

## FB-Multiplier Output – Abutment 2 (North) – Service-I

| Layer | # Bars/Strands | Area<br>in^2 | Layer Dia.<br>in | Prestressing<br>ksi |
|-------|----------------|--------------|------------------|---------------------|
| 1     | 4              | 1.00         | 0.00             | 0.00                |

-----  
INPUT DATA FOR SECTION : 3  
-----

File Set Number = 2  
File Set Segment = 1  
  
Section Length (L) = 142.00000 ft

### Section Nonlinear Properties

-----  
- Steel Stress Strain Properties -  
-----

H-Pile Yield Stress (FY) = 0.5000E+02 ksi  
Modulus of Elasticity (ES) = 0.2900E+05 ksi

- Shape of Section : USER DEFINED H-PILE

Units are in in

Orientation : OR = 2 Web along 2 axis

OR = 3 Web along 3 axis

| Depth | Width | Web Width | Flange Width | Orientation |
|-------|-------|-----------|--------------|-------------|
| 13.8  | 14.7  | 0.615     | 0.615        | 3           |

\*\*\*\*\*  
\* PILE SET DATA \*  
\*\*\*\*\*

NOTE : Piles are organized into pile sets. Each pile set is  
composed of pile segments, as specified by the user.

### List of Pile Sets and Piles

| Pile Set | Piles Assigned to the Pile Set    |
|----------|-----------------------------------|
| 1        | 3, 4, 5, 6, 7, 12, 13, 14, 15, 16 |
| 2        | 1, 2, 8, 9, 10, 11, 17, 18        |

### Total length for each Pile Set

| Pile Set | Length<br>in |
|----------|--------------|
| 1        | 1872.00      |
| 2        | 1704.00      |

\*\*\*\*\*  
\* EXTERNAL LOADS APPLIED TO SUBSTRUCTURE \*  
\*\*\*\*\*

-----  
SUBSTRUCTURE # 1  
-----

| NODE | CASE | FXp<br>kips | FYp<br>kips | FZp<br>kips | MXp<br>kip-ft | MYp<br>kip-ft | MZp<br>kip-ft |
|------|------|-------------|-------------|-------------|---------------|---------------|---------------|
|------|------|-------------|-------------|-------------|---------------|---------------|---------------|

|    |   |        |       |        |        |        |      |
|----|---|--------|-------|--------|--------|--------|------|
| 81 | 1 | -12.91 | 35.83 | 401.47 | 457.08 | 238.57 | 0.00 |
| 83 | 1 | -12.91 | 29.84 | 321.20 | 434.97 | 246.57 | 0.00 |
| 85 | 1 | -12.91 | 30.32 | 325.01 | 449.37 | 254.57 | 0.00 |
| 87 | 1 | -12.91 | 30.41 | 326.71 | 462.21 | 262.58 | 0.00 |
| 88 | 1 | -12.91 | 30.63 | 337.19 | 475.93 | 270.58 | 0.00 |
| 90 | 1 | -12.91 | 28.53 | 305.48 | 476.92 | 278.58 | 0.00 |
| 91 | 1 | -3.52  | 14.72 | 223.06 | 184.81 | 79.07  | 0.00 |
| 92 | 1 | -3.52  | 17.60 | 263.21 | 205.40 | 81.32  | 0.00 |
| 94 | 1 | -3.52  | 18.17 | 268.58 | 213.39 | 83.54  | 0.00 |
| 96 | 1 | -3.52  | 18.24 | 272.82 | 217.98 | 85.79  | 0.00 |
| 97 | 1 | -3.52  | 18.46 | 276.53 | 224.03 | 88.08  | 0.00 |
| 99 | 1 | -3.52  | 18.54 | 273.52 | 229.83 | 90.33  | 0.00 |
| 81 | 2 | -10.70 | 32.60 | 379.41 | 398.84 | 198.65 | 0.00 |
| 83 | 2 | -10.70 | 26.61 | 303.22 | 374.72 | 205.29 | 0.00 |
| 85 | 2 | -10.70 | 27.10 | 307.13 | 387.13 | 211.92 | 0.00 |
| 87 | 2 | -10.70 | 27.19 | 309.20 | 397.96 | 218.55 | 0.00 |
| 88 | 2 | -10.70 | 27.41 | 317.13 | 409.69 | 225.19 | 0.00 |
| 90 | 2 | -10.70 | 25.30 | 288.10 | 408.69 | 231.82 | 0.00 |
| 91 | 2 | -10.70 | 18.86 | 281.18 | 271.64 | 229.47 | 0.00 |
| 92 | 2 | -10.70 | 21.75 | 320.36 | 294.88 | 236.31 | 0.00 |
| 94 | 2 | -10.70 | 22.31 | 329.37 | 305.49 | 243.05 | 0.00 |
| 96 | 2 | -10.70 | 22.39 | 330.16 | 312.73 | 249.90 | 0.00 |
| 97 | 2 | -10.70 | 22.61 | 334.78 | 321.48 | 256.85 | 0.00 |
| 99 | 2 | -10.70 | 22.69 | 338.59 | 329.93 | 263.70 | 0.00 |

\*\*\*\*\*  
\* OUTPUT STAGE 2 OF 2: ANALYSIS RESULTS \*  
\*\*\*\*\*

\*\*\*\*\*  
\* RESULTS FOR LOAD CASE 1 \*  
\*\*\*\*\*

\*\*\*\*\*  
\* CONVERGENCE REPORT \*  
\*\*\*\*\*

The solution converged in 20 iterations

### Summary of Maximum Out-Of-Balance Forces (Absolute Values)

FZ = 0.000 kips  
FX = 0.000 kips  
FY = 0.000 kips  
MXX = 0.001 kip-ft  
MYX = 0.000 kip-ft  
MZZ = 0.000 kip-ft

### Summary of Displacements at Pile Heads

| NODE | X<br>in    | Y<br>in    | Z<br>in    |
|------|------------|------------|------------|
| 1    | -.6484E-01 | 0.2812E+00 | 0.5054E+00 |
| 2    | -.6483E-01 | 0.2589E+00 | 0.4908E+00 |
| 3    | -.6483E-01 | 0.2354E+00 | 0.4726E+00 |
| 4    | -.6482E-01 | 0.2194E+00 | 0.4577E+00 |
| 5    | -.6481E-01 | 0.2031E+00 | 0.4403E+00 |
| 6    | -.6481E-01 | 0.1872E+00 | 0.4213E+00 |
| 7    | -.6480E-01 | 0.1712E+00 | 0.4004E+00 |
| 8    | -.6480E-01 | 0.1560E+00 | 0.3796E+00 |
| 9    | -.6480E-01 | 0.1404E+00 | 0.3576E+00 |

## FB-Multiplier Output – Abutment 2 (North) – Service-I

|    |            |            |            |
|----|------------|------------|------------|
| 10 | -.7197E-01 | 0.2812E+00 | 0.4257E+00 |
| 11 | -.7198E-01 | 0.2556E+00 | 0.4088E+00 |
| 12 | -.7198E-01 | 0.2354E+00 | 0.3929E+00 |
| 13 | -.7199E-01 | 0.2194E+00 | 0.3781E+00 |
| 14 | -.7200E-01 | 0.2031E+00 | 0.3607E+00 |
| 15 | -.7200E-01 | 0.1872E+00 | 0.3417E+00 |
| 16 | -.7200E-01 | 0.1712E+00 | 0.3209E+00 |
| 17 | -.7201E-01 | 0.1525E+00 | 0.2952E+00 |
| 18 | -.7201E-01 | 0.1404E+00 | 0.2781E+00 |

---

Sum of Total Soil Spring Forces for Piles

|                   |   |           |      |
|-------------------|---|-----------|------|
| Xp Direction      | = | -98.5443  | kips |
| Yp Direction      | = | 291.0875  | kips |
| Zp Direction      | = | 4506.3011 | kips |
| Sum of Tip Forces | = | 544.7386  | kips |

---

Summary of Pile Forces for Load CASE 1

### 1. Axial Force (kips)

| Pile # | Maximum Force | Minimum Force |
|--------|---------------|---------------|
| 1      | -0.84930E+02  | -0.35784E+03  |
| 2      | -0.82940E+02  | -0.34832E+03  |
| 3      | 0.49197E-01   | -0.24304E+03  |
| 4      | 0.51652E-01   | -0.23639E+03  |
| 5      | 0.54512E-01   | -0.22855E+03  |
| 6      | 0.57715E-01   | -0.21967E+03  |
| 7      | 0.61202E-01   | -0.20984E+03  |
| 8      | -0.66498E+02  | -0.27603E+03  |
| 9      | -0.63079E+02  | -0.26137E+03  |
| 10     | -0.73509E+02  | -0.30638E+03  |
| 11     | -0.70967E+02  | -0.29532E+03  |
| 12     | 0.62457E-01   | -0.20626E+03  |
| 13     | 0.64897E-01   | -0.19922E+03  |
| 14     | 0.67714E-01   | -0.19097E+03  |
| 15     | 0.70747E-01   | -0.18192E+03  |
| 16     | 0.74012E-01   | -0.17193E+03  |
| 17     | -0.53098E+02  | -0.21886E+03  |
| 18     | -0.50308E+02  | -0.20699E+03  |

### 2. Pile Shear Force in 2 Direction (kips)

| Pile # | Maximum Shear | Minimum Shear |
|--------|---------------|---------------|
| 1      | 0.12956E+01   | -0.39321E+01  |
| 2      | 0.13980E+01   | -0.40921E+01  |
| 3      | 0.81365E+00   | -0.24787E+01  |
| 4      | 0.77843E+00   | -0.25370E+01  |
| 5      | 0.77266E+00   | -0.26078E+01  |
| 6      | 0.86542E+00   | -0.26928E+01  |
| 7      | 0.97249E+00   | -0.27957E+01  |
| 8      | 0.16456E+01   | -0.51159E+01  |
| 9      | 0.16287E+01   | -0.54140E+01  |
| 10     | 0.14180E+01   | -0.44046E+01  |
| 11     | 0.15506E+01   | -0.46100E+01  |
| 12     | 0.95124E+00   | -0.28062E+01  |
| 13     | 0.91879E+00   | -0.28726E+01  |
| 14     | 0.87696E+00   | -0.29491E+01  |
| 15     | 0.90307E+00   | -0.30410E+01  |
| 16     | 0.10208E+01   | -0.31516E+01  |

|    |             |              |
|----|-------------|--------------|
| 17 | 0.18431E+01 | -0.58002E+01 |
| 18 | 0.18349E+01 | -0.60545E+01 |

### 3. Pile Shear Force in 3 Direction (kips)

| Pile # | Maximum Shear | Minimum Shear |
|--------|---------------|---------------|
| 1      | 0.83607E+01   | -0.22055E+02  |
| 2      | 0.74102E+01   | -0.20719E+02  |
| 3      | 0.24731E+01   | -0.72052E+01  |
| 4      | 0.25346E+01   | -0.68058E+01  |
| 5      | 0.25826E+01   | -0.63840E+01  |
| 6      | 0.26117E+01   | -0.59525E+01  |
| 7      | 0.26216E+01   | -0.54889E+01  |
| 8      | 0.67497E+01   | -0.13536E+02  |
| 9      | 0.65349E+01   | -0.12170E+02  |
| 10     | 0.83759E+01   | -0.22085E+02  |
| 11     | 0.72902E+01   | -0.20530E+02  |
| 12     | 0.24107E+01   | -0.72856E+01  |
| 13     | 0.24064E+01   | -0.68764E+01  |
| 14     | 0.24621E+01   | -0.64400E+01  |
| 15     | 0.25006E+01   | -0.59890E+01  |
| 16     | 0.25173E+01   | -0.55053E+01  |
| 17     | 0.66412E+01   | -0.13156E+02  |
| 18     | 0.64696E+01   | -0.12062E+02  |

### 4. Bending Moment About 2 Axis (kip-ft and ft)

| Pile | Node | Depth Below Cap | Maximum Moment | Node | Depth Below Cap | Minimum Moment |
|------|------|-----------------|----------------|------|-----------------|----------------|
| 1    | 1    | 0.00000E+00     | 0.9919E+02     | 498  | 0.1420E+02      | -0.51702E+02   |
| 2    | 2    | 0.00000E+00     | 0.9001E+02     | 537  | 0.1420E+02      | -0.48484E+02   |
| 3    | 3    | 0.00000E+00     | 0.2855E+02     | 575  | 0.1170E+02      | -0.16613E+02   |
| 4    | 4    | 0.00000E+00     | 0.2627E+02     | 614  | 0.1170E+02      | -0.15908E+02   |
| 5    | 5    | 0.00000E+00     | 0.2391E+02     | 653  | 0.1170E+02      | -0.15151E+02   |
| 6    | 6    | 0.00000E+00     | 0.2154E+02     | 692  | 0.1170E+02      | -0.14367E+02   |
| 7    | 7    | 0.00000E+00     | 0.1906E+02     | 731  | 0.1170E+02      | -0.13514E+02   |
| 8    | 8    | 0.00000E+00     | 0.4397E+02     | 770  | 0.1065E+02      | -0.33585E+02   |
| 9    | 9    | 0.00000E+00     | 0.3606E+02     | 809  | 0.1065E+02      | -0.32471E+02   |
| 10   | 10   | 0.00000E+00     | 0.9895E+02     | 849  | 0.1420E+02      | -0.51585E+02   |
| 11   | 11   | 0.00000E+00     | 0.8838E+02     | 888  | 0.1420E+02      | -0.47883E+02   |
| 12   | 12   | 0.00000E+00     | 0.2863E+02     | 926  | 0.1170E+02      | -0.16652E+02   |
| 13   | 13   | 0.00000E+00     | 0.2633E+02     | 965  | 0.1170E+02      | -0.15936E+02   |
| 14   | 14   | 0.00000E+00     | 0.2392E+02     | 1004 | 0.1170E+02      | -0.15159E+02   |
| 15   | 15   | 0.00000E+00     | 0.2148E+02     | 1043 | 0.1170E+02      | -0.14337E+02   |
| 16   | 16   | 0.00000E+00     | 0.1894E+02     | 1082 | 0.1170E+02      | -0.13438E+02   |
| 17   | 17   | 0.00000E+00     | 0.4175E+02     | 1121 | 0.1065E+02      | -0.33072E+02   |
| 18   | 18   | 0.00000E+00     | 0.3550E+02     | 1160 | 0.1065E+02      | -0.32160E+02   |

### 5. Bending Moment About 3 Axis (kip-ft and ft)

| Pile | Node | Depth Below Cap | Maximum Moment | Node | Depth Below Cap | Minimum Moment |
|------|------|-----------------|----------------|------|-----------------|----------------|
| 1    | 498  | 0.14200E+02     | 0.5761E+01     | 1    | 0.0000E+00      | -0.17348E+02   |
| 2    | 536  | 0.10650E+02     | 0.5897E+01     | 2    | 0.0000E+00      | -0.17740E+02   |
| 3    | 575  | 0.11700E+02     | 0.4845E+01     | 3    | 0.0000E+00      | -0.10994E+02   |
| 4    | 614  | 0.11700E+02     | 0.5006E+01     | 4    | 0.0000E+00      | -0.11069E+02   |
| 5    | 653  | 0.11700E+02     | 0.5198E+01     | 5    | 0.0000E+00      | -0.11179E+02   |
| 6    | 692  | 0.11700E+02     | 0.5407E+01     | 6    | 0.0000E+00      | -0.11350E+02   |
| 7    | 731  | 0.11700E+02     | 0.5640E+01     | 7    | 0.0000E+00      | -0.11586E+02   |
| 8    | 770  | 0.10650E+02     | 0.7992E+01     | 8    | 0.0000E+00      | -0.19841E+02   |
| 9    | 809  | 0.10650E+02     | 0.8479E+01     | 9    | 0.0000E+00      | -0.20655E+02   |
| 10   | 849  | 0.14200E+02     | 0.6406E+01     | 10   | 0.0000E+00      | -0.19388E+02   |
| 11   | 887  | 0.10650E+02     | 0.6559E+01     | 11   | 0.0000E+00      | -0.19892E+02   |
| 12   | 926  | 0.11700E+02     | 0.5389E+01     | 12   | 0.0000E+00      | -0.12458E+02   |
| 13   | 965  | 0.11700E+02     | 0.5571E+01     | 13   | 0.0000E+00      | -0.12552E+02   |

## FB-Multiplier Output – Abutment 2 (North) – Service-I

|    |      |             |            |    |            |              |
|----|------|-------------|------------|----|------------|--------------|
| 14 | 1004 | 0.11700E+02 | 0.5774E+01 | 14 | 0.0000E+00 | -0.12666E+02 |
| 15 | 1043 | 0.11700E+02 | 0.5997E+01 | 15 | 0.0000E+00 | -0.12844E+02 |
| 16 | 1082 | 0.11700E+02 | 0.6244E+01 | 16 | 0.0000E+00 | -0.13095E+02 |
| 17 | 1121 | 0.10650E+02 | 0.8922E+01 | 17 | 0.0000E+00 | -0.22493E+02 |
| 18 | 1160 | 0.10650E+02 | 0.9339E+01 | 18 | 0.0000E+00 | -0.23195E+02 |

\*\*\*\*\*  
 \* RESULTS FOR LOAD CASE 2 \*  
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\*\*\*\*\*  
 \* CONVERGENCE REPORT \*  
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The solution converged in 15 iterations

### Summary of Maximum Out-Of-Balance Forces (Absolute Values)

FZ = 0.000 kips  
 FX = 0.002 kips  
 FY = 0.001 kips  
 MXX = 0.005 kip-ft  
 MYY = 0.000 kip-ft  
 MZZ = 0.000 kip-ft

### Summary of Displacements at Pile Heads

| NODE | X          | Y          | Z          |
|------|------------|------------|------------|
|      | in         | in         | in         |
| 1    | -.8886E-01 | 0.2508E+00 | 0.4808E+00 |
| 2    | -.8886E-01 | 0.2400E+00 | 0.4808E+00 |
| 3    | -.8886E-01 | 0.2285E+00 | 0.4780E+00 |
| 4    | -.8885E-01 | 0.2207E+00 | 0.4736E+00 |
| 5    | -.8884E-01 | 0.2128E+00 | 0.4669E+00 |
| 6    | -.8884E-01 | 0.2050E+00 | 0.4580E+00 |
| 7    | -.8883E-01 | 0.1971E+00 | 0.4471E+00 |
| 8    | -.8883E-01 | 0.1896E+00 | 0.4354E+00 |
| 9    | -.8883E-01 | 0.1820E+00 | 0.4227E+00 |
| 10   | -.9233E-01 | 0.2508E+00 | 0.4014E+00 |
| 11   | -.9234E-01 | 0.2384E+00 | 0.4012E+00 |
| 12   | -.9234E-01 | 0.2285E+00 | 0.3986E+00 |
| 13   | -.9235E-01 | 0.2207E+00 | 0.3942E+00 |
| 14   | -.9236E-01 | 0.2128E+00 | 0.3875E+00 |
| 15   | -.9236E-01 | 0.2050E+00 | 0.3786E+00 |
| 16   | -.9237E-01 | 0.1971E+00 | 0.3677E+00 |
| 17   | -.9237E-01 | 0.1879E+00 | 0.3533E+00 |
| 18   | -.9237E-01 | 0.1820E+00 | 0.3433E+00 |

### Sum of Total Soil Spring Forces for Piles

|                   |   |           |      |
|-------------------|---|-----------|------|
| Xp Direction      | = | -128.3421 | kips |
| Yp Direction      | = | 296.5547  | kips |
| Zp Direction      | = | 4750.1865 | kips |
| Sum of Tip Forces | = | 573.1170  | kips |

### Summary of Pile Forces for Load CASE 2

#### 1. Axial Force (kips)

| Pile # | Maximum Force | Minimum Force |
|--------|---------------|---------------|
| 1      | -0.81528E+02  | -0.34194E+03  |
| 2      | -0.81521E+02  | -0.34191E+03  |
| 3      | 0.48304E-01   | -0.24544E+03  |
| 4      | 0.49026E-01   | -0.24349E+03  |
| 5      | 0.50143E-01   | -0.24048E+03  |
| 6      | 0.51604E-01   | -0.23651E+03  |
| 7      | 0.53396E-01   | -0.23162E+03  |
| 8      | -0.74946E+02  | -0.31268E+03  |
| 9      | -0.73058E+02  | -0.30442E+03  |
| 10     | -0.69848E+02  | -0.29046E+03  |
| 11     | -0.69813E+02  | -0.29031E+03  |
| 12     | 0.61525E-01   | -0.20892E+03  |
| 13     | 0.62243E-01   | -0.20687E+03  |
| 14     | 0.63545E-01   | -0.20372E+03  |
| 15     | 0.64807E-01   | -0.19949E+03  |
| 16     | 0.66580E-01   | -0.19431E+03  |
| 17     | -0.62391E+02  | -0.25843E+03  |
| 18     | -0.60826E+02  | -0.25175E+03  |

#### 2. Pile Shear Force in 2 Direction (kips)

| Pile # | Maximum Shear | Minimum Shear |
|--------|---------------|---------------|
| 1      | 0.19786E+01   | -0.59780E+01  |
| 2      | 0.20472E+01   | -0.60881E+01  |
| 3      | 0.11980E+01   | -0.35919E+01  |
| 4      | 0.11722E+01   | -0.36162E+01  |
| 5      | 0.11445E+01   | -0.36426E+01  |
| 6      | 0.11182E+01   | -0.36749E+01  |
| 7      | 0.10937E+01   | -0.37170E+01  |
| 8      | 0.22732E+01   | -0.65699E+01  |
| 9      | 0.22987E+01   | -0.66998E+01  |
| 10     | 0.20302E+01   | -0.62346E+01  |
| 11     | 0.21131E+01   | -0.63642E+01  |
| 12     | 0.12952E+01   | -0.37786E+01  |
| 13     | 0.12716E+01   | -0.38048E+01  |
| 14     | 0.12460E+01   | -0.38336E+01  |
| 15     | 0.12204E+01   | -0.38681E+01  |
| 16     | 0.11949E+01   | -0.39118E+01  |
| 17     | 0.23570E+01   | -0.68858E+01  |
| 18     | 0.23793E+01   | -0.69922E+01  |

#### 3. Pile Shear Force in 3 Direction (kips)

| Pile # | Maximum Shear | Minimum Shear |
|--------|---------------|---------------|
| 1      | 0.71079E+01   | -0.19954E+02  |
| 2      | 0.65893E+01   | -0.19239E+02  |
| 3      | 0.23624E+01   | -0.68705E+01  |
| 4      | 0.23886E+01   | -0.66650E+01  |
| 5      | 0.24098E+01   | -0.64542E+01  |
| 6      | 0.24242E+01   | -0.62457E+01  |
| 7      | 0.24321E+01   | -0.60310E+01  |
| 8      | 0.65668E+01   | -0.15730E+02  |
| 9      | 0.66069E+01   | -0.15151E+02  |
| 10     | 0.71365E+01   | -0.19991E+02  |
| 11     | 0.65445E+01   | -0.19163E+02  |
| 12     | 0.23182E+01   | -0.69604E+01  |
| 13     | 0.22766E+01   | -0.67519E+01  |
| 14     | 0.23007E+01   | -0.65367E+01  |
| 15     | 0.23191E+01   | -0.63225E+01  |
| 16     | 0.23320E+01   | -0.61004E+01  |

## FB-Multiplier Output – Abutment 2 (North) – Service-I

17 0.64979E+01 -0.15600E+02  
18 0.65302E+01 -0.15142E+02

### 4. Bending Moment About 2 Axis (kip-ft and ft)

| Pile | Node | Depth Below Cap | Maximum Moment | Node | Depth Below Cap | Minimum Moment |
|------|------|-----------------|----------------|------|-----------------|----------------|
| 1    | 1    | 0.00000E+00     | 0.8588E+02     | 498  | 0.1420E+02      | -0.47065E+02   |
| 2    | 2    | 0.00000E+00     | 0.8119E+02     | 537  | 0.1420E+02      | -0.45390E+02   |
| 3    | 3    | 0.00000E+00     | 0.2713E+02     | 575  | 0.1170E+02      | -0.15957E+02   |
| 4    | 4    | 0.00000E+00     | 0.2599E+02     | 614  | 0.1170E+02      | -0.15595E+02   |
| 5    | 5    | 0.00000E+00     | 0.2483E+02     | 653  | 0.1170E+02      | -0.15219E+02   |
| 6    | 6    | 0.00000E+00     | 0.2368E+02     | 692  | 0.1170E+02      | -0.14842E+02   |
| 7    | 7    | 0.00000E+00     | 0.2250E+02     | 731  | 0.1170E+02      | -0.14452E+02   |
| 8    | 8    | 0.00000E+00     | 0.5869E+02     | 771  | 0.1420E+02      | -0.37190E+02   |
| 9    | 9    | 0.00000E+00     | 0.5512E+02     | 810  | 0.1420E+02      | -0.35892E+02   |
| 10   | 10   | 0.00000E+00     | 0.8570E+02     | 849  | 0.1420E+02      | -0.46979E+02   |
| 11   | 11   | 0.00000E+00     | 0.8031E+02     | 888  | 0.1420E+02      | -0.45055E+02   |
| 12   | 12   | 0.00000E+00     | 0.2724E+02     | 926  | 0.1170E+02      | -0.16025E+02   |
| 13   | 13   | 0.00000E+00     | 0.2610E+02     | 965  | 0.1170E+02      | -0.15662E+02   |
| 14   | 14   | 0.00000E+00     | 0.2492E+02     | 1004 | 0.1170E+02      | -0.15284E+02   |
| 15   | 15   | 0.00000E+00     | 0.2375E+02     | 1043 | 0.1170E+02      | -0.14902E+02   |
| 16   | 16   | 0.00000E+00     | 0.2254E+02     | 1082 | 0.1170E+02      | -0.14500E+02   |
| 17   | 17   | 0.00000E+00     | 0.5763E+02     | 1122 | 0.1420E+02      | -0.36823E+02   |
| 18   | 18   | 0.00000E+00     | 0.5483E+02     | 1161 | 0.1420E+02      | -0.35811E+02   |

### 5. Bending Moment About 3 Axis (kip-ft and ft)

| Pile | Node | Depth Below Cap | Maximum Moment | Node | Depth Below Cap | Minimum Moment |
|------|------|-----------------|----------------|------|-----------------|----------------|
| 1    | 498  | 0.14200E+02     | 0.8341E+01     | 1    | 0.0000E+00      | -0.26613E+02   |
| 2    | 537  | 0.14200E+02     | 0.8377E+01     | 2    | 0.0000E+00      | -0.26873E+02   |
| 3    | 575  | 0.11700E+02     | 0.6692E+01     | 3    | 0.0000E+00      | -0.16395E+02   |
| 4    | 614  | 0.11700E+02     | 0.6790E+01     | 4    | 0.0000E+00      | -0.16366E+02   |
| 5    | 653  | 0.11700E+02     | 0.6895E+01     | 5    | 0.0000E+00      | -0.16334E+02   |
| 6    | 692  | 0.11700E+02     | 0.7007E+01     | 6    | 0.0000E+00      | -0.16329E+02   |
| 7    | 731  | 0.11700E+02     | 0.7127E+01     | 7    | 0.0000E+00      | -0.16374E+02   |
| 8    | 770  | 0.10650E+02     | 0.9629E+01     | 8    | 0.0000E+00      | -0.27384E+02   |
| 9    | 809  | 0.10650E+02     | 0.9855E+01     | 9    | 0.0000E+00      | -0.27734E+02   |
| 10   | 849  | 0.14200E+02     | 0.8654E+01     | 10   | 0.0000E+00      | -0.27633E+02   |
| 11   | 888  | 0.14200E+02     | 0.8697E+01     | 11   | 0.0000E+00      | -0.27930E+02   |
| 12   | 926  | 0.11700E+02     | 0.6968E+01     | 12   | 0.0000E+00      | -0.17196E+02   |
| 13   | 965  | 0.11700E+02     | 0.7071E+01     | 13   | 0.0000E+00      | -0.17171E+02   |
| 14   | 1004 | 0.11700E+02     | 0.7179E+01     | 14   | 0.0000E+00      | -0.17148E+02   |
| 15   | 1043 | 0.11700E+02     | 0.7291E+01     | 15   | 0.0000E+00      | -0.17152E+02   |
| 16   | 1082 | 0.11700E+02     | 0.7413E+01     | 16   | 0.0000E+00      | -0.17197E+02   |
| 17   | 1122 | 0.10650E+02     | 0.1000E+02     | 17   | 0.0000E+00      | -0.28564E+02   |
| 18   | 1160 | 0.10650E+02     | 0.1019E+02     | 18   | 0.0000E+00      | -0.28856E+02   |

\*\*\*\*\*  
\* SUBSTRUCTURE 1 MAX/MIN RESPONSES FOR ALL LOAD CASES \*  
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### Pile demands

| Demand type                    | Value       | Unit   | Load case | Load comb. | Pile |
|--------------------------------|-------------|--------|-----------|------------|------|
| Max axial force (tension is +) | 0.7401E-01  | kips   | 1         | 0          | 16   |
| Min axial force                | -0.3578E+03 | kips   | 1         | 0          | 1    |
| Max shear in 2 direction       | 0.2379E+01  | kips   | 2         | 0          | 18   |
| Min shear in 2 direction       | -0.6992E+01 | kips   | 2         | 0          | 18   |
| Max shear in 3 direction       | 0.8376E+01  | kips   | 1         | 0          | 10   |
| Min shear in 3 direction       | -0.2209E+02 | kips   | 1         | 0          | 10   |
| Max moment about 2 axis        | 0.9919E+02  | kip-ft | 1         | 0          | 1    |
| Min moment about 2 axis        | -0.5170E+02 | kip-ft | 1         | 0          | 1    |
| Max moment about 3 axis        | 0.1019E+02  | kip-ft | 2         | 0          | 18   |

Min moment about 3 axis -0.2886E+02 kip-ft 2 0 18  
Max torsional force 0.4292E-01 kip-ft 1 0 7  
Min torsional force 0.2517E-70 kip-ft 2 0 10  
Max demand/capacity ratio 0.5315E+00 1 0 1

### Soil demands

| Demand type              | Value       | Unit   | Load case | Load comb. | Pile |
|--------------------------|-------------|--------|-----------|------------|------|
| Max Zp soil force        | 0.1385E+03  | kips   | 2         | 0          | 3    |
| Min Zp soil force        | 0.5040E-03  | kips   | 2         | 0          | 16   |
| Max Xp soil force        | 0.2270E+01  | kips   | 2         | 0          | 18   |
| Min Xp soil force        | -0.3888E+01 | kips   | 2         | 0          | 18   |
| Max Yp soil force        | 0.1033E+02  | kips   | 1         | 0          | 1    |
| Min Yp soil force        | -0.6060E+01 | kips   | 1         | 0          | 1    |
| Max torsional soil force | -0.2517E-70 | kip-ft | 2         | 0          | 10   |

### Pile head displacements

| Displacement type  | Value       | Unit | Load case | Load comb. | Pile |
|--------------------|-------------|------|-----------|------------|------|
| Max Z displacement | 0.5054E+00  | in   | 1         | 0          | 1    |
| Min Z displacement | 0.2781E+00  | in   | 1         | 0          | 18   |
| Max X displacement | -0.6480E-01 | in   | 1         | 0          | 9    |
| Min X displacement | -0.9237E-01 | in   | 2         | 0          | 18   |
| Max Y displacement | 0.2812E+00  | in   | 1         | 0          | 1    |
| Min Y displacement | 0.1404E+00  | in   | 1         | 0          | 9    |

## FB-Multiplier Output – Abutment 2 (North) – Strength-I

```

*****
*
*   The University of Florida, Florida Department of
*   Transportation, Marc Hoyt, Mike McVay, Cliff Hays,
*   Mark Williams, Petros Christou, Jae Chung,
*   Gary Consolazio, and Michael Davidson
*   disclaim any warranty, expressed or implied,
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*   warranty of fitness for a particular purpose
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*   developers shall not be liable for any damages
*   incurred through the use of FB-Multiplier.
*
*
*   :::: F B - M U L T I P L I E R ::::
*   v5.6.0
*
*   Written by Marc Hoyt, Mike McVay, Cliff Hays,
*   Mark Williams, Petros Christou, Jae Chung,
*   Gary Consolazio, and Michael Davidson.
*
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*   possible under the law.
*
*   © 2019 Bridge Software Institute
*   All rights reserved.
*
*   FB-Multiplier calculates the response of
*   bridge-pier-pile-soil structures.
*
*   FB-Multiplier analysis types include preload,
*   static, pushover, modal, and transient dynamic.
*
*   FB-Multiplier accounts for linear and nonlinear
*   pile and pier structural members, linear pile caps
*   and superstructure, and nonlinear soil behavior.
*
*   Contact the Bridge Software Institute for support
*   https://bsi.ce.ufl.edu
*
*****

```

Analysis Start = 10:38pm  
 Analysis End = 10:38pm  
 Analysis Duration = 11 second(s)

Input Data File Name = Abutment 2 - STR I.in  
 Analysis Date = 4- 2-2020  
 License ID Number = 432000000

```

*****
*   OUTPUT STAGE 1 OF 2: INTERPRETATION OF INPUT FILE
*   *****

```

```

*****
*   PROJECT DATA
*   *****

```

Project client = MaineDOT  
 Project name = Veranda Street Bridge Replacement  
 Project manager = T. Cote  
 Computed by = A. Piccolino  
 Project description = 75297 - Abutment 2 (North) - Strength I

```

*****
*   SELECTIVE PRINT OUTPUT CONTROL
*   *****

```

| Print Flag                                 | State |
|--|-------|
| Pile displacements                         | Off   |
| Pile element forces                        | Off   |
| Pile ID numbers                            | Off   |
| Pile cap stresses                          | Off   |
| Substructure coordinates                   | Off   |
| Substructure interaction diagrams          | Off   |
| Substructure material stress-strain curves | Off   |
| Substructure member section properties     | Off   |
| Pier columns and pier cap displacements    | Off   |
| Pier columns and pier cap forces           | On    |
| Soil response forces                       | Off   |
| Soil data per layer                        | On    |
| Soil curve data per pile node              | Off   |
| Soil resistance curves                     | Off   |
| Bridge span properties                     | Off   |
| Bridge span temperature data               | Off   |
| Bridge span displacements                  | Off   |
| Bridge span element forces                 | Off   |
| Discrete spring forces                     | Off   |
| Out of balance forces                      | Off   |
| XML output                                 | Off   |
| Eigenvectors                               | Off   |

```

*****
*   ANALYSIS CONTROL INFORMATION
*   *****

```

Memory specified for solution = 1024 MB

Number of cores = 1

Type of analysis = Static

-----  
 - Linear / Nonlinear analysis settings -  
 -----

Soil stiffness = Nonlinear  
 Pile stiffness = Nonlinear

-----  
 - Miscellaneous analysis settings -  
 -----

Units = English (kips & ft; lbs & in)

Convergence tolerance = 0.10 kips  
 Maximum number of iterations = 100

Number of substructures = 1

## FB-Multiplier Output – Abutment 2 (North) – Strength-I

\*\*\*\*\*  
 \* SOIL BEHAVIOR \*  
 \*\*\*\*\*

Springs are defined at the following DOF for embedded nodes:  
 X-TRANSLATION Y-TRANSLATION Z-TRANSLATION  
 Z-ROTATION

\*\*\*\*\*  
 \* LOAD FACTORS FOR SELF WEIGHT AND BUOYANCY \*  
 \*\*\*\*\*

| LOAD CASE NO. | SELF WEIGHT FACTOR | BUOYANCY FACTOR |
|---------------|--------------------|-----------------|
| 1             | 1.00               | 1.00            |
| 2             | 1.00               | 1.00            |
| 3             | 1.00               | 1.00            |
| 4             | 1.00               | 1.00            |

\*\*\*\*\*  
 \* PILE CAP DATA \*  
 \*\*\*\*\*

NOTE: Xp-Grid: Distance between axes along Xp axis  
 Yp-Grid: Distance between axes along Yp axis

Number of Grid Points in Xp direction (NPX) = 23  
 Number of Grid Points in Yp direction (NPY) = 6

Grid Spacing in the Xp direction (in):

|       |        |       |        |       |        |       |
|-------|--------|-------|--------|-------|--------|-------|
| 57.08 | 129.47 | 95.28 | 22.54  | 11.09 | 106.88 | 96.55 |
| 21.01 | 117.97 | 21.82 | 96.22  | 67.07 | 117.71 | 41.46 |
| 76.44 | 84.03  | 33.93 | 117.97 | 34.57 | 83.15  | 37.82 |
| 18.00 |        |       |        |       |        |       |

Grid Spacing in the Yp direction (in):

|       |       |       |       |       |
|-------|-------|-------|-------|-------|
| 18.00 | 36.00 | 12.00 | 24.00 | 18.00 |
|-------|-------|-------|-------|-------|

\*\*\*\*\*  
 \* PILE TO PILE CAP CONNECTION \*  
 \*\*\*\*\*

Pile head fixity = FIXED

\*\*\*\*\*  
 \* INPUT SOIL LAYER DATA \*  
 \*\*\*\*\*

P-Y SOIL LAYER DATA

-----  
 - SOIL SET # 1 -  
 -----

| SET | LAYER | MODEL | PHI<br>deg | RK<br>lbs/in^3 | GAMMA<br>pcf |
|-----|-------|-------|------------|----------------|--------------|
| 1   | 1     | 2     | 0.3200E+02 | 0.9000E+02     | 0.1100E+03   |
|     |       |       | 0.3200E+02 | 0.9000E+02     | 0.1100E+03   |

| SET | LAYER | MODEL | GAMMA<br>pcf | CU<br>psf  | E50        |
|-----|-------|-------|--------------|------------|------------|
| 1   | 2     | 4     | 0.1050E+03   | 0.3500E+03 | 0.1000E-01 |

0.1050E+03 0.3500E+03 0.1000E-01

| SET | LAYER | MODEL | GAMMA<br>pcf | CU<br>psf  | E50        | Cavg<br>psf |
|-----|-------|-------|--------------|------------|------------|-------------|
| 1   | 3     | 6     | 0.1150E+03   | 0.5000E+03 | 0.5000E-02 | 0.5000E+03  |
|     |       |       | 0.1150E+03   | 0.1500E+04 | 0.5000E-02 | 0.1500E+04  |

| SET | LAYER | MODEL | PHI<br>deg | RK<br>lbs/in^3 | GAMMA<br>pcf |
|-----|-------|-------|------------|----------------|--------------|
| 1   | 4     | 2     | 0.3000E+02 | 0.3000E+02     | 0.1050E+03   |
|     |       |       | 0.3400E+02 | 0.6000E+02     | 0.1150E+03   |

| SET | LAYER | MODEL | PHI<br>deg | RK<br>lbs/in^3 | GAMMA<br>pcf |
|-----|-------|-------|------------|----------------|--------------|
| 1   | 5     | 2     | 0.3600E+02 | 0.7000E+02     | 0.1200E+03   |
|     |       |       | 0.3600E+02 | 0.7000E+02     | 0.1200E+03   |

| SET | LAYER | MODEL | Qu<br>psf  |
|-----|-------|-------|------------|
| 1   | 6     | 8     | 0.5040E+06 |

-----  
 - SOIL SET # 2 -  
 -----

| SET | LAYER | MODEL | PHI<br>deg | RK<br>lbs/in^3 | GAMMA<br>pcf |
|-----|-------|-------|------------|----------------|--------------|
| 2   | 1     | 2     | 0.3200E+02 | 0.9000E+02     | 0.1100E+03   |
|     |       |       | 0.3200E+02 | 0.9000E+02     | 0.1100E+03   |

| SET | LAYER | MODEL | GAMMA<br>pcf | CU<br>psf  | E50        | Cavg<br>psf |
|-----|-------|-------|--------------|------------|------------|-------------|
| 2   | 2     | 6     | 0.1150E+03   | 0.5000E+03 | 0.1000E-01 | 0.5000E+03  |
|     |       |       | 0.1150E+03   | 0.5000E+03 | 0.1000E-01 | 0.5000E+03  |

| SET | LAYER | MODEL | GAMMA<br>pcf | CU<br>psf  | E50        | Cavg<br>psf |
|-----|-------|-------|--------------|------------|------------|-------------|
| 2   | 3     | 6     | 0.1150E+03   | 0.5000E+03 | 0.5000E-02 | 0.5000E+03  |
|     |       |       | 0.1150E+03   | 0.1500E+04 | 0.5000E-02 | 0.1500E+04  |

| SET | LAYER | MODEL | PHI<br>deg | RK<br>lbs/in^3 | GAMMA<br>pcf |
|-----|-------|-------|------------|----------------|--------------|
| 2   | 4     | 2     | 0.3000E+02 | 0.3000E+02     | 0.1050E+03   |
|     |       |       | 0.3400E+02 | 0.6000E+02     | 0.1150E+03   |

| SET | LAYER | MODEL | PHI<br>deg | RK<br>lbs/in^3 | GAMMA<br>pcf |
|-----|-------|-------|------------|----------------|--------------|
| 2   | 5     | 2     | 0.3600E+02 | 0.7000E+02     | 0.1200E+03   |
|     |       |       | 0.3600E+02 | 0.7000E+02     | 0.1200E+03   |

| SET | LAYER | MODEL | Qu<br>psf  |
|-----|-------|-------|------------|
| 2   | 6     | 8     | 0.5040E+06 |

T-Z SOIL LAYER DATA

-----  
 - SOIL SET # 1 -  
 -----

| SET | LAYER | MODEL | G<br>ksi   | POISSON    | TAU MAX<br>psf | ELEVATION<br>ft | ELEV. PIEZ.<br>ft |
|-----|-------|-------|------------|------------|----------------|-----------------|-------------------|
| 1   | 1     | 1     | 0.9700E+00 | 0.3000E+00 | 0.1000E+00     | 0.1300E+02      | 0.5000E+01        |
|     |       |       | 0.9700E+00 | 0.3000E+00 | 0.1000E+00     | 0.7200E+01      | 0.5000E+01        |

# FB-Multiplier Output – Abutment 2 (North) – Strength-I

| SET | LAYER | MODEL | G<br>ksi                 | POISSON                  | TAU MAX<br>psf           | ELEVATION<br>ft            | ELEV. PIEZ.<br>ft        |
|-----|-------|-------|--------------------------|--------------------------|--------------------------|----------------------------|--------------------------|
| 1   | 2     | 1     | 0.6900E+00<br>0.6900E+00 | 0.4000E+00<br>0.4000E+00 | 0.1000E+00<br>0.1000E+00 | 0.7200E+01<br>0.3800E+01   | 0.5000E+01<br>0.5000E+01 |
| SET | LAYER | MODEL | G<br>ksi                 | POISSON                  | TAU MAX<br>psf           | ELEVATION<br>ft            | ELEV. PIEZ.<br>ft        |
| 1   | 3     | 1     | 0.6900E+00<br>0.6900E+00 | 0.4500E+00<br>0.5000E+00 | 0.1000E+00<br>0.1000E+00 | 0.3800E+01<br>-0.5470E+02  | 0.5000E+01<br>0.5000E+01 |
| SET | LAYER | MODEL | G<br>ksi                 | POISSON                  | TAU MAX<br>psf           | ELEVATION<br>ft            | ELEV. PIEZ.<br>ft        |
| 1   | 4     | 1     | 0.6900E+00<br>0.1460E+01 | 0.3000E+00<br>0.4000E+00 | 0.1000E+00<br>0.1000E+00 | -0.5470E+02<br>-0.6630E+02 | 0.5000E+01<br>0.5000E+01 |
| SET | LAYER | MODEL | G<br>ksi                 | POISSON                  | TAU MAX<br>psf           | ELEVATION<br>ft            | ELEV. PIEZ.<br>ft        |
| 1   | 5     | 1     | 0.2010E+01<br>0.2010E+01 | 0.2500E+00<br>0.2500E+00 | 0.8270E+03<br>0.8270E+03 | -0.6630E+02<br>-0.1322E+03 | 0.5000E+01<br>0.5000E+01 |
| SET | LAYER | MODEL | G<br>ksi                 | POISSON                  | TAU MAX<br>psf           | ELEVATION<br>ft            | ELEV. PIEZ.<br>ft        |
| 1   | 6     | 1     | 0.5200E+03<br>0.5200E+03 | 0.2500E+00<br>0.2500E+00 | 0.5040E+06<br>0.5040E+06 | -0.1322E+03<br>-0.1500E+03 | 0.5000E+01<br>0.5000E+01 |

-----  
- SOIL SET # 2 -  
-----

| SET | LAYER | MODEL | G<br>ksi                 | POISSON                  | TAU MAX<br>psf           | ELEVATION<br>ft            | ELEV. PIEZ.<br>ft        |
|-----|-------|-------|--------------------------|--------------------------|--------------------------|----------------------------|--------------------------|
| 2   | 1     | 1     | 0.9700E+00<br>0.9700E+00 | 0.3000E+00<br>0.3000E+00 | 0.1000E+00<br>0.1000E+00 | 0.1300E+02<br>0.7200E+01   | 0.5000E+01<br>0.5000E+01 |
| SET | LAYER | MODEL | G<br>ksi                 | POISSON                  | TAU MAX<br>psf           | ELEVATION<br>ft            | ELEV. PIEZ.<br>ft        |
| 2   | 2     | 1     | 0.6900E+00<br>0.6900E+00 | 0.4500E+00<br>0.4500E+00 | 0.1000E+00<br>0.1000E+00 | 0.7200E+01<br>0.3800E+01   | 0.5000E+01<br>0.5000E+01 |
| SET | LAYER | MODEL | G<br>ksi                 | POISSON                  | TAU MAX<br>psf           | ELEVATION<br>ft            | ELEV. PIEZ.<br>ft        |
| 2   | 3     | 1     | 0.6900E+00<br>0.6900E+00 | 0.4500E+00<br>0.5000E+00 | 0.4000E+03<br>0.1000E+04 | 0.3800E+01<br>-0.5470E+02  | 0.5000E+01<br>0.5000E+01 |
| SET | LAYER | MODEL | G<br>ksi                 | POISSON                  | TAU MAX<br>psf           | ELEVATION<br>ft            | ELEV. PIEZ.<br>ft        |
| 2   | 4     | 1     | 0.6900E+00<br>0.1460E+01 | 0.3000E+00<br>0.4000E+00 | 0.2000E+04<br>0.3500E+04 | -0.5470E+02<br>-0.6630E+02 | 0.5000E+01<br>0.5000E+01 |
| SET | LAYER | MODEL | G<br>ksi                 | POISSON                  | TAU MAX<br>psf           | ELEVATION<br>ft            | ELEV. PIEZ.<br>ft        |
| 2   | 5     | 1     | 0.2010E+01<br>0.2010E+01 | 0.2500E+00<br>0.2500E+00 | 0.4600E+04<br>0.8900E+04 | -0.6630E+02<br>-0.1322E+03 | 0.5000E+01<br>0.5000E+01 |
| SET | LAYER | MODEL | G<br>ksi                 | POISSON                  | TAU MAX<br>psf           | ELEVATION<br>ft            | ELEV. PIEZ.<br>ft        |
| 2   | 6     | 1     | 0.5200E+03<br>0.5200E+03 | 0.2500E+00<br>0.2500E+00 | 0.5040E+06<br>0.5040E+06 | -0.1322E+03<br>-0.1500E+03 | 0.5000E+01<br>0.5000E+01 |

T-THETA SOIL LAYER DATA

-----  
- SOIL SET # 1 -  
-----

| SET | LAYER | MODEL | G<br>ksi                 | TAU MAX<br>psf           |
|-----|-------|-------|--------------------------|--------------------------|
| 1   | 1     | 1     | 0.9700E+00<br>0.9700E+00 | 0.1000E+00<br>0.1000E+00 |
| SET | LAYER | MODEL | G<br>ksi                 | TAU MAX<br>psf           |
| 1   | 2     | 1     | 0.6900E+00<br>0.6900E+00 | 0.1000E+00<br>0.1000E+00 |
| SET | LAYER | MODEL | G<br>ksi                 | TAU MAX<br>psf           |
| 1   | 3     | 1     | 0.6900E+00<br>0.6900E+00 | 0.1000E+00<br>0.1000E+00 |
| SET | LAYER | MODEL | G<br>ksi                 | TAU MAX<br>psf           |
| 1   | 4     | 1     | 0.6900E+00<br>0.1460E+01 | 0.1000E+00<br>0.1000E+00 |
| SET | LAYER | MODEL | G<br>ksi                 | TAU MAX<br>psf           |
| 1   | 5     | 1     | 0.2010E+01<br>0.2010E+01 | 0.8270E+03<br>0.8270E+03 |
| SET | LAYER | MODEL | G<br>ksi                 | TAU MAX<br>psf           |
| 1   | 6     | 1     | 0.5200E+03<br>0.5200E+03 | 0.5040E+06<br>0.5040E+06 |

-----  
- SOIL SET # 2 -  
-----

| SET | LAYER | MODEL | G<br>ksi                 | TAU MAX<br>psf           |
|-----|-------|-------|--------------------------|--------------------------|
| 2   | 1     | 1     | 0.9700E+00<br>0.9700E+00 | 0.1000E+00<br>0.1000E+00 |
| SET | LAYER | MODEL | G<br>ksi                 | TAU MAX<br>psf           |
| 2   | 2     | 1     | 0.6900E+00<br>0.6900E+00 | 0.1000E+00<br>0.1000E+00 |
| SET | LAYER | MODEL | G<br>ksi                 | TAU MAX<br>psf           |
| 2   | 3     | 1     | 0.6900E+00<br>0.6900E+00 | 0.4000E+03<br>0.1000E+04 |
| SET | LAYER | MODEL | G<br>ksi                 | TAU MAX<br>psf           |
| 2   | 4     | 1     | 0.6900E+00<br>0.1460E+01 | 0.2000E+04<br>0.3500E+04 |
| SET | LAYER | MODEL | G<br>ksi                 | TAU MAX<br>psf           |
| 2   | 5     | 1     | 0.2010E+01<br>0.2010E+01 | 0.4600E+04<br>0.8900E+04 |
| SET | LAYER | MODEL | G<br>ksi                 | TAU MAX<br>psf           |
| 2   | 6     | 1     | 0.5200E+03<br>0.5200E+03 | 0.5040E+06<br>0.5040E+06 |

Q-Z SOIL LAYER DATA



## FB-Multiplier Output – Abutment 2 (North) – Strength-I

```

-----
- SOIL SET # 1 -
-----

Driven Pile (McVay)
Shear Modulus           =      520.0000 ksi
Poisson's Ratio         =      0.2000
Nominal Tip Resistance   =     200.0000 kips

-----
- SOIL SET # 2 -
-----

Driven Pile (McVay)
Shear Modulus           =      520.0000 ksi
Poisson's Ratio         =      0.2000
Nominal Tip Resistance   =     200.0000 kips

*****
*                PILE SECTION DATA                *
*****

NOTE: Pile sets consist of pile segments based on user input.
      The program groups all segments from every pile set and
      assigns a unique section number to each segment.

Number of pile sections      =      3

-----
-                INPUT DATA FOR SECTION : 1          -
-----

Pile Set Number           =      1
Pile Set Segment          =      1

Section Length (L)        =     142.00000 ft

-----
Section Nonlinear Properties
-----

- Concrete Stress Strain Properties -
-----

Concrete Strength (FPC)    = 0.5000E+01 ksi
Modulus of Elasticity (EC) = 0.4287E+04 ksi

No. Gauss Integ. points in the concrete = 60

-----
- Steel Stress Strain Properties -
-----

Mild Steel Yield Stress (FY) = 0.7500E+02 ksi
Modulus of Elasticity (ES)  = 0.2900E+05 ksi

Steel Casing Yield Stress (FY) = 0.8000E+02 ksi
Modulus of Elasticity (ES)    = 0.2900E+05 ksi

- Shape of Section : CIRCULAR

- Reinforcement and Confinement Data

Number of Reinforcement Layers = 1
Diameter                      = 9.6250 in
Tied/Spiral Reinforcement Flag = 1

```

```

(Spiral = 1;
Tied = 2)
Confinement Flag           = 0
(Unconfined = 0;
Confined: Tied/Spiral = 1;
Confined: Tied/Spiral w/ Casing = 2;
Confined: Tied/Spiral w/ Confine-Only Casing = 3)
Outer Shell Thickness       = 0.5450E+00 in

- Total Area of Steel Reinforcement = 4.0000 in^2

WARNING : The number of bars is changed to a multiple of 4.
This is to ensure a symmetric section for the
analysis. The area is changed to result in the
same total area of reinforcement.

Layer # Bars/Strands Area Layer Dia. Prestressing
      in^2 in ksi
1      4      1.00    0.00    0.00

-----
-                INPUT DATA FOR SECTION : 2          -
-----

Pile Set Number           =      1
Pile Set Segment          =      2

Section Length (L)        =     14.000000 ft

-----
Section Nonlinear Properties
-----

- Concrete Stress Strain Properties -
-----

Concrete Strength (FPC)    = 0.5000E+01 ksi
Modulus of Elasticity (EC) = 0.4287E+04 ksi

No. Gauss Integ. points in the concrete = 60

-----
- Steel Stress Strain Properties -
-----

Mild Steel Yield Stress (FY) = 0.7500E+02 ksi
Modulus of Elasticity (ES)  = 0.2900E+05 ksi

- Shape of Section : CIRCULAR

- Reinforcement and Confinement Data

Number of Reinforcement Layers = 1
Diameter                      = 9.6250 in
Tied/Spiral Reinforcement Flag = 1
(Spiral = 1;
Tied = 2)
Confinement Flag           = 0
(Unconfined = 0;
Confined: Tied/Spiral = 1;
Confined: Tied/Spiral w/ Casing = 2;
Confined: Tied/Spiral w/ Confine-Only Casing = 3)

- Total Area of Steel Reinforcement = 4.0000 in^2

WARNING : The number of bars is changed to a multiple of 4.
This is to ensure a symmetric section for the

```

## FB-Multiplier Output – Abutment 2 (North) – Strength-I

analysis. The area is changed to result in the same total area of reinforcement.

| Layer | # Bars/Strands | Area in^2 | Layer Dia. in | Prestressing ksi |
|-------|----------------|-----------|---------------|------------------|
| 1     | 4              | 1.00      | 0.00          | 0.00             |

-----  
INPUT DATA FOR SECTION : 3  
-----

Pile Set Number = 2  
Pile Set Segment = 1

Section Length (L) = 142.00000 ft

---

Section Nonlinear Properties

-----  
- Steel Stress Strain Properties -  
-----

H-Pile Yield Stress (FY) = 0.5000E+02 ksi  
Modulus of Elasticity (ES) = 0.2900E+05 ksi

- Shape of Section : USER DEFINED H-PILE  
Units are in in  
Orientation : OR = 2 Web along 2 axis  
OR = 3 Web along 3 axis

| Depth | Width | Web Width | Flange Width | Orientation |
|-------|-------|-----------|--------------|-------------|
| 13.8  | 14.7  | 0.615     | 0.615        | 3           |

\*\*\*\*\*  
\* PILE SET DATA \*  
\*\*\*\*\*

NOTE : Piles are organized into pile sets. Each pile set is composed of pile segments, as specified by the user.

---

List of Pile Sets and Piles

| Pile Set | Piles Assigned to the Pile Set    |
|----------|-----------------------------------|
| 1        | 3, 4, 5, 6, 7, 12, 13, 14, 15, 16 |
| 2        | 1, 2, 8, 9, 10, 11, 17, 18        |

---

Total length for each Pile Set

| Pile Set | Length in |
|----------|-----------|
| 1        | 1872.00   |
| 2        | 1704.00   |

\*\*\*\*\*  
\* EXTERNAL LOADS APPLIED TO SUBSTRUCTURE \*  
\*\*\*\*\*

-----  
SUBSTRUCTURE # 1  
-----

| NODE | CASE | FXp kips | FYp kips | FZp kips | MXp kip-ft | MYp kip-ft | MZp kip-ft |
|------|------|----------|----------|----------|------------|------------|------------|
| 81   | 1    | -18.19   | 48.66    | 556.49   | 614.60     | 331.33     | 0.00       |
| 83   | 1    | -18.19   | 40.58    | 447.42   | 584.93     | 342.61     | 0.00       |
| 85   | 1    | -18.19   | 41.23    | 451.94   | 604.56     | 353.88     | 0.00       |
| 87   | 1    | -18.19   | 41.35    | 453.30   | 622.06     | 365.16     | 0.00       |
| 88   | 1    | -18.19   | 41.65    | 471.92   | 640.77     | 376.44     | 0.00       |
| 90   | 1    | -18.19   | 38.81    | 426.54   | 642.30     | 387.71     | 0.00       |
| 91   | 1    | -1.76    | 14.69    | 286.60   | 133.09     | 39.53      | 0.00       |
| 92   | 1    | -1.76    | 18.58    | 336.78   | 157.56     | 40.66      | 0.00       |
| 94   | 1    | -1.76    | 19.34    | 343.42   | 165.09     | 41.77      | 0.00       |
| 96   | 1    | -1.76    | 19.44    | 348.70   | 167.97     | 42.90      | 0.00       |
| 97   | 1    | -1.76    | 19.74    | 353.40   | 172.77     | 44.04      | 0.00       |
| 99   | 1    | -1.76    | 19.85    | 349.69   | 177.28     | 45.17      | 0.00       |
| 81   | 2    | -18.19   | 41.45    | 438.42   | 574.03     | 331.33     | 0.00       |
| 83   | 2    | -18.19   | 36.06    | 351.51   | 559.84     | 342.61     | 0.00       |
| 85   | 2    | -18.19   | 36.50    | 354.61   | 578.51     | 353.88     | 0.00       |
| 87   | 2    | -18.19   | 36.58    | 354.71   | 595.76     | 365.16     | 0.00       |
| 88   | 2    | -18.19   | 36.78    | 373.32   | 613.82     | 376.44     | 0.00       |
| 90   | 2    | -18.19   | 34.88    | 335.15   | 620.43     | 387.71     | 0.00       |
| 91   | 2    | -1.76    | 10.81    | 198.14   | 111.55     | 39.53      | 0.00       |
| 92   | 2    | -1.76    | 13.40    | 234.28   | 128.52     | 40.66      | 0.00       |
| 94   | 2    | -1.76    | 13.91    | 239.19   | 134.17     | 41.77      | 0.00       |
| 96   | 2    | -1.76    | 13.98    | 243.03   | 136.74     | 42.90      | 0.00       |
| 97   | 2    | -1.76    | 14.18    | 246.29   | 140.61     | 44.04      | 0.00       |
| 99   | 2    | -1.76    | 14.25    | 243.53   | 144.27     | 45.17      | 0.00       |
| 81   | 3    | -14.32   | 43.02    | 517.88   | 512.66     | 261.48     | 0.00       |
| 83   | 3    | -14.32   | 34.94    | 415.94   | 479.50     | 270.36     | 0.00       |
| 85   | 3    | -14.32   | 35.59    | 420.65   | 495.63     | 279.24     | 0.00       |
| 87   | 3    | -14.32   | 35.71    | 422.67   | 509.64     | 288.12     | 0.00       |
| 88   | 3    | -14.32   | 36.01    | 436.81   | 524.85     | 297.00     | 0.00       |
| 90   | 3    | -14.32   | 33.17    | 396.11   | 522.89     | 305.88     | 0.00       |
| 91   | 3    | -14.32   | 21.94    | 388.31   | 285.04     | 302.73     | 0.00       |
| 92   | 3    | -14.32   | 25.83    | 436.79   | 314.16     | 311.90     | 0.00       |
| 94   | 3    | -14.32   | 26.60    | 449.80   | 326.25     | 320.92     | 0.00       |
| 96   | 3    | -14.32   | 26.70    | 449.05   | 333.78     | 330.09     | 0.00       |
| 97   | 3    | -14.32   | 26.99    | 455.35   | 343.30     | 339.40     | 0.00       |
| 99   | 3    | -14.32   | 27.11    | 463.58   | 352.45     | 348.56     | 0.00       |
| 81   | 4    | -14.32   | 35.81    | 399.81   | 472.10     | 261.48     | 0.00       |
| 83   | 4    | -14.32   | 30.42    | 320.04   | 454.41     | 270.36     | 0.00       |
| 85   | 4    | -14.32   | 30.86    | 323.31   | 469.58     | 279.24     | 0.00       |
| 87   | 4    | -14.32   | 30.94    | 324.08   | 483.34     | 288.12     | 0.00       |
| 88   | 4    | -14.32   | 31.14    | 338.21   | 497.90     | 297.00     | 0.00       |
| 90   | 4    | -14.32   | 29.24    | 304.72   | 501.01     | 305.88     | 0.00       |
| 91   | 4    | -14.32   | 18.06    | 299.86   | 263.50     | 302.73     | 0.00       |
| 92   | 4    | -14.32   | 20.66    | 334.29   | 285.11     | 311.90     | 0.00       |
| 94   | 4    | -14.32   | 21.16    | 345.57   | 295.34     | 320.92     | 0.00       |
| 96   | 4    | -14.32   | 21.23    | 343.38   | 302.55     | 330.09     | 0.00       |
| 97   | 4    | -14.32   | 21.43    | 348.23   | 311.13     | 339.40     | 0.00       |
| 99   | 4    | -14.32   | 21.50    | 357.42   | 319.43     | 348.56     | 0.00       |

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\* OUTPUT STAGE 2 OF 2: ANALYSIS RESULTS \*  
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\* RESULTS FOR LOAD CASE 1 \*  
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\* CONVERGENCE REPORT \*  
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The solution converged in 16 iterations

## FB-Multiplier Output – Abutment 2 (North) – Strength-I

### Summary of Maximum Out-Of-Balance Forces (Absolute Values)

FZ = 0.000 kips  
 FX = 0.001 kips  
 FY = 0.000 kips  
 MXX = 0.002 kip-ft  
 MYY = 0.000 kip-ft  
 MZZ = 0.000 kip-ft

### Summary of Displacements at Pile Heads

| NODE | X<br>in    | Y<br>in    | Z<br>in    |
|------|------------|------------|------------|
| 1    | -.9230E-01 | 0.4510E+00 | 0.6750E+00 |
| 2    | -.9230E-01 | 0.4037E+00 | 0.6488E+00 |
| 3    | -.9229E-01 | 0.3537E+00 | 0.6174E+00 |
| 4    | -.9228E-01 | 0.3197E+00 | 0.5926E+00 |
| 5    | -.9227E-01 | 0.2852E+00 | 0.5644E+00 |
| 6    | -.9227E-01 | 0.2515E+00 | 0.5343E+00 |
| 7    | -.9226E-01 | 0.2176E+00 | 0.5018E+00 |
| 8    | -.9226E-01 | 0.1854E+00 | 0.4697E+00 |
| 9    | -.9226E-01 | 0.1524E+00 | 0.4361E+00 |
| 10   | -.1075E+00 | 0.4510E+00 | 0.6031E+00 |
| 11   | -.1075E+00 | 0.3966E+00 | 0.5728E+00 |
| 12   | -.1075E+00 | 0.3537E+00 | 0.5455E+00 |
| 13   | -.1075E+00 | 0.3197E+00 | 0.5208E+00 |
| 14   | -.1075E+00 | 0.2852E+00 | 0.4927E+00 |
| 15   | -.1075E+00 | 0.2515E+00 | 0.4626E+00 |
| 16   | -.1075E+00 | 0.2176E+00 | 0.4302E+00 |
| 17   | -.1075E+00 | 0.1781E+00 | 0.3906E+00 |
| 18   | -.1075E+00 | 0.1524E+00 | 0.3644E+00 |

### Sum of Total Soil Spring Forces for Piles

Xp Direction = -119.8304 kips  
 Yp Direction = 364.2593 kips  
 Zp Direction = 5737.7222 kips  
 Sum of Tip Forces = 684.9925 kips

### Summary of Pile Forces for Load CASE 1

#### 1. Axial Force (kips)

| Pile # | Maximum Force | Minimum Force |
|--------|---------------|---------------|
| 1      | -0.10602E+03  | -0.46227E+03  |
| 2      | -0.10310E+03  | -0.44645E+03  |
| 3      | 0.24761E-01   | -0.30652E+03  |
| 4      | 0.28998E-01   | -0.29580E+03  |
| 5      | 0.33794E-01   | -0.28355E+03  |
| 6      | 0.38887E-01   | -0.27036E+03  |
| 7      | 0.44334E-01   | -0.25604E+03  |
| 8      | -0.79942E+02  | -0.33481E+03  |
| 9      | -0.75046E+02  | -0.31312E+03  |
| 10     | -0.97685E+02  | -0.41848E+03  |
| 11     | -0.93910E+02  | -0.39979E+03  |
| 12     | 0.37019E-01   | -0.27522E+03  |
| 13     | 0.41180E-01   | -0.26436E+03  |
| 14     | 0.45877E-01   | -0.25194E+03  |

|    |              |              |
|----|--------------|--------------|
| 15 | 0.50856E-01  | -0.23855E+03 |
| 16 | 0.56229E-01  | -0.22381E+03 |
| 17 | -0.68197E+02 | -0.28334E+03 |
| 18 | -0.64142E+02 | -0.26592E+03 |

#### 2. Pile Shear Force in 2 Direction (kips)

| Pile # | Maximum Shear | Minimum Shear |
|--------|---------------|---------------|
| 1      | 0.11311E+01   | -0.41395E+01  |
| 2      | 0.11919E+01   | -0.43761E+01  |
| 3      | 0.11896E+01   | -0.27844E+01  |
| 4      | 0.11809E+01   | -0.28845E+01  |
| 5      | 0.11580E+01   | -0.30063E+01  |
| 6      | 0.11211E+01   | -0.31563E+01  |
| 7      | 0.10628E+01   | -0.33501E+01  |
| 8      | 0.22653E+01   | -0.62992E+01  |
| 9      | 0.23342E+01   | -0.69319E+01  |
| 10     | 0.13297E+01   | -0.48916E+01  |
| 11     | 0.13874E+01   | -0.52139E+01  |
| 12     | 0.14101E+01   | -0.33070E+01  |
| 13     | 0.14118E+01   | -0.34289E+01  |
| 14     | 0.13981E+01   | -0.35758E+01  |
| 15     | 0.13701E+01   | -0.37536E+01  |
| 16     | 0.13297E+01   | -0.39778E+01  |
| 17     | 0.26636E+01   | -0.75382E+01  |
| 18     | 0.27428E+01   | -0.80839E+01  |

#### 3. Pile Shear Force in 3 Direction (kips)

| Pile # | Maximum Shear | Minimum Shear |
|--------|---------------|---------------|
| 1      | 0.11440E+02   | -0.30226E+02  |
| 2      | 0.11061E+02   | -0.28293E+02  |
| 3      | 0.42216E+01   | -0.97937E+01  |
| 4      | 0.37467E+01   | -0.91125E+01  |
| 5      | 0.32215E+01   | -0.83742E+01  |
| 6      | 0.26739E+01   | -0.76008E+01  |
| 7      | 0.23631E+01   | -0.67523E+01  |
| 8      | 0.63957E+01   | -0.16004E+02  |
| 9      | 0.64332E+01   | -0.13358E+02  |
| 10     | 0.11351E+02   | -0.30248E+02  |
| 11     | 0.10923E+02   | -0.27987E+02  |
| 12     | 0.42498E+01   | -0.98517E+01  |
| 13     | 0.37958E+01   | -0.91604E+01  |
| 14     | 0.32904E+01   | -0.84076E+01  |
| 15     | 0.27632E+01   | -0.76151E+01  |
| 16     | 0.22095E+01   | -0.67445E+01  |
| 17     | 0.62683E+01   | -0.15214E+02  |
| 18     | 0.62657E+01   | -0.13062E+02  |

#### 4. Bending Moment About 2 Axis (kip-ft and ft)

| Pile | Node | Depth Below Cap | Maximum Moment | Node | Depth Below Cap | Minimum Moment |
|------|------|-----------------|----------------|------|-----------------|----------------|
| 1    | 1    | 0.00000E+00     | 0.1614E+03     | 498  | 0.1420E+02      | -0.68497E+02   |
| 2    | 2    | 0.00000E+00     | 0.1467E+03     | 537  | 0.1420E+02      | -0.64719E+02   |
| 3    | 3    | 0.00000E+00     | 0.4501E+02     | 575  | 0.1170E+02      | -0.20799E+02   |
| 4    | 4    | 0.00000E+00     | 0.4077E+02     | 614  | 0.1170E+02      | -0.19640E+02   |
| 5    | 5    | 0.00000E+00     | 0.3628E+02     | 653  | 0.1170E+02      | -0.18356E+02   |
| 6    | 6    | 0.00000E+00     | 0.3173E+02     | 692  | 0.1170E+02      | -0.16988E+02   |
| 7    | 7    | 0.00000E+00     | 0.2691E+02     | 731  | 0.1170E+02      | -0.15468E+02   |
| 8    | 8    | 0.00000E+00     | 0.6211E+02     | 771  | 0.1420E+02      | -0.36902E+02   |
| 9    | 9    | 0.00000E+00     | 0.4633E+02     | 809  | 0.1065E+02      | -0.31518E+02   |
| 10   | 10   | 0.00000E+00     | 0.1611E+03     | 849  | 0.1420E+02      | -0.68253E+02   |

## FB-Multiplier Output – Abutment 2 (North) – Strength-I

|    |    |             |            |      |            |              |
|----|----|-------------|------------|------|------------|--------------|
| 11 | 11 | 0.00000E+00 | 0.1440E+03 | 888  | 0.1420E+02 | -0.63866E+02 |
| 12 | 12 | 0.00000E+00 | 0.4501E+02 | 926  | 0.1170E+02 | -0.20662E+02 |
| 13 | 13 | 0.00000E+00 | 0.4077E+02 | 965  | 0.1170E+02 | -0.19511E+02 |
| 14 | 14 | 0.00000E+00 | 0.3626E+02 | 1004 | 0.1170E+02 | -0.18232E+02 |
| 15 | 15 | 0.00000E+00 | 0.3165E+02 | 1043 | 0.1170E+02 | -0.16871E+02 |
| 16 | 16 | 0.00000E+00 | 0.2677E+02 | 1082 | 0.1170E+02 | -0.15348E+02 |
| 17 | 17 | 0.00000E+00 | 0.5778E+02 | 1122 | 0.1420E+02 | -0.35498E+02 |
| 18 | 18 | 0.00000E+00 | 0.4522E+02 | 1161 | 0.1420E+02 | -0.31003E+02 |

### 5. Bending Moment About 3 Axis (kip-ft and ft)

| Pile | Node | Depth Below Cap | Maximum Moment | Node | Depth Below Cap | Minimum Moment |
|------|------|-----------------|----------------|------|-----------------|----------------|
| 1    | 498  | 0.14200E+02     | 0.7248E+01     | 1    | 0.0000E+00      | -0.19963E+02   |
| 2    | 537  | 0.14200E+02     | 0.7426E+01     | 2    | 0.0000E+00      | -0.20618E+02   |
| 3    | 575  | 0.11700E+02     | 0.5488E+01     | 3    | 0.0000E+00      | -0.13273E+02   |
| 4    | 614  | 0.11700E+02     | 0.5753E+01     | 4    | 0.0000E+00      | -0.13446E+02   |
| 5    | 653  | 0.11700E+02     | 0.6059E+01     | 5    | 0.0000E+00      | -0.13672E+02   |
| 6    | 692  | 0.11700E+02     | 0.6412E+01     | 6    | 0.0000E+00      | -0.13996E+02   |
| 7    | 731  | 0.11700E+02     | 0.6835E+01     | 7    | 0.0000E+00      | -0.14478E+02   |
| 8    | 770  | 0.10650E+02     | 0.9992E+01     | 8    | 0.0000E+00      | -0.25272E+02   |
| 9    | 809  | 0.10650E+02     | 0.1104E+02     | 9    | 0.0000E+00      | -0.27100E+02   |
| 10   | 849  | 0.14200E+02     | 0.8457E+01     | 10   | 0.0000E+00      | -0.23583E+02   |
| 11   | 888  | 0.14200E+02     | 0.8706E+01     | 11   | 0.0000E+00      | -0.24485E+02   |
| 12   | 926  | 0.11700E+02     | 0.6359E+01     | 12   | 0.0000E+00      | -0.15780E+02   |
| 13   | 965  | 0.11700E+02     | 0.6672E+01     | 13   | 0.0000E+00      | -0.16023E+02   |
| 14   | 1004 | 0.11700E+02     | 0.7027E+01     | 14   | 0.0000E+00      | -0.16335E+02   |
| 15   | 1043 | 0.11700E+02     | 0.7429E+01     | 15   | 0.0000E+00      | -0.16760E+02   |
| 16   | 1082 | 0.11700E+02     | 0.7923E+01     | 16   | 0.0000E+00      | -0.17339E+02   |
| 17   | 1121 | 0.10650E+02     | 0.1169E+02     | 17   | 0.0000E+00      | -0.30379E+02   |
| 18   | 1160 | 0.10650E+02     | 0.1261E+02     | 18   | 0.0000E+00      | -0.31978E+02   |

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 \* RESULTS FOR LOAD CASE 2 \*  
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 \* CONVERGENCE REPORT \*  
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The solution converged in 24 iterations

### Summary of Maximum Out-Of-Balance Forces (Absolute Values)

FZ = 0.000 kips  
 FX = 0.000 kips  
 FY = 0.000 kips  
 MXX = 0.000 kip-ft  
 MYY = 0.000 kip-ft  
 MZZ = 0.000 kip-ft

### Summary of Displacements at Pile Heads

| NODE | X<br>in    | Y<br>in    | Z<br>in    |
|------|------------|------------|------------|
| 1    | -.8255E-01 | 0.3802E+00 | 0.5603E+00 |
| 2    | -.8255E-01 | 0.3402E+00 | 0.5335E+00 |
| 3    | -.8254E-01 | 0.2979E+00 | 0.5022E+00 |
| 4    | -.8254E-01 | 0.2692E+00 | 0.4782E+00 |
| 5    | -.8253E-01 | 0.2401E+00 | 0.4515E+00 |
| 6    | -.8252E-01 | 0.2116E+00 | 0.4234E+00 |
| 7    | -.8252E-01 | 0.1829E+00 | 0.3935E+00 |

|    |            |            |            |
|----|------------|------------|------------|
| 8  | -.8252E-01 | 0.1557E+00 | 0.3643E+00 |
| 9  | -.8252E-01 | 0.1279E+00 | 0.3338E+00 |
| 10 | -.9537E-01 | 0.3802E+00 | 0.4604E+00 |
| 11 | -.9538E-01 | 0.3342E+00 | 0.4295E+00 |
| 12 | -.9538E-01 | 0.2979E+00 | 0.4023E+00 |
| 13 | -.9539E-01 | 0.2692E+00 | 0.3784E+00 |
| 14 | -.9540E-01 | 0.2401E+00 | 0.3517E+00 |
| 15 | -.9540E-01 | 0.2116E+00 | 0.3237E+00 |
| 16 | -.9540E-01 | 0.1829E+00 | 0.2939E+00 |
| 17 | -.9540E-01 | 0.1495E+00 | 0.2579E+00 |
| 18 | -.9540E-01 | 0.1279E+00 | 0.2342E+00 |

### Sum of Total Soil Spring Forces for Piles

Xp Direction = -119.6959 kips  
 Yp Direction = 302.7279 kips  
 Zp Direction = 4523.7003 kips  
 Sum of Tip Forces = 546.4246 kips

### Summary of Pile Forces for Load CASE 2

#### 1. Axial Force (kips)

| Pile # | Maximum Force | Minimum Force |
|--------|---------------|---------------|
| 1      | -0.92311E+02  | -0.39205E+03  |
| 2      | -0.88789E+02  | -0.37531E+03  |
| 3      | 0.44291E-01   | -0.25616E+03  |
| 4      | 0.48279E-01   | -0.24551E+03  |
| 5      | 0.52684E-01   | -0.23357E+03  |
| 6      | 0.57365E-01   | -0.22065E+03  |
| 7      | 0.62349E-01   | -0.20657E+03  |
| 8      | -0.64117E+02  | -0.26581E+03  |
| 9      | -0.59306E+02  | -0.24527E+03  |
| 10     | -0.78612E+02  | -0.32888E+03  |
| 11     | -0.74067E+02  | -0.30882E+03  |
| 12     | 0.60913E-01   | -0.21066E+03  |
| 13     | 0.64854E-01   | -0.19935E+03  |
| 14     | 0.69160E-01   | -0.18668E+03  |
| 15     | 0.73576E-01   | -0.17328E+03  |
| 16     | 0.78138E-01   | -0.15891E+03  |
| 17     | -0.46988E+02  | -0.19283E+03  |
| 18     | -0.43050E+02  | -0.17599E+03  |

#### 2. Pile Shear Force in 2 Direction (kips)

| Pile # | Maximum Shear | Minimum Shear |
|--------|---------------|---------------|
| 1      | 0.12177E+01   | -0.41593E+01  |
| 2      | 0.13976E+01   | -0.44150E+01  |
| 3      | 0.10717E+01   | -0.27760E+01  |
| 4      | 0.10413E+01   | -0.28888E+01  |
| 5      | 0.99797E+00   | -0.30311E+01  |
| 6      | 0.95953E+00   | -0.32082E+01  |
| 7      | 0.11640E+01   | -0.34287E+01  |
| 8      | 0.20657E+01   | -0.65384E+01  |
| 9      | 0.19894E+01   | -0.72130E+01  |
| 10     | 0.13733E+01   | -0.48878E+01  |
| 11     | 0.16137E+01   | -0.52318E+01  |
| 12     | 0.12979E+01   | -0.32971E+01  |
| 13     | 0.12755E+01   | -0.34310E+01  |
| 14     | 0.12375E+01   | -0.35931E+01  |

## FB-Multiplier Output – Abutment 2 (North) – Strength-I

|    |             |              |
|----|-------------|--------------|
| 15 | 0.11761E+01 | -0.37857E+01 |
| 16 | 0.12177E+01 | -0.40189E+01 |
| 17 | 0.24377E+01 | -0.77392E+01 |
| 18 | 0.24151E+01 | -0.82963E+01 |

### 3. Pile Shear Force in 3 Direction (kips)

| Pile # | Maximum Shear | Minimum Shear |
|--------|---------------|---------------|
| 1      | 0.10704E+02   | -0.25869E+02  |
| 2      | 0.98211E+01   | -0.23897E+02  |
| 3      | 0.31394E+01   | -0.81689E+01  |
| 4      | 0.26659E+01   | -0.75098E+01  |
| 5      | 0.26053E+01   | -0.67964E+01  |
| 6      | 0.26761E+01   | -0.60436E+01  |
| 7      | 0.26895E+01   | -0.52005E+01  |
| 8      | 0.68766E+01   | -0.11500E+02  |
| 9      | 0.58672E+01   | -0.85050E+01  |
| 10     | 0.10655E+02   | -0.25913E+02  |
| 11     | 0.96461E+01   | -0.23604E+02  |
| 12     | 0.32567E+01   | -0.82745E+01  |
| 13     | 0.27950E+01   | -0.75965E+01  |
| 14     | 0.24192E+01   | -0.68537E+01  |
| 15     | 0.25005E+01   | -0.60625E+01  |
| 16     | 0.25211E+01   | -0.51770E+01  |
| 17     | 0.66185E+01   | -0.10659E+02  |
| 18     | 0.58202E+01   | -0.82285E+01  |

### 4. Bending Moment About 2 Axis (kip-ft and ft)

| Pile | Node | Depth Below Cap | Maximum Moment | Node | Depth Below Cap | Minimum Moment |
|------|------|-----------------|----------------|------|-----------------|----------------|
| 1    | 1    | 0.00000E+00     | 0.1232E+03     | 498  | 0.1420E+02      | -0.63317E+02   |
| 2    | 2    | 0.00000E+00     | 0.1090E+03     | 537  | 0.1420E+02      | -0.58959E+02   |
| 3    | 3    | 0.00000E+00     | 0.3348E+02     | 575  | 0.1170E+02      | -0.19132E+02   |
| 4    | 4    | 0.00000E+00     | 0.2958E+02     | 614  | 0.1170E+02      | -0.17992E+02   |
| 5    | 5    | 0.00000E+00     | 0.2548E+02     | 653  | 0.1170E+02      | -0.16737E+02   |
| 6    | 6    | 0.00000E+00     | 0.2130E+02     | 692  | 0.1170E+02      | -0.15382E+02   |
| 7    | 7    | 0.00000E+00     | 0.1679E+02     | 731  | 0.1170E+02      | -0.13835E+02   |
| 8    | 8    | 0.00000E+00     | 0.2865E+02     | 770  | 0.1065E+02      | -0.35648E+02   |
| 9    | 9    | 0.00000E+00     | 0.1230E+02     | 809  | 0.1065E+02      | -0.32469E+02   |
| 10   | 10   | 0.00000E+00     | 0.1228E+03     | 849  | 0.1420E+02      | -0.63055E+02   |
| 11   | 11   | 0.00000E+00     | 0.1063E+03     | 888  | 0.1420E+02      | -0.58017E+02   |
| 12   | 12   | 0.00000E+00     | 0.3354E+02     | 926  | 0.1170E+02      | -0.19130E+02   |
| 13   | 13   | 0.00000E+00     | 0.2959E+02     | 965  | 0.1170E+02      | -0.17977E+02   |
| 14   | 14   | 0.00000E+00     | 0.2540E+02     | 1004 | 0.1170E+02      | -0.16686E+02   |
| 15   | 15   | 0.00000E+00     | 0.2109E+02     | 1043 | 0.1170E+02      | -0.15268E+02   |
| 16   | 16   | 0.00000E+00     | 0.1647E+02     | 1082 | 0.1170E+02      | -0.13635E+02   |
| 17   | 17   | 0.00000E+00     | 0.2423E+02     | 1121 | 0.1065E+02      | -0.34479E+02   |
| 18   | 18   | 0.00000E+00     | 0.1121E+02     | 1160 | 0.1065E+02      | -0.31837E+02   |

### 5. Bending Moment About 3 Axis (kip-ft and ft)

| Pile | Node | Depth Below Cap | Maximum Moment | Node | Depth Below Cap | Minimum Moment |
|------|------|-----------------|----------------|------|-----------------|----------------|
| 1    | 498  | 0.1420E+02      | 0.6826E+01     | 1    | 0.0000E+00      | -0.19087E+02   |
| 2    | 537  | 0.1420E+02      | 0.6994E+01     | 2    | 0.0000E+00      | -0.19780E+02   |
| 3    | 575  | 0.1170E+02      | 0.5515E+01     | 3    | 0.0000E+00      | -0.12619E+02   |
| 4    | 614  | 0.1170E+02      | 0.5795E+01     | 4    | 0.0000E+00      | -0.12847E+02   |
| 5    | 653  | 0.1170E+02      | 0.6131E+01     | 5    | 0.0000E+00      | -0.13173E+02   |
| 6    | 692  | 0.1170E+02      | 0.6533E+01     | 6    | 0.0000E+00      | -0.13626E+02   |
| 7    | 731  | 0.1170E+02      | 0.7004E+01     | 7    | 0.0000E+00      | -0.14227E+02   |
| 8    | 770  | 0.1065E+02      | 0.1046E+02     | 8    | 0.0000E+00      | -0.25190E+02   |
| 9    | 809  | 0.1065E+02      | 0.1161E+02     | 9    | 0.0000E+00      | -0.27037E+02   |
| 10   | 849  | 0.1420E+02      | 0.7910E+01     | 10   | 0.0000E+00      | -0.22396E+02   |
| 11   | 888  | 0.1420E+02      | 0.8143E+01     | 11   | 0.0000E+00      | -0.23335E+02   |

|    |      |             |            |    |            |              |
|----|------|-------------|------------|----|------------|--------------|
| 12 | 926  | 0.11700E+02 | 0.6372E+01 | 12 | 0.0000E+00 | -0.15015E+02 |
| 13 | 965  | 0.11700E+02 | 0.6692E+01 | 13 | 0.0000E+00 | -0.15311E+02 |
| 14 | 1004 | 0.11700E+02 | 0.7070E+01 | 14 | 0.0000E+00 | -0.15686E+02 |
| 15 | 1043 | 0.11700E+02 | 0.7498E+01 | 15 | 0.0000E+00 | -0.16167E+02 |
| 16 | 1082 | 0.11700E+02 | 0.7989E+01 | 16 | 0.0000E+00 | -0.16784E+02 |
| 17 | 1121 | 0.10650E+02 | 0.1213E+02 | 17 | 0.0000E+00 | -0.29912E+02 |
| 18 | 1160 | 0.10650E+02 | 0.1309E+02 | 18 | 0.0000E+00 | -0.31458E+02 |

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 \* RESULTS FOR LOAD CASE 3 \*  
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 \* CONVERGENCE REPORT \*  
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The solution converged in 22 iterations

#### Summary of Maximum Out-Of-Balance Forces (Absolute Values)

FZ = 0.000 kips  
 FX = 0.000 kips  
 FY = 0.000 kips  
 MXX = 0.001 kip-ft  
 MYY = 0.000 kip-ft  
 MZZ = 0.000 kip-ft

#### Summary of Displacements at Pile Heads

| NODE | X in       | Y in       | Z in       |
|------|------------|------------|------------|
| 1    | -.1447E+00 | 0.3809E+00 | 0.6296E+00 |
| 2    | -.1447E+00 | 0.3580E+00 | 0.6301E+00 |
| 3    | -.1447E+00 | 0.3338E+00 | 0.6270E+00 |
| 4    | -.1447E+00 | 0.3173E+00 | 0.6216E+00 |
| 5    | -.1447E+00 | 0.3005E+00 | 0.6130E+00 |
| 6    | -.1447E+00 | 0.2841E+00 | 0.6015E+00 |
| 7    | -.1447E+00 | 0.2676E+00 | 0.5873E+00 |
| 8    | -.1447E+00 | 0.2519E+00 | 0.5720E+00 |
| 9    | -.1447E+00 | 0.2359E+00 | 0.5554E+00 |
| 10   | -.1521E+00 | 0.3809E+00 | 0.5587E+00 |
| 11   | -.1521E+00 | 0.3546E+00 | 0.5591E+00 |
| 12   | -.1521E+00 | 0.3338E+00 | 0.5561E+00 |
| 13   | -.1521E+00 | 0.3173E+00 | 0.5508E+00 |
| 14   | -.1521E+00 | 0.3005E+00 | 0.5421E+00 |
| 15   | -.1521E+00 | 0.2841E+00 | 0.5307E+00 |
| 16   | -.1521E+00 | 0.2676E+00 | 0.5165E+00 |
| 17   | -.1521E+00 | 0.2484E+00 | 0.4976E+00 |
| 18   | -.1521E+00 | 0.2359E+00 | 0.4847E+00 |

#### Sum of Total Soil Spring Forces for Piles

Xp Direction = -171.8577 kips  
 Yp Direction = 373.6538 kips  
 Zp Direction = 6164.4603 kips  
 Sum of Tip Forces = 733.8080 kips

#### Summary of Pile Forces for Load CASE 3

## FB-Multiplier Output – Abutment 2 (North) – Strength-I

### 1. Axial Force (kips)

| Pile # | Maximum Force | Minimum Force |
|--------|---------------|---------------|
| 1      | -0.10086E+03  | -0.43472E+03  |
| 2      | -0.10093E+03  | -0.43505E+03  |
| 3      | 0.23105E-01   | -0.31068E+03  |
| 4      | 0.24034E-01   | -0.30835E+03  |
| 5      | 0.25516E-01   | -0.30462E+03  |
| 6      | 0.27481E-01   | -0.29965E+03  |
| 7      | 0.29906E-01   | -0.29350E+03  |
| 8      | -0.93814E+02  | -0.39932E+03  |
| 9      | -0.91627E+02  | -0.38940E+03  |
| 10     | -0.92100E+02  | -0.39103E+03  |
| 11     | -0.92151E+02  | -0.39128E+03  |
| 12     | 0.35216E-01   | -0.27988E+03  |
| 13     | 0.36127E-01   | -0.27753E+03  |
| 14     | 0.37581E-01   | -0.27376E+03  |
| 15     | 0.39509E-01   | -0.26874E+03  |
| 16     | 0.41890E-01   | -0.26250E+03  |
| 17     | -0.83891E+02  | -0.35265E+03  |
| 18     | -0.82076E+02  | -0.34441E+03  |

### 2. Pile Shear Force in 2 Direction (kips)

| Pile # | Maximum Shear | Minimum Shear |
|--------|---------------|---------------|
| 1      | 0.19529E+01   | -0.75589E+01  |
| 2      | 0.20972E+01   | -0.77648E+01  |
| 3      | 0.20085E+01   | -0.47465E+01  |
| 4      | 0.20045E+01   | -0.48055E+01  |
| 5      | 0.19945E+01   | -0.48694E+01  |
| 6      | 0.19812E+01   | -0.49418E+01  |
| 7      | 0.19656E+01   | -0.50287E+01  |
| 8      | 0.29972E+01   | -0.88516E+01  |
| 9      | 0.31494E+01   | -0.91087E+01  |
| 10     | 0.20124E+01   | -0.79664E+01  |
| 11     | 0.21858E+01   | -0.82121E+01  |
| 12     | 0.21194E+01   | -0.50220E+01  |
| 13     | 0.21205E+01   | -0.50863E+01  |
| 14     | 0.21159E+01   | -0.51557E+01  |
| 15     | 0.21078E+01   | -0.52332E+01  |
| 16     | 0.20977E+01   | -0.53251E+01  |
| 17     | 0.31359E+01   | -0.93753E+01  |
| 18     | 0.32606E+01   | -0.95845E+01  |

### 3. Pile Shear Force in 3 Direction (kips)

| Pile # | Maximum Shear | Minimum Shear |
|--------|---------------|---------------|
| 1      | 0.10713E+02   | -0.26904E+02  |
| 2      | 0.10401E+02   | -0.25802E+02  |
| 3      | 0.39361E+01   | -0.91215E+01  |
| 4      | 0.37106E+01   | -0.87641E+01  |
| 5      | 0.34722E+01   | -0.83916E+01  |
| 6      | 0.32316E+01   | -0.80172E+01  |
| 7      | 0.29825E+01   | -0.76260E+01  |
| 8      | 0.75815E+01   | -0.19839E+02  |
| 9      | 0.69013E+01   | -0.18756E+02  |
| 10     | 0.10660E+02   | -0.26919E+02  |
| 11     | 0.10306E+02   | -0.25639E+02  |
| 12     | 0.39613E+01   | -0.91854E+01  |
| 13     | 0.37421E+01   | -0.88227E+01  |
| 14     | 0.35101E+01   | -0.84447E+01  |

|    |             |              |
|----|-------------|--------------|
| 15 | 0.32760E+01 | -0.80649E+01 |
| 16 | 0.30331E+01 | -0.76680E+01 |
| 17 | 0.74657E+01 | -0.19552E+02 |
| 18 | 0.69406E+01 | -0.18694E+02 |

### 4. Bending Moment About 2 Axis (kip-ft and ft)

| Pile | Node | Depth Below Cap | Maximum Moment | Node | Depth Below Cap | Minimum Moment |
|------|------|-----------------|----------------|------|-----------------|----------------|
| 1    | 1    | 0.00000E+00     | 0.1383E+03     | 498  | 0.1420E+02      | -0.62160E+02   |
| 2    | 2    | 0.00000E+00     | 0.1305E+03     | 537  | 0.1420E+02      | -0.59995E+02   |
| 3    | 3    | 0.00000E+00     | 0.4181E+02     | 575  | 0.1170E+02      | -0.19533E+02   |
| 4    | 4    | 0.00000E+00     | 0.3969E+02     | 614  | 0.1170E+02      | -0.18932E+02   |
| 5    | 5    | 0.00000E+00     | 0.3750E+02     | 653  | 0.1170E+02      | -0.18291E+02   |
| 6    | 6    | 0.00000E+00     | 0.3530E+02     | 692  | 0.1170E+02      | -0.17632E+02   |
| 7    | 7    | 0.00000E+00     | 0.3304E+02     | 731  | 0.1170E+02      | -0.16933E+02   |
| 8    | 8    | 0.00000E+00     | 0.8985E+02     | 771  | 0.1420E+02      | -0.47088E+02   |
| 9    | 9    | 0.00000E+00     | 0.8283E+02     | 810  | 0.1420E+02      | -0.44641E+02   |
| 10   | 10   | 0.00000E+00     | 0.1379E+03     | 849  | 0.1420E+02      | -0.61946E+02   |
| 11   | 11   | 0.00000E+00     | 0.1290E+03     | 888  | 0.1420E+02      | -0.59450E+02   |
| 12   | 12   | 0.00000E+00     | 0.4184E+02     | 926  | 0.1170E+02      | -0.19428E+02   |
| 13   | 13   | 0.00000E+00     | 0.3971E+02     | 965  | 0.1170E+02      | -0.18830E+02   |
| 14   | 14   | 0.00000E+00     | 0.3751E+02     | 1004 | 0.1170E+02      | -0.18192E+02   |
| 15   | 15   | 0.00000E+00     | 0.3531E+02     | 1043 | 0.1170E+02      | -0.17538E+02   |
| 16   | 16   | 0.00000E+00     | 0.3303E+02     | 1082 | 0.1170E+02      | -0.16843E+02   |
| 17   | 17   | 0.00000E+00     | 0.8789E+02     | 1122 | 0.1420E+02      | -0.46403E+02   |
| 18   | 18   | 0.00000E+00     | 0.8238E+02     | 1161 | 0.1420E+02      | -0.44492E+02   |

### 5. Bending Moment About 3 Axis (kip-ft and ft)

| Pile | Node | Depth Below Cap | Maximum Moment | Node | Depth Below Cap | Minimum Moment |
|------|------|-----------------|----------------|------|-----------------|----------------|
| 1    | 498  | 0.14200E+02     | 0.1228E+02     | 1    | 0.0000E+00      | -0.36759E+02   |
| 2    | 537  | 0.14200E+02     | 0.1245E+02     | 2    | 0.0000E+00      | -0.37342E+02   |
| 3    | 575  | 0.11700E+02     | 0.8673E+01     | 3    | 0.0000E+00      | -0.23420E+02   |
| 4    | 614  | 0.11700E+02     | 0.8868E+01     | 4    | 0.0000E+00      | -0.23477E+02   |
| 5    | 653  | 0.11700E+02     | 0.9072E+01     | 5    | 0.0000E+00      | -0.23532E+02   |
| 6    | 692  | 0.11700E+02     | 0.9280E+01     | 6    | 0.0000E+00      | -0.23625E+02   |
| 7    | 731  | 0.11700E+02     | 0.9502E+01     | 7    | 0.0000E+00      | -0.23778E+02   |
| 8    | 771  | 0.14200E+02     | 0.1313E+02     | 8    | 0.0000E+00      | -0.39551E+02   |
| 9    | 810  | 0.14200E+02     | 0.1326E+02     | 9    | 0.0000E+00      | -0.40286E+02   |
| 10   | 849  | 0.14200E+02     | 0.1286E+02     | 10   | 0.0000E+00      | -0.38575E+02   |
| 11   | 888  | 0.14200E+02     | 0.1308E+02     | 11   | 0.0000E+00      | -0.39263E+02   |
| 12   | 926  | 0.11700E+02     | 0.9062E+01     | 12   | 0.0000E+00      | -0.24680E+02   |
| 13   | 965  | 0.11700E+02     | 0.9266E+01     | 13   | 0.0000E+00      | -0.24760E+02   |
| 14   | 1004 | 0.11700E+02     | 0.9480E+01     | 14   | 0.0000E+00      | -0.24838E+02   |
| 15   | 1043 | 0.11700E+02     | 0.9698E+01     | 15   | 0.0000E+00      | -0.24950E+02   |
| 16   | 1082 | 0.11700E+02     | 0.9929E+01     | 16   | 0.0000E+00      | -0.25125E+02   |
| 17   | 1122 | 0.14200E+02     | 0.1382E+02     | 17   | 0.0000E+00      | -0.41711E+02   |
| 18   | 1161 | 0.14200E+02     | 0.1394E+02     | 18   | 0.0000E+00      | -0.42316E+02   |

\*\*\*\*\*  
 \* RESULTS FOR LOAD CASE 4 \*  
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 \* CONVERGENCE REPORT \*  
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The solution converged in 23 iterations

Summary of Maximum Out-Of-Balance Forces (Absolute Values)

FZ = 0.000 kips

## FB-Multiplier Output – Abutment 2 (North) – Strength-I

FX = 0.000 kips  
FY = 0.000 kips  
MXX = 0.001 kip-ft  
MYY = 0.000 kip-ft  
MZZ = 0.000 kip-ft

### Summary of Displacements at Pile Heads

| NODE | X<br>in    | Y<br>in    | Z<br>in    |
|------|------------|------------|------------|
| 1    | -.1306E+00 | 0.3235E+00 | 0.5171E+00 |
| 2    | -.1306E+00 | 0.3039E+00 | 0.5158E+00 |
| 3    | -.1306E+00 | 0.2833E+00 | 0.5115E+00 |
| 4    | -.1306E+00 | 0.2692E+00 | 0.5060E+00 |
| 5    | -.1306E+00 | 0.2549E+00 | 0.4979E+00 |
| 6    | -.1306E+00 | 0.2410E+00 | 0.4877E+00 |
| 7    | -.1306E+00 | 0.2269E+00 | 0.4753E+00 |
| 8    | -.1306E+00 | 0.2135E+00 | 0.4621E+00 |
| 9    | -.1306E+00 | 0.1998E+00 | 0.4478E+00 |
| 10   | -.1369E+00 | 0.3235E+00 | 0.4173E+00 |
| 11   | -.1369E+00 | 0.3010E+00 | 0.4156E+00 |
| 12   | -.1369E+00 | 0.2833E+00 | 0.4117E+00 |
| 13   | -.1369E+00 | 0.2692E+00 | 0.4062E+00 |
| 14   | -.1369E+00 | 0.2549E+00 | 0.3982E+00 |
| 15   | -.1369E+00 | 0.2410E+00 | 0.3880E+00 |
| 16   | -.1369E+00 | 0.2269E+00 | 0.3756E+00 |
| 17   | -.1369E+00 | 0.2105E+00 | 0.3593E+00 |
| 18   | -.1369E+00 | 0.1998E+00 | 0.3481E+00 |

### Sum of Total Soil Spring Forces for Piles

Xp Direction = -171.8207 kips  
Yp Direction = 312.3307 kips  
Zp Direction = 4950.4405 kips  
Sum of Tip Forces = 596.4947 kips

### Summary of Pile Forces for Load CASE 4

#### 1. Axial Force (kips)

| Pile # | Maximum Force | Minimum Force |
|--------|---------------|---------------|
| 1      | -0.86568E+02  | -0.36495E+03  |
| 2      | -0.86389E+02  | -0.36412E+03  |
| 3      | 0.42730E-01   | -0.26028E+03  |
| 4      | 0.43649E-01   | -0.25786E+03  |
| 5      | 0.44994E-01   | -0.25429E+03  |
| 6      | 0.46702E-01   | -0.24974E+03  |
| 7      | 0.48761E-01   | -0.24421E+03  |
| 8      | -0.78847E+02  | -0.32992E+03  |
| 9      | -0.76773E+02  | -0.32072E+03  |
| 10     | -0.72246E+02  | -0.30087E+03  |
| 11     | -0.71930E+02  | -0.30038E+03  |
| 12     | 0.59350E-01   | -0.21508E+03  |
| 13     | 0.60262E-01   | -0.21251E+03  |
| 14     | 0.61594E-01   | -0.20872E+03  |
| 15     | 0.63281E-01   | -0.20389E+03  |
| 16     | 0.65310E-01   | -0.19802E+03  |
| 17     | -0.63336E+02  | -0.26247E+03  |
| 18     | -0.61583E+02  | -0.25498E+03  |

#### 2. Pile Shear Force in 2 Direction (kips)

| Pile # | Maximum Shear | Minimum Shear |
|--------|---------------|---------------|
| 1      | 0.23201E+01   | -0.76645E+01  |
| 2      | 0.24951E+01   | -0.78841E+01  |
| 3      | 0.18559E+01   | -0.47540E+01  |
| 4      | 0.18339E+01   | -0.48194E+01  |
| 5      | 0.18077E+01   | -0.48912E+01  |
| 6      | 0.17802E+01   | -0.49708E+01  |
| 7      | 0.17516E+01   | -0.50641E+01  |
| 8      | 0.32026E+01   | -0.90488E+01  |
| 9      | 0.32836E+01   | -0.93165E+01  |
| 10     | 0.23737E+01   | -0.80699E+01  |
| 11     | 0.25844E+01   | -0.83305E+01  |
| 12     | 0.19958E+01   | -0.50470E+01  |
| 13     | 0.19816E+01   | -0.51179E+01  |
| 14     | 0.19633E+01   | -0.51957E+01  |
| 15     | 0.19432E+01   | -0.52808E+01  |
| 16     | 0.19211E+01   | -0.53789E+01  |
| 17     | 0.33385E+01   | -0.95652E+01  |
| 18     | 0.34084E+01   | -0.97806E+01  |

#### 3. Pile Shear Force in 3 Direction (kips)

| Pile # | Maximum Shear | Minimum Shear |
|--------|---------------|---------------|
| 1      | 0.93503E+01   | -0.22493E+02  |
| 2      | 0.87073E+01   | -0.21338E+02  |
| 3      | 0.29296E+01   | -0.75139E+01  |
| 4      | 0.27030E+01   | -0.71614E+01  |
| 5      | 0.24704E+01   | -0.67939E+01  |
| 6      | 0.23105E+01   | -0.64243E+01  |
| 7      | 0.23276E+01   | -0.60375E+01  |
| 8      | 0.66765E+01   | -0.15220E+02  |
| 9      | 0.67443E+01   | -0.14155E+02  |
| 10     | 0.93459E+01   | -0.22535E+02  |
| 11     | 0.86198E+01   | -0.21192E+02  |
| 12     | 0.30334E+01   | -0.76271E+01  |
| 13     | 0.28106E+01   | -0.72666E+01  |
| 14     | 0.25809E+01   | -0.68898E+01  |
| 15     | 0.23543E+01   | -0.65103E+01  |
| 16     | 0.21821E+01   | -0.61123E+01  |
| 17     | 0.65563E+01   | -0.14944E+02  |
| 18     | 0.66089E+01   | -0.14098E+02  |

#### 4. Bending Moment About 2 Axis (kip-ft and ft)

| Pile | Node | Depth Below Cap | Maximum Moment | Node | Depth Below Cap | Minimum Moment |
|------|------|-----------------|----------------|------|-----------------|----------------|
| 1    | 1    | 0.00000E+00     | 0.1010E+03     | 498  | 0.1420E+02      | -0.56407E+02   |
| 2    | 2    | 0.00000E+00     | 0.9317E+02     | 537  | 0.1420E+02      | -0.53841E+02   |
| 3    | 3    | 0.00000E+00     | 0.3058E+02     | 575  | 0.1170E+02      | -0.17884E+02   |
| 4    | 4    | 0.00000E+00     | 0.2860E+02     | 614  | 0.1170E+02      | -0.17271E+02   |
| 5    | 5    | 0.00000E+00     | 0.2656E+02     | 653  | 0.1170E+02      | -0.16622E+02   |
| 6    | 6    | 0.00000E+00     | 0.2452E+02     | 692  | 0.1170E+02      | -0.15960E+02   |
| 7    | 7    | 0.00000E+00     | 0.2241E+02     | 731  | 0.1170E+02      | -0.15259E+02   |
| 8    | 8    | 0.00000E+00     | 0.5365E+02     | 771  | 0.1420E+02      | -0.39877E+02   |
| 9    | 9    | 0.00000E+00     | 0.4721E+02     | 810  | 0.1420E+02      | -0.37586E+02   |
| 10   | 10   | 0.00000E+00     | 0.1006E+03     | 849  | 0.1420E+02      | -0.56209E+02   |
| 11   | 11   | 0.00000E+00     | 0.9163E+02     | 888  | 0.1420E+02      | -0.53265E+02   |
| 12   | 12   | 0.00000E+00     | 0.3066E+02     | 926  | 0.1170E+02      | -0.17920E+02   |
| 13   | 13   | 0.00000E+00     | 0.2866E+02     | 965  | 0.1170E+02      | -0.17308E+02   |
| 14   | 14   | 0.00000E+00     | 0.2658E+02     | 1004 | 0.1170E+02      | -0.16661E+02   |
| 15   | 15   | 0.00000E+00     | 0.2450E+02     | 1043 | 0.1170E+02      | -0.15998E+02   |

## FB-Multiplier Output – Abutment 2 (North) – Strength-I

|    |    |             |            |      |            |              |
|----|----|-------------|------------|------|------------|--------------|
| 16 | 16 | 0.00000E+00 | 0.2236E+02 | 1082 | 0.1170E+02 | -0.15290E+02 |
| 17 | 17 | 0.00000E+00 | 0.5171E+02 | 1122 | 0.1420E+02 | -0.39212E+02 |
| 18 | 18 | 0.00000E+00 | 0.4664E+02 | 1161 | 0.1420E+02 | -0.37420E+02 |

|                    |             |    |   |   |    |
|--------------------|-------------|----|---|---|----|
| Min Z displacement | 0.2342E+00  | in | 2 | 0 | 18 |
| Max X displacement | -0.8252E-01 | in | 2 | 0 | 9  |
| Min X displacement | -0.1521E+00 | in | 3 | 0 | 18 |
| Max Y displacement | 0.4510E+00  | in | 1 | 0 | 1  |
| Min Y displacement | 0.1279E+00  | in | 2 | 0 | 9  |

### 5. Bending Moment About 3 Axis (kip-ft and ft)

| Pile | Node | Depth Below Cap | Maximum Moment | Node | Depth Below Cap | Minimum Moment |
|------|------|-----------------|----------------|------|-----------------|----------------|
| 1    | 498  | 0.14200E+02     | 0.1175E+02     | 1    | 0.0000E+00      | -0.35665E+02   |
| 2    | 537  | 0.14200E+02     | 0.1190E+02     | 2    | 0.0000E+00      | -0.36276E+02   |
| 3    | 575  | 0.11700E+02     | 0.8757E+01     | 3    | 0.0000E+00      | -0.22538E+02   |
| 4    | 614  | 0.11700E+02     | 0.8948E+01     | 4    | 0.0000E+00      | -0.22629E+02   |
| 5    | 653  | 0.11700E+02     | 0.9153E+01     | 5    | 0.0000E+00      | -0.22728E+02   |
| 6    | 692  | 0.11700E+02     | 0.9365E+01     | 6    | 0.0000E+00      | -0.22860E+02   |
| 7    | 731  | 0.11700E+02     | 0.9595E+01     | 7    | 0.0000E+00      | -0.23051E+02   |
| 8    | 770  | 0.10650E+02     | 0.1313E+02     | 8    | 0.0000E+00      | -0.38919E+02   |
| 9    | 809  | 0.10650E+02     | 0.1362E+02     | 9    | 0.0000E+00      | -0.39711E+02   |
| 10   | 849  | 0.14200E+02     | 0.1227E+02     | 10   | 0.0000E+00      | -0.37333E+02   |
| 11   | 888  | 0.14200E+02     | 0.1246E+02     | 11   | 0.0000E+00      | -0.38052E+02   |
| 12   | 926  | 0.11700E+02     | 0.9159E+01     | 12   | 0.0000E+00      | -0.23815E+02   |
| 13   | 965  | 0.11700E+02     | 0.9360E+01     | 13   | 0.0000E+00      | -0.23929E+02   |
| 14   | 1004 | 0.11700E+02     | 0.9574E+01     | 14   | 0.0000E+00      | -0.24056E+02   |
| 15   | 1043 | 0.11700E+02     | 0.9794E+01     | 15   | 0.0000E+00      | -0.24213E+02   |
| 16   | 1082 | 0.11700E+02     | 0.1003E+02     | 16   | 0.0000E+00      | -0.24423E+02   |
| 17   | 1121 | 0.10650E+02     | 0.1373E+02     | 17   | 0.0000E+00      | -0.40905E+02   |
| 18   | 1160 | 0.10650E+02     | 0.1411E+02     | 18   | 0.0000E+00      | -0.41547E+02   |

\*\*\*\*\*  
 \* SUBSTRUCTURE 1 MAX/MIN RESPONSES FOR ALL LOAD CASES \*  
 \*\*\*\*\*

### Pile demands

| Demand type                    | Value       | Unit   | Load case | Load comb. | Pile |
|--------------------------------|-------------|--------|-----------|------------|------|
| Max axial force (tension is +) | 0.7814E-01  | kips   | 2         | 0          | 16   |
| Min axial force                | -0.4623E+03 | kips   | 1         | 0          | 1    |
| Max shear in 2 direction       | 0.3408E+01  | kips   | 4         | 0          | 18   |
| Min shear in 2 direction       | -0.9781E+01 | kips   | 4         | 0          | 18   |
| Max shear in 3 direction       | 0.1144E+02  | kips   | 1         | 0          | 1    |
| Min shear in 3 direction       | -0.3025E+02 | kips   | 1         | 0          | 10   |
| Max moment about 2 axis        | 0.1614E+03  | kip-ft | 1         | 0          | 1    |
| Min moment about 2 axis        | -0.6850E+02 | kip-ft | 1         | 0          | 1    |
| Max moment about 3 axis        | 0.1411E+02  | kip-ft | 4         | 0          | 18   |
| Min moment about 3 axis        | -0.4232E+02 | kip-ft | 3         | 0          | 18   |
| Max torsional force            | 0.8636E-01  | kip-ft | 1         | 0          | 7    |
| Min torsional force            | 0.5750E-70  | kip-ft | 4         | 0          | 10   |
| Max demand/capacity ratio      | 0.7343E+00  |        | 1         | 0          | 1    |

### Soil demands

| Demand type              | Value       | Unit   | Load case | Load comb. | Pile |
|--------------------------|-------------|--------|-----------|------------|------|
| Max Zp soil force        | 0.1923E+03  | kips   | 3         | 0          | 3    |
| Min Zp soil force        | 0.5040E-03  | kips   | 2         | 0          | 16   |
| Max Xp soil force        | 0.3042E+01  | kips   | 4         | 0          | 18   |
| Min Xp soil force        | -0.5413E+01 | kips   | 4         | 0          | 18   |
| Max Yp soil force        | 0.1236E+02  | kips   | 1         | 0          | 1    |
| Min Yp soil force        | -0.6543E+01 | kips   | 2         | 0          | 1    |
| Max torsional soil force | -0.5750E-70 | kip-ft | 4         | 0          | 10   |

### Pile head displacements

| Displacement type  | Value      | Unit | Load case | Load comb. | Pile |
|--------------------|------------|------|-----------|------------|------|
| Max Z displacement | 0.6750E+00 | in   | 1         | 0          | 1    |



## FB-Multiplier Output – Abutment 2 (North) – Strength-IV

```

*****
*
*   The University of Florida, Florida Department of
*   Transportation, Marc Hoyt, Mike McVay, Cliff Hays,
*   Mark Williams, Petros Christou, Jae Chung,
*   Gary Consolazio, and Michael Davidson
*   disclaim any warranty, expressed or implied,
*   including but not limited to, any implied
*   warranty of fitness for a particular purpose
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*   developers shall not be liable for any damages
*   incurred through the use of FB-Multiplier.
*
*
*   :::: F B - M U L T I P L I E R ::::
*   v5.6.0
*
*   Written by Marc Hoyt, Mike McVay, Cliff Hays,
*   Mark Williams, Petros Christou, Jae Chung,
*   Gary Consolazio, and Michael Davidson.
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*
*   © 2019 Bridge Software Institute
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*
*   FB-Multiplier calculates the response of
*   bridge-pier-pile-soil structures.
*
*   FB-Multiplier analysis types include preload,
*   static, pushover, modal, and transient dynamic.
*
*   FB-Multiplier accounts for linear and nonlinear
*   pile and pier structural members, linear pile caps
*   and superstructure, and nonlinear soil behavior.
*
*   Contact the Bridge Software Institute for support
*   https://bsi.ce.ufl.edu
*
*****

```

Analysis Start = 10:40pm  
 Analysis End = 10:40pm  
 Analysis Duration = 6 second(s)

Input Data File Name = Abutment 2 - STR IV.in  
 Analysis Date = 4- 2-2020  
 License ID Number = 432000000

```

*****
*   OUTPUT STAGE 1 OF 2: INTERPRETATION OF INPUT FILE
*   *****

```

```

*****
*   PROJECT DATA
*   *****

```

Project client = MaineDOT  
 Project name = Veranda Street Bridge Replacement  
 Project manager = T. Cote  
 Computed by = A. Piccolino  
 Project description = 75297 - Abutment 2 (North) - Strength-IV

```

*****
*   SELECTIVE PRINT OUTPUT CONTROL
*   *****

```

| Print Flag                                 | State |
|--|-------|
| Pile displacements                         | Off   |
| Pile element forces                        | Off   |
| Pile ID numbers                            | Off   |
| Pile cap stresses                          | Off   |
| Substructure coordinates                   | Off   |
| Substructure interaction diagrams          | Off   |
| Substructure material stress-strain curves | Off   |
| Substructure member section properties     | Off   |
| Pier columns and pier cap displacements    | Off   |
| Pier columns and pier cap forces           | On    |
| Soil response forces                       | Off   |
| Soil data per layer                        | On    |
| Soil curve data per pile node              | Off   |
| Soil resistance curves                     | Off   |
| Bridge span properties                     | Off   |
| Bridge span temperature data               | Off   |
| Bridge span displacements                  | Off   |
| Bridge span element forces                 | Off   |
| Discrete spring forces                     | Off   |
| Out of balance forces                      | Off   |
| XML output                                 | Off   |
| Eigenvectors                               | Off   |

```

*****
*   ANALYSIS CONTROL INFORMATION
*   *****

```

Memory specified for solution = 1024 MB

Number of cores = 1

Type of analysis = Static

-----  
 - Linear / Nonlinear analysis settings -  
 -----

Soil stiffness = Nonlinear  
 Pile stiffness = Nonlinear

-----  
 - Miscellaneous analysis settings -  
 -----

Units = English (kips & ft; lbs & in)

Convergence tolerance = 0.10 kips  
 Maximum number of iterations = 100

Number of substructures = 1

# FB-Multiplier Output – Abutment 2 (North) – Strength-IV

\*\*\*\*\*  
 \* SOIL BEHAVIOR \*  
 \*\*\*\*\*

Springs are defined at the following DOF for embedded nodes:  
 X-TRANSLATION Y-TRANSLATION Z-TRANSLATION  
 Z-ROTATION

\*\*\*\*\*  
 \* LOAD FACTORS FOR SELF WEIGHT AND BUOYANCY \*  
 \*\*\*\*\*

| LOAD CASE NO. | SELF WEIGHT FACTOR | BUOYANCY FACTOR |
|---------------|--------------------|-----------------|
| 1             | 1.00               | 1.00            |
| 2             | 1.00               | 1.00            |

\*\*\*\*\*  
 \* PILE CAP DATA \*  
 \*\*\*\*\*

NOTE: Xp-Grid: Distance between axes along Xp axis  
 Yp-Grid: Distance between axes along Yp axis

Number of Grid Points in Xp direction (NPX) = 23  
 Number of Grid Points in Yp direction (NPY) = 6

Grid Spacing in the Xp direction (in):  

|       |        |       |        |       |        |       |
|-------|--------|-------|--------|-------|--------|-------|
| 57.08 | 129.47 | 95.28 | 22.54  | 11.09 | 106.88 | 96.55 |
| 21.01 | 117.97 | 21.82 | 96.22  | 67.07 | 117.71 | 41.46 |
| 76.44 | 84.03  | 33.93 | 117.97 | 34.57 | 83.15  | 37.82 |
| 18.00 |        |       |        |       |        |       |

Grid Spacing in the Yp direction (in):  

|       |       |       |       |       |
|-------|-------|-------|-------|-------|
| 18.00 | 36.00 | 12.00 | 24.00 | 18.00 |
|-------|-------|-------|-------|-------|

\*\*\*\*\*  
 \* PILE TO PILE CAP CONNECTION \*  
 \*\*\*\*\*

Pile head fixity = FIXED

\*\*\*\*\*  
 \* INPUT SOIL LAYER DATA \*  
 \*\*\*\*\*

P-Y SOIL LAYER DATA

-----  
 - SOIL SET # 1 -  
 -----

| SET | LAYER | MODEL | PHI<br>deg               | RK<br>lbs/in^3           | GAMMA<br>pcf             |
|-----|-------|-------|--------------------------|--------------------------|--------------------------|
| 1   | 1     | 2     | 0.3200E+02<br>0.3200E+02 | 0.9000E+02<br>0.9000E+02 | 0.1100E+03<br>0.1100E+03 |

| SET | LAYER | MODEL | GAMMA<br>pcf             | CU<br>psf                | E50                      |
|-----|-------|-------|--------------------------|--------------------------|--------------------------|
| 1   | 2     | 4     | 0.1050E+03<br>0.1050E+03 | 0.3500E+03<br>0.3500E+03 | 0.1000E-01<br>0.1000E-01 |

| SET | LAYER | MODEL | GAMMA<br>pcf             | CU<br>psf                | E50                      | Cavg<br>psf              |
|-----|-------|-------|--------------------------|--------------------------|--------------------------|--------------------------|
| 1   | 3     | 6     | 0.1150E+03<br>0.1150E+03 | 0.5000E+03<br>0.1500E+04 | 0.5000E-02<br>0.5000E-02 | 0.5000E+03<br>0.1500E+04 |

| SET | LAYER | MODEL | PHI<br>deg               | RK<br>lbs/in^3           | GAMMA<br>pcf             |
|-----|-------|-------|--------------------------|--------------------------|--------------------------|
| 1   | 4     | 2     | 0.3000E+02<br>0.3400E+02 | 0.3000E+02<br>0.6000E+02 | 0.1050E+03<br>0.1150E+03 |

| SET | LAYER | MODEL | PHI<br>deg               | RK<br>lbs/in^3           | GAMMA<br>pcf             |
|-----|-------|-------|--------------------------|--------------------------|--------------------------|
| 1   | 5     | 2     | 0.3600E+02<br>0.3600E+02 | 0.7000E+02<br>0.7000E+02 | 0.1200E+03<br>0.1200E+03 |

| SET | LAYER | MODEL | Qu<br>psf  |
|-----|-------|-------|------------|
| 1   | 6     | 8     | 0.5040E+06 |

-----  
 - SOIL SET # 2 -  
 -----

| SET | LAYER | MODEL | PHI<br>deg               | RK<br>lbs/in^3           | GAMMA<br>pcf             |
|-----|-------|-------|--------------------------|--------------------------|--------------------------|
| 2   | 1     | 2     | 0.3200E+02<br>0.3200E+02 | 0.9000E+02<br>0.9000E+02 | 0.1100E+03<br>0.1100E+03 |

| SET | LAYER | MODEL | GAMMA<br>pcf             | CU<br>psf                | E50                      | Cavg<br>psf              |
|-----|-------|-------|--------------------------|--------------------------|--------------------------|--------------------------|
| 2   | 2     | 6     | 0.1150E+03<br>0.1150E+03 | 0.5000E+03<br>0.5000E+03 | 0.1000E-01<br>0.1000E-01 | 0.5000E+03<br>0.5000E+03 |

| SET | LAYER | MODEL | GAMMA<br>pcf             | CU<br>psf                | E50                      | Cavg<br>psf              |
|-----|-------|-------|--------------------------|--------------------------|--------------------------|--------------------------|
| 2   | 3     | 6     | 0.1150E+03<br>0.1150E+03 | 0.5000E+03<br>0.1500E+04 | 0.5000E-02<br>0.5000E-02 | 0.5000E+03<br>0.1500E+04 |

| SET | LAYER | MODEL | PHI<br>deg               | RK<br>lbs/in^3           | GAMMA<br>pcf             |
|-----|-------|-------|--------------------------|--------------------------|--------------------------|
| 2   | 4     | 2     | 0.3000E+02<br>0.3400E+02 | 0.3000E+02<br>0.6000E+02 | 0.1050E+03<br>0.1150E+03 |

| SET | LAYER | MODEL | PHI<br>deg               | RK<br>lbs/in^3           | GAMMA<br>pcf             |
|-----|-------|-------|--------------------------|--------------------------|--------------------------|
| 2   | 5     | 2     | 0.3600E+02<br>0.3600E+02 | 0.7000E+02<br>0.7000E+02 | 0.1200E+03<br>0.1200E+03 |

| SET | LAYER | MODEL | Qu<br>psf  |
|-----|-------|-------|------------|
| 2   | 6     | 8     | 0.5040E+06 |

T-Z SOIL LAYER DATA

-----  
 - SOIL SET # 1 -  
 -----

| SET | LAYER | MODEL | G<br>ksi                 | POISSON                  | TAU MAX<br>psf           | ELEVATION<br>ft          | ELEV. PIEZ.<br>ft        |
|-----|-------|-------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|
| 1   | 1     | 1     | 0.9700E+00<br>0.9700E+00 | 0.3000E+00<br>0.3000E+00 | 0.1000E+00<br>0.1000E+00 | 0.1300E+02<br>0.7200E+01 | 0.5000E+01<br>0.5000E+01 |

| SET | LAYER | MODEL | G<br>ksi | POISSON | TAU MAX<br>psf | ELEVATION<br>ft | ELEV. PIEZ.<br>ft |
|-----|-------|-------|----------|---------|----------------|-----------------|-------------------|
|-----|-------|-------|----------|---------|----------------|-----------------|-------------------|

# FB-Multiplier Output – Abutment 2 (North) – Strength-IV

|     |       |       |                          |                          |                          |                            |                          |
|-----|-------|-------|--------------------------|--------------------------|--------------------------|----------------------------|--------------------------|
| 1   | 2     | 1     | 0.6900E+00<br>0.6900E+00 | 0.4000E+00<br>0.4000E+00 | 0.1000E+00<br>0.1000E+00 | 0.7200E+01<br>0.3800E+01   | 0.5000E+01<br>0.5000E+01 |
| SET | LAYER | MODEL | G<br>ksi                 | POISSON                  | TAU MAX<br>psf           | ELEVATION<br>ft            | ELEV. PIEZ.<br>ft        |
| 1   | 3     | 1     | 0.6900E+00<br>0.6900E+00 | 0.4500E+00<br>0.5000E+00 | 0.1000E+00<br>0.1000E+00 | 0.3800E+01<br>-0.5470E+02  | 0.5000E+01<br>0.5000E+01 |
| SET | LAYER | MODEL | G<br>ksi                 | POISSON                  | TAU MAX<br>psf           | ELEVATION<br>ft            | ELEV. PIEZ.<br>ft        |
| 1   | 4     | 1     | 0.6900E+00<br>0.1460E+01 | 0.3000E+00<br>0.4000E+00 | 0.1000E+00<br>0.1000E+00 | -0.5470E+02<br>-0.6630E+02 | 0.5000E+01<br>0.5000E+01 |
| SET | LAYER | MODEL | G<br>ksi                 | POISSON                  | TAU MAX<br>psf           | ELEVATION<br>ft            | ELEV. PIEZ.<br>ft        |
| 1   | 5     | 1     | 0.2010E+01<br>0.2010E+01 | 0.2500E+00<br>0.2500E+00 | 0.8270E+03<br>0.8270E+03 | -0.6630E+02<br>-0.1322E+03 | 0.5000E+01<br>0.5000E+01 |
| SET | LAYER | MODEL | G<br>ksi                 | POISSON                  | TAU MAX<br>psf           | ELEVATION<br>ft            | ELEV. PIEZ.<br>ft        |
| 1   | 6     | 1     | 0.5200E+03<br>0.5200E+03 | 0.2500E+00<br>0.2500E+00 | 0.5040E+06<br>0.5040E+06 | -0.1322E+03<br>-0.1500E+03 | 0.5000E+01<br>0.5000E+01 |

-----  
- SOIL SET # 2 -  
-----

|     |       |       |                          |                          |                          |                            |                          |
|-----|-------|-------|--------------------------|--------------------------|--------------------------|----------------------------|--------------------------|
| SET | LAYER | MODEL | G<br>ksi                 | POISSON                  | TAU MAX<br>psf           | ELEVATION<br>ft            | ELEV. PIEZ.<br>ft        |
| 2   | 1     | 1     | 0.9700E+00<br>0.9700E+00 | 0.3000E+00<br>0.3000E+00 | 0.1000E+00<br>0.1000E+00 | 0.1300E+02<br>0.7200E+01   | 0.5000E+01<br>0.5000E+01 |
| SET | LAYER | MODEL | G<br>ksi                 | POISSON                  | TAU MAX<br>psf           | ELEVATION<br>ft            | ELEV. PIEZ.<br>ft        |
| 2   | 2     | 1     | 0.6900E+00<br>0.6900E+00 | 0.4500E+00<br>0.4500E+00 | 0.1000E+00<br>0.1000E+00 | 0.7200E+01<br>0.3800E+01   | 0.5000E+01<br>0.5000E+01 |
| SET | LAYER | MODEL | G<br>ksi                 | POISSON                  | TAU MAX<br>psf           | ELEVATION<br>ft            | ELEV. PIEZ.<br>ft        |
| 2   | 3     | 1     | 0.6900E+00<br>0.6900E+00 | 0.4500E+00<br>0.5000E+00 | 0.4000E+03<br>0.1000E+04 | 0.3800E+01<br>-0.5470E+02  | 0.5000E+01<br>0.5000E+01 |
| SET | LAYER | MODEL | G<br>ksi                 | POISSON                  | TAU MAX<br>psf           | ELEVATION<br>ft            | ELEV. PIEZ.<br>ft        |
| 2   | 4     | 1     | 0.6900E+00<br>0.1460E+01 | 0.3000E+00<br>0.4000E+00 | 0.2000E+04<br>0.3500E+04 | -0.5470E+02<br>-0.6630E+02 | 0.5000E+01<br>0.5000E+01 |
| SET | LAYER | MODEL | G<br>ksi                 | POISSON                  | TAU MAX<br>psf           | ELEVATION<br>ft            | ELEV. PIEZ.<br>ft        |
| 2   | 5     | 1     | 0.2010E+01<br>0.2010E+01 | 0.2500E+00<br>0.2500E+00 | 0.4600E+04<br>0.8900E+04 | -0.6630E+02<br>-0.1322E+03 | 0.5000E+01<br>0.5000E+01 |
| SET | LAYER | MODEL | G<br>ksi                 | POISSON                  | TAU MAX<br>psf           | ELEVATION<br>ft            | ELEV. PIEZ.<br>ft        |
| 2   | 6     | 1     | 0.5200E+03<br>0.5200E+03 | 0.2500E+00<br>0.2500E+00 | 0.5040E+06<br>0.5040E+06 | -0.1322E+03<br>-0.1500E+03 | 0.5000E+01<br>0.5000E+01 |

T-THETA SOIL LAYER DATA

-----  
- SOIL SET # 1 -  
-----

|     |       |       |          |                |
|-----|-------|-------|----------|----------------|
| SET | LAYER | MODEL | G<br>ksi | TAU MAX<br>psf |
|-----|-------|-------|----------|----------------|

|     |       |       |                          |                          |
|-----|-------|-------|--------------------------|--------------------------|
| 1   | 1     | 1     | 0.9700E+00<br>0.9700E+00 | 0.1000E+00<br>0.1000E+00 |
| SET | LAYER | MODEL | G<br>ksi                 | TAU MAX<br>psf           |
| 1   | 2     | 1     | 0.6900E+00<br>0.6900E+00 | 0.1000E+00<br>0.1000E+00 |
| SET | LAYER | MODEL | G<br>ksi                 | TAU MAX<br>psf           |
| 1   | 3     | 1     | 0.6900E+00<br>0.6900E+00 | 0.1000E+00<br>0.1000E+00 |
| SET | LAYER | MODEL | G<br>ksi                 | TAU MAX<br>psf           |
| 1   | 4     | 1     | 0.6900E+00<br>0.1460E+01 | 0.1000E+00<br>0.1000E+00 |
| SET | LAYER | MODEL | G<br>ksi                 | TAU MAX<br>psf           |
| 1   | 5     | 1     | 0.2010E+01<br>0.2010E+01 | 0.8270E+03<br>0.8270E+03 |
| SET | LAYER | MODEL | G<br>ksi                 | TAU MAX<br>psf           |
| 1   | 6     | 1     | 0.5200E+03<br>0.5200E+03 | 0.5040E+06<br>0.5040E+06 |

-----  
- SOIL SET # 2 -  
-----

|     |       |       |                          |                          |
|-----|-------|-------|--------------------------|--------------------------|
| SET | LAYER | MODEL | G<br>ksi                 | TAU MAX<br>psf           |
| 2   | 1     | 1     | 0.9700E+00<br>0.9700E+00 | 0.1000E+00<br>0.1000E+00 |
| SET | LAYER | MODEL | G<br>ksi                 | TAU MAX<br>psf           |
| 2   | 2     | 1     | 0.6900E+00<br>0.6900E+00 | 0.1000E+00<br>0.1000E+00 |
| SET | LAYER | MODEL | G<br>ksi                 | TAU MAX<br>psf           |
| 2   | 3     | 1     | 0.6900E+00<br>0.6900E+00 | 0.4000E+03<br>0.1000E+04 |
| SET | LAYER | MODEL | G<br>ksi                 | TAU MAX<br>psf           |
| 2   | 4     | 1     | 0.6900E+00<br>0.1460E+01 | 0.2000E+04<br>0.3500E+04 |
| SET | LAYER | MODEL | G<br>ksi                 | TAU MAX<br>psf           |
| 2   | 5     | 1     | 0.2010E+01<br>0.2010E+01 | 0.4600E+04<br>0.8900E+04 |
| SET | LAYER | MODEL | G<br>ksi                 | TAU MAX<br>psf           |
| 2   | 6     | 1     | 0.5200E+03<br>0.5200E+03 | 0.5040E+06<br>0.5040E+06 |

Q-Z SOIL LAYER DATA

-----  
- SOIL SET # 1 -  
-----

## FB-Multiplier Output – Abutment 2 (North) – Strength-IV

```

-----
Driven Pile (McVay)
Shear Modulus           =      520.0000 ksi
Poisson's Ratio         =      0.2000
Nominal Tip Resistance   =     200.0000 kips

-----
- SOIL SET # 2 -
-----

Driven Pile (McVay)
Shear Modulus           =      520.0000 ksi
Poisson's Ratio         =      0.2000
Nominal Tip Resistance   =     200.0000 kips

*****
*                PILE SECTION DATA                *
*****

NOTE: Pile sets consist of pile segments based on user input.
      The program groups all segments from every pile set and
      assigns a unique section number to each segment.

Number of pile sections      =      3

-----
-                INPUT DATA FOR SECTION : 1        -
-----

File Set Number             =      1
File Set Segment            =      1

Section Length (L)          =     142.00000 ft

-----
Section Nonlinear Properties
-----

- Concrete Stress Strain Properties -
-----

Concrete Strength (FPC)      = 0.5000E+01 ksi
Modulus of Elasticity (EC)   = 0.4287E+04 ksi

No. Gauss Integ. points in the concrete = 60

-----
- Steel Stress Strain Properties -
-----

Mild Steel Yield Stress (FY) = 0.7500E+02 ksi
Modulus of Elasticity (ES)   = 0.2900E+05 ksi

Steel Casing Yield Stress (FY) = 0.8000E+02 ksi
Modulus of Elasticity (ES)   = 0.2900E+05 ksi

- Shape of Section : CIRCULAR

- Reinforcement and Confinement Data

Number of Reinforcement Layers = 1
Diameter                       = 9.6250 in
Tied/Spiral Reinforcement Flag = 1
(Spiral = 1;
Tied = 2)
Confinement Flag               = 0
(Unconfined = 0;
Confined: Tied/Spiral = 1;
Confined: Tied/Spiral w/ Casing = 2;
Confined: Tied/Spiral w/ Confine-Only Casing = 3)

- Total Area of Steel Reinforcement = 4.0000 in^2

WARNING : The number of bars is changed to a multiple of 4.
This is to ensure a symmetric section for the
analysis. The area is changed to result in the
same total area of reinforcement.

```

```

Confinement Flag           = 0
(Unconfined = 0;
Confined: Tied/Spiral = 1;
Confined: Tied/Spiral w/ Casing = 2;
Confined: Tied/Spiral w/ Confine-Only Casing = 3)
Outer Shell Thickness       = 0.5450E+00 in

- Total Area of Steel Reinforcement = 4.0000 in^2

WARNING : The number of bars is changed to a multiple of 4.
This is to ensure a symmetric section for the
analysis. The area is changed to result in the
same total area of reinforcement.

Layer # Bars/Strands Area Layer Dia. Prestressing
      in^2 in ksi
1      4      1.00 0.00 0.00

-----
-                INPUT DATA FOR SECTION : 2        -
-----

File Set Number             =      1
File Set Segment            =      2

Section Length (L)          =     14.000000 ft

-----
Section Nonlinear Properties
-----

- Concrete Stress Strain Properties -
-----

Concrete Strength (FPC)      = 0.5000E+01 ksi
Modulus of Elasticity (EC)   = 0.4287E+04 ksi

No. Gauss Integ. points in the concrete = 60

-----
- Steel Stress Strain Properties -
-----

Mild Steel Yield Stress (FY) = 0.7500E+02 ksi
Modulus of Elasticity (ES)   = 0.2900E+05 ksi

- Shape of Section : CIRCULAR

- Reinforcement and Confinement Data

Number of Reinforcement Layers = 1
Diameter                       = 9.6250 in
Tied/Spiral Reinforcement Flag = 1
(Spiral = 1;
Tied = 2)
Confinement Flag               = 0
(Unconfined = 0;
Confined: Tied/Spiral = 1;
Confined: Tied/Spiral w/ Casing = 2;
Confined: Tied/Spiral w/ Confine-Only Casing = 3)

- Total Area of Steel Reinforcement = 4.0000 in^2

WARNING : The number of bars is changed to a multiple of 4.
This is to ensure a symmetric section for the
analysis. The area is changed to result in the
same total area of reinforcement.

```

## FB-Multiplier Output – Abutment 2 (North) – Strength-IV

|       |                |              |                  |                     |
|-------|----------------|--------------|------------------|---------------------|
| Layer | # Bars/Strands | Area<br>in^2 | Layer Dia.<br>in | Prestressing<br>ksi |
| 1     | 4              | 1.00         | 0.00             | 0.00                |

-----  
INPUT DATA FOR SECTION : 3  
-----

Pile Set Number = 2  
Pile Set Segment = 1  
  
Section Length (L) = 142.00000 ft

### Section Nonlinear Properties

-----  
- Steel Stress Strain Properties -  
-----

H-Pile Yield Stress (FY) = 0.5000E+02 ksi  
Modulus of Elasticity (ES) = 0.2900E+05 ksi

- Shape of Section : USER DEFINED H-PILE

Units are in in  
Orientation : OR = 2 Web along 2 axis  
OR = 3 Web along 3 axis

|       |       |           |              |             |
|-------|-------|-----------|--------------|-------------|
| Depth | Width | Web Width | Flange Width | Orientation |
| 13.8  | 14.7  | 0.615     | 0.615        | 3           |

\*\*\*\*\*  
\* PILE SET DATA \*  
\*\*\*\*\*

NOTE : Piles are organized into pile sets. Each pile set is  
composed of pile segments, as specified by the user.

### List of Pile Sets and Piles

|          |                                   |
|----------|-----------------------------------|
| Pile Set | Piles Assigned to the Pile Set    |
| 1        | 3, 4, 5, 6, 7, 12, 13, 14, 15, 16 |
| 2        | 1, 2, 8, 9, 10, 11, 17, 18        |

### Total length for each Pile Set

|          |              |
|----------|--------------|
| Pile Set | Length<br>in |
| 1        | 1872.00      |
| 2        | 1704.00      |

\*\*\*\*\*  
\* EXTERNAL LOADS APPLIED TO SUBSTRUCTURE \*  
\*\*\*\*\*

-----  
SUBSTRUCTURE # 1  
-----

|      |      |             |             |             |               |               |               |
|------|------|-------------|-------------|-------------|---------------|---------------|---------------|
| NODE | CASE | FXp<br>kips | FYp<br>kips | FZp<br>kips | MXp<br>kip-ft | MYp<br>kip-ft | MZp<br>kip-ft |
|------|------|-------------|-------------|-------------|---------------|---------------|---------------|

|    |   |       |       |        |        |       |      |
|----|---|-------|-------|--------|--------|-------|------|
| 81 | 1 | -1.76 | 24.69 | 457.68 | 181.39 | 34.47 | 0.00 |
| 83 | 1 | -1.76 | 16.60 | 363.29 | 136.86 | 35.56 | 0.00 |
| 85 | 1 | -1.76 | 17.26 | 369.64 | 141.63 | 36.65 | 0.00 |
| 87 | 1 | -1.76 | 17.38 | 374.60 | 144.27 | 37.74 | 0.00 |
| 88 | 1 | -1.76 | 17.68 | 374.01 | 148.11 | 38.83 | 0.00 |
| 90 | 1 | -1.76 | 14.84 | 343.53 | 134.78 | 39.92 | 0.00 |
| 91 | 1 | -1.76 | 14.69 | 330.72 | 133.09 | 39.53 | 0.00 |
| 92 | 1 | -1.76 | 18.58 | 390.94 | 157.56 | 40.66 | 0.00 |
| 94 | 1 | -1.76 | 19.34 | 399.00 | 165.09 | 41.77 | 0.00 |
| 96 | 1 | -1.76 | 19.44 | 405.36 | 167.97 | 42.90 | 0.00 |
| 97 | 1 | -1.76 | 19.74 | 410.92 | 172.77 | 44.04 | 0.00 |
| 99 | 1 | -1.76 | 19.85 | 406.41 | 177.28 | 45.17 | 0.00 |
| 81 | 2 | -1.76 | 17.48 | 274.32 | 140.83 | 34.47 | 0.00 |
| 83 | 2 | -1.76 | 12.09 | 217.76 | 111.77 | 35.56 | 0.00 |
| 85 | 2 | -1.76 | 12.52 | 221.60 | 115.58 | 36.65 | 0.00 |
| 87 | 2 | -1.76 | 12.60 | 224.52 | 117.97 | 37.74 | 0.00 |
| 88 | 2 | -1.76 | 12.80 | 224.09 | 121.16 | 38.83 | 0.00 |
| 90 | 2 | -1.76 | 10.91 | 205.85 | 112.90 | 39.92 | 0.00 |
| 91 | 2 | -1.76 | 10.81 | 198.14 | 111.55 | 39.53 | 0.00 |
| 92 | 2 | -1.76 | 13.40 | 234.28 | 128.52 | 40.66 | 0.00 |
| 94 | 2 | -1.76 | 13.91 | 239.19 | 134.17 | 41.77 | 0.00 |
| 96 | 2 | -1.76 | 13.98 | 243.03 | 136.74 | 42.90 | 0.00 |
| 97 | 2 | -1.76 | 14.18 | 246.29 | 140.61 | 44.04 | 0.00 |
| 99 | 2 | -1.76 | 14.25 | 243.53 | 144.27 | 45.17 | 0.00 |

\*\*\*\*\*  
\* OUTPUT STAGE 2 OF 2: ANALYSIS RESULTS \*  
\*\*\*\*\*

\*\*\*\*\*  
\* RESULTS FOR LOAD CASE 1 \*  
\*\*\*\*\*

\*\*\*\*\*  
\* CONVERGENCE REPORT \*  
\*\*\*\*\*

The solution converged in 16 iterations

### Summary of Maximum Out-Of-Balance Forces (Absolute Values)

FZ = 0.000 kips  
FX = 0.000 kips  
FY = 0.000 kips  
MXX = 0.001 kip-ft  
MYX = 0.000 kip-ft  
MZZ = 0.000 kip-ft

### Summary of Displacements at Pile Heads

|      |            |            |            |
|------|------------|------------|------------|
| NODE | X<br>in    | Y<br>in    | Z<br>in    |
| 1    | -.8289E-02 | 0.1412E-01 | 0.4543E+00 |
| 2    | -.8287E-02 | 0.1448E-01 | 0.4590E+00 |
| 3    | -.8282E-02 | 0.1483E-01 | 0.4607E+00 |
| 4    | -.8278E-02 | 0.1505E-01 | 0.4590E+00 |
| 5    | -.8273E-02 | 0.1524E-01 | 0.4546E+00 |
| 6    | -.8268E-02 | 0.1541E-01 | 0.4477E+00 |
| 7    | -.8264E-02 | 0.1557E-01 | 0.4384E+00 |
| 8    | -.8262E-02 | 0.1570E-01 | 0.4280E+00 |
| 9    | -.8261E-02 | 0.1582E-01 | 0.4165E+00 |

## FB-Multiplier Output – Abutment 2 (North) – Strength-IV

|    |            |            |            |
|----|------------|------------|------------|
| 10 | -.8174E-02 | 0.1412E-01 | 0.5658E+00 |
| 11 | -.8176E-02 | 0.1453E-01 | 0.5709E+00 |
| 12 | -.8181E-02 | 0.1483E-01 | 0.5722E+00 |
| 13 | -.8185E-02 | 0.1505E-01 | 0.5705E+00 |
| 14 | -.8191E-02 | 0.1524E-01 | 0.5661E+00 |
| 15 | -.8195E-02 | 0.1541E-01 | 0.5591E+00 |
| 16 | -.8199E-02 | 0.1557E-01 | 0.5498E+00 |
| 17 | -.8202E-02 | 0.1573E-01 | 0.5369E+00 |
| 18 | -.8202E-02 | 0.1582E-01 | 0.5279E+00 |

---

Sum of Total Soil Spring Forces for Piles

|                   |   |           |      |
|-------------------|---|-----------|------|
| Xp Direction      | = | -21.1378  | kips |
| Yp Direction      | = | 220.5788  | kips |
| Zp Direction      | = | 5537.6148 | kips |
| Sum of Tip Forces | = | 663.7884  | kips |

---

Summary of Pile Forces for Load CASE 1

### 1. Axial Force (kips)

| Pile # | Maximum Force | Minimum Force |
|--------|---------------|---------------|
| 1      | -0.77725E+02  | -0.32494E+03  |
| 2      | -0.78351E+02  | -0.32840E+03  |
| 3      | 0.51142E-01   | -0.23778E+03  |
| 4      | 0.51421E-01   | -0.23702E+03  |
| 5      | 0.52149E-01   | -0.23503E+03  |
| 6      | 0.53288E-01   | -0.23192E+03  |
| 7      | 0.54823E-01   | -0.22770E+03  |
| 8      | -0.73850E+02  | -0.30787E+03  |
| 9      | -0.72134E+02  | -0.30039E+03  |
| 10     | -0.93013E+02  | -0.39543E+03  |
| 11     | -0.93677E+02  | -0.39865E+03  |
| 12     | 0.32469E-01   | -0.28695E+03  |
| 13     | 0.32756E-01   | -0.28621E+03  |
| 14     | 0.33507E-01   | -0.28428E+03  |
| 15     | 0.34686E-01   | -0.28125E+03  |
| 16     | 0.36261E-01   | -0.27718E+03  |
| 17     | -0.89239E+02  | -0.37742E+03  |
| 18     | -0.88038E+02  | -0.37179E+03  |

### 2. Pile Shear Force in 2 Direction (kips)

| Pile # | Maximum Shear | Minimum Shear |
|--------|---------------|---------------|
| 1      | 0.24450E+00   | -0.11276E+01  |
| 2      | 0.23732E+00   | -0.10827E+01  |
| 3      | 0.21514E+00   | -0.54275E+00  |
| 4      | 0.20779E+00   | -0.49302E+00  |
| 5      | 0.19999E+00   | -0.43990E+00  |
| 6      | 0.19323E+00   | -0.39169E+00  |
| 7      | 0.18785E+00   | -0.35207E+00  |
| 8      | 0.18486E+00   | -0.61280E+00  |
| 9      | 0.18550E+00   | -0.59739E+00  |
| 10     | 0.24230E+00   | -0.11083E+01  |
| 11     | 0.23328E+00   | -0.10525E+01  |
| 12     | 0.21439E+00   | -0.52680E+00  |
| 13     | 0.20680E+00   | -0.47803E+00  |
| 14     | 0.19869E+00   | -0.42577E+00  |
| 15     | 0.19136E+00   | -0.37849E+00  |
| 16     | 0.18533E+00   | -0.33996E+00  |

|    |             |              |
|----|-------------|--------------|
| 17 | 0.18672E+00 | -0.59362E+00 |
| 18 | 0.18706E+00 | -0.58436E+00 |

### 3. Pile Shear Force in 3 Direction (kips)

| Pile # | Maximum Shear | Minimum Shear |
|--------|---------------|---------------|
| 1      | 0.33041E+01   | -0.17896E+02  |
| 2      | 0.33214E+01   | -0.17930E+02  |
| 3      | 0.10732E+01   | -0.57897E+01  |
| 4      | 0.10742E+01   | -0.58011E+01  |
| 5      | 0.10730E+01   | -0.58142E+01  |
| 6      | 0.10689E+01   | -0.58284E+01  |
| 7      | 0.10618E+01   | -0.58440E+01  |
| 8      | 0.33804E+01   | -0.18063E+02  |
| 9      | 0.33864E+01   | -0.18076E+02  |
| 10     | 0.33040E+01   | -0.17880E+02  |
| 11     | 0.33257E+01   | -0.17922E+02  |
| 12     | 0.11136E+01   | -0.57337E+01  |
| 13     | 0.11153E+01   | -0.57445E+01  |
| 14     | 0.11162E+01   | -0.57553E+01  |
| 15     | 0.11161E+01   | -0.57655E+01  |
| 16     | 0.11148E+01   | -0.57755E+01  |
| 17     | 0.33815E+01   | -0.18048E+02  |
| 18     | 0.33851E+01   | -0.18057E+02  |

### 4. Bending Moment About 2 Axis (kip-ft and ft)

| Pile | Node | Depth Below Cap | Maximum Moment | Node | Depth Below Cap | Minimum Moment |
|------|------|-----------------|----------------|------|-----------------|----------------|
| 1    | 1    | 0.00000E+00     | 0.1100E+03     | 498  | 0.1420E+02      | -0.16778E+02   |
| 2    | 2    | 0.00000E+00     | 0.1101E+03     | 537  | 0.1420E+02      | -0.16845E+02   |
| 3    | 3    | 0.00000E+00     | 0.2989E+02     | 575  | 0.1170E+02      | -0.59036E+01   |
| 4    | 4    | 0.00000E+00     | 0.2994E+02     | 614  | 0.1170E+02      | -0.59225E+01   |
| 5    | 5    | 0.00000E+00     | 0.3001E+02     | 653  | 0.1170E+02      | -0.59437E+01   |
| 6    | 6    | 0.00000E+00     | 0.3008E+02     | 692  | 0.1170E+02      | -0.59671E+01   |
| 7    | 7    | 0.00000E+00     | 0.3017E+02     | 731  | 0.1170E+02      | -0.59933E+01   |
| 8    | 8    | 0.00000E+00     | 0.1108E+03     | 771  | 0.1420E+02      | -0.17068E+02   |
| 9    | 9    | 0.00000E+00     | 0.1109E+03     | 810  | 0.1420E+02      | -0.17089E+02   |
| 10   | 10   | 0.00000E+00     | 0.1098E+03     | 849  | 0.1420E+02      | -0.16799E+02   |
| 11   | 11   | 0.00000E+00     | 0.1100E+03     | 888  | 0.1420E+02      | -0.16879E+02   |
| 12   | 12   | 0.00000E+00     | 0.2945E+02     | 926  | 0.1170E+02      | -0.59113E+01   |
| 13   | 13   | 0.00000E+00     | 0.2950E+02     | 965  | 0.1170E+02      | -0.59279E+01   |
| 14   | 14   | 0.00000E+00     | 0.2956E+02     | 1004 | 0.1170E+02      | -0.59425E+01   |
| 15   | 15   | 0.00000E+00     | 0.2961E+02     | 1043 | 0.1170E+02      | -0.59540E+01   |
| 16   | 16   | 0.00000E+00     | 0.2967E+02     | 1082 | 0.1170E+02      | -0.59626E+01   |
| 17   | 17   | 0.00000E+00     | 0.1107E+03     | 1122 | 0.1420E+02      | -0.17094E+02   |
| 18   | 18   | 0.00000E+00     | 0.1107E+03     | 1161 | 0.1420E+02      | -0.17109E+02   |

### 5. Bending Moment About 3 Axis (kip-ft and ft)

| Pile | Node | Depth Below Cap | Maximum Moment | Node | Depth Below Cap | Minimum Moment |
|------|------|-----------------|----------------|------|-----------------|----------------|
| 1    | 497  | 0.10650E+02     | 0.1254E+01     | 1    | 0.0000E+00      | -0.43148E+01   |
| 2    | 536  | 0.10650E+02     | 0.1237E+01     | 2    | 0.0000E+00      | -0.40868E+01   |
| 3    | 575  | 0.11700E+02     | 0.8908E+00     | 3    | 0.0000E+00      | -0.20984E+01   |
| 4    | 614  | 0.11700E+02     | 0.8471E+00     | 4    | 0.0000E+00      | -0.18293E+01   |
| 5    | 653  | 0.11700E+02     | 0.8018E+00     | 5    | 0.0000E+00      | -0.15396E+01   |
| 6    | 692  | 0.11700E+02     | 0.7598E+00     | 6    | 0.0000E+00      | -0.12763E+01   |
| 7    | 731  | 0.11700E+02     | 0.7253E+00     | 7    | 0.0000E+00      | -0.10589E+01   |
| 8    | 770  | 0.10650E+02     | 0.1067E+01     | 8    | 0.0000E+00      | -0.16193E+01   |
| 9    | 809  | 0.10650E+02     | 0.1061E+01     | 9    | 0.0000E+00      | -0.15363E+01   |
| 10   | 848  | 0.10650E+02     | 0.1239E+01     | 10   | 0.0000E+00      | -0.42602E+01   |
| 11   | 887  | 0.10650E+02     | 0.1218E+01     | 11   | 0.0000E+00      | -0.39765E+01   |
| 12   | 926  | 0.11700E+02     | 0.8723E+00     | 12   | 0.0000E+00      | -0.20419E+01   |
| 13   | 965  | 0.11700E+02     | 0.8282E+00     | 13   | 0.0000E+00      | -0.17799E+01   |

## FB-Multiplier Output – Abutment 2 (North) – Strength-IV

|    |      |             |            |    |            |              |
|----|------|-------------|------------|----|------------|--------------|
| 14 | 1004 | 0.11700E+02 | 0.7809E+00 | 14 | 0.0000E+00 | -0.14982E+01 |
| 15 | 1043 | 0.11700E+02 | 0.7380E+00 | 15 | 0.0000E+00 | -0.12426E+01 |
| 16 | 1082 | 0.11700E+02 | 0.7029E+00 | 16 | 0.0000E+00 | -0.10336E+01 |
| 17 | 1121 | 0.10650E+02 | 0.1059E+01 | 17 | 0.0000E+00 | -0.15620E+01 |
| 18 | 1160 | 0.10650E+02 | 0.1055E+01 | 18 | 0.0000E+00 | -0.15117E+01 |

\*\*\*\*\*  
 \* RESULTS FOR LOAD CASE 2 \*  
 \*\*\*\*\*

\*\*\*\*\*  
 \* CONVERGENCE REPORT \*  
 \*\*\*\*\*

The solution converged in 19 iterations

### Summary of Maximum Out-Of-Balance Forces (Absolute Values)

FZ = 0.000 kips  
 FX = 0.000 kips  
 FY = 0.000 kips  
 MXX = 0.001 kip-ft  
 MYY = 0.000 kip-ft  
 MZZ = 0.000 kip-ft

### Summary of Displacements at Pile Heads

| NODE | X          | Y          | Z          |
|------|------------|------------|------------|
|      | in         | in         | in         |
| 1    | -.7303E-02 | 0.2142E-01 | 0.3050E+00 |
| 2    | -.7302E-02 | 0.2158E-01 | 0.3064E+00 |
| 3    | -.7299E-02 | 0.2173E-01 | 0.3059E+00 |
| 4    | -.7295E-02 | 0.2182E-01 | 0.3038E+00 |
| 5    | -.7292E-02 | 0.2189E-01 | 0.2999E+00 |
| 6    | -.7289E-02 | 0.2195E-01 | 0.2944E+00 |
| 7    | -.7286E-02 | 0.2199E-01 | 0.2875E+00 |
| 8    | -.7284E-02 | 0.2202E-01 | 0.2798E+00 |
| 9    | -.7284E-02 | 0.2205E-01 | 0.2715E+00 |
| 10   | -.7251E-02 | 0.2142E-01 | 0.3442E+00 |
| 11   | -.7253E-02 | 0.2160E-01 | 0.3457E+00 |
| 12   | -.7256E-02 | 0.2173E-01 | 0.3451E+00 |
| 13   | -.7259E-02 | 0.2182E-01 | 0.3430E+00 |
| 14   | -.7263E-02 | 0.2189E-01 | 0.3391E+00 |
| 15   | -.7266E-02 | 0.2195E-01 | 0.3336E+00 |
| 16   | -.7269E-02 | 0.2199E-01 | 0.3266E+00 |
| 17   | -.7271E-02 | 0.2203E-01 | 0.3172E+00 |
| 18   | -.7271E-02 | 0.2205E-01 | 0.3107E+00 |

### Sum of Total Soil Spring Forces for Piles

|                   |   |           |      |
|-------------------|---|-----------|------|
| Xp Direction      | = | -21.1203  | kips |
| Yp Direction      | = | 159.9850  | kips |
| Zp Direction      | = | 3684.1206 | kips |
| Sum of Tip Forces | = | 444.3690  | kips |

### Summary of Pile Forces for Load CASE 2

#### 1. Axial Force (kips)

| Pile # | Maximum Force | Minimum Force |
|--------|---------------|---------------|
| 1      | -0.54686E+02  | -0.22561E+03  |
| 2      | -0.54921E+02  | -0.22661E+03  |
| 3      | 0.76312E-01   | -0.16474E+03  |
| 4      | 0.76639E-01   | -0.16370E+03  |
| 5      | 0.77231E-01   | -0.16182E+03  |
| 6      | 0.78057E-01   | -0.15917E+03  |
| 7      | 0.79103E-01   | -0.15579E+03  |
| 8      | -0.50594E+02  | -0.20820E+03  |
| 9      | -0.49226E+02  | -0.20238E+03  |
| 10     | -0.60957E+02  | -0.25231E+03  |
| 11     | -0.61203E+02  | -0.25336E+03  |
| 12     | 0.70198E-01   | -0.18357E+03  |
| 13     | 0.70539E-01   | -0.18254E+03  |
| 14     | 0.71157E-01   | -0.18068E+03  |
| 15     | 0.72020E-01   | -0.17805E+03  |
| 16     | 0.73115E-01   | -0.17470E+03  |
| 17     | -0.56653E+02  | -0.23398E+03  |
| 18     | -0.55602E+02  | -0.22951E+03  |

#### 2. Pile Shear Force in 2 Direction (kips)

| Pile # | Maximum Shear | Minimum Shear |
|--------|---------------|---------------|
| 1      | 0.27624E+00   | -0.11823E+01  |
| 2      | 0.27423E+00   | -0.11486E+01  |
| 3      | 0.27453E+00   | -0.58333E+00  |
| 4      | 0.26358E+00   | -0.54579E+00  |
| 5      | 0.25181E+00   | -0.50553E+00  |
| 6      | 0.24114E+00   | -0.46918E+00  |
| 7      | 0.23225E+00   | -0.43887E+00  |
| 8      | 0.25959E+00   | -0.79301E+00  |
| 9      | 0.25890E+00   | -0.78141E+00  |
| 10     | 0.27549E+00   | -0.11724E+01  |
| 11     | 0.27305E+00   | -0.11306E+01  |
| 12     | 0.27330E+00   | -0.57766E+00  |
| 13     | 0.26250E+00   | -0.54057E+00  |
| 14     | 0.25093E+00   | -0.50086E+00  |
| 15     | 0.24043E+00   | -0.46491E+00  |
| 16     | 0.23174E+00   | -0.43526E+00  |
| 17     | 0.25978E+00   | -0.78405E+00  |
| 18     | 0.25937E+00   | -0.77714E+00  |

#### 3. Pile Shear Force in 3 Direction (kips)

| Pile # | Maximum Shear | Minimum Shear |
|--------|---------------|---------------|
| 1      | 0.32413E+01   | -0.11884E+02  |
| 2      | 0.32479E+01   | -0.11906E+02  |
| 3      | 0.14273E+01   | -0.38485E+01  |
| 4      | 0.14300E+01   | -0.38554E+01  |
| 5      | 0.14323E+01   | -0.38620E+01  |
| 6      | 0.14340E+01   | -0.38678E+01  |
| 7      | 0.14350E+01   | -0.38724E+01  |
| 8      | 0.32644E+01   | -0.11984E+02  |
| 9      | 0.32647E+01   | -0.11989E+02  |
| 10     | 0.32444E+01   | -0.11879E+02  |
| 11     | 0.32522E+01   | -0.11907E+02  |
| 12     | 0.14312E+01   | -0.38391E+01  |
| 13     | 0.14339E+01   | -0.38463E+01  |
| 14     | 0.14362E+01   | -0.38532E+01  |
| 15     | 0.14378E+01   | -0.38591E+01  |
| 16     | 0.14387E+01   | -0.38641E+01  |

## FB-Multiplier Output – Abutment 2 (North) – Strength-IV

17 0.32677E+01 -0.11980E+02  
18 0.32679E+01 -0.11982E+02

### 4. Bending Moment About 2 Axis (kip-ft and ft)

| Pile | Node | Depth Below Cap | Maximum Moment | Node | Depth Below Cap | Minimum Moment |
|------|------|-----------------|----------------|------|-----------------|----------------|
| 1    | 1    | 0.00000E+00     | 0.6019E+02     | 498  | 0.1420E+02      | -0.12061E+02   |
| 2    | 2    | 0.00000E+00     | 0.6029E+02     | 537  | 0.1420E+02      | -0.12102E+02   |
| 3    | 3    | 0.00000E+00     | 0.1706E+02     | 575  | 0.1170E+02      | -0.52043E+01   |
| 4    | 4    | 0.00000E+00     | 0.1709E+02     | 614  | 0.1170E+02      | -0.52155E+01   |
| 5    | 5    | 0.00000E+00     | 0.1711E+02     | 653  | 0.1170E+02      | -0.52251E+01   |
| 6    | 6    | 0.00000E+00     | 0.1714E+02     | 692  | 0.1170E+02      | -0.52326E+01   |
| 7    | 7    | 0.00000E+00     | 0.1715E+02     | 731  | 0.1170E+02      | -0.52379E+01   |
| 8    | 8    | 0.00000E+00     | 0.6064E+02     | 771  | 0.1420E+02      | -0.12207E+02   |
| 9    | 9    | 0.00000E+00     | 0.6066E+02     | 810  | 0.1420E+02      | -0.12213E+02   |
| 10   | 10   | 0.00000E+00     | 0.6017E+02     | 849  | 0.1420E+02      | -0.12065E+02   |
| 11   | 11   | 0.00000E+00     | 0.6031E+02     | 888  | 0.1420E+02      | -0.12115E+02   |
| 12   | 12   | 0.00000E+00     | 0.1701E+02     | 926  | 0.1170E+02      | -0.52064E+01   |
| 13   | 13   | 0.00000E+00     | 0.1704E+02     | 965  | 0.1170E+02      | -0.52178E+01   |
| 14   | 14   | 0.00000E+00     | 0.1707E+02     | 1004 | 0.1170E+02      | -0.52276E+01   |
| 15   | 15   | 0.00000E+00     | 0.1710E+02     | 1043 | 0.1170E+02      | -0.52350E+01   |
| 16   | 16   | 0.00000E+00     | 0.1712E+02     | 1082 | 0.1170E+02      | -0.52403E+01   |
| 17   | 17   | 0.00000E+00     | 0.6062E+02     | 1122 | 0.1420E+02      | -0.12214E+02   |
| 18   | 18   | 0.00000E+00     | 0.6063E+02     | 1161 | 0.1420E+02      | -0.12216E+02   |

### 5. Bending Moment About 3 Axis (kip-ft and ft)

| Pile | Node | Depth Below Cap | Maximum Moment | Node | Depth Below Cap | Minimum Moment |
|------|------|-----------------|----------------|------|-----------------|----------------|
| 1    | 497  | 0.10650E+02     | 0.1373E+01     | 1    | 0.0000E+00      | -0.40997E+01   |
| 2    | 536  | 0.10650E+02     | 0.1353E+01     | 2    | 0.0000E+00      | -0.39403E+01   |
| 3    | 575  | 0.11700E+02     | 0.9577E+00     | 3    | 0.0000E+00      | -0.20944E+01   |
| 4    | 614  | 0.11700E+02     | 0.9158E+00     | 4    | 0.0000E+00      | -0.19026E+01   |
| 5    | 653  | 0.11700E+02     | 0.8707E+00     | 5    | 0.0000E+00      | -0.16963E+01   |
| 6    | 692  | 0.11700E+02     | 0.8298E+00     | 6    | 0.0000E+00      | -0.15097E+01   |
| 7    | 731  | 0.11700E+02     | 0.7957E+00     | 7    | 0.0000E+00      | -0.13534E+01   |
| 8    | 770  | 0.10650E+02     | 0.1146E+01     | 8    | 0.0000E+00      | -0.21984E+01   |
| 9    | 809  | 0.10650E+02     | 0.1139E+01     | 9    | 0.0000E+00      | -0.21397E+01   |
| 10   | 848  | 0.10650E+02     | 0.1364E+01     | 10   | 0.0000E+00      | -0.40719E+01   |
| 11   | 887  | 0.10650E+02     | 0.1340E+01     | 11   | 0.0000E+00      | -0.38730E+01   |
| 12   | 926  | 0.11700E+02     | 0.9517E+00     | 12   | 0.0000E+00      | -0.20762E+01   |
| 13   | 965  | 0.11700E+02     | 0.9104E+00     | 13   | 0.0000E+00      | -0.18862E+01   |
| 14   | 1004 | 0.11700E+02     | 0.8661E+00     | 14   | 0.0000E+00      | -0.16822E+01   |
| 15   | 1043 | 0.11700E+02     | 0.8259E+00     | 15   | 0.0000E+00      | -0.14970E+01   |
| 16   | 1082 | 0.11700E+02     | 0.7926E+00     | 16   | 0.0000E+00      | -0.13437E+01   |
| 17   | 1121 | 0.10650E+02     | 0.1141E+01     | 17   | 0.0000E+00      | -0.21675E+01   |
| 18   | 1160 | 0.10650E+02     | 0.1137E+01     | 18   | 0.0000E+00      | -0.21321E+01   |

\*\*\*\*\*  
\* SUBSTRUCTURE 1 MAX/MIN RESPONSES FOR ALL LOAD CASES \*  
\*\*\*\*\*

### Pile demands

| Demand type                    | Value       | Unit   | Load case | Load comb. | Pile |
|--------------------------------|-------------|--------|-----------|------------|------|
| Max axial force (tension is +) | 0.7910E-01  | kips   | 2         | 0          | 7    |
| Min axial force                | -0.3987E+03 | kips   | 1         | 0          | 11   |
| Max shear in 2 direction       | 0.2762E+00  | kips   | 2         | 0          | 1    |
| Min shear in 2 direction       | -0.1182E+01 | kips   | 2         | 0          | 1    |
| Max shear in 3 direction       | 0.3386E+01  | kips   | 1         | 0          | 9    |
| Min shear in 3 direction       | -0.1808E+02 | kips   | 1         | 0          | 9    |
| Max moment about 2 axis        | 0.1109E+03  | kip-ft | 1         | 0          | 9    |
| Min moment about 2 axis        | -0.1711E+02 | kip-ft | 1         | 0          | 18   |
| Max moment about 3 axis        | 0.1373E+01  | kip-ft | 2         | 0          | 1    |

Min moment about 3 axis -0.4315E+01 kip-ft 1 0 1  
Max torsional force -0.7267E-74 kip-ft 2 0 9  
Min torsional force -0.2086E-02 kip-ft 1 0 12  
Max demand/capacity ratio 0.5921E+00 1 0 11

### Soil demands

| Demand type              | Value       | Unit   | Load case | Load comb. | Pile |
|--------------------------|-------------|--------|-----------|------------|------|
| Max Zp soil force        | 0.1724E+03  | kips   | 1         | 0          | 12   |
| Min Zp soil force        | 0.5040E-03  | kips   | 2         | 0          | 7    |
| Max Xp soil force        | 0.3149E+00  | kips   | 2         | 0          | 3    |
| Min Xp soil force        | -0.8937E+00 | kips   | 2         | 0          | 1    |
| Max Yp soil force        | 0.7652E+01  | kips   | 1         | 0          | 18   |
| Min Yp soil force        | -0.3688E+01 | kips   | 1         | 0          | 18   |
| Max torsional soil force | 0.5338E-03  | kip-ft | 1         | 0          | 1    |

### Pile head displacements

| Displacement type  | Value       | Unit | Load case | Load comb. | Pile |
|--------------------|-------------|------|-----------|------------|------|
| Max Z displacement | 0.5722E+00  | in   | 1         | 0          | 12   |
| Min Z displacement | 0.2715E+00  | in   | 2         | 0          | 9    |
| Max X displacement | -0.7251E-02 | in   | 2         | 0          | 10   |
| Min X displacement | -0.8289E-02 | in   | 1         | 0          | 1    |
| Max Y displacement | 0.2205E-01  | in   | 2         | 0          | 9    |
| Min Y displacement | 0.1412E-01  | in   | 1         | 0          | 1    |



## FB-Multiplier Output – Wingwall – Strength-I

```

*****
*
*   The University of Florida, Florida Department of
*   Transportation, Marc Hoyt, Mike McVay, Cliff Hays,
*   Mark Williams, Petros Christou, Jae Chung,
*   Gary Consolazio, and Michael Davidson
*   disclaim any warranty, expressed or implied,
*   including but not limited to, any implied
*   warranty of fitness for a particular purpose
*   or accuracy of the FB-Multiplier software. The
*   developers shall not be liable for any damages
*   incurred through the use of FB-Multiplier.
*
*
*   :::: F B - M U L T I P L I E R ::::
*   v5.6.0
*
*   Written by Marc Hoyt, Mike McVay, Cliff Hays,
*   Mark Williams, Petros Christou, Jae Chung,
*   Gary Consolazio, and Michael Davidson.
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*
*   FB-Multiplier calculates the response of
*   bridge-pier-pile-soil structures.
*
*   FB-Multiplier analysis types include preload,
*   static, pushover, modal, and transient dynamic.
*
*   FB-Multiplier accounts for linear and nonlinear
*   pile and pier structural members, linear pile caps
*   and superstructure, and nonlinear soil behavior.
*
*   Contact the Bridge Software Institute for support
*   https://bsi.ce.ufl.edu
*
*****

```

```

Analysis Start   = 10:45pm
Analysis End     = 10:45pm
Analysis Duration = 2 second(s)

```

```

Input Data File Name = East WW - STR I.in
Analysis Date       = 4- 2-2020
License ID Number   = 432000000

```

```

*****
*   OUTPUT STAGE 1 OF 2: INTERPRETATION OF INPUT FILE
*   *****

```

```

*****
*   PROJECT DATA
*   *****

```

```

Project client   = MaineDOT
Project name     = Veranda Street Bridge Replacement
Project manager  = T. Cote
Computed by      = A. Piccolino
Project description = 75297 - Abutment 1 East Wingwall - Strength I

```

```

*****
*   SELECTIVE PRINT OUTPUT CONTROL
*   *****

```

| Print Flag                                 | State |
|--|-------|
| Pile displacements                         | Off   |
| Pile element forces                        | Off   |
| Pile ID numbers                            | Off   |
| Pile cap stresses                          | Off   |
| Substructure coordinates                   | Off   |
| Substructure interaction diagrams          | Off   |
| Substructure material stress-strain curves | Off   |
| Substructure member section properties     | Off   |
| Pier columns and pier cap displacements    | Off   |
| Pier columns and pier cap forces           | On    |
| Soil response forces                       | Off   |
| Soil data per layer                        | On    |
| Soil curve data per pile node              | Off   |
| Soil resistance curves                     | Off   |
| Bridge span properties                     | Off   |
| Bridge span temperature data               | Off   |
| Bridge span displacements                  | Off   |
| Bridge span element forces                 | Off   |
| Discrete spring forces                     | Off   |
| Out of balance forces                      | Off   |
| XML output                                 | Off   |
| Eigenvectors                               | Off   |

```

*****
*   ANALYSIS CONTROL INFORMATION
*   *****

```

```

Memory specified for solution = 1024 MB

```

```

Number of cores = 1

```

```

Type of analysis = Static

```

```

-----
- Linear / Nonlinear analysis settings
-----

```

```

Soil stiffness = Nonlinear
Pile stiffness = Nonlinear

```

```

-----
- Miscellaneous analysis settings
-----

```

```

Units = English (kips & ft; lbs & in)

```

```

Convergence tolerance = 0.10 kips
Maximum number of iterations = 100

```

```

Number of substructures = 1

```

# FB-Multiplier Output – Wingwall – Strength-I

\*\*\*\*\*  
 \* SOIL BEHAVIOR \*  
 \*\*\*\*\*

Springs are defined at the following DOF for embedded nodes:  
 X-TRANSLATION Y-TRANSLATION Z-TRANSLATION  
 Z-ROTATION

\*\*\*\*\*  
 \* LOAD FACTORS FOR SELF WEIGHT AND BUOYANCY \*  
 \*\*\*\*\*

| LOAD CASE NO. | SELF WEIGHT FACTOR | BUOYANCY FACTOR |
|---------------|--------------------|-----------------|
| 1             | 1.00               | 1.00            |

\*\*\*\*\*  
 \* PILE CAP DATA \*  
 \*\*\*\*\*

NOTE: Xp-Grid: Distance between axes along Xp axis  
 Yp-Grid: Distance between axes along Yp axis

Number of Grid Points in Xp direction (NPX) = 4  
 Number of Grid Points in Yp direction (NPY) = 5

Grid Spacing in the Xp direction (in):  
 69.00 192.00 78.00

Grid Spacing in the Yp direction (in):  
 18.00 66.00 6.00 18.00

\*\*\*\*\*  
 \* PILE TO PILE CAP CONNECTION \*  
 \*\*\*\*\*

Pile head fixity = FIXED

\*\*\*\*\*  
 \* INPUT SOIL LAYER DATA \*  
 \*\*\*\*\*

P-Y SOIL LAYER DATA

-----  
 - SOIL SET # 1 -  
 -----

| SET | LAYER | MODEL | PHI<br>deg               | RK<br>lbs/in^3           | GAMMA<br>pcf             |                          |
|-----|-------|-------|--------------------------|--------------------------|--------------------------|--------------------------|
| 1   | 1     | 2     | 0.3200E+02<br>0.3200E+02 | 0.9000E+02<br>0.9000E+02 | 0.1100E+03<br>0.1100E+03 |                          |
| SET | LAYER | MODEL | GAMMA<br>pcf             | CU<br>psf                | E50                      |                          |
| 1   | 2     | 4     | 0.1050E+03<br>0.1050E+03 | 0.3500E+03<br>0.3500E+03 | 0.1000E-01<br>0.1000E-01 |                          |
| SET | LAYER | MODEL | GAMMA<br>pcf             | CU<br>psf                | E50                      | Cavg<br>psf              |
| 1   | 3     | 6     | 0.1150E+03<br>0.1150E+03 | 0.5000E+03<br>0.1500E+04 | 0.5000E-02<br>0.5000E-02 | 0.5000E+03<br>0.1500E+04 |

| SET | LAYER | MODEL | PHI<br>deg               | RK<br>lbs/in^3           | GAMMA<br>pcf             |
|-----|-------|-------|--------------------------|--------------------------|--------------------------|
| 1   | 4     | 2     | 0.3000E+02<br>0.3400E+02 | 0.3000E+02<br>0.6000E+02 | 0.1050E+03<br>0.1150E+03 |

| SET | LAYER | MODEL | PHI<br>deg               | RK<br>lbs/in^3           | GAMMA<br>pcf             |
|-----|-------|-------|--------------------------|--------------------------|--------------------------|
| 1   | 5     | 2     | 0.3600E+02<br>0.3600E+02 | 0.7000E+02<br>0.7000E+02 | 0.1200E+03<br>0.1200E+03 |

| SET | LAYER | MODEL | Qu<br>psf  |
|-----|-------|-------|------------|
| 1   | 6     | 8     | 0.5040E+06 |

-----  
 - SOIL SET # 2 -  
 -----

| SET | LAYER | MODEL | PHI<br>deg               | RK<br>lbs/in^3           | GAMMA<br>pcf             |
|-----|-------|-------|--------------------------|--------------------------|--------------------------|
| 2   | 1     | 2     | 0.3200E+02<br>0.3200E+02 | 0.9000E+02<br>0.9000E+02 | 0.1100E+03<br>0.1100E+03 |

| SET | LAYER | MODEL | GAMMA<br>pcf             | CU<br>psf                | E50                      | Cavg<br>psf              |
|-----|-------|-------|--------------------------|--------------------------|--------------------------|--------------------------|
| 2   | 2     | 6     | 0.1150E+03<br>0.1150E+03 | 0.5000E+03<br>0.5000E+03 | 0.1000E-01<br>0.1000E-01 | 0.5000E+03<br>0.5000E+03 |

| SET | LAYER | MODEL | GAMMA<br>pcf             | CU<br>psf                | E50                      | Cavg<br>psf              |
|-----|-------|-------|--------------------------|--------------------------|--------------------------|--------------------------|
| 2   | 3     | 6     | 0.1150E+03<br>0.1150E+03 | 0.5000E+03<br>0.1500E+04 | 0.5000E-02<br>0.5000E-02 | 0.5000E+03<br>0.1500E+04 |

| SET | LAYER | MODEL | PHI<br>deg               | RK<br>lbs/in^3           | GAMMA<br>pcf             |
|-----|-------|-------|--------------------------|--------------------------|--------------------------|
| 2   | 4     | 2     | 0.3000E+02<br>0.3400E+02 | 0.3000E+02<br>0.6000E+02 | 0.1050E+03<br>0.1150E+03 |

| SET | LAYER | MODEL | PHI<br>deg               | RK<br>lbs/in^3           | GAMMA<br>pcf             |
|-----|-------|-------|--------------------------|--------------------------|--------------------------|
| 2   | 5     | 2     | 0.3600E+02<br>0.3600E+02 | 0.7000E+02<br>0.7000E+02 | 0.1200E+03<br>0.1200E+03 |

| SET | LAYER | MODEL | Qu<br>psf  |
|-----|-------|-------|------------|
| 2   | 6     | 8     | 0.5040E+06 |

T-Z SOIL LAYER DATA

-----  
 - SOIL SET # 1 -  
 -----

| SET | LAYER | MODEL | G<br>ksi                 | POISSON                  | TAU MAX<br>psf           | ELEVATION<br>ft          | ELEV. PIEZ.<br>ft        |
|-----|-------|-------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|
| 1   | 1     | 1     | 0.9700E+00<br>0.9700E+00 | 0.3000E+00<br>0.3000E+00 | 0.1000E+00<br>0.1000E+00 | 0.1200E+02<br>0.8200E+01 | 0.5000E+01<br>0.5000E+01 |

| SET | LAYER | MODEL | G<br>ksi                 | POISSON                  | TAU MAX<br>psf           | ELEVATION<br>ft          | ELEV. PIEZ.<br>ft        |
|-----|-------|-------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|
| 1   | 2     | 1     | 0.6900E+00<br>0.6900E+00 | 0.4000E+00<br>0.4000E+00 | 0.1000E+00<br>0.1000E+00 | 0.8200E+01<br>0.5000E+01 | 0.5000E+01<br>0.5000E+01 |

| SET | LAYER | MODEL | G | POISSON | TAU MAX | ELEVATION | ELEV. PIEZ. |
|-----|-------|-------|---|---------|---------|-----------|-------------|
|-----|-------|-------|---|---------|---------|-----------|-------------|

# FB-Multiplier Output – Wingwall – Strength-I

|     |       |       |                                 |                          |                                 |                                 |                                |
|-----|-------|-------|---------------------------------|--------------------------|---------------------------------|---------------------------------|--------------------------------|
| 1   | 3     | 1     | ksi<br>0.6900E+00<br>0.6900E+00 | 0.4500E+00<br>0.5000E+00 | psf<br>0.1000E+00<br>0.1000E+00 | ft<br>0.5000E+01<br>-0.4960E+02 | ft<br>0.5000E+01<br>0.5000E+01 |
| SET | LAYER | MODEL | G<br>ksi                        | POISSON                  | TAU MAX<br>psf                  | ELEVATION<br>ft                 | ELEV. PIEZ.<br>ft              |
| 1   | 4     | 1     | 0.6900E+00<br>0.1460E+01        | 0.3000E+00<br>0.4000E+00 | 0.1000E+00<br>0.1000E+00        | -0.4960E+02<br>-0.6090E+02      | 0.5000E+01<br>0.5000E+01       |
| SET | LAYER | MODEL | G<br>ksi                        | POISSON                  | TAU MAX<br>psf                  | ELEVATION<br>ft                 | ELEV. PIEZ.<br>ft              |
| 1   | 5     | 1     | 0.2010E+01<br>0.2010E+01        | 0.2500E+00<br>0.2500E+00 | 0.8270E+03<br>0.8270E+03        | -0.6090E+02<br>-0.1079E+03      | 0.5000E+01<br>0.5000E+01       |
| SET | LAYER | MODEL | G<br>ksi                        | POISSON                  | TAU MAX<br>psf                  | ELEVATION<br>ft                 | ELEV. PIEZ.<br>ft              |
| 1   | 6     | 1     | 0.5200E+03<br>0.5200E+03        | 0.2500E+00<br>0.2500E+00 | 0.5040E+06<br>0.5040E+06        | -0.1079E+03<br>-0.1300E+03      | 0.5000E+01<br>0.5000E+01       |

-----  
- SOIL SET # 2 -  
-----

|     |       |       |                          |                          |                          |                            |                          |
|-----|-------|-------|--------------------------|--------------------------|--------------------------|----------------------------|--------------------------|
| SET | LAYER | MODEL | G<br>ksi                 | POISSON                  | TAU MAX<br>psf           | ELEVATION<br>ft            | ELEV. PIEZ.<br>ft        |
| 2   | 1     | 1     | 0.9700E+00<br>0.9700E+00 | 0.3000E+00<br>0.3000E+00 | 0.1000E+00<br>0.1000E+00 | 0.1200E+02<br>0.8200E+01   | 0.5000E+01<br>0.5000E+01 |
| SET | LAYER | MODEL | G<br>ksi                 | POISSON                  | TAU MAX<br>psf           | ELEVATION<br>ft            | ELEV. PIEZ.<br>ft        |
| 2   | 2     | 1     | 0.6900E+00<br>0.6900E+00 | 0.4500E+00<br>0.4500E+00 | 0.1000E+00<br>0.4200E+03 | 0.8200E+01<br>0.5000E+01   | 0.5000E+01<br>0.5000E+01 |
| SET | LAYER | MODEL | G<br>ksi                 | POISSON                  | TAU MAX<br>psf           | ELEVATION<br>ft            | ELEV. PIEZ.<br>ft        |
| 2   | 3     | 1     | 0.6900E+00<br>0.6900E+00 | 0.4500E+00<br>0.5000E+00 | 0.4200E+03<br>0.1040E+04 | 0.5000E+01<br>-0.4960E+02  | 0.5000E+01<br>0.5000E+01 |
| SET | LAYER | MODEL | G<br>ksi                 | POISSON                  | TAU MAX<br>psf           | ELEVATION<br>ft            | ELEV. PIEZ.<br>ft        |
| 2   | 4     | 1     | 0.6900E+00<br>0.1460E+01 | 0.3000E+00<br>0.4000E+00 | 0.1840E+04<br>0.3250E+04 | -0.4960E+02<br>-0.6090E+02 | 0.5000E+01<br>0.5000E+01 |
| SET | LAYER | MODEL | G<br>ksi                 | POISSON                  | TAU MAX<br>psf           | ELEVATION<br>ft            | ELEV. PIEZ.<br>ft        |
| 2   | 5     | 1     | 0.2010E+01<br>0.2010E+01 | 0.2500E+00<br>0.2500E+00 | 0.4200E+04<br>0.7240E+04 | -0.6090E+02<br>-0.1079E+03 | 0.5000E+01<br>0.5000E+01 |
| SET | LAYER | MODEL | G<br>ksi                 | POISSON                  | TAU MAX<br>psf           | ELEVATION<br>ft            | ELEV. PIEZ.<br>ft        |
| 2   | 6     | 1     | 0.5200E+03<br>0.5200E+03 | 0.2500E+00<br>0.2500E+00 | 0.5040E+06<br>0.5040E+06 | -0.1079E+03<br>-0.1300E+03 | 0.5000E+01<br>0.5000E+01 |

T-THETA SOIL LAYER DATA

-----  
- SOIL SET # 1 -  
-----

|     |       |       |                          |                          |
|-----|-------|-------|--------------------------|--------------------------|
| SET | LAYER | MODEL | G<br>ksi                 | TAU MAX<br>psf           |
| 1   | 1     | 1     | 0.9700E+00<br>0.9700E+00 | 0.1000E+00<br>0.1000E+00 |

|     |       |       |   |         |
|-----|-------|-------|---|---------|
| SET | LAYER | MODEL | G | TAU MAX |
|-----|-------|-------|---|---------|

|     |       |       |                                 |                                 |
|-----|-------|-------|---------------------------------|---------------------------------|
| 1   | 2     | 1     | ksi<br>0.6900E+00<br>0.6900E+00 | psf<br>0.1000E+00<br>0.1000E+00 |
| SET | LAYER | MODEL | G<br>ksi                        | TAU MAX<br>psf                  |
| 1   | 3     | 1     | 0.6900E+00<br>0.6900E+00        | 0.1000E+00<br>0.1000E+00        |
| SET | LAYER | MODEL | G<br>ksi                        | TAU MAX<br>psf                  |
| 1   | 4     | 1     | 0.6900E+00<br>0.1460E+01        | 0.1000E+00<br>0.1000E+00        |
| SET | LAYER | MODEL | G<br>ksi                        | TAU MAX<br>psf                  |
| 1   | 5     | 1     | 0.2010E+01<br>0.2010E+01        | 0.8270E+03<br>0.8270E+03        |
| SET | LAYER | MODEL | G<br>ksi                        | TAU MAX<br>psf                  |
| 1   | 6     | 1     | 0.5200E+03<br>0.5200E+03        | 0.5040E+06<br>0.5040E+06        |

-----  
- SOIL SET # 2 -  
-----

|     |       |       |                          |                          |
|-----|-------|-------|--------------------------|--------------------------|
| SET | LAYER | MODEL | G<br>ksi                 | TAU MAX<br>psf           |
| 2   | 1     | 1     | 0.9700E+00<br>0.9700E+00 | 0.1000E+00<br>0.1000E+00 |
| SET | LAYER | MODEL | G<br>ksi                 | TAU MAX<br>psf           |
| 2   | 2     | 1     | 0.6900E+00<br>0.6900E+00 | 0.1000E+00<br>0.4200E+03 |
| SET | LAYER | MODEL | G<br>ksi                 | TAU MAX<br>psf           |
| 2   | 3     | 1     | 0.6900E+00<br>0.6900E+00 | 0.4200E+03<br>0.1040E+04 |
| SET | LAYER | MODEL | G<br>ksi                 | TAU MAX<br>psf           |
| 2   | 4     | 1     | 0.6900E+00<br>0.1460E+01 | 0.1840E+04<br>0.3250E+04 |
| SET | LAYER | MODEL | G<br>ksi                 | TAU MAX<br>psf           |
| 2   | 5     | 1     | 0.2010E+01<br>0.2010E+01 | 0.4200E+04<br>0.7240E+04 |
| SET | LAYER | MODEL | G<br>ksi                 | TAU MAX<br>psf           |
| 2   | 6     | 1     | 0.5200E+03<br>0.5200E+03 | 0.5040E+06<br>0.5040E+06 |

Q-Z SOIL LAYER DATA

-----  
- SOIL SET # 1 -  
-----

Driven Pile (McVay)  
Shear Modulus = 520.0000 ksi

## FB-Multiplier Output – Wingwall – Strength-I

```

Poisson's Ratio           =      0.2000
Nominal Tip Resistance     =     200.0000 kips

-----
- SOIL SET # 2 -
-----

Driven Pile (McVay)
Shear Modulus             =     520.0000 ksi
Poisson's Ratio           =      0.2000
Nominal Tip Resistance     =     200.0000 kips

*****
*           PILE SECTION DATA           *
*****

NOTE: Pile sets consist of pile segments based on user input.
      The program groups all segments from every pile set and
      assigns a unique section number to each segment.

Number of pile sections    =      3

-----
-           INPUT DATA FOR SECTION : 1           -
-----

Pile Set Number           =      1
Pile Set Segment          =      1

Section Length (L)        =     117.00000    ft

-----
Section Nonlinear Properties
-----
- Concrete Stress Strain Properties -
-----

Concrete Strength (FPC)    =     0.5000E+01    ksi
Modulus of Elasticity (EC) =     0.4287E+04    ksi

No. Gauss Integ. points in the concrete =      60

-----
- Steel Stress Strain Properties -
-----

Mild Steel Yield Stress (FY) =     0.7500E+02    ksi
Modulus of Elasticity (ES)  =     0.2900E+05    ksi

Steel Casing Yield Stress (FY) =     0.8000E+02    ksi
Modulus of Elasticity (ES)   =     0.2900E+05    ksi

- Shape of Section : CIRCULAR

- Reinforcement and Confinement Data

Number of Reinforcement Layers =      1
Diameter                       =      9.6250    in
Tied/Spiral Reinforcement Flag =      1
(Spiral = 1;
Tied = 2)
Confinement Flag              =      0
(Unconfined = 0;
Confined: Tied/Spiral = 1;
Confined: Tied/Spiral w/ Casing = 2;
Confined: Tied/Spiral w/ Casing = 2;

```

```

Confined: Tied/Spiral w/ Confine-Only Casing = 3)
Outer Shell Thickness        =     0.5450E+00    in

- Total Area of Steel Reinforcement =      4.0000    in^2

WARNING : The number of bars is changed to a multiple of 4.
This is to ensure a symmetric section for the
analysis. The area is changed to result in the
same total area of reinforcement.

Layer  # Bars/Strands   Area   Layer Dia.   Prestressing
      in^2             in          ksi
1         4           1.00     0.00         0.00

-----
-           INPUT DATA FOR SECTION : 2           -
-----

Pile Set Number           =      1
Pile Set Segment          =      2

Section Length (L)        =     15.000000    ft

-----
Section Nonlinear Properties
-----
- Concrete Stress Strain Properties -
-----

Concrete Strength (FPC)    =     0.5000E+01    ksi
Modulus of Elasticity (EC) =     0.4287E+04    ksi

No. Gauss Integ. points in the concrete =      60

-----
- Steel Stress Strain Properties -
-----

Mild Steel Yield Stress (FY) =     0.7500E+02    ksi
Modulus of Elasticity (ES)  =     0.2900E+05    ksi

- Shape of Section : CIRCULAR

- Reinforcement and Confinement Data

Number of Reinforcement Layers =      1
Diameter                       =      9.6250    in
Tied/Spiral Reinforcement Flag =      1
(Spiral = 1;
Tied = 2)
Confinement Flag              =      0
(Unconfined = 0;
Confined: Tied/Spiral = 1;
Confined: Tied/Spiral w/ Casing = 2;
Confined: Tied/Spiral w/ Confine-Only Casing = 3)

- Total Area of Steel Reinforcement =      4.0000    in^2

WARNING : The number of bars is changed to a multiple of 4.
This is to ensure a symmetric section for the
analysis. The area is changed to result in the
same total area of reinforcement.

Layer  # Bars/Strands   Area   Layer Dia.   Prestressing
      in^2             in          ksi
1         4           1.00     0.00         0.00

```

## FB-Multiplier Output – Wingwall – Strength-I

-----  
 - INPUT DATA FOR SECTION : 3 -  
 -----

Pile Set Number = 2  
 Pile Set Segment = 1  
  
 Section Length (L) = 118.00000 ft

### Section Nonlinear Properties

-----  
 - Steel Stress Strain Properties -  
 -----

H-Pile Yield Stress (FY) = 0.5000E+02 ksi  
 Modulus of Elasticity (ES) = 0.2900E+05 ksi

- Shape of Section : USER DEFINED H-PILE

Units are in in

Orientation : OR = 2 Web along 2 axis

OR = 3 Web along 3 axis

| Depth | Width | Web Width | Flange Width | Orientation |
|-------|-------|-----------|--------------|-------------|
| 13.8  | 14.7  | 0.615     | 0.615        | 3           |

\*\*\*\*\*  
 \* PILE SET DATA \*  
 \*\*\*\*\*

NOTE : Piles are organized into pile sets. Each pile set is composed of pile segments, as specified by the user.

### List of Pile Sets and Piles

| Pile Set | Piles Assigned to the Pile Set |
|----------|--------------------------------|
| 1        |                                |
| 2        | 1, 2, 3, 4                     |

### Total length for each Pile Set

| Pile Set | Length in |
|----------|-----------|
| 1        | 1584.00   |
| 2        | 1416.00   |

\*\*\*\*\*  
 \* EXTERNAL LOADS APPLIED TO SUBSTRUCTURE \*  
 \*\*\*\*\*

-----  
 - SUBSTRUCTURE # 1 -  
 -----

| NODE | CASE | FXp<br>kips | FYp<br>kips | FZp<br>kips | MXp<br>kip-ft | MYp<br>kip-ft | MZp<br>kip-ft |
|------|------|-------------|-------------|-------------|---------------|---------------|---------------|
| 11   | 1    | 0.00        | 4.04        | 35.22       | 58.69         | 0.00          | 0.00          |
| 12   | 1    | 0.00        | 13.16       | 117.50      | 181.27        | 0.00          | 0.00          |
| 13   | 1    | 0.00        | 9.12        | 88.56       | 100.55        | 0.00          | 0.00          |
| 14   | 1    | 0.00        | 1.98        | 20.78       | 16.35         | 0.00          | 0.00          |

|    |   |      |       |        |        |      |      |
|----|---|------|-------|--------|--------|------|------|
| 41 | 1 | 0.00 | 7.71  | 67.73  | 110.21 | 0.00 | 0.00 |
| 42 | 1 | 0.00 | 16.16 | 149.36 | 204.94 | 0.00 | 0.00 |
| 43 | 1 | 0.00 | 4.42  | 44.97  | 41.71  | 0.00 | 0.00 |

\*\*\*\*\*  
 \* OUTPUT STAGE 2 OF 2: ANALYSIS RESULTS \*  
 \*\*\*\*\*

\*\*\*\*\*  
 \* RESULTS FOR LOAD CASE 1 \*  
 \*\*\*\*\*

\*\*\*\*\*  
 \* CONVERGENCE REPORT \*  
 \*\*\*\*\*

The solution converged in 21 iterations

### Summary of Maximum Out-Of-Balance Forces (Absolute Values)

FZ = 0.010 kips  
 FX = 0.099 kips  
 FY = 0.000 kips  
 MXX = 0.000 kip-ft  
 MYY = 0.000 kip-ft  
 MZZ = 0.000 kip-ft

### Summary of Displacements at Pile Heads

| NODE | X<br>in    | Y<br>in    | Z<br>in    |
|------|------------|------------|------------|
| 1    | -.1036E-02 | 0.3016E-01 | 0.1572E+00 |
| 2    | -.1036E-02 | 0.2200E-02 | 0.1155E+00 |
| 3    | -.1152E-01 | 0.3016E-01 | 0.2163E+00 |
| 4    | -.1152E-01 | 0.2200E-02 | 0.1745E+00 |

### Sum of Total Soil Spring Forces for Piles

Xp Direction = -0.0129 kips  
 Yp Direction = 56.8323 kips  
 Zp Direction = 709.9680 kips  
 Sum of Tip Forces = 35.7607 kips

### Summary of Pile Forces for Load CASE 1

#### 1. Axial Force (kips)

| Pile # | Maximum Force | Minimum Force |
|--------|---------------|---------------|
| 1      | -0.22539E+02  | -0.16181E+03  |
| 2      | -0.16364E+02  | -0.12405E+03  |
| 3      | -0.31954E+02  | -0.21193E+03  |
| 4      | -0.25224E+02  | -0.17687E+03  |

#### 2. Pile Shear Force in 2 Direction (kips)

## FB-Multiplier Output – Wingwall – Strength-I

| Pile # | Maximum Shear | Minimum Shear |
|--------|---------------|---------------|
| 1      | 0.10669E+01   | -0.16823E+00  |
| 2      | 0.13521E+01   | -0.20193E+00  |
| 3      | 0.34023E+00   | -0.32870E+00  |
| 4      | 0.45178E+00   | -0.66741E+00  |

### 3. Pile Shear Force in 3 Direction (kips)

| Pile # | Maximum Shear | Minimum Shear |
|--------|---------------|---------------|
| 1      | 0.40067E+01   | -0.14947E+02  |
| 2      | 0.25621E+01   | -0.11546E+02  |
| 3      | 0.40148E+01   | -0.14930E+02  |
| 4      | 0.25573E+01   | -0.11510E+02  |

### 4. Bending Moment About 2 Axis (kip-ft and ft)

| Pile | Node | Depth Below Cap | Maximum Moment | Node | Depth Below Cap | Minimum Moment |
|------|------|-----------------|----------------|------|-----------------|----------------|
| 1    | 1    | 0.00000E+00     | 0.8059E+02     | 66   | 0.1180E+02      | -0.14465E+02   |
| 2    | 2    | 0.00000E+00     | 0.6337E+02     | 105  | 0.1180E+02      | -0.86674E+01   |
| 3    | 3    | 0.00000E+00     | 0.8053E+02     | 144  | 0.1180E+02      | -0.14496E+02   |
| 4    | 4    | 0.00000E+00     | 0.6325E+02     | 183  | 0.1180E+02      | -0.86907E+01   |

### 5. Bending Moment About 3 Axis (kip-ft and ft)

| Pile | Node | Depth Below Cap | Maximum Moment | Node | Depth Below Cap | Minimum Moment |
|------|------|-----------------|----------------|------|-----------------|----------------|
| 1    | 1    | 0.00000E+00     | 0.5773E+01     | 66   | 0.1180E+02      | -0.69491E+00   |
| 2    | 2    | 0.00000E+00     | 0.6491E+01     | 105  | 0.1180E+02      | -0.77379E+00   |
| 3    | 142  | 0.59000E+01     | 0.2032E+01     | 145  | 0.1475E+02      | -0.11659E+00   |
| 4    | 181  | 0.59000E+01     | 0.2377E+01     | 184  | 0.1475E+02      | -0.28220E+00   |

\*\*\*\*\*  
 \* SUBSTRUCTURE 1 MAX/MIN RESPONSES FOR ALL LOAD CASES \*  
 \*\*\*\*\*

#### Pile demands

| Demand type                    | Value       | Unit   | Load case | Load comb. | Pile |
|--------------------------------|-------------|--------|-----------|------------|------|
| Max axial force (tension is +) | -0.1636E+02 | kips   | 1         | 0          | 2    |
| Min axial force                | -0.2119E+03 | kips   | 1         | 0          | 3    |
| Max shear in 2 direction       | 0.1352E+01  | kips   | 1         | 0          | 2    |
| Min shear in 2 direction       | -0.6674E+00 | kips   | 1         | 0          | 4    |
| Max shear in 3 direction       | 0.4015E+01  | kips   | 1         | 0          | 3    |
| Min shear in 3 direction       | -0.1495E+02 | kips   | 1         | 0          | 1    |
| Max moment about 2 axis        | 0.8059E+02  | kip-ft | 1         | 0          | 1    |
| Min moment about 2 axis        | -0.1450E+02 | kip-ft | 1         | 0          | 3    |
| Max moment about 3 axis        | 0.6491E+01  | kip-ft | 1         | 0          | 2    |
| Min moment about 3 axis        | -0.7738E+00 | kip-ft | 1         | 0          | 2    |
| Max torsional force            | 0.1169E-01  | kip-ft | 1         | 0          | 1    |
| Min torsional force            | 0.5522E-64  | kip-ft | 1         | 0          | 2    |
| Max demand/capacity ratio      | 0.3454E+00  |        | 1         | 0          | 3    |

#### Soil demands

| Demand type       | Value       | Unit | Load case | Load comb. | Pile |
|-------------------|-------------|------|-----------|------------|------|
| Max Zp soil force | 0.3219E+02  | kips | 1         | 0          | 3    |
| Min Zp soil force | 0.7185E-03  | kips | 1         | 0          | 2    |
| Max Xp soil force | 0.6352E+00  | kips | 1         | 0          | 2    |
| Min Xp soil force | -0.8526E+00 | kips | 1         | 0          | 4    |
| Max Yp soil force | 0.5570E+01  | kips | 1         | 0          | 3    |

|                          |             |        |   |   |   |
|--------------------------|-------------|--------|---|---|---|
| Min Yp soil force        | -0.2836E+01 | kips   | 1 | 0 | 3 |
| Max torsional soil force | -0.5522E-64 | kip-ft | 1 | 0 | 2 |

#### Pile head displacements

| Displacement type  | Value       | Unit | Load case | Load comb. | Pile |
|--------------------|-------------|------|-----------|------------|------|
| Max Z displacement | 0.2163E+00  | in   | 1         | 0          | 3    |
| Min Z displacement | 0.1155E+00  | in   | 1         | 0          | 2    |
| Max X displacement | -0.1036E-02 | in   | 1         | 0          | 1    |
| Min X displacement | -0.1152E-01 | in   | 1         | 0          | 3    |
| Max Y displacement | 0.3016E-01  | in   | 1         | 0          | 3    |
| Min Y displacement | 0.2200E-02  | in   | 1         | 0          | 2    |

## SOIL ASSUMPTIONS

abutments and piers are anticipated to rely primarily on end bearing below the Presumpscot clay, in the glacial till or at top of rock.

## 2.3 Subsurface Material Properties

Geotechnical design parameters for soil and rock were developed for each stratum based on material descriptions, standard published correlations, and engineering judgment. A summary of soil and rock design properties at the proposed bridge abutments and approaches, as interpreted from available borings and laboratory testing, are presented in Table 2-3 below.

**Table 2-3: Engineering Properties of Soil and Rock**

| Layer                            | $\overline{N}_{60}$<br>(bpf) | $\overline{N}_{160}$<br>(bpf) | $\gamma$<br>(pcf) | $\Phi$<br>(deg.) | $S_u$<br>(psf) | $k_{aw}$<br>(pci) | $k_{bw}$<br>(pci) | G<br>(ksi) | E<br>(ksi) |
|----------------------------------|------------------------------|-------------------------------|-------------------|------------------|----------------|-------------------|-------------------|------------|------------|
| 1 – Fill                         | 12                           | 7                             | 110               | 32               | ---            | 90                | 50                | 0.97       | 2.43       |
| 2 – Marine Silt & Clay – Crust   | 5                            | 4                             | 105               | 33*              | 350            | ---               | ---               | 0.69       | 1.67       |
| 3 – Marine Silt & Clay           | 3                            | 3                             | 115               | 34*              | 500-1500       | ---               | ---               | 0.69       | 1.67       |
| 4a – Marine Sand (Loose)         | 3                            | 3                             | 105               | 30               | ---            | 45                | 30                | 0.69       | 1.74       |
| 4b – Marine Sand (Med. To Dense) | 16                           | 14                            | 115               | 34               | ---            | 115               | 60                | 1.46       | 3.68       |
| 5 – Glacial Till                 | 33                           | 26                            | 120               | 36               | ---            | 170               | 70                | 2.01       | 5.38       |
| 6 – Phyllite Bedrock             | ---                          | ---                           | 170               | 25               | --             | ---               | ---               | 520        | 1250       |

Where:  $\overline{N}_{60}$  = Average SPT-N value of stratum, corrected for hammer efficiency, in blows per foot.  
 $\overline{N}_{160}$  = Average SPT-N value of stratum, corrected for hammer efficiency and effective overburden pressure, in blows per foot.  
 $\gamma$  = Total unit weight of soil, based on grain size and relative density per Bowles 4<sup>th</sup> Edition, Table 3-4 and FB-MultiPier Soil Parameter Tables.  
 $\phi$  = Internal friction angle of soil, per multiple SPT-N value correlations. \*Drained friction angle for clays calculated per FHWA GEC No. 5, Figure 74. Values increased by 3 degrees due to overconsolidation.  
 $S_u$  = Undrained shear strength of soil, per plasticity correlations and in-situ vane shear testing.  
 $k$  = Subgrade modulus, based on FB-MultiPier Help Manual and NAVFAC DM7.01 as presented in the FB-MultiPier Soil Parameter Table. AW above water, BW below water.  
G = Shear modulus, taken as  $E / [2(1 + \mu)]$  per Bowles 5th Edition, pg. 121, equation (a).  
E = Elastic modulus, based on grain size and relative density as presented in AASHTO LRFD 7<sup>th</sup> Ed. Table C10.4.6.3-1.

For the phyllite bedrock, unconfined compression test results indicated strengths and elastic parameters which ranged significantly, both above and below typical reference values. From examination of the test specimens it appears that the lower-bound values were likely the result of failures upon preferential failure surfaces and foliation planes. For the selected foundation types, the design sensitivity to variations within the ranges observed will be minimal, therefore lower-bound typical values were assigned to this layer per “AASHTO Standard Specifications for Highway Bridges”, 17<sup>th</sup> Edition, section 4.4.8. A design unconfined compression strength of intact rock of 3.5 ksi is recommended. Additional rock property recommendations specifically applicable to axial analysis are provided in subsequent sections below.

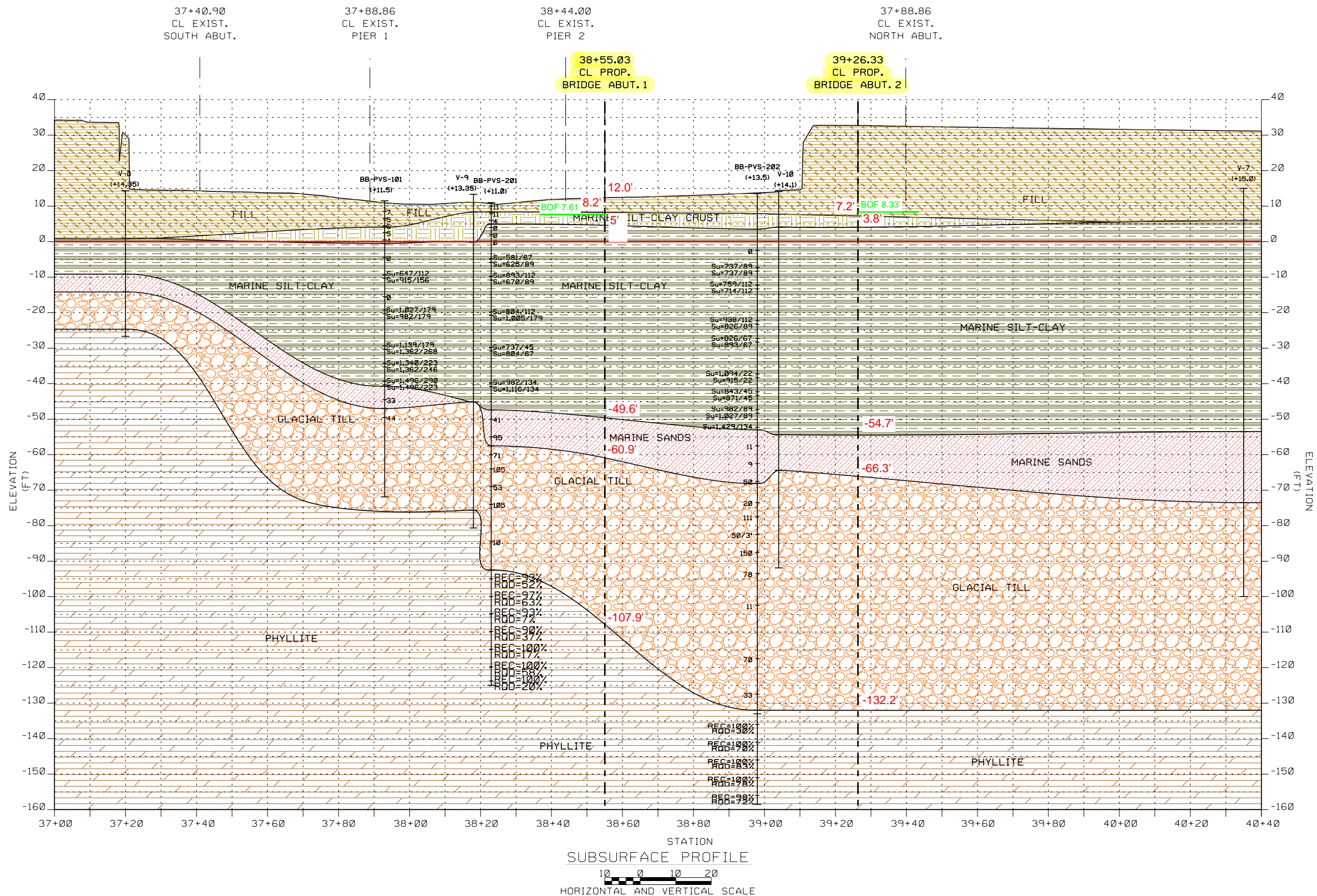


Filename: Subsurface Profile\_11-06-18\_2D.dgn

Date: 6/26/2019

Username:

Division:



- LEGEND:
- FILL
  - MARINE SILT-CLAY CRUST
  - MARINE SILT-CLAY
  - MARINE SANDS
  - GLACIAL TILL
  - PHYLLITE

NOTES:

1. THIS SUBSURFACE PROFILE WAS DEVELOPED THROUGH INTERPRETATION OF WIDELY SPACED TEST BORING DATA AND IT IS NOT MEANT TO BE INTERPRETED AS A 'FOR CONSTRUCTION' DOCUMENT. CONDITIONS WILL VARY FROM THOSE DEPICTED HEREIN.

2. ELEVATIONS ARE IN FEET AND REFERENCE THE NORTH AMERICAN VERTICAL DATUM OF 1988 (NAVD88).

3. THICKNESS OF SOIL STRATA BETWEEN BORINGS ARE ESTIMATED. STRATA BOUNDARIES ARE BASED ON INTERPRETATION OF THE BORINGS AND ARE SHOWN ONLY TO AID IN VISUALIZING SUBSURFACE CONDITION. ACTUAL STRATA BOUNDARIES BETWEEN BORINGS MAY DIFFER FROM THE CONDITIONS SHOWN HEREIN. REFER TO THE BORING LOGS FOR DESCRIPTION OF INDIVIDUAL SAMPLES.

4. SPT-N VALUES GIVEN ARE N60 VALUES, CORRECTED FOR HAMMER TYPE AND EFFICIENCY. REFER TO THE BORING LOGS FOR APPLICABLE EFFICIENCY FACTORS.

|                         |  |                              |  |                   |  |                         |  |              |  |
|-------------------------|--|------------------------------|--|-------------------|--|-------------------------|--|--------------|--|
| STATE OF MAINE          |  | DEPARTMENT OF TRANSPORTATION |  | BRIDGE NO. 5933   |  | WIN 021745.00           |  | BRIDGE PLANS |  |
| VERANDA STREET OVERPASS |  | VERANDA STREET               |  | CUMBERLAND COUNTY |  | WEST SUBSURFACE PROFILE |  | SHEET NUMBER |  |
| PORTLAND                |  | PORTLAND                     |  | PORTLAND          |  | PORTLAND                |  | PORTLAND     |  |
| BY                      |  | DATE                         |  | SIGNATURE         |  | P.E. NUMBER             |  | DATE         |  |
| P. Bishop               |  | A. Stephens                  |  |                   |  |                         |  |              |  |
| DESIGN-DETAILED         |  | CHECKED-REVIEWED             |  | DESIGN-DETAILED   |  | REVISIONS 1             |  | REVISIONS 2  |  |
| N. Wiley                |  | J. Wough                     |  |                   |  | REVISIONS 3             |  | REVISIONS 4  |  |
|                         |  |                              |  |                   |  | FIELD CHANGES           |  |              |  |

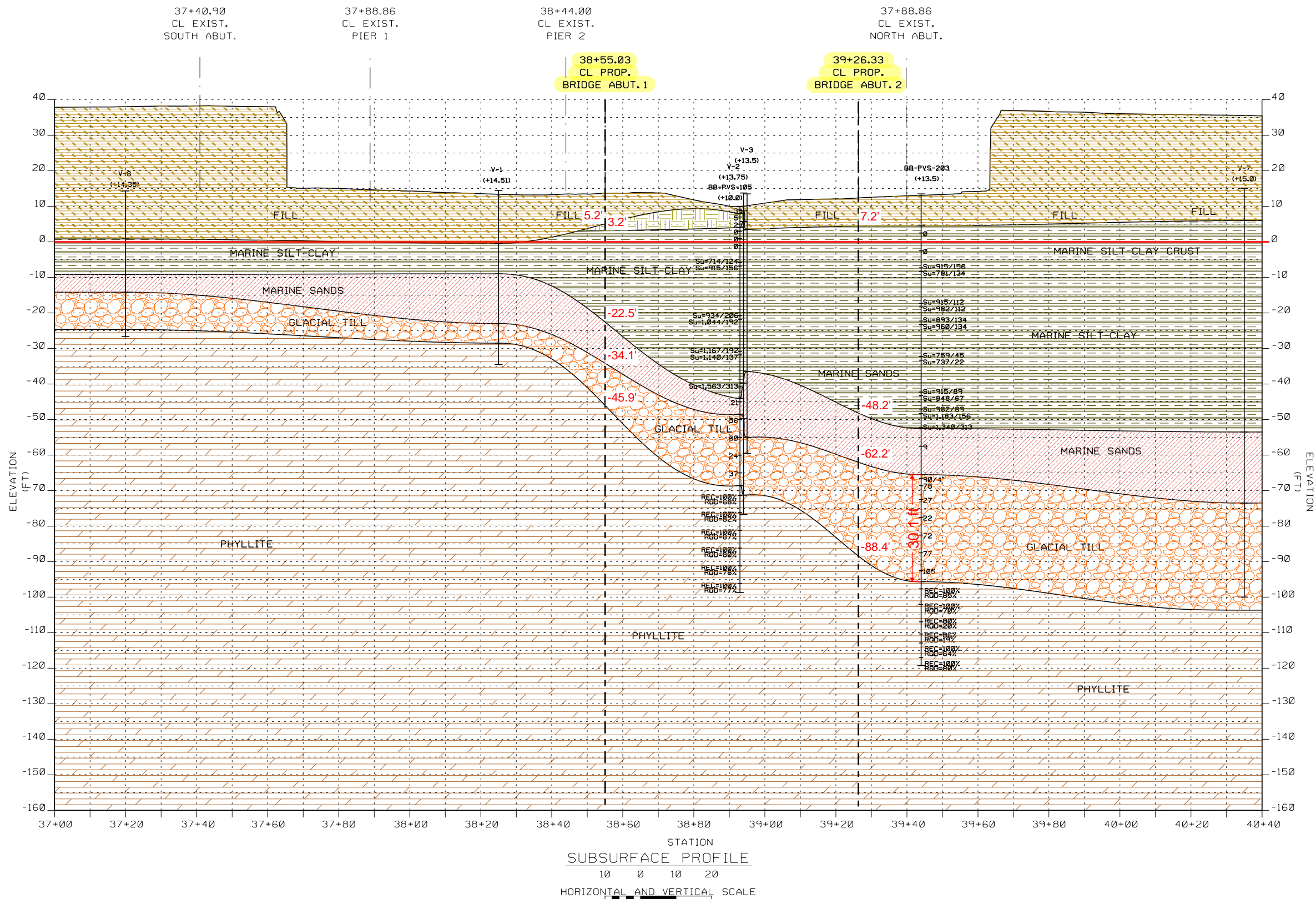
FIGURE 5 - SUBSURFACE PROFILE, WEST SIDE



Date:6/26/2019

Username:

Division: Filename: Subsurface Profile\_11-06-18\_2D.dgn



- LEGEND:
- FILL
  - MARINE SILT-CLAY CRUST
  - MARINE SILT-CLAY
  - MARINE SANDS
  - GLACIAL TILL
  - PHYLLITE

- NOTES:
1. THIS SUBSURFACE PROFILE WAS DEVELOPED THROUGH INTERPRETATION OF WIDELY SPACED TEST BORING DATA AND IT IS NOT MEANT TO BE INTERPRETED AS A 'FOR CONSTRUCTION' DOCUMENT. CONDITIONS WILL VARY FROM THOSE DEPICTED HEREIN.
  2. ELEVATIONS ARE IN FEET AND REFERENCE THE NORTH AMERICAN VERTICAL DATUM OF 1988 (NAVD88)
  3. THICKNESS OF SOIL STRATA BETWEEN BORINGS ARE ESTIMATED. STRATA BOUNDARIES ARE BASED ON INTERPRETATION OF THE BORINGS AND ARE SHOWN ONLY TO AID IN VISUALIZING SUBSURFACE CONDITION. ACTUAL STRATA BOUNDARIES BETWEEN BORINGS MAY DIFFER FROM THE CONDITIONS SHOWN HEREIN. REFER TO THE BORING LOGS FOR DESCRIPTION OF INDIVIDUAL SAMPLES.
  4. SPT-N VALUES GIVEN ARE N60 VALUES, CORRECTED FOR HAMMER TYPE AND EFFICIENCY. REFER TO THE BORING LOGS FOR APPLICABLE EFFICIENCY FACTORS.

STATE OF MAINE  
DEPARTMENT OF TRANSPORTATION

VERANDA STREET OVERPASS  
VERANDA STREET  
PORTLAND  
CUMBERLAND COUNTY

SHEET NUMBER

BRIDGE NO. 5933

WIN 021745.00

BRIDGE PLANS

| PROJ. MANAGER    | BY       | DATE | SIGNATURE | P.E. NUMBER | DATE |
|------------------|----------|------|-----------|-------------|------|
| DESIGN-DETAILED  | N. Wiley |      |           |             |      |
| CHECKED-REVIEWED | J. Wough |      |           |             |      |
| DESIGN-DETAILED  |          |      |           |             |      |
| REVISIONS 1      |          |      |           |             |      |
| REVISIONS 2      |          |      |           |             |      |
| REVISIONS 3      |          |      |           |             |      |
| REVISIONS 4      |          |      |           |             |      |
| FIELD CHANGES    |          |      |           |             |      |

FIGURE 6 - SUBSURFACE PROFILE, EAST SIDE



|         |                                 |            |            |                |        |
|---------|---------------------------------|------------|------------|----------------|--------|
| For     | MEDOT I-295 over Veranda Street | Job no.    | 75297      | Sheet no.      | 1 of 7 |
| Made by | ACP                             | Checked by | JCJ        | Backchecked by | .      |
| Date    | 11/12/2019                      | Date       | 03/20/2020 | Date           | .      |

# MAINEDOT I-295 OVER VERANDA STREET

## FOUNDATION ANALYSIS FOR FINAL DESIGN

### MICROPILE AXIAL/STRUCTURAL ASSESSMENT

|       |                           |             |           |           |        |
|-------|---------------------------|-------------|-----------|-----------|--------|
| For:  | I-295 over Veranda Street | Job Number: | 75297     | Sheet No. | 1 of 3 |
| By:   | ACP                       | Check By:   | JCJ       | Check by: |        |
| Date: | 11/12/2019                | Date:       | 3/20/2020 | Date:     |        |

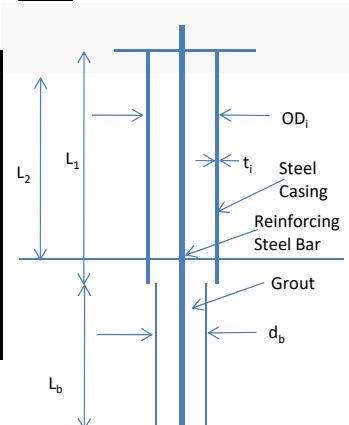
# HNTB

## Axial Resistance of Micropiles - Abutment 1

### Lithology

|            | Lithology              | Included in Grout-to-Ground Bond | Strata Top Elevation (ft) | Nominal Grout-to-Ground Bond Strength, $\alpha_b$ (ksf) | Unit Tip Resistance, $q_p$ (ksf) <sup>1</sup> |
|------------|------------------------|----------------------------------|---------------------------|---|---|
| Stratum 1  | Fill                   | N                                | 12.0                      | 0.0   |   |
| Stratum 2  | Marine Silt-Clay Crust | N                                | 8.2                       | 0.0   |   |
| Stratum 3  | Marine Silt-Clay       | N                                | 5.0                       | 0.0   |   |
| Stratum 4  | Marine Sand            | N                                | -49.6                     | 0.0   |   |
| Stratum 5  | Glacial Till           | N                                | -60.9                     | 0.0   |   |
| Stratum 6  | Bedrock                | Y                                | -107.9                    | 20.0  |   |
| Stratum 7  | None                   | N                                |                           |   |   |
| Stratum 8  | None                   | N                                |                           |   |   |
| Stratum 9  | None                   | N                                |                           |   |   |
| Stratum 10 | None                   | N                                |                           |   |   |

### Sketch



| Parameter         |                    | Value   | Unit                | Definition  | Reference                             |
|-------------------|--------------------|---------|---------------------|---|---------------------------------------|
| Loading           | Q                  | 281.0   | kips                | Maximum Factored Axial Compressive Load Per Micropile   | See Note 2                            |
|                   | Q <sub>g</sub>     |         | kips                | Maximum Factored Axial Compressive Load Per Substructure  |                                       |
|                   | Q <sub>u</sub>     | 0.0     | kips                | Maximum Factored Axial Uplift Load Per Micropile  |                                       |
|                   | Q <sub>ug</sub>    | 100.0   | kips                | Maximum Factored Axial Uplift Load Per Substructure   |                                       |
| Downdrag          | Method             | A       | A or L or N         | "A" for Alpha (α), "L" for Lambda (λ), or "N" for Nordland/Thurman (used by Driven)   |                                       |
|                   | Q <sub>DDn</sub>   | 0.0     | kips                | Additional Load Caused by Downdrag <sup>3</sup>   | Ref. 1, Article 10.7.1.6.2 & 3.11.8   |
|                   | γ <sub>p max</sub> | 1.40    | -                   | Maximum Load Factor for Particular Design Method <sup>4</sup>   | Ref. 1, Table 3.4.1-2                 |
|                   | γ <sub>p min</sub> | 0.25    | -                   | Minimum Load Factor for Particular Design Method <sup>5</sup>   | Ref. 1, Table 3.4.1-2                 |
|                   | c                  | 1       | -                   | Skin Friction Reduction Factor for Coating on Pile (1 if no coating)  |                                       |
|                   | Q <sub>DDr</sub>   | 0.0     | kips                | Factored Axial Compressive Load Induced by Downdrag = Q <sub>DDN</sub> γ <sub>p max</sub> c   |                                       |
| Pile Properties   | OD <sub>i</sub>    | 9.625   | in                  | Micropile Casing Outside Diameter before Corrosion  | Ref. 6, Table 3                       |
|                   | t <sub>i</sub>     | 0.545   | in                  | Micropile Casing Wall Thickness before Corrosion  | Ref. 6, Table 3                       |
|                   | t <sub>c</sub>     | 0.001   | in/year             | Micropile Casing Wall Corrosion Loss Rate   | Ref. 4, Pg 8-34                       |
|                   | D <sub>i</sub>     | 100     | years               | Service Design Life   |                                       |
|                   | t                  | 0.273   | in                  | Micropile Casing Wall Thickness after Corrosion = t <sub>i</sub> - (t <sub>c</sub> D <sub>i</sub> ) ≤ t <sub>i</sub> / 2 (thread reduction)               |                                       |
|                   | OD                 | 9.080   | in                  | Micropile Casing Outside Diameter after Corrosion = OD <sub>i</sub> - (2 t <sub>c</sub> D <sub>i</sub> )  |                                       |
|                   | d <sub>b</sub>     | 0.69    | ft                  | Diameter of Micropile Drill Hole Through Bonded Length= (OD - 2t <sub>i</sub> - 0.25)/12in/ft   |                                       |
|                   | r                  | 18      | -                   | Reinforcing Bar Number Designation  |                                       |
|                   | d <sub>bar</sub>   | 2.26    | in                  | Reinforcing Bar Diameter  |                                       |
|                   | n <sub>b</sub>     | 1       | -                   | Number of Reinforcing Bars  |                                       |
|                   | n <sub>px</sub>    | 9       | -                   | Number of Micropiles Per Row in the Longitudinal Direction  |                                       |
|                   | n <sub>py</sub>    | 2       | -                   | Number of Micropiles Per Row in the Transverse Direction  |                                       |
|                   | n <sub>p</sub>     | 18      | -                   | Number of Piles in Group  |                                       |
|                   | f <sub>y</sub>     | 80.0    | ksi                 | Yield Strength of Steel Casing  |                                       |
|                   | f <sub>b</sub>     | 75.0    | ksi                 | Yield Strength of Steel Reinforcement   |                                       |
|                   | f <sub>ym</sub>    | 75.0    | ksi                 | Minimum Yield Strength of Steel Casing or Steel Reinforcement ≤ 0.003 * 29,000 ksi = 87 ksi (Strain Compatibility)  | Ref. 3, Pg 5-11, Ref. 1, 10.9.3.10.2a |
|                   | f' <sub>c</sub>    | 5.0     | ksi                 | Compressive Strength of Grout   |                                       |
|                   | γ <sub>g</sub>     | 150     | pcf                 | Unit Weight of Grout  |                                       |
|                   | E <sub>grout</sub> | 4,287   | ksi                 | Elastic Modulus of Grout = 33,000 (γ <sub>g</sub> /1000) <sup>1.5</sup> f' <sub>c</sub> <sup>0.5</sup>  |                                       |
|                   | Construction       | A       | -                   | Micropile Construction Method   | Ref. 1, Article 10.9.1                |
|                   | L <sub>1</sub>     | 117.0   | ft                  | Longest Cased Length (for Buckling Analysis)  |                                       |
|                   | L <sub>2</sub>     | 117.0   | ft                  | Shortest Cased Length (for Lateral Analysis)  |                                       |
|                   | L <sub>b min</sub> | 10.0    | ft                  | Shortest Uncased Length (for Lateral Analysis)  |                                       |
|                   | L <sub>b</sub>     | 10.0    | ft                  | Uncased Length (Bonded Length)  |                                       |
|                   | L <sub>p</sub>     | 0.0     | ft                  | Plunge Length is the Distance Casing is Pushed Down into the Grouted Bond Length, Before the Grout Sets   |                                       |
|                   | P <sub>t</sub>     | 0       | kips                | Factored Axial Load Transfer to Ground Through Plunge Length = φ [π d <sub>b</sub> α <sub>b</sub> L <sub>p</sub> ]  | Ref. 1, 10.9.3.10.4-1                 |
|                   | α                  | N/A     | -                   | Batter = rise / run   |                                       |
|                   | N <sub>bmn</sub>   | 0       | -                   | Number of Battered Micropiles   |                                       |
|                   | s <sub>x</sub>     | 160.000 | in                  | Longitudinal Direction Center to Center Micropile Spacing   |                                       |
|                   | s <sub>y</sub>     | 72.000  | in                  | Transverse Direction Center to Center Micropile Spacing   |                                       |
|                   | s <sub>x b</sub>   | 16.623  | B                   | Longitudinal Direction Center to Center Micropile Spacing = s <sub>x</sub> / OD <sub>i</sub>  |                                       |
|                   | s <sub>y b</sub>   | 7.481   | B                   | Longitudinal Direction Center to Center Micropile Spacing = s <sub>y</sub> / OD <sub>i</sub>  |                                       |
|                   | Tip                | L       | -                   | Do Micropile Tips Bear on Cohesionless Soil ("L") or Cohesive Soil ("C")  |                                       |
|                   | Bottom Cap         | 7.61    | ft                  | Bottom of Pile Cap Elevation  |                                       |
|                   | Embedment          | 1.50    | ft                  | Length of Micropile Set into Cap  |                                       |
| Area Calculations | A <sub>r</sub>     | 4.0     | in <sup>2</sup>     | Cross Sectional Area of Steel Single Reinforcing Bar  |                                       |
|                   | A <sub>b</sub>     | 4.0     | in <sup>2</sup>     | Cross Sectional Area of Steel Reinforcement = (n <sub>b</sub> ) (A <sub>r</sub> )   |                                       |
|                   | A <sub>ci</sub>    | 15.5    | in <sup>2</sup>     | Cross Sectional Area of Steel Casing Before Corrosion = PI [ (OD <sub>i</sub> /2) <sup>2</sup> - ((OD <sub>i</sub> -2t <sub>i</sub> )/2) <sup>2</sup> ]   |                                       |
|                   | A <sub>c</sub>     | 7.5     | in <sup>2</sup>     | Cross Sectional Area of Steel Casing After Corrosion/Thread Reduction = PI [ (OD/2) <sup>2</sup> - ((OD <sub>i</sub> -2t <sub>i</sub> )/2) <sup>2</sup> ] |                                       |
|                   | A <sub>g</sub>     | 53.2    | in <sup>2</sup>     | Cross Sectional Area Inside Casing (Excluding Bar Area) = PI ((OD-2t)/2) <sup>2</sup> - A <sub>b</sub>  |                                       |
|                   | A <sub>bu</sub>    | 49.9    | in <sup>2</sup>     | Cross Sectional Area of Uncased Length (Excluding Bar Area) (1/8" Clearance Assumed) = PI ((OD-2t-0.25)/2) <sup>2</sup> - A <sub>b</sub>                  |                                       |
|                   | A <sub>sci</sub>   | 2.5     | ft <sup>2</sup> /ft | Unit Surface Area of Steel Casing before Corrosion = PI OD <sub>i</sub> / 12  |                                       |
|                   | A <sub>sc</sub>    | 2.4     | ft <sup>2</sup> /ft | Unit Surface Area of Steel Casing after Corrosion = PI OD / 12  |                                       |
|                   | A <sub>s</sub>     | 2.2     | ft <sup>2</sup> /ft | Unit Surface Area of Uncased Concrete (1/8" Clearance Assumed) = PI (OD-2t-0.25) / 12   |                                       |
|                   | A <sub>p</sub>     | 0.4     | ft <sup>2</sup>     | Cross Sectional Area of Micropile Tip = PI ((OD-2t-0.25)/2) <sup>2</sup> / 144  | 94                                    |

|              |                           |                    |           |                  |        |
|--------------|---------------------------|--------------------|-----------|------------------|--------|
| <b>For:</b>  | I-295 over Veranda Street | <b>Job Number:</b> | 75297     | <b>Sheet No.</b> | 2 of 3 |
| <b>By:</b>   | ACP                       | <b>Check By:</b>   | JCJ       | <b>Check by:</b> |        |
| <b>Date:</b> | 11/12/2019                | <b>Date:</b>       | 3/20/2020 | <b>Date:</b>     |        |

# HNTB

| Parameter   | Value                    | Unit  | Definition      | Reference   |
|---|--------------------------|-------|-----------------|---|
| Geotechnical Resistance Factors                         | $\phi_{STAT PS}$         | 0.55  | -               | Resistance Factor for Presumptive Side Shear Resistance   |
|   | $\phi_{STAT PT}$         | 0.5   | -               | Resistance Factor for Presumptive Tip Resistance  |
|   | $\phi_{STAT LT}$         | 0.7   | -               | Resistance Factor for Side Shear and Tip Resistance if Load Tested ( $\leq 0.7$ is required)  |
|   | $\phi_{BL}$              | 0.6   | -               | Resistance Factor for Block Failure in Clay   |
|   | $\phi_{UP P}$            | 0.55  | -               | Resistance Factor for Presumptive Uplift Resistance   |
|   | $\phi_{UP T}$            | 0.7   | -               | Resistance Factor for Uplift Resistance if Load Tested ( $\leq 0.7$ is required)  |
| Geotechnical Axial Compression of Single Micropile      | $\phi_{UG}$              | 0.45  | -               | Resistance Factor for Uplift Resistance of Group in Sand or Clay  |
|   | $R_s$                    | 433.8 | kips            | Nominal Grout-to-Ground Bond Resistance over Length of Micropile = $\pi d_b L_b \alpha_b$   |
|   | $A_p$                    | 0.4   | ft <sup>2</sup> | Area of Micropile Tip   |
|   | $q_p$                    | 0.0   | ksf             | Unit Tip Resistance   |
|   | $R_p$                    | 0.0   | kips            | Nominal Tip Resistance = $A_p q_p$  |
|   | $R_n$                    | 433.8 | kips            | Nominal Axial Compressive Geotechnical Resistance = $R_s + R_p$   |
|   | $\phi_{STAT PS}$         | 0.7   | -               | Resistance Factor for Presumptive Side Shear Resistance   |
|   | $\phi_{STAT PT}$         | 0.5   | -               | Resistance Factor for Presumptive Tip Resistance  |
|   | $R_R$                    | 303.7 | kips            | Factored Axial Compressive Geotechnical Resistance = $\phi_{STAT PT} R_p + \phi_{STAT PS} R_s$  |
|   | $Q$                      | 281.0 | kips            | Maximum Factored Axial Compressive Load Per Micropile   |
|   | $Q_{DDr}$                | 0.0   | kips            | Factored Axial Compressive Load Induced by Downdrag = $Q_{DDN} \gamma_P \max c$   |
| Geotechnical Uplift of Single Micropile                 | $Q_R$                    | 281.0 | kips            | Factored Axial Compressive Load = $Q_{DDr} + Q$   |
|   | Adequate?                | OK    | -               | $R_R > Q_R$   |
|   | $R_s$                    | 433.8 | kips            | Nominal Grout-to-Ground Bond Resistance over Length of Micropile = $\pi d_b L_b \alpha_b$   |
|   | SW                       | 11.3  | kips            | Pile Selfweight = $L_2 [(490 \text{ pcf } (A_b + A_c)/144 \text{ in}^2/\text{ft}^2) + (\gamma_g A_{gu}/144 \text{ in}^2/\text{ft}^2)] + L_b [(490 \text{ pcf } (A_b)/144 \text{ in}^2/\text{ft}^2) + (\gamma_g A_{gu}/144 \text{ in}^2/\text{ft}^2)]$ |
|   | $\phi_{UP P}$            | 0.55  | -               | Resistance Factor for Presumptive Uplift Resistance   |
| Structural Resistance Factors                           | $R_R$                    | 249.9 | kips            | Factored Uplift Resistance = $\phi_{UP P} R_s + SW$   |
|   | $Q_u$                    | 0.0   | kips            | Maximum Factored Axial Uplift Load Per Micropile  |
|   | Adequate?                | OK    | -               | $R_R > Q_u$   |
|   | $\phi_{TC}$              | 0.80  | -               | Resistance Factor for Tension in the Cased Length   |
|   | $\phi_{CC}$              | 0.75  | -               | Resistance Factor for Compression in the Cased Length   |
| Strength Limit State for Cased Section in Compression   | $\phi_{TU}$              | 0.80  | -               | Resistance Factor for Tension in the Uncased Length   |
|   | $\phi_{CU}$              | 0.75  | -               | Resistance Factor for Compression in the Uncased Length   |
|   | $\phi_c$                 | 0.80  | -               | Resistance Factor for Combined Axial and Flexure (Axial Compressive Resistance of Pipe Pile)  |
|   | $\phi_f$                 | 1.00  | -               | Resistance Factor for Combined Axial and Flexure (Flexural Resistance)  |
|   | $f'_c$                   | 5     | ksi             | Compressive Strength of Grout   |
|   | $f_{ym}$                 | 75.0  | ksi             | Minimum Yield Strength of Steel   |
|   | $A_b$                    | 4.0   | in <sup>2</sup> | Cross Sectional Area of Steel Reinforcement   |
|   | $A_c$                    | 7.5   | in <sup>2</sup> | Cross Sectional Area of Steel Casing  |
|   | $A_R$                    | 53.2  | in <sup>2</sup> | Cross Sectional Area Inside Casing  |
|   | $R_{n CC}$               | 927.9 | kips            | Nominal Structural Axial Compressive Resistance of Single Cased Micropile = $0.85 (0.85 f'_c A_R + f_y (A_c + A_b))$  |
| Strength Limit State for Uncased Section in Compression | $\phi_{CC}$              | 0.75  | -               | Resistance Factor for Compression in the Cased Length   |
|   | $R_{CC}$                 | 695.9 | kips            | Factored Structural Axial Compressive Resistance of Single Cased Micropile = $\phi_{CC} R_{n CC}$   |
|   | $Q$                      | 281.0 | kips            | Maximum Factored Axial Compressive Load Per Micropile   |
|   | Adequate?                | OK    | -               | $R_{CC} > Q$  |
|   | $f'_c$                   | 5     | ksi             | Compressive Strength of Grout   |
|   | $f_{ym}$                 | 75.0  | ksi             | Minimum Yield Strength of Steel   |
|   | $A_b$                    | 4.0   | in <sup>2</sup> | Cross Sectional Area of Steel Reinforcement   |
|   | $A_{gu}$                 | 49.9  | in <sup>2</sup> | Cross Sectional Area of Grout in the Uncased Length   |
| Strength Limit State for Cased Section in Tension       | $R_{n CU}$               | 435.3 | kips            | Nominal Structural Axial Compressive Resistance of Single Uncased Micropile = $0.85 (0.85 f'_c A_R + f_y (A_c + A_b))$  |
|   | $\phi_{CU}$              | 0.75  | -               | Resistance Factor for Compression in the Uncased Length   |
|   | $R_{CU}$                 | 326.5 | kips            | Factored Structural Axial Compressive Resistance of Single Uncased Micropile = $\phi_{CU} R_{n CU}$   |
|   | $Q$                      | 281.0 | kips            | Maximum Factored Axial Compressive Load Per Micropile   |
|   | Adequate?                | OK    | -               | $R_{CU} > Q$  |
|   | $f_{ym}$                 | 75.0  | ksi             | Minimum Yield Strength of Steel   |
|   | $A_b$                    | 4.0   | in <sup>2</sup> | Cross Sectional Area of Steel Reinforcement   |
| Strength Limit State for Uncased Section in Tension     | $A_{ct}$                 | 7.5   | in <sup>2</sup> | Cross Sectional Area of Steel Casing After Corrosion and Accounting for Thread Reduction  |
|   | $R_{n TC}$               | 865.5 | kips            | Nominal Structural Tensile Resistance of a Single Cased Micropile = $f_{ym} (A_b + A_{ct})$   |
|   | $\phi_{TC}$              | 0.80  | -               | Resistance Factor for Tension in the Cased Length   |
|   | $R_{TC}$                 | 692.4 | kips            | Factored Structural Tensile Resistance of a Single Cased Micropile = $\phi_{TC} R_{n TC}$   |
|   | $Q_u$                    | 0.0   | kips            | Maximum Factored Axial Uplift Load Per Micropile  |
|   | Adequate?                | OK    | -               | $R_{TC} > Q_u$  |
| Elastic Shortening                                      | $f_b$                    | 75.0  | ksi             | Minimum Yield Strength of Steel Reinforcement (Assumes Couplers Provide Greater or Equal Capacity)  |
|   | $A_b$                    | 4.0   | in <sup>2</sup> | Cross Sectional Area of Steel Reinforcement   |
|   | $R_{n TU}$               | 300.0 | kips            | Nominal Structural Tensile Resistance of a Single Uncased Micropile = $f_b A_b$   |
|   | $\phi_{TU}$              | 0.80  | -               | Resistance Factor for Tension in the Uncased Length   |
|   | $R_{TU}$                 | 240.0 | kips            | Factored Structural Tensile Resistance of a Single Uncased Micropile = $\phi_{TU} R_{n TU}$   |
|   | $Q_u$                    | 0.0   | kips            | Maximum Factored Axial Uplift Load Per Micropile  |
| Elastic Shortening                                      | Adequate?                | OK    | -               | $R_{TU} > Q_u$  |
|   | $\delta_{cased}$         | 1.00  | in              | Elastic Settlement of Cased Length of Pile (Does Not Account for Load Shed Along Pile Length) (Note 8)  |
|   | $\delta_{bond}$          | 0.15  | in              | Elastic Settlement of Bond Length of Pile (Does Not Account for Load Shed Along Pile Length) (Note 8)   |
|   | $\delta_{elastic}$       | 0.00  | in              | Immediate Elastic Settlement at Micropile Tip   |
|   | $\delta_{consolidation}$ | 0.00  | in              | Consolidation Settlement of Cohesive Soil at Micropile Tip  |
|   | $\delta_{secondary}$     | 0.00  | in              | Secondary Settlement of Organic Soil at Micropile Tip   |
| Elastic Shortening                                      | $\delta_{total}$         | 1.15  | in              | Total Settlement = $\delta_{cased} + \delta_{bond} + \delta_{elastic} + \delta_{consolidation} + \delta_{secondary}$  |



|              |                           |                    |           |                  |        |
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| <b>By:</b>   | ACP                       | <b>Check By:</b>   | JCJ       | <b>Check by:</b> |        |
| <b>Date:</b> | 11/12/2019                | <b>Date:</b>       | 3/20/2020 | <b>Date:</b>     |        |

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| Parameter                             |                     | Value   | Unit            | Definition   | Reference             |
|---------------------------------------|---------------------|---------|-----------------|--|-----------------------|
| Sectional Properties                  | S <sub>casing</sub> | 15.2    | in <sup>3</sup> | Elastic Section Modulus of Casing = $\pi ((ODI-ti)^4 - (ODI-2ti)^4)/(32*ODI)$  |                       |
|                                       | S <sub>bar</sub>    | 1.1     | in <sup>3</sup> | Elastic Section Modulus of Bar = $\pi d_{bar}^3 / 32$  |                       |
|                                       | Z <sub>casing</sub> | 21.1    | in <sup>3</sup> | Plastic Section Modulus of Casing = $((ODI-ti)^3-(ODI-2ti)^3)/6$   |                       |
|                                       | Z <sub>bar</sub>    | 1.9     | in <sup>3</sup> | Plastic Section Modulus of Bar = $d_{bar}^3 / 6$   |                       |
| Combined Axial Resistance and Flexure | P <sub>u</sub>      | 281.0   | kips            | Axial Compressive Load = Q   | Defined Above         |
|                                       | P <sub>r</sub>      | 695.9   | kip             | Factored Axial Compressive Resistance = R <sub>CU</sub>  | Defined Above         |
|                                       | M <sub>ux</sub>     | 493.2   | kip-in          | Factored Moment Per Micropile About x Axis   | FB MultiPier Analysis |
|                                       | M <sub>uy</sub>     | 279.6   | kip-in          | Factored Moment Per Micropile About y Axis   | FB MultiPier Analysis |
|                                       | M <sub>u</sub>      | 566.9   | kip-in          | Factored Moment Resultant Per Micropile  |                       |
|                                       | M <sub>ps</sub>     | 1,835.3 | kip-in          | Nominal Plastic Moment Resistance = f <sub>y casing</sub> Z <sub>casing</sub> + f <sub>y bar</sub> Z <sub>bar</sub>  |                       |
|                                       | M <sub>yc</sub>     | 1,301.2 | kip-in          | Nominal Yield Moment Resistance = f <sub>y casing</sub> S <sub>casing</sub> + f <sub>y bar</sub> S <sub>bar</sub>    |                       |
|                                       | D/t                 | 33.3    | -               | Casing Outside Diameter (after Corrosion or Thread Reduction) / Wall Thickness (after Corrosion or Thread Reduction) |                       |
|                                       | E/fy                | 362.5   | -               | Elastic Modulus of Steel Casing / Yield Strength of Steel Casing   |                       |
|                                       | M <sub>n</sub>      | 1,835.3 | kip-in          | Nominal Moment Resistance =  | Ref. 1, 6.12.2.3.2    |
|                                       | M <sub>rx</sub>     | 1,835.3 | kip-in          | Factored Flexural Resistance about x Axis  | Ref. 1, 6.12.2.3.2    |
|                                       | M <sub>ry</sub>     | 1,835.3 | kip-in          | Factored Flexural Resistance about y Axis  | Ref. 1, 6.12.2.3.2    |
|                                       | D/C                 | 0.68    | -               | Combined Axial and Flexure Demand over Capacity Ratio  | Ref. 1, 6.9.2.2       |
|                                       | Adequate            | OK      | -               | D/C ≤ 1  |                       |

## Notes:

- Only enter unit tip resistance for the bearing strata, and to neglect tip resistance leave this parameter blank. Typically it is neglected unless the tip is in sound rock.
- Loads per micropile were determined from FB Pier Analysis which utilized Factored Loads Provided by Structural Engineer.
- Additional load caused by downdrag is the side shear resistance in or above any layers anticipated to settle greater than 0.4" and which are in contact with the pile. This side shear resistance is calculated elsewhere either with a hand calculation or by the FHWA's Driven Software. This side shear resistance is a negative and is accounted for as an additional load.
- If Alpha (a) Method is used  $g_p = 1.4$ , if Lambda (l) Method is used  $g_p = 1.05$ , if Nordland/Thurman (N) Method is used the load factor for the Alpha Method will be used.
- If Alpha (a) Method is used  $g_p = 0.25$ , if Lambda (l) Method is used  $g_p = 0.3$ , if Nordland/Thurman (N) Method is used the load factor for the Alpha Method will be used.
- Group Reduction Factor for Geotechnical Axial Compression:  
If Cohesive and  $2.5B \leq$  center to center pile spacing  $\leq 6B$ ,  $\eta = 0.65$ , Interpolated between. Use only if cap is not in firm contact with the ground and if the soil at the surface is soft.  
If center to center pile spacing  $> 6B$ ,  $\eta = 1$   
If cohesionless and center to center pile spacing  $\geq 2.5 B$ ,  $\eta = 1$
- $Q_g = (2X + 2Y) Z S_u + X Y N_c S_u$
- $\delta_{cased}$  and  $\delta_{bond}$  = Maximum Nominal Load per Micropile \*  $L_1 * 12 / [490 \text{ pcf} * (\text{Area Steel} / \text{Total Area}) + 150 \text{ pcf} * (\text{Grout Area} / \text{Total Area})]$

## References:

- AASHTO. *LRFD Bridge Design Specifications*. Fifth Ed. 2010
- Bruce, D.A., Cadden, A.W., Sabatini, P.J. *Practical Advice for Foundation Design - Micropiles for Structural Support*
- FHWA NHI-05-039. *Micropile Design and Construction*. December 2005
- FHWA NHI-97-013. *Design and Construction of Driven Pile Foundations*. November 1998
- FHWA-SA-97-070. *Micropile Design and Construction Guidelines*. June 2000
- ASTM A252. *Standard Specifications for Welded and Seamless Steel Pipe Piles*. 2010

|              |                                 |                    |           |                  |        |
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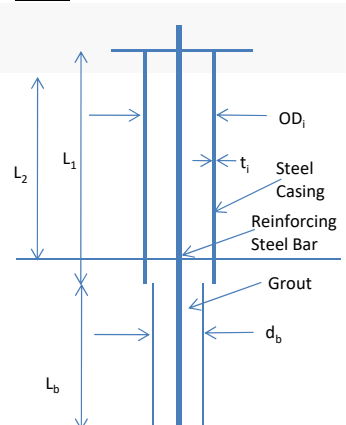
# HNTB

## Axial Resistance of Micropiles - Abutment 2

### Lithology

|            | Lithology              | Included in Grout-to-Ground Bond | Strata Top Elevation (ft) | Nominal Grout-to-Ground Bond Strength, $\alpha_b$ (ksf) | Unit Tip Resistance, $q_p$ (ksf) <sup>1</sup> |
|------------|------------------------|----------------------------------|---------------------------|---|---|
| Stratum 1  | Fill                   | N                                | 13.0                      | 0.0   |   |
| Stratum 2  | Marine Silt-Clay Crust | N                                | 7.2                       | 0.0   |   |
| Stratum 3  | Marine Silt-Clay       | N                                | 3.8                       | 0.0   |   |
| Stratum 4  | Marine Sand            | N                                | -54.7                     | 0.0   |   |
| Stratum 5  | Glacial Till           | N                                | -66.3                     | 5.0   |   |
| Stratum 6  | Bedrock                | Y                                | -132.2                    | 20.0  |   |
| Stratum 7  | None                   | N                                |                           |   |   |
| Stratum 8  | None                   | N                                |                           |   |   |
| Stratum 9  | None                   | N                                |                           |   |   |
| Stratum 10 | None                   | N                                |                           |   |   |

### Sketch



| Parameter         |                    | Value   | Unit                | Definition  | Reference                             |
|-------------------|--------------------|---------|---------------------|---|---------------------------------------|
| Loading           | Q                  | 311.0   | kips                | Maximum Factored Axial Compressive Load Per Micropile   | See Note 2                            |
|                   | Q <sub>g</sub>     |         | kips                | Maximum Factored Axial Compressive Load Per Substructure  |                                       |
|                   | Q <sub>u</sub>     | 0.0     | kips                | Maximum Factored Axial Uplift Load Per Micropile  |                                       |
|                   | Q <sub>ug</sub>    | 100.0   | kips                | Maximum Factored Axial Uplift Load Per Substructure   |                                       |
| Downdrag          | Method             | A       | A or L or N         | "A" for Alpha (α), "L" for Lambda (λ), or "N" for Nordland/Thurman (used by Driven)   |                                       |
|                   | Q <sub>DDn</sub>   | 0.0     | kips                | Additional Load Caused by Downdrag <sup>3</sup>   | Ref. 1, Article 10.7.1.6.2 & 3.11.8   |
|                   | γ <sub>p max</sub> | 1.40    | -                   | Maximum Load Factor for Particular Design Method <sup>4</sup>   | Ref. 1, Table 3.4.1-2                 |
|                   | γ <sub>p min</sub> | 0.25    | -                   | Minimum Load Factor for Particular Design Method <sup>5</sup>   | Ref. 1, Table 3.4.1-2                 |
|                   | c                  | 1       | -                   | Skin Friction Reduction Factor for Coating on Pile (1 if no coating)  |                                       |
|                   | Q <sub>DDr</sub>   | 0.0     | kips                | Factored Axial Compressive Load Induced by Downdrag = Q <sub>DDN</sub> γ <sub>p max</sub> c   |                                       |
| Pile Properties   | OD <sub>i</sub>    | 9.625   | in                  | Micropile Casing Outside Diameter before Corrosion  | Ref. 6, Table 3                       |
|                   | t <sub>i</sub>     | 0.545   | in                  | Micropile Casing Wall Thickness before Corrosion  | Ref. 6, Table 3                       |
|                   | t <sub>c</sub>     | 0.001   | in/year             | Micropile Casing Wall Corrosion Loss Rate   | Ref. 4, Pg 8-34                       |
|                   | D <sub>i</sub>     | 100     | years               | Service Design Life   |                                       |
|                   | t                  | 0.273   | in                  | Micropile Casing Wall Thickness after Corrosion = t <sub>i</sub> - (t <sub>c</sub> D <sub>i</sub> ) ≤ t <sub>i</sub> / 2 (thread reduction)               |                                       |
|                   | OD                 | 9.080   | in                  | Micropile Casing Outside Diameter after Corrosion = OD <sub>i</sub> - (2 t <sub>c</sub> D <sub>i</sub> )  |                                       |
|                   | d <sub>b</sub>     | 0.69    | ft                  | Diameter of Micropile Drill Hole Through Bonded Length= (OD - 2t <sub>i</sub> - 0.25)/12in/ft   |                                       |
|                   | r                  | 18      | -                   | Reinforcing Bar Number Designation  |                                       |
|                   | d <sub>bar</sub>   | 2.26    | in                  | Reinforcing Bar Diameter  |                                       |
|                   | n <sub>b</sub>     | 1       | -                   | Number of Reinforcing Bars  |                                       |
|                   | n <sub>px</sub>    | 9       | -                   | Number of Micropiles Per Row in the Longitudinal Direction  |                                       |
|                   | n <sub>py</sub>    | 2       | -                   | Number of Micropiles Per Row in the Transverse Direction  |                                       |
|                   | n <sub>p</sub>     | 18      | -                   | Number of Piles in Group  |                                       |
|                   | f <sub>y</sub>     | 80.0    | ksi                 | Yield Strength of Steel Casing  |                                       |
|                   | f <sub>b</sub>     | 75.0    | ksi                 | Yield Strength of Steel Reinforcement   |                                       |
|                   | f <sub>ym</sub>    | 75.0    | ksi                 | Minimum Yield Strength of Steel Casing or Steel Reinforcement ≤ 0.003 * 29,000 ksi = 87 ksi (Strain Compatibility)  | Ref. 3, Pg 5-11, Ref. 1, 10.9.3.10.2a |
|                   | f' <sub>c</sub>    | 5.0     | ksi                 | Compressive Strength of Grout   |                                       |
|                   | γ <sub>g</sub>     | 150     | pcf                 | Unit Weight of Grout  |                                       |
|                   | E <sub>grout</sub> | 4,287   | ksi                 | Elastic Modulus of Grout = 33,000 (γ <sub>g</sub> /1000) <sup>1.5</sup> f' <sub>c</sub> <sup>0.5</sup>  |                                       |
|                   | Construction       | B       | -                   | Micropile Construction Method   | Ref. 1, Article 10.9.1                |
|                   | L <sub>1</sub>     | 75.0    | ft                  | Longest Cased Length (for Buckling Analysis)  |                                       |
|                   | L <sub>2</sub>     | 75.0    | ft                  | Shortest Cased Length (for Lateral Analysis)  |                                       |
|                   | L <sub>b min</sub> | 11.0    | ft                  | Shortest Uncased Length (for Lateral Analysis)  |                                       |
|                   | L <sub>b</sub>     | 11.0    | ft                  | Uncased Length (Bonded Length)  |                                       |
|                   | L <sub>p</sub>     | 0.0     | ft                  | Plunge Length is the Distance Casing is Pushed Down into the Grouted Bond Length, Before the Grout Sets   |                                       |
|                   | P <sub>t</sub>     | 0       | kips                | Factored Axial Load Transfer to Ground Through Plunge Length = φ [π d <sub>b</sub> α <sub>b</sub> L <sub>p</sub> ]  | Ref. 1, 10.9.3.10.4-1                 |
|                   | α                  | N/A     | -                   | Batter = rise / run   |                                       |
|                   | N <sub>bmn</sub>   | 0       | -                   | Number of Battered Micropiles   |                                       |
|                   | s <sub>x</sub>     | 160.000 | in                  | Longitudinal Direction Center to Center Micropile Spacing   |                                       |
|                   | s <sub>y</sub>     | 72.000  | in                  | Transverse Direction Center to Center Micropile Spacing   |                                       |
|                   | s <sub>x b</sub>   | 16.623  | B                   | Longitudinal Direction Center to Center Micropile Spacing = s <sub>x</sub> / OD <sub>i</sub>  |                                       |
|                   | s <sub>y b</sub>   | 7.481   | B                   | Longitudinal Direction Center to Center Micropile Spacing = s <sub>y</sub> / OD <sub>i</sub>  |                                       |
|                   | Tip                | L       | -                   | Do Micropile Tips Bear on Cohesionless Soil ("L") or Cohesive Soil ("C")  |                                       |
|                   | Bottom Cap         | 8.33    | ft                  | Bottom of Pile Cap Elevation  |                                       |
|                   | Embedment          | 1.50    | ft                  | Length of Micropile Set into Cap  |                                       |
| Area Calculations | A <sub>r</sub>     | 4.0     | in <sup>2</sup>     | Cross Sectional Area of Steel Single Reinforcing Bar  |                                       |
|                   | A <sub>b</sub>     | 4.0     | in <sup>2</sup>     | Cross Sectional Area of Steel Reinforcement = (n <sub>b</sub> ) (A <sub>r</sub> )   |                                       |
|                   | A <sub>ci</sub>    | 15.5    | in <sup>2</sup>     | Cross Sectional Area of Steel Casing Before Corrosion = PI [ (OD <sub>i</sub> /2) <sup>2</sup> - ((OD <sub>i</sub> -2t <sub>i</sub> )/2) <sup>2</sup> ]   |                                       |
|                   | A <sub>c</sub>     | 7.5     | in <sup>2</sup>     | Cross Sectional Area of Steel Casing After Corrosion/Thread Reduction = PI [ (OD/2) <sup>2</sup> - ((OD <sub>i</sub> -2t <sub>i</sub> )/2) <sup>2</sup> ] |                                       |
|                   | A <sub>g</sub>     | 53.2    | in <sup>2</sup>     | Cross Sectional Area Inside Casing (Excluding Bar Area) = PI ((OD-2t)/2) <sup>2</sup> - A <sub>b</sub>  |                                       |
|                   | A <sub>bu</sub>    | 49.9    | in <sup>2</sup>     | Cross Sectional Area of Uncased Length (Excluding Bar Area) (1/8" Clearance Assumed) = PI ((OD-2t-0.25)/2) <sup>2</sup> - A <sub>b</sub>                  |                                       |
|                   | A <sub>sci</sub>   | 2.5     | ft <sup>2</sup> /ft | Unit Surface Area of Steel Casing before Corrosion = PI OD <sub>i</sub> / 12  |                                       |
|                   | A <sub>sc</sub>    | 2.4     | ft <sup>2</sup> /ft | Unit Surface Area of Steel Casing after Corrosion = PI OD / 12  |                                       |
|                   | A <sub>s</sub>     | 2.2     | ft <sup>2</sup> /ft | Unit Surface Area of Uncased Concrete (1/8" Clearance Assumed) = PI (OD-2t-0.25) / 12   |                                       |
|                   | A <sub>p</sub>     | 0.4     | ft <sup>2</sup>     | Cross Sectional Area of Micropile Tip = PI ((OD-2t-0.25)/2) <sup>2</sup> / 144  | 97                                    |

|              |                                 |                    |           |                  |        |
|--------------|---------------------------------|--------------------|-----------|------------------|--------|
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| <b>By:</b>   | ACP                             | <b>Check By:</b>   | JCJ       | <b>Check by:</b> |        |
| <b>Date:</b> | 11/12/2019                      | <b>Date:</b>       | 3/20/2020 | <b>Date:</b>     |        |

# HNTB

| Parameter   | Value                    | Unit  | Definition      | Reference   |
|---|--------------------------|-------|-----------------|---|
| Geotechnical Resistance Factors                         | $\phi_{STAT PS}$         | 0.55  | -               | Resistance Factor for Presumptive Side Shear Resistance   |
|   | $\phi_{STAT PT}$         | 0.5   | -               | Resistance Factor for Presumptive Tip Resistance  |
|   | $\phi_{STAT LT}$         | 0.7   | -               | Resistance Factor for Side Shear and Tip Resistance if Load Tested ( $\leq 0.7$ is required)  |
|   | $\phi_{BL}$              | 0.6   | -               | Resistance Factor for Block Failure in Clay   |
|   | $\phi_{UP P}$            | 0.55  | -               | Resistance Factor for Presumptive Uplift Resistance   |
|   | $\phi_{UP T}$            | 0.7   | -               | Resistance Factor for Uplift Resistance if Load Tested ( $\leq 0.7$ is required)  |
| Geotechnical Axial Compression of Single Micropile      | $\phi_{UG}$              | 0.45  | -               | Resistance Factor for Uplift Resistance of Group in Sand or Clay  |
|   | $R_s$                    | 477.2 | kips            | Nominal Grout-to-Ground Bond Resistance over Length of Micropile = $\pi d_b L_b \alpha_b$   |
|   | $A_p$                    | 0.4   | ft <sup>2</sup> | Area of Micropile Tip   |
|   | $q_p$                    | 0.0   | ksf             | Unit Tip Resistance   |
|   | $R_p$                    | 0.0   | kips            | Nominal Tip Resistance = $A_p q_p$  |
|   | $R_n$                    | 477.2 | kips            | Nominal Axial Compressive Geotechnical Resistance = $R_s + R_p$   |
|   | $\phi_{STAT PS}$         | 0.7   | -               | Resistance Factor for Presumptive Side Shear Resistance   |
|   | $\phi_{STAT PT}$         | 0.5   | -               | Resistance Factor for Presumptive Tip Resistance  |
|   | $R_R$                    | 334.0 | kips            | Factored Axial Compressive Geotechnical Resistance = $\phi_{STAT PT} R_p + \phi_{STAT PS} R_s$  |
|   | $Q$                      | 311.0 | kips            | Maximum Factored Axial Compressive Load Per Micropile   |
| Geotechnical Uplift of Single Micropile                 | $Q_{DDr}$                | 0.0   | kips            | Factored Axial Compressive Load Induced by Downdrag = $Q_{DDN} \gamma_P \max c$   |
|   | $Q_R$                    | 311.0 | kips            | Factored Axial Compressive Load = $Q_{DDr} + Q$   |
|   | Adequate?                | OK    | -               | $R_R > Q_R$   |
|   | $R_s$                    | 477.2 | kips            | Nominal Grout-to-Ground Bond Resistance over Length of Micropile = $\pi d_b L_b \alpha_b$   |
|   | SW                       | 7.6   | kips            | Pile Selfweight = $L_2 [(490 \text{ pcf } (A_b + A_c)/144 \text{ in}^2/\text{ft}^2) + (\gamma_g A_{gu}/144 \text{ in}^2/\text{ft}^2)] + L_b [(490 \text{ pcf } (A_b)/144 \text{ in}^2/\text{ft}^2) + (\gamma_g A_{gu}/144 \text{ in}^2/\text{ft}^2)]$ |
| Structural Resistance Factors                           | $\phi_{UP P}$            | 0.55  | -               | Resistance Factor for Presumptive Uplift Resistance   |
|   | $R_u$                    | 270.0 | kips            | Factored Uplift Resistance = $\phi_{UP P} R_s + SW$   |
|   | $Q_u$                    | 0.0   | kips            | Maximum Factored Axial Uplift Load Per Micropile  |
|   | Adequate?                | OK    | -               | $R_u > Q_u$   |
|   | $\phi_{TC}$              | 0.80  | -               | Resistance Factor for Tension in the Cased Length   |
| Strength Limit State for Cased Section in Compression   | $\phi_{CC}$              | 0.75  | -               | Resistance Factor for Compression in the Cased Length   |
|   | $\phi_{TU}$              | 0.80  | -               | Resistance Factor for Tension in the Uncased Length   |
|   | $\phi_{CU}$              | 0.75  | -               | Resistance Factor for Compression in the Uncased Length   |
|   | $\phi_c$                 | 0.80  | -               | Resistance Factor for Combined Axial and Flexure (Axial Compressive Resistance of Pipe Pile)  |
|   | $\phi_f$                 | 1.00  | -               | Resistance Factor for Combined Axial and Flexure (Flexural Resistance)  |
|   | $f'_c$                   | 5     | ksi             | Compressive Strength of Grout   |
|   | $f_{ym}$                 | 75.0  | ksi             | Minimum Yield Strength of Steel   |
|   | $A_b$                    | 4.0   | in <sup>2</sup> | Cross Sectional Area of Steel Reinforcement   |
|   | $A_c$                    | 7.5   | in <sup>2</sup> | Cross Sectional Area of Steel Casing  |
|   | $A_R$                    | 53.2  | in <sup>2</sup> | Cross Sectional Area Inside Casing  |
| Strength Limit State for Uncased Section in Compression | $R_{n CC}$               | 927.9 | kips            | Nominal Structural Axial Compressive Resistance of Single Cased Micropile = $0.85 (0.85 f'_c A_R + f_y (A_c + A_b))$  |
|   | $\phi_{CC}$              | 0.75  | -               | Resistance Factor for Compression in the Cased Length   |
|   | $R_{CC}$                 | 695.9 | kips            | Factored Structural Axial Compressive Resistance of Single Cased Micropile = $\phi_{CC} R_{n CC}$   |
|   | $Q$                      | 311.0 | kips            | Maximum Factored Axial Compressive Load Per Micropile   |
|   | Adequate?                | OK    | -               | $R_{CC} > Q$  |
| Strength Limit State for Uncased Section in Tension     | $f'_c$                   | 5     | ksi             | Compressive Strength of Grout   |
|   | $f_{ym}$                 | 75.0  | ksi             | Minimum Yield Strength of Steel   |
|   | $A_b$                    | 4.0   | in <sup>2</sup> | Cross Sectional Area of Steel Reinforcement   |
|   | $A_{gu}$                 | 49.9  | in <sup>2</sup> | Cross Sectional Area of Grout in the Uncased Length   |
|   | $R_{n CU}$               | 435.3 | kips            | Nominal Structural Axial Compressive Resistance of Single Uncased Micropile = $0.85 (0.85 f'_c A_R + f_y (A_c + A_b))$  |
|   | $\phi_{CU}$              | 0.75  | -               | Resistance Factor for Compression in the Uncased Length   |
|   | $R_{CU}$                 | 326.5 | kips            | Factored Structural Axial Compressive Resistance of Single Uncased Micropile = $\phi_{CU} R_{n CU}$   |
|   | $Q$                      | 311.0 | kips            | Maximum Factored Axial Compressive Load Per Micropile   |
| Strength Limit State for Cased Section in Tension       | Adequate?                | OK    | -               | $R_{CU} > Q$  |
|   | $f_{ym}$                 | 75.0  | ksi             | Minimum Yield Strength of Steel   |
|   | $A_b$                    | 4.0   | in <sup>2</sup> | Cross Sectional Area of Steel Reinforcement   |
|   | $A_{ct}$                 | 7.5   | in <sup>2</sup> | Cross Sectional Area of Steel Casing After Corrosion and Accounting for Thread Reduction  |
|   | $R_{n TC}$               | 865.5 | kips            | Nominal Structural Tensile Resistance of a Single Cased Micropile = $f_{ym} (A_b + A_{ct})$   |
|   | $\phi_{TC}$              | 0.80  | -               | Resistance Factor for Tension in the Cased Length   |
| Strength Limit State for Uncased Section in Tension     | $R_{TC}$                 | 692.4 | kips            | Factored Structural Tensile Resistance of a Single Cased Micropile = $\phi_{TC} R_{n TC}$   |
|   | $Q_u$                    | 0.0   | kips            | Maximum Factored Axial Uplift Load Per Micropile  |
|   | Adequate?                | OK    | -               | $R_{TC} > Q_u$  |
|   | $f_b$                    | 75.0  | ksi             | Minimum Yield Strength of Steel Reinforcement (Assumes Couplers Provide Greater or Equal Capacity)  |
|   | $A_b$                    | 4.0   | in <sup>2</sup> | Cross Sectional Area of Steel Reinforcement   |
| Elastic Shortening                                      | $R_{n TU}$               | 300.0 | kips            | Nominal Structural Tensile Resistance of a Single Uncased Micropile = $f_b A_b$   |
|   | $\phi_{TU}$              | 0.80  | -               | Resistance Factor for Tension in the Uncased Length   |
|   | $R_{TU}$                 | 240.0 | kips            | Factored Structural Tensile Resistance of a Single Uncased Micropile = $\phi_{TU} R_{n TU}$   |
|   | $Q_u$                    | 0.0   | kips            | Maximum Factored Axial Uplift Load Per Micropile  |
|   | Adequate?                | OK    | -               | $R_{TU} > Q_u$  |
| Elastic Shortening                                      | $\delta_{cased}$         | 0.71  | in              | Elastic Settlement of Cased Length of Pile (Does Not Account for Load Shed Along Pile Length) (Note 8)  |
|   | $\delta_{bond}$          | 0.18  | in              | Elastic Settlement of Bond Length of Pile (Does Not Account for Load Shed Along Pile Length) (Note 8)   |
|   | $\delta_{elastic}$       | 0.00  | in              | Immediate Elastic Settlement at Micropile Tip   |
|   | $\delta_{consolidation}$ | 0.00  | in              | Consolidation Settlement of Cohesive Soil at Micropile Tip  |
|   | $\delta_{secondary}$     | 0.00  | in              | Secondary Settlement of Organic Soil at Micropile Tip   |
| Elastic Shortening                                      | $\delta_{total}$         | 0.89  | in              | Total Settlement = $\delta_{cased} + \delta_{bond} + \delta_{elastic} + \delta_{consolidation} + \delta_{secondary}$  |



|              |                                 |                    |           |                  |        |
|--------------|---------------------------------|--------------------|-----------|------------------|--------|
| <b>For:</b>  | MEDOT I-295 over Veranda Street | <b>Job Number:</b> | 75297     | <b>Sheet No.</b> | 3 of 3 |
| <b>By:</b>   | ACP                             | <b>Check By:</b>   | JCJ       | <b>Check by:</b> |        |
| <b>Date:</b> | 11/12/2019                      | <b>Date:</b>       | 3/20/2020 | <b>Date:</b>     |        |

# HNTB

| Parameter                             |                     | Value   | Unit            | Definition   | Reference             |
|---------------------------------------|---------------------|---------|-----------------|--|-----------------------|
| Sectional Properties                  | S <sub>casing</sub> | 15.2    | in <sup>3</sup> | Elastic Section Modulus of Casing = $\pi (OD^4 - (OD-2t)^4)/(32*OD)$   |                       |
|                                       | S <sub>bar</sub>    | 1.1     | in <sup>3</sup> | Elastic Section Modulus of Bar = $\pi d_{bar}^3 / 32$  |                       |
|                                       | Z <sub>casing</sub> | 21.1    | in <sup>3</sup> | Plastic Section Modulus of Casing = $(OD^3-(OD-2t)^3)/6$   |                       |
|                                       | Z <sub>bar</sub>    | 1.9     | in <sup>3</sup> | Plastic Section Modulus of Bar = $d_{bar}^3 / 6$   |                       |
| Combined Axial Resistance and Flexure | P <sub>u</sub>      | 311.0   | kips            | Axial Compressive Load = Q   | Defined Above         |
|                                       | P <sub>r</sub>      | 695.9   | kip             | Factored Axial Compressive Resistance = R <sub>CU</sub>  | Defined Above         |
|                                       | M <sub>ux</sub>     | 540.0   | kip-in          | Factored Moment Per Micropile About x Axis   | FB MultiPier Analysis |
|                                       | M <sub>uy</sub>     | 301.2   | kip-in          | Factored Moment Per Micropile About y Axis   | FB MultiPier Analysis |
|                                       | M <sub>u</sub>      | 618.3   | kip-in          | Factored Moment Resultant Per Micropile  |                       |
|                                       | M <sub>ps</sub>     | 1,835.3 | kip-in          | Nominal Plastic Moment Resistance = f <sub>y casing</sub> Z <sub>casing</sub> + f <sub>y bar</sub> Z <sub>bar</sub>  |                       |
|                                       | M <sub>yc</sub>     | 1,301.2 | kip-in          | Nominal Yield Moment Resistance = f <sub>y casing</sub> S <sub>casing</sub> + f <sub>y bar</sub> S <sub>bar</sub>    |                       |
|                                       | D/t                 | 16.7    | -               | Casing Outside Diameter (after Corrosion or Thread Reduction) / Wall Thickness (after Corrosion or Thread Reduction) |                       |
|                                       | E/fy                | 362.5   | -               | Elastic Modulus of Steel Casing / Yield Strength of Steel Casing   |                       |
|                                       | M <sub>n</sub>      | 1,835.3 | kip-in          | Nominal Moment Resistance =  | Ref. 1, 6.12.2.3.2    |
|                                       | M <sub>rx</sub>     | 1,835.3 | kip-in          | Factored Flexural Resistance about x Axis  | Ref. 1, 6.12.2.3.2    |
|                                       | M <sub>ry</sub>     | 1,835.3 | kip-in          | Factored Flexural Resistance about y Axis  | Ref. 1, 6.12.2.3.2    |
|                                       | D/C                 | 0.75    | -               | Combined Axial and Flexure Demand over Capacity Ratio  | Ref. 1, 6.9.2.2       |
| Adequate                              | OK                  | -       | D/C ≤ 1         |  |                       |

## Notes:

- Only enter unit tip resistance for the bearing strata, and to neglect tip resistance leave this parameter blank. Typically it is neglected unless the tip is in sound rock.
- Loads per micropile were determined from FB Pier Analysis which utilized Factored Loads Provided by Structural Engineer.
- Additional load caused by downdrag is the side shear resistance in or above any layers anticipated to settle greater than 0.4" and which are in contact with the pile. This side shear resistance is calculated elsewhere either with a hand calculation or by the FHWA's Driven Software. This side shear resistance is a negative and is accounted for as an additional load.
- If Alpha (a) Method is used  $g_p = 1.4$ , if Lambda (l) Method is used  $g_p = 1.05$ , if Nordland/Thurman (N) Method is used the load factor for the Alpha Method will be used.
- If Alpha (a) Method is used  $g_p = 0.25$ , if Lambda (l) Method is used  $g_p = 0.3$ , if Nordland/Thurman (N) Method is used the load factor for the Alpha Method will be used.
- Group Reduction Factor for Geotechnical Axial Compression:  
If Cohesive and  $2.5B \leq \text{center to center pile spacing} \leq 6B$ ,  $\eta = 0.65$ , Interpolated between. Use only if cap is not in firm contact with the ground and if the soil at the surface is soft.  
If center to center pile spacing > 6B,  $\eta = 1$   
If cohesionless and center to center pile spacing  $\geq 2.5 B$ ,  $\eta = 1$
- $Q_g = (2X + 2Y) Z S_u + X Y N_c S_u$
- $\delta_{cased}$  and  $\delta_{bond}$  = Maximum Nominal Load per Micropile \*  $L_1 * 12 / [490 \text{ pcf} * (\text{Area Steel} / \text{Total Area}) + 150 \text{ pcf} * (\text{Grout Area} / \text{Total Area})]$

## References:

- AASHTO. *LRFD Bridge Design Specifications*. Fifth Ed. 2010
- Bruce, D.A., Cadden, A.W., Sabatini, P.J. *Practical Advice for Foundation Design - Micropiles for Structural Support*
- FHWA NHI-05-039. *Micropile Design and Construction*. December 2005
- FHWA NHI-97-013. *Design and Construction of Driven Pile Foundations*. November 1998
- FHWA-SA-97-070. *Micropile Design and Construction Guidelines*. June 2000
- ASTM A252. *Standard Specifications for Welded and Seamless Steel Pipe Piles*. 2010

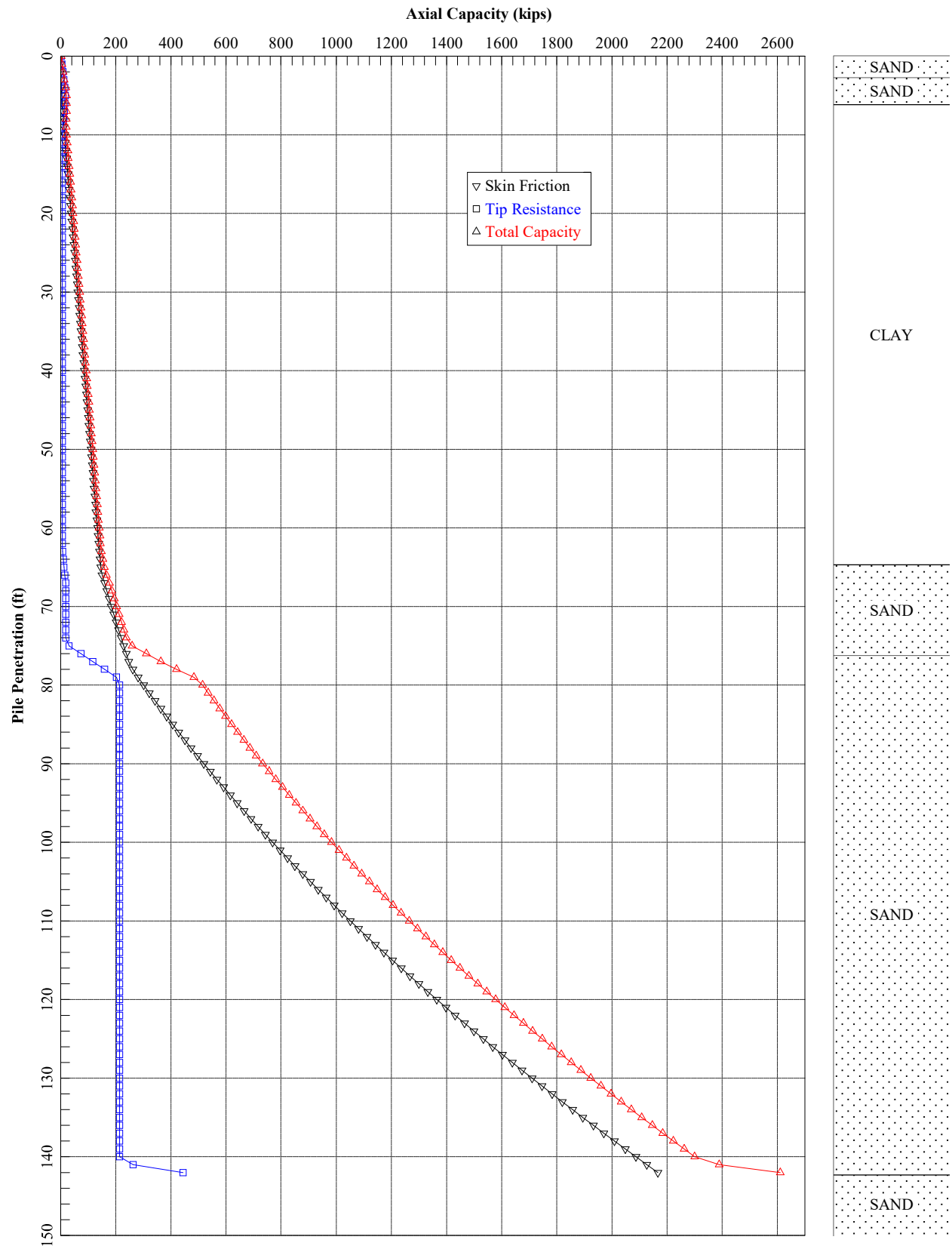
|         |                                 |            |            |                |          |
|---------|---------------------------------|------------|------------|----------------|----------|
| For     | MEDOT I-295 over Veranda Street | Job no.    | 75297      | Sheet no.      | 1 of 216 |
| Made by | ACP                             | Checked by | JCJ        | Backchecked by | .        |
| Date    | 02/21/2020                      | Date       | 02/24/2020 | Date           | .        |

# **MAINEDOT I-295 OVER VERANDA STREET**

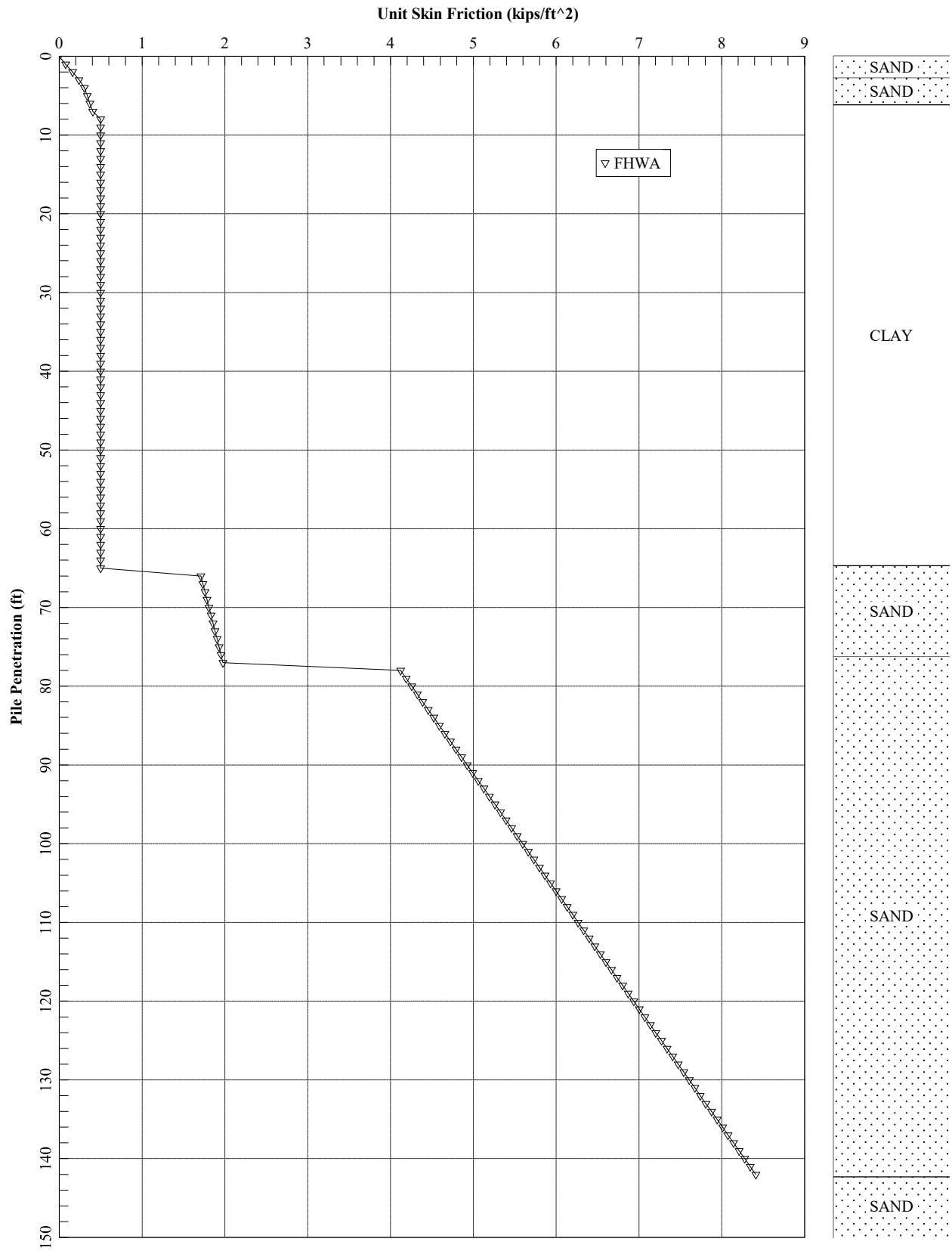
## **FOUNDATION ANALYSIS FOR FINAL DESIGN**

### **DRIVEN H-PILE AXIAL AND DRIVABILITY ASSESSMENT**

## **APILE AXIAL CAPACITY ANALYSIS**



Abutment 2 Southbound Piles



Abutment 2 Southbound Piles

=====

APILE for Windows, Version 2019.9.3

Serial Number : 160779486

A Program for Analyzing the Axial Capacity  
and Short-term Settlement of Driven Piles  
under Axial Loading.  
(c) Copyright ENSOFT, Inc., 1987-2015  
All Rights Reserved

=====

This program is licensed to :

HNTB Corporation  
Parsippany, New Jersey

Path to file locations : T:\75297\_MaineDOT\_I-295 Veranda Final  
Design\Geotech\Calcs\Deep Foundations\Piles\2020-02-21 Driveability Analysis\APILE\  
Name of input data file : Abutment 2 SB Piles Driveability\_2020-02-21.ap9d  
Name of output file : Abutment 2 SB Piles Driveability\_2020-02-21.ap9o  
Name of plot output file : Abutment 2 SB Piles Driveability\_2020-02-21.ap9p

-----  
Time and Date of Analysis  
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Date: April 02, 2020 Time: 00:49:35

1

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\* INPUT INFORMATION \*  
\*\*\*\*\*

Abutment 2 SB Abutment H-Piles

DESIGNER : ACP

JOB NUMBER : 75297

METHOD FOR UNIT LOAD TRANSFERS :

- FHWA (Federal Highway Administration)  
Unfactored Unit Side Friction and Unit Side Resistance are used.

#### COMPUTATION METHOD(S) FOR PILE CAPACITY :

- FHWA (Federal Highway Administration)

#### TYPE OF LOADING :

- COMPRESSION

#### PILE TYPE :

H-Pile/Steel Pile

#### DATA FOR AXIAL STIFFNESS :

- MODULUS OF ELASTICITY = 0.290E+08 PSI
- CROSS SECTION AREA = 202.86 IN<sup>2</sup>

#### NONCIRCULAR PILE PROPERTIES :

- TOTAL PILE LENGTH, TL = 142.20 FT.
- BATTER ANGLE = 0.00 DEG
- PILE STICKUP LENGTH, PSL = 0.00 FT.
- ZERO FRICTION LENGTH, ZFL = 0.00 FT.
- PERIMETER OF PILE = 57.00 IN.
- TIP AREA OF PILE = 202.86 IN<sup>2</sup>
- INCREMENT OF PILE LENGTH  
USED IN COMPUTATION = 1.00 FT.

#### SOIL INFORMATIONS :

| DEPTH<br>FT. | SOIL<br>TYPE | LATERAL<br>EARTH<br>PRESSURE | EFFECTIVE<br>UNIT<br>WEIGHT<br>LB/FT <sup>3</sup> | FRICTION<br>ANGLE<br>DEGREES | BEARING<br>CAPACITY<br>FACTOR |
|--------------|--------------|------------------------------|---|------------------------------|-------------------------------|
| 0.00         | SAND         | 0.80*                        | 110.00  | 32.00                        | 28.00**                       |
| 2.80         | SAND         | 0.80*                        | 110.00  | 32.00                        | 28.00**                       |
| 2.80         | SAND         | 0.80*                        | 42.60   | 33.00                        | 32.00**                       |
| 6.20         | SAND         | 0.80*                        | 42.60   | 33.00                        | 32.00**                       |

|        |      |       |        |       |         |
|--------|------|-------|--------|-------|---------|
| 6.20   | CLAY | 0.80* | 42.60  | 0.00  | 8.00**  |
| 64.70  | CLAY | 0.80* | 42.60  | 0.00  | 8.00**  |
| 64.70  | SAND | 0.80* | 42.60  | 30.00 | 20.00** |
| 76.30  | SAND | 0.80* | 42.60  | 30.00 | 20.00** |
| 76.30  | SAND | 0.80* | 57.60  | 36.00 | 42.00** |
| 142.20 | SAND | 0.80* | 57.60  | 36.00 | 42.00** |
| 142.20 | SAND | 0.80* | 107.60 | 48.00 | 50.00** |
| 150.00 | SAND | 0.80* | 107.60 | 48.00 | 50.00** |

\* VALUE ASSUMED BY THE PROGRAM

\*\* VALUE ESTIMATED BY THE PROGRAM BASED ON FRICTION ANGLE

| MAXIMUM<br>UNIT<br>FRICTION<br>KSF | MAXIMUM<br>UNIT<br>BEARING<br>KSF | UNDISTURB<br>SHEAR<br>STRENGTH<br>KSF | REMOLDED<br>SHEAR<br>STRENGTH<br>KSF | BLOW<br>COUNT | UNIT SKIN<br>FRICTION<br>KSF | UNIT END<br>BEARING<br>KSF |
|------------------------------------|-----------------------------------|---------------------------------------|--------------------------------------|---------------|------------------------------|----------------------------|
| 0.10E+08*                          | 0.10E+08*                         | 0.00                                  | 0.00                                 | 0.00          | 0.00                         | 0.00                       |
| 0.10E+08*                          | 0.10E+08*                         | 0.00                                  | 0.00                                 | 0.00          | 0.00                         | 0.00                       |
| 0.10E+08*                          | 0.10E+08*                         | 0.00                                  | 0.00                                 | 0.00          | 0.00                         | 0.00                       |
| 0.10E+08*                          | 0.10E+08*                         | 0.00                                  | 0.00                                 | 0.00          | 0.00                         | 0.00                       |
| 0.10E+08*                          | 0.10E+08*                         | 0.50                                  | 0.00                                 | 0.00          | 0.00                         | 0.00                       |
| 0.10E+08*                          | 0.10E+08*                         | 0.50                                  | 0.00                                 | 0.00          | 0.00                         | 0.00                       |
| 0.10E+08*                          | 0.10E+08*                         | 0.00                                  | 0.00                                 | 0.00          | 0.00                         | 0.00                       |
| 0.10E+08*                          | 0.10E+08*                         | 0.00                                  | 0.00                                 | 0.00          | 0.00                         | 0.00                       |
| 0.10E+08*                          | 0.10E+08*                         | 0.00                                  | 0.00                                 | 0.00          | 0.00                         | 0.00                       |
| 0.10E+08*                          | 0.10E+08*                         | 0.00                                  | 0.00                                 | 0.00          | 0.00                         | 0.00                       |
| 0.10E+08*                          | 0.10E+08*                         | 0.00                                  | 0.00                                 | 0.00          | 0.00                         | 0.00                       |
| 0.10E+08*                          | 0.10E+08*                         | 0.00                                  | 0.00                                 | 0.00          | 0.00                         | 0.00                       |

\* MAXIMUM UNIT FRICTION AND/OR MAXIMUM UNIT BEARING WERE SET TO BE 0.10E+08 BECAUSE THE USER DOES NOT PLAN TO LIMIT THE COMPUTED DATA.

| DEPTH<br>FT. | LRFD FACTOR<br>ON UNIT<br>FRICTION | LRFD FACTOR<br>ON UNIT<br>BEARING |
|--------------|------------------------------------|-----------------------------------|
| 0.00         | 1.000                              | 1.000                             |
| 2.80         | 1.000                              | 1.000                             |
| 2.80         | 1.000                              | 1.000                             |
| 6.20         | 1.000                              | 1.000                             |
| 6.20         | 1.000                              | 1.000                             |
| 64.70        | 1.000                              | 1.000                             |
| 64.70        | 1.000                              | 1.000                             |
| 76.30        | 1.000                              | 1.000                             |
| 76.30        | 1.000                              | 1.000                             |



|        |       |       |
|--------|-------|-------|
| 142.20 | 1.000 | 1.000 |
| 142.20 | 1.000 | 1.000 |
| 150.00 | 1.000 | 1.000 |

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 \* COMPUTATION RESULT \*  
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\*\*\*\*\*  
 \* FED. HWY. METHOD \*  
 \*\*\*\*\*

| PILE<br>PENETRATION<br>FT. | TOTAL SKIN<br>FRICTION<br>KIP | END<br>BEARING<br>KIP | ULTIMATE<br>CAPACITY<br>KIP |
|----------------------------|-------------------------------|-----------------------|-----------------------------|
| 0.00                       | 0.0                           | 2.2                   | 2.2                         |
| 1.00                       | 0.2                           | 4.3                   | 4.5                         |
| 2.00                       | 0.8                           | 7.7                   | 8.5                         |
| 3.00                       | 1.7                           | 11.8                  | 13.5                        |
| 4.00                       | 3.0                           | 14.9                  | 18.0                        |
| 5.00                       | 4.5                           | 16.8                  | 21.3                        |
| 6.00                       | 6.2                           | 15.1                  | 21.3                        |
| 7.00                       | 8.1                           | 12.9                  | 20.9                        |
| 8.00                       | 10.2                          | 10.2                  | 20.5                        |
| 9.00                       | 12.6                          | 7.2                   | 19.8                        |
| 10.00                      | 15.0                          | 6.3                   | 21.3                        |
| 11.00                      | 17.3                          | 6.3                   | 23.7                        |
| 12.00                      | 19.7                          | 6.3                   | 26.1                        |
| 13.00                      | 22.1                          | 6.3                   | 28.4                        |
| 14.00                      | 24.5                          | 6.3                   | 30.8                        |
| 15.00                      | 26.8                          | 6.3                   | 33.2                        |
| 16.00                      | 29.2                          | 6.3                   | 35.6                        |
| 17.00                      | 31.6                          | 6.3                   | 37.9                        |
| 18.00                      | 34.0                          | 6.3                   | 40.3                        |
| 19.00                      | 36.3                          | 6.3                   | 42.7                        |
| 20.00                      | 38.7                          | 6.3                   | 45.1                        |
| 21.00                      | 41.1                          | 6.3                   | 47.4                        |
| 22.00                      | 43.5                          | 6.3                   | 49.8                        |
| 23.00                      | 45.8                          | 6.3                   | 52.2                        |
| 24.00                      | 48.2                          | 6.3                   | 54.6                        |
| 25.00                      | 50.6                          | 6.3                   | 56.9                        |
| 26.00                      | 53.0                          | 6.3                   | 59.3                        |
| 27.00                      | 55.3                          | 6.3                   | 61.7                        |
| 28.00                      | 57.7                          | 6.3                   | 64.1                        |
| 29.00                      | 60.1                          | 6.3                   | 66.4                        |

|       |       |       |       |
|-------|-------|-------|-------|
| 30.00 | 62.5  | 6.3   | 68.8  |
| 31.00 | 64.8  | 6.3   | 71.2  |
| 32.00 | 67.2  | 6.3   | 73.6  |
| 33.00 | 69.6  | 6.3   | 75.9  |
| 34.00 | 72.0  | 6.3   | 78.3  |
| 35.00 | 74.3  | 6.3   | 80.7  |
| 36.00 | 76.7  | 6.3   | 83.1  |
| 37.00 | 79.1  | 6.3   | 85.4  |
| 38.00 | 81.5  | 6.3   | 87.8  |
| 39.00 | 83.8  | 6.3   | 90.2  |
| 40.00 | 86.2  | 6.3   | 92.6  |
| 41.00 | 88.6  | 6.3   | 94.9  |
| 42.00 | 91.0  | 6.3   | 97.3  |
| 43.00 | 93.3  | 6.3   | 99.7  |
| 44.00 | 95.7  | 6.3   | 102.1 |
| 45.00 | 98.1  | 6.3   | 104.4 |
| 46.00 | 100.5 | 6.3   | 106.8 |
| 47.00 | 102.8 | 6.3   | 109.2 |
| 48.00 | 105.2 | 6.3   | 111.6 |
| 49.00 | 107.6 | 6.3   | 113.9 |
| 50.00 | 110.0 | 6.3   | 116.3 |
| 51.00 | 112.3 | 6.3   | 118.7 |
| 52.00 | 114.7 | 6.3   | 121.1 |
| 53.00 | 117.1 | 6.3   | 123.4 |
| 54.00 | 119.5 | 6.3   | 125.8 |
| 55.00 | 121.8 | 6.3   | 128.2 |
| 56.00 | 124.2 | 6.3   | 130.6 |
| 57.00 | 126.6 | 6.3   | 132.9 |
| 58.00 | 129.0 | 6.3   | 135.3 |
| 59.00 | 131.3 | 6.3   | 137.7 |
| 60.00 | 133.7 | 6.3   | 140.1 |
| 61.00 | 136.1 | 6.3   | 142.4 |
| 62.00 | 138.5 | 6.3   | 144.8 |
| 63.00 | 140.8 | 7.1   | 147.9 |
| 64.00 | 143.2 | 9.8   | 153.0 |
| 65.00 | 145.6 | 12.6  | 158.1 |
| 66.00 | 150.8 | 15.3  | 166.1 |
| 67.00 | 159.0 | 18.0  | 177.1 |
| 68.00 | 167.3 | 18.8  | 186.1 |
| 69.00 | 175.7 | 18.8  | 194.5 |
| 70.00 | 184.3 | 18.8  | 203.0 |
| 71.00 | 192.9 | 18.8  | 211.7 |
| 72.00 | 201.7 | 18.8  | 220.4 |
| 73.00 | 210.6 | 18.8  | 229.3 |
| 74.00 | 219.5 | 18.8  | 238.3 |
| 75.00 | 228.6 | 30.3  | 258.9 |
| 76.00 | 237.9 | 73.2  | 311.1 |
| 77.00 | 247.2 | 116.2 | 363.4 |
| 78.00 | 261.7 | 159.1 | 420.8 |
| 79.00 | 281.4 | 202.1 | 483.5 |

|        |        |       |        |
|--------|--------|-------|--------|
| 80.00  | 301.5  | 213.6 | 515.0  |
| 81.00  | 321.8  | 213.6 | 535.4  |
| 82.00  | 342.5  | 213.6 | 556.1  |
| 83.00  | 363.5  | 213.6 | 577.1  |
| 84.00  | 384.9  | 213.6 | 598.4  |
| 85.00  | 406.5  | 213.6 | 620.1  |
| 86.00  | 428.5  | 213.6 | 642.0  |
| 87.00  | 450.7  | 213.6 | 664.3  |
| 88.00  | 473.3  | 213.6 | 686.9  |
| 89.00  | 496.2  | 213.6 | 709.8  |
| 90.00  | 519.5  | 213.6 | 733.1  |
| 91.00  | 543.0  | 213.6 | 756.6  |
| 92.00  | 566.9  | 213.6 | 780.5  |
| 93.00  | 591.1  | 213.6 | 804.7  |
| 94.00  | 615.6  | 213.6 | 829.2  |
| 95.00  | 640.4  | 213.6 | 854.0  |
| 96.00  | 665.6  | 213.6 | 879.1  |
| 97.00  | 691.0  | 213.6 | 904.6  |
| 98.00  | 716.8  | 213.6 | 930.4  |
| 99.00  | 742.9  | 213.6 | 956.5  |
| 100.00 | 769.3  | 213.6 | 982.9  |
| 101.00 | 796.1  | 213.6 | 1009.7 |
| 102.00 | 823.1  | 213.6 | 1036.7 |
| 103.00 | 850.5  | 213.6 | 1064.1 |
| 104.00 | 878.2  | 213.6 | 1091.8 |
| 105.00 | 906.2  | 213.6 | 1119.8 |
| 106.00 | 934.6  | 213.6 | 1148.1 |
| 107.00 | 963.2  | 213.6 | 1176.8 |
| 108.00 | 992.2  | 213.6 | 1205.7 |
| 109.00 | 1021.5 | 213.6 | 1235.0 |
| 110.00 | 1051.1 | 213.6 | 1264.6 |
| 111.00 | 1081.0 | 213.6 | 1294.5 |
| 112.00 | 1111.2 | 213.6 | 1324.8 |
| 113.00 | 1141.8 | 213.6 | 1355.3 |
| 114.00 | 1172.7 | 213.6 | 1386.2 |
| 115.00 | 1203.9 | 213.6 | 1417.4 |
| 116.00 | 1235.4 | 213.6 | 1448.9 |
| 117.00 | 1267.2 | 213.6 | 1480.8 |
| 118.00 | 1299.4 | 213.6 | 1512.9 |
| 119.00 | 1331.8 | 213.6 | 1545.4 |
| 120.00 | 1364.6 | 213.6 | 1578.2 |
| 121.00 | 1397.7 | 213.6 | 1611.3 |
| 122.00 | 1431.1 | 213.6 | 1644.7 |
| 123.00 | 1464.9 | 213.6 | 1678.5 |
| 124.00 | 1499.0 | 213.6 | 1712.5 |
| 125.00 | 1533.3 | 213.6 | 1746.9 |
| 126.00 | 1568.0 | 213.6 | 1781.6 |
| 127.00 | 1603.0 | 213.6 | 1816.6 |
| 128.00 | 1638.4 | 213.6 | 1852.0 |
| 129.00 | 1674.0 | 213.6 | 1887.6 |

|        |        |       |        |
|--------|--------|-------|--------|
| 130.00 | 1710.0 | 213.6 | 1923.6 |
| 131.00 | 1746.3 | 213.6 | 1959.9 |
| 132.00 | 1782.9 | 213.6 | 1996.5 |
| 133.00 | 1819.8 | 213.6 | 2033.4 |
| 134.00 | 1857.1 | 213.6 | 2070.7 |
| 135.00 | 1894.7 | 213.6 | 2108.2 |
| 136.00 | 1932.5 | 213.6 | 2146.1 |
| 137.00 | 1970.7 | 213.6 | 2184.3 |
| 138.00 | 2009.3 | 213.6 | 2222.8 |
| 139.00 | 2048.1 | 213.6 | 2261.7 |
| 140.00 | 2087.3 | 213.6 | 2300.8 |
| 141.00 | 2126.7 | 262.3 | 2389.1 |
| 142.00 | 2166.5 | 444.3 | 2610.9 |

NOTES:

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

\*\*\*\*\*  
 \* COMPUTE LOAD-DISTRIBUTION AND LOAD-SETTLEMENT \*  
 \* CURVES FOR AXIAL LOADING \*  
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| T-Z CURVE NO. | NO. OF POINTS | DEPTH TO CURVE FT. | LOAD TRANSFER PSI | PILE MOVEMENT IN. |
|---------------|---------------|--------------------|-------------------|-------------------|
| 1             | 10            | 0.0000E+00         | 0.0000E+00        | 0.0000E+00        |
|               |               |                    | 0.0000E+00        | 0.2903E-01        |
|               |               |                    | 0.0000E+00        | 0.5625E-01        |
|               |               |                    | 0.0000E+00        | 0.1034E+00        |
|               |               |                    | 0.0000E+00        | 0.1451E+00        |
|               |               |                    | 0.0000E+00        | 0.1814E+00        |
|               |               |                    | 0.0000E+00        | 0.3629E+00        |
|               |               |                    | 0.0000E+00        | 0.5443E+00        |
|               |               |                    | 0.0000E+00        | 0.9072E+00        |
|               |               |                    | 0.0000E+00        | 0.3629E+01        |
| 2             | 10            | 0.1425E+01         | 0.0000E+00        | 0.0000E+00        |
|               |               |                    | 0.2378E+00        | 0.2903E-01        |
|               |               |                    | 0.3963E+00        | 0.5625E-01        |
|               |               |                    | 0.5945E+00        | 0.1034E+00        |
|               |               |                    | 0.7134E+00        | 0.1451E+00        |
|               |               |                    | 0.7926E+00        | 0.1814E+00        |
|               |               |                    | 0.7926E+00        | 0.3629E+00        |

|   |    |            |            |            |
|---|----|------------|------------|------------|
| 3 | 10 | 0.2758E+01 | 0.7926E+00 | 0.5443E+00 |
|   |    |            | 0.7926E+00 | 0.9072E+00 |
|   |    |            | 0.7926E+00 | 0.3629E+01 |
|   |    |            | 0.0000E+00 | 0.0000E+00 |
|   |    |            | 0.4603E+00 | 0.2903E-01 |
|   |    |            | 0.7671E+00 | 0.5625E-01 |
|   |    |            | 0.1151E+01 | 0.1034E+00 |
|   |    |            | 0.1381E+01 | 0.1451E+00 |
|   |    |            | 0.1534E+01 | 0.1814E+00 |
|   |    |            | 0.1534E+01 | 0.3629E+00 |
|   |    |            | 0.1534E+01 | 0.5443E+00 |
|   |    |            | 0.1534E+01 | 0.9072E+00 |
|   |    |            | 0.1534E+01 | 0.3629E+01 |
| 4 | 10 | 0.2800E+01 | 0.0000E+00 | 0.0000E+00 |
|   |    |            | 0.4672E+00 | 0.2903E-01 |
|   |    |            | 0.7787E+00 | 0.5625E-01 |
|   |    |            | 0.1168E+01 | 0.1034E+00 |
|   |    |            | 0.1402E+01 | 0.1451E+00 |
|   |    |            | 0.1557E+01 | 0.1814E+00 |
|   |    |            | 0.1557E+01 | 0.3629E+00 |
|   |    |            | 0.1557E+01 | 0.5443E+00 |
|   |    |            | 0.1557E+01 | 0.9072E+00 |
|   |    |            | 0.1557E+01 | 0.3629E+01 |
|   |    |            | 0.0000E+00 | 0.0000E+00 |
|   |    |            | 0.6692E+00 | 0.2903E-01 |
|   |    |            | 0.1115E+01 | 0.5625E-01 |
| 5 | 10 | 0.4525E+01 | 0.1673E+01 | 0.1034E+00 |
|   |    |            | 0.2008E+01 | 0.1451E+00 |
|   |    |            | 0.2231E+01 | 0.1814E+00 |
|   |    |            | 0.2231E+01 | 0.3629E+00 |
|   |    |            | 0.2231E+01 | 0.5443E+00 |
|   |    |            | 0.2231E+01 | 0.9072E+00 |
|   |    |            | 0.2231E+01 | 0.3629E+01 |
|   |    |            | 0.0000E+00 | 0.0000E+00 |
|   |    |            | 0.7871E+00 | 0.2903E-01 |
|   |    |            | 0.1312E+01 | 0.5625E-01 |
|   |    |            | 0.1968E+01 | 0.1034E+00 |
|   |    |            | 0.2361E+01 | 0.1451E+00 |
|   |    |            | 0.2624E+01 | 0.1814E+00 |
| 6 | 10 | 0.6158E+01 | 0.2624E+01 | 0.3629E+00 |
|   |    |            | 0.2624E+01 | 0.5443E+00 |
|   |    |            | 0.2624E+01 | 0.9072E+00 |
|   |    |            | 0.2624E+01 | 0.3629E+01 |
|   |    |            | 0.0000E+00 | 0.0000E+00 |
|   |    |            | 0.7901E+00 | 0.2903E-01 |
|   |    |            | 0.0000E+00 | 0.0000E+00 |
|   |    |            | 0.0000E+00 | 0.0000E+00 |
|   |    |            | 0.0000E+00 | 0.0000E+00 |
|   |    |            | 0.0000E+00 | 0.0000E+00 |
|   |    |            | 0.0000E+00 | 0.0000E+00 |
|   |    |            | 0.0000E+00 | 0.0000E+00 |
|   |    |            | 0.0000E+00 | 0.0000E+00 |
| 7 | 10 | 0.6200E+01 | 0.0000E+00 | 0.0000E+00 |
|   |    |            | 0.0000E+00 | 0.0000E+00 |
|   |    |            | 0.0000E+00 | 0.0000E+00 |

|    |    |            |            |            |
|----|----|------------|------------|------------|
| 8  | 10 | 0.3548E+02 | 0.1317E+01 | 0.5625E-01 |
|    |    |            | 0.1975E+01 | 0.1034E+00 |
|    |    |            | 0.2370E+01 | 0.1451E+00 |
|    |    |            | 0.2634E+01 | 0.1814E+00 |
|    |    |            | 0.2370E+01 | 0.3629E+00 |
|    |    |            | 0.2370E+01 | 0.5443E+00 |
|    |    |            | 0.2370E+01 | 0.9072E+00 |
|    |    |            | 0.2370E+01 | 0.3629E+01 |
| 9  | 10 | 0.6466E+02 | 0.0000E+00 | 0.0000E+00 |
|    |    |            | 0.1042E+01 | 0.2903E-01 |
|    |    |            | 0.1736E+01 | 0.5625E-01 |
|    |    |            | 0.2604E+01 | 0.1034E+00 |
|    |    |            | 0.3125E+01 | 0.1451E+00 |
|    |    |            | 0.3472E+01 | 0.1814E+00 |
|    |    |            | 0.3125E+01 | 0.3629E+00 |
|    |    |            | 0.3125E+01 | 0.5443E+00 |
| 10 | 10 | 0.6470E+02 | 0.3125E+01 | 0.9072E+00 |
|    |    |            | 0.3125E+01 | 0.3629E+01 |
|    |    |            | 0.0000E+00 | 0.0000E+00 |
|    |    |            | 0.1042E+01 | 0.2903E-01 |
|    |    |            | 0.1736E+01 | 0.5625E-01 |
|    |    |            | 0.2604E+01 | 0.1034E+00 |
|    |    |            | 0.3125E+01 | 0.1451E+00 |
|    |    |            | 0.3472E+01 | 0.1814E+00 |
| 11 | 10 | 0.7053E+02 | 0.3125E+01 | 0.3629E+00 |
|    |    |            | 0.3125E+01 | 0.5443E+00 |
|    |    |            | 0.3125E+01 | 0.9072E+00 |
|    |    |            | 0.3472E+01 | 0.3629E+01 |
|    |    |            | 0.0000E+00 | 0.0000E+00 |
|    |    |            | 0.1042E+01 | 0.2903E-01 |
|    |    |            | 0.1736E+01 | 0.5625E-01 |
|    |    |            | 0.2604E+01 | 0.1034E+00 |
|    |    |            | 0.3125E+01 | 0.1451E+00 |
|    |    |            | 0.3472E+01 | 0.1814E+00 |
|    |    |            | 0.3472E+01 | 0.3629E+00 |
|    |    |            | 0.3472E+01 | 0.5443E+00 |
|    |    |            | 0.3472E+01 | 0.9072E+00 |
|    |    |            | 0.3472E+01 | 0.3629E+01 |
|    |    |            | 0.0000E+00 | 0.0000E+00 |
|    |    |            | 0.3793E+01 | 0.2903E-01 |
|    |    |            | 0.6322E+01 | 0.5625E-01 |
|    |    |            | 0.9483E+01 | 0.1034E+00 |
|    |    |            | 0.1138E+02 | 0.1451E+00 |
|    |    |            | 0.1264E+02 | 0.1814E+00 |
|    |    |            | 0.1264E+02 | 0.3629E+00 |
|    |    |            | 0.1264E+02 | 0.5443E+00 |
|    |    |            |            |            |
|    |    |            |            |            |

|    |    |            |            |            |
|----|----|------------|------------|------------|
| 12 | 10 | 0.7626E+02 | 0.1264E+02 | 0.9072E+00 |
|    |    |            | 0.1264E+02 | 0.3629E+01 |
|    |    |            | 0.0000E+00 | 0.0000E+00 |
|    |    |            | 0.4082E+01 | 0.2903E-01 |
|    |    |            | 0.6803E+01 | 0.5625E-01 |
|    |    |            | 0.1021E+02 | 0.1034E+00 |
|    |    |            | 0.1225E+02 | 0.1451E+00 |
|    |    |            | 0.1361E+02 | 0.1814E+00 |
|    |    |            | 0.1361E+02 | 0.3629E+00 |
|    |    |            | 0.1361E+02 | 0.5443E+00 |
| 13 | 10 | 0.7630E+02 | 0.1361E+02 | 0.9072E+00 |
|    |    |            | 0.1361E+02 | 0.3629E+01 |
|    |    |            | 0.0000E+00 | 0.0000E+00 |
|    |    |            | 0.4084E+01 | 0.2903E-01 |
|    |    |            | 0.6807E+01 | 0.5625E-01 |
|    |    |            | 0.1021E+02 | 0.1034E+00 |
|    |    |            | 0.1225E+02 | 0.1451E+00 |
|    |    |            | 0.1361E+02 | 0.1814E+00 |
|    |    |            | 0.1361E+02 | 0.3629E+00 |
|    |    |            | 0.1361E+02 | 0.5443E+00 |
| 14 | 10 | 0.1093E+03 | 0.1361E+02 | 0.9072E+00 |
|    |    |            | 0.1361E+02 | 0.3629E+01 |
|    |    |            | 0.0000E+00 | 0.0000E+00 |
|    |    |            | 0.1295E+02 | 0.2903E-01 |
|    |    |            | 0.2159E+02 | 0.5625E-01 |
|    |    |            | 0.3238E+02 | 0.1034E+00 |
|    |    |            | 0.3886E+02 | 0.1451E+00 |
|    |    |            | 0.4318E+02 | 0.1814E+00 |
|    |    |            | 0.4318E+02 | 0.3629E+00 |
|    |    |            | 0.4318E+02 | 0.5443E+00 |
| 15 | 10 | 0.1422E+03 | 0.4318E+02 | 0.9072E+00 |
|    |    |            | 0.4318E+02 | 0.3629E+01 |
|    |    |            | 0.0000E+00 | 0.0000E+00 |
|    |    |            | 0.1752E+02 | 0.2903E-01 |
|    |    |            | 0.2921E+02 | 0.5625E-01 |
|    |    |            | 0.4381E+02 | 0.1034E+00 |
|    |    |            | 0.5257E+02 | 0.1451E+00 |
|    |    |            | 0.5841E+02 | 0.1814E+00 |
|    |    |            | 0.5841E+02 | 0.3629E+00 |
|    |    |            | 0.5841E+02 | 0.5443E+00 |
| 16 | 10 | 0.1422E+03 | 0.5841E+02 | 0.9072E+00 |
|    |    |            | 0.5841E+02 | 0.3629E+01 |
|    |    |            | 0.0000E+00 | 0.0000E+00 |
|    |    |            | 0.1752E+02 | 0.2903E-01 |
|    |    |            | 0.2921E+02 | 0.5625E-01 |

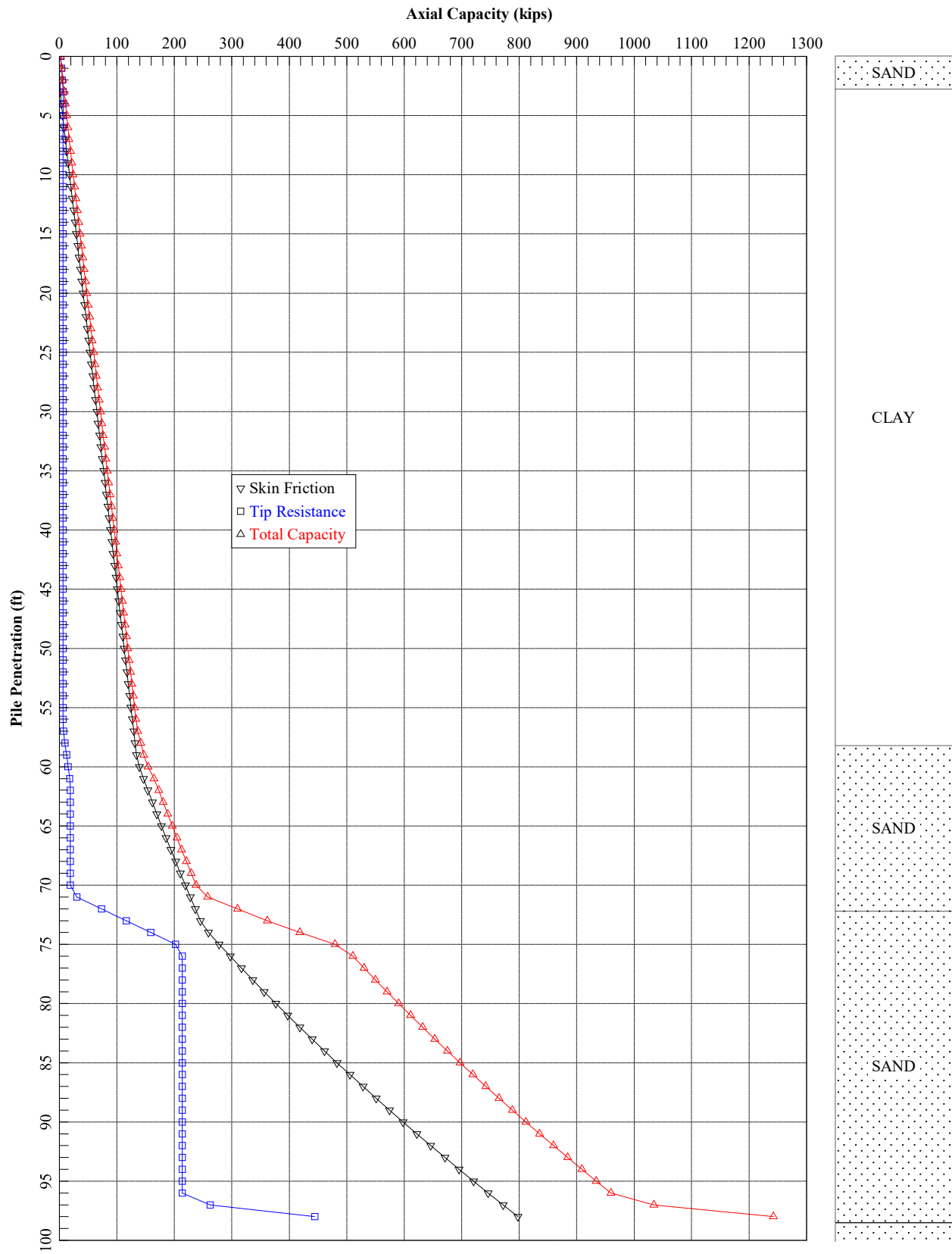
|    |    |            |            |            |
|----|----|------------|------------|------------|
|    |    |            | 0.4381E+02 | 0.1034E+00 |
|    |    |            | 0.5257E+02 | 0.1451E+00 |
|    |    |            | 0.5841E+02 | 0.1814E+00 |
|    |    |            | 0.5841E+02 | 0.3629E+00 |
|    |    |            | 0.5841E+02 | 0.5443E+00 |
|    |    |            | 0.5841E+02 | 0.9072E+00 |
|    |    |            | 0.5841E+02 | 0.3629E+01 |
| 17 | 10 | 0.1461E+03 | 0.0000E+00 | 0.0000E+00 |
|    |    |            | 0.1752E+02 | 0.2903E-01 |
|    |    |            | 0.2921E+02 | 0.5625E-01 |
|    |    |            | 0.4381E+02 | 0.1034E+00 |
|    |    |            | 0.5257E+02 | 0.1451E+00 |
|    |    |            | 0.5841E+02 | 0.1814E+00 |
|    |    |            | 0.5841E+02 | 0.3629E+00 |
|    |    |            | 0.5841E+02 | 0.5443E+00 |
|    |    |            | 0.5841E+02 | 0.9072E+00 |
|    |    |            | 0.5841E+02 | 0.3629E+01 |
| 18 | 10 | 0.1500E+03 | 0.0000E+00 | 0.0000E+00 |
|    |    |            | 0.1752E+02 | 0.2903E-01 |
|    |    |            | 0.2921E+02 | 0.5625E-01 |
|    |    |            | 0.4381E+02 | 0.1034E+00 |
|    |    |            | 0.5257E+02 | 0.1451E+00 |
|    |    |            | 0.5841E+02 | 0.1814E+00 |
|    |    |            | 0.5841E+02 | 0.3629E+00 |
|    |    |            | 0.5841E+02 | 0.5443E+00 |
|    |    |            | 0.5841E+02 | 0.9072E+00 |
|    |    |            | 0.5841E+02 | 0.3629E+01 |

| TIP        | LOAD | TIP MOVEMENT |
|------------|------|--------------|
|            | KIP  | IN.          |
| 0.0000E+00 |      | 0.0000E+00   |
| 0.2777E+02 |      | 0.9072E-02   |
| 0.5554E+02 |      | 0.1814E-01   |
| 0.1111E+03 |      | 0.3629E-01   |
| 0.2222E+03 |      | 0.2359E+00   |
| 0.3332E+03 |      | 0.7620E+00   |
| 0.3999E+03 |      | 0.1324E+01   |
| 0.4443E+03 |      | 0.1814E+01   |
| 0.4443E+03 |      | 0.2722E+01   |
| 0.4443E+03 |      | 0.3629E+01   |

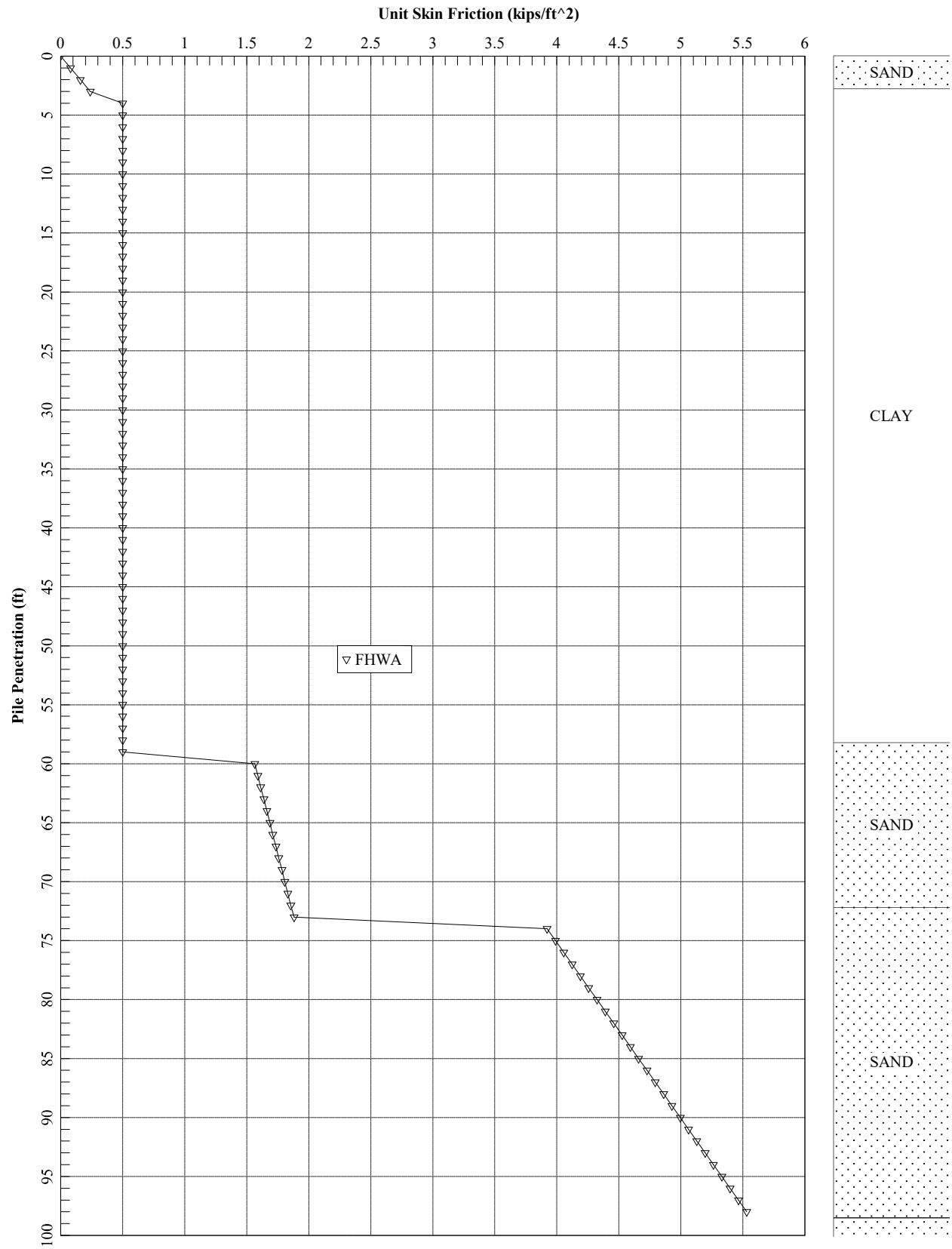
LOAD VERSUS SETTLEMENT CURVE  
\*\*\*\*\*



| TOP LOAD<br>KIP | TOP MOVEMENT<br>IN. | TIP LOAD<br>KIP | TIP MOVEMENT<br>IN. |
|-----------------|---------------------|-----------------|---------------------|
| 0.5135E+01      | 0.1044E-02          | 0.3061E+00      | 0.1000E-03          |
| 0.5135E+02      | 0.1044E-01          | 0.3061E+01      | 0.1000E-02          |
| 0.2552E+03      | 0.5233E-01          | 0.1531E+02      | 0.5000E-02          |
| 0.4906E+03      | 0.1033E+00          | 0.3061E+02      | 0.1000E-01          |
| 0.8781E+03      | 0.1937E+00          | 0.6122E+02      | 0.2000E-01          |
| 0.1526E+04      | 0.3705E+00          | 0.1187E+03      | 0.5000E-01          |
| 0.1872E+04      | 0.4821E+00          | 0.1354E+03      | 0.8000E-01          |
| 0.2040E+04      | 0.5437E+00          | 0.1465E+03      | 0.1000E+00          |
| 0.2363E+04      | 0.7288E+00          | 0.2022E+03      | 0.2000E+00          |
| 0.2439E+04      | 0.1051E+01          | 0.2779E+03      | 0.5000E+00          |
| 0.2498E+04      | 0.1368E+01          | 0.3377E+03      | 0.8000E+00          |
| 0.2522E+04      | 0.1575E+01          | 0.3614E+03      | 0.1000E+01          |
| 0.2605E+04      | 0.2599E+01          | 0.4443E+03      | 0.2000E+01          |



Abutment 2 Northbound Piles



Abutment 2 Northbound Piles

=====

APILE for Windows, Version 2019.9.3

Serial Number : 160779486

A Program for Analyzing the Axial Capacity  
and Short-term Settlement of Driven Piles  
under Axial Loading.  
(c) Copyright ENSOFT, Inc., 1987-2015  
All Rights Reserved

=====

This program is licensed to :

HNTB Corporation  
Parsippany, New Jersey

Path to file locations : T:\75297\_MaineDOT\_I-295 Veranda Final  
Design\Geotech\Calcs\Deep Foundations\Piles\2020-02-21 Driveability Analysis\APILE\  
Name of input data file : Abutment 2 NB Piles Driveability\_2020-02-21.ap9d  
Name of output file : Abutment 2 NB Piles Driveability\_2020-02-21.ap9o  
Name of plot output file : Abutment 2 NB Piles Driveability\_2020-02-21.ap9p

-----  
Time and Date of Analysis  
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Date: April 02, 2020 Time: 01:03:19

1

\*\*\*\*\*  
\* INPUT INFORMATION \*  
\*\*\*\*\*

Abutment 2 NB H-Piles

DESIGNER : ACP

JOB NUMBER : 75297

METHOD FOR UNIT LOAD TRANSFERS :

- FHWA (Federal Highway Administration)  
Unfactored Unit Side Friction and Unit Side Resistance are used.

#### COMPUTATION METHOD(S) FOR PILE CAPACITY :

- FHWA (Federal Highway Administration)

#### TYPE OF LOADING :

- COMPRESSION

#### PILE TYPE :

H-Pile/Steel Pile

#### DATA FOR AXIAL STIFFNESS :

- MODULUS OF ELASTICITY = 0.290E+08 PSI
- CROSS SECTION AREA = 202.86 IN<sup>2</sup>

#### NONCIRCULAR PILE PROPERTIES :

- TOTAL PILE LENGTH, TL = 98.40 FT.
- BATTER ANGLE = 0.00 DEG
- PILE STICKUP LENGTH, PSL = 0.00 FT.
- ZERO FRICTION LENGTH, ZFL = 0.00 FT.
- PERIMETER OF PILE = 57.00 IN.
- TIP AREA OF PILE = 202.86 IN<sup>2</sup>
- INCREMENT OF PILE LENGTH  
USED IN COMPUTATION = 1.00 FT.

#### SOIL INFORMATIONS :

| DEPTH<br>FT. | SOIL<br>TYPE | LATERAL<br>EARTH<br>PRESSURE | EFFECTIVE<br>UNIT<br>WEIGHT<br>LB/FT <sup>3</sup> | FRICTION<br>ANGLE<br>DEGREES | BEARING<br>CAPACITY<br>FACTOR |
|--------------|--------------|------------------------------|---|------------------------------|-------------------------------|
| 0.00         | SAND         | 0.80*                        | 110.00  | 32.00                        | 28.00**                       |
| 2.80         | SAND         | 0.80*                        | 110.00  | 32.00                        | 28.00**                       |
| 2.80         | CLAY         | 0.80*                        | 42.60   | 0.00                         | 8.00**                        |
| 58.20        | CLAY         | 0.80*                        | 42.60   | 0.00                         | 8.00**                        |

|        |      |       |        |       |         |
|--------|------|-------|--------|-------|---------|
| 58.20  | SAND | 0.80* | 42.60  | 30.00 | 20.00** |
| 72.20  | SAND | 0.80* | 42.60  | 30.00 | 20.00** |
| 72.20  | SAND | 0.80* | 57.60  | 36.00 | 42.00** |
| 98.40  | SAND | 0.80* | 57.60  | 36.00 | 42.00** |
| 98.40  | SAND | 0.80* | 107.60 | 48.00 | 50.00** |
| 110.00 | SAND | 0.80* | 107.60 | 48.00 | 50.00** |

\* VALUE ASSUMED BY THE PROGRAM

\*\* VALUE ESTIMATED BY THE PROGRAM BASED ON FRICTION ANGLE

| MAXIMUM<br>UNIT<br>FRICTION<br>KSF | MAXIMUM<br>UNIT<br>BEARING<br>KSF | UNDISTURB<br>SHEAR<br>STRENGTH<br>KSF | REMOLDED<br>SHEAR<br>STRENGTH<br>KSF | BLOW<br>COUNT | UNIT SKIN<br>FRICTION<br>KSF | UNIT END<br>BEARING<br>KSF |
|------------------------------------|-----------------------------------|---------------------------------------|--------------------------------------|---------------|------------------------------|----------------------------|
| 0.10E+08*                          | 0.10E+08*                         | 0.00                                  | 0.00                                 | 0.00          | 0.00                         | 0.00                       |
| 0.10E+08*                          | 0.10E+08*                         | 0.00                                  | 0.00                                 | 0.00          | 0.00                         | 0.00                       |
| 0.10E+08*                          | 0.10E+08*                         | 0.50                                  | 0.00                                 | 0.00          | 0.00                         | 0.00                       |
| 0.10E+08*                          | 0.10E+08*                         | 0.50                                  | 0.00                                 | 0.00          | 0.00                         | 0.00                       |
| 0.10E+08*                          | 0.10E+08*                         | 0.00                                  | 0.00                                 | 0.00          | 0.00                         | 0.00                       |
| 0.10E+08*                          | 0.10E+08*                         | 0.00                                  | 0.00                                 | 0.00          | 0.00                         | 0.00                       |
| 0.10E+08*                          | 0.10E+08*                         | 0.00                                  | 0.00                                 | 0.00          | 0.00                         | 0.00                       |
| 0.10E+08*                          | 0.10E+08*                         | 0.00                                  | 0.00                                 | 0.00          | 0.00                         | 0.00                       |
| 0.10E+08*                          | 0.10E+08*                         | 0.00                                  | 0.00                                 | 0.00          | 0.00                         | 0.00                       |
| 0.10E+08*                          | 0.10E+08*                         | 0.00                                  | 0.00                                 | 0.00          | 0.00                         | 0.00                       |

\* MAXIMUM UNIT FRICTION AND/OR MAXIMUM UNIT BEARING  
WERE SET TO BE 0.10E+08 BECAUSE THE USER DOES NOT  
PLAN TO LIMIT THE COMPUTED DATA.

| DEPTH<br>FT. | LRFD FACTOR<br>ON UNIT<br>FRICTION | LRFD FACTOR<br>ON UNIT<br>BEARING |
|--------------|------------------------------------|-----------------------------------|
| 0.00         | 1.000                              | 1.000                             |
| 2.80         | 1.000                              | 1.000                             |
| 2.80         | 1.000                              | 1.000                             |
| 58.20        | 1.000                              | 1.000                             |
| 58.20        | 1.000                              | 1.000                             |
| 72.20        | 1.000                              | 1.000                             |
| 72.20        | 1.000                              | 1.000                             |
| 98.40        | 1.000                              | 1.000                             |
| 98.40        | 1.000                              | 1.000                             |
| 110.00       | 1.000                              | 1.000                             |

\*\*\*\*\*  
 \* COMPUTATION RESULT \*  
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\*\*\*\*\*  
 \* FED. HWY. METHOD \*  
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| PILE<br>PENETRATION<br>FT. | TOTAL SKIN<br>FRICTION<br>KIP | END<br>BEARING<br>KIP | ULTIMATE<br>CAPACITY<br>KIP |
|----------------------------|-------------------------------|-----------------------|-----------------------------|
| 0.00                       | 0.0                           | 2.2                   | 2.2                         |
| 1.00                       | 0.2                           | 3.8                   | 4.0                         |
| 2.00                       | 0.8                           | 5.2                   | 6.0                         |
| 3.00                       | 1.7                           | 6.8                   | 8.5                         |
| 4.00                       | 3.5                           | 7.2                   | 10.6                        |
| 5.00                       | 5.8                           | 6.6                   | 12.5                        |
| 6.00                       | 8.2                           | 6.3                   | 14.6                        |
| 7.00                       | 10.6                          | 6.3                   | 16.9                        |
| 8.00                       | 13.0                          | 6.3                   | 19.3                        |
| 9.00                       | 15.3                          | 6.3                   | 21.7                        |
| 10.00                      | 17.7                          | 6.3                   | 24.1                        |
| 11.00                      | 20.1                          | 6.3                   | 26.4                        |
| 12.00                      | 22.5                          | 6.3                   | 28.8                        |
| 13.00                      | 24.8                          | 6.3                   | 31.2                        |
| 14.00                      | 27.2                          | 6.3                   | 33.6                        |
| 15.00                      | 29.6                          | 6.3                   | 35.9                        |
| 16.00                      | 32.0                          | 6.3                   | 38.3                        |
| 17.00                      | 34.3                          | 6.3                   | 40.7                        |
| 18.00                      | 36.7                          | 6.3                   | 43.1                        |
| 19.00                      | 39.1                          | 6.3                   | 45.4                        |
| 20.00                      | 41.5                          | 6.3                   | 47.8                        |
| 21.00                      | 43.8                          | 6.3                   | 50.2                        |
| 22.00                      | 46.2                          | 6.3                   | 52.6                        |
| 23.00                      | 48.6                          | 6.3                   | 54.9                        |
| 24.00                      | 51.0                          | 6.3                   | 57.3                        |
| 25.00                      | 53.3                          | 6.3                   | 59.7                        |
| 26.00                      | 55.7                          | 6.3                   | 62.1                        |
| 27.00                      | 58.1                          | 6.3                   | 64.4                        |
| 28.00                      | 60.5                          | 6.3                   | 66.8                        |
| 29.00                      | 62.8                          | 6.3                   | 69.2                        |
| 30.00                      | 65.2                          | 6.3                   | 71.6                        |
| 31.00                      | 67.6                          | 6.3                   | 73.9                        |
| 32.00                      | 70.0                          | 6.3                   | 76.3                        |
| 33.00                      | 72.3                          | 6.3                   | 78.7                        |
| 34.00                      | 74.7                          | 6.3                   | 81.1                        |
| 35.00                      | 77.1                          | 6.3                   | 83.4                        |

|       |       |       |       |
|-------|-------|-------|-------|
| 36.00 | 79.5  | 6.3   | 85.8  |
| 37.00 | 81.8  | 6.3   | 88.2  |
| 38.00 | 84.2  | 6.3   | 90.6  |
| 39.00 | 86.6  | 6.3   | 92.9  |
| 40.00 | 89.0  | 6.3   | 95.3  |
| 41.00 | 91.3  | 6.3   | 97.7  |
| 42.00 | 93.7  | 6.3   | 100.1 |
| 43.00 | 96.1  | 6.3   | 102.4 |
| 44.00 | 98.5  | 6.3   | 104.8 |
| 45.00 | 100.8 | 6.3   | 107.2 |
| 46.00 | 103.2 | 6.3   | 109.6 |
| 47.00 | 105.6 | 6.3   | 111.9 |
| 48.00 | 108.0 | 6.3   | 114.3 |
| 49.00 | 110.3 | 6.3   | 116.7 |
| 50.00 | 112.7 | 6.3   | 119.1 |
| 51.00 | 115.1 | 6.3   | 121.4 |
| 52.00 | 117.5 | 6.3   | 123.8 |
| 53.00 | 119.8 | 6.3   | 126.2 |
| 54.00 | 122.2 | 6.3   | 128.6 |
| 55.00 | 124.6 | 6.3   | 130.9 |
| 56.00 | 127.0 | 6.3   | 133.3 |
| 57.00 | 129.3 | 7.1   | 136.4 |
| 58.00 | 131.7 | 9.8   | 141.5 |
| 59.00 | 134.1 | 12.6  | 146.6 |
| 60.00 | 139.0 | 15.3  | 154.3 |
| 61.00 | 146.5 | 18.0  | 164.5 |
| 62.00 | 154.1 | 18.8  | 172.9 |
| 63.00 | 161.8 | 18.8  | 180.6 |
| 64.00 | 169.7 | 18.8  | 188.4 |
| 65.00 | 177.6 | 18.8  | 196.4 |
| 66.00 | 185.7 | 18.8  | 204.5 |
| 67.00 | 193.9 | 18.8  | 212.7 |
| 68.00 | 202.2 | 18.8  | 221.0 |
| 69.00 | 210.6 | 18.8  | 229.4 |
| 70.00 | 219.1 | 18.8  | 237.9 |
| 71.00 | 227.8 | 30.3  | 258.1 |
| 72.00 | 236.5 | 73.2  | 309.8 |
| 73.00 | 245.4 | 116.2 | 361.6 |
| 74.00 | 259.2 | 159.1 | 418.3 |
| 75.00 | 278.0 | 202.1 | 480.0 |
| 76.00 | 297.1 | 213.6 | 510.7 |
| 77.00 | 316.5 | 213.6 | 530.1 |
| 78.00 | 336.3 | 213.6 | 549.8 |
| 79.00 | 356.3 | 213.6 | 569.9 |
| 80.00 | 376.7 | 213.6 | 590.3 |
| 81.00 | 397.4 | 213.6 | 611.0 |
| 82.00 | 418.4 | 213.6 | 632.0 |
| 83.00 | 439.8 | 213.6 | 653.3 |
| 84.00 | 461.4 | 213.6 | 675.0 |
| 85.00 | 483.4 | 213.6 | 697.0 |



|       |       |       |        |
|-------|-------|-------|--------|
| 86.00 | 505.7 | 213.6 | 719.3  |
| 87.00 | 528.3 | 213.6 | 741.9  |
| 88.00 | 551.2 | 213.6 | 764.8  |
| 89.00 | 574.5 | 213.6 | 788.0  |
| 90.00 | 598.0 | 213.6 | 811.6  |
| 91.00 | 621.9 | 213.6 | 835.5  |
| 92.00 | 646.1 | 213.6 | 859.7  |
| 93.00 | 670.7 | 213.6 | 884.2  |
| 94.00 | 695.5 | 213.6 | 909.1  |
| 95.00 | 720.7 | 213.6 | 934.2  |
| 96.00 | 746.1 | 213.6 | 959.7  |
| 97.00 | 771.9 | 262.3 | 1034.3 |
| 98.00 | 798.0 | 444.3 | 1242.4 |

NOTES:

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

\*\*\*\*\*  
 \* COMPUTE LOAD-DISTRIBUTION AND LOAD-SETTLEMENT \*  
 \* CURVES FOR AXIAL LOADING \*  
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| T-Z CURVE<br>NO. | NO. OF<br>POINTS | DEPTH TO CURVE<br>FT. | LOAD TRANSFER<br>PSI | PILE MOVEMENT<br>IN. |
|------------------|------------------|-----------------------|----------------------|----------------------|
| 1                | 10               | 0.0000E+00            |                      |                      |
|                  |                  |                       | 0.0000E+00           | 0.0000E+00           |
|                  |                  |                       | 0.0000E+00           | 0.2903E-01           |
|                  |                  |                       | 0.0000E+00           | 0.5625E-01           |
|                  |                  |                       | 0.0000E+00           | 0.1034E+00           |
|                  |                  |                       | 0.0000E+00           | 0.1451E+00           |
|                  |                  |                       | 0.0000E+00           | 0.1814E+00           |
|                  |                  |                       | 0.0000E+00           | 0.3629E+00           |
|                  |                  |                       | 0.0000E+00           | 0.5443E+00           |
|                  |                  |                       | 0.0000E+00           | 0.9072E+00           |
| 2                | 10               | 0.1425E+01            | 0.0000E+00           | 0.3629E+01           |
|                  |                  |                       | 0.0000E+00           | 0.0000E+00           |
|                  |                  |                       | 0.2378E+00           | 0.2903E-01           |
|                  |                  |                       | 0.3963E+00           | 0.5625E-01           |
|                  |                  |                       | 0.5945E+00           | 0.1034E+00           |
|                  |                  |                       | 0.7134E+00           | 0.1451E+00           |
|                  |                  |                       | 0.7926E+00           | 0.1814E+00           |
|                  |                  |                       | 0.7926E+00           | 0.3629E+00           |

|   |    |            |            |            |
|---|----|------------|------------|------------|
| 3 | 10 | 0.2758E+01 | 0.7926E+00 | 0.5443E+00 |
|   |    |            | 0.7926E+00 | 0.9072E+00 |
|   |    |            | 0.7926E+00 | 0.3629E+01 |
|   |    |            | 0.0000E+00 | 0.0000E+00 |
|   |    |            | 0.4603E+00 | 0.2903E-01 |
|   |    |            | 0.7671E+00 | 0.5625E-01 |
|   |    |            | 0.1151E+01 | 0.1034E+00 |
|   |    |            | 0.1381E+01 | 0.1451E+00 |
|   |    |            | 0.1534E+01 | 0.1814E+00 |
|   |    |            | 0.1534E+01 | 0.3629E+00 |
|   |    |            | 0.1534E+01 | 0.5443E+00 |
|   |    |            | 0.1534E+01 | 0.9072E+00 |
|   |    |            | 0.1534E+01 | 0.3629E+01 |
| 4 | 10 | 0.2800E+01 | 0.0000E+00 | 0.0000E+00 |
|   |    |            | 0.4672E+00 | 0.2903E-01 |
|   |    |            | 0.7787E+00 | 0.5625E-01 |
|   |    |            | 0.1168E+01 | 0.1034E+00 |
|   |    |            | 0.1402E+01 | 0.1451E+00 |
|   |    |            | 0.1557E+01 | 0.1814E+00 |
|   |    |            | 0.1402E+01 | 0.3629E+00 |
|   |    |            | 0.1402E+01 | 0.5443E+00 |
|   |    |            | 0.1402E+01 | 0.9072E+00 |
|   |    |            | 0.1402E+01 | 0.3629E+01 |
|   |    |            | 0.0000E+00 | 0.0000E+00 |
|   |    |            | 0.1042E+01 | 0.2903E-01 |
|   |    |            | 0.1736E+01 | 0.5625E-01 |
| 5 | 10 | 0.3053E+02 | 0.2604E+01 | 0.1034E+00 |
|   |    |            | 0.3125E+01 | 0.1451E+00 |
|   |    |            | 0.3472E+01 | 0.1814E+00 |
|   |    |            | 0.3125E+01 | 0.3629E+00 |
|   |    |            | 0.3125E+01 | 0.5443E+00 |
|   |    |            | 0.3125E+01 | 0.9072E+00 |
|   |    |            | 0.3125E+01 | 0.3629E+01 |
|   |    |            | 0.0000E+00 | 0.0000E+00 |
|   |    |            | 0.1042E+01 | 0.2903E-01 |
|   |    |            | 0.1736E+01 | 0.5625E-01 |
|   |    |            | 0.2604E+01 | 0.1034E+00 |
|   |    |            | 0.3125E+01 | 0.1451E+00 |
|   |    |            | 0.3472E+01 | 0.1814E+00 |
| 6 | 10 | 0.5816E+02 | 0.3125E+01 | 0.3629E+00 |
|   |    |            | 0.3125E+01 | 0.5443E+00 |
|   |    |            | 0.3125E+01 | 0.9072E+00 |
|   |    |            | 0.3125E+01 | 0.3629E+01 |
|   |    |            | 0.0000E+00 | 0.0000E+00 |
|   |    |            | 0.1042E+01 | 0.2903E-01 |
|   |    |            | 0.1736E+01 | 0.5625E-01 |
|   |    |            | 0.2604E+01 | 0.1034E+00 |
|   |    |            | 0.3125E+01 | 0.1451E+00 |
|   |    |            | 0.3472E+01 | 0.1814E+00 |
|   |    |            | 0.3125E+01 | 0.3629E+00 |
|   |    |            | 0.3125E+01 | 0.5443E+00 |
|   |    |            | 0.3125E+01 | 0.9072E+00 |
| 7 | 10 | 0.5820E+02 | 0.3125E+01 | 0.3629E+01 |
|   |    |            | 0.0000E+00 | 0.0000E+00 |
|   |    |            | 0.1042E+01 | 0.2903E-01 |

|    |    |            |            |            |
|----|----|------------|------------|------------|
| 8  | 10 | 0.6523E+02 | 0.1736E+01 | 0.5625E-01 |
|    |    |            | 0.2604E+01 | 0.1034E+00 |
|    |    |            | 0.3125E+01 | 0.1451E+00 |
|    |    |            | 0.3472E+01 | 0.1814E+00 |
|    |    |            | 0.3472E+01 | 0.3629E+00 |
|    |    |            | 0.3472E+01 | 0.5443E+00 |
|    |    |            | 0.3472E+01 | 0.9072E+00 |
|    |    |            | 0.3472E+01 | 0.3629E+01 |
|    |    |            | 0.0000E+00 | 0.0000E+00 |
|    |    |            | 0.3526E+01 | 0.2903E-01 |
|    |    |            | 0.5877E+01 | 0.5625E-01 |
|    |    |            | 0.8815E+01 | 0.1034E+00 |
|    |    |            | 0.1058E+02 | 0.1451E+00 |
|    |    |            | 0.1175E+02 | 0.1814E+00 |
| 9  | 10 | 0.7216E+02 | 0.1175E+02 | 0.3629E+00 |
|    |    |            | 0.1175E+02 | 0.5443E+00 |
|    |    |            | 0.1175E+02 | 0.9072E+00 |
|    |    |            | 0.1175E+02 | 0.3629E+01 |
|    |    |            | 0.0000E+00 | 0.0000E+00 |
|    |    |            | 0.3875E+01 | 0.2903E-01 |
|    |    |            | 0.6459E+01 | 0.5625E-01 |
|    |    |            | 0.9689E+01 | 0.1034E+00 |
|    |    |            | 0.1163E+02 | 0.1451E+00 |
|    |    |            | 0.1292E+02 | 0.1814E+00 |
|    |    |            | 0.1292E+02 | 0.3629E+00 |
|    |    |            | 0.1292E+02 | 0.5443E+00 |
|    |    |            | 0.1292E+02 | 0.9072E+00 |
|    |    |            | 0.1292E+02 | 0.3629E+01 |
| 10 | 10 | 0.7220E+02 | 0.0000E+00 | 0.0000E+00 |
|    |    |            | 0.3878E+01 | 0.2903E-01 |
|    |    |            | 0.6463E+01 | 0.5625E-01 |
|    |    |            | 0.9694E+01 | 0.1034E+00 |
|    |    |            | 0.1163E+02 | 0.1451E+00 |
|    |    |            | 0.1293E+02 | 0.1814E+00 |
|    |    |            | 0.1293E+02 | 0.3629E+00 |
|    |    |            | 0.1293E+02 | 0.5443E+00 |
|    |    |            | 0.1293E+02 | 0.9072E+00 |
|    |    |            | 0.1293E+02 | 0.3629E+01 |
|    |    |            | 0.0000E+00 | 0.0000E+00 |
|    |    |            | 0.9753E+01 | 0.2903E-01 |
|    |    |            | 0.1626E+02 | 0.5625E-01 |
|    |    |            | 0.2438E+02 | 0.1034E+00 |
| 11 | 10 | 0.8533E+02 | 0.2926E+02 | 0.1451E+00 |
|    |    |            | 0.3251E+02 | 0.1814E+00 |
|    |    |            | 0.3251E+02 | 0.3629E+00 |
|    |    |            | 0.3251E+02 | 0.5443E+00 |

|    |    |            |            |            |
|----|----|------------|------------|------------|
| 12 | 10 | 0.9836E+02 | 0.3251E+02 | 0.9072E+00 |
|    |    |            | 0.3251E+02 | 0.3629E+01 |
|    |    |            | 0.0000E+00 | 0.0000E+00 |
|    |    |            | 0.1152E+02 | 0.2903E-01 |
|    |    |            | 0.1921E+02 | 0.5625E-01 |
|    |    |            | 0.2881E+02 | 0.1034E+00 |
|    |    |            | 0.3457E+02 | 0.1451E+00 |
|    |    |            | 0.3841E+02 | 0.1814E+00 |
|    |    |            | 0.3841E+02 | 0.3629E+00 |
|    |    |            | 0.3841E+02 | 0.5443E+00 |
| 13 | 10 | 0.9840E+02 | 0.3841E+02 | 0.9072E+00 |
|    |    |            | 0.3841E+02 | 0.3629E+01 |
|    |    |            | 0.0000E+00 | 0.0000E+00 |
|    |    |            | 0.1152E+02 | 0.2903E-01 |
|    |    |            | 0.1921E+02 | 0.5625E-01 |
|    |    |            | 0.2881E+02 | 0.1034E+00 |
|    |    |            | 0.3457E+02 | 0.1451E+00 |
|    |    |            | 0.3841E+02 | 0.1814E+00 |
|    |    |            | 0.3841E+02 | 0.3629E+00 |
|    |    |            | 0.3841E+02 | 0.5443E+00 |
| 14 | 10 | 0.1042E+03 | 0.3841E+02 | 0.9072E+00 |
|    |    |            | 0.3841E+02 | 0.3629E+01 |
|    |    |            | 0.0000E+00 | 0.0000E+00 |
|    |    |            | 0.1152E+02 | 0.2903E-01 |
|    |    |            | 0.1921E+02 | 0.5625E-01 |
|    |    |            | 0.2881E+02 | 0.1034E+00 |
|    |    |            | 0.3457E+02 | 0.1451E+00 |
|    |    |            | 0.3841E+02 | 0.1814E+00 |
|    |    |            | 0.3841E+02 | 0.3629E+00 |
|    |    |            | 0.3841E+02 | 0.5443E+00 |
| 15 | 10 | 0.1100E+03 | 0.3841E+02 | 0.9072E+00 |
|    |    |            | 0.3841E+02 | 0.3629E+01 |
|    |    |            | 0.0000E+00 | 0.0000E+00 |
|    |    |            | 0.1152E+02 | 0.2903E-01 |
|    |    |            | 0.1921E+02 | 0.5625E-01 |
|    |    |            | 0.2881E+02 | 0.1034E+00 |
|    |    |            | 0.3457E+02 | 0.1451E+00 |
|    |    |            | 0.3841E+02 | 0.1814E+00 |
|    |    |            | 0.3841E+02 | 0.3629E+00 |
|    |    |            | 0.3841E+02 | 0.5443E+00 |

TIP      LOAD                      TIP   MOVEMENT

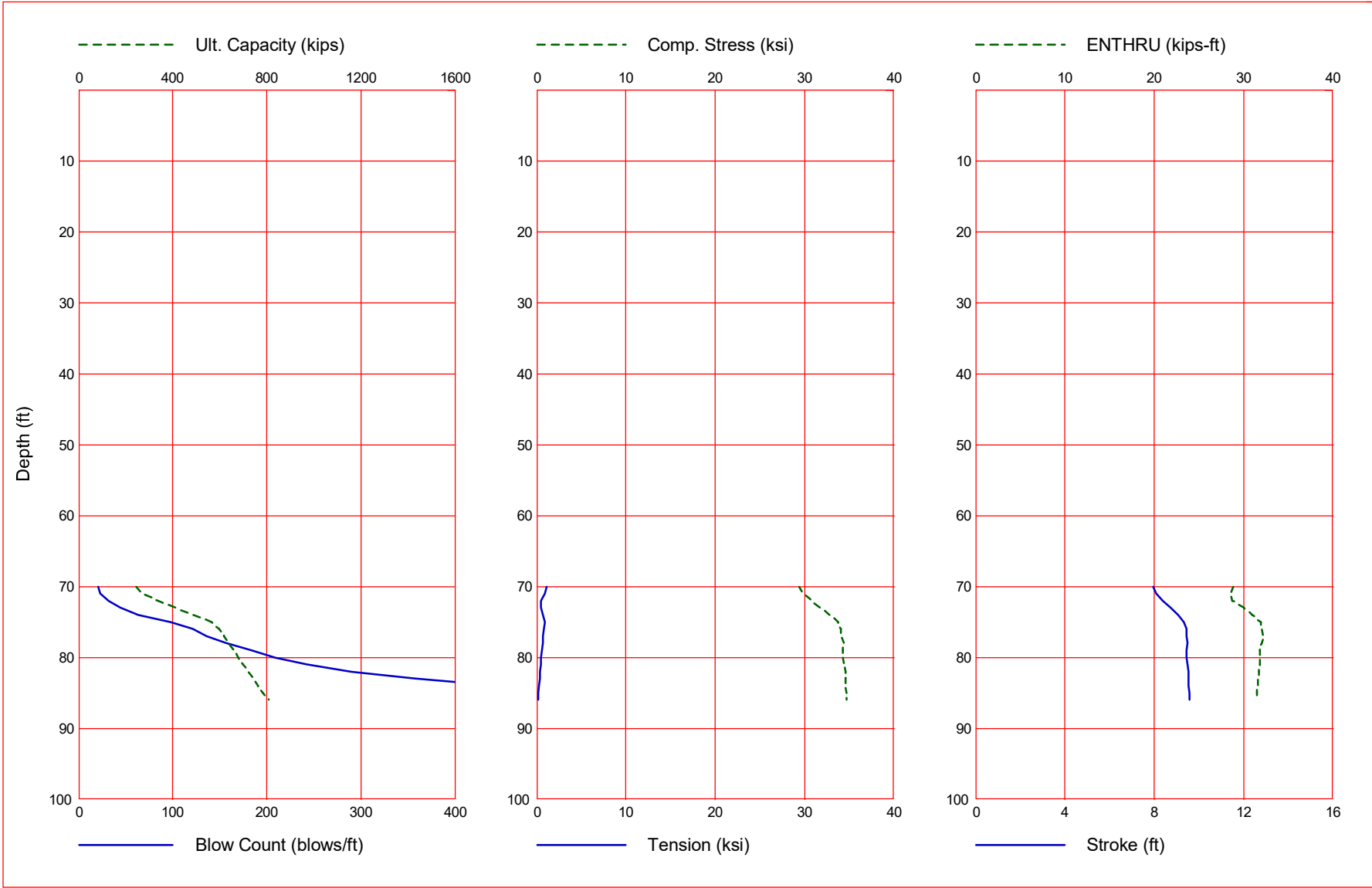
| KIP        | IN.        |
|------------|------------|
| 0.0000E+00 | 0.0000E+00 |
| 0.2777E+02 | 0.9072E-02 |
| 0.5554E+02 | 0.1814E-01 |
| 0.1111E+03 | 0.3629E-01 |
| 0.2222E+03 | 0.2359E+00 |
| 0.3332E+03 | 0.7620E+00 |
| 0.3999E+03 | 0.1324E+01 |
| 0.4443E+03 | 0.1814E+01 |
| 0.4443E+03 | 0.2722E+01 |
| 0.4443E+03 | 0.3629E+01 |

LOAD VERSUS SETTLEMENT CURVE  
\*\*\*\*\*

| TOP LOAD<br>KIP | TOP MOVEMENT<br>IN. | TIP LOAD<br>KIP | TIP MOVEMENT<br>IN. |
|-----------------|---------------------|-----------------|---------------------|
| 0.1446E+01      | 0.3165E-03          | 0.3061E+00      | 0.1000E-03          |
| 0.1446E+02      | 0.3165E-02          | 0.3061E+01      | 0.1000E-02          |
| 0.7230E+02      | 0.1582E-01          | 0.1531E+02      | 0.5000E-02          |
| 0.1448E+03      | 0.3167E-01          | 0.3061E+02      | 0.1000E-01          |
| 0.2829E+03      | 0.6309E-01          | 0.6122E+02      | 0.2000E-01          |
| 0.5566E+03      | 0.1367E+00          | 0.1187E+03      | 0.5000E-01          |
| 0.7114E+03      | 0.1911E+00          | 0.1354E+03      | 0.8000E-01          |
| 0.7976E+03      | 0.2255E+00          | 0.1465E+03      | 0.1000E+00          |
| 0.1002E+04      | 0.3630E+00          | 0.2022E+03      | 0.2000E+00          |
| 0.1073E+04      | 0.6779E+00          | 0.2779E+03      | 0.5000E+00          |
| 0.1133E+04      | 0.9899E+00          | 0.3377E+03      | 0.8000E+00          |
| 0.1157E+04      | 0.1195E+01          | 0.3614E+03      | 0.1000E+01          |
| 0.1240E+04      | 0.2211E+01          | 0.4443E+03      | 0.2000E+01          |

## GRL WEAP DRIVABILITY ANALYSIS

Gain/Loss 1 at Shaft and Toe 1.000 / 1.000



Gain/Loss 1 at Shaft and Toe 1.000 / 1.000

| Depth<br>ft | Ultimate<br>Capacity<br>kips | Friction<br>kips | End<br>Bearing<br>kips | Blow<br>Count<br>blows/ft | Comp.<br>Stress<br>ksi | Tension<br>Stress<br>ksi | Stroke<br>ft | ENTHRU<br>kips-ft |
|-------------|------------------------------|------------------|------------------------|---------------------------|------------------------|--------------------------|--------------|-------------------|
| 70.0        | 245.9                        | 219.3            | 26.5                   | 20.8                      | 29.377                 | -1.104                   | 7.94         | 28.9              |
| 71.0        | 270.7                        | 228.0            | 42.8                   | 23.0                      | 29.822                 | -0.918                   | 8.09         | 28.6              |
| 72.0        | 340.1                        | 236.7            | 103.3                  | 31.8                      | 30.735                 | -0.477                   | 8.38         | 28.7              |
| 73.0        | 409.4                        | 245.6            | 163.7                  | 43.9                      | 31.782                 | -0.505                   | 8.73         | 30.0              |
| 74.0        | 483.8                        | 259.4            | 224.4                  | 63.7                      | 32.838                 | -0.654                   | 9.06         | 31.0              |
| 75.0        | 563.3                        | 278.2            | 285.1                  | 97.8                      | 33.785                 | -0.860                   | 9.33         | 31.9              |
| 76.0        | 599.4                        | 297.4            | 302.0                  | 121.5                     | 34.058                 | -0.842                   | 9.43         | 32.1              |
| 77.0        | 618.8                        | 316.8            | 302.0                  | 136.0                     | 34.110                 | -0.742                   | 9.47         | 32.2              |
| 78.0        | 638.6                        | 336.6            | 302.0                  | 156.2                     | 34.373                 | -0.662                   | 9.50         | 32.1              |
| 79.0        | 658.7                        | 356.6            | 302.0                  | 183.4                     | 34.280                 | -0.611                   | 9.43         | 31.8              |
| 80.0        | 679.1                        | 377.0            | 302.0                  | 209.6                     | 34.264                 | -0.528                   | 9.47         | 31.8              |
| 81.0        | 699.8                        | 397.7            | 302.0                  | 242.5                     | 34.352                 | -0.433                   | 9.49         | 31.8              |
| 82.0        | 720.8                        | 418.8            | 302.0                  | 290.2                     | 34.585                 | -0.390                   | 9.52         | 31.7              |
| 83.0        | 742.2                        | 440.1            | 302.0                  | 356.7                     | 34.579                 | -0.326                   | 9.53         | 31.6              |
| 84.0        | 763.8                        | 461.8            | 302.0                  | 448.3                     | 34.590                 | -0.228                   | 9.55         | 31.6              |
| 85.0        | 785.8                        | 483.8            | 302.0                  | 612.5                     | 34.679                 | -0.174                   | 9.57         | 31.5              |
| 86.0        | 808.2                        | 506.1            | 302.0                  | 932.3                     | 34.756                 | -0.149                   | 9.58         | 31.4              |

Total Continuous Driving Time 91.00 minutes; Total Number of Blows 3492 (starting at penetration 70.0 ft)



GRLWEAP - Version 2010  
WAVE EQUATION ANALYSIS OF PILE FOUNDATIONS

written by GRL Engineers, Inc. (formerly Goble Rausche Likins  
and Associates, Inc.) with cooperation from Pile Dynamics, Inc.  
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ABOUT THE WAVE EQUATION ANALYSIS RESULTS

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

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

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

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

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

Input File: T:\75297 MAINEDOT\_I-295 VERANDA FINAL DESIGN\GEOTECH\CALCS\DEEP FOUNDATIONS\PILES\2020-02-21 DRIVEABILITY ANALYSIS\GRLWEAP\66 K-FT DELMAG D 25-32 \ABUTMENT 2 NB PILES DRIVEABILITY 2020-02-21.GWW  
 Hammer File: C:\ProgramData\PDI\GRLWEAP\2010\Resource\HAMMER2010.GW  
 Hammer File Version: 2003 (12/4/2018)

# Input File Contents

## Abutment 2 NB H-Pile - Delmag D25-32

| OUT               | OSG | HAM         | STR | FUL                               | PEL | N                 | SPL | N-U       | P-D | %SK       | ISM | 0         | PHI | RSA      | ITR | H-D  | MXT | DEx   |  |
|-------------------|-----|-------------|-----|-----------------------------------|-----|-------------------|-----|-----------|-----|-----------|-----|-----------|-----|----------|-----|------|-----|-------|--|
| -100              | 0   | 10          | 0   | 1                                 | 0   | 0                 | 0   | 0         | 3   | 0         | 0   | 0         | 0   | 0        | 0   | 0    | 0   | 0.000 |  |
| Pile g            |     | Hammer g    |     | Toe Area                          |     | Pile Size         |     | Pile Type |     |           |     |           |     |          |     |      |     |       |  |
| 32.170            |     | 32.170      |     | 203.230                           |     | 14.690            |     | H Pile    |     |           |     |           |     |          |     |      |     |       |  |
| W Cp              |     | A Cp        |     | E Cp                              |     | T Cp              |     | CoR       |     | ROut      |     | StCp      |     |          |     |      |     |       |  |
| 1.900             |     | 227.000     |     | 530.0                             |     | 2.000             |     | 0.800     |     | 0.010     |     | 0.0       |     |          |     |      |     |       |  |
| A Cu              |     | E Cu        |     | T Cu                              |     | CoR               |     | ROut      |     | StCu      |     |           |     |          |     |      |     |       |  |
| 0.000             |     | 0.0         |     | 0.000                             |     | 0.000             |     | 0.000     |     | 0.0       |     |           |     |          |     |      |     |       |  |
| LPle              |     | APle        |     | EPle                              |     | WPle              |     | Peri      |     | CI        |     | CoR       |     | ROut     |     |      |     |       |  |
| 86.000            |     | 26.10       |     | 29000.0                           |     | 492.000           |     | 4.754     |     | 0         |     | 1.000     |     | 0.010    |     |      |     |       |  |
| FFatigue          |     | F0          |     | 0-Bottom                          |     |                   |     |           |     |           |     |           |     |          |     |      |     |       |  |
| 0                 |     | 0.000       |     | 0.000                             |     |                   |     |           |     |           |     |           |     |          |     |      |     |       |  |
| Manufac           |     | Hmr Name    |     | HmrType                           |     | No                |     | Seg-s     |     |           |     |           |     |          |     |      |     |       |  |
| DELMAG            |     | D 25-32     |     | 1                                 |     | 3                 |     |           |     |           |     |           |     |          |     |      |     |       |  |
| Ram Wt            |     | Ram L       |     | Ram Dia                           |     | MaxStrk           |     | RtdStrk   |     | Efficy    |     |           |     |          |     |      |     |       |  |
| 5.51              |     | 123.20      |     | 16.51                             |     | 13.76             |     | 12.04     |     | 0.80      |     |           |     |          |     |      |     |       |  |
| IB. Wt            |     | IB. L       |     | IB.Dia                            |     | IB CoR            |     | IB RO     |     |           |     |           |     |          |     |      |     |       |  |
| 1.36              |     | 28.15       |     | 16.51                             |     | 0.900             |     | 0.010     |     |           |     |           |     |          |     |      |     |       |  |
| CompStrk          |     | A Chamber   |     | V Chamber                         |     | C Delay           |     | C Duratn  |     | Exp Coeff |     | VolCStart |     | Vol      |     | CEnd |     |       |  |
| 14.72             |     | 214.03      |     | 257.40                            |     | 0.0005            |     | 0.0020    |     | 1.250     |     | 0.00      |     | 0.00     |     |      |     |       |  |
| P atm             |     | P1          |     | P2                                |     | P3                |     | P4        |     | P5        |     |           |     |          |     |      |     |       |  |
| 14.70             |     | 1500.00     |     | 1350.00                           |     | 1215.00           |     | 1095.00   |     | 0.00      |     |           |     |          |     |      |     |       |  |
| Stroke            |     | Effic.      |     | Pressure                          |     | R-Weight          |     | T-Delay   |     | Exp-Coeff |     | Eps-Str   |     | Total-AW |     |      |     |       |  |
| 12.0400           |     | 0.8000      |     | 1500.0000                         |     | 0.0000            |     | 0.0000    |     | 0.0000    |     | 0.0100    |     | 0.0000   |     |      |     |       |  |
| Qs                |     | Qt          |     | Js                                |     | Jt                |     | Qx        |     | Jx        |     | Rati      |     | Dept     |     |      |     |       |  |
| 0.000             |     | 0.000       |     | 0.000                             |     | 0.000             |     | 0.000     |     | 0.000     |     | 0.000     |     | 0.000    |     |      |     |       |  |
| Research          |     | Soil Model: |     | Atoe, Plug,                       |     | Gap,              |     | Q-fac     |     |           |     |           |     |          |     |      |     |       |  |
| 0.000             |     | 0.000       |     | 0.000                             |     | 0.000             |     |           |     |           |     |           |     |          |     |      |     |       |  |
| Research          |     | Soil Model: |     | RD-skn: m, d,                     |     | toe: m, d         |     |           |     |           |     |           |     |          |     |      |     |       |  |
| 0.000             |     | 0.000       |     | 0.000                             |     |                   |     |           |     |           |     |           |     |          |     |      |     |       |  |
| Research          |     | Toe Plug:   |     | Res-int, Q-int, D-int,            |     | Res-plug, Q-plug, |     | D-plug    |     |           |     |           |     |          |     |      |     |       |  |
| 0.000             |     | 0.000       |     | 0.000                             |     | 0.000             |     | 0.000     |     |           |     |           |     |          |     |      |     |       |  |
| Research          |     | Toe Plug:   |     | RD plug toe: m, d                 |     |                   |     |           |     |           |     |           |     |          |     |      |     |       |  |
| 0.000             |     | 0.000       |     |                                   |     |                   |     |           |     |           |     |           |     |          |     |      |     |       |  |
| Research          |     | Toe Plug:   |     | New Toe Plug Model is NOT applied |     |                   |     |           |     |           |     |           |     |          |     |      |     |       |  |
| Res. Distribution |     |             |     |                                   |     |                   |     |           |     |           |     |           |     |          |     |      |     |       |  |
| Dpth              |     | Rskn        |     | Rtoe                              |     | Qs                |     | Qt        |     | Js        |     | Jt        |     | SU F     |     | LimL |     | TSf0  |  |
| 0.00              |     | 0.00        |     | 3.10                              |     | 0.10              |     | 0.10      |     | 0.05      |     | 0.15      |     | 1.20     |     | 6.56 |     | 1.000 |  |
| 1.00              |     | 0.08        |     | 5.36                              |     | 0.10              |     | 0.10      |     | 0.05      |     | 0.15      |     | 1.20     |     | 6.56 |     | 1.000 |  |
| 2.00              |     | 0.16        |     | 7.34                              |     | 0.10              |     | 0.10      |     | 0.05      |     | 0.15      |     | 1.20     |     | 6.56 |     | 1.000 |  |
| 3.00              |     | 0.24        |     | 9.60                              |     | 0.10              |     | 0.10      |     | 0.20      |     | 0.15      |     | 2.00     |     | 6.56 |     | 1.000 |  |
| 4.00              |     | 0.50        |     | 10.16                             |     | 0.10              |     | 0.10      |     | 0.20      |     | 0.15      |     | 2.00     |     | 6.56 |     | 1.000 |  |
| 5.00              |     | 0.50        |     | 9.31                              |     | 0.10              |     | 0.10      |     | 0.20      |     | 0.15      |     | 2.00     |     | 6.56 |     | 1.000 |  |
| 6.00              |     | 0.50        |     | 8.89                              |     | 0.10              |     | 0.10      |     | 0.20      |     | 0.15      |     | 2.00     |     | 6.56 |     | 1.000 |  |
| 7.00              |     | 0.50        |     | 8.89                              |     | 0.10              |     | 0.10      |     | 0.20      |     | 0.15      |     | 2.00     |     | 6.56 |     | 1.000 |  |
| 8.00              |     | 0.50        |     | 8.89                              |     | 0.10              |     | 0.10      |     | 0.20      |     | 0.15      |     | 2.00     |     | 6.56 |     | 1.000 |  |
| 9.00              |     | 0.50        |     | 8.89                              |     | 0.10              |     | 0.10      |     | 0.20      |     | 0.15      |     | 2.00     |     | 6.56 |     | 1.000 |  |
| 10.00             |     | 0.50        |     | 8.89                              |     | 0.10              |     | 0.10      |     | 0.20      |     | 0.15      |     | 2.00     |     | 6.56 |     | 1.000 |  |
| 11.00             |     | 0.50        |     | 8.89                              |     | 0.10              |     | 0.10      |     | 0.20      |     | 0.15      |     | 2.00     |     | 6.56 |     | 1.000 |  |
| 12.00             |     | 0.50        |     | 8.89                              |     | 0.10              |     | 0.10      |     | 0.20      |     | 0.15      |     | 2.00     |     | 6.56 |     | 1.000 |  |

[illegible]

|                                  |         |         |         |         |       |       |       |      |       |
|----------------------------------|---------|---------|---------|---------|-------|-------|-------|------|-------|
| 72.00                            | 1.86    | 103.31  | 0.10    | 0.10    | 0.05  | 0.15  | 1.20  | 6.56 | 1.000 |
| 73.00                            | 1.88    | 163.71  | 0.10    | 0.10    | 0.05  | 0.15  | 1.20  | 6.56 | 1.000 |
| 74.00                            | 3.92    | 224.40  | 0.10    | 0.10    | 0.05  | 0.15  | 1.20  | 6.56 | 1.000 |
| 75.00                            | 3.99    | 285.09  | 0.10    | 0.10    | 0.05  | 0.15  | 1.20  | 6.56 | 1.000 |
| 76.00                            | 4.06    | 302.02  | 0.10    | 0.10    | 0.05  | 0.15  | 1.20  | 6.56 | 1.000 |
| 77.00                            | 4.12    | 302.02  | 0.10    | 0.10    | 0.05  | 0.15  | 1.20  | 6.56 | 1.000 |
| 78.00                            | 4.19    | 302.02  | 0.10    | 0.10    | 0.05  | 0.15  | 1.20  | 6.56 | 1.000 |
| 79.00                            | 4.26    | 302.02  | 0.10    | 0.10    | 0.05  | 0.15  | 1.20  | 6.56 | 1.000 |
| 80.00                            | 4.32    | 302.02  | 0.10    | 0.10    | 0.05  | 0.15  | 1.20  | 6.56 | 1.000 |
| 81.00                            | 4.39    | 302.02  | 0.10    | 0.10    | 0.05  | 0.15  | 1.20  | 6.56 | 1.000 |
| 82.00                            | 4.46    | 302.02  | 0.10    | 0.10    | 0.05  | 0.15  | 1.20  | 6.56 | 1.000 |
| 83.00                            | 4.53    | 302.02  | 0.10    | 0.10    | 0.05  | 0.15  | 1.20  | 6.56 | 1.000 |
| 84.00                            | 4.59    | 302.02  | 0.10    | 0.10    | 0.05  | 0.15  | 1.20  | 6.56 | 1.000 |
| 85.00                            | 4.66    | 302.02  | 0.10    | 0.10    | 0.05  | 0.15  | 1.20  | 6.56 | 1.000 |
| 86.00                            | 4.73    | 302.02  | 0.10    | 0.10    | 0.05  | 0.15  | 1.20  | 6.56 | 1.000 |
| Gain/Loss factors: shaft and toe |         |         |         |         |       |       |       |      |       |
| 1.00000                          | 0.90000 | 0.80000 | 0.70000 | 0.60000 |       |       |       |      |       |
| 1.00000                          | 1.00000 | 1.00000 | 1.00000 | 1.00000 |       |       |       |      |       |
| Dpth                             | L       | Wait    | Strk    | Pmx%    | Eff.  | Stff  | CoR   |      |       |
| 70.00                            | 0.00    | 0.00    | 0.000   | 0.0     | 0.000 | 0.000 | 0.000 |      |       |
| 71.00                            | 0.00    | 0.00    | 0.000   | 0.0     | 0.000 | 0.000 | 0.000 |      |       |
| 72.00                            | 0.00    | 0.00    | 0.000   | 0.0     | 0.000 | 0.000 | 0.000 |      |       |
| 73.00                            | 0.00    | 0.00    | 0.000   | 0.0     | 0.000 | 0.000 | 0.000 |      |       |
| 74.00                            | 0.00    | 0.00    | 0.000   | 0.0     | 0.000 | 0.000 | 0.000 |      |       |
| 75.00                            | 0.00    | 0.00    | 0.000   | 0.0     | 0.000 | 0.000 | 0.000 |      |       |
| 76.00                            | 0.00    | 0.00    | 0.000   | 0.0     | 0.000 | 0.000 | 0.000 |      |       |
| 77.00                            | 0.00    | 0.00    | 0.000   | 0.0     | 0.000 | 0.000 | 0.000 |      |       |
| 78.00                            | 0.00    | 0.00    | 0.000   | 0.0     | 0.000 | 0.000 | 0.000 |      |       |
| 79.00                            | 0.00    | 0.00    | 0.000   | 0.0     | 0.000 | 0.000 | 0.000 |      |       |
| 80.00                            | 0.00    | 0.00    | 0.000   | 0.0     | 0.000 | 0.000 | 0.000 |      |       |
| 81.00                            | 0.00    | 0.00    | 0.000   | 0.0     | 0.000 | 0.000 | 0.000 |      |       |
| 82.00                            | 0.00    | 0.00    | 0.000   | 0.0     | 0.000 | 0.000 | 0.000 |      |       |
| 83.00                            | 0.00    | 0.00    | 0.000   | 0.0     | 0.000 | 0.000 | 0.000 |      |       |
| 84.00                            | 0.00    | 0.00    | 0.000   | 0.0     | 0.000 | 0.000 | 0.000 |      |       |
| 85.00                            | 0.00    | 0.00    | 0.000   | 0.0     | 0.000 | 0.000 | 0.000 |      |       |
| 86.00                            | 0.00    | 0.00    | 0.000   | 0.0     | 0.000 | 0.000 | 0.000 |      |       |
| 0.00                             | 0.00    | 0.00    | 0.000   | 0.0     | 0.000 | 0.000 | 0.000 |      |       |

GRLWEAP: WAVE EQUATION ANALYSIS OF PILE FOUNDATIONS  
Version 2010  
English Units

Abutment 2 NB H-Pile - Delmag D25-32

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|                   |                |                  |   |
|-------------------|----------------|------------------|---|
| Hammer Model:     | D 25-32        | Made by:         | DELMAG                                    |
| No.               | Weight<br>kips | Stiffn<br>k/inch | CoR      C-Slk<br>ft      Dampg<br>k/ft/s |
| 1                 | 1.837          |                  |   |
| 2                 | 1.837          | 151179.4         | 1.000      0.0000                         |
| 3                 | 1.837          | 151179.4         | 1.000      0.0000                         |
| Imp Block         | 1.360          | 89695.7          | 0.900      0.0100                         |
| Helmet            | 1.900          | 60155.0          | 0.800      0.0100      9.9                |
| Combined Pile Top |                | 19069.2          |   |

HAMMER OPTIONS:

|                    |           |                          |           |
|--------------------|-----------|--------------------------|-----------|
| Hammer File ID No. | 10        | Hammer Type              | OE Diesel |
| Stroke Option      | FxdP-VarS | Stroke Convergence Crit. | 0.010     |
| Fuel Pump Setting  | Maximum   |                          |           |

HAMMER DATA:

|                      |        |         |                    |        |         |
|----------------------|--------|---------|--------------------|--------|---------|
| Ram Weight           | (kips) | 5.51    | Ram Length         | (inch) | 123.20  |
| Maximum Stroke       | (ft)   | 13.76   |                    |        |         |
| Rated Stroke         | (ft)   | 12.04   | Efficiency         |        | 0.800   |
| Maximum Pressure     | (psi)  | 1500.00 | Actual Pressure    | (psi)  | 1500.00 |
| Compression Exponent |        | 1.350   | Expansion Exponent |        | 1.250   |
| Ram Diameter         | (inch) | 16.51   |                    |        |         |
| Combustion Delay     | (s)    | 0.00050 | Ignition Duration  | (s)    | 0.00200 |

The Hammer Data Includes Estimated (NON-MEASURED) Quantities

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HAMMER CUSHION

|                      |           |         |
|----------------------|-----------|---------|
| Cross Sect. Area     | (in2)     | 227.00  |
| Elastic-Modulus      | (ksi)     | 530.0   |
| Thickness            | (inch)    | 2.00    |
| Coeff of Restitution |           | 0.8     |
| RoundOut             | (ft)      | 0.0     |
| Stiffness            | (kips/in) | 60155.0 |

PILE CUSHION

|                      |           |      |
|----------------------|-----------|------|
| Cross Sect. Area     | (in2)     | 0.00 |
| Elastic-Modulus      | (ksi)     | 0.0  |
| Thickness            | (inch)    | 0.00 |
| Coeff of Restitution |           | 1.0  |
| RoundOut             | (ft)      | 0.0  |
| Stiffness            | (kips/in) | 0.0  |

Abutment 2 NB H-Pile - Delmag D25-32  
HNTB Corporation

04/02/2020  
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Depth (ft) 70.0 Standard Soil Setup  
Shaft Gain/Loss Factor 1.000 Toe Gain/Loss Factor 1.000

PILE PROFILE:

Toe Area (in2) 203.230 Pile Type H Pile  
Pile Size (inch) 14.690

| L b Top | Area  | E-Mod  | Spec Wt | Perim | C Index | Wave Sp | EA/c   |
|---------|-------|--------|---------|-------|---------|---------|--------|
| ft      | in2   | ksi    | lb/ft3  | ft    |         | ft/s    | k/ft/s |
| 0.0     | 26.10 | 29000. | 492.0   | 4.8   | 0       | 16524.  | 45.8   |
| 86.0    | 26.10 | 29000. | 492.0   | 4.8   | 0       | 16524.  | 45.8   |

Wave Travel Time 2L/c (ms) 10.409

| Pile and Soil Model |        |        |       |       |      | Total Capacity Rut (kips) |        |       | 245.9 |       |      |
|---------------------|--------|--------|-------|-------|------|---------------------------|--------|-------|-------|-------|------|
| No.                 | Weight | Stiffn | C-Slk | T-Slk | CoR  | Soil-S                    | Soil-D | Quake | LbTop | Perim | Area |
|                     | kips   | k/in   | ft    | ft    |      | kips                      | s/ft   | inch  | ft    | ft    | in2  |
| 1                   | 0.295  | 19069  | 0.010 | 0.000 | 1.00 | 0.0                       | 0.000  | 0.100 | 3.31  | 4.8   | 26.1 |
| 2                   | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 0.0                       | 0.000  | 0.100 | 6.62  | 4.8   | 26.1 |
| 5                   | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 0.1                       | 0.050  | 0.100 | 16.54 | 4.8   | 26.1 |
| 6                   | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 3.1                       | 0.142  | 0.100 | 19.85 | 4.8   | 26.1 |
| 7                   | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 7.8                       | 0.200  | 0.100 | 23.15 | 4.8   | 26.1 |
| 8                   | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 7.9                       | 0.200  | 0.100 | 26.46 | 4.8   | 26.1 |
| 23                  | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 10.8                      | 0.107  | 0.100 | 76.08 | 4.8   | 26.1 |
| 24                  | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 25.3                      | 0.050  | 0.100 | 79.38 | 4.8   | 26.1 |
| 25                  | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 26.5                      | 0.050  | 0.100 | 82.69 | 4.8   | 26.1 |
| 26                  | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 27.8                      | 0.050  | 0.100 | 86.00 | 4.8   | 26.1 |
| Toe                 |        |        |       |       |      | 26.5                      | 0.150  | 0.100 |       |       |      |

7.669 kips total unreduced pile weight (g= 32.17 ft/s2)

7.669 kips total reduced pile weight (g= 32.17 ft/s2)

PILE, SOIL, ANALYSIS OPTIONS:

Uniform pile  
No. of Slacks/Splices 0  
File Segments: Automatic  
File Damping (%) 3  
File Damping Fact. (k/ft/s) 2.748

Driveability Analysis

Soil Damping Option Smith  
Max No Analysis Iterations 0 Time Increment/Critical 160  
Output Time Interval 1 Analysis Time-Input (ms) 0  
Output Level: Normal

Gravity Mass, Pile, Hammer: 32.170 32.170 32.170

Output Segment Generation: Automatic

| Depth | Stroke | Pressure | Efficy |
|-------|--------|----------|--------|
| ft    | ft     | Ratio    |        |
| 70.00 | 12.04  | 1.00     | 0.800  |

Abutment 2 NB H-Pile - Delmag D25-32  
HNTB Corporation

04/02/2020  
GRLWEAP Version 2010

| Rut   | Bl Ct | Stroke | (ft) | Ten Str | i  | t  | Comp Str | i | t | ENTHRU | Bl Rt |
|-------|-------|--------|------|---------|----|----|----------|---|---|--------|-------|
| kip   | b/ft  | down   | up   | ksi     |    |    | ksi      |   |   | kip-ft | b/min |
| 245.9 | 20.8  | 7.94   | 7.93 | -1.10   | 7  | 34 | 29.38    | 7 | 3 | 28.9   | 42.0  |
| 229.8 | 18.7  | 7.80   | 7.77 | -1.07   | 14 | 36 | 28.98    | 1 | 2 | 29.3   | 42.4  |
| 213.7 | 16.6  | 7.65   | 7.61 | -1.26   | 7  | 38 | 28.39    | 1 | 2 | 29.6   | 42.9  |
| 197.6 | 14.5  | 7.49   | 7.44 | -1.47   | 13 | 38 | 27.91    | 1 | 2 | 29.9   | 43.3  |
| 181.5 | 12.6  | 7.32   | 7.25 | -1.89   | 14 | 39 | 27.29    | 1 | 2 | 30.4   | 43.9  |

Abutment 2 NB H-Pile - Delmag D25-32  
HNTB Corporation

04/02/2020  
GRLWEAP Version 2010

Depth (ft) 71.0 Standard Soil Setup  
Shaft Gain/Loss Factor 1.000 Toe Gain/Loss Factor 1.000

PILE PROFILE:

Toe Area (in2) 203.230 Pile Type H Pile  
Pile Size (inch) 14.690

| L b Top | Area  | E-Mod  | Spec Wt | Perim | C Index | Wave Sp | EA/c   |
|---------|-------|--------|---------|-------|---------|---------|--------|
| ft      | in2   | ksi    | lb/ft3  | ft    |         | ft/s    | k/ft/s |
| 0.0     | 26.10 | 29000. | 492.0   | 4.8   | 0       | 16524.  | 45.8   |
| 86.0    | 26.10 | 29000. | 492.0   | 4.8   | 0       | 16524.  | 45.8   |

Wave Travel Time 2L/c (ms) 10.409

| Pile and Soil Model |        |        |       |       |      | Total Capacity Rut (kips) |        |       | 270.7 |       |      |
|---------------------|--------|--------|-------|-------|------|---------------------------|--------|-------|-------|-------|------|
| No.                 | Weight | Stiffn | C-Slk | T-Slk | CoR  | Soil-S                    | Soil-D | Quake | LbTop | Perim | Area |
|                     | kips   | k/in   | ft    | ft    |      | kips                      | s/ft   | inch  | ft    | ft    | in2  |
| 1                   | 0.295  | 19069  | 0.010 | 0.000 | 1.00 | 0.0                       | 0.000  | 0.100 | 3.31  | 4.8   | 26.1 |
| 2                   | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 0.0                       | 0.000  | 0.100 | 6.62  | 4.8   | 26.1 |
| 5                   | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 0.5                       | 0.050  | 0.100 | 16.54 | 4.8   | 26.1 |
| 6                   | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 5.0                       | 0.177  | 0.100 | 19.85 | 4.8   | 26.1 |
| 7                   | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 7.9                       | 0.200  | 0.100 | 23.15 | 4.8   | 26.1 |
| 23                  | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 15.9                      | 0.066  | 0.100 | 76.08 | 4.8   | 26.1 |
| 24                  | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 25.6                      | 0.050  | 0.100 | 79.38 | 4.8   | 26.1 |
| 25                  | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 26.9                      | 0.050  | 0.100 | 82.69 | 4.8   | 26.1 |
| 26                  | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 28.2                      | 0.050  | 0.100 | 86.00 | 4.8   | 26.1 |
| Toe                 |        |        |       |       |      | 42.8                      | 0.150  | 0.100 |       |       |      |

7.669 kips total unreduced pile weight (g= 32.17 ft/s2)  
7.669 kips total reduced pile weight (g= 32.17 ft/s2)

| Depth | Stroke | Pressure | Efficy |
|-------|--------|----------|--------|
| ft    | ft     | Ratio    |        |
| 71.00 | 12.04  | 1.00     | 0.800  |



Abutment 2 NB H-Pile - Delmag D25-32  
HNTB Corporation

04/02/2020  
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| Rut<br>kips | Bl Ct<br>b/ft | Stroke<br>down | (ft)<br>up | Ten Str<br>ksi | i | t  | Comp Str<br>ksi | i | t | ENTHRU<br>kip-ft | Bl Rt<br>b/min |
|-------------|---------------|----------------|------------|----------------|---|----|-----------------|---|---|------------------|----------------|
| 270.7       | 23.0          | 8.09           | 8.08       | -0.92          | 6 | 34 | 29.82           | 6 | 3 | 28.6             | 41.6           |
| 254.4       | 21.3          | 7.95           | 7.93       | -1.05          | 6 | 34 | 29.48           | 6 | 3 | 29.0             | 42.0           |
| 238.0       | 19.5          | 7.81           | 7.79       | -1.03          | 6 | 34 | 28.86           | 6 | 3 | 29.3             | 42.4           |
| 221.6       | 17.2          | 7.66           | 7.63       | -1.26          | 7 | 37 | 28.42           | 6 | 3 | 29.7             | 42.8           |
| 205.2       | 15.1          | 7.50           | 7.45       | -1.43          | 9 | 38 | 27.94           | 1 | 2 | 30.0             | 43.3           |

Abutment 2 NB H-Pile - Delmag D25-32  
HNTB Corporation

04/02/2020  
GRLWEAP Version 2010

Depth (ft) 72.0 Standard Soil Setup  
Shaft Gain/Loss Factor 1.000 Toe Gain/Loss Factor 1.000

PILE PROFILE:

Toe Area (in2) 203.230 Pile Type H Pile  
Pile Size (inch) 14.690

| L b Top | Area  | E-Mod  | Spec Wt | Perim | C Index | Wave Sp | EA/c   |
|---------|-------|--------|---------|-------|---------|---------|--------|
| ft      | in2   | ksi    | lb/ft3  | ft    |         | ft/s    | k/ft/s |
| 0.0     | 26.10 | 29000. | 492.0   | 4.8   | 0       | 16524.  | 45.8   |
| 86.0    | 26.10 | 29000. | 492.0   | 4.8   | 0       | 16524.  | 45.8   |

Wave Travel Time 2L/c (ms) 10.409

| Pile and Soil Model |        |        |       |       |      | Total Capacity Rut (kips) |        |       | 340.1 |       |      |
|---------------------|--------|--------|-------|-------|------|---------------------------|--------|-------|-------|-------|------|
| No.                 | Weight | Stiffn | C-Slk | T-Slk | CoR  | Soil-S                    | Soil-D | Quake | LbTop | Perim | Area |
|                     | kips   | k/in   | ft    | ft    |      | kips                      | s/ft   | inch  | ft    | ft    | in2  |
| 1                   | 0.295  | 19069  | 0.010 | 0.000 | 1.00 | 0.0                       | 0.000  | 0.100 | 3.31  | 4.8   | 26.1 |
| 2                   | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 0.0                       | 0.000  | 0.100 | 6.62  | 4.8   | 26.1 |
| 5                   | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 1.2                       | 0.065  | 0.100 | 16.54 | 4.8   | 26.1 |
| 6                   | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 6.6                       | 0.197  | 0.100 | 19.85 | 4.8   | 26.1 |
| 7                   | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 7.9                       | 0.200  | 0.100 | 23.15 | 4.8   | 26.1 |
| 22                  | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 7.9                       | 0.187  | 0.100 | 72.77 | 4.8   | 26.1 |
| 23                  | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 21.2                      | 0.050  | 0.100 | 76.08 | 4.8   | 26.1 |
| 24                  | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 26.0                      | 0.050  | 0.100 | 79.38 | 4.8   | 26.1 |
| 25                  | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 27.3                      | 0.050  | 0.100 | 82.69 | 4.8   | 26.1 |
| 26                  | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 28.6                      | 0.050  | 0.100 | 86.00 | 4.8   | 26.1 |
| Toe                 |        |        |       |       |      | 103.3                     | 0.150  | 0.100 |       |       |      |

7.669 kips total unreduced pile weight (g= 32.17 ft/s2)

7.669 kips total reduced pile weight (g= 32.17 ft/s2)

| Depth | Stroke | Pressure | Efficy |
|-------|--------|----------|--------|
| ft    | ft     | Ratio    |        |
| 72.00 | 12.04  | 1.00     | 0.800  |

Abutment 2 NB H-Pile - Delmag D25-32  
HNTB Corporation

04/02/2020  
GRLWEAP Version 2010

| Rut<br>kips | Bl Ct<br>b/ft | Stroke<br>down | (ft)<br>up | Ten Str<br>ksi | i | t  | Comp Str<br>ksi | i | t | ENTHRU<br>kip-ft | Bl Rt<br>b/min |
|-------------|---------------|----------------|------------|----------------|---|----|-----------------|---|---|------------------|----------------|
| 340.1       | 31.8          | 8.38           | 8.43       | -0.48          | 6 | 50 | 30.74           | 6 | 3 | 28.7             | 40.8           |
| 323.4       | 29.2          | 8.32           | 8.32       | -0.03          | 6 | 50 | 30.50           | 6 | 3 | 28.8             | 41.0           |
| 306.7       | 26.8          | 8.20           | 8.20       | 0.00           | 1 | 0  | 30.09           | 6 | 3 | 28.9             | 41.3           |
| 290.0       | 24.7          | 8.08           | 8.08       | -0.38          | 6 | 33 | 29.67           | 1 | 2 | 29.0             | 41.6           |
| 273.3       | 22.6          | 7.95           | 7.95       | -0.80          | 6 | 33 | 29.27           | 1 | 2 | 29.2             | 42.0           |

Abutment 2 NB H-Pile - Delmag D25-32  
HNTB Corporation

04/02/2020  
GRLWEAP Version 2010

Depth (ft) 73.0 Standard Soil Setup  
Shaft Gain/Loss Factor 1.000 Toe Gain/Loss Factor 1.000

PILE PROFILE:

Toe Area (in2) 203.230 Pile Type H Pile  
Pile Size (inch) 14.690

| L b Top | Area  | E-Mod  | Spec Wt | Perim | C Index | Wave Sp | EA/c   |
|---------|-------|--------|---------|-------|---------|---------|--------|
| ft      | in2   | ksi    | lb/ft3  | ft    |         | ft/s    | k/ft/s |
| 0.0     | 26.10 | 29000. | 492.0   | 4.8   | 0       | 16524.  | 45.8   |
| 86.0    | 26.10 | 29000. | 492.0   | 4.8   | 0       | 16524.  | 45.8   |

Wave Travel Time 2L/c (ms) 10.409

| Pile and Soil Model |        |        |       |       |      | Total Capacity Rut (kips) |        |       | 409.4 |       |      |
|---------------------|--------|--------|-------|-------|------|---------------------------|--------|-------|-------|-------|------|
| No.                 | Weight | Stiffn | C-Slk | T-Slk | CoR  | Soil-S                    | Soil-D | Quake | LbTop | Perim | Area |
|                     | kips   | k/in   | ft    | ft    |      | kips                      | s/ft   | inch  | ft    | ft    | in2  |
| 1                   | 0.295  | 19069  | 0.010 | 0.000 | 1.00 | 0.0                       | 0.000  | 0.100 | 3.31  | 4.8   | 26.1 |
| 2                   | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 0.0                       | 0.000  | 0.100 | 6.62  | 4.8   | 26.1 |
| 4                   | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 0.0                       | 0.050  | 0.100 | 13.23 | 4.8   | 26.1 |
| 5                   | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 2.5                       | 0.126  | 0.100 | 16.54 | 4.8   | 26.1 |
| 6                   | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 7.7                       | 0.200  | 0.100 | 19.85 | 4.8   | 26.1 |
| 7                   | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 7.9                       | 0.200  | 0.100 | 23.15 | 4.8   | 26.1 |
| 22                  | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 9.4                       | 0.128  | 0.100 | 72.77 | 4.8   | 26.1 |
| 23                  | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 25.0                      | 0.050  | 0.100 | 76.08 | 4.8   | 26.1 |
| 24                  | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 26.4                      | 0.050  | 0.100 | 79.38 | 4.8   | 26.1 |
| 25                  | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 27.7                      | 0.050  | 0.100 | 82.69 | 4.8   | 26.1 |
| 26                  | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 29.0                      | 0.050  | 0.100 | 86.00 | 4.8   | 26.1 |
| Toe                 |        |        |       |       |      | 163.7                     | 0.150  | 0.100 |       |       |      |

7.669 kips total unreduced pile weight (g= 32.17 ft/s2)

7.669 kips total reduced pile weight (g= 32.17 ft/s2)

| Depth | Stroke | Pressure | Efficy |
|-------|--------|----------|--------|
| ft    | ft     | Ratio    |        |
| 73.00 | 12.04  | 1.00     | 0.800  |

Abutment 2 NB H-Pile - Delmag D25-32  
HNTB Corporation

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| Rut<br>kips | Bl Ct<br>b/ft | Stroke<br>down | (ft)<br>up | Ten Str<br>ksi | i | t  | Comp Str<br>ksi | i | t | ENTHRU<br>kip-ft | Bl Rt<br>b/min |
|-------------|---------------|----------------|------------|----------------|---|----|-----------------|---|---|------------------|----------------|
| 409.4       | 43.9          | 8.73           | 8.71       | -0.51          | 5 | 46 | 31.78           | 6 | 3 | 30.0             | 40.1           |
| 392.4       | 40.3          | 8.62           | 8.63       | -0.50          | 6 | 48 | 31.29           | 1 | 2 | 29.8             | 40.3           |
| 375.4       | 37.0          | 8.52           | 8.54       | -0.51          | 6 | 49 | 30.96           | 6 | 3 | 29.6             | 40.5           |
| 358.4       | 33.8          | 8.37           | 8.42       | -0.47          | 6 | 27 | 30.57           | 5 | 3 | 29.7             | 40.8           |
| 341.5       | 31.0          | 8.24           | 8.31       | -0.46          | 6 | 27 | 30.15           | 5 | 3 | 29.6             | 41.1           |

Abutment 2 NB H-Pile - Delmag D25-32  
HNTB Corporation

04/02/2020  
GRLWEAP Version 2010

Depth (ft) 74.0 Standard Soil Setup  
Shaft Gain/Loss Factor 1.000 Toe Gain/Loss Factor 1.000

PILE PROFILE:

Toe Area (in2) 203.230 Pile Type H Pile  
Pile Size (inch) 14.690

| L b Top | Area  | E-Mod  | Spec Wt | Perim | C Index | Wave Sp | EA/c   |
|---------|-------|--------|---------|-------|---------|---------|--------|
| ft      | in2   | ksi    | lb/ft3  | ft    |         | ft/s    | k/ft/s |
| 0.0     | 26.10 | 29000. | 492.0   | 4.8   | 0       | 16524.  | 45.8   |
| 86.0    | 26.10 | 29000. | 492.0   | 4.8   | 0       | 16524.  | 45.8   |

Wave Travel Time 2L/c (ms) 10.409

| Pile and Soil Model |        |        |       |       |      | Total Capacity Rut (kips) |        |       | 483.8 |       |      |
|---------------------|--------|--------|-------|-------|------|---------------------------|--------|-------|-------|-------|------|
| No.                 | Weight | Stiffn | C-Slk | T-Slk | CoR  | Soil-S                    | Soil-D | Quake | LbTop | Perim | Area |
|                     | kips   | k/in   | ft    | ft    |      | kips                      | s/ft   | inch  | ft    | ft    | in2  |
| 1                   | 0.295  | 19069  | 0.010 | 0.000 | 1.00 | 0.0                       | 0.000  | 0.100 | 3.31  | 4.8   | 26.1 |
| 2                   | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 0.0                       | 0.000  | 0.100 | 6.62  | 4.8   | 26.1 |
| 4                   | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 0.3                       | 0.050  | 0.100 | 13.23 | 4.8   | 26.1 |
| 5                   | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 4.5                       | 0.168  | 0.100 | 16.54 | 4.8   | 26.1 |
| 6                   | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 7.9                       | 0.200  | 0.100 | 19.85 | 4.8   | 26.1 |
| 22                  | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 14.3                      | 0.076  | 0.100 | 72.77 | 4.8   | 26.1 |
| 23                  | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 25.5                      | 0.050  | 0.100 | 76.08 | 4.8   | 26.1 |
| 24                  | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 26.8                      | 0.050  | 0.100 | 79.38 | 4.8   | 26.1 |
| 25                  | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 28.1                      | 0.050  | 0.100 | 82.69 | 4.8   | 26.1 |
| 26                  | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 34.1                      | 0.050  | 0.100 | 86.00 | 4.8   | 26.1 |
| Toe                 |        |        |       |       |      | 224.4                     | 0.150  | 0.100 |       |       |      |

7.669 kips total unreduced pile weight (g= 32.17 ft/s2)

7.669 kips total reduced pile weight (g= 32.17 ft/s2)

| Depth | Stroke | Pressure | Efficy |
|-------|--------|----------|--------|
| ft    | ft     | Ratio    |        |
| 74.00 | 12.04  | 1.00     | 0.800  |

Abutment 2 NB H-Pile - Delmag D25-32  
HNTB Corporation

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| Rut   | Bl Ct | Stroke | (ft) | Ten Str | i | t  | Comp Str | i | t | ENTHRU | Bl Rt |
|-------|-------|--------|------|---------|---|----|----------|---|---|--------|-------|
| kip   | b/ft  | down   | up   | ksi     |   |    | ksi      |   |   | kip-ft | b/min |
| 483.8 | 63.7  | 9.06   | 8.99 | -0.65   | 5 | 45 | 32.84    | 5 | 2 | 31.0   | 39.4  |
| 466.4 | 57.6  | 8.98   | 8.92 | -0.69   | 5 | 47 | 32.46    | 5 | 2 | 30.9   | 39.6  |
| 449.0 | 51.9  | 8.87   | 8.83 | -0.73   | 6 | 48 | 32.22    | 5 | 2 | 30.9   | 39.8  |
| 431.5 | 47.2  | 8.77   | 8.76 | -0.75   | 6 | 49 | 31.74    | 5 | 2 | 30.8   | 40.0  |
| 414.1 | 42.6  | 8.67   | 8.67 | -0.93   | 8 | 26 | 31.51    | 5 | 2 | 31.0   | 40.2  |

Abutment 2 NB H-Pile - Delmag D25-32  
HNTB Corporation

04/02/2020  
GRLWEAP Version 2010

Depth (ft) 75.0 Standard Soil Setup  
Shaft Gain/Loss Factor 1.000 Toe Gain/Loss Factor 1.000

PILE PROFILE:

Toe Area (in2) 203.230 Pile Type H Pile  
Pile Size (inch) 14.690

| L b Top | Area  | E-Mod  | Spec Wt | Perim | C Index | Wave Sp | EA/c   |
|---------|-------|--------|---------|-------|---------|---------|--------|
| ft      | in2   | ksi    | lb/ft3  | ft    |         | ft/s    | k/ft/s |
| 0.0     | 26.10 | 29000. | 492.0   | 4.8   | 0       | 16524.  | 45.8   |
| 86.0    | 26.10 | 29000. | 492.0   | 4.8   | 0       | 16524.  | 45.8   |

Wave Travel Time 2L/c (ms) 10.409

| Pile and Soil Model |        |        |       |       |      | Total Capacity Rut (kips) |        |       | 563.3 |       |      |
|---------------------|--------|--------|-------|-------|------|---------------------------|--------|-------|-------|-------|------|
| No.                 | Weight | Stiffn | C-Slk | T-Slk | CoR  | Soil-S                    | Soil-D | Quake | LbTop | Perim | Area |
|                     | kips   | k/in   | ft    | ft    |      | kips                      | s/ft   | inch  | ft    | ft    | in2  |
| 1                   | 0.295  | 19069  | 0.010 | 0.000 | 1.00 | 0.0                       | 0.000  | 0.100 | 3.31  | 4.8   | 26.1 |
| 2                   | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 0.0                       | 0.000  | 0.100 | 6.62  | 4.8   | 26.1 |
| 4                   | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 0.9                       | 0.053  | 0.100 | 13.23 | 4.8   | 26.1 |
| 5                   | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 6.2                       | 0.193  | 0.100 | 16.54 | 4.8   | 26.1 |
| 6                   | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 7.9                       | 0.200  | 0.100 | 19.85 | 4.8   | 26.1 |
| 21                  | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 7.9                       | 0.195  | 0.100 | 69.46 | 4.8   | 26.1 |
| 22                  | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 19.6                      | 0.053  | 0.100 | 72.77 | 4.8   | 26.1 |
| 23                  | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 25.9                      | 0.050  | 0.100 | 76.08 | 4.8   | 26.1 |
| 24                  | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 27.2                      | 0.050  | 0.100 | 79.38 | 4.8   | 26.1 |
| 25                  | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 28.4                      | 0.050  | 0.100 | 82.69 | 4.8   | 26.1 |
| 26                  | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 44.2                      | 0.050  | 0.100 | 86.00 | 4.8   | 26.1 |
| Toe                 |        |        |       |       |      | 285.1                     | 0.150  | 0.100 |       |       |      |

7.669 kips total unreduced pile weight (g= 32.17 ft/s2)

7.669 kips total reduced pile weight (g= 32.17 ft/s2)

| Depth | Stroke | Pressure | Efficy |
|-------|--------|----------|--------|
| ft    | ft     | Ratio    |        |
| 75.00 | 12.04  | 1.00     | 0.800  |



Abutment 2 NB H-Pile - Delmag D25-32  
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| Rut   | Bl Ct | Stroke | (ft) | Ten Str | i | t  | Comp Str | i | t | ENTHRU | Bl Rt |
|-------|-------|--------|------|---------|---|----|----------|---|---|--------|-------|
| kip   | b/ft  | down   | up   | ksi     |   |    | ksi      |   |   | kip-ft | b/min |
| 563.3 | 97.8  | 9.33   | 9.24 | -0.86   | 5 | 45 | 33.78    | 5 | 2 | 31.9   | 38.9  |
| 545.3 | 85.9  | 9.27   | 9.20 | -0.93   | 5 | 46 | 33.47    | 5 | 2 | 31.9   | 39.0  |
| 527.2 | 75.7  | 9.19   | 9.15 | -0.96   | 5 | 47 | 33.29    | 5 | 2 | 32.0   | 39.1  |
| 509.1 | 67.8  | 9.12   | 9.08 | -1.04   | 6 | 48 | 32.93    | 5 | 2 | 32.0   | 39.2  |
| 491.1 | 60.7  | 9.02   | 9.01 | -1.33   | 9 | 50 | 32.57    | 5 | 2 | 32.1   | 39.4  |

Abutment 2 NB H-Pile - Delmag D25-32  
HNTB Corporation

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GRLWEAP Version 2010

Depth (ft) 76.0 Standard Soil Setup  
Shaft Gain/Loss Factor 1.000 Toe Gain/Loss Factor 1.000

PILE PROFILE:

Toe Area (in2) 203.230 Pile Type H Pile  
Pile Size (inch) 14.690

| L b Top | Area  | E-Mod  | Spec Wt | Perim | C Index | Wave Sp | EA/c   |
|---------|-------|--------|---------|-------|---------|---------|--------|
| ft      | in2   | ksi    | lb/ft3  | ft    |         | ft/s    | k/ft/s |
| 0.0     | 26.10 | 29000. | 492.0   | 4.8   | 0       | 16524.  | 45.8   |
| 86.0    | 26.10 | 29000. | 492.0   | 4.8   | 0       | 16524.  | 45.8   |

Wave Travel Time 2L/c (ms) 10.409

| Pile and Soil Model |        |        |       |       |      | Total Capacity Rut (kips) |        |       | 599.4 |       |      |
|---------------------|--------|--------|-------|-------|------|---------------------------|--------|-------|-------|-------|------|
| No.                 | Weight | Stiffn | C-Slk | T-Slk | CoR  | Soil-S                    | Soil-D | Quake | LbTop | Perim | Area |
|                     | kips   | k/in   | ft    | ft    |      | kips                      | s/ft   | inch  | ft    | ft    | in2  |
| 1                   | 0.295  | 19069  | 0.010 | 0.000 | 1.00 | 0.0                       | 0.000  | 0.100 | 3.31  | 4.8   | 26.1 |
| 2                   | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 0.0                       | 0.000  | 0.100 | 6.62  | 4.8   | 26.1 |
| 4                   | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 2.0                       | 0.108  | 0.100 | 13.23 | 4.8   | 26.1 |
| 5                   | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 7.5                       | 0.200  | 0.100 | 16.54 | 4.8   | 26.1 |
| 6                   | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 7.9                       | 0.200  | 0.100 | 19.85 | 4.8   | 26.1 |
| 21                  | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 8.4                       | 0.150  | 0.100 | 69.46 | 4.8   | 26.1 |
| 22                  | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 24.3                      | 0.050  | 0.100 | 72.77 | 4.8   | 26.1 |
| 23                  | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 26.3                      | 0.050  | 0.100 | 76.08 | 4.8   | 26.1 |
| 24                  | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 27.6                      | 0.050  | 0.100 | 79.38 | 4.8   | 26.1 |
| 25                  | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 28.8                      | 0.050  | 0.100 | 82.69 | 4.8   | 26.1 |
| 26                  | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 54.5                      | 0.050  | 0.100 | 86.00 | 4.8   | 26.1 |
| Toe                 |        |        |       |       |      | 302.0                     | 0.150  | 0.100 |       |       |      |

7.669 kips total unreduced pile weight (g= 32.17 ft/s2)

7.669 kips total reduced pile weight (g= 32.17 ft/s2)

| Depth | Stroke | Pressure | Efficy |
|-------|--------|----------|--------|
| ft    | ft     | Ratio    |        |
| 76.00 | 12.04  | 1.00     | 0.800  |

Abutment 2 NB H-Pile - Delmag D25-32  
HNTB Corporation

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| Rut<br>kips | Bl Ct<br>b/ft | Stroke<br>down | (ft)<br>up | Ten Str<br>ksi | i | t  | Comp Str<br>ksi | i | t | ENTHRU<br>kip-ft | Bl Rt<br>b/min |
|-------------|---------------|----------------|------------|----------------|---|----|-----------------|---|---|------------------|----------------|
| 599.4       | 121.5         | 9.43           | 9.35       | -0.84          | 5 | 45 | 34.06           | 5 | 2 | 32.1             | 38.7           |
| 580.7       | 104.4         | 9.36           | 9.30       | -0.93          | 5 | 46 | 33.81           | 5 | 2 | 32.1             | 38.8           |
| 562.0       | 90.3          | 9.31           | 9.25       | -0.99          | 5 | 47 | 33.59           | 5 | 2 | 32.3             | 38.9           |
| 543.3       | 79.8          | 9.23           | 9.20       | -1.09          | 7 | 48 | 33.33           | 5 | 2 | 32.3             | 39.0           |
| 524.6       | 70.0          | 9.17           | 9.13       | -1.38          | 9 | 50 | 33.07           | 5 | 2 | 32.6             | 39.1           |

Abutment 2 NB H-Pile - Delmag D25-32  
HNTB Corporation

04/02/2020  
GRLWEAP Version 2010

Depth (ft) 77.0 Standard Soil Setup  
Shaft Gain/Loss Factor 1.000 Toe Gain/Loss Factor 1.000

PILE PROFILE:

Toe Area (in2) 203.230 Pile Type H Pile  
Pile Size (inch) 14.690

| L b Top | Area  | E-Mod  | Spec Wt | Perim | C Index | Wave Sp | EA/c   |
|---------|-------|--------|---------|-------|---------|---------|--------|
| ft      | in2   | ksi    | lb/ft3  | ft    |         | ft/s    | k/ft/s |
| 0.0     | 26.10 | 29000. | 492.0   | 4.8   | 0       | 16524.  | 45.8   |
| 86.0    | 26.10 | 29000. | 492.0   | 4.8   | 0       | 16524.  | 45.8   |

Wave Travel Time 2L/c (ms) 10.409

| Pile and Soil Model |        |        |       |       |      | Total Capacity Rut (kips) |        |       | 618.8 |       |      |
|---------------------|--------|--------|-------|-------|------|---------------------------|--------|-------|-------|-------|------|
| No.                 | Weight | Stiffn | C-Slk | T-Slk | CoR  | Soil-S                    | Soil-D | Quake | LbTop | Perim | Area |
|                     | kips   | k/in   | ft    | ft    |      | kips                      | s/ft   | inch  | ft    | ft    | in2  |
| 1                   | 0.295  | 19069  | 0.010 | 0.000 | 1.00 | 0.0                       | 0.000  | 0.100 | 3.31  | 4.8   | 26.1 |
| 2                   | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 0.0                       | 0.000  | 0.100 | 6.62  | 4.8   | 26.1 |
| 3                   | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 0.2                       | 0.050  | 0.100 | 9.92  | 4.8   | 26.1 |
| 4                   | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 3.9                       | 0.158  | 0.100 | 13.23 | 4.8   | 26.1 |
| 5                   | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 7.9                       | 0.200  | 0.100 | 16.54 | 4.8   | 26.1 |
| 21                  | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 12.8                      | 0.088  | 0.100 | 69.46 | 4.8   | 26.1 |
| 22                  | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 25.4                      | 0.050  | 0.100 | 72.77 | 4.8   | 26.1 |
| 23                  | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 26.7                      | 0.050  | 0.100 | 76.08 | 4.8   | 26.1 |
| 24                  | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 27.9                      | 0.050  | 0.100 | 79.38 | 4.8   | 26.1 |
| 25                  | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 31.5                      | 0.050  | 0.100 | 82.69 | 4.8   | 26.1 |
| 26                  | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 62.7                      | 0.050  | 0.100 | 86.00 | 4.8   | 26.1 |
| Toe                 |        |        |       |       |      | 302.0                     | 0.150  | 0.100 |       |       |      |

7.669 kips total unreduced pile weight (g= 32.17 ft/s2)

7.669 kips total reduced pile weight (g= 32.17 ft/s2)

| Depth | Stroke | Pressure | Efficy |
|-------|--------|----------|--------|
| ft    | ft     | Ratio    |        |
| 77.00 | 12.04  | 1.00     | 0.800  |

Abutment 2 NB H-Pile - Delmag D25-32  
HNTB Corporation

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| Rut<br>kips | Bl Ct<br>b/ft | Stroke<br>down | (ft)<br>up | Ten Str<br>ksi | i | t  | Comp Str<br>ksi | i | t | ENTHRU<br>kip-ft | Bl Rt<br>b/min |
|-------------|---------------|----------------|------------|----------------|---|----|-----------------|---|---|------------------|----------------|
| 618.8       | 136.0         | 9.47           | 9.38       | -0.74          | 5 | 45 | 34.11           | 4 | 2 | 32.2             | 38.6           |
| 599.5       | 115.6         | 9.41           | 9.34       | -0.86          | 5 | 46 | 33.92           | 4 | 2 | 32.2             | 38.7           |
| 580.1       | 99.3          | 9.34           | 9.29       | -0.95          | 5 | 47 | 33.69           | 4 | 2 | 32.3             | 38.8           |
| 560.8       | 85.8          | 9.29           | 9.24       | -1.05          | 7 | 48 | 33.47           | 4 | 2 | 32.5             | 38.9           |
| 541.4       | 75.3          | 9.22           | 9.18       | -1.34          | 9 | 49 | 33.22           | 4 | 2 | 32.7             | 39.0           |

Abutment 2 NB H-Pile - Delmag D25-32  
HNTB Corporation

04/02/2020  
GRLWEAP Version 2010

Depth (ft) 78.0 Standard Soil Setup  
Shaft Gain/Loss Factor 1.000 Toe Gain/Loss Factor 1.000

PILE PROFILE:

Toe Area (in2) 203.230 Pile Type H Pile  
Pile Size (inch) 14.690

| L b Top | Area  | E-Mod  | Spec Wt | Perim | C Index | Wave Sp | EA/c   |
|---------|-------|--------|---------|-------|---------|---------|--------|
| ft      | in2   | ksi    | lb/ft3  | ft    |         | ft/s    | k/ft/s |
| 0.0     | 26.10 | 29000. | 492.0   | 4.8   | 0       | 16524.  | 45.8   |
| 86.0    | 26.10 | 29000. | 492.0   | 4.8   | 0       | 16524.  | 45.8   |

Wave Travel Time 2L/c (ms) 10.409

| Pile and Soil Model |        |        |       |       |      | Total Capacity Rut (kips) |        |       | 638.6 |       |      |
|---------------------|--------|--------|-------|-------|------|---------------------------|--------|-------|-------|-------|------|
| No.                 | Weight | Stiffn | C-Slk | T-Slk | CoR  | Soil-S                    | Soil-D | Quake | LbTop | Perim | Area |
|                     | kips   | k/in   | ft    | ft    |      | kips                      | s/ft   | inch  | ft    | ft    | in2  |
| 1                   | 0.295  | 19069  | 0.010 | 0.000 | 1.00 | 0.0                       | 0.000  | 0.100 | 3.31  | 4.8   | 26.1 |
| 2                   | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 0.0                       | 0.000  | 0.100 | 6.62  | 4.8   | 26.1 |
| 3                   | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 0.7                       | 0.050  | 0.100 | 9.92  | 4.8   | 26.1 |
| 4                   | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 5.7                       | 0.186  | 0.100 | 13.23 | 4.8   | 26.1 |
| 5                   | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 7.9                       | 0.200  | 0.100 | 16.54 | 4.8   | 26.1 |
| 21                  | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 17.9                      | 0.057  | 0.100 | 69.46 | 4.8   | 26.1 |
| 22                  | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 25.8                      | 0.050  | 0.100 | 72.77 | 4.8   | 26.1 |
| 23                  | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 27.1                      | 0.050  | 0.100 | 76.08 | 4.8   | 26.1 |
| 24                  | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 28.3                      | 0.050  | 0.100 | 79.38 | 4.8   | 26.1 |
| 25                  | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 41.1                      | 0.050  | 0.100 | 82.69 | 4.8   | 26.1 |
| 26                  | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 64.2                      | 0.050  | 0.100 | 86.00 | 4.8   | 26.1 |
| Toe                 |        |        |       |       |      | 302.0                     | 0.150  | 0.100 |       |       |      |

7.669 kips total unreduced pile weight (g= 32.17 ft/s2)

7.669 kips total reduced pile weight (g= 32.17 ft/s2)

| Depth | Stroke | Pressure | Efficy |
|-------|--------|----------|--------|
| ft    | ft     | Ratio    |        |
| 78.00 | 12.04  | 1.00     | 0.800  |

Abutment 2 NB H-Pile - Delmag D25-32  
HNTB Corporation

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| Rut<br>kips | Bl Ct<br>b/ft | Stroke<br>down | (ft)<br>up | Ten Str<br>ksi | i | t  | Comp Str<br>ksi | i | t | ENTHRU<br>kip-ft | Bl Rt<br>b/min |
|-------------|---------------|----------------|------------|----------------|---|----|-----------------|---|---|------------------|----------------|
| 638.6       | 156.2         | 9.50           | 9.42       | -0.66          | 4 | 45 | 34.37           | 4 | 2 | 32.1             | 38.5           |
| 618.6       | 129.3         | 9.46           | 9.37       | -0.77          | 5 | 46 | 34.15           | 4 | 2 | 32.3             | 38.6           |
| 598.6       | 108.6         | 9.39           | 9.33       | -0.89          | 5 | 46 | 33.90           | 4 | 2 | 32.5             | 38.7           |
| 578.6       | 93.5          | 9.33           | 9.28       | -1.02          | 7 | 47 | 33.67           | 4 | 2 | 32.5             | 38.8           |
| 558.6       | 80.7          | 9.28           | 9.22       | -1.31          | 9 | 49 | 33.43           | 4 | 2 | 32.8             | 38.9           |

Abutment 2 NB H-Pile - Delmag D25-32  
HNTB Corporation

04/02/2020  
GRLWEAP Version 2010

Depth (ft) 79.0 Standard Soil Setup  
Shaft Gain/Loss Factor 1.000 Toe Gain/Loss Factor 1.000

PILE PROFILE:

Toe Area (in2) 203.230 Pile Type H Pile  
Pile Size (inch) 14.690

| L b Top | Area  | E-Mod  | Spec Wt | Perim | C Index | Wave Sp | EA/c   |
|---------|-------|--------|---------|-------|---------|---------|--------|
| ft      | in2   | ksi    | lb/ft3  | ft    |         | ft/s    | k/ft/s |
| 0.0     | 26.10 | 29000. | 492.0   | 4.8   | 0       | 16524.  | 45.8   |
| 86.0    | 26.10 | 29000. | 492.0   | 4.8   | 0       | 16524.  | 45.8   |

Wave Travel Time 2L/c (ms) 10.409

| Pile and Soil Model |        |        |       |       |      | Total Capacity Rut (kips) |        |       | 658.7 |       |      |
|---------------------|--------|--------|-------|-------|------|---------------------------|--------|-------|-------|-------|------|
| No.                 | Weight | Stiffn | C-Slk | T-Slk | CoR  | Soil-S                    | Soil-D | Quake | LbTop | Perim | Area |
|                     | kips   | k/in   | ft    | ft    |      | kips                      | s/ft   | inch  | ft    | ft    | in2  |
| 1                   | 0.295  | 19069  | 0.010 | 0.000 | 1.00 | 0.0                       | 0.000  | 0.100 | 3.31  | 4.8   | 26.1 |
| 2                   | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 0.0                       | 0.000  | 0.100 | 6.62  | 4.8   | 26.1 |
| 3                   | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 1.6                       | 0.087  | 0.100 | 9.92  | 4.8   | 26.1 |
| 4                   | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 7.1                       | 0.200  | 0.100 | 13.23 | 4.8   | 26.1 |
| 5                   | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 7.9                       | 0.200  | 0.100 | 16.54 | 4.8   | 26.1 |
| 20                  | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 7.9                       | 0.169  | 0.100 | 66.15 | 4.8   | 26.1 |
| 21                  | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 23.2                      | 0.050  | 0.100 | 69.46 | 4.8   | 26.1 |
| 22                  | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 26.2                      | 0.050  | 0.100 | 72.77 | 4.8   | 26.1 |
| 23                  | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 27.5                      | 0.050  | 0.100 | 76.08 | 4.8   | 26.1 |
| 24                  | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 28.7                      | 0.050  | 0.100 | 79.38 | 4.8   | 26.1 |
| 25                  | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 51.3                      | 0.050  | 0.100 | 82.69 | 4.8   | 26.1 |
| 26                  | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 65.2                      | 0.050  | 0.100 | 86.00 | 4.8   | 26.1 |
| Toe                 |        |        |       |       |      | 302.0                     | 0.150  | 0.100 |       |       |      |

7.669 kips total unreduced pile weight (g= 32.17 ft/s2)  
7.669 kips total reduced pile weight (g= 32.17 ft/s2)

| Depth | Stroke | Pressure | Efficy |
|-------|--------|----------|--------|
| ft    | ft     | Ratio    |        |
| 79.00 | 12.04  | 1.00     | 0.800  |



Abutment 2 NB H-Pile - Delmag D25-32  
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| Rut<br>kips | Bl Ct<br>b/ft | Stroke<br>down | (ft)<br>up | Ten Str<br>ksi | i  | t  | Comp Str<br>ksi | i | t | ENTHRU<br>kip-ft | Bl Rt<br>b/min |
|-------------|---------------|----------------|------------|----------------|----|----|-----------------|---|---|------------------|----------------|
| 658.7       | 183.4         | 9.43           | 9.45       | -0.61          | 4  | 45 | 34.28           | 4 | 2 | 31.8             | 38.5           |
| 638.0       | 145.9         | 9.49           | 9.41       | -0.72          | 4  | 45 | 34.31           | 4 | 2 | 32.3             | 38.5           |
| 617.3       | 120.9         | 9.43           | 9.37       | -0.84          | 4  | 46 | 34.08           | 4 | 2 | 32.5             | 38.6           |
| 596.6       | 101.7         | 9.38           | 9.32       | -0.99          | 7  | 47 | 33.81           | 4 | 2 | 32.7             | 38.7           |
| 576.0       | 87.7          | 9.32           | 9.28       | -1.28          | 19 | 25 | 33.58           | 4 | 2 | 32.8             | 38.8           |

Abutment 2 NB H-Pile - Delmag D25-32  
HNTB Corporation

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Depth (ft) 80.0 Standard Soil Setup  
Shaft Gain/Loss Factor 1.000 Toe Gain/Loss Factor 1.000

PILE PROFILE:

Toe Area (in2) 203.230 Pile Type H Pile  
Pile Size (inch) 14.690

| L b Top | Area  | E-Mod  | Spec Wt | Perim | C Index | Wave Sp | EA/c   |
|---------|-------|--------|---------|-------|---------|---------|--------|
| ft      | in2   | ksi    | lb/ft3  | ft    |         | ft/s    | k/ft/s |
| 0.0     | 26.10 | 29000. | 492.0   | 4.8   | 0       | 16524.  | 45.8   |
| 86.0    | 26.10 | 29000. | 492.0   | 4.8   | 0       | 16524.  | 45.8   |

Wave Travel Time 2L/c (ms) 10.409

| Pile and Soil Model |        |        |       |       |      | Total Capacity Rut (kips) |        |       | 679.1 |       |      |
|---------------------|--------|--------|-------|-------|------|---------------------------|--------|-------|-------|-------|------|
| No.                 | Weight | Stiffn | C-Slk | T-Slk | CoR  | Soil-S                    | Soil-D | Quake | LbTop | Perim | Area |
|                     | kips   | k/in   | ft    | ft    |      | kips                      | s/ft   | inch  | ft    | ft    | in2  |
| 1                   | 0.295  | 19069  | 0.010 | 0.000 | 1.00 | 0.0                       | 0.000  | 0.100 | 3.31  | 4.8   | 26.1 |
| 2                   | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 0.1                       | 0.050  | 0.100 | 6.62  | 4.8   | 26.1 |
| 3                   | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 3.2                       | 0.146  | 0.100 | 9.92  | 4.8   | 26.1 |
| 4                   | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 7.9                       | 0.200  | 0.100 | 13.23 | 4.8   | 26.1 |
| 5                   | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 7.9                       | 0.200  | 0.100 | 16.54 | 4.8   | 26.1 |
| 20                  | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 11.2                      | 0.103  | 0.100 | 66.15 | 4.8   | 26.1 |
| 21                  | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 25.3                      | 0.050  | 0.100 | 69.46 | 4.8   | 26.1 |
| 22                  | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 26.6                      | 0.050  | 0.100 | 72.77 | 4.8   | 26.1 |
| 23                  | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 27.8                      | 0.050  | 0.100 | 76.08 | 4.8   | 26.1 |
| 24                  | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 29.8                      | 0.050  | 0.100 | 79.38 | 4.8   | 26.1 |
| 25                  | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 61.0                      | 0.050  | 0.100 | 82.69 | 4.8   | 26.1 |
| 26                  | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 66.2                      | 0.050  | 0.100 | 86.00 | 4.8   | 26.1 |
| Toe                 |        |        |       |       |      | 302.0                     | 0.150  | 0.100 |       |       |      |

7.669 kips total unreduced pile weight (g= 32.17 ft/s2)  
7.669 kips total reduced pile weight (g= 32.17 ft/s2)

| Depth | Stroke | Pressure | Efficy |
|-------|--------|----------|--------|
| ft    | ft     | Ratio    |        |
| 80.00 | 12.04  | 1.00     | 0.800  |

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| Rut<br>kips | Bl Ct<br>b/ft | Stroke<br>down | (ft)<br>up | Ten Str<br>ksi | i  | t  | Comp Str<br>ksi | i | t | ENTHRU<br>kip-ft | Bl Rt<br>b/min |
|-------------|---------------|----------------|------------|----------------|----|----|-----------------|---|---|------------------|----------------|
| 679.1       | 209.6         | 9.47           | 9.46       | -0.53          | 4  | 44 | 34.26           | 4 | 2 | 31.8             | 38.5           |
| 657.7       | 164.3         | 9.52           | 9.44       | -0.65          | 4  | 45 | 34.31           | 4 | 2 | 32.3             | 38.5           |
| 636.4       | 135.7         | 9.48           | 9.41       | -0.79          | 4  | 46 | 34.11           | 3 | 2 | 32.5             | 38.5           |
| 615.0       | 112.6         | 9.42           | 9.37       | -0.94          | 6  | 47 | 33.88           | 4 | 2 | 32.7             | 38.6           |
| 593.6       | 95.0          | 9.37           | 9.32       | -1.31          | 19 | 25 | 33.63           | 3 | 2 | 32.9             | 38.7           |

Abutment 2 NB H-Pile - Delmag D25-32  
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Depth (ft) 81.0 Standard Soil Setup  
Shaft Gain/Loss Factor 1.000 Toe Gain/Loss Factor 1.000

PILE PROFILE:

Toe Area (in2) 203.230 Pile Type H Pile  
Pile Size (inch) 14.690

| L b Top | Area  | E-Mod  | Spec Wt | Perim | C Index | Wave Sp | EA/c   |
|---------|-------|--------|---------|-------|---------|---------|--------|
| ft      | in2   | ksi    | lb/ft3  | ft    |         | ft/s    | k/ft/s |
| 0.0     | 26.10 | 29000. | 492.0   | 4.8   | 0       | 16524.  | 45.8   |
| 86.0    | 26.10 | 29000. | 492.0   | 4.8   | 0       | 16524.  | 45.8   |

Wave Travel Time 2L/c (ms) 10.409

| Pile and Soil Model |        |        |       |       |      | Total Capacity Rut (kips) |        |       | 699.8 |       |      |
|---------------------|--------|--------|-------|-------|------|---------------------------|--------|-------|-------|-------|------|
| No.                 | Weight | Stiffn | C-Slk | T-Slk | CoR  | Soil-S                    | Soil-D | Quake | LbTop | Perim | Area |
|                     | kips   | k/in   | ft    | ft    |      | kips                      | s/ft   | inch  | ft    | ft    | in2  |
| 1                   | 0.295  | 19069  | 0.010 | 0.000 | 1.00 | 0.0                       | 0.000  | 0.100 | 3.31  | 4.8   | 26.1 |
| 2                   | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 0.5                       | 0.050  | 0.100 | 6.62  | 4.8   | 26.1 |
| 3                   | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 5.2                       | 0.179  | 0.100 | 9.92  | 4.8   | 26.1 |
| 4                   | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 7.9                       | 0.200  | 0.100 | 13.23 | 4.8   | 26.1 |
| 20                  | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 16.3                      | 0.064  | 0.100 | 66.15 | 4.8   | 26.1 |
| 21                  | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 25.7                      | 0.050  | 0.100 | 69.46 | 4.8   | 26.1 |
| 22                  | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 27.0                      | 0.050  | 0.100 | 72.77 | 4.8   | 26.1 |
| 23                  | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 28.2                      | 0.050  | 0.100 | 76.08 | 4.8   | 26.1 |
| 24                  | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 38.0                      | 0.050  | 0.100 | 79.38 | 4.8   | 26.1 |
| 25                  | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 63.8                      | 0.050  | 0.100 | 82.69 | 4.8   | 26.1 |
| 26                  | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 67.3                      | 0.050  | 0.100 | 86.00 | 4.8   | 26.1 |
| Toe                 |        |        |       |       |      | 302.0                     | 0.150  | 0.100 |       |       |      |

7.669 kips total unreduced pile weight (g= 32.17 ft/s2)

7.669 kips total reduced pile weight (g= 32.17 ft/s2)

| Depth | Stroke | Pressure | Efficy |
|-------|--------|----------|--------|
| ft    | ft     | Ratio    |        |
| 81.00 | 12.04  | 1.00     | 0.800  |

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| Rut<br>kips | Bl Ct<br>b/ft | Stroke<br>down | (ft)<br>up | Ten Str<br>ksi | i  | t  | Comp Str<br>ksi | i | t | ENTHRU<br>kip-ft | Bl Rt<br>b/min |
|-------------|---------------|----------------|------------|----------------|----|----|-----------------|---|---|------------------|----------------|
| 699.8       | 242.5         | 9.49           | 9.49       | -0.43          | 3  | 44 | 34.35           | 3 | 2 | 31.8             | 38.5           |
| 677.7       | 185.8         | 9.57           | 9.48       | -0.55          | 4  | 45 | 34.53           | 3 | 2 | 32.3             | 38.4           |
| 655.7       | 151.6         | 9.52           | 9.44       | -0.71          | 4  | 45 | 34.33           | 3 | 2 | 32.5             | 38.5           |
| 633.6       | 125.0         | 9.46           | 9.40       | -0.91          | 6  | 46 | 34.00           | 3 | 2 | 32.7             | 38.6           |
| 611.6       | 104.1         | 9.41           | 9.36       | -1.34          | 19 | 24 | 33.80           | 3 | 2 | 32.9             | 38.6           |

Abutment 2 NB H-Pile - Delmag D25-32  
HNTB Corporation

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Depth (ft) 82.0 Standard Soil Setup  
Shaft Gain/Loss Factor 1.000 Toe Gain/Loss Factor 1.000

PILE PROFILE:

Toe Area (in2) 203.230 Pile Type H Pile  
Pile Size (inch) 14.690

| L b Top | Area  | E-Mod  | Spec Wt | Perim | C Index | Wave Sp | EA/c   |
|---------|-------|--------|---------|-------|---------|---------|--------|
| ft      | in2   | ksi    | lb/ft3  | ft    |         | ft/s    | k/ft/s |
| 0.0     | 26.10 | 29000. | 492.0   | 4.8   | 0       | 16524.  | 45.8   |
| 86.0    | 26.10 | 29000. | 492.0   | 4.8   | 0       | 16524.  | 45.8   |

Wave Travel Time 2L/c (ms) 10.409

| Pile and Soil Model |        |        |       |       |      | Total Capacity Rut (kips) |        |       | 720.8 |       |      |
|---------------------|--------|--------|-------|-------|------|---------------------------|--------|-------|-------|-------|------|
| No.                 | Weight | Stiffn | C-Slk | T-Slk | CoR  | Soil-S                    | Soil-D | Quake | LbTop | Perim | Area |
|                     | kips   | k/in   | ft    | ft    |      | kips                      | s/ft   | inch  | ft    | ft    | in2  |
| 1                   | 0.295  | 19069  | 0.010 | 0.000 | 1.00 | 0.0                       | 0.000  | 0.100 | 3.31  | 4.8   | 26.1 |
| 2                   | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 1.3                       | 0.069  | 0.100 | 6.62  | 4.8   | 26.1 |
| 3                   | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 6.7                       | 0.198  | 0.100 | 9.92  | 4.8   | 26.1 |
| 4                   | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 7.9                       | 0.200  | 0.100 | 13.23 | 4.8   | 26.1 |
| 19                  | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 7.9                       | 0.184  | 0.100 | 62.85 | 4.8   | 26.1 |
| 20                  | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 21.6                      | 0.050  | 0.100 | 66.15 | 4.8   | 26.1 |
| 21                  | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 26.1                      | 0.050  | 0.100 | 69.46 | 4.8   | 26.1 |
| 22                  | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 27.3                      | 0.050  | 0.100 | 72.77 | 4.8   | 26.1 |
| 23                  | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 28.6                      | 0.050  | 0.100 | 76.08 | 4.8   | 26.1 |
| 24                  | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 48.1                      | 0.050  | 0.100 | 79.38 | 4.8   | 26.1 |
| 25                  | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 64.9                      | 0.050  | 0.100 | 82.69 | 4.8   | 26.1 |
| 26                  | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 68.4                      | 0.050  | 0.100 | 86.00 | 4.8   | 26.1 |
| Toe                 |        |        |       |       |      | 302.0                     | 0.150  | 0.100 |       |       |      |

7.669 kips total unreduced pile weight (g= 32.17 ft/s2)  
7.669 kips total reduced pile weight (g= 32.17 ft/s2)

| Depth | Stroke | Pressure | Efficy |
|-------|--------|----------|--------|
| ft    | ft     | Ratio    |        |
| 82.00 | 12.04  | 1.00     | 0.800  |

Abutment 2 NB H-Pile - Delmag D25-32  
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| Rut<br>kips | Bl Ct<br>b/ft | Stroke<br>down | (ft)<br>up | Ten Str<br>ksi | i  | t  | Comp Str<br>ksi | i | t | ENTHRU<br>kip-ft | Bl Rt<br>b/min |
|-------------|---------------|----------------|------------|----------------|----|----|-----------------|---|---|------------------|----------------|
| 720.8       | 290.2         | 9.52           | 9.52       | -0.39          | 3  | 44 | 34.58           | 3 | 2 | 31.7             | 38.4           |
| 698.1       | 219.4         | 9.49           | 9.49       | -0.48          | 3  | 44 | 34.44           | 3 | 2 | 32.0             | 38.4           |
| 675.3       | 169.3         | 9.55           | 9.47       | -0.64          | 4  | 45 | 34.48           | 3 | 2 | 32.5             | 38.4           |
| 652.6       | 138.8         | 9.49           | 9.43       | -0.86          | 6  | 46 | 34.17           | 3 | 2 | 32.7             | 38.5           |
| 629.8       | 113.6         | 9.46           | 9.39       | -1.39          | 19 | 24 | 34.03           | 3 | 2 | 33.1             | 38.6           |

Abutment 2 NB H-Pile - Delmag D25-32  
HNTB Corporation

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GRLWEAP Version 2010

Depth (ft) 83.0 Standard Soil Setup  
Shaft Gain/Loss Factor 1.000 Toe Gain/Loss Factor 1.000

PILE PROFILE:

Toe Area (in2) 203.230 Pile Type H Pile  
Pile Size (inch) 14.690

| L b Top | Area  | E-Mod  | Spec Wt | Perim | C Index | Wave Sp | EA/c   |
|---------|-------|--------|---------|-------|---------|---------|--------|
| ft      | in2   | ksi    | lb/ft3  | ft    |         | ft/s    | k/ft/s |
| 0.0     | 26.10 | 29000. | 492.0   | 4.8   | 0       | 16524.  | 45.8   |
| 86.0    | 26.10 | 29000. | 492.0   | 4.8   | 0       | 16524.  | 45.8   |

Wave Travel Time 2L/c (ms) 10.409

| Pile and Soil Model |        |        |       |       |      | Total Capacity Rut (kips) |        |       | 742.2 |       |      |
|---------------------|--------|--------|-------|-------|------|---------------------------|--------|-------|-------|-------|------|
| No.                 | Weight | Stiffn | C-Slk | T-Slk | CoR  | Soil-S                    | Soil-D | Quake | LbTop | Perim | Area |
|                     | kips   | k/in   | ft    | ft    |      | kips                      | s/ft   | inch  | ft    | ft    | in2  |
| 1                   | 0.295  | 19069  | 0.010 | 0.000 | 1.00 | 0.0                       | 0.050  | 0.100 | 3.31  | 4.8   | 26.1 |
| 2                   | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 2.6                       | 0.131  | 0.100 | 6.62  | 4.8   | 26.1 |
| 3                   | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 7.8                       | 0.200  | 0.100 | 9.92  | 4.8   | 26.1 |
| 4                   | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 7.9                       | 0.200  | 0.100 | 13.23 | 4.8   | 26.1 |
| 19                  | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 9.7                       | 0.122  | 0.100 | 62.85 | 4.8   | 26.1 |
| 20                  | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 25.1                      | 0.050  | 0.100 | 66.15 | 4.8   | 26.1 |
| 21                  | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 26.5                      | 0.050  | 0.100 | 69.46 | 4.8   | 26.1 |
| 22                  | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 27.7                      | 0.050  | 0.100 | 72.77 | 4.8   | 26.1 |
| 23                  | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 29.0                      | 0.050  | 0.100 | 76.08 | 4.8   | 26.1 |
| 24                  | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 58.5                      | 0.050  | 0.100 | 79.38 | 4.8   | 26.1 |
| 25                  | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 65.9                      | 0.050  | 0.100 | 82.69 | 4.8   | 26.1 |
| 26                  | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 69.4                      | 0.050  | 0.100 | 86.00 | 4.8   | 26.1 |
| Toe                 |        |        |       |       |      | 302.0                     | 0.150  | 0.100 |       |       |      |

7.669 kips total unreduced pile weight (g= 32.17 ft/s2)  
7.669 kips total reduced pile weight (g= 32.17 ft/s2)

| Depth | Stroke | Pressure | Efficy |
|-------|--------|----------|--------|
| ft    | ft     | Ratio    |        |
| 83.00 | 12.04  | 1.00     | 0.800  |



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| Rut<br>kips | Bl Ct<br>b/ft | Stroke<br>down | (ft)<br>up | Ten Str<br>ksi | i  | t  | Comp Str<br>ksi | i | t | ENTHRU<br>kip-ft | Bl Rt<br>b/min |
|-------------|---------------|----------------|------------|----------------|----|----|-----------------|---|---|------------------|----------------|
| 742.2       | 356.7         | 9.53           | 9.54       | -0.33          | 3  | 44 | 34.58           | 3 | 2 | 31.6             | 38.4           |
| 718.7       | 254.2         | 9.52           | 9.51       | -0.43          | 3  | 44 | 34.40           | 3 | 2 | 32.0             | 38.4           |
| 695.3       | 195.8         | 9.49           | 9.49       | -0.56          | 4  | 45 | 34.22           | 3 | 2 | 32.2             | 38.4           |
| 671.8       | 153.2         | 9.55           | 9.46       | -0.81          | 6  | 46 | 34.24           | 3 | 2 | 32.8             | 38.4           |
| 648.3       | 126.3         | 9.51           | 9.43       | -1.38          | 19 | 24 | 34.14           | 3 | 2 | 33.1             | 38.5           |

Abutment 2 NB H-Pile - Delmag D25-32  
HNTB Corporation

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Depth (ft) 84.0 Standard Soil Setup  
Shaft Gain/Loss Factor 1.000 Toe Gain/Loss Factor 1.000

PILE PROFILE:

Toe Area (in2) 203.230 Pile Type H Pile  
Pile Size (inch) 14.690

| L b Top | Area  | E-Mod  | Spec Wt | Perim | C Index | Wave Sp | EA/c   |
|---------|-------|--------|---------|-------|---------|---------|--------|
| ft      | in2   | ksi    | lb/ft3  | ft    |         | ft/s    | k/ft/s |
| 0.0     | 26.10 | 29000. | 492.0   | 4.8   | 0       | 16524.  | 45.8   |
| 86.0    | 26.10 | 29000. | 492.0   | 4.8   | 0       | 16524.  | 45.8   |

Wave Travel Time 2L/c (ms) 10.409

| Pile and Soil Model |        |        |       |       |      | Total Capacity Rut (kips) |        |       | 763.8 |       |      |
|---------------------|--------|--------|-------|-------|------|---------------------------|--------|-------|-------|-------|------|
| No.                 | Weight | Stiffn | C-Slk | T-Slk | CoR  | Soil-S                    | Soil-D | Quake | LbTop | Perim | Area |
|                     | kips   | k/in   | ft    | ft    |      | kips                      | s/ft   | inch  | ft    | ft    | in2  |
| 1                   | 0.295  | 19069  | 0.010 | 0.000 | 1.00 | 0.3                       | 0.050  | 0.100 | 3.31  | 4.8   | 26.1 |
| 2                   | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 4.6                       | 0.170  | 0.100 | 6.62  | 4.8   | 26.1 |
| 3                   | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 7.9                       | 0.200  | 0.100 | 9.92  | 4.8   | 26.1 |
| 19                  | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 14.7                      | 0.073  | 0.100 | 62.85 | 4.8   | 26.1 |
| 20                  | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 25.6                      | 0.050  | 0.100 | 66.15 | 4.8   | 26.1 |
| 21                  | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 26.9                      | 0.050  | 0.100 | 69.46 | 4.8   | 26.1 |
| 22                  | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 28.1                      | 0.050  | 0.100 | 72.77 | 4.8   | 26.1 |
| 23                  | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 34.9                      | 0.050  | 0.100 | 76.08 | 4.8   | 26.1 |
| 24                  | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 63.5                      | 0.050  | 0.100 | 79.38 | 4.8   | 26.1 |
| 25                  | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 67.0                      | 0.050  | 0.100 | 82.69 | 4.8   | 26.1 |
| 26                  | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 70.5                      | 0.050  | 0.100 | 86.00 | 4.8   | 26.1 |
| Toe                 |        |        |       |       |      | 302.0                     | 0.150  | 0.100 |       |       |      |

7.669 kips total unreduced pile weight (g= 32.17 ft/s2)

7.669 kips total reduced pile weight (g= 32.17 ft/s2)

| Depth | Stroke | Pressure | Efficy |
|-------|--------|----------|--------|
| ft    | ft     | Ratio    |        |
| 84.00 | 12.04  | 1.00     | 0.800  |

Abutment 2 NB H-Pile - Delmag D25-32  
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| Rut<br>kips | Bl Ct<br>b/ft | Stroke<br>down | (ft)<br>up | Ten Str<br>ksi | i  | t  | Comp Str<br>ksi | i | t | ENTHRU<br>kip-ft | Bl Rt<br>b/min |
|-------------|---------------|----------------|------------|----------------|----|----|-----------------|---|---|------------------|----------------|
| 763.8       | 448.3         | 9.55           | 9.54       | -0.23          | 3  | 43 | 34.59           | 2 | 2 | 31.6             | 38.3           |
| 739.7       | 305.7         | 9.54           | 9.53       | -0.34          | 3  | 44 | 34.44           | 2 | 2 | 31.9             | 38.4           |
| 715.5       | 226.3         | 9.51           | 9.52       | -0.48          | 4  | 45 | 34.29           | 2 | 2 | 32.1             | 38.4           |
| 691.3       | 170.7         | 9.58           | 9.49       | -0.75          | 6  | 46 | 34.44           | 2 | 2 | 32.9             | 38.4           |
| 667.1       | 139.3         | 9.55           | 9.47       | -1.39          | 19 | 24 | 34.16           | 2 | 2 | 33.1             | 38.4           |

Abutment 2 NB H-Pile - Delmag D25-32  
HNTB Corporation

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Depth (ft) 85.0 Standard Soil Setup  
Shaft Gain/Loss Factor 1.000 Toe Gain/Loss Factor 1.000

PILE PROFILE:

Toe Area (in2) 203.230 Pile Type H Pile  
Pile Size (inch) 14.690

| L b Top | Area  | E-Mod  | Spec Wt | Perim | C Index | Wave Sp | EA/c   |
|---------|-------|--------|---------|-------|---------|---------|--------|
| ft      | in2   | ksi    | lb/ft3  | ft    |         | ft/s    | k/ft/s |
| 0.0     | 26.10 | 29000. | 492.0   | 4.8   | 0       | 16524.  | 45.8   |
| 86.0    | 26.10 | 29000. | 492.0   | 4.8   | 0       | 16524.  | 45.8   |

Wave Travel Time 2L/c (ms) 10.409

| Pile and Soil Model |        |        |       |       |      | Total Capacity Rut (kips) |        |       | 785.8 |       |      |
|---------------------|--------|--------|-------|-------|------|---------------------------|--------|-------|-------|-------|------|
| No.                 | Weight | Stiffn | C-Slk | T-Slk | CoR  | Soil-S                    | Soil-D | Quake | LbTop | Perim | Area |
|                     | kips   | k/in   | ft    | ft    |      | kips                      | s/ft   | inch  | ft    | ft    | in2  |
| 1                   | 0.295  | 19069  | 0.010 | 0.000 | 1.00 | 1.0                       | 0.056  | 0.100 | 3.31  | 4.8   | 26.1 |
| 2                   | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 6.3                       | 0.194  | 0.100 | 6.62  | 4.8   | 26.1 |
| 3                   | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 7.9                       | 0.200  | 0.100 | 9.92  | 4.8   | 26.1 |
| 18                  | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 7.9                       | 0.193  | 0.100 | 59.54 | 4.8   | 26.1 |
| 19                  | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 20.0                      | 0.052  | 0.100 | 62.85 | 4.8   | 26.1 |
| 20                  | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 25.9                      | 0.050  | 0.100 | 66.15 | 4.8   | 26.1 |
| 21                  | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 27.2                      | 0.050  | 0.100 | 69.46 | 4.8   | 26.1 |
| 22                  | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 28.5                      | 0.050  | 0.100 | 72.77 | 4.8   | 26.1 |
| 23                  | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 45.0                      | 0.050  | 0.100 | 76.08 | 4.8   | 26.1 |
| 24                  | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 64.6                      | 0.050  | 0.100 | 79.38 | 4.8   | 26.1 |
| 25                  | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 68.0                      | 0.050  | 0.100 | 82.69 | 4.8   | 26.1 |
| 26                  | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 71.5                      | 0.050  | 0.100 | 86.00 | 4.8   | 26.1 |
| Toe                 |        |        |       |       |      | 302.0                     | 0.150  | 0.100 |       |       |      |

7.669 kips total unreduced pile weight (g= 32.17 ft/s2)  
7.669 kips total reduced pile weight (g= 32.17 ft/s2)

| Depth | Stroke | Pressure | Efficy |
|-------|--------|----------|--------|
| ft    | ft     | Ratio    |        |
| 85.00 | 12.04  | 1.00     | 0.800  |

Abutment 2 NB H-Pile - Delmag D25-32  
HNTB Corporation

04/02/2020  
GRLWEAP Version 2010

| Rut<br>kips | Bl Ct<br>b/ft | Stroke<br>down | (ft)<br>up | Ten Str<br>ksi | i  | t  | Comp Str<br>ksi | i | t | ENTHRU<br>kip-ft | Bl Rt<br>b/min |
|-------------|---------------|----------------|------------|----------------|----|----|-----------------|---|---|------------------|----------------|
| 785.8       | 612.5         | 9.57           | 9.57       | -0.17          | 2  | 43 | 34.68           | 2 | 2 | 31.5             | 38.3           |
| 760.9       | 378.0         | 9.55           | 9.55       | -0.25          | 3  | 44 | 34.55           | 2 | 2 | 31.8             | 38.3           |
| 736.0       | 255.2         | 9.64           | 9.54       | -0.41          | 4  | 44 | 34.73           | 2 | 2 | 32.4             | 38.3           |
| 711.1       | 193.8         | 9.61           | 9.51       | -0.69          | 6  | 45 | 34.50           | 2 | 2 | 32.7             | 38.3           |
| 686.2       | 157.2         | 9.50           | 9.49       | -1.44          | 19 | 23 | 34.16           | 2 | 2 | 32.8             | 38.4           |

Abutment 2 NB H-Pile - Delmag D25-32  
HNTB Corporation

04/02/2020  
GRLWEAP Version 2010

Depth (ft) 86.0 Standard Soil Setup  
Shaft Gain/Loss Factor 1.000 Toe Gain/Loss Factor 1.000

PILE PROFILE:

Toe Area (in2) 203.230 Pile Type H Pile  
Pile Size (inch) 14.690

| L b Top | Area  | E-Mod  | Spec Wt | Perim | C Index | Wave Sp | EA/c   |
|---------|-------|--------|---------|-------|---------|---------|--------|
| ft      | in2   | ksi    | lb/ft3  | ft    |         | ft/s    | k/ft/s |
| 0.0     | 26.10 | 29000. | 492.0   | 4.8   | 0       | 16524.  | 45.8   |
| 86.0    | 26.10 | 29000. | 492.0   | 4.8   | 0       | 16524.  | 45.8   |

Wave Travel Time 2L/c (ms) 10.409

| Pile and Soil Model |        |        |       |       |      | Total Capacity Rut (kips) |        |       | 808.2 |       |      |
|---------------------|--------|--------|-------|-------|------|---------------------------|--------|-------|-------|-------|------|
| No.                 | Weight | Stiffn | C-Slk | T-Slk | CoR  | Soil-S                    | Soil-D | Quake | LbTop | Perim | Area |
|                     | kips   | k/in   | ft    | ft    |      | kips                      | s/ft   | inch  | ft    | ft    | in2  |
| 1                   | 0.295  | 19069  | 0.010 | 0.000 | 1.00 | 2.1                       | 0.113  | 0.100 | 3.31  | 4.8   | 26.1 |
| 2                   | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 7.6                       | 0.200  | 0.100 | 6.62  | 4.8   | 26.1 |
| 3                   | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 7.9                       | 0.200  | 0.100 | 9.92  | 4.8   | 26.1 |
| 18                  | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 8.6                       | 0.144  | 0.100 | 59.54 | 4.8   | 26.1 |
| 19                  | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 24.5                      | 0.050  | 0.100 | 62.85 | 4.8   | 26.1 |
| 20                  | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 26.3                      | 0.050  | 0.100 | 66.15 | 4.8   | 26.1 |
| 21                  | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 27.6                      | 0.050  | 0.100 | 69.46 | 4.8   | 26.1 |
| 22                  | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 28.9                      | 0.050  | 0.100 | 72.77 | 4.8   | 26.1 |
| 23                  | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 55.3                      | 0.050  | 0.100 | 76.08 | 4.8   | 26.1 |
| 24                  | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 65.6                      | 0.050  | 0.100 | 79.38 | 4.8   | 26.1 |
| 25                  | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 69.1                      | 0.050  | 0.100 | 82.69 | 4.8   | 26.1 |
| 26                  | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 72.6                      | 0.050  | 0.100 | 86.00 | 4.8   | 26.1 |
| Toe                 |        |        |       |       |      | 302.0                     | 0.150  | 0.100 |       |       |      |

7.669 kips total unreduced pile weight (g= 32.17 ft/s2)  
7.669 kips total reduced pile weight (g= 32.17 ft/s2)

| Depth | Stroke | Pressure | Efficy |
|-------|--------|----------|--------|
| ft    | ft     | Ratio    |        |
| 86.00 | 12.04  | 1.00     | 0.800  |

Abutment 2 NB H-Pile - Delmag D25-32  
HNTB Corporation

04/02/2020  
GRLWEAP Version 2010

| Rut<br>kips | Bl Ct<br>b/ft | Stroke<br>down | (ft)<br>up | Ten Str<br>ksi | i  | t  | Comp Str<br>ksi | i | t | ENTHRU<br>kip-ft | Bl Rt<br>b/min |
|-------------|---------------|----------------|------------|----------------|----|----|-----------------|---|---|------------------|----------------|
| 808.2       | 932.3         | 9.58           | 9.58       | -0.15          | 2  | 18 | 34.76           | 2 | 2 | 31.4             | 38.3           |
| 782.5       | 480.3         | 9.58           | 9.57       | -0.19          | 2  | 43 | 34.70           | 2 | 2 | 31.7             | 38.3           |
| 756.8       | 317.4         | 9.57           | 9.56       | -0.34          | 4  | 44 | 34.56           | 2 | 2 | 32.0             | 38.3           |
| 731.2       | 230.6         | 9.54           | 9.55       | -0.63          | 6  | 45 | 34.41           | 2 | 2 | 32.3             | 38.3           |
| 705.5       | 175.6         | 9.53           | 9.52       | -1.44          | 18 | 23 | 34.27           | 2 | 2 | 32.8             | 38.4           |

SUMMARY OVER DEPTHS

| G/L at Shaft and Toe: 1.000 1.000 |       |        |        |       |         |         |        |        |
|-----------------------------------|-------|--------|--------|-------|---------|---------|--------|--------|
| Depth                             | Rut   | Frictn | End Bg | Bl Ct | Com Str | Ten Str | Stroke | ENTHRU |
| ft                                | kips  | kips   | kips   | bl/ft | ksi     | ksi     | ft     | kip-ft |
| 70.0                              | 245.9 | 219.3  | 26.5   | 20.8  | 29.377  | -1.104  | 7.94   | 28.9   |
| 71.0                              | 270.7 | 228.0  | 42.8   | 23.0  | 29.822  | -0.918  | 8.09   | 28.6   |
| 72.0                              | 340.1 | 236.7  | 103.3  | 31.8  | 30.735  | -0.477  | 8.38   | 28.7   |
| 73.0                              | 409.4 | 245.6  | 163.7  | 43.9  | 31.782  | -0.505  | 8.73   | 30.0   |
| 74.0                              | 483.8 | 259.4  | 224.4  | 63.7  | 32.838  | -0.654  | 9.06   | 31.0   |
| 75.0                              | 563.3 | 278.2  | 285.1  | 97.8  | 33.785  | -0.860  | 9.33   | 31.9   |
| 76.0                              | 599.4 | 297.4  | 302.0  | 121.5 | 34.058  | -0.842  | 9.43   | 32.1   |
| 77.0                              | 618.8 | 316.8  | 302.0  | 136.0 | 34.110  | -0.742  | 9.47   | 32.2   |
| 78.0                              | 638.6 | 336.6  | 302.0  | 156.2 | 34.373  | -0.662  | 9.50   | 32.1   |
| 79.0                              | 658.7 | 356.6  | 302.0  | 183.4 | 34.280  | -0.611  | 9.43   | 31.8   |
| 80.0                              | 679.1 | 377.0  | 302.0  | 209.6 | 34.264  | -0.528  | 9.47   | 31.8   |
| 81.0                              | 699.8 | 397.7  | 302.0  | 242.5 | 34.352  | -0.433  | 9.49   | 31.8   |
| 82.0                              | 720.8 | 418.8  | 302.0  | 290.2 | 34.585  | -0.390  | 9.52   | 31.7   |
| 83.0                              | 742.2 | 440.1  | 302.0  | 356.7 | 34.579  | -0.326  | 9.53   | 31.6   |
| 84.0                              | 763.8 | 461.8  | 302.0  | 448.3 | 34.590  | -0.228  | 9.55   | 31.6   |
| 85.0                              | 785.8 | 483.8  | 302.0  | 612.5 | 34.679  | -0.174  | 9.57   | 31.5   |
| 86.0                              | 808.2 | 506.1  | 302.0  | 932.3 | 34.756  | -0.149  | 9.58   | 31.4   |

Total Driving Time 91 minutes;  
Starting at penetration 70.0 ft

Total No. of Blows 3492

| G/L at Shaft and Toe: 0.900 1.000 |       |        |        |       |         |         |        |        |
|-----------------------------------|-------|--------|--------|-------|---------|---------|--------|--------|
| Depth                             | Rut   | Frictn | End Bg | Bl Ct | Com Str | Ten Str | Stroke | ENTHRU |
| ft                                | kips  | kips   | kips   | bl/ft | ksi     | ksi     | ft     | kip-ft |
| 70.0                              | 229.8 | 203.2  | 26.5   | 18.7  | 28.975  | -1.067  | 7.80   | 29.3   |
| 71.0                              | 254.4 | 211.6  | 42.8   | 21.3  | 29.477  | -1.047  | 7.95   | 29.0   |
| 72.0                              | 323.4 | 220.1  | 103.3  | 29.2  | 30.496  | -0.030  | 8.32   | 28.8   |
| 73.0                              | 392.4 | 228.7  | 163.7  | 40.3  | 31.287  | -0.495  | 8.62   | 29.8   |
| 74.0                              | 466.4 | 242.0  | 224.4  | 57.6  | 32.457  | -0.694  | 8.98   | 30.9   |
| 75.0                              | 545.3 | 260.2  | 285.1  | 85.9  | 33.468  | -0.928  | 9.27   | 31.9   |
| 76.0                              | 580.7 | 278.7  | 302.0  | 104.4 | 33.813  | -0.935  | 9.36   | 32.1   |
| 77.0                              | 599.5 | 297.5  | 302.0  | 115.6 | 33.925  | -0.858  | 9.41   | 32.2   |
| 78.0                              | 618.6 | 316.6  | 302.0  | 129.3 | 34.150  | -0.767  | 9.46   | 32.3   |
| 79.0                              | 638.0 | 336.0  | 302.0  | 145.9 | 34.309  | -0.721  | 9.49   | 32.3   |
| 80.0                              | 657.7 | 355.7  | 302.0  | 164.3 | 34.309  | -0.648  | 9.52   | 32.3   |
| 81.0                              | 677.7 | 375.7  | 302.0  | 185.8 | 34.526  | -0.551  | 9.57   | 32.3   |
| 82.0                              | 698.1 | 396.0  | 302.0  | 219.4 | 34.441  | -0.482  | 9.49   | 32.0   |
| 83.0                              | 718.7 | 416.7  | 302.0  | 254.2 | 34.396  | -0.427  | 9.52   | 32.0   |
| 84.0                              | 739.7 | 437.6  | 302.0  | 305.7 | 34.442  | -0.341  | 9.54   | 31.9   |
| 85.0                              | 760.9 | 458.9  | 302.0  | 378.0 | 34.550  | -0.253  | 9.55   | 31.8   |
| 86.0                              | 782.5 | 480.5  | 302.0  | 480.3 | 34.700  | -0.191  | 9.58   | 31.7   |

Total Driving Time 64 minutes;  
Starting at penetration 70.0 ft

Total No. of Blows 2487



SUMMARY OVER DEPTHS

| G/L at Shaft and Toe: 0.800 1.000 |       |        |        |       |         |         |        |        |
|-----------------------------------|-------|--------|--------|-------|---------|---------|--------|--------|
| Depth                             | Rut   | Frictn | End Bg | Bl Ct | Com Str | Ten Str | Stroke | ENTHRU |
| ft                                | kips  | kips   | kips   | bl/ft | ksi     | ksi     | ft     | kip-ft |
| 70.0                              | 213.7 | 187.1  | 26.5   | 16.6  | 28.392  | -1.259  | 7.65   | 29.6   |
| 71.0                              | 238.0 | 195.2  | 42.8   | 19.5  | 28.865  | -1.026  | 7.81   | 29.3   |
| 72.0                              | 306.7 | 203.4  | 103.3  | 26.8  | 30.093  | 0.000   | 8.20   | 28.9   |
| 73.0                              | 375.4 | 211.7  | 163.7  | 37.0  | 30.959  | -0.508  | 8.52   | 29.6   |
| 74.0                              | 449.0 | 224.6  | 224.4  | 51.9  | 32.224  | -0.729  | 8.87   | 30.9   |
| 75.0                              | 527.2 | 242.1  | 285.1  | 75.7  | 33.292  | -0.964  | 9.19   | 32.0   |
| 76.0                              | 562.0 | 260.0  | 302.0  | 90.3  | 33.587  | -0.994  | 9.31   | 32.3   |
| 77.0                              | 580.1 | 278.1  | 302.0  | 99.3  | 33.691  | -0.950  | 9.34   | 32.3   |
| 78.0                              | 598.6 | 296.6  | 302.0  | 108.6 | 33.900  | -0.892  | 9.39   | 32.5   |
| 79.0                              | 617.3 | 315.3  | 302.0  | 120.9 | 34.082  | -0.840  | 9.43   | 32.5   |
| 80.0                              | 636.4 | 334.3  | 302.0  | 135.7 | 34.114  | -0.790  | 9.48   | 32.5   |
| 81.0                              | 655.7 | 353.7  | 302.0  | 151.6 | 34.330  | -0.713  | 9.52   | 32.5   |
| 82.0                              | 675.3 | 373.3  | 302.0  | 169.3 | 34.481  | -0.637  | 9.55   | 32.5   |
| 83.0                              | 695.3 | 393.2  | 302.0  | 195.8 | 34.220  | -0.560  | 9.49   | 32.2   |
| 84.0                              | 715.5 | 413.5  | 302.0  | 226.3 | 34.290  | -0.484  | 9.51   | 32.1   |
| 85.0                              | 736.0 | 434.0  | 302.0  | 255.2 | 34.728  | -0.411  | 9.64   | 32.4   |
| 86.0                              | 756.8 | 454.8  | 302.0  | 317.4 | 34.562  | -0.339  | 9.57   | 32.0   |

Total Driving Time 50 minutes;  
Starting at penetration 70.0 ft

Total No. of Blows 1931

| G/L at Shaft and Toe: 0.700 1.000 |       |        |        |       |         |         |        |        |
|-----------------------------------|-------|--------|--------|-------|---------|---------|--------|--------|
| Depth                             | Rut   | Frictn | End Bg | Bl Ct | Com Str | Ten Str | Stroke | ENTHRU |
| ft                                | kips  | kips   | kips   | bl/ft | ksi     | ksi     | ft     | kip-ft |
| 70.0                              | 197.6 | 171.0  | 26.5   | 14.5  | 27.910  | -1.471  | 7.49   | 29.9   |
| 71.0                              | 221.6 | 178.8  | 42.8   | 17.2  | 28.418  | -1.256  | 7.66   | 29.7   |
| 72.0                              | 290.0 | 186.7  | 103.3  | 24.7  | 29.669  | -0.378  | 8.08   | 29.0   |
| 73.0                              | 358.4 | 194.7  | 163.7  | 33.8  | 30.573  | -0.471  | 8.37   | 29.7   |
| 74.0                              | 431.5 | 207.1  | 224.4  | 47.2  | 31.741  | -0.747  | 8.77   | 30.8   |
| 75.0                              | 509.1 | 224.0  | 285.1  | 67.8  | 32.930  | -1.044  | 9.12   | 32.0   |
| 76.0                              | 543.3 | 241.3  | 302.0  | 79.8  | 33.326  | -1.085  | 9.23   | 32.3   |
| 77.0                              | 560.8 | 258.8  | 302.0  | 85.8  | 33.469  | -1.051  | 9.29   | 32.5   |
| 78.0                              | 578.6 | 276.5  | 302.0  | 93.5  | 33.675  | -1.020  | 9.33   | 32.5   |
| 79.0                              | 596.6 | 294.6  | 302.0  | 101.7 | 33.810  | -0.986  | 9.38   | 32.7   |
| 80.0                              | 615.0 | 313.0  | 302.0  | 112.6 | 33.880  | -0.945  | 9.42   | 32.7   |
| 81.0                              | 633.6 | 331.6  | 302.0  | 125.0 | 34.004  | -0.907  | 9.46   | 32.7   |
| 82.0                              | 652.6 | 350.5  | 302.0  | 138.8 | 34.167  | -0.864  | 9.49   | 32.7   |
| 83.0                              | 671.8 | 369.8  | 302.0  | 153.2 | 34.243  | -0.806  | 9.55   | 32.8   |
| 84.0                              | 691.3 | 389.3  | 302.0  | 170.7 | 34.439  | -0.751  | 9.58   | 32.9   |
| 85.0                              | 711.1 | 409.1  | 302.0  | 193.8 | 34.499  | -0.695  | 9.61   | 32.7   |
| 86.0                              | 731.2 | 429.2  | 302.0  | 230.6 | 34.407  | -0.634  | 9.54   | 32.3   |

Total Driving Time 40 minutes;  
Starting at penetration 70.0 ft

Total No. of Blows 1568

SUMMARY OVER DEPTHS

| G/L at Shaft and Toe: 0.600 1.000 |       |        |        |       |         |         |        |        |
|-----------------------------------|-------|--------|--------|-------|---------|---------|--------|--------|
| Depth                             | Rut   | Frictn | End Bg | Bl Ct | Com Str | Ten Str | Stroke | ENTHRU |
| ft                                | kips  | kips   | kips   | bl/ft | ksi     | ksi     | ft     | kip-ft |
| 70.0                              | 181.5 | 154.9  | 26.5   | 12.6  | 27.287  | -1.893  | 7.32   | 30.4   |
| 71.0                              | 205.2 | 162.4  | 42.8   | 15.1  | 27.945  | -1.433  | 7.50   | 30.0   |
| 72.0                              | 273.3 | 170.0  | 103.3  | 22.6  | 29.268  | -0.800  | 7.95   | 29.2   |
| 73.0                              | 341.5 | 177.7  | 163.7  | 31.0  | 30.149  | -0.458  | 8.24   | 29.6   |
| 74.0                              | 414.1 | 189.7  | 224.4  | 42.6  | 31.514  | -0.929  | 8.67   | 31.0   |
| 75.0                              | 491.1 | 206.0  | 285.1  | 60.7  | 32.570  | -1.326  | 9.02   | 32.1   |
| 76.0                              | 524.6 | 222.6  | 302.0  | 70.0  | 33.065  | -1.378  | 9.17   | 32.6   |
| 77.0                              | 541.4 | 239.4  | 302.0  | 75.3  | 33.215  | -1.344  | 9.22   | 32.7   |
| 78.0                              | 558.6 | 256.5  | 302.0  | 80.7  | 33.425  | -1.311  | 9.28   | 32.8   |
| 79.0                              | 576.0 | 273.9  | 302.0  | 87.7  | 33.579  | -1.281  | 9.32   | 32.8   |
| 80.0                              | 593.6 | 291.6  | 302.0  | 95.0  | 33.625  | -1.314  | 9.37   | 32.9   |
| 81.0                              | 611.6 | 309.6  | 302.0  | 104.1 | 33.805  | -1.345  | 9.41   | 32.9   |
| 82.0                              | 629.8 | 327.8  | 302.0  | 113.6 | 34.032  | -1.390  | 9.46   | 33.1   |
| 83.0                              | 648.3 | 346.3  | 302.0  | 126.3 | 34.139  | -1.381  | 9.51   | 33.1   |
| 84.0                              | 667.1 | 365.1  | 302.0  | 139.3 | 34.162  | -1.393  | 9.55   | 33.1   |
| 85.0                              | 686.2 | 384.2  | 302.0  | 157.2 | 34.158  | -1.440  | 9.50   | 32.8   |
| 86.0                              | 705.5 | 403.5  | 302.0  | 175.6 | 34.266  | -1.439  | 9.53   | 32.8   |

Total Driving Time 34 minutes;  
Starting at penetration 70.0 ft

Total No. of Blows 1316

Table of Depths Analyzed with Driving System Modifiers

| Depth | Temp.<br>Length | Wait<br>Time | Equivalent<br>Stroke | Pressure<br>Ratio | Efficy. | Stiffn.<br>Factor | Cushion<br>CoR |
|-------|-----------------|--------------|----------------------|-------------------|---------|-------------------|----------------|
| ft    | ft              | hr           | ft                   |                   |         |                   |                |
| 70.00 | 86.00           | 0.00         | 12.04                | 1.00              | 0.80    | 1.00              | 1.00           |
| 71.00 | 86.00           | 0.00         | 12.04                | 1.00              | 0.80    | 1.00              | 1.00           |
| 72.00 | 86.00           | 0.00         | 12.04                | 1.00              | 0.80    | 1.00              | 1.00           |
| 73.00 | 86.00           | 0.00         | 12.04                | 1.00              | 0.80    | 1.00              | 1.00           |
| 74.00 | 86.00           | 0.00         | 12.04                | 1.00              | 0.80    | 1.00              | 1.00           |
| 75.00 | 86.00           | 0.00         | 12.04                | 1.00              | 0.80    | 1.00              | 1.00           |
| 76.00 | 86.00           | 0.00         | 12.04                | 1.00              | 0.80    | 1.00              | 1.00           |
| 77.00 | 86.00           | 0.00         | 12.04                | 1.00              | 0.80    | 1.00              | 1.00           |
| 78.00 | 86.00           | 0.00         | 12.04                | 1.00              | 0.80    | 1.00              | 1.00           |
| 79.00 | 86.00           | 0.00         | 12.04                | 1.00              | 0.80    | 1.00              | 1.00           |
| 80.00 | 86.00           | 0.00         | 12.04                | 1.00              | 0.80    | 1.00              | 1.00           |
| 81.00 | 86.00           | 0.00         | 12.04                | 1.00              | 0.80    | 1.00              | 1.00           |
| 82.00 | 86.00           | 0.00         | 12.04                | 1.00              | 0.80    | 1.00              | 1.00           |
| 83.00 | 86.00           | 0.00         | 12.04                | 1.00              | 0.80    | 1.00              | 1.00           |
| 84.00 | 86.00           | 0.00         | 12.04                | 1.00              | 0.80    | 1.00              | 1.00           |
| 85.00 | 86.00           | 0.00         | 12.04                | 1.00              | 0.80    | 1.00              | 1.00           |
| 86.00 | 86.00           | 0.00         | 12.04                | 1.00              | 0.80    | 1.00              | 1.00           |

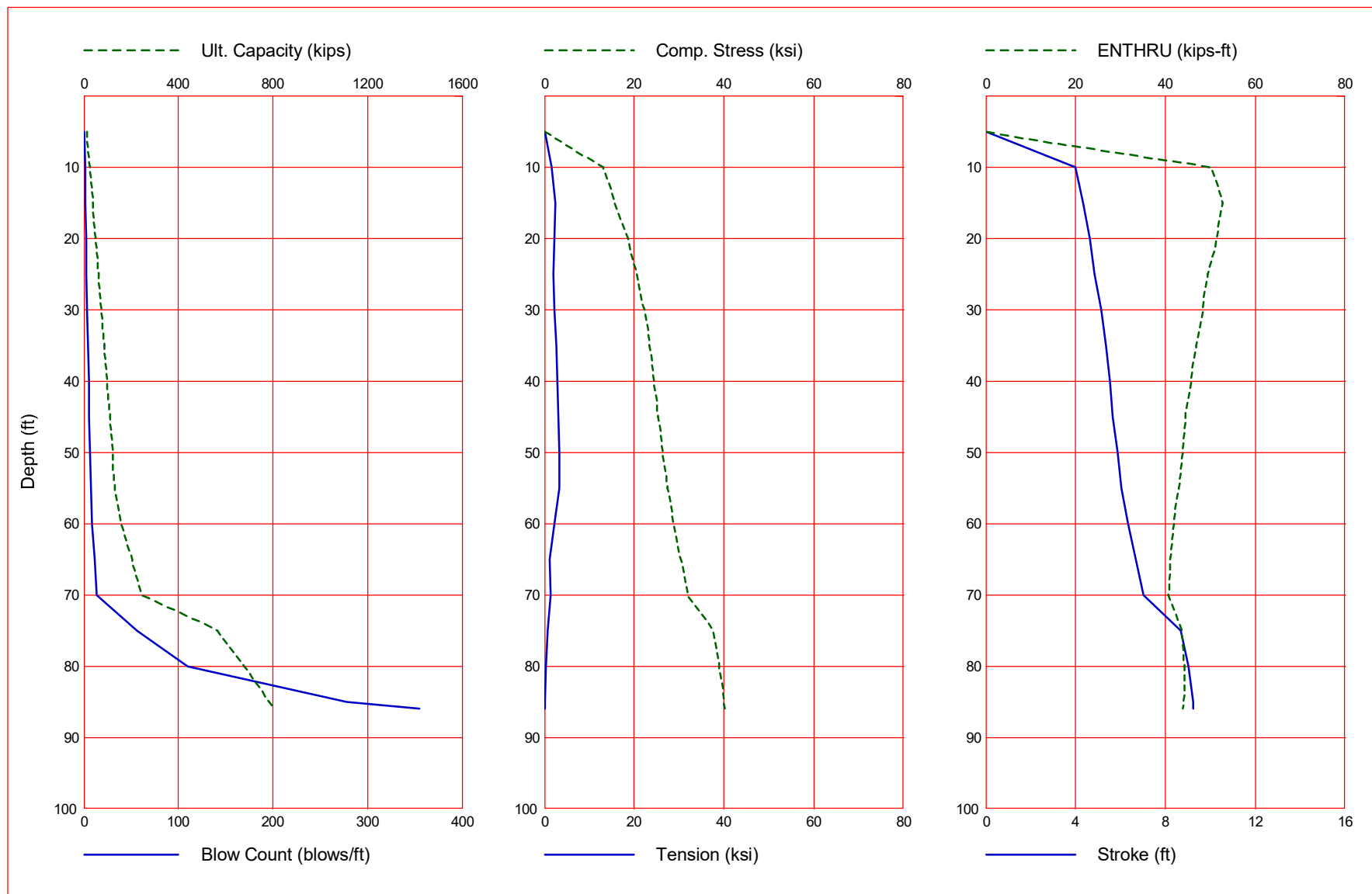
Soil Layer Resistance Values

| Depth | Shaft<br>Res. | End<br>Bearing | Shaft<br>Quake | Toe<br>Quake | Shaft<br>Damping | Toe<br>Damping | Soil<br>Setup | Limit<br>Distance | Setup<br>Time |
|-------|---------------|----------------|----------------|--------------|------------------|----------------|---------------|-------------------|---------------|
| ft    | k/ft2         | kips           | inch           | inch         | s/ft             | s/ft           | Normlzd       | ft                | hrs           |
| 0.00  | 0.00          | 3.10           | 0.100          | 0.100        | 0.050            | 0.150          | 0.333         | 6.560             | 1.000         |
| 1.00  | 0.08          | 5.36           | 0.100          | 0.100        | 0.050            | 0.150          | 0.333         | 6.560             | 1.000         |
| 2.00  | 0.16          | 7.34           | 0.100          | 0.100        | 0.050            | 0.150          | 0.333         | 6.560             | 1.000         |
| 3.00  | 0.24          | 9.60           | 0.100          | 0.100        | 0.200            | 0.150          | 1.000         | 6.560             | 1.000         |
| 4.00  | 0.50          | 10.16          | 0.100          | 0.100        | 0.200            | 0.150          | 1.000         | 6.560             | 1.000         |
| 5.00  | 0.50          | 9.31           | 0.100          | 0.100        | 0.200            | 0.150          | 1.000         | 6.560             | 1.000         |
| 6.00  | 0.50          | 8.89           | 0.100          | 0.100        | 0.200            | 0.150          | 1.000         | 6.560             | 1.000         |
| 7.00  | 0.50          | 8.89           | 0.100          | 0.100        | 0.200            | 0.150          | 1.000         | 6.560             | 1.000         |
| 8.00  | 0.50          | 8.89           | 0.100          | 0.100        | 0.200            | 0.150          | 1.000         | 6.560             | 1.000         |
| 9.00  | 0.50          | 8.89           | 0.100          | 0.100        | 0.200            | 0.150          | 1.000         | 6.560             | 1.000         |
| 10.00 | 0.50          | 8.89           | 0.100          | 0.100        | 0.200            | 0.150          | 1.000         | 6.560             | 1.000         |
| 11.00 | 0.50          | 8.89           | 0.100          | 0.100        | 0.200            | 0.150          | 1.000         | 6.560             | 1.000         |
| 12.00 | 0.50          | 8.89           | 0.100          | 0.100        | 0.200            | 0.150          | 1.000         | 6.560             | 1.000         |
| 13.00 | 0.50          | 8.89           | 0.100          | 0.100        | 0.200            | 0.150          | 1.000         | 6.560             | 1.000         |
| 14.00 | 0.50          | 8.89           | 0.100          | 0.100        | 0.200            | 0.150          | 1.000         | 6.560             | 1.000         |
| 15.00 | 0.50          | 8.89           | 0.100          | 0.100        | 0.200            | 0.150          | 1.000         | 6.560             | 1.000         |
| 16.00 | 0.50          | 8.89           | 0.100          | 0.100        | 0.200            | 0.150          | 1.000         | 6.560             | 1.000         |
| 17.00 | 0.50          | 8.89           | 0.100          | 0.100        | 0.200            | 0.150          | 1.000         | 6.560             | 1.000         |
| 18.00 | 0.50          | 8.89           | 0.100          | 0.100        | 0.200            | 0.150          | 1.000         | 6.560             | 1.000         |
| 19.00 | 0.50          | 8.89           | 0.100          | 0.100        | 0.200            | 0.150          | 1.000         | 6.560             | 1.000         |
| 20.00 | 0.50          | 8.89           | 0.100          | 0.100        | 0.200            | 0.150          | 1.000         | 6.560             | 1.000         |
| 21.00 | 0.50          | 8.89           | 0.100          | 0.100        | 0.200            | 0.150          | 1.000         | 6.560             | 1.000         |
| 22.00 | 0.50          | 8.89           | 0.100          | 0.100        | 0.200            | 0.150          | 1.000         | 6.560             | 1.000         |
| 23.00 | 0.50          | 8.89           | 0.100          | 0.100        | 0.200            | 0.150          | 1.000         | 6.560             | 1.000         |
| 24.00 | 0.50          | 8.89           | 0.100          | 0.100        | 0.200            | 0.150          | 1.000         | 6.560             | 1.000         |
| 25.00 | 0.50          | 8.89           | 0.100          | 0.100        | 0.200            | 0.150          | 1.000         | 6.560             | 1.000         |

[illegible]

|       |      |        |       |       |       |       |       |       |       |
|-------|------|--------|-------|-------|-------|-------|-------|-------|-------|
| 85.00 | 4.66 | 302.02 | 0.100 | 0.100 | 0.050 | 0.150 | 0.333 | 6.560 | 1.000 |
| 86.00 | 4.73 | 302.02 | 0.100 | 0.100 | 0.050 | 0.150 | 0.333 | 6.560 | 1.000 |

Gain/Loss 1 at Shaft and Toe 1.000 / 1.000



Gain/Loss 1 at Shaft and Toe 1.000 / 1.000

| Depth<br>ft | Ultimate<br>Capacity<br>kips | Friction<br>kips | End<br>Bearing<br>kips | Blow<br>Count<br>blows/ft | Comp.<br>Stress<br>ksi | Tension<br>Stress<br>ksi | Stroke<br>ft | ENTHRU<br>kips-ft |
|-------------|------------------------------|------------------|------------------------|---------------------------|------------------------|--------------------------|--------------|-------------------|
| 5.0         | 15.2                         | 5.8              | 9.3                    | -1.0                      | 0.000                  | 0.000                    | 0.00         | 0.0               |
| 10.0        | 26.6                         | 17.7             | 8.9                    | 1.5                       | 13.147                 | -1.705                   | 3.98         | 50.3              |
| 15.0        | 38.5                         | 29.6             | 8.9                    | 1.9                       | 15.687                 | -2.371                   | 4.35         | 52.8              |
| 20.0        | 50.4                         | 41.5             | 8.9                    | 2.3                       | 18.757                 | -2.247                   | 4.63         | 51.6              |
| 25.0        | 62.3                         | 53.4             | 8.9                    | 2.9                       | 20.555                 | -2.021                   | 4.85         | 49.4              |
| 30.0        | 74.2                         | 65.3             | 8.9                    | 3.6                       | 22.234                 | -2.219                   | 5.13         | 48.3              |
| 35.0        | 86.0                         | 77.2             | 8.9                    | 4.3                       | 23.447                 | -2.636                   | 5.34         | 46.9              |
| 40.0        | 97.9                         | 89.0             | 8.9                    | 5.1                       | 24.506                 | -2.889                   | 5.53         | 45.8              |
| 45.0        | 109.8                        | 100.9            | 8.9                    | 5.9                       | 25.300                 | -3.030                   | 5.67         | 44.4              |
| 50.0        | 121.7                        | 112.8            | 8.9                    | 6.7                       | 26.367                 | -3.234                   | 5.87         | 43.8              |
| 55.0        | 133.6                        | 124.7            | 8.9                    | 7.4                       | 27.388                 | -3.400                   | 6.05         | 43.0              |
| 60.0        | 160.7                        | 139.1            | 21.6                   | 8.9                       | 28.781                 | -2.289                   | 6.35         | 41.9              |
| 65.0        | 204.3                        | 177.8            | 26.5                   | 11.3                      | 30.422                 | -1.177                   | 6.68         | 41.1              |
| 70.0        | 245.9                        | 219.3            | 26.5                   | 13.8                      | 31.788                 | -1.442                   | 7.02         | 40.7              |
| 75.0        | 563.3                        | 278.2            | 285.1                  | 56.3                      | 37.620                 | -0.698                   | 8.68         | 43.6              |
| 80.0        | 679.1                        | 377.0            | 302.0                  | 109.4                     | 38.907                 | -0.417                   | 9.03         | 44.2              |
| 85.0        | 785.8                        | 483.8            | 302.0                  | 278.4                     | 40.088                 | -0.136                   | 9.23         | 44.1              |
| 86.0        | 808.2                        | 506.1            | 302.0                  | 355.4                     | 40.137                 | -0.080                   | 9.22         | 43.8              |

Total Continuous Driving Time 55.00 minutes; Total Number of Blows 2217 (starting at penetration 5.0 ft)

GRLWEAP - Version 2010  
WAVE EQUATION ANALYSIS OF PILE FOUNDATIONS

written by GRL Engineers, Inc. (formerly Goble Rausche Likins  
and Associates, Inc.) with cooperation from Pile Dynamics, Inc.  
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ABOUT THE WAVE EQUATION ANALYSIS RESULTS

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

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

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

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

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



Input File: T:\75297 MAINEDOT\_I-295 VERANDA FINAL DESIGN\GEOTECH\CALCS\DEEP FOUNDATIONS\PILES\2020-02-21 DRIVEABILITY ANALYSIS\GRLWEAP\90 K-FT DELMAG D 36-32 \ABUTMENT 2 NB PILES DRIVEABILITY 2020-02-21.GWW  
 Hammer File: C:\ProgramData\PDI\GRLWEAP\2010\Resource\HAMMER2010.GW  
 Hammer File Version: 2003 (12/4/2018)

# Input File Contents

## Abutment 2 NB H-Pile- Delmag D36-32

| OUT               | OSG | HAM         | STR | FUL                               | PEL | N                 | SPL | N-U       | P-D | %SK       | ISM | 0         | PHI | RSA      | ITR | H-D  | MXT | DEx   |  |
|-------------------|-----|-------------|-----|-----------------------------------|-----|-------------------|-----|-----------|-----|-----------|-----|-----------|-----|----------|-----|------|-----|-------|--|
| -100              | 0   | 20          | 0   | 1                                 | 0   | 0                 | 0   | 0         | 3   | 0         | 0   | 0         | 0   | 0        | 0   | 0    | 0   | 0.000 |  |
| Pile g            |     | Hammer g    |     | Toe Area                          |     | Pile Size         |     | Pile Type |     |           |     |           |     |          |     |      |     |       |  |
| 32.170            |     | 32.170      |     | 203.230                           |     | 14.690            |     | H Pile    |     |           |     |           |     |          |     |      |     |       |  |
| W Cp              |     | A Cp        |     | E Cp                              |     | T Cp              |     | CoR       |     | ROut      |     | StCp      |     |          |     |      |     |       |  |
| 1.900             |     | 227.000     |     | 530.0                             |     | 2.000             |     | 0.800     |     | 0.010     |     | 0.0       |     |          |     |      |     |       |  |
| A Cu              |     | E Cu        |     | T Cu                              |     | CoR               |     | ROut      |     | StCu      |     |           |     |          |     |      |     |       |  |
| 0.000             |     | 0.0         |     | 0.000                             |     | 0.000             |     | 0.000     |     | 0.0       |     |           |     |          |     |      |     |       |  |
| LPle              |     | APle        |     | EPle                              |     | WPle              |     | Peri      |     | CI        |     | CoR       |     | ROut     |     |      |     |       |  |
| 86.000            |     | 26.10       |     | 29000.0                           |     | 492.000           |     | 4.754     |     | 0         |     | 1.000     |     | 0.010    |     |      |     |       |  |
| FFatigue          |     | F0          |     | 0-Bottom                          |     |                   |     |           |     |           |     |           |     |          |     |      |     |       |  |
| 0                 |     | 0.000       |     | 0.000                             |     |                   |     |           |     |           |     |           |     |          |     |      |     |       |  |
| Manufac           |     | Hmr Name    |     | HmrType                           |     | No                |     | Seg-s     |     |           |     |           |     |          |     |      |     |       |  |
| DELMAG            |     | D 36-32     |     | 1                                 |     | 4                 |     |           |     |           |     |           |     |          |     |      |     |       |  |
| Ram Wt            |     | Ram L       |     | Ram Dia                           |     | MaxStrk           |     | RtdStrk   |     | Efficy    |     |           |     |          |     |      |     |       |  |
| 7.93              |     | 106.90      |     | 19.66                             |     | 13.14             |     | 11.42     |     | 0.80      |     |           |     |          |     |      |     |       |  |
| IB. Wt            |     | IB. L       |     | IB.Dia                            |     | IB CoR            |     | IB RO     |     |           |     |           |     |          |     |      |     |       |  |
| 2.27              |     | 33.30       |     | 19.66                             |     | 0.900             |     | 0.010     |     |           |     |           |     |          |     |      |     |       |  |
| CompStrk          |     | A Chamber   |     | V Chamber                         |     | C Delay           |     | C Duratn  |     | Exp Coeff |     | VolCStart |     | Vol      |     | CEnd |     |       |  |
| 14.80             |     | 304.30      |     | 355.80                            |     | 0.0010            |     | 0.0020    |     | 1.250     |     | 0.00      |     | 0.00     |     |      |     |       |  |
| P atm             |     | P1          |     | P2                                |     | P3                |     | P4        |     | P5        |     |           |     |          |     |      |     |       |  |
| 14.70             |     | 1500.00     |     | 1350.00                           |     | 1215.00           |     | 1095.00   |     | 0.00      |     |           |     |          |     |      |     |       |  |
| Stroke            |     | Effic.      |     | Pressure                          |     | R-Weight          |     | T-Delay   |     | Exp-Coeff |     | Eps-Str   |     | Total-AW |     |      |     |       |  |
| 11.4200           |     | 0.8000      |     | 1500.0000                         |     | 0.0000            |     | 0.0000    |     | 0.0000    |     | 0.0100    |     | 0.0000   |     |      |     |       |  |
| Qs                |     | Qt          |     | Js                                |     | Jt                |     | Qx        |     | Jx        |     | Rati      |     | Dept     |     |      |     |       |  |
| 0.000             |     | 0.000       |     | 0.000                             |     | 0.000             |     | 0.000     |     | 0.000     |     | 0.000     |     | 0.000    |     |      |     |       |  |
| Research          |     | Soil Model: |     | Atoe, Plug,                       |     | Gap,              |     | Q-fac     |     |           |     |           |     |          |     |      |     |       |  |
| 0.000             |     | 0.000       |     | 0.000                             |     | 0.000             |     |           |     |           |     |           |     |          |     |      |     |       |  |
| Research          |     | Soil Model: |     | RD-skn: m, d,                     |     | toe: m, d         |     |           |     |           |     |           |     |          |     |      |     |       |  |
| 0.000             |     | 0.000       |     | 0.000                             |     |                   |     |           |     |           |     |           |     |          |     |      |     |       |  |
| Research          |     | Toe Plug:   |     | Res-int, Q-int, D-int,            |     | Res-plug, Q-plug, |     | D-plug    |     |           |     |           |     |          |     |      |     |       |  |
| 0.000             |     | 0.000       |     | 0.000                             |     | 0.000             |     | 0.000     |     |           |     |           |     |          |     |      |     |       |  |
| Research          |     | Toe Plug:   |     | RD plug toe: m, d                 |     |                   |     |           |     |           |     |           |     |          |     |      |     |       |  |
| 0.000             |     | 0.000       |     |                                   |     |                   |     |           |     |           |     |           |     |          |     |      |     |       |  |
| Research          |     | Toe Plug:   |     | New Toe Plug Model is NOT applied |     |                   |     |           |     |           |     |           |     |          |     |      |     |       |  |
| Res. Distribution |     |             |     |                                   |     |                   |     |           |     |           |     |           |     |          |     |      |     |       |  |
| Dpth              |     | Rskn        |     | Rtoe                              |     | Qs                |     | Qt        |     | Js        |     | Jt        |     | SU F     |     | LimL |     | TSf0  |  |
| 0.00              |     | 0.00        |     | 3.10                              |     | 0.10              |     | 0.10      |     | 0.05      |     | 0.15      |     | 1.20     |     | 6.56 |     | 1.000 |  |
| 1.00              |     | 0.08        |     | 5.36                              |     | 0.10              |     | 0.10      |     | 0.05      |     | 0.15      |     | 1.20     |     | 6.56 |     | 1.000 |  |
| 2.00              |     | 0.16        |     | 7.34                              |     | 0.10              |     | 0.10      |     | 0.05      |     | 0.15      |     | 1.20     |     | 6.56 |     | 1.000 |  |
| 3.00              |     | 0.24        |     | 9.60                              |     | 0.10              |     | 0.10      |     | 0.20      |     | 0.15      |     | 2.00     |     | 6.56 |     | 1.000 |  |
| 4.00              |     | 0.50        |     | 10.16                             |     | 0.10              |     | 0.10      |     | 0.20      |     | 0.15      |     | 2.00     |     | 6.56 |     | 1.000 |  |
| 5.00              |     | 0.50        |     | 9.31                              |     | 0.10              |     | 0.10      |     | 0.20      |     | 0.15      |     | 2.00     |     | 6.56 |     | 1.000 |  |
| 6.00              |     | 0.50        |     | 8.89                              |     | 0.10              |     | 0.10      |     | 0.20      |     | 0.15      |     | 2.00     |     | 6.56 |     | 1.000 |  |
| 7.00              |     | 0.50        |     | 8.89                              |     | 0.10              |     | 0.10      |     | 0.20      |     | 0.15      |     | 2.00     |     | 6.56 |     | 1.000 |  |
| 8.00              |     | 0.50        |     | 8.89                              |     | 0.10              |     | 0.10      |     | 0.20      |     | 0.15      |     | 2.00     |     | 6.56 |     | 1.000 |  |
| 9.00              |     | 0.50        |     | 8.89                              |     | 0.10              |     | 0.10      |     | 0.20      |     | 0.15      |     | 2.00     |     | 6.56 |     | 1.000 |  |
| 10.00             |     | 0.50        |     | 8.89                              |     | 0.10              |     | 0.10      |     | 0.20      |     | 0.15      |     | 2.00     |     | 6.56 |     | 1.000 |  |
| 11.00             |     | 0.50        |     | 8.89                              |     | 0.10              |     | 0.10      |     | 0.20      |     | 0.15      |     | 2.00     |     | 6.56 |     | 1.000 |  |
| 12.00             |     | 0.50        |     | 8.89                              |     | 0.10              |     | 0.10      |     | 0.20      |     | 0.15      |     | 2.00     |     | 6.56 |     | 1.000 |  |

[illegible]

|       |      |        |      |      |      |      |      |      |       |
|-------|------|--------|------|------|------|------|------|------|-------|
| 72.00 | 1.86 | 103.31 | 0.10 | 0.10 | 0.05 | 0.15 | 1.20 | 6.56 | 1.000 |
| 73.00 | 1.88 | 163.71 | 0.10 | 0.10 | 0.05 | 0.15 | 1.20 | 6.56 | 1.000 |
| 74.00 | 3.92 | 224.40 | 0.10 | 0.10 | 0.05 | 0.15 | 1.20 | 6.56 | 1.000 |
| 75.00 | 3.99 | 285.09 | 0.10 | 0.10 | 0.05 | 0.15 | 1.20 | 6.56 | 1.000 |
| 76.00 | 4.06 | 302.02 | 0.10 | 0.10 | 0.05 | 0.15 | 1.20 | 6.56 | 1.000 |
| 77.00 | 4.12 | 302.02 | 0.10 | 0.10 | 0.05 | 0.15 | 1.20 | 6.56 | 1.000 |
| 78.00 | 4.19 | 302.02 | 0.10 | 0.10 | 0.05 | 0.15 | 1.20 | 6.56 | 1.000 |
| 79.00 | 4.26 | 302.02 | 0.10 | 0.10 | 0.05 | 0.15 | 1.20 | 6.56 | 1.000 |
| 80.00 | 4.32 | 302.02 | 0.10 | 0.10 | 0.05 | 0.15 | 1.20 | 6.56 | 1.000 |
| 81.00 | 4.39 | 302.02 | 0.10 | 0.10 | 0.05 | 0.15 | 1.20 | 6.56 | 1.000 |
| 82.00 | 4.46 | 302.02 | 0.10 | 0.10 | 0.05 | 0.15 | 1.20 | 6.56 | 1.000 |
| 83.00 | 4.53 | 302.02 | 0.10 | 0.10 | 0.05 | 0.15 | 1.20 | 6.56 | 1.000 |
| 84.00 | 4.59 | 302.02 | 0.10 | 0.10 | 0.05 | 0.15 | 1.20 | 6.56 | 1.000 |
| 85.00 | 4.66 | 302.02 | 0.10 | 0.10 | 0.05 | 0.15 | 1.20 | 6.56 | 1.000 |
| 86.00 | 4.73 | 302.02 | 0.10 | 0.10 | 0.05 | 0.15 | 1.20 | 6.56 | 1.000 |

Gain/Loss factors: shaft and toe

|         |         |         |         |         |
|---------|---------|---------|---------|---------|
| 1.00000 | 0.90000 | 0.80000 | 0.70000 | 0.60000 |
| 1.00000 | 1.00000 | 1.00000 | 1.00000 | 1.00000 |

| Dpth  | L    | Wait | Strk  | Pmx% | Eff.  | Stff  | CoR   |
|-------|------|------|-------|------|-------|-------|-------|
| 5.00  | 0.00 | 0.00 | 0.000 | 0.0  | 0.000 | 0.000 | 0.000 |
| 10.00 | 0.00 | 0.00 | 0.000 | 0.0  | 0.000 | 0.000 | 0.000 |
| 15.00 | 0.00 | 0.00 | 0.000 | 0.0  | 0.000 | 0.000 | 0.000 |
| 20.00 | 0.00 | 0.00 | 0.000 | 0.0  | 0.000 | 0.000 | 0.000 |
| 25.00 | 0.00 | 0.00 | 0.000 | 0.0  | 0.000 | 0.000 | 0.000 |
| 30.00 | 0.00 | 0.00 | 0.000 | 0.0  | 0.000 | 0.000 | 0.000 |
| 35.00 | 0.00 | 0.00 | 0.000 | 0.0  | 0.000 | 0.000 | 0.000 |
| 40.00 | 0.00 | 0.00 | 0.000 | 0.0  | 0.000 | 0.000 | 0.000 |
| 45.00 | 0.00 | 0.00 | 0.000 | 0.0  | 0.000 | 0.000 | 0.000 |
| 50.00 | 0.00 | 0.00 | 0.000 | 0.0  | 0.000 | 0.000 | 0.000 |
| 55.00 | 0.00 | 0.00 | 0.000 | 0.0  | 0.000 | 0.000 | 0.000 |
| 60.00 | 0.00 | 0.00 | 0.000 | 0.0  | 0.000 | 0.000 | 0.000 |
| 65.00 | 0.00 | 0.00 | 0.000 | 0.0  | 0.000 | 0.000 | 0.000 |
| 70.00 | 0.00 | 0.00 | 0.000 | 0.0  | 0.000 | 0.000 | 0.000 |
| 75.00 | 0.00 | 0.00 | 0.000 | 0.0  | 0.000 | 0.000 | 0.000 |
| 80.00 | 0.00 | 0.00 | 0.000 | 0.0  | 0.000 | 0.000 | 0.000 |
| 85.00 | 0.00 | 0.00 | 0.000 | 0.0  | 0.000 | 0.000 | 0.000 |
| 86.00 | 0.00 | 0.00 | 0.000 | 0.0  | 0.000 | 0.000 | 0.000 |
| 0.00  | 0.00 | 0.00 | 0.000 | 0.0  | 0.000 | 0.000 | 0.000 |

GRLWEAP: WAVE EQUATION ANALYSIS OF PILE FOUNDATIONS  
Version 2010  
English Units

Abutment 2 NB H-Pile- Delmag D36-32

|                   |                |                  |        |
|-------------------|----------------|------------------|--------|
| Hammer Model:     | D 36-32        | Made by:         | DELMAG |
| No.               | Weight<br>kips | Stiffn<br>k/inch | CoR    |
| 1                 | 1.982          |                  |        |
| 2                 | 1.982          | 329410.3         | 1.000  |
| 3                 | 1.982          | 329410.3         | 1.000  |
| 4                 | 1.982          | 329410.3         | 1.000  |
| Imp Block         | 2.270          | 146663.7         | 0.900  |
| Helmet            | 1.900          | 60155.0          | 0.800  |
| Combined Pile Top |                | 19069.2          |        |

HAMMER OPTIONS:

|                    |           |                          |           |
|--------------------|-----------|--------------------------|-----------|
| Hammer File ID No. | 20        | Hammer Type              | OE Diesel |
| Stroke Option      | FxdP-VarS | Stroke Convergence Crit. | 0.010     |
| Fuel Pump Setting  | Maximum   |                          |           |

HAMMER DATA:

|                      |        |         |                    |        |         |
|----------------------|--------|---------|--------------------|--------|---------|
| Ram Weight           | (kips) | 7.93    | Ram Length         | (inch) | 106.90  |
| Maximum Stroke       | (ft)   | 13.14   |                    |        |         |
| Rated Stroke         | (ft)   | 11.42   | Efficiency         |        | 0.800   |
| Maximum Pressure     | (psi)  | 1500.00 | Actual Pressure    | (psi)  | 1500.00 |
| Compression Exponent |        | 1.350   | Expansion Exponent |        | 1.250   |
| Ram Diameter         | (inch) | 19.66   |                    |        |         |
| Combustion Delay     | (s)    | 0.00100 | Ignition Duration  | (s)    | 0.00200 |

The Hammer Data Includes Estimated (NON-MEASURED) Quantities

HAMMER CUSHION

|                      |           |         |
|----------------------|-----------|---------|
| Cross Sect. Area     | (in2)     | 227.00  |
| Elastic-Modulus      | (ksi)     | 530.0   |
| Thickness            | (inch)    | 2.00    |
| Coeff of Restitution |           | 0.8     |
| RoundOut             | (ft)      | 0.0     |
| Stiffness            | (kips/in) | 60155.0 |

PILE CUSHION

|                      |           |      |
|----------------------|-----------|------|
| Cross Sect. Area     | (in2)     | 0.00 |
| Elastic-Modulus      | (ksi)     | 0.0  |
| Thickness            | (inch)    | 0.00 |
| Coeff of Restitution |           | 1.0  |
| RoundOut             | (ft)      | 0.0  |
| Stiffness            | (kips/in) | 0.0  |

Abutment 2 NB H-Pile- Delmag D36-32  
HNTB Corporation

04/02/2020  
GRLWEAP Version 2010

Depth (ft) 5.0 Standard Soil Setup  
Shaft Gain/Loss Factor 1.000 Toe Gain/Loss Factor 1.000

PILE PROFILE:

Toe Area (in2) 203.230 Pile Type H Pile  
Pile Size (inch) 14.690

| L b Top | Area  | E-Mod  | Spec Wt | Perim | C Index | Wave Sp | EA/c   |
|---------|-------|--------|---------|-------|---------|---------|--------|
| ft      | in2   | ksi    | lb/ft3  | ft    |         | ft/s    | k/ft/s |
| 0.0     | 26.10 | 29000. | 492.0   | 4.8   | 0       | 16524.  | 45.8   |
| 86.0    | 26.10 | 29000. | 492.0   | 4.8   | 0       | 16524.  | 45.8   |

Wave Travel Time 2L/c (ms) 10.409

| Pile and Soil Model |        |        |       |       |      | Total Capacity Rut (kips) |        |       | 15.2  |       |      |
|---------------------|--------|--------|-------|-------|------|---------------------------|--------|-------|-------|-------|------|
| No.                 | Weight | Stiffn | C-Slk | T-Slk | CoR  | Soil-S                    | Soil-D | Quake | LbTop | Perim | Area |
|                     | kips   | k/in   | ft    | ft    |      | kips                      | s/ft   | inch  | ft    | ft    | in2  |
| 1                   | 0.295  | 19069  | 0.010 | 0.000 | 1.00 | 0.0                       | 0.000  | 0.100 | 3.31  | 4.8   | 26.1 |
| 2                   | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 0.0                       | 0.000  | 0.100 | 6.62  | 4.8   | 26.1 |
| 25                  | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 0.5                       | 0.050  | 0.100 | 82.69 | 4.8   | 26.1 |
| 26                  | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 5.3                       | 0.180  | 0.100 | 86.00 | 4.8   | 26.1 |
| Toe                 |        |        |       |       |      | 9.3                       | 0.150  | 0.100 |       |       |      |

7.669 kips total unreduced pile weight (g= 32.17 ft/s2)

7.669 kips total reduced pile weight (g= 32.17 ft/s2)

PILE, SOIL, ANALYSIS OPTIONS:

Uniform pile  
No. of Slacks/Splices 0  
Pile Segments: Automatic  
Pile Damping (%) 3  
Pile Damping Fact. (k/ft/s) 2.748

Driveability Analysis

Soil Damping Option Smith  
Max No Analysis Iterations 0 Time Increment/Critical 160  
Output Time Interval 1 Analysis Time-Input (ms) 0  
Output Level: Normal

Gravity Mass, Pile, Hammer: 32.170 32.170 32.170

Output Segment Generation: Automatic

| Depth | Stroke | Pressure | Efficy |
|-------|--------|----------|--------|
| ft    | ft     | Ratio    |        |
| 5.00  | 11.42  | 1.00     | 0.800  |

\*\*\* CAUTION: RAM MIGHT BLOW OUT; Combustion pressure was reduced \*\*\*

Abutment 2 NB H-Pile- Delmag D36-32  
HNTB Corporation

04/02/2020  
GRLWEAP Version 2010

| Rut<br>kips | Bl Ct<br>b/ft | Stroke<br>down | (ft)<br>up | Ten<br>ksi | Str<br>ksi | i | t | Comp | Str<br>ksi | i | t | ENTHRU<br>kip-ft | Bl Rt<br>b/min |
|-------------|---------------|----------------|------------|------------|------------|---|---|------|------------|---|---|------------------|----------------|
| 15.2        | Hammer        | did not        | run        |            |            |   |   |      |            |   |   |                  |                |
| 14.7        | Hammer        | did not        | run        |            |            |   |   |      |            |   |   |                  |                |
| 14.2        | Hammer        | did not        | run        |            |            |   |   |      |            |   |   |                  |                |
| 13.7        | Hammer        | did not        | run        |            |            |   |   |      |            |   |   |                  |                |
| 13.1        | Hammer        | did not        | run        |            |            |   |   |      |            |   |   |                  |                |

Abutment 2 NB H-Pile- Delmag D36-32  
HNTB Corporation

04/02/2020  
GRLWEAP Version 2010

Depth (ft) 10.0 Standard Soil Setup  
Shaft Gain/Loss Factor 1.000 Toe Gain/Loss Factor 1.000

PILE PROFILE:

Toe Area (in2) 203.230 Pile Type H Pile  
Pile Size (inch) 14.690

| L b Top | Area  | E-Mod  | Spec Wt | Perim | C Index | Wave Sp | EA/c   |
|---------|-------|--------|---------|-------|---------|---------|--------|
| ft      | in2   | ksi    | lb/ft3  | ft    |         | ft/s    | k/ft/s |
| 0.0     | 26.10 | 29000. | 492.0   | 4.8   | 0       | 16524.  | 45.8   |
| 86.0    | 26.10 | 29000. | 492.0   | 4.8   | 0       | 16524.  | 45.8   |

Wave Travel Time 2L/c (ms) 10.409

| Pile and Soil Model |        |        |       |       |      | Total Capacity Rut (kips) |        |       | 26.6  |       |      |
|---------------------|--------|--------|-------|-------|------|---------------------------|--------|-------|-------|-------|------|
| No.                 | Weight | Stiffn | C-Slk | T-Slk | CoR  | Soil-S                    | Soil-D | Quake | LbTop | Perim | Area |
|                     | kips   | k/in   | ft    | ft    |      | kips                      | s/ft   | inch  | ft    | ft    | in2  |
| 1                   | 0.295  | 19069  | 0.010 | 0.000 | 1.00 | 0.0                       | 0.000  | 0.100 | 3.31  | 4.8   | 26.1 |
| 2                   | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 0.0                       | 0.000  | 0.100 | 6.62  | 4.8   | 26.1 |
| 23                  | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 0.0                       | 0.050  | 0.100 | 76.08 | 4.8   | 26.1 |
| 24                  | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 2.2                       | 0.117  | 0.100 | 79.38 | 4.8   | 26.1 |
| 25                  | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 7.6                       | 0.200  | 0.100 | 82.69 | 4.8   | 26.1 |
| 26                  | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 7.9                       | 0.200  | 0.100 | 86.00 | 4.8   | 26.1 |
| Toe                 |        |        |       |       |      | 8.9                       | 0.150  | 0.100 |       |       |      |

7.669 kips total unreduced pile weight (g= 32.17 ft/s2)

7.669 kips total reduced pile weight (g= 32.17 ft/s2)

| Depth | Stroke | Pressure | Efficy |
|-------|--------|----------|--------|
| ft    | ft     | Ratio    |        |
| 10.00 | 11.42  | 1.00     | 0.800  |

Abutment 2 NB H-Pile- Delmag D36-32  
HNTB Corporation

04/02/2020  
GRLWEAP Version 2010

| Rut<br>kips | Bl Ct<br>b/ft | Stroke (ft)<br>down up | Ten Str<br>ksi | i | t  | Comp Str<br>ksi | i | t | ENTHRU<br>kip-ft | Bl Rt<br>b/min |
|-------------|---------------|------------------------|----------------|---|----|-----------------|---|---|------------------|----------------|
| 26.6        | 1.5           | 3.98 4.01              | -1.70          | 5 | 15 | 13.15           | 1 | 5 | 50.3             | 59.2           |
| 24.9        | 1.5           | 3.93 3.95              | -1.47          | 5 | 15 | 12.69           | 1 | 5 | 49.4             | 59.5           |
| 23.2        | Hammer        | did not run            |                |   |    |                 |   |   |                  |                |
| 21.5        | Hammer        | did not run            |                |   |    |                 |   |   |                  |                |
| 19.9        | Hammer        | did not run            |                |   |    |                 |   |   |                  |                |



Abutment 2 NB H-Pile- Delmag D36-32  
HNTB Corporation

04/02/2020  
GRLWEAP Version 2010

|                        |      |       |                      |       |
|------------------------|------|-------|----------------------|-------|
| Depth                  | (ft) | 15.0  | Standard Soil Setup  |       |
| Shaft Gain/Loss Factor |      | 1.000 | Toe Gain/Loss Factor | 1.000 |

PILE PROFILE:

|           |        |         |           |        |
|-----------|--------|---------|-----------|--------|
| Toe Area  | (in2)  | 203.230 | File Type | H File |
| File Size | (inch) | 14.690  |           |        |

|         |       |        |         |       |         |         |        |
|---------|-------|--------|---------|-------|---------|---------|--------|
| L b Top | Area  | E-Mod  | Spec Wt | Perim | C Index | Wave Sp | EA/c   |
| ft      | in2   | ksi    | lb/ft3  | ft    |         | ft/s    | k/ft/s |
| 0.0     | 26.10 | 29000. | 492.0   | 4.8   | 0       | 16524.  | 45.8   |
| 86.0    | 26.10 | 29000. | 492.0   | 4.8   | 0       | 16524.  | 45.8   |

Wave Travel Time 2L/c (ms) 10.409

| Pile and Soil Model |        |        |       |       |      | Total Capacity Rut (kips) |        |       |       | 38.5  |      |
|---------------------|--------|--------|-------|-------|------|---------------------------|--------|-------|-------|-------|------|
| No.                 | Weight | Stiffn | C-Slk | T-Slk | CoR  | Soil-S                    | Soil-D | Quake | LbTop | Perim | Area |
|                     | kips   | k/in   | ft    | ft    |      | kips                      | s/ft   | inch  | ft    | ft    | in2  |
| 1                   | 0.295  | 19069  | 0.010 | 0.000 | 1.00 | 0.0                       | 0.000  | 0.100 | 3.31  | 4.8   | 26.1 |
| 2                   | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 0.0                       | 0.000  | 0.100 | 6.62  | 4.8   | 26.1 |
| 22                  | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 0.6                       | 0.050  | 0.100 | 72.77 | 4.8   | 26.1 |
| 23                  | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 5.4                       | 0.182  | 0.100 | 76.08 | 4.8   | 26.1 |
| 24                  | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 7.9                       | 0.200  | 0.100 | 79.38 | 4.8   | 26.1 |
| 26                  | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 7.9                       | 0.200  | 0.100 | 86.00 | 4.8   | 26.1 |
| Toe                 |        |        |       |       |      | 8.9                       | 0.150  | 0.100 |       |       |      |

7.669 kips total unreduced pile weight (g= 32.17 ft/s2)

7.669 kips total reduced pile weight (g= 32.17 ft/s2)

|       |        |          |        |
|-------|--------|----------|--------|
| Depth | Stroke | Pressure | Efficy |
| ft    | ft     | Ratio    |        |
| 15.00 | 11.42  | 1.00     | 0.800  |

Abutment 2 NB H-Pile- Delmag D36-32  
HNTB Corporation

04/02/2020  
GRLWEAP Version 2010

| Rut  | Bl Ct | Stroke | (ft) | Ten Str | i | t  | Comp Str | i | t | ENTHRU | Bl Rt |
|------|-------|--------|------|---------|---|----|----------|---|---|--------|-------|
| kip  | b/ft  | down   | up   | ksi     |   |    | ksi      |   |   | kip-ft | b/min |
| 38.5 | 1.9   | 4.35   | 4.32 | -2.37   | 4 | 14 | 15.69    | 1 | 2 | 52.8   | 56.9  |
| 35.6 | 1.8   | 4.28   | 4.25 | -2.32   | 4 | 14 | 15.16    | 1 | 4 | 53.0   | 57.4  |
| 32.7 | 1.7   | 4.20   | 4.18 | -2.28   | 4 | 14 | 14.74    | 1 | 4 | 52.5   | 57.9  |
| 29.9 | 1.6   | 4.12   | 4.10 | -2.14   | 4 | 15 | 14.15    | 1 | 5 | 51.8   | 58.4  |
| 27.0 | 1.6   | 4.03   | 4.02 | -1.93   | 5 | 15 | 13.42    | 1 | 5 | 50.8   | 59.0  |

Abutment 2 NB H-Pile- Delmag D36-32  
HNTB Corporation

04/02/2020  
GRLWEAP Version 2010

Depth (ft) 20.0 Standard Soil Setup  
Shaft Gain/Loss Factor 1.000 Toe Gain/Loss Factor 1.000

PILE PROFILE:

Toe Area (in2) 203.230 Pile Type H Pile  
Pile Size (inch) 14.690

| L b Top | Area  | E-Mod  | Spec Wt | Perim | C Index | Wave Sp | EA/c   |
|---------|-------|--------|---------|-------|---------|---------|--------|
| ft      | in2   | ksi    | lb/ft3  | ft    |         | ft/s    | k/ft/s |
| 0.0     | 26.10 | 29000. | 492.0   | 4.8   | 0       | 16524.  | 45.8   |
| 86.0    | 26.10 | 29000. | 492.0   | 4.8   | 0       | 16524.  | 45.8   |

Wave Travel Time 2L/c (ms) 10.409

| Pile and Soil Model |        |        |       |       |      | Total Capacity Rut (kips) |        |       | 50.4  |       |      |
|---------------------|--------|--------|-------|-------|------|---------------------------|--------|-------|-------|-------|------|
| No.                 | Weight | Stiffn | C-Slk | T-Slk | CoR  | Soil-S                    | Soil-D | Quake | LbTop | Perim | Area |
|                     | kips   | k/in   | ft    | ft    |      | kips                      | s/ft   | inch  | ft    | ft    | in2  |
| 1                   | 0.295  | 19069  | 0.010 | 0.000 | 1.00 | 0.0                       | 0.000  | 0.100 | 3.31  | 4.8   | 26.1 |
| 2                   | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 0.0                       | 0.000  | 0.100 | 6.62  | 4.8   | 26.1 |
| 20                  | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 0.0                       | 0.050  | 0.100 | 66.15 | 4.8   | 26.1 |
| 21                  | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 2.4                       | 0.122  | 0.100 | 69.46 | 4.8   | 26.1 |
| 22                  | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 7.7                       | 0.200  | 0.100 | 72.77 | 4.8   | 26.1 |
| 23                  | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 7.9                       | 0.200  | 0.100 | 76.08 | 4.8   | 26.1 |
| 26                  | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 7.9                       | 0.200  | 0.100 | 86.00 | 4.8   | 26.1 |
| Toe                 |        |        |       |       |      | 8.9                       | 0.150  | 0.100 |       |       |      |

7.669 kips total unreduced pile weight (g= 32.17 ft/s2)

7.669 kips total reduced pile weight (g= 32.17 ft/s2)

| Depth | Stroke | Pressure | Efficy |
|-------|--------|----------|--------|
| ft    | ft     | Ratio    |        |
| 20.00 | 11.42  | 1.00     | 0.800  |

Abutment 2 NB H-Pile- Delmag D36-32  
HNTB Corporation

04/02/2020  
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| Rut  | Bl Ct | Stroke | (ft) | Ten Str | i | t  | Comp Str | i | t | ENTHRU | Bl Rt |
|------|-------|--------|------|---------|---|----|----------|---|---|--------|-------|
| kip  | b/ft  | down   | up   | ksi     |   |    | ksi      |   |   | kip-ft | b/min |
| 50.4 | 2.3   | 4.63   | 4.59 | -2.25   | 4 | 14 | 18.76    | 1 | 2 | 51.6   | 55.2  |
| 46.3 | 2.1   | 4.54   | 4.50 | -2.30   | 4 | 14 | 17.85    | 1 | 2 | 51.9   | 55.7  |
| 42.3 | 2.0   | 4.44   | 4.41 | -2.31   | 4 | 14 | 16.80    | 1 | 2 | 52.4   | 56.3  |
| 38.2 | 1.8   | 4.35   | 4.32 | -2.32   | 4 | 14 | 15.70    | 1 | 2 | 52.9   | 57.0  |
| 34.1 | 1.7   | 4.24   | 4.22 | -2.32   | 4 | 14 | 14.90    | 1 | 4 | 52.7   | 57.6  |

Abutment 2 NB H-Pile- Delmag D36-32  
HNTB Corporation

04/02/2020  
GRLWEAP Version 2010

Depth (ft) 25.0 Standard Soil Setup  
Shaft Gain/Loss Factor 1.000 Toe Gain/Loss Factor 1.000

PILE PROFILE:

Toe Area (in2) 203.230 Pile Type H Pile  
Pile Size (inch) 14.690

| L b Top | Area  | E-Mod  | Spec Wt | Perim | C Index | Wave Sp | EA/c   |
|---------|-------|--------|---------|-------|---------|---------|--------|
| ft      | in2   | ksi    | lb/ft3  | ft    |         | ft/s    | k/ft/s |
| 0.0     | 26.10 | 29000. | 492.0   | 4.8   | 0       | 16524.  | 45.8   |
| 86.0    | 26.10 | 29000. | 492.0   | 4.8   | 0       | 16524.  | 45.8   |

Wave Travel Time 2L/c (ms) 10.409

| Pile and Soil Model |        |        |       |       |      | Total Capacity Rut (kips) |        |       | 62.3  |       |      |
|---------------------|--------|--------|-------|-------|------|---------------------------|--------|-------|-------|-------|------|
| No.                 | Weight | Stiffn | C-Slk | T-Slk | CoR  | Soil-S                    | Soil-D | Quake | LbTop | Perim | Area |
|                     | kips   | k/in   | ft    | ft    |      | kips                      | s/ft   | inch  | ft    | ft    | in2  |
| 1                   | 0.295  | 19069  | 0.010 | 0.000 | 1.00 | 0.0                       | 0.000  | 0.100 | 3.31  | 4.8   | 26.1 |
| 2                   | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 0.0                       | 0.000  | 0.100 | 6.62  | 4.8   | 26.1 |
| 19                  | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 0.6                       | 0.050  | 0.100 | 62.85 | 4.8   | 26.1 |
| 20                  | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 5.6                       | 0.184  | 0.100 | 66.15 | 4.8   | 26.1 |
| 21                  | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 7.9                       | 0.200  | 0.100 | 69.46 | 4.8   | 26.1 |
| 26                  | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 7.9                       | 0.200  | 0.100 | 86.00 | 4.8   | 26.1 |
| Toe                 |        |        |       |       |      | 8.9                       | 0.150  | 0.100 |       |       |      |

7.669 kips total unreduced pile weight (g= 32.17 ft/s2)

7.669 kips total reduced pile weight (g= 32.17 ft/s2)

| Depth | Stroke | Pressure | Efficy |
|-------|--------|----------|--------|
| ft    | ft     | Ratio    |        |
| 25.00 | 11.42  | 1.00     | 0.800  |

Abutment 2 NB H-Pile- Delmag D36-32  
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| Rut  | Bl Ct | Stroke | (ft) | Ten Str | i | t  | Comp Str | i | t | ENTHRU | Bl Rt |
|------|-------|--------|------|---------|---|----|----------|---|---|--------|-------|
| kip  | b/ft  | down   | up   | ksi     |   |    | ksi      |   |   | kip-ft | b/min |
| 62.3 | 2.9   | 4.85   | 4.87 | -2.02   | 4 | 14 | 20.55    | 2 | 2 | 49.4   | 53.7  |
| 57.0 | 2.6   | 4.79   | 4.74 | -2.04   | 4 | 14 | 20.09    | 1 | 2 | 50.6   | 54.3  |
| 51.8 | 2.4   | 4.67   | 4.63 | -2.12   | 4 | 14 | 19.08    | 1 | 2 | 51.4   | 54.9  |
| 46.5 | 2.1   | 4.54   | 4.51 | -2.25   | 4 | 14 | 17.84    | 1 | 2 | 51.8   | 55.6  |
| 41.3 | 1.9   | 4.42   | 4.39 | -2.28   | 4 | 14 | 16.56    | 1 | 2 | 52.5   | 56.4  |

Abutment 2 NB H-Pile- Delmag D36-32  
HNTB Corporation

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GRLWEAP Version 2010

Depth (ft) 30.0 Standard Soil Setup  
Shaft Gain/Loss Factor 1.000 Toe Gain/Loss Factor 1.000

PILE PROFILE:

Toe Area (in2) 203.230 Pile Type H Pile  
Pile Size (inch) 14.690

| L b Top | Area  | E-Mod  | Spec Wt | Perim | C Index | Wave Sp | EA/c   |
|---------|-------|--------|---------|-------|---------|---------|--------|
| ft      | in2   | ksi    | lb/ft3  | ft    |         | ft/s    | k/ft/s |
| 0.0     | 26.10 | 29000. | 492.0   | 4.8   | 0       | 16524.  | 45.8   |
| 86.0    | 26.10 | 29000. | 492.0   | 4.8   | 0       | 16524.  | 45.8   |

Wave Travel Time 2L/c (ms) 10.409

| Pile and Soil Model |        |        |       |       |      | Total Capacity Rut (kips) |        |       | 74.2  |       |      |
|---------------------|--------|--------|-------|-------|------|---------------------------|--------|-------|-------|-------|------|
| No.                 | Weight | Stiffn | C-Slk | T-Slk | CoR  | Soil-S                    | Soil-D | Quake | LbTop | Perim | Area |
|                     | kips   | k/in   | ft    | ft    |      | kips                      | s/ft   | inch  | ft    | ft    | in2  |
| 1                   | 0.295  | 19069  | 0.010 | 0.000 | 1.00 | 0.0                       | 0.000  | 0.100 | 3.31  | 4.8   | 26.1 |
| 2                   | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 0.0                       | 0.000  | 0.100 | 6.62  | 4.8   | 26.1 |
| 17                  | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 0.0                       | 0.050  | 0.100 | 56.23 | 4.8   | 26.1 |
| 18                  | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 2.5                       | 0.126  | 0.100 | 59.54 | 4.8   | 26.1 |
| 19                  | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 7.7                       | 0.200  | 0.100 | 62.85 | 4.8   | 26.1 |
| 20                  | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 7.9                       | 0.200  | 0.100 | 66.15 | 4.8   | 26.1 |
| 26                  | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 7.9                       | 0.200  | 0.100 | 86.00 | 4.8   | 26.1 |
| Toe                 |        |        |       |       |      | 8.9                       | 0.150  | 0.100 |       |       |      |

7.669 kips total unreduced pile weight (g= 32.17 ft/s2)

7.669 kips total reduced pile weight (g= 32.17 ft/s2)

| Depth | Stroke | Pressure | Efficy |
|-------|--------|----------|--------|
| ft    | ft     | Ratio    |        |
| 30.00 | 11.42  | 1.00     | 0.800  |

Abutment 2 NB H-Pile- Delmag D36-32  
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| Rut  | Bl Ct | Stroke | (ft) | Ten Str | i  | t  | Comp Str | i | t | ENTHRU | Bl Rt |
|------|-------|--------|------|---------|----|----|----------|---|---|--------|-------|
| kips | b/ft  | down   | up   | ksi     |    |    | ksi      |   |   | kip-ft | b/min |
| 74.2 | 3.6   | 5.13   | 5.09 | -2.22   | 25 | 8  | 22.23    | 1 | 2 | 48.3   | 52.4  |
| 67.7 | 3.3   | 5.01   | 4.97 | -2.21   | 25 | 8  | 21.52    | 1 | 2 | 49.0   | 53.0  |
| 61.3 | 2.9   | 4.88   | 4.84 | -2.15   | 25 | 8  | 20.74    | 1 | 2 | 49.9   | 53.7  |
| 54.8 | 2.5   | 4.74   | 4.70 | -2.06   | 4  | 14 | 19.74    | 1 | 2 | 50.9   | 54.5  |
| 48.4 | 2.2   | 4.60   | 4.55 | -2.18   | 4  | 14 | 18.39    | 1 | 2 | 51.7   | 55.3  |



Abutment 2 NB H-Pile- Delmag D36-32  
HNTB Corporation

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GRLWEAP Version 2010

Depth (ft) 35.0 Standard Soil Setup  
Shaft Gain/Loss Factor 1.000 Toe Gain/Loss Factor 1.000

PILE PROFILE:

Toe Area (in2) 203.230 Pile Type H Pile  
Pile Size (inch) 14.690

| L b Top | Area  | E-Mod  | Spec Wt | Perim | C Index | Wave Sp | EA/c   |
|---------|-------|--------|---------|-------|---------|---------|--------|
| ft      | in2   | ksi    | lb/ft3  | ft    |         | ft/s    | k/ft/s |
| 0.0     | 26.10 | 29000. | 492.0   | 4.8   | 0       | 16524.  | 45.8   |
| 86.0    | 26.10 | 29000. | 492.0   | 4.8   | 0       | 16524.  | 45.8   |

Wave Travel Time 2L/c (ms) 10.409

| Pile and Soil Model |        |        |       |       |      | Total Capacity Rut (kips) |        |       | 86.0  |       |      |
|---------------------|--------|--------|-------|-------|------|---------------------------|--------|-------|-------|-------|------|
| No.                 | Weight | Stiffn | C-Slk | T-Slk | CoR  | Soil-S                    | Soil-D | Quake | LbTop | Perim | Area |
|                     | kips   | k/in   | ft    | ft    |      | kips                      | s/ft   | inch  | ft    | ft    | in2  |
| 1                   | 0.295  | 19069  | 0.010 | 0.000 | 1.00 | 0.0                       | 0.000  | 0.100 | 3.31  | 4.8   | 26.1 |
| 2                   | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 0.0                       | 0.000  | 0.100 | 6.62  | 4.8   | 26.1 |
| 16                  | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 0.7                       | 0.050  | 0.100 | 52.92 | 4.8   | 26.1 |
| 17                  | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 5.7                       | 0.186  | 0.100 | 56.23 | 4.8   | 26.1 |
| 18                  | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 7.9                       | 0.200  | 0.100 | 59.54 | 4.8   | 26.1 |
| 26                  | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 7.9                       | 0.200  | 0.100 | 86.00 | 4.8   | 26.1 |
| Toe                 |        |        |       |       |      | 8.9                       | 0.150  | 0.100 |       |       |      |

7.669 kips total unreduced pile weight (g= 32.17 ft/s2)

7.669 kips total reduced pile weight (g= 32.17 ft/s2)

| Depth | Stroke | Pressure | Efficy |
|-------|--------|----------|--------|
| ft    | ft     | Ratio    |        |
| 35.00 | 11.42  | 1.00     | 0.800  |

Abutment 2 NB H-Pile- Delmag D36-32  
HNTB Corporation

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| Rut  | Bl Ct | Stroke | (ft) | Ten Str | i  | t | Comp Str | i | t | ENTHRU | Bl Rt |
|------|-------|--------|------|---------|----|---|----------|---|---|--------|-------|
| kips | b/ft  | down   | up   | ksi     |    |   | ksi      |   |   | kip-ft | b/min |
| 86.0 | 4.3   | 5.34   | 5.31 | -2.64   | 25 | 8 | 23.45    | 2 | 2 | 46.9   | 51.3  |
| 78.4 | 3.9   | 5.21   | 5.18 | -2.64   | 25 | 8 | 22.74    | 2 | 2 | 47.7   | 52.0  |
| 70.8 | 3.4   | 5.07   | 5.04 | -2.55   | 25 | 8 | 21.92    | 1 | 2 | 48.6   | 52.7  |
| 63.1 | 3.0   | 4.92   | 4.88 | -2.45   | 25 | 8 | 21.05    | 1 | 2 | 49.6   | 53.5  |
| 55.5 | 2.6   | 4.77   | 4.72 | -2.31   | 25 | 8 | 19.87    | 1 | 2 | 50.7   | 54.4  |

Abutment 2 NB H-Pile- Delmag D36-32  
HNTB Corporation

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GRLWEAP Version 2010

Depth (ft) 40.0 Standard Soil Setup  
Shaft Gain/Loss Factor 1.000 Toe Gain/Loss Factor 1.000

PILE PROFILE:

Toe Area (in2) 203.230 Pile Type H Pile  
Pile Size (inch) 14.690

| L b Top | Area  | E-Mod  | Spec Wt | Perim | C Index | Wave Sp | EA/c   |
|---------|-------|--------|---------|-------|---------|---------|--------|
| ft      | in2   | ksi    | lb/ft3  | ft    |         | ft/s    | k/ft/s |
| 0.0     | 26.10 | 29000. | 492.0   | 4.8   | 0       | 16524.  | 45.8   |
| 86.0    | 26.10 | 29000. | 492.0   | 4.8   | 0       | 16524.  | 45.8   |

Wave Travel Time 2L/c (ms) 10.409

| No. | Weight<br>kips | Pile and Soil Model |             |             |                | CoR | Total Capacity Rut (kips) |               |             | 97.9        |             |
|-----|----------------|---------------------|-------------|-------------|----------------|-----|---------------------------|---------------|-------------|-------------|-------------|
|     |                | Stiffn<br>k/in      | C-Slk<br>ft | T-Slk<br>ft | Soil-S<br>kips |     | Soil-D<br>s/ft            | Quake<br>inch | LbTop<br>ft | Perim<br>ft | Area<br>in2 |
| 1   | 0.295          | 19069               | 0.010       | 0.000       | 1.00           | 0.0 | 0.000                     | 0.100         | 3.31        | 4.8         | 26.1        |
| 2   | 0.295          | 19069               | 0.000       | 0.000       | 1.00           | 0.0 | 0.000                     | 0.100         | 6.62        | 4.8         | 26.1        |
| 14  | 0.295          | 19069               | 0.000       | 0.000       | 1.00           | 0.0 | 0.050                     | 0.100         | 46.31       | 4.8         | 26.1        |
| 15  | 0.295          | 19069               | 0.000       | 0.000       | 1.00           | 2.6 | 0.131                     | 0.100         | 49.62       | 4.8         | 26.1        |
| 16  | 0.295          | 19069               | 0.000       | 0.000       | 1.00           | 7.8 | 0.200                     | 0.100         | 52.92       | 4.8         | 26.1        |
| 17  | 0.295          | 19069               | 0.000       | 0.000       | 1.00           | 7.9 | 0.200                     | 0.100         | 56.23       | 4.8         | 26.1        |
| 26  | 0.295          | 19069               | 0.000       | 0.000       | 1.00           | 7.9 | 0.200                     | 0.100         | 86.00       | 4.8         | 26.1        |
| Toe |                |                     |             |             |                | 8.9 | 0.150                     | 0.100         |             |             |             |

7.669 kips total unreduced pile weight (g= 32.17 ft/s2)

7.669 kips total reduced pile weight (g= 32.17 ft/s2)

| Depth<br>ft | Stroke<br>ft | Pressure<br>Ratio | Efficy |
|-------------|--------------|-------------------|--------|
| 40.00       | 11.42        | 1.00              | 0.800  |

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| Rut  | Bl Ct | Stroke | (ft) | Ten Str | i  | t | Comp Str | i | t | ENTHRU | Bl Rt |
|------|-------|--------|------|---------|----|---|----------|---|---|--------|-------|
| kip  | b/ft  | down   | up   | ksi     |    |   | ksi      |   |   | kip-ft | b/min |
| 97.9 | 5.1   | 5.53   | 5.51 | -2.89   | 25 | 8 | 24.51    | 1 | 2 | 45.8   | 50.4  |
| 89.1 | 4.5   | 5.40   | 5.37 | -2.93   | 25 | 8 | 23.83    | 2 | 2 | 46.6   | 51.1  |
| 80.3 | 4.0   | 5.25   | 5.22 | -2.93   | 25 | 8 | 23.02    | 2 | 2 | 47.4   | 51.8  |
| 71.5 | 3.5   | 5.09   | 5.06 | -2.82   | 25 | 8 | 22.08    | 1 | 2 | 48.4   | 52.6  |
| 62.6 | 3.0   | 4.92   | 4.88 | -2.65   | 25 | 8 | 21.06    | 1 | 2 | 49.7   | 53.5  |

Abutment 2 NB H-Pile- Delmag D36-32  
HNTB Corporation

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GRLWEAP Version 2010

Depth (ft) 45.0 Standard Soil Setup  
Shaft Gain/Loss Factor 1.000 Toe Gain/Loss Factor 1.000

PILE PROFILE:

Toe Area (in2) 203.230 Pile Type H Pile  
Pile Size (inch) 14.690

| L b Top | Area  | E-Mod  | Spec Wt | Perim | C Index | Wave Sp | EA/c   |
|---------|-------|--------|---------|-------|---------|---------|--------|
| ft      | in2   | ksi    | lb/ft3  | ft    |         | ft/s    | k/ft/s |
| 0.0     | 26.10 | 29000. | 492.0   | 4.8   | 0       | 16524.  | 45.8   |
| 86.0    | 26.10 | 29000. | 492.0   | 4.8   | 0       | 16524.  | 45.8   |

Wave Travel Time 2L/c (ms) 10.409

| Pile and Soil Model |        |        |       |       |      | Total Capacity Rut (kips) |        |       | 109.8 |       |      |
|---------------------|--------|--------|-------|-------|------|---------------------------|--------|-------|-------|-------|------|
| No.                 | Weight | Stiffn | C-Slk | T-Slk | CoR  | Soil-S                    | Soil-D | Quake | LbTop | Perim | Area |
|                     | kips   | k/in   | ft    | ft    |      | kips                      | s/ft   | inch  | ft    | ft    | in2  |
| 1                   | 0.295  | 19069  | 0.010 | 0.000 | 1.00 | 0.0                       | 0.000  | 0.100 | 3.31  | 4.8   | 26.1 |
| 2                   | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 0.0                       | 0.000  | 0.100 | 6.62  | 4.8   | 26.1 |
| 13                  | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 0.8                       | 0.050  | 0.100 | 43.00 | 4.8   | 26.1 |
| 14                  | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 5.8                       | 0.188  | 0.100 | 46.31 | 4.8   | 26.1 |
| 15                  | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 7.9                       | 0.200  | 0.100 | 49.62 | 4.8   | 26.1 |
| 26                  | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 7.9                       | 0.200  | 0.100 | 86.00 | 4.8   | 26.1 |
| Toe                 |        |        |       |       |      | 8.9                       | 0.150  | 0.100 |       |       |      |

7.669 kips total unreduced pile weight (g= 32.17 ft/s2)

7.669 kips total reduced pile weight (g= 32.17 ft/s2)

| Depth | Stroke | Pressure | Efficy |
|-------|--------|----------|--------|
| ft    | ft     | Ratio    |        |
| 45.00 | 11.42  | 1.00     | 0.800  |

Abutment 2 NB H-Pile- Delmag D36-32  
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| Rut<br>kips | Bl Ct<br>b/ft | Stroke<br>down | (ft)<br>up | Ten Str<br>ksi | i  | t | Comp Str<br>ksi | i | t | ENTHRU<br>kip-ft | Bl Rt<br>b/min |
|-------------|---------------|----------------|------------|----------------|----|---|-----------------|---|---|------------------|----------------|
| 109.8       | 5.9           | 5.67           | 5.72       | -3.03          | 25 | 8 | 25.30           | 1 | 2 | 44.4             | 49.6           |
| 99.8        | 5.2           | 5.57           | 5.55       | -3.13          | 25 | 8 | 24.81           | 2 | 2 | 45.6             | 50.2           |
| 89.8        | 4.6           | 5.40           | 5.39       | -3.18          | 25 | 8 | 23.95           | 1 | 2 | 46.4             | 51.0           |
| 79.8        | 4.0           | 5.25           | 5.22       | -3.16          | 25 | 8 | 23.06           | 2 | 2 | 47.4             | 51.7           |
| 69.8        | 3.4           | 5.06           | 5.03       | -2.99          | 25 | 8 | 22.00           | 1 | 2 | 48.6             | 52.7           |

Abutment 2 NB H-Pile- Delmag D36-32  
HNTB Corporation

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GRLWEAP Version 2010

Depth (ft) 50.0 Standard Soil Setup  
Shaft Gain/Loss Factor 1.000 Toe Gain/Loss Factor 1.000

PILE PROFILE:

Toe Area (in2) 203.230 Pile Type H Pile  
Pile Size (inch) 14.690

| L b Top | Area  | E-Mod  | Spec Wt | Perim | C Index | Wave Sp | EA/c   |
|---------|-------|--------|---------|-------|---------|---------|--------|
| ft      | in2   | ksi    | lb/ft3  | ft    |         | ft/s    | k/ft/s |
| 0.0     | 26.10 | 29000. | 492.0   | 4.8   | 0       | 16524.  | 45.8   |
| 86.0    | 26.10 | 29000. | 492.0   | 4.8   | 0       | 16524.  | 45.8   |

Wave Travel Time 2L/c (ms) 10.409

| Pile and Soil Model |        |        |       |       |      | Total Capacity Rut (kips) |        |       | 121.7 |       |      |
|---------------------|--------|--------|-------|-------|------|---------------------------|--------|-------|-------|-------|------|
| No.                 | Weight | Stiffn | C-Slk | T-Slk | CoR  | Soil-S                    | Soil-D | Quake | LbTop | Perim | Area |
|                     | kips   | k/in   | ft    | ft    |      | kips                      | s/ft   | inch  | ft    | ft    | in2  |
| 1                   | 0.295  | 19069  | 0.010 | 0.000 | 1.00 | 0.0                       | 0.000  | 0.100 | 3.31  | 4.8   | 26.1 |
| 2                   | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 0.0                       | 0.000  | 0.100 | 6.62  | 4.8   | 26.1 |
| 11                  | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 0.0                       | 0.050  | 0.100 | 36.38 | 4.8   | 26.1 |
| 12                  | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 2.8                       | 0.135  | 0.100 | 39.69 | 4.8   | 26.1 |
| 13                  | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 7.8                       | 0.200  | 0.100 | 43.00 | 4.8   | 26.1 |
| 14                  | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 7.9                       | 0.200  | 0.100 | 46.31 | 4.8   | 26.1 |
| 26                  | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 7.9                       | 0.200  | 0.100 | 86.00 | 4.8   | 26.1 |
| Toe                 |        |        |       |       |      | 8.9                       | 0.150  | 0.100 |       |       |      |

7.669 kips total unreduced pile weight (g= 32.17 ft/s2)

7.669 kips total reduced pile weight (g= 32.17 ft/s2)

| Depth | Stroke | Pressure | Efficy |
|-------|--------|----------|--------|
| ft    | ft     | Ratio    |        |
| 50.00 | 11.42  | 1.00     | 0.800  |

Abutment 2 NB H-Pile- Delmag D36-32  
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| Rut<br>kips | Bl Ct<br>b/ft | Stroke<br>down | (ft)<br>up | Ten Str<br>ksi | i  | t | Comp Str<br>ksi | i | t | ENTHRU<br>kip-ft | Bl Rt<br>b/min |
|-------------|---------------|----------------|------------|----------------|----|---|-----------------|---|---|------------------|----------------|
| 121.7       | 6.7           | 5.87           | 5.90       | -3.23          | 25 | 8 | 26.37           | 2 | 2 | 43.8             | 48.7           |
| 110.5       | 6.0           | 5.69           | 5.74       | -3.27          | 25 | 8 | 25.53           | 2 | 2 | 44.4             | 49.5           |
| 99.3        | 5.1           | 5.57           | 5.56       | -3.37          | 25 | 8 | 24.88           | 1 | 2 | 45.5             | 50.2           |
| 88.1        | 4.5           | 5.39           | 5.36       | -3.29          | 25 | 8 | 23.95           | 1 | 2 | 46.5             | 51.1           |
| 76.9        | 3.8           | 5.21           | 5.17       | -3.23          | 25 | 8 | 22.93           | 1 | 2 | 47.8             | 52.0           |



Abutment 2 NB H-Pile- Delmag D36-32  
HNTB Corporation

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Depth (ft) 55.0 Standard Soil Setup  
Shaft Gain/Loss Factor 1.000 Toe Gain/Loss Factor 1.000

PILE PROFILE:

Toe Area (in2) 203.230 Pile Type H Pile  
Pile Size (inch) 14.690

| L b Top | Area  | E-Mod  | Spec Wt | Perim | C Index | Wave Sp | EA/c   |
|---------|-------|--------|---------|-------|---------|---------|--------|
| ft      | in2   | ksi    | lb/ft3  | ft    |         | ft/s    | k/ft/s |
| 0.0     | 26.10 | 29000. | 492.0   | 4.8   | 0       | 16524.  | 45.8   |
| 86.0    | 26.10 | 29000. | 492.0   | 4.8   | 0       | 16524.  | 45.8   |

Wave Travel Time 2L/c (ms) 10.409

| Pile and Soil Model |        |        |       |       |      | Total Capacity Rut (kips) |        |       | 133.6 |       |      |
|---------------------|--------|--------|-------|-------|------|---------------------------|--------|-------|-------|-------|------|
| No.                 | Weight | Stiffn | C-Slk | T-Slk | CoR  | Soil-S                    | Soil-D | Quake | LbTop | Perim | Area |
|                     | kips   | k/in   | ft    | ft    |      | kips                      | s/ft   | inch  | ft    | ft    | in2  |
| 1                   | 0.295  | 19069  | 0.010 | 0.000 | 1.00 | 0.0                       | 0.000  | 0.100 | 3.31  | 4.8   | 26.1 |
| 2                   | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 0.0                       | 0.000  | 0.100 | 6.62  | 4.8   | 26.1 |
| 10                  | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 0.8                       | 0.050  | 0.100 | 33.08 | 4.8   | 26.1 |
| 11                  | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 5.9                       | 0.190  | 0.100 | 36.38 | 4.8   | 26.1 |
| 12                  | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 7.9                       | 0.200  | 0.100 | 39.69 | 4.8   | 26.1 |
| 26                  | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 7.9                       | 0.200  | 0.100 | 86.00 | 4.8   | 26.1 |
| Toe                 |        |        |       |       |      | 8.9                       | 0.150  | 0.100 |       |       |      |

7.669 kips total unreduced pile weight (g= 32.17 ft/s2)

7.669 kips total reduced pile weight (g= 32.17 ft/s2)

| Depth | Stroke | Pressure | Efficy |
|-------|--------|----------|--------|
| ft    | ft     | Ratio    |        |
| 55.00 | 11.42  | 1.00     | 0.800  |

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| Rut<br>kips | Bl Ct<br>b/ft | Stroke<br>down | (ft)<br>up | Ten Str<br>ksi | i  | t | Comp Str<br>ksi | i  | t | ENTHRU<br>kip-ft | Bl Rt<br>b/min |
|-------------|---------------|----------------|------------|----------------|----|---|-----------------|----|---|------------------|----------------|
| 133.6       | 7.4           | 6.05           | 6.08       | -3.40          | 25 | 8 | 27.39           | 11 | 4 | 43.0             | 48.0           |
| 121.2       | 6.7           | 5.88           | 5.91       | -3.47          | 25 | 8 | 26.55           | 11 | 4 | 43.8             | 48.7           |
| 108.8       | 5.8           | 5.67           | 5.73       | -3.48          | 25 | 8 | 25.58           | 2  | 2 | 44.5             | 49.6           |
| 96.4        | 5.0           | 5.53           | 5.52       | -3.53          | 25 | 8 | 24.83           | 3  | 2 | 45.8             | 50.3           |
| 84.0        | 4.2           | 5.34           | 5.30       | -3.43          | 25 | 8 | 23.73           | 1  | 2 | 46.9             | 51.4           |

Abutment 2 NB H-Pile- Delmag D36-32  
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Depth (ft) 60.0 Standard Soil Setup  
Shaft Gain/Loss Factor 1.000 Toe Gain/Loss Factor 1.000

PILE PROFILE:

Toe Area (in2) 203.230 Pile Type H Pile  
Pile Size (inch) 14.690

| L b Top | Area  | E-Mod  | Spec Wt | Perim | C Index | Wave Sp | EA/c   |
|---------|-------|--------|---------|-------|---------|---------|--------|
| ft      | in2   | ksi    | lb/ft3  | ft    |         | ft/s    | k/ft/s |
| 0.0     | 26.10 | 29000. | 492.0   | 4.8   | 0       | 16524.  | 45.8   |
| 86.0    | 26.10 | 29000. | 492.0   | 4.8   | 0       | 16524.  | 45.8   |

Wave Travel Time 2L/c (ms) 10.409

| Pile and Soil Model |        |        |       |       |      | Total Capacity Rut (kips) |        |       | 160.7 |       |      |
|---------------------|--------|--------|-------|-------|------|---------------------------|--------|-------|-------|-------|------|
| No.                 | Weight | Stiffn | C-Slk | T-Slk | CoR  | Soil-S                    | Soil-D | Quake | LbTop | Perim | Area |
|                     | kips   | k/in   | ft    | ft    |      | kips                      | s/ft   | inch  | ft    | ft    | in2  |
| 1                   | 0.295  | 19069  | 0.010 | 0.000 | 1.00 | 0.0                       | 0.000  | 0.100 | 3.31  | 4.8   | 26.1 |
| 2                   | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 0.0                       | 0.000  | 0.100 | 6.62  | 4.8   | 26.1 |
| 8                   | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 0.0                       | 0.050  | 0.100 | 26.46 | 4.8   | 26.1 |
| 9                   | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 2.9                       | 0.138  | 0.100 | 29.77 | 4.8   | 26.1 |
| 10                  | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 7.8                       | 0.200  | 0.100 | 33.08 | 4.8   | 26.1 |
| 11                  | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 7.9                       | 0.200  | 0.100 | 36.38 | 4.8   | 26.1 |
| 26                  | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 10.4                      | 0.112  | 0.100 | 86.00 | 4.8   | 26.1 |
| Toe                 |        |        |       |       |      | 21.6                      | 0.150  | 0.100 |       |       |      |

7.669 kips total unreduced pile weight (g= 32.17 ft/s2)

7.669 kips total reduced pile weight (g= 32.17 ft/s2)

| Depth | Stroke | Pressure | Efficy |
|-------|--------|----------|--------|
| ft    | ft     | Ratio    |        |
| 60.00 | 11.42  | 1.00     | 0.800  |

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| Rut<br>kips | Bl Ct<br>b/ft | Stroke<br>down | (ft)<br>up | Ten Str<br>ksi | i  | t | Comp Str<br>ksi | i | t | ENTHRU<br>kip-ft | Bl Rt<br>b/min |
|-------------|---------------|----------------|------------|----------------|----|---|-----------------|---|---|------------------|----------------|
| 160.7       | 8.9           | 6.35           | 6.37       | -2.29          | 25 | 8 | 28.78           | 9 | 3 | 41.9             | 46.9           |
| 147.3       | 8.0           | 6.18           | 6.20       | -2.26          | 25 | 8 | 28.00           | 3 | 2 | 42.5             | 47.5           |
| 133.9       | 7.2           | 6.00           | 6.03       | -2.27          | 25 | 8 | 27.16           | 3 | 2 | 43.2             | 48.2           |
| 120.4       | 6.4           | 5.80           | 5.85       | -2.33          | 25 | 8 | 26.20           | 2 | 2 | 43.9             | 49.0           |
| 107.0       | 5.4           | 5.65           | 5.63       | -2.26          | 25 | 8 | 25.43           | 2 | 2 | 45.3             | 49.8           |

Abutment 2 NB H-Pile- Delmag D36-32  
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Depth (ft) 65.0 Standard Soil Setup  
Shaft Gain/Loss Factor 1.000 Toe Gain/Loss Factor 1.000

PILE PROFILE:

Toe Area (in2) 203.230 Pile Type H Pile  
Pile Size (inch) 14.690

| L b Top | Area  | E-Mod  | Spec Wt | Perim | C Index | Wave Sp | EA/c   |
|---------|-------|--------|---------|-------|---------|---------|--------|
| ft      | in2   | ksi    | lb/ft3  | ft    |         | ft/s    | k/ft/s |
| 0.0     | 26.10 | 29000. | 492.0   | 4.8   | 0       | 16524.  | 45.8   |
| 86.0    | 26.10 | 29000. | 492.0   | 4.8   | 0       | 16524.  | 45.8   |

Wave Travel Time 2L/c (ms) 10.409

| Pile and Soil Model |        |        |       |       |      | Total Capacity Rut (kips) |        |       | 204.3 |       |      |
|---------------------|--------|--------|-------|-------|------|---------------------------|--------|-------|-------|-------|------|
| No.                 | Weight | Stiffn | C-Slk | T-Slk | CoR  | Soil-S                    | Soil-D | Quake | LbTop | Perim | Area |
|                     | kips   | k/in   | ft    | ft    |      | kips                      | s/ft   | inch  | ft    | ft    | in2  |
| 1                   | 0.295  | 19069  | 0.010 | 0.000 | 1.00 | 0.0                       | 0.000  | 0.100 | 3.31  | 4.8   | 26.1 |
| 2                   | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 0.0                       | 0.000  | 0.100 | 6.62  | 4.8   | 26.1 |
| 7                   | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 0.9                       | 0.052  | 0.100 | 23.15 | 4.8   | 26.1 |
| 8                   | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 6.1                       | 0.191  | 0.100 | 26.46 | 4.8   | 26.1 |
| 9                   | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 7.9                       | 0.200  | 0.100 | 29.77 | 4.8   | 26.1 |
| 24                  | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 7.9                       | 0.197  | 0.100 | 79.38 | 4.8   | 26.1 |
| 25                  | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 19.2                      | 0.054  | 0.100 | 82.69 | 4.8   | 26.1 |
| 26                  | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 25.9                      | 0.050  | 0.100 | 86.00 | 4.8   | 26.1 |
| Toe                 |        |        |       |       |      | 26.5                      | 0.150  | 0.100 |       |       |      |

7.669 kips total unreduced pile weight (g= 32.17 ft/s2)

7.669 kips total reduced pile weight (g= 32.17 ft/s2)

| Depth | Stroke | Pressure | Efficy |
|-------|--------|----------|--------|
| ft    | ft     | Ratio    |        |
| 65.00 | 11.42  | 1.00     | 0.800  |

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| Rut   | Bl Ct | Stroke | (ft) | Ten Str | i  | t  | Comp Str | i | t | ENTHRU | Bl Rt |
|-------|-------|--------|------|---------|----|----|----------|---|---|--------|-------|
| kip   | b/ft  | down   | up   | ksi     |    |    | ksi      |   |   | kip-ft | b/min |
| 204.3 | 11.3  | 6.68   | 6.70 | -1.18   | 25 | 8  | 30.42    | 8 | 3 | 41.1   | 45.7  |
| 189.6 | 10.0  | 6.51   | 6.53 | -1.19   | 25 | 8  | 29.64    | 8 | 3 | 41.4   | 46.3  |
| 174.9 | 8.9   | 6.33   | 6.35 | -1.18   | 25 | 8  | 28.80    | 8 | 3 | 41.9   | 46.9  |
| 160.2 | 7.9   | 6.14   | 6.17 | -1.11   | 25 | 8  | 27.88    | 2 | 2 | 42.5   | 47.6  |
| 145.5 | 7.1   | 5.94   | 5.98 | -1.19   | 4  | 14 | 26.98    | 8 | 3 | 43.4   | 48.4  |

Abutment 2 NB H-Pile- Delmag D36-32  
HNTB Corporation

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Depth (ft) 70.0 Standard Soil Setup  
Shaft Gain/Loss Factor 1.000 Toe Gain/Loss Factor 1.000

PILE PROFILE:

Toe Area (in2) 203.230 Pile Type H Pile  
Pile Size (inch) 14.690

| L b Top | Area  | E-Mod  | Spec Wt | Perim | C Index | Wave Sp | EA/c   |
|---------|-------|--------|---------|-------|---------|---------|--------|
| ft      | in2   | ksi    | lb/ft3  | ft    |         | ft/s    | k/ft/s |
| 0.0     | 26.10 | 29000. | 492.0   | 4.8   | 0       | 16524.  | 45.8   |
| 86.0    | 26.10 | 29000. | 492.0   | 4.8   | 0       | 16524.  | 45.8   |

Wave Travel Time 2L/c (ms) 10.409

| Pile and Soil Model |        |        |       |       |      | Total Capacity Rut (kips) |        |       | 245.9 |       |      |
|---------------------|--------|--------|-------|-------|------|---------------------------|--------|-------|-------|-------|------|
| No.                 | Weight | Stiffn | C-Slk | T-Slk | CoR  | Soil-S                    | Soil-D | Quake | LbTop | Perim | Area |
|                     | kips   | k/in   | ft    | ft    |      | kips                      | s/ft   | inch  | ft    | ft    | in2  |
| 1                   | 0.295  | 19069  | 0.010 | 0.000 | 1.00 | 0.0                       | 0.000  | 0.100 | 3.31  | 4.8   | 26.1 |
| 2                   | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 0.0                       | 0.000  | 0.100 | 6.62  | 4.8   | 26.1 |
| 5                   | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 0.1                       | 0.050  | 0.100 | 16.54 | 4.8   | 26.1 |
| 6                   | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 3.1                       | 0.142  | 0.100 | 19.85 | 4.8   | 26.1 |
| 7                   | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 7.8                       | 0.200  | 0.100 | 23.15 | 4.8   | 26.1 |
| 8                   | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 7.9                       | 0.200  | 0.100 | 26.46 | 4.8   | 26.1 |
| 23                  | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 10.8                      | 0.107  | 0.100 | 76.08 | 4.8   | 26.1 |
| 24                  | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 25.3                      | 0.050  | 0.100 | 79.38 | 4.8   | 26.1 |
| 25                  | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 26.5                      | 0.050  | 0.100 | 82.69 | 4.8   | 26.1 |
| 26                  | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 27.8                      | 0.050  | 0.100 | 86.00 | 4.8   | 26.1 |
| Toe                 |        |        |       |       |      | 26.5                      | 0.150  | 0.100 |       |       |      |

7.669 kips total unreduced pile weight (g= 32.17 ft/s2)

7.669 kips total reduced pile weight (g= 32.17 ft/s2)

| Depth | Stroke | Pressure | Efficy |
|-------|--------|----------|--------|
| ft    | ft     | Ratio    |        |
| 70.00 | 11.42  | 1.00     | 0.800  |

Abutment 2 NB H-Pile- Delmag D36-32  
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| Rut<br>kips | Bl Ct<br>b/ft | Stroke<br>down | (ft)<br>up | Ten Str<br>ksi | i  | t  | Comp Str<br>ksi | i | t | ENTHRU<br>kip-ft | Bl Rt<br>b/min |
|-------------|---------------|----------------|------------|----------------|----|----|-----------------|---|---|------------------|----------------|
| 245.9       | 13.8          | 7.02           | 6.98       | -1.44          | 7  | 38 | 31.79           | 6 | 3 | 40.7             | 44.7           |
| 229.8       | 12.2          | 6.87           | 6.81       | -1.15          | 7  | 39 | 31.13           | 6 | 3 | 41.2             | 45.2           |
| 213.7       | 10.9          | 6.62           | 6.64       | -0.99          | 25 | 8  | 30.10           | 6 | 3 | 41.3             | 45.9           |
| 197.6       | 9.6           | 6.43           | 6.45       | -0.98          | 25 | 8  | 29.29           | 6 | 3 | 41.8             | 46.6           |
| 181.5       | 8.5           | 6.23           | 6.26       | -0.95          | 25 | 8  | 28.35           | 6 | 3 | 42.3             | 47.3           |



Abutment 2 NB H-Pile- Delmag D36-32  
HNTB Corporation

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Depth (ft) 75.0 Standard Soil Setup  
Shaft Gain/Loss Factor 1.000 Toe Gain/Loss Factor 1.000

PILE PROFILE:

Toe Area (in2) 203.230 Pile Type H Pile  
Pile Size (inch) 14.690

| L b Top | Area  | E-Mod  | Spec Wt | Perim | C Index | Wave Sp | EA/c   |
|---------|-------|--------|---------|-------|---------|---------|--------|
| ft      | in2   | ksi    | lb/ft3  | ft    |         | ft/s    | k/ft/s |
| 0.0     | 26.10 | 29000. | 492.0   | 4.8   | 0       | 16524.  | 45.8   |
| 86.0    | 26.10 | 29000. | 492.0   | 4.8   | 0       | 16524.  | 45.8   |

Wave Travel Time 2L/c (ms) 10.409

| Pile and Soil Model |        |        |       |       |      | Total Capacity Rut (kips) |        |       | 563.3 |       |      |
|---------------------|--------|--------|-------|-------|------|---------------------------|--------|-------|-------|-------|------|
| No.                 | Weight | Stiffn | C-Slk | T-Slk | CoR  | Soil-S                    | Soil-D | Quake | LbTop | Perim | Area |
|                     | kips   | k/in   | ft    | ft    |      | kips                      | s/ft   | inch  | ft    | ft    | in2  |
| 1                   | 0.295  | 19069  | 0.010 | 0.000 | 1.00 | 0.0                       | 0.000  | 0.100 | 3.31  | 4.8   | 26.1 |
| 2                   | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 0.0                       | 0.000  | 0.100 | 6.62  | 4.8   | 26.1 |
| 4                   | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 0.9                       | 0.053  | 0.100 | 13.23 | 4.8   | 26.1 |
| 5                   | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 6.2                       | 0.193  | 0.100 | 16.54 | 4.8   | 26.1 |
| 6                   | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 7.9                       | 0.200  | 0.100 | 19.85 | 4.8   | 26.1 |
| 21                  | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 7.9                       | 0.195  | 0.100 | 69.46 | 4.8   | 26.1 |
| 22                  | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 19.6                      | 0.053  | 0.100 | 72.77 | 4.8   | 26.1 |
| 23                  | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 25.9                      | 0.050  | 0.100 | 76.08 | 4.8   | 26.1 |
| 24                  | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 27.2                      | 0.050  | 0.100 | 79.38 | 4.8   | 26.1 |
| 25                  | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 28.4                      | 0.050  | 0.100 | 82.69 | 4.8   | 26.1 |
| 26                  | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 44.2                      | 0.050  | 0.100 | 86.00 | 4.8   | 26.1 |
| Toe                 |        |        |       |       |      | 285.1                     | 0.150  | 0.100 |       |       |      |

7.669 kips total unreduced pile weight (g= 32.17 ft/s2)

7.669 kips total reduced pile weight (g= 32.17 ft/s2)

| Depth | Stroke | Pressure | Efficy |
|-------|--------|----------|--------|
| ft    | ft     | Ratio    |        |
| 75.00 | 11.42  | 1.00     | 0.800  |

Abutment 2 NB H-Pile- Delmag D36-32  
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| Rut<br>kips | Bl Ct<br>b/ft | Stroke<br>down | (ft)<br>up | Ten Str<br>ksi | i | t  | Comp Str<br>ksi | i | t | ENTHRU<br>kip-ft | Bl Rt<br>b/min |
|-------------|---------------|----------------|------------|----------------|---|----|-----------------|---|---|------------------|----------------|
| 563.3       | 56.3          | 8.68           | 8.66       | -0.70          | 5 | 49 | 37.62           | 5 | 2 | 43.6             | 40.1           |
| 545.3       | 50.5          | 8.59           | 8.59       | -0.76          | 5 | 50 | 37.23           | 5 | 2 | 43.5             | 40.3           |
| 527.2       | 45.3          | 8.51           | 8.51       | -0.64          | 5 | 50 | 36.89           | 5 | 2 | 43.6             | 40.5           |
| 509.1       | 40.7          | 8.41           | 8.42       | -0.52          | 5 | 27 | 36.44           | 1 | 2 | 43.7             | 40.7           |
| 491.1       | 36.6          | 8.30           | 8.31       | -0.80          | 5 | 27 | 36.00           | 1 | 2 | 43.8             | 41.0           |

Abutment 2 NB H-Pile- Delmag D36-32  
HNTB Corporation

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Depth (ft) 80.0 Standard Soil Setup  
Shaft Gain/Loss Factor 1.000 Toe Gain/Loss Factor 1.000

PILE PROFILE:

Toe Area (in2) 203.230 Pile Type H Pile  
Pile Size (inch) 14.690

| L b Top | Area  | E-Mod  | Spec Wt | Perim | C Index | Wave Sp | EA/c   |
|---------|-------|--------|---------|-------|---------|---------|--------|
| ft      | in2   | ksi    | lb/ft3  | ft    |         | ft/s    | k/ft/s |
| 0.0     | 26.10 | 29000. | 492.0   | 4.8   | 0       | 16524.  | 45.8   |
| 86.0    | 26.10 | 29000. | 492.0   | 4.8   | 0       | 16524.  | 45.8   |

Wave Travel Time 2L/c (ms) 10.409

| Pile and Soil Model |        |        |       |       |      | Total Capacity Rut (kips) |        |       | 679.1 |       |      |
|---------------------|--------|--------|-------|-------|------|---------------------------|--------|-------|-------|-------|------|
| No.                 | Weight | Stiffn | C-Slk | T-Slk | CoR  | Soil-S                    | Soil-D | Quake | LbTop | Perim | Area |
|                     | kips   | k/in   | ft    | ft    |      | kips                      | s/ft   | inch  | ft    | ft    | in2  |
| 1                   | 0.295  | 19069  | 0.010 | 0.000 | 1.00 | 0.0                       | 0.000  | 0.100 | 3.31  | 4.8   | 26.1 |
| 2                   | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 0.1                       | 0.050  | 0.100 | 6.62  | 4.8   | 26.1 |
| 3                   | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 3.2                       | 0.146  | 0.100 | 9.92  | 4.8   | 26.1 |
| 4                   | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 7.9                       | 0.200  | 0.100 | 13.23 | 4.8   | 26.1 |
| 5                   | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 7.9                       | 0.200  | 0.100 | 16.54 | 4.8   | 26.1 |
| 20                  | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 11.2                      | 0.103  | 0.100 | 66.15 | 4.8   | 26.1 |
| 21                  | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 25.3                      | 0.050  | 0.100 | 69.46 | 4.8   | 26.1 |
| 22                  | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 26.6                      | 0.050  | 0.100 | 72.77 | 4.8   | 26.1 |
| 23                  | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 27.8                      | 0.050  | 0.100 | 76.08 | 4.8   | 26.1 |
| 24                  | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 29.8                      | 0.050  | 0.100 | 79.38 | 4.8   | 26.1 |
| 25                  | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 61.0                      | 0.050  | 0.100 | 82.69 | 4.8   | 26.1 |
| 26                  | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 66.2                      | 0.050  | 0.100 | 86.00 | 4.8   | 26.1 |
| Toe                 |        |        |       |       |      | 302.0                     | 0.150  | 0.100 |       |       |      |

7.669 kips total unreduced pile weight (g= 32.17 ft/s2)  
7.669 kips total reduced pile weight (g= 32.17 ft/s2)

| Depth | Stroke | Pressure | Efficy |
|-------|--------|----------|--------|
| ft    | ft     | Ratio    |        |
| 80.00 | 11.42  | 1.00     | 0.800  |

Abutment 2 NB H-Pile- Delmag D36-32  
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| Rut<br>kips | Bl Ct<br>b/ft | Stroke<br>down | (ft)<br>up | Ten Str<br>ksi | i | t  | Comp Str<br>ksi | i | t | ENTHRU<br>kip-ft | Bl Rt<br>b/min |
|-------------|---------------|----------------|------------|----------------|---|----|-----------------|---|---|------------------|----------------|
| 679.1       | 109.4         | 9.03           | 9.03       | -0.42          | 4 | 47 | 38.91           | 3 | 2 | 44.2             | 39.3           |
| 657.7       | 91.0          | 8.99           | 8.98       | -0.53          | 4 | 48 | 38.71           | 3 | 2 | 44.6             | 39.4           |
| 636.4       | 76.7          | 8.93           | 8.92       | -0.60          | 4 | 49 | 38.45           | 3 | 2 | 44.8             | 39.5           |
| 615.0       | 64.9          | 8.85           | 8.83       | -0.66          | 4 | 49 | 38.16           | 3 | 2 | 45.1             | 39.7           |
| 593.6       | 56.0          | 8.77           | 8.74       | -0.61          | 4 | 50 | 37.74           | 3 | 2 | 45.4             | 39.9           |

Abutment 2 NB H-Pile- Delmag D36-32  
HNTB Corporation

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GRLWEAP Version 2010

Depth (ft) 85.0 Standard Soil Setup  
Shaft Gain/Loss Factor 1.000 Toe Gain/Loss Factor 1.000

PILE PROFILE:

Toe Area (in2) 203.230 Pile Type H Pile  
Pile Size (inch) 14.690

| L b Top | Area  | E-Mod  | Spec Wt | Perim | C Index | Wave Sp | EA/c   |
|---------|-------|--------|---------|-------|---------|---------|--------|
| ft      | in2   | ksi    | lb/ft3  | ft    |         | ft/s    | k/ft/s |
| 0.0     | 26.10 | 29000. | 492.0   | 4.8   | 0       | 16524.  | 45.8   |
| 86.0    | 26.10 | 29000. | 492.0   | 4.8   | 0       | 16524.  | 45.8   |

Wave Travel Time 2L/c (ms) 10.409

| Pile and Soil Model |        |        |       |       |      | Total Capacity Rut (kips) |        |       | 785.8 |       |      |
|---------------------|--------|--------|-------|-------|------|---------------------------|--------|-------|-------|-------|------|
| No.                 | Weight | Stiffn | C-Slk | T-Slk | CoR  | Soil-S                    | Soil-D | Quake | LbTop | Perim | Area |
|                     | kips   | k/in   | ft    | ft    |      | kips                      | s/ft   | inch  | ft    | ft    | in2  |
| 1                   | 0.295  | 19069  | 0.010 | 0.000 | 1.00 | 1.0                       | 0.056  | 0.100 | 3.31  | 4.8   | 26.1 |
| 2                   | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 6.3                       | 0.194  | 0.100 | 6.62  | 4.8   | 26.1 |
| 3                   | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 7.9                       | 0.200  | 0.100 | 9.92  | 4.8   | 26.1 |
| 18                  | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 7.9                       | 0.193  | 0.100 | 59.54 | 4.8   | 26.1 |
| 19                  | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 20.0                      | 0.052  | 0.100 | 62.85 | 4.8   | 26.1 |
| 20                  | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 25.9                      | 0.050  | 0.100 | 66.15 | 4.8   | 26.1 |
| 21                  | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 27.2                      | 0.050  | 0.100 | 69.46 | 4.8   | 26.1 |
| 22                  | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 28.5                      | 0.050  | 0.100 | 72.77 | 4.8   | 26.1 |
| 23                  | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 45.0                      | 0.050  | 0.100 | 76.08 | 4.8   | 26.1 |
| 24                  | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 64.6                      | 0.050  | 0.100 | 79.38 | 4.8   | 26.1 |
| 25                  | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 68.0                      | 0.050  | 0.100 | 82.69 | 4.8   | 26.1 |
| 26                  | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 71.5                      | 0.050  | 0.100 | 86.00 | 4.8   | 26.1 |
| Toe                 |        |        |       |       |      | 302.0                     | 0.150  | 0.100 |       |       |      |

7.669 kips total unreduced pile weight (g= 32.17 ft/s2)  
7.669 kips total reduced pile weight (g= 32.17 ft/s2)

| Depth | Stroke | Pressure | Efficy |
|-------|--------|----------|--------|
| ft    | ft     | Ratio    |        |
| 85.00 | 11.42  | 1.00     | 0.800  |

Abutment 2 NB H-Pile- Delmag D36-32  
HNTB Corporation

04/02/2020  
GRLWEAP Version 2010

| Rut<br>kips | Bl Ct<br>b/ft | Stroke<br>down | (ft)<br>up | Ten Str<br>ksi | i | t  | Comp Str<br>ksi | i | t | ENTHRU<br>kip-ft | Bl Rt<br>b/min |
|-------------|---------------|----------------|------------|----------------|---|----|-----------------|---|---|------------------|----------------|
| 785.8       | 278.4         | 9.23           | 9.19       | -0.14          | 2 | 46 | 40.09           | 2 | 2 | 44.1             | 39.0           |
| 760.9       | 190.8         | 9.21           | 9.18       | -0.19          | 2 | 46 | 39.89           | 2 | 2 | 44.6             | 39.0           |
| 736.0       | 139.2         | 9.18           | 9.14       | -0.24          | 3 | 47 | 39.62           | 2 | 2 | 45.2             | 39.1           |
| 711.1       | 111.4         | 9.13           | 9.12       | -0.32          | 3 | 47 | 39.27           | 2 | 2 | 45.3             | 39.1           |
| 686.2       | 88.3          | 9.09           | 9.05       | -0.46          | 7 | 49 | 39.03           | 2 | 2 | 46.1             | 39.2           |

Abutment 2 NB H-Pile- Delmag D36-32  
HNTB Corporation

04/02/2020  
GRLWEAP Version 2010

Depth (ft) 86.0 Standard Soil Setup  
Shaft Gain/Loss Factor 1.000 Toe Gain/Loss Factor 1.000

PILE PROFILE:

Toe Area (in2) 203.230 Pile Type H Pile  
Pile Size (inch) 14.690

| L b Top | Area  | E-Mod  | Spec Wt | Perim | C Index | Wave Sp | EA/c   |
|---------|-------|--------|---------|-------|---------|---------|--------|
| ft      | in2   | ksi    | lb/ft3  | ft    |         | ft/s    | k/ft/s |
| 0.0     | 26.10 | 29000. | 492.0   | 4.8   | 0       | 16524.  | 45.8   |
| 86.0    | 26.10 | 29000. | 492.0   | 4.8   | 0       | 16524.  | 45.8   |

Wave Travel Time 2L/c (ms) 10.409

| Pile and Soil Model |        |        |       |       |      | Total Capacity Rut (kips) |        |       | 808.2 |       |      |
|---------------------|--------|--------|-------|-------|------|---------------------------|--------|-------|-------|-------|------|
| No.                 | Weight | Stiffn | C-Slk | T-Slk | CoR  | Soil-S                    | Soil-D | Quake | LbTop | Perim | Area |
|                     | kips   | k/in   | ft    | ft    |      | kips                      | s/ft   | inch  | ft    | ft    | in2  |
| 1                   | 0.295  | 19069  | 0.010 | 0.000 | 1.00 | 2.1                       | 0.113  | 0.100 | 3.31  | 4.8   | 26.1 |
| 2                   | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 7.6                       | 0.200  | 0.100 | 6.62  | 4.8   | 26.1 |
| 3                   | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 7.9                       | 0.200  | 0.100 | 9.92  | 4.8   | 26.1 |
| 18                  | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 8.6                       | 0.144  | 0.100 | 59.54 | 4.8   | 26.1 |
| 19                  | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 24.5                      | 0.050  | 0.100 | 62.85 | 4.8   | 26.1 |
| 20                  | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 26.3                      | 0.050  | 0.100 | 66.15 | 4.8   | 26.1 |
| 21                  | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 27.6                      | 0.050  | 0.100 | 69.46 | 4.8   | 26.1 |
| 22                  | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 28.9                      | 0.050  | 0.100 | 72.77 | 4.8   | 26.1 |
| 23                  | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 55.3                      | 0.050  | 0.100 | 76.08 | 4.8   | 26.1 |
| 24                  | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 65.6                      | 0.050  | 0.100 | 79.38 | 4.8   | 26.1 |
| 25                  | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 69.1                      | 0.050  | 0.100 | 82.69 | 4.8   | 26.1 |
| 26                  | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 72.6                      | 0.050  | 0.100 | 86.00 | 4.8   | 26.1 |
| Toe                 |        |        |       |       |      | 302.0                     | 0.150  | 0.100 |       |       |      |

7.669 kips total unreduced pile weight (g= 32.17 ft/s2)  
7.669 kips total reduced pile weight (g= 32.17 ft/s2)

| Depth | Stroke | Pressure | Efficy |
|-------|--------|----------|--------|
| ft    | ft     | Ratio    |        |
| 86.00 | 11.42  | 1.00     | 0.800  |

Abutment 2 NB H-Pile- Delmag D36-32  
HNTB Corporation

04/02/2020  
GRLWEAP Version 2010

| Rut<br>kips | Bl Ct<br>b/ft | Stroke<br>down | (ft)<br>up | Ten Str<br>ksi | i | t  | Comp Str<br>ksi | i | t | ENTHRU<br>kip-ft | Bl Rt<br>b/min |
|-------------|---------------|----------------|------------|----------------|---|----|-----------------|---|---|------------------|----------------|
| 808.2       | 355.4         | 9.22           | 9.21       | -0.08          | 2 | 45 | 40.14           | 2 | 2 | 43.8             | 39.0           |
| 782.5       | 237.5         | 9.23           | 9.21       | -0.14          | 2 | 46 | 40.00           | 2 | 2 | 44.4             | 38.9           |
| 756.8       | 168.0         | 9.21           | 9.20       | -0.19          | 2 | 46 | 39.73           | 2 | 2 | 44.9             | 39.0           |
| 731.2       | 125.7         | 9.16           | 9.15       | -0.25          | 3 | 47 | 39.51           | 2 | 2 | 45.4             | 39.1           |
| 705.5       | 99.8          | 9.12           | 9.10       | -0.40          | 7 | 48 | 39.16           | 2 | 2 | 45.8             | 39.1           |



SUMMARY OVER DEPTHS

| G/L at Shaft and Toe: 1.000 1.000 |       |        |        |        |         |         |        |        |
|-----------------------------------|-------|--------|--------|--------|---------|---------|--------|--------|
| Depth                             | Rut   | Frictn | End Bg | Bl Ct  | Com Str | Ten Str | Stroke | ENTHRU |
| ft                                | kips  | kips   | kips   | bl/ft  | ksi     | ksi     | ft     | kip-ft |
| 5.0                               | 15.2  | 5.8    | 9.3    | Hammer | did not | run     |        |        |
| 10.0                              | 26.6  | 17.7   | 8.9    | 1.5    | 13.147  | -1.705  | 3.98   | 50.3   |
| 15.0                              | 38.5  | 29.6   | 8.9    | 1.9    | 15.687  | -2.371  | 4.35   | 52.8   |
| 20.0                              | 50.4  | 41.5   | 8.9    | 2.3    | 18.757  | -2.247  | 4.63   | 51.6   |
| 25.0                              | 62.3  | 53.4   | 8.9    | 2.9    | 20.555  | -2.021  | 4.85   | 49.4   |
| 30.0                              | 74.2  | 65.3   | 8.9    | 3.6    | 22.234  | -2.219  | 5.13   | 48.3   |
| 35.0                              | 86.0  | 77.2   | 8.9    | 4.3    | 23.447  | -2.636  | 5.34   | 46.9   |
| 40.0                              | 97.9  | 89.0   | 8.9    | 5.1    | 24.506  | -2.889  | 5.53   | 45.8   |
| 45.0                              | 109.8 | 100.9  | 8.9    | 5.9    | 25.300  | -3.030  | 5.67   | 44.4   |
| 50.0                              | 121.7 | 112.8  | 8.9    | 6.7    | 26.367  | -3.234  | 5.87   | 43.8   |
| 55.0                              | 133.6 | 124.7  | 8.9    | 7.4    | 27.388  | -3.400  | 6.05   | 43.0   |
| 60.0                              | 160.7 | 139.1  | 21.6   | 8.9    | 28.781  | -2.289  | 6.35   | 41.9   |
| 65.0                              | 204.3 | 177.8  | 26.5   | 11.3   | 30.422  | -1.177  | 6.68   | 41.1   |
| 70.0                              | 245.9 | 219.3  | 26.5   | 13.8   | 31.788  | -1.442  | 7.02   | 40.7   |
| 75.0                              | 563.3 | 278.2  | 285.1  | 56.3   | 37.620  | -0.698  | 8.68   | 43.6   |
| 80.0                              | 679.1 | 377.0  | 302.0  | 109.4  | 38.907  | -0.417  | 9.03   | 44.2   |
| 85.0                              | 785.8 | 483.8  | 302.0  | 278.4  | 40.088  | -0.136  | 9.23   | 44.1   |
| 86.0                              | 808.2 | 506.1  | 302.0  | 355.4  | 40.137  | -0.080  | 9.22   | 43.8   |

Total Driving Time 55 minutes;  
Starting at penetration 5.0 ft

Total No. of Blows 2217

| G/L at Shaft and Toe: 0.900 1.000 |       |        |        |        |         |         |        |        |
|-----------------------------------|-------|--------|--------|--------|---------|---------|--------|--------|
| Depth                             | Rut   | Frictn | End Bg | Bl Ct  | Com Str | Ten Str | Stroke | ENTHRU |
| ft                                | kips  | kips   | kips   | bl/ft  | ksi     | ksi     | ft     | kip-ft |
| 5.0                               | 14.7  | 5.3    | 9.3    | Hammer | did not | run     |        |        |
| 10.0                              | 24.9  | 16.0   | 8.9    | 1.5    | 12.694  | -1.474  | 3.93   | 49.4   |
| 15.0                              | 35.6  | 26.7   | 8.9    | 1.8    | 15.159  | -2.318  | 4.28   | 53.0   |
| 20.0                              | 46.3  | 37.4   | 8.9    | 2.1    | 17.848  | -2.295  | 4.54   | 51.9   |
| 25.0                              | 57.0  | 48.1   | 8.9    | 2.6    | 20.091  | -2.043  | 4.79   | 50.6   |
| 30.0                              | 67.7  | 58.8   | 8.9    | 3.3    | 21.524  | -2.210  | 5.01   | 49.0   |
| 35.0                              | 78.4  | 69.5   | 8.9    | 3.9    | 22.744  | -2.637  | 5.21   | 47.7   |
| 40.0                              | 89.1  | 80.2   | 8.9    | 4.5    | 23.829  | -2.930  | 5.40   | 46.6   |
| 45.0                              | 99.8  | 90.9   | 8.9    | 5.2    | 24.811  | -3.129  | 5.57   | 45.6   |
| 50.0                              | 110.5 | 101.6  | 8.9    | 6.0    | 25.528  | -3.274  | 5.69   | 44.4   |
| 55.0                              | 121.2 | 112.3  | 8.9    | 6.7    | 26.550  | -3.471  | 5.88   | 43.8   |
| 60.0                              | 147.3 | 125.7  | 21.6   | 8.0    | 28.000  | -2.264  | 6.18   | 42.5   |
| 65.0                              | 189.6 | 163.1  | 26.5   | 10.0   | 29.636  | -1.187  | 6.51   | 41.4   |
| 70.0                              | 229.8 | 203.2  | 26.5   | 12.2   | 31.134  | -1.150  | 6.87   | 41.2   |
| 75.0                              | 545.3 | 260.2  | 285.1  | 50.5   | 37.234  | -0.762  | 8.59   | 43.5   |
| 80.0                              | 657.7 | 355.7  | 302.0  | 91.0   | 38.706  | -0.526  | 8.99   | 44.6   |
| 85.0                              | 760.9 | 458.9  | 302.0  | 190.8  | 39.890  | -0.189  | 9.21   | 44.6   |
| 86.0                              | 782.5 | 480.5  | 302.0  | 237.5  | 40.005  | -0.140  | 9.23   | 44.4   |

Total Driving Time 42 minutes;  
Starting at penetration 5.0 ft

Total No. of Blows 1736

SUMMARY OVER DEPTHS

| G/L at Shaft and Toe: 0.800 1.000 |       |        |        |        |         |         |        |        |  |
|-----------------------------------|-------|--------|--------|--------|---------|---------|--------|--------|--|
| Depth                             | Rut   | Frictn | End Bg | Bl Ct  | Com Str | Ten Str | Stroke | ENTHRU |  |
| ft                                | kips  | kips   | kips   | bl/ft  | ksi     | ksi     | ft     | kip-ft |  |
| 5.0                               | 14.2  | 4.8    | 9.3    | Hammer | did not | run     |        |        |  |
| 10.0                              | 23.2  | 14.4   | 8.9    | Hammer | did not | run     |        |        |  |
| 15.0                              | 32.7  | 23.9   | 8.9    | 1.7    | 14.744  | -2.284  | 4.20   | 52.5   |  |
| 20.0                              | 42.3  | 33.4   | 8.9    | 2.0    | 16.798  | -2.310  | 4.44   | 52.4   |  |
| 25.0                              | 51.8  | 42.9   | 8.9    | 2.4    | 19.084  | -2.115  | 4.67   | 51.4   |  |
| 30.0                              | 61.3  | 52.4   | 8.9    | 2.9    | 20.744  | -2.145  | 4.88   | 49.9   |  |
| 35.0                              | 70.8  | 61.9   | 8.9    | 3.4    | 21.918  | -2.549  | 5.07   | 48.6   |  |
| 40.0                              | 80.3  | 71.4   | 8.9    | 4.0    | 23.022  | -2.928  | 5.25   | 47.4   |  |
| 45.0                              | 89.8  | 80.9   | 8.9    | 4.6    | 23.947  | -3.177  | 5.40   | 46.4   |  |
| 50.0                              | 99.3  | 90.4   | 8.9    | 5.1    | 24.883  | -3.372  | 5.57   | 45.5   |  |
| 55.0                              | 108.8 | 99.9   | 8.9    | 5.8    | 25.578  | -3.481  | 5.67   | 44.5   |  |
| 60.0                              | 133.9 | 112.3  | 21.6   | 7.2    | 27.156  | -2.267  | 6.00   | 43.2   |  |
| 65.0                              | 174.9 | 148.4  | 26.5   | 8.9    | 28.805  | -1.180  | 6.33   | 41.9   |  |
| 70.0                              | 213.7 | 187.1  | 26.5   | 10.9   | 30.100  | -0.994  | 6.62   | 41.3   |  |
| 75.0                              | 527.2 | 242.1  | 285.1  | 45.3   | 36.892  | -0.644  | 8.51   | 43.6   |  |
| 80.0                              | 636.4 | 334.3  | 302.0  | 76.7   | 38.450  | -0.600  | 8.93   | 44.8   |  |
| 85.0                              | 736.0 | 434.0  | 302.0  | 139.2  | 39.620  | -0.239  | 9.18   | 45.2   |  |
| 86.0                              | 756.8 | 454.8  | 302.0  | 168.0  | 39.727  | -0.194  | 9.21   | 44.9   |  |

Total Driving Time 34 minutes; Total No. of Blows 1405  
Starting at penetration 5.0 ft

| G/L at Shaft and Toe: 0.700 1.000 |       |        |        |        |         |         |        |        |  |
|-----------------------------------|-------|--------|--------|--------|---------|---------|--------|--------|--|
| Depth                             | Rut   | Frictn | End Bg | Bl Ct  | Com Str | Ten Str | Stroke | ENTHRU |  |
| ft                                | kips  | kips   | kips   | bl/ft  | ksi     | ksi     | ft     | kip-ft |  |
| 5.0                               | 13.7  | 4.3    | 9.3    | Hammer | did not | run     |        |        |  |
| 10.0                              | 21.5  | 12.7   | 8.9    | Hammer | did not | run     |        |        |  |
| 15.0                              | 29.9  | 21.0   | 8.9    | 1.6    | 14.152  | -2.138  | 4.12   | 51.8   |  |
| 20.0                              | 38.2  | 29.3   | 8.9    | 1.8    | 15.702  | -2.319  | 4.35   | 52.9   |  |
| 25.0                              | 46.5  | 37.6   | 8.9    | 2.1    | 17.845  | -2.248  | 4.54   | 51.8   |  |
| 30.0                              | 54.8  | 45.9   | 8.9    | 2.5    | 19.737  | -2.059  | 4.74   | 50.9   |  |
| 35.0                              | 63.1  | 54.3   | 8.9    | 3.0    | 21.048  | -2.446  | 4.92   | 49.6   |  |
| 40.0                              | 71.5  | 62.6   | 8.9    | 3.5    | 22.083  | -2.818  | 5.09   | 48.4   |  |
| 45.0                              | 79.8  | 70.9   | 8.9    | 4.0    | 23.059  | -3.164  | 5.25   | 47.4   |  |
| 50.0                              | 88.1  | 79.2   | 8.9    | 4.5    | 23.947  | -3.290  | 5.39   | 46.5   |  |
| 55.0                              | 96.4  | 87.5   | 8.9    | 5.0    | 24.831  | -3.534  | 5.53   | 45.8   |  |
| 60.0                              | 120.4 | 98.9   | 21.6   | 6.4    | 26.201  | -2.330  | 5.80   | 43.9   |  |
| 65.0                              | 160.2 | 133.6  | 26.5   | 7.9    | 27.882  | -1.108  | 6.14   | 42.5   |  |
| 70.0                              | 197.6 | 171.0  | 26.5   | 9.6    | 29.287  | -0.985  | 6.43   | 41.8   |  |
| 75.0                              | 509.1 | 224.0  | 285.1  | 40.7   | 36.436  | -0.521  | 8.41   | 43.7   |  |
| 80.0                              | 615.0 | 313.0  | 302.0  | 64.9   | 38.160  | -0.658  | 8.85   | 45.1   |  |
| 85.0                              | 711.1 | 409.1  | 302.0  | 111.4  | 39.269  | -0.321  | 9.13   | 45.3   |  |
| 86.0                              | 731.2 | 429.2  | 302.0  | 125.7  | 39.509  | -0.254  | 9.16   | 45.4   |  |

Total Driving Time 28 minutes; Total No. of Blows 1185  
Starting at penetration 5.0 ft

SUMMARY OVER DEPTHS

| G/L at Shaft and Toe: 0.600 1.000 |       |        |        |        |         |         |        |        |  |
|-----------------------------------|-------|--------|--------|--------|---------|---------|--------|--------|--|
| Depth                             | Rut   | Frictn | End Bg | Bl Ct  | Com Str | Ten Str | Stroke | ENTHRU |  |
| ft                                | kips  | kips   | kips   | bl/ft  | ksi     | ksi     | ft     | kip-ft |  |
| 5.0                               | 13.1  | 3.8    | 9.3    | Hammer | did not | run     |        |        |  |
| 10.0                              | 19.9  | 11.0   | 8.9    | Hammer | did not | run     |        |        |  |
| 15.0                              | 27.0  | 18.1   | 8.9    | 1.6    | 13.421  | -1.930  | 4.03   | 50.8   |  |
| 20.0                              | 34.1  | 25.2   | 8.9    | 1.7    | 14.896  | -2.319  | 4.24   | 52.7   |  |
| 25.0                              | 41.3  | 32.4   | 8.9    | 1.9    | 16.560  | -2.281  | 4.42   | 52.5   |  |
| 30.0                              | 48.4  | 39.5   | 8.9    | 2.2    | 18.385  | -2.176  | 4.60   | 51.7   |  |
| 35.0                              | 55.5  | 46.6   | 8.9    | 2.6    | 19.869  | -2.311  | 4.77   | 50.7   |  |
| 40.0                              | 62.6  | 53.8   | 8.9    | 3.0    | 21.062  | -2.654  | 4.92   | 49.7   |  |
| 45.0                              | 69.8  | 60.9   | 8.9    | 3.4    | 22.001  | -2.985  | 5.06   | 48.6   |  |
| 50.0                              | 76.9  | 68.0   | 8.9    | 3.8    | 22.929  | -3.231  | 5.21   | 47.8   |  |
| 55.0                              | 84.0  | 75.1   | 8.9    | 4.2    | 23.728  | -3.434  | 5.34   | 46.9   |  |
| 60.0                              | 107.0 | 85.4   | 21.6   | 5.4    | 25.427  | -2.258  | 5.65   | 45.3   |  |
| 65.0                              | 145.5 | 118.9  | 26.5   | 7.1    | 26.977  | -1.188  | 5.94   | 43.4   |  |
| 70.0                              | 181.5 | 154.9  | 26.5   | 8.5    | 28.349  | -0.954  | 6.23   | 42.3   |  |
| 75.0                              | 491.1 | 206.0  | 285.1  | 36.6   | 35.998  | -0.801  | 8.30   | 43.8   |  |
| 80.0                              | 593.6 | 291.6  | 302.0  | 56.0   | 37.741  | -0.609  | 8.77   | 45.4   |  |
| 85.0                              | 686.2 | 384.2  | 302.0  | 88.3   | 39.034  | -0.465  | 9.09   | 46.1   |  |
| 86.0                              | 705.5 | 403.5  | 302.0  | 99.8   | 39.162  | -0.395  | 9.12   | 45.8   |  |

Total Driving Time 24 minutes;  
Starting at penetration 5.0 ft

Total No. of Blows 1002

Table of Depths Analyzed with Driving System Modifiers

| Depth | Temp.<br>Length | Wait<br>Time | Equivalent<br>Stroke | Pressure<br>Ratio | Efficy. | Stiffn.<br>Factor | Cushion<br>CoR |
|-------|-----------------|--------------|----------------------|-------------------|---------|-------------------|----------------|
| ft    | ft              | hr           | ft                   |                   |         |                   |                |
| 5.00  | 86.00           | 0.00         | 11.42                | 1.00              | 0.80    | 1.00              | 1.00           |
| 10.00 | 86.00           | 0.00         | 11.42                | 1.00              | 0.80    | 1.00              | 1.00           |
| 15.00 | 86.00           | 0.00         | 11.42                | 1.00              | 0.80    | 1.00              | 1.00           |
| 20.00 | 86.00           | 0.00         | 11.42                | 1.00              | 0.80    | 1.00              | 1.00           |
| 25.00 | 86.00           | 0.00         | 11.42                | 1.00              | 0.80    | 1.00              | 1.00           |
| 30.00 | 86.00           | 0.00         | 11.42                | 1.00              | 0.80    | 1.00              | 1.00           |
| 35.00 | 86.00           | 0.00         | 11.42                | 1.00              | 0.80    | 1.00              | 1.00           |
| 40.00 | 86.00           | 0.00         | 11.42                | 1.00              | 0.80    | 1.00              | 1.00           |
| 45.00 | 86.00           | 0.00         | 11.42                | 1.00              | 0.80    | 1.00              | 1.00           |
| 50.00 | 86.00           | 0.00         | 11.42                | 1.00              | 0.80    | 1.00              | 1.00           |
| 55.00 | 86.00           | 0.00         | 11.42                | 1.00              | 0.80    | 1.00              | 1.00           |
| 60.00 | 86.00           | 0.00         | 11.42                | 1.00              | 0.80    | 1.00              | 1.00           |
| 65.00 | 86.00           | 0.00         | 11.42                | 1.00              | 0.80    | 1.00              | 1.00           |
| 70.00 | 86.00           | 0.00         | 11.42                | 1.00              | 0.80    | 1.00              | 1.00           |
| 75.00 | 86.00           | 0.00         | 11.42                | 1.00              | 0.80    | 1.00              | 1.00           |
| 80.00 | 86.00           | 0.00         | 11.42                | 1.00              | 0.80    | 1.00              | 1.00           |
| 85.00 | 86.00           | 0.00         | 11.42                | 1.00              | 0.80    | 1.00              | 1.00           |
| 86.00 | 86.00           | 0.00         | 11.42                | 1.00              | 0.80    | 1.00              | 1.00           |

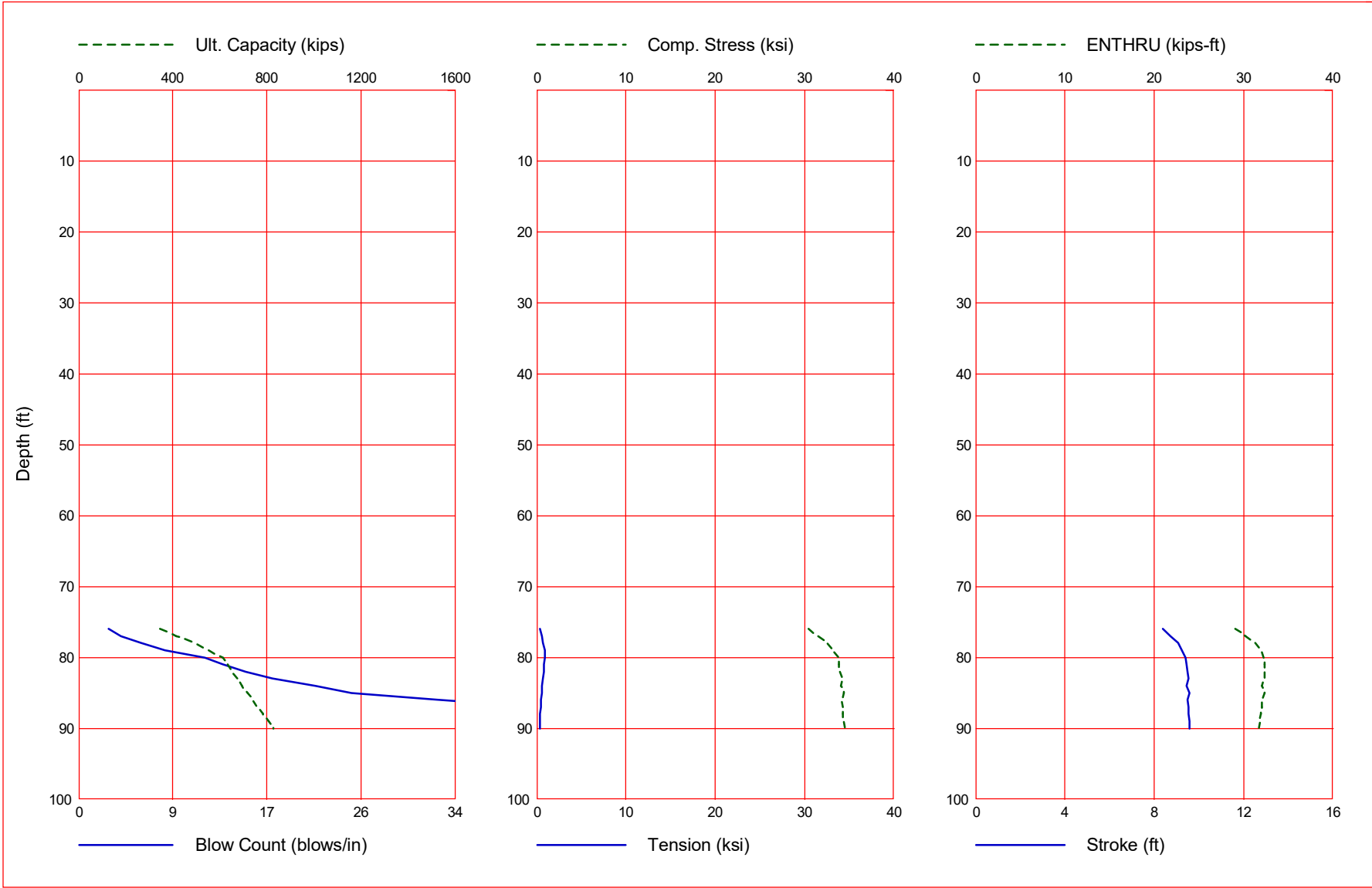
Soil Layer Resistance Values

| Depth | Shaft<br>Res. | End<br>Bearing | Shaft<br>Quake | Toe<br>Quake | Shaft<br>Damping | Toe<br>Damping | Soil<br>Setup | Limit<br>Distance | Setup<br>Time |
|-------|---------------|----------------|----------------|--------------|------------------|----------------|---------------|-------------------|---------------|
| ft    | k/ft2         | kips           | inch           | inch         | s/ft             | s/ft           | Normlzd       | ft                | hrs           |
| 0.00  | 0.00          | 3.10           | 0.100          | 0.100        | 0.050            | 0.150          | 0.333         | 6.560             | 1.000         |
| 1.00  | 0.08          | 5.36           | 0.100          | 0.100        | 0.050            | 0.150          | 0.333         | 6.560             | 1.000         |
| 2.00  | 0.16          | 7.34           | 0.100          | 0.100        | 0.050            | 0.150          | 0.333         | 6.560             | 1.000         |
| 3.00  | 0.24          | 9.60           | 0.100          | 0.100        | 0.200            | 0.150          | 1.000         | 6.560             | 1.000         |
| 4.00  | 0.50          | 10.16          | 0.100          | 0.100        | 0.200            | 0.150          | 1.000         | 6.560             | 1.000         |
| 5.00  | 0.50          | 9.31           | 0.100          | 0.100        | 0.200            | 0.150          | 1.000         | 6.560             | 1.000         |
| 6.00  | 0.50          | 8.89           | 0.100          | 0.100        | 0.200            | 0.150          | 1.000         | 6.560             | 1.000         |
| 7.00  | 0.50          | 8.89           | 0.100          | 0.100        | 0.200            | 0.150          | 1.000         | 6.560             | 1.000         |
| 8.00  | 0.50          | 8.89           | 0.100          | 0.100        | 0.200            | 0.150          | 1.000         | 6.560             | 1.000         |
| 9.00  | 0.50          | 8.89           | 0.100          | 0.100        | 0.200            | 0.150          | 1.000         | 6.560             | 1.000         |
| 10.00 | 0.50          | 8.89           | 0.100          | 0.100        | 0.200            | 0.150          | 1.000         | 6.560             | 1.000         |
| 11.00 | 0.50          | 8.89           | 0.100          | 0.100        | 0.200            | 0.150          | 1.000         | 6.560             | 1.000         |
| 12.00 | 0.50          | 8.89           | 0.100          | 0.100        | 0.200            | 0.150          | 1.000         | 6.560             | 1.000         |
| 13.00 | 0.50          | 8.89           | 0.100          | 0.100        | 0.200            | 0.150          | 1.000         | 6.560             | 1.000         |
| 14.00 | 0.50          | 8.89           | 0.100          | 0.100        | 0.200            | 0.150          | 1.000         | 6.560             | 1.000         |
| 15.00 | 0.50          | 8.89           | 0.100          | 0.100        | 0.200            | 0.150          | 1.000         | 6.560             | 1.000         |
| 16.00 | 0.50          | 8.89           | 0.100          | 0.100        | 0.200            | 0.150          | 1.000         | 6.560             | 1.000         |
| 17.00 | 0.50          | 8.89           | 0.100          | 0.100        | 0.200            | 0.150          | 1.000         | 6.560             | 1.000         |
| 18.00 | 0.50          | 8.89           | 0.100          | 0.100        | 0.200            | 0.150          | 1.000         | 6.560             | 1.000         |
| 19.00 | 0.50          | 8.89           | 0.100          | 0.100        | 0.200            | 0.150          | 1.000         | 6.560             | 1.000         |
| 20.00 | 0.50          | 8.89           | 0.100          | 0.100        | 0.200            | 0.150          | 1.000         | 6.560             | 1.000         |
| 21.00 | 0.50          | 8.89           | 0.100          | 0.100        | 0.200            | 0.150          | 1.000         | 6.560             | 1.000         |
| 22.00 | 0.50          | 8.89           | 0.100          | 0.100        | 0.200            | 0.150          | 1.000         | 6.560             | 1.000         |
| 23.00 | 0.50          | 8.89           | 0.100          | 0.100        | 0.200            | 0.150          | 1.000         | 6.560             | 1.000         |
| 24.00 | 0.50          | 8.89           | 0.100          | 0.100        | 0.200            | 0.150          | 1.000         | 6.560             | 1.000         |

[illegible]

|       |      |        |       |       |       |       |       |       |       |
|-------|------|--------|-------|-------|-------|-------|-------|-------|-------|
| 84.00 | 4.59 | 302.02 | 0.100 | 0.100 | 0.050 | 0.150 | 0.333 | 6.560 | 1.000 |
| 85.00 | 4.66 | 302.02 | 0.100 | 0.100 | 0.050 | 0.150 | 0.333 | 6.560 | 1.000 |
| 86.00 | 4.73 | 302.02 | 0.100 | 0.100 | 0.050 | 0.150 | 0.333 | 6.560 | 1.000 |

Gain/Loss 1 at Shaft and Toe 1.000 / 1.000



Gain/Loss 1 at Shaft and Toe 1.000 / 1.000

| Depth<br>ft | Ultimate<br>Capacity<br>kips | Friction<br>kips | End<br>Bearing<br>kips | Blow<br>Count<br>blows/in | Comp.<br>Stress<br>ksi | Tension<br>Stress<br>ksi | Stroke<br>ft | ENTHRU<br>kips-ft |
|-------------|------------------------------|------------------|------------------------|---------------------------|------------------------|--------------------------|--------------|-------------------|
| 76.0        | 344.4                        | 241.1            | 103.3                  | 2.7                       | 30.480                 | -0.410                   | 8.39         | 29.1              |
| 77.0        | 416.8                        | 253.0            | 163.9                  | 3.8                       | 31.555                 | -0.638                   | 8.74         | 30.2              |
| 78.0        | 494.4                        | 270.0            | 224.4                  | 5.7                       | 32.584                 | -0.723                   | 9.07         | 31.3              |
| 79.0        | 552.9                        | 289.7            | 263.2                  | 7.8                       | 33.230                 | -0.861                   | 9.25         | 31.9              |
| 80.0        | 611.8                        | 309.8            | 302.0                  | 11.4                      | 33.711                 | -0.908                   | 9.40         | 32.3              |
| 81.0        | 632.2                        | 330.2            | 302.0                  | 13.1                      | 33.886                 | -0.836                   | 9.45         | 32.4              |
| 82.0        | 653.0                        | 350.9            | 302.0                  | 15.1                      | 33.994                 | -0.754                   | 9.48         | 32.4              |
| 83.0        | 674.0                        | 372.0            | 302.0                  | 17.5                      | 34.142                 | -0.658                   | 9.53         | 32.4              |
| 84.0        | 695.3                        | 393.3            | 302.0                  | 21.4                      | 34.040                 | -0.596                   | 9.46         | 32.1              |
| 85.0        | 717.0                        | 415.0            | 302.0                  | 24.6                      | 34.364                 | -0.538                   | 9.58         | 32.4              |
| 86.0        | 739.0                        | 436.9            | 302.0                  | 32.4                      | 34.217                 | -0.528                   | 9.51         | 32.0              |
| 87.0        | 761.3                        | 459.2            | 302.0                  | 41.6                      | 34.262                 | -0.497                   | 9.53         | 32.0              |
| 88.0        | 783.9                        | 481.9            | 302.0                  | 59.7                      | 34.288                 | -0.426                   | 9.55         | 31.9              |
| 89.0        | 806.8                        | 504.8            | 302.0                  | 101.8                     | 34.354                 | -0.416                   | 9.56         | 31.8              |
| 90.0        | 830.1                        | 528.1            | 302.0                  | 295.7                     | 34.521                 | -0.394                   | 9.58         | 31.7              |

Total Continuous Driving Time 158.00 minutes; Total Number of Blows 6062 (starting at penetration 76.0 ft)



GRLWEAP - Version 2010  
WAVE EQUATION ANALYSIS OF PILE FOUNDATIONS

written by GRL Engineers, Inc. (formerly Goble Rausche Likins and Associates, Inc.) with cooperation from Pile Dynamics, Inc.  
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ABOUT THE WAVE EQUATION ANALYSIS RESULTS

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

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

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

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

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

Input File: T:\75297 MAINEDOT I-295 VERANDA FINAL DESIGN\GEOTECH\CALCS\DEEP FOUNDATIONS  
 \FILES\2020-02-21 DRIVEABILITY ANALYSIS\GRLWEAP\66 K-FT DELMAG D 25-32\ABUTMENT 2 SB FILES  
 DRIVEABILITY\_2020-02-21.GWW  
 Hammer File: C:\ProgramData\PDI\GRLWEAP\2010\Resource\HAMMER2010.GW  
 Hammer File Version: 2003 (12/4/2018)

# Input File Contents

```

  Abutment 2 SB H-Pile- Delmag D25-32
OUT OSG HAM STR FUL PEL N SPL N-U P-D %SK ISM 0 PHI RSA ITR H-D MXT DEx
-100 0 10 0 1 0 0 0 0 3 0 0 0 0 0 0 0 0.000
  File g Hammer g Toe Area Pile Size Pile Type
  32.170 32.170 203.230 14.690 H Pile
    W Cp A Cp E Cp T Cp CoR ROut StCp
    1.900 227.000 530.0 2.000 0.800 0.010 0.0
    A Cu E Cu T Cu CoR ROut StCu
    0.000 0.0 0.000 0.000 0.000 0.0
    LPle APle EPle WPle Peri CI CoR ROut
    90.000 26.10 29000.0 492.000 4.754 0 1.000 0.010
  FFatigue F0 0-Bottom
    0 0.000 0.000
Manufac Hmr Name HmrType No Seg-s
DELMAG D 25-32 1 3
  Ram Wt Ram L Ram Dia MaxStrk RtdStrk Efficy
    5.51 123.20 16.51 13.76 12.04 0.80
  IB. Wt IB. L IB.Dia IB CoR IB RO
    1.36 28.15 16.51 0.900 0.010
CompStrk A Chamber V Chamber C Delay C Duratn Exp Coeff VolCStart Vol CEnd
    14.72 214.03 257.40 0.0005 0.0020 1.250 0.00 0.00
  P atm P1 P2 P3 P4 P5
    14.70 1500.00 1350.00 1215.00 1095.00 0.00
  Stroke Effic. Pressure R-Weight T-Delay Exp-Coeff Eps-Str Total-AW
    12.0400 0.8000 1500.0000 0.0000 0.0000 0.0000 0.0100 0.0000
    Qs Qt Js Jt Qx Jx Rati Dept
    0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000
Research Soil Model: Atoe, Plug, Gap, Q-fac
    0.000 0.000 0.000 0.000
Research Soil Model: RD-skn: m, d, toe: m, d
    0.000 0.000 0.000 0.000
Research Toe Plug: Res-int, Q-int, D-int, Res-plug, Q-plug, D-plug
    0.000 0.000 0.000 0.000 0.000 0.000
Research Toe Plug: RD plug toe: m, d
    0.000 0.000
Research Toe Plug: New Toe Plug Model is NOT applied
Res. Distribution
  Dpth Rskn Rtoe Qs Qt Js Jt SU F LimL TSf0
    0.00 0.00 3.10 0.10 0.10 0.05 0.15 1.20 6.56 1.000
    2.00 0.16 10.87 0.10 0.10 0.05 0.15 1.20 6.56 1.000
    4.00 0.30 21.03 0.10 0.10 0.05 0.15 1.20 6.56 1.000
    6.00 0.37 21.31 0.10 0.10 0.05 0.15 1.20 6.56 1.000
    8.00 0.50 14.40 0.10 0.10 0.20 0.15 2.00 6.56 1.000
    10.00 0.50 8.89 0.10 0.10 0.20 0.15 2.00 6.56 1.000
    12.00 0.50 8.89 0.10 0.10 0.20 0.15 2.00 6.56 1.000
    14.00 0.50 8.89 0.10 0.10 0.20 0.15 2.00 6.56 1.000
    16.00 0.50 8.89 0.10 0.10 0.20 0.15 2.00 6.56 1.000
    18.00 0.50 8.89 0.10 0.10 0.20 0.15 2.00 6.56 1.000
    20.00 0.50 8.89 0.10 0.10 0.20 0.15 2.00 6.56 1.000
    22.00 0.50 8.89 0.10 0.10 0.20 0.15 2.00 6.56 1.000
    24.00 0.50 8.89 0.10 0.10 0.20 0.15 2.00 6.56 1.000
    26.00 0.50 8.89 0.10 0.10 0.20 0.15 2.00 6.56 1.000
    28.00 0.50 8.89 0.10 0.10 0.20 0.15 2.00 6.56 1.000
    30.00 0.50 8.89 0.10 0.10 0.20 0.15 2.00 6.56 1.000
    32.00 0.50 8.89 0.10 0.10 0.20 0.15 2.00 6.56 1.000
    34.00 0.50 8.89 0.10 0.10 0.20 0.15 2.00 6.56 1.000
    36.00 0.50 8.89 0.10 0.10 0.20 0.15 2.00 6.56 1.000

```

|                                  |         |         |         |         |       |       |       |      |       |
|----------------------------------|---------|---------|---------|---------|-------|-------|-------|------|-------|
| 38.00                            | 0.50    | 8.89    | 0.10    | 0.10    | 0.20  | 0.15  | 2.00  | 6.56 | 1.000 |
| 40.00                            | 0.50    | 8.89    | 0.10    | 0.10    | 0.20  | 0.15  | 2.00  | 6.56 | 1.000 |
| 42.00                            | 0.50    | 8.89    | 0.10    | 0.10    | 0.20  | 0.15  | 2.00  | 6.56 | 1.000 |
| 44.00                            | 0.50    | 8.89    | 0.10    | 0.10    | 0.20  | 0.15  | 2.00  | 6.56 | 1.000 |
| 46.00                            | 0.50    | 8.89    | 0.10    | 0.10    | 0.20  | 0.15  | 2.00  | 6.56 | 1.000 |
| 48.00                            | 0.50    | 8.89    | 0.10    | 0.10    | 0.20  | 0.15  | 2.00  | 6.56 | 1.000 |
| 50.00                            | 0.50    | 8.89    | 0.10    | 0.10    | 0.20  | 0.15  | 2.00  | 6.56 | 1.000 |
| 52.00                            | 0.50    | 8.89    | 0.10    | 0.10    | 0.20  | 0.15  | 2.00  | 6.56 | 1.000 |
| 54.00                            | 0.50    | 8.89    | 0.10    | 0.10    | 0.20  | 0.15  | 2.00  | 6.56 | 1.000 |
| 56.00                            | 0.50    | 8.89    | 0.10    | 0.10    | 0.20  | 0.15  | 2.00  | 6.56 | 1.000 |
| 58.00                            | 0.50    | 8.89    | 0.10    | 0.10    | 0.20  | 0.15  | 2.00  | 6.56 | 1.000 |
| 60.00                            | 0.50    | 8.89    | 0.10    | 0.10    | 0.20  | 0.15  | 2.00  | 6.56 | 1.000 |
| 62.00                            | 0.50    | 8.89    | 0.10    | 0.10    | 0.20  | 0.15  | 2.00  | 6.56 | 1.000 |
| 64.00                            | 0.50    | 13.83   | 0.10    | 0.10    | 0.20  | 0.15  | 2.00  | 6.56 | 1.000 |
| 66.00                            | 1.71    | 21.59   | 0.10    | 0.10    | 0.05  | 0.15  | 1.20  | 6.56 | 1.000 |
| 68.00                            | 1.76    | 26.53   | 0.10    | 0.10    | 0.05  | 0.15  | 1.20  | 6.56 | 1.000 |
| 70.00                            | 1.81    | 26.53   | 0.10    | 0.10    | 0.05  | 0.15  | 1.20  | 6.56 | 1.000 |
| 72.00                            | 1.86    | 26.53   | 0.10    | 0.10    | 0.05  | 0.15  | 1.20  | 6.56 | 1.000 |
| 74.00                            | 1.91    | 26.53   | 0.10    | 0.10    | 0.05  | 0.15  | 1.20  | 6.56 | 1.000 |
| 76.00                            | 1.95    | 103.31  | 0.10    | 0.10    | 0.05  | 0.15  | 1.20  | 6.56 | 1.000 |
| 78.00                            | 4.12    | 224.40  | 0.10    | 0.10    | 0.05  | 0.15  | 1.20  | 6.56 | 1.000 |
| 80.00                            | 4.26    | 302.02  | 0.10    | 0.10    | 0.05  | 0.15  | 1.20  | 6.56 | 1.000 |
| 82.00                            | 4.39    | 302.02  | 0.10    | 0.10    | 0.05  | 0.15  | 1.20  | 6.56 | 1.000 |
| 84.00                            | 4.52    | 302.02  | 0.10    | 0.10    | 0.05  | 0.15  | 1.20  | 6.56 | 1.000 |
| 86.00                            | 4.66    | 302.02  | 0.10    | 0.10    | 0.05  | 0.15  | 1.20  | 6.56 | 1.000 |
| 88.00                            | 4.79    | 302.02  | 0.10    | 0.10    | 0.05  | 0.15  | 1.20  | 6.56 | 1.000 |
| 90.00                            | 4.93    | 302.02  | 0.10    | 0.10    | 0.05  | 0.15  | 1.20  | 6.56 | 1.000 |
| Gain/Loss factors: shaft and toe |         |         |         |         |       |       |       |      |       |
| 1.00000                          | 0.90000 | 0.80000 | 0.70000 | 0.60000 |       |       |       |      |       |
| 1.00000                          | 1.00000 | 1.00000 | 1.00000 | 1.00000 |       |       |       |      |       |
| Dpth                             | L       | Wait    | Strk    | Pmx%    | Eff.  | Stff  | CoR   |      |       |
| 76.00                            | 0.00    | 0.00    | 0.000   | 0.0     | 0.000 | 0.000 | 0.000 |      |       |
| 77.00                            | 0.00    | 0.00    | 0.000   | 0.0     | 0.000 | 0.000 | 0.000 |      |       |
| 78.00                            | 0.00    | 0.00    | 0.000   | 0.0     | 0.000 | 0.000 | 0.000 |      |       |
| 79.00                            | 0.00    | 0.00    | 0.000   | 0.0     | 0.000 | 0.000 | 0.000 |      |       |
| 80.00                            | 0.00    | 0.00    | 0.000   | 0.0     | 0.000 | 0.000 | 0.000 |      |       |
| 81.00                            | 0.00    | 0.00    | 0.000   | 0.0     | 0.000 | 0.000 | 0.000 |      |       |
| 82.00                            | 0.00    | 0.00    | 0.000   | 0.0     | 0.000 | 0.000 | 0.000 |      |       |
| 83.00                            | 0.00    | 0.00    | 0.000   | 0.0     | 0.000 | 0.000 | 0.000 |      |       |
| 84.00                            | 0.00    | 0.00    | 0.000   | 0.0     | 0.000 | 0.000 | 0.000 |      |       |
| 85.00                            | 0.00    | 0.00    | 0.000   | 0.0     | 0.000 | 0.000 | 0.000 |      |       |
| 86.00                            | 0.00    | 0.00    | 0.000   | 0.0     | 0.000 | 0.000 | 0.000 |      |       |
| 87.00                            | 0.00    | 0.00    | 0.000   | 0.0     | 0.000 | 0.000 | 0.000 |      |       |
| 88.00                            | 0.00    | 0.00    | 0.000   | 0.0     | 0.000 | 0.000 | 0.000 |      |       |
| 89.00                            | 0.00    | 0.00    | 0.000   | 0.0     | 0.000 | 0.000 | 0.000 |      |       |
| 90.00                            | 0.00    | 0.00    | 0.000   | 0.0     | 0.000 | 0.000 | 0.000 |      |       |
| 0.00                             | 0.00    | 0.00    | 0.000   | 0.0     | 0.000 | 0.000 | 0.000 |      |       |

GRLWEAP: WAVE EQUATION ANALYSIS OF PILE FOUNDATIONS  
Version 2010  
English Units

Abutment 2 SB H-Pile- Delmag D25-32

|                   |                |                  |                                 |
|-------------------|----------------|------------------|---------------------------------|
| Hammer Model:     | D 25-32        | Made by:         | DELMAG                          |
| No.               | Weight<br>kips | Stiffn<br>k/inch | CoR C-Slk<br>ft Dampg<br>k/ft/s |
| 1                 | 1.837          |                  |                                 |
| 2                 | 1.837          | 151179.4         | 1.000 0.0000                    |
| 3                 | 1.837          | 151179.4         | 1.000 0.0000                    |
| Imp Block         | 1.360          | 89695.7          | 0.900 0.0100                    |
| Helmet            | 1.900          | 60155.0          | 0.800 0.0100 9.9                |
| Combined Pile Top |                | 18922.5          |                                 |

HAMMER OPTIONS:

|                    |           |                          |           |
|--------------------|-----------|--------------------------|-----------|
| Hammer File ID No. | 10        | Hammer Type              | OE Diesel |
| Stroke Option      | FxdP-VarS | Stroke Convergence Crit. | 0.010     |
| Fuel Pump Setting  | Maximum   |                          |           |

HAMMER DATA:

|                      |        |         |                    |        |         |
|----------------------|--------|---------|--------------------|--------|---------|
| Ram Weight           | (kips) | 5.51    | Ram Length         | (inch) | 123.20  |
| Maximum Stroke       | (ft)   | 13.76   |                    |        |         |
| Rated Stroke         | (ft)   | 12.04   | Efficiency         |        | 0.800   |
| Maximum Pressure     | (psi)  | 1500.00 | Actual Pressure    | (psi)  | 1500.00 |
| Compression Exponent |        | 1.350   | Expansion Exponent |        | 1.250   |
| Ram Diameter         | (inch) | 16.51   |                    |        |         |
| Combustion Delay     | (s)    | 0.00050 | Ignition Duration  | (s)    | 0.00200 |

The Hammer Data Includes Estimated (NON-MEASURED) Quantities

|                      |           |         |                      |           |      |
|----------------------|-----------|---------|----------------------|-----------|------|
| HAMMER CUSHION       |           |         | PILE CUSHION         |           |      |
| Cross Sect. Area     | (in2)     | 227.00  | Cross Sect. Area     | (in2)     | 0.00 |
| Elastic-Modulus      | (ksi)     | 530.0   | Elastic-Modulus      | (ksi)     | 0.0  |
| Thickness            | (inch)    | 2.00    | Thickness            | (inch)    | 0.00 |
| Coeff of Restitution |           | 0.8     | Coeff of Restitution |           | 1.0  |
| RoundOut             | (ft)      | 0.0     | RoundOut             | (ft)      | 0.0  |
| Stiffness            | (kips/in) | 60155.0 | Stiffness            | (kips/in) | 0.0  |

Abutment 2 SB H-Pile- Delmag D25-32  
HNTB Corporation

04/02/2020  
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Depth (ft) 76.0 Standard Soil Setup  
Shaft Gain/Loss Factor 1.000 Toe Gain/Loss Factor 1.000

PILE PROFILE:

Toe Area (in2) 203.230 File Type H File  
Pile Size (inch) 14.690

| L b Top | Area  | E-Mod  | Spec Wt | Perim | C Index | Wave Sp | EA/c   |
|---------|-------|--------|---------|-------|---------|---------|--------|
| ft      | in2   | ksi    | lb/ft3  | ft    |         | ft/s    | k/ft/s |
| 0.0     | 26.10 | 29000. | 492.0   | 4.8   | 0       | 16524.  | 45.8   |
| 90.0    | 26.10 | 29000. | 492.0   | 4.8   | 0       | 16524.  | 45.8   |

Wave Travel Time 2L/c (ms) 10.893

| No. | Weight | File and Soil Model    | Total Capacity | Rut    | (kips) | 344.4            |
|-----|--------|------------------------|----------------|--------|--------|------------------|
|     | kips   | Stiffn C-Slk T-Slk CoR | Soil-S         | Soil-D | Quake  | LbTop Perim Area |
|     |        | k/in ft ft             | kips           | s/ft   | inch   | ft ft in2        |
| 1   | 0.297  | 18923 0.010 0.000 1.00 | 0.0            | 0.000  | 0.100  | 3.33 4.8 26.1    |
| 2   | 0.297  | 18923 0.000 0.000 1.00 | 0.0            | 0.000  | 0.100  | 6.67 4.8 26.1    |
| 5   | 0.297  | 18923 0.000 0.000 1.00 | 1.3            | 0.050  | 0.100  | 16.67 4.8 26.1   |
| 6   | 0.297  | 18922 0.000 0.000 1.00 | 4.8            | 0.050  | 0.100  | 20.00 4.8 26.1   |
| 7   | 0.297  | 18922 0.000 0.000 1.00 | 7.3            | 0.157  | 0.100  | 23.33 4.8 26.1   |
| 8   | 0.297  | 18922 0.000 0.000 1.00 | 7.9            | 0.200  | 0.100  | 26.67 4.8 26.1   |
| 24  | 0.297  | 18922 0.000 0.000 1.00 | 13.7           | 0.142  | 0.100  | 80.00 4.8 26.1   |
| 25  | 0.297  | 18922 0.000 0.000 1.00 | 27.8           | 0.050  | 0.100  | 83.33 4.8 26.1   |
| 26  | 0.297  | 18922 0.000 0.000 1.00 | 29.1           | 0.050  | 0.100  | 86.67 4.8 26.1   |
| 27  | 0.297  | 18923 0.000 0.000 1.00 | 30.4           | 0.050  | 0.100  | 90.00 4.8 26.1   |
| Toe |        |                        | 103.3          | 0.150  | 0.100  |                  |

8.026 kips total unreduced pile weight (g= 32.17 ft/s2)  
8.026 kips total reduced pile weight (g= 32.17 ft/s2)

PILE, SOIL, ANALYSIS OPTIONS:

Uniform pile  
No. of Slacks/Splices 0  
File Segments: Automatic  
File Damping (%) 3  
File Damping Fact. (k/ft/s) 2.748

Driveability Analysis  
Soil Damping Option Smith  
Max No Analysis Iterations 0 Time Increment/Critical 160  
Output Time Interval 1 Analysis Time-Input (ms) 0  
Output Level: Normal  
Gravity Mass, Pile, Hammer: 32.170 32.170 32.170  
Output Segment Generation: Automatic

| Depth | Stroke | Pressure | Efficy |
|-------|--------|----------|--------|
| ft    | ft     | Ratio    |        |
| 76.00 | 12.04  | 1.00     | 0.800  |

Abutment 2 SB H-Pile- Delmag D25-32  
HNTB Corporation

04/02/2020  
GRLWEAP Version 2010

| Rut<br>kips | Bl Ct<br>b/ft | Stroke (ft)<br>down up | Ten Str<br>ksi | i | t  | Comp Str<br>ksi | i | t | ENTHRU<br>kip-ft | Bl Rt<br>b/min |
|-------------|---------------|------------------------|----------------|---|----|-----------------|---|---|------------------|----------------|
| 344.4       | 32.5          | 8.39 8.42              | -0.41          | 6 | 25 | 30.48           | 2 | 2 | 29.1             | 40.8           |
| 327.0       | 30.0          | 8.25 8.31              | -0.12          | 5 | 25 | 30.07           | 2 | 2 | 28.8             | 41.1           |
| 309.6       | 27.3          | 8.21 8.20              | -0.08          | 6 | 28 | 30.05           | 1 | 2 | 29.0             | 41.3           |
| 292.2       | 25.0          | 8.08 8.07              | 0.00           | 1 | 0  | 29.71           | 1 | 2 | 29.1             | 41.6           |
| 274.8       | 22.9          | 7.95 7.95              | -0.54          | 6 | 34 | 29.26           | 1 | 2 | 29.2             | 42.0           |

Abutment 2 SB H-Pile- Delmag D25-32  
HNTB Corporation

04/02/2020  
GRLWEAP Version 2010

Depth (ft) 77.0 Standard Soil Setup  
Shaft Gain/Loss Factor 1.000 Toe Gain/Loss Factor 1.000

PILE PROFILE:

Toe Area (in2) 203.230 Pile Type H Pile  
Pile Size (inch) 14.690

| L b Top | Area  | E-Mod  | Spec Wt | Perim | C Index | Wave Sp | EA/c   |
|---------|-------|--------|---------|-------|---------|---------|--------|
| ft      | in2   | ksi    | lb/ft3  | ft    |         | ft/s    | k/ft/s |
| 0.0     | 26.10 | 29000. | 492.0   | 4.8   | 0       | 16524.  | 45.8   |
| 90.0    | 26.10 | 29000. | 492.0   | 4.8   | 0       | 16524.  | 45.8   |

Wave Travel Time 2L/c (ms) 10.893

| File and Soil Model |        |        |       |       |      | Total Capacity Rut (kips) |        |       | 416.8 |       |      |
|---------------------|--------|--------|-------|-------|------|---------------------------|--------|-------|-------|-------|------|
| No.                 | Weight | Stiffn | C-Slk | T-Slk | CoR  | Soil-S                    | Soil-D | Quake | LbTop | Perim | Area |
|                     | kips   | k/in   | ft    | ft    |      | kips                      | s/ft   | inch  | ft    | ft    | in2  |
| 1                   | 0.297  | 18923  | 0.010 | 0.000 | 1.00 | 0.0                       | 0.000  | 0.100 | 3.33  | 4.8   | 26.1 |
| 2                   | 0.297  | 18923  | 0.000 | 0.000 | 1.00 | 0.0                       | 0.000  | 0.100 | 6.67  | 4.8   | 26.1 |
| 4                   | 0.297  | 18923  | 0.000 | 0.000 | 1.00 | 0.0                       | 0.050  | 0.100 | 13.33 | 4.8   | 26.1 |
| 5                   | 0.297  | 18923  | 0.000 | 0.000 | 1.00 | 2.5                       | 0.050  | 0.100 | 16.67 | 4.8   | 26.1 |
| 6                   | 0.297  | 18922  | 0.000 | 0.000 | 1.00 | 5.6                       | 0.063  | 0.100 | 20.00 | 4.8   | 26.1 |
| 7                   | 0.297  | 18922  | 0.000 | 0.000 | 1.00 | 7.8                       | 0.189  | 0.100 | 23.33 | 4.8   | 26.1 |
| 8                   | 0.297  | 18922  | 0.000 | 0.000 | 1.00 | 7.9                       | 0.200  | 0.100 | 26.67 | 4.8   | 26.1 |
| 24                  | 0.297  | 18922  | 0.000 | 0.000 | 1.00 | 19.5                      | 0.097  | 0.100 | 80.00 | 4.8   | 26.1 |
| 25                  | 0.297  | 18922  | 0.000 | 0.000 | 1.00 | 28.2                      | 0.050  | 0.100 | 83.33 | 4.8   | 26.1 |
| 26                  | 0.297  | 18922  | 0.000 | 0.000 | 1.00 | 29.5                      | 0.050  | 0.100 | 86.67 | 4.8   | 26.1 |
| 27                  | 0.297  | 18923  | 0.000 | 0.000 | 1.00 | 33.2                      | 0.050  | 0.100 | 90.00 | 4.8   | 26.1 |
| Toe                 |        |        |       |       |      | 163.9                     | 0.150  | 0.100 |       |       |      |

8.026 kips total unreduced pile weight (g= 32.17 ft/s2)  
8.026 kips total reduced pile weight (g= 32.17 ft/s2)

| Depth | Stroke | Pressure | Efficy |
|-------|--------|----------|--------|
| ft    | ft     | Ratio    |        |
| 77.00 | 12.04  | 1.00     | 0.800  |

Abutment 2 SB H-Pile- Delmag D25-32  
HNTB Corporation

04/02/2020  
GRLWEAP Version 2010

| Rut   | Bl Ct | Stroke (ft) |      | Ten Str | i | t  | Comp Str | i | t | ENTHRU | Bl Rt |
|-------|-------|-------------|------|---------|---|----|----------|---|---|--------|-------|
| kips  | b/ft  | down        | up   | ksi     |   |    | ksi      |   |   | kip-ft | b/min |
| 416.8 | 46.0  | 8.74        | 8.72 | -0.64   | 6 | 47 | 31.56    | 2 | 2 | 30.2   | 40.1  |
| 399.0 | 41.7  | 8.63        | 8.62 | -0.57   | 6 | 48 | 31.32    | 1 | 2 | 30.1   | 40.3  |
| 381.2 | 38.1  | 8.52        | 8.53 | -0.52   | 6 | 49 | 30.92    | 2 | 2 | 29.9   | 40.5  |
| 363.4 | 34.9  | 8.38        | 8.42 | -0.55   | 6 | 27 | 30.50    | 2 | 2 | 29.7   | 40.8  |
| 345.6 | 31.9  | 8.24        | 8.32 | -0.57   | 6 | 28 | 30.07    | 3 | 2 | 29.6   | 41.1  |



Abutment 2 SB H-Pile- Delmag D25-32  
HNTB Corporation

04/02/2020  
GRLWEAP Version 2010

Depth (ft) 78.0 Standard Soil Setup  
Shaft Gain/Loss Factor 1.000 Toe Gain/Loss Factor 1.000

PILE PROFILE:

Toe Area (in2) 203.230 Pile Type H Pile  
Pile Size (inch) 14.690

| L b Top | Area  | E-Mod  | Spec Wt | Perim | C Index | Wave Sp | EA/c   |
|---------|-------|--------|---------|-------|---------|---------|--------|
| ft      | in2   | ksi    | lb/ft3  | ft    |         | ft/s    | k/ft/s |
| 0.0     | 26.10 | 29000. | 492.0   | 4.8   | 0       | 16524.  | 45.8   |
| 90.0    | 26.10 | 29000. | 492.0   | 4.8   | 0       | 16524.  | 45.8   |

Wave Travel Time 2L/c (ms) 10.893

| File and Soil Model |        |        |       |       |      | Total Capacity Rut (kips) |        |       | 494.4 |       |      |
|---------------------|--------|--------|-------|-------|------|---------------------------|--------|-------|-------|-------|------|
| No.                 | Weight | Stiffn | C-Slk | T-Slk | CoR  | Soil-S                    | Soil-D | Quake | LbTop | Perim | Area |
|                     | kips   | k/in   | ft    | ft    |      | kips                      | s/ft   | inch  | ft    | ft    | in2  |
| 1                   | 0.297  | 18923  | 0.010 | 0.000 | 1.00 | 0.0                       | 0.000  | 0.100 | 3.33  | 4.8   | 26.1 |
| 2                   | 0.297  | 18923  | 0.000 | 0.000 | 1.00 | 0.0                       | 0.000  | 0.100 | 6.67  | 4.8   | 26.1 |
| 4                   | 0.297  | 18923  | 0.000 | 0.000 | 1.00 | 0.3                       | 0.050  | 0.100 | 13.33 | 4.8   | 26.1 |
| 5                   | 0.297  | 18923  | 0.000 | 0.000 | 1.00 | 3.6                       | 0.050  | 0.100 | 16.67 | 4.8   | 26.1 |
| 6                   | 0.297  | 18922  | 0.000 | 0.000 | 1.00 | 6.4                       | 0.099  | 0.100 | 20.00 | 4.8   | 26.1 |
| 7                   | 0.297  | 18922  | 0.000 | 0.000 | 1.00 | 7.9                       | 0.200  | 0.100 | 23.33 | 4.8   | 26.1 |
| 23                  | 0.297  | 18922  | 0.000 | 0.000 | 1.00 | 8.6                       | 0.194  | 0.100 | 76.67 | 4.8   | 26.1 |
| 24                  | 0.297  | 18922  | 0.000 | 0.000 | 1.00 | 24.8                      | 0.067  | 0.100 | 80.00 | 4.8   | 26.1 |
| 25                  | 0.297  | 18922  | 0.000 | 0.000 | 1.00 | 28.6                      | 0.050  | 0.100 | 83.33 | 4.8   | 26.1 |
| 26                  | 0.297  | 18922  | 0.000 | 0.000 | 1.00 | 29.9                      | 0.050  | 0.100 | 86.67 | 4.8   | 26.1 |
| 27                  | 0.297  | 18923  | 0.000 | 0.000 | 1.00 | 41.1                      | 0.050  | 0.100 | 90.00 | 4.8   | 26.1 |
| Toe                 |        |        |       |       |      | 224.4                     | 0.150  | 0.100 |       |       |      |

8.026 kips total unreduced pile weight (g= 32.17 ft/s2)

8.026 kips total reduced pile weight (g= 32.17 ft/s2)

| Depth | Stroke | Pressure | Efficacy |
|-------|--------|----------|----------|
| ft    | ft     | Ratio    |          |
| 78.00 | 12.04  | 1.00     | 0.800    |

Abutment 2 SB H-Pile- Delmag D25-32  
HNTB Corporation

04/02/2020  
GRLWEAP Version 2010

| Rut   | Bl Ct | Stroke (ft) |      | Ten Str | i | t  | Comp Str | i | t | ENTHRU | Bl Rt |
|-------|-------|-------------|------|---------|---|----|----------|---|---|--------|-------|
| kip   | b/ft  | down        | up   | ksi     |   |    | ksi      |   |   | kip-ft | b/min |
| 494.4 | 68.0  | 9.07        | 8.99 | -0.72   | 6 | 46 | 32.58    | 3 | 2 | 31.3   | 39.4  |
| 476.1 | 60.7  | 8.96        | 8.91 | -0.76   | 6 | 48 | 32.32    | 2 | 2 | 31.3   | 39.6  |
| 457.7 | 54.4  | 8.87        | 8.84 | -0.81   | 6 | 49 | 32.07    | 2 | 2 | 31.2   | 39.8  |
| 439.4 | 49.1  | 8.76        | 8.75 | -0.83   | 6 | 50 | 31.70    | 2 | 2 | 31.1   | 40.0  |
| 421.1 | 44.4  | 8.65        | 8.67 | -0.95   | 7 | 27 | 31.35    | 3 | 2 | 31.0   | 40.2  |

Abutment 2 SB H-Pile- Delmag D25-32  
HNTB Corporation

04/02/2020  
GRLWEAP Version 2010

Depth (ft) 79.0 Standard Soil Setup  
Shaft Gain/Loss Factor 1.000 Toe Gain/Loss Factor 1.000

PILE PROFILE:

Toe Area (in2) 203.230 Pile Type H Pile  
Pile Size (inch) 14.690

| L b Top | Area  | E-Mod  | Spec Wt | Perim | C Index | Wave Sp | EA/c   |
|---------|-------|--------|---------|-------|---------|---------|--------|
| ft      | in2   | ksi    | lb/ft3  | ft    |         | ft/s    | k/ft/s |
| 0.0     | 26.10 | 29000. | 492.0   | 4.8   | 0       | 16524.  | 45.8   |
| 90.0    | 26.10 | 29000. | 492.0   | 4.8   | 0       | 16524.  | 45.8   |

Wave Travel Time 2L/c (ms) 10.893

| File and Soil Model |        |        |       |       |      | Total Capacity Rut (kips) |        |       | 552.9 |       |      |
|---------------------|--------|--------|-------|-------|------|---------------------------|--------|-------|-------|-------|------|
| No.                 | Weight | Stiffn | C-Slk | T-Slk | CoR  | Soil-S                    | Soil-D | Quake | LbTop | Perim | Area |
|                     | kips   | k/in   | ft    | ft    |      | kips                      | s/ft   | inch  | ft    | ft    | in2  |
| 1                   | 0.297  | 18923  | 0.010 | 0.000 | 1.00 | 0.0                       | 0.000  | 0.100 | 3.33  | 4.8   | 26.1 |
| 2                   | 0.297  | 18923  | 0.000 | 0.000 | 1.00 | 0.0                       | 0.000  | 0.100 | 6.67  | 4.8   | 26.1 |
| 4                   | 0.297  | 18923  | 0.000 | 0.000 | 1.00 | 1.0                       | 0.050  | 0.100 | 13.33 | 4.8   | 26.1 |
| 5                   | 0.297  | 18923  | 0.000 | 0.000 | 1.00 | 4.6                       | 0.050  | 0.100 | 16.67 | 4.8   | 26.1 |
| 6                   | 0.297  | 18922  | 0.000 | 0.000 | 1.00 | 7.1                       | 0.144  | 0.100 | 20.00 | 4.8   | 26.1 |
| 7                   | 0.297  | 18922  | 0.000 | 0.000 | 1.00 | 7.9                       | 0.200  | 0.100 | 23.33 | 4.8   | 26.1 |
| 23                  | 0.297  | 18922  | 0.000 | 0.000 | 1.00 | 11.9                      | 0.158  | 0.100 | 76.67 | 4.8   | 26.1 |
| 24                  | 0.297  | 18922  | 0.000 | 0.000 | 1.00 | 27.5                      | 0.051  | 0.100 | 80.00 | 4.8   | 26.1 |
| 25                  | 0.297  | 18922  | 0.000 | 0.000 | 1.00 | 28.9                      | 0.050  | 0.100 | 83.33 | 4.8   | 26.1 |
| 26                  | 0.297  | 18922  | 0.000 | 0.000 | 1.00 | 30.2                      | 0.050  | 0.100 | 86.67 | 4.8   | 26.1 |
| 27                  | 0.297  | 18923  | 0.000 | 0.000 | 1.00 | 51.7                      | 0.050  | 0.100 | 90.00 | 4.8   | 26.1 |
| Toe                 |        |        |       |       |      | 263.2                     | 0.150  | 0.100 |       |       |      |

8.026 kips total unreduced pile weight (g= 32.17 ft/s2)

8.026 kips total reduced pile weight (g= 32.17 ft/s2)

| Depth | Stroke | Pressure | Efficacy |
|-------|--------|----------|----------|
| ft    | ft     | Ratio    |          |
| 79.00 | 12.04  | 1.00     | 0.800    |

Abutment 2 SB H-Pile- Delmag D25-32  
HNTB Corporation

04/02/2020  
GRLWEAP Version 2010

| Rut<br>kips | Bl Ct<br>b/ft | Stroke (ft)<br>down | Ten Str<br>up<br>ksi | i     | t | Comp Str<br>ksi | i     | t | ENTHRU<br>kip-ft | Bl Rt<br>b/min |      |
|-------------|---------------|---------------------|----------------------|-------|---|-----------------|-------|---|------------------|----------------|------|
| 552.9       | 93.4          | 9.25                | 9.17                 | -0.86 | 6 | 47              | 33.23 | 5 | 2                | 31.9           | 39.0 |
| 533.9       | 82.1          | 9.16                | 9.11                 | -0.94 | 6 | 48              | 32.91 | 4 | 2                | 31.8           | 39.2 |
| 515.0       | 72.3          | 9.10                | 9.05                 | -1.01 | 6 | 48              | 32.72 | 4 | 2                | 31.9           | 39.3 |
| 496.0       | 64.2          | 8.99                | 8.98                 | -1.05 | 6 | 49              | 32.44 | 3 | 2                | 31.9           | 39.5 |
| 477.0       | 57.3          | 8.91                | 8.91                 | -0.96 | 9 | 26              | 32.15 | 2 | 2                | 31.9           | 39.6 |

Abutment 2 SB H-Pile- Delmag D25-32  
HNTB Corporation

04/02/2020  
GRLWEAP Version 2010

Depth (ft) 80.0 Standard Soil Setup  
Shaft Gain/Loss Factor 1.000 Toe Gain/Loss Factor 1.000

PILE PROFILE:

Toe Area (in2) 203.230 Pile Type H Pile  
Pile Size (inch) 14.690

| L b Top | Area  | E-Mod  | Spec Wt | Perim | C Index | Wave Sp | EA/c   |
|---------|-------|--------|---------|-------|---------|---------|--------|
| ft      | in2   | ksi    | lb/ft3  | ft    |         | ft/s    | k/ft/s |
| 0.0     | 26.10 | 29000. | 492.0   | 4.8   | 0       | 16524.  | 45.8   |
| 90.0    | 26.10 | 29000. | 492.0   | 4.8   | 0       | 16524.  | 45.8   |

Wave Travel Time 2L/c (ms) 10.893

| No. | Weight | Stiffn | C-Slk | T-Slk | CoR  | Soil-S | Soil-D | Quake | LbTop | Perim | Area |
|-----|--------|--------|-------|-------|------|--------|--------|-------|-------|-------|------|
|     | kips   | k/in   | ft    | ft    |      | kips   | s/ft   | inch  | ft    | ft    | in2  |
| 1   | 0.297  | 18923  | 0.010 | 0.000 | 1.00 | 0.0    | 0.000  | 0.100 | 3.33  | 4.8   | 26.1 |
| 2   | 0.297  | 18923  | 0.000 | 0.000 | 1.00 | 0.0    | 0.000  | 0.100 | 6.67  | 4.8   | 26.1 |
| 4   | 0.297  | 18923  | 0.000 | 0.000 | 1.00 | 2.1    | 0.050  | 0.100 | 13.33 | 4.8   | 26.1 |
| 5   | 0.297  | 18923  | 0.000 | 0.000 | 1.00 | 5.3    | 0.056  | 0.100 | 16.67 | 4.8   | 26.1 |
| 6   | 0.297  | 18922  | 0.000 | 0.000 | 1.00 | 7.7    | 0.181  | 0.100 | 20.00 | 4.8   | 26.1 |
| 7   | 0.297  | 18922  | 0.000 | 0.000 | 1.00 | 7.9    | 0.200  | 0.100 | 23.33 | 4.8   | 26.1 |
| 23  | 0.297  | 18922  | 0.000 | 0.000 | 1.00 | 17.5   | 0.108  | 0.100 | 76.67 | 4.8   | 26.1 |
| 24  | 0.297  | 18922  | 0.000 | 0.000 | 1.00 | 28.0   | 0.050  | 0.100 | 80.00 | 4.8   | 26.1 |
| 25  | 0.297  | 18922  | 0.000 | 0.000 | 1.00 | 29.3   | 0.050  | 0.100 | 83.33 | 4.8   | 26.1 |
| 26  | 0.297  | 18922  | 0.000 | 0.000 | 1.00 | 31.7   | 0.050  | 0.100 | 86.67 | 4.8   | 26.1 |
| 27  | 0.297  | 18923  | 0.000 | 0.000 | 1.00 | 61.4   | 0.050  | 0.100 | 90.00 | 4.8   | 26.1 |
| Toe |        |        |       |       |      | 302.0  | 0.150  | 0.100 |       |       |      |

8.026 kips total unreduced pile weight (g= 32.17 ft/s2)

8.026 kips total reduced pile weight (g= 32.17 ft/s2)

| Depth | Stroke | Pressure | Efficacy |
|-------|--------|----------|----------|
| ft    | ft     | Ratio    |          |
| 80.00 | 12.04  | 1.00     | 0.800    |

Abutment 2 SB H-Pile- Delmag D25-32  
HNTB Corporation

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| Rut<br>kips | Bl Ct<br>b/ft | Stroke (ft)<br>down | Ten Str<br>up<br>ksi | i     | t  | Comp Str<br>ksi | i     | t | ENTHRU<br>kip-ft | Bl Rt<br>b/min |      |
|-------------|---------------|---------------------|----------------------|-------|----|-----------------|-------|---|------------------|----------------|------|
| 611.8       | 137.3         | 9.40                | 9.33                 | -0.91 | 5  | 46              | 33.71 | 6 | 3                | 32.3           | 38.7 |
| 592.1       | 114.7         | 9.35                | 9.28                 | -1.00 | 6  | 47              | 33.54 | 3 | 2                | 32.4           | 38.8 |
| 572.5       | 98.2          | 9.28                | 9.23                 | -1.08 | 6  | 48              | 33.31 | 4 | 2                | 32.5           | 38.9 |
| 552.8       | 84.9          | 9.20                | 9.16                 | -1.16 | 6  | 49              | 33.06 | 4 | 2                | 32.6           | 39.1 |
| 533.1       | 74.4          | 9.14                | 9.11                 | -1.38 | 14 | 27              | 32.86 | 3 | 2                | 32.7           | 39.2 |

Abutment 2 SB H-Pile- Delmag D25-32  
HNTB Corporation

04/02/2020  
GRLWEAP Version 2010

Depth (ft) 81.0 Standard Soil Setup  
Shaft Gain/Loss Factor 1.000 Toe Gain/Loss Factor 1.000

PILE PROFILE:

Toe Area (in2) 203.230 File Type H File  
Pile Size (inch) 14.690

| L b Top | Area  | E-Mod  | Spec Wt | Perim | C Index | Wave Sp | EA/c   |
|---------|-------|--------|---------|-------|---------|---------|--------|
| ft      | in2   | ksi    | lb/ft3  | ft    |         | ft/s    | k/ft/s |
| 0.0     | 26.10 | 29000. | 492.0   | 4.8   | 0       | 16524.  | 45.8   |
| 90.0    | 26.10 | 29000. | 492.0   | 4.8   | 0       | 16524.  | 45.8   |

Wave Travel Time 2L/c (ms) 10.893

| No. | Weight | File and Soil Model    | Total Capacity | Rut    | (kips) | 632.2            |
|-----|--------|------------------------|----------------|--------|--------|------------------|
|     | kips   | Stiffn C-Slk T-Slk CoR | Soil-S         | Soil-D | Quake  | LbTop Perim Area |
|     |        | k/in ft ft             | kips           | s/ft   | inch   | ft ft in2        |
| 1   | 0.297  | 18923 0.010 0.000 1.00 | 0.0            | 0.000  | 0.100  | 3.33 4.8 26.1    |
| 2   | 0.297  | 18923 0.000 0.000 1.00 | 0.0            | 0.000  | 0.100  | 6.67 4.8 26.1    |
| 3   | 0.297  | 18922 0.000 0.000 1.00 | 0.2            | 0.050  | 0.100  | 10.00 4.8 26.1   |
| 4   | 0.297  | 18923 0.000 0.000 1.00 | 3.3            | 0.050  | 0.100  | 13.33 4.8 26.1   |
| 5   | 0.297  | 18923 0.000 0.000 1.00 | 6.1            | 0.085  | 0.100  | 16.67 4.8 26.1   |
| 6   | 0.297  | 18922 0.000 0.000 1.00 | 7.9            | 0.199  | 0.100  | 20.00 4.8 26.1   |
| 7   | 0.297  | 18922 0.000 0.000 1.00 | 7.9            | 0.200  | 0.100  | 23.33 4.8 26.1   |
| 22  | 0.297  | 18922 0.000 0.000 1.00 | 8.1            | 0.199  | 0.100  | 73.33 4.8 26.1   |
| 23  | 0.297  | 18922 0.000 0.000 1.00 | 23.3           | 0.076  | 0.100  | 76.67 4.8 26.1   |
| 24  | 0.297  | 18922 0.000 0.000 1.00 | 28.4           | 0.050  | 0.100  | 80.00 4.8 26.1   |
| 25  | 0.297  | 18922 0.000 0.000 1.00 | 29.7           | 0.050  | 0.100  | 83.33 4.8 26.1   |
| 26  | 0.297  | 18922 0.000 0.000 1.00 | 37.9           | 0.050  | 0.100  | 86.67 4.8 26.1   |
| 27  | 0.297  | 18923 0.000 0.000 1.00 | 66.5           | 0.050  | 0.100  | 90.00 4.8 26.1   |
| Toe |        |                        | 302.0          | 0.150  | 0.100  |                  |

8.026 kips total unreduced pile weight (g= 32.17 ft/s2)  
8.026 kips total reduced pile weight (g= 32.17 ft/s2)

| Depth | Stroke | Pressure | Efficy |
|-------|--------|----------|--------|
| ft    | ft     | Ratio    |        |
| 81.00 | 12.04  | 1.00     | 0.800  |

Abutment 2 SB H-Pile- Delmag D25-32  
HNTB Corporation

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| Rut   | Bl Ct | Stroke (ft) | Ten Str | i     | t  | Comp Str | i     | t | ENTHRU | Bl Rt |      |
|-------|-------|-------------|---------|-------|----|----------|-------|---|--------|-------|------|
| kips  | b/ft  | down        | up      | ksi   |    | ksi      |       |   | kip-ft | b/min |      |
| 632.2 | 156.8 | 9.45        | 9.37    | -0.84 | 5  | 46       | 33.89 | 4 | 2      | 32.4  | 38.6 |
| 611.9 | 129.6 | 9.38        | 9.33    | -0.94 | 5  | 47       | 33.64 | 3 | 2      | 32.4  | 38.7 |
| 591.6 | 108.4 | 9.33        | 9.27    | -1.03 | 5  | 48       | 33.49 | 4 | 2      | 32.5  | 38.8 |
| 571.2 | 92.9  | 9.26        | 9.22    | -1.12 | 6  | 49       | 33.25 | 3 | 2      | 32.6  | 38.9 |
| 550.9 | 80.5  | 9.19        | 9.16    | -1.36 | 15 | 27       | 33.02 | 3 | 2      | 32.7  | 39.1 |



Abutment 2 SB H-Pile- Delmag D25-32  
HNTB Corporation

04/02/2020  
GRLWEAP Version 2010

Depth (ft) 82.0 Standard Soil Setup  
Shaft Gain/Loss Factor 1.000 Toe Gain/Loss Factor 1.000

PILE PROFILE:

Toe Area (in2) 203.230 File Type H Pile  
Pile Size (inch) 14.690

| L b Top | Area  | E-Mod  | Spec Wt | Perim | C Index | Wave Sp | EA/c   |
|---------|-------|--------|---------|-------|---------|---------|--------|
| ft      | in2   | ksi    | lb/ft3  | ft    |         | ft/s    | k/ft/s |
| 0.0     | 26.10 | 29000. | 492.0   | 4.8   | 0       | 16524.  | 45.8   |
| 90.0    | 26.10 | 29000. | 492.0   | 4.8   | 0       | 16524.  | 45.8   |

Wave Travel Time 2L/c (ms) 10.893

| File and Soil Model |        |        |       |       |      | Total Capacity Rut (kips) |        |       | 653.0 |       |      |
|---------------------|--------|--------|-------|-------|------|---------------------------|--------|-------|-------|-------|------|
| No.                 | Weight | Stiffn | C-Slk | T-Slk | CoR  | Soil-S                    | Soil-D | Quake | LbTop | Perim | Area |
|                     | kips   | k/in   | ft    | ft    |      | kips                      | s/ft   | inch  | ft    | ft    | in2  |
| 1                   | 0.297  | 18923  | 0.010 | 0.000 | 1.00 | 0.0                       | 0.000  | 0.100 | 3.33  | 4.8   | 26.1 |
| 2                   | 0.297  | 18923  | 0.000 | 0.000 | 1.00 | 0.0                       | 0.000  | 0.100 | 6.67  | 4.8   | 26.1 |
| 3                   | 0.297  | 18922  | 0.000 | 0.000 | 1.00 | 0.8                       | 0.050  | 0.100 | 10.00 | 4.8   | 26.1 |
| 4                   | 0.297  | 18923  | 0.000 | 0.000 | 1.00 | 4.3                       | 0.050  | 0.100 | 13.33 | 4.8   | 26.1 |
| 5                   | 0.297  | 18923  | 0.000 | 0.000 | 1.00 | 6.9                       | 0.130  | 0.100 | 16.67 | 4.8   | 26.1 |
| 6                   | 0.297  | 18922  | 0.000 | 0.000 | 1.00 | 7.9                       | 0.200  | 0.100 | 20.00 | 4.8   | 26.1 |
| 22                  | 0.297  | 18922  | 0.000 | 0.000 | 1.00 | 10.5                      | 0.173  | 0.100 | 73.33 | 4.8   | 26.1 |
| 23                  | 0.297  | 18922  | 0.000 | 0.000 | 1.00 | 26.9                      | 0.054  | 0.100 | 76.67 | 4.8   | 26.1 |
| 24                  | 0.297  | 18922  | 0.000 | 0.000 | 1.00 | 28.8                      | 0.050  | 0.100 | 80.00 | 4.8   | 26.1 |
| 25                  | 0.297  | 18922  | 0.000 | 0.000 | 1.00 | 30.1                      | 0.050  | 0.100 | 83.33 | 4.8   | 26.1 |
| 26                  | 0.297  | 18922  | 0.000 | 0.000 | 1.00 | 48.1                      | 0.050  | 0.100 | 86.67 | 4.8   | 26.1 |
| 27                  | 0.297  | 18923  | 0.000 | 0.000 | 1.00 | 67.8                      | 0.050  | 0.100 | 90.00 | 4.8   | 26.1 |
| Toe                 |        |        |       |       |      | 302.0                     | 0.150  | 0.100 |       |       |      |

8.026 kips total unreduced pile weight (g= 32.17 ft/s2)  
8.026 kips total reduced pile weight (g= 32.17 ft/s2)

| Depth | Stroke | Pressure | Efficy |
|-------|--------|----------|--------|
| ft    | ft     | Ratio    |        |
| 82.00 | 12.04  | 1.00     | 0.800  |

Abutment 2 SB H-Pile- Delmag D25-32  
HNTB Corporation

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| Rut<br>kips | Bl Ct<br>b/ft | Stroke (ft)<br>down up | Ten Str<br>ksi | i  | t  | Comp Str<br>ksi | i | t | ENTHRU<br>kip-ft | Bl Rt<br>b/min |
|-------------|---------------|------------------------|----------------|----|----|-----------------|---|---|------------------|----------------|
| 653.0       | 181.3         | 9.48 9.40              | -0.75          | 5  | 46 | 33.99           | 5 | 2 | 32.4             | 38.5           |
| 631.9       | 146.1         | 9.44 9.36              | -0.87          | 5  | 47 | 33.84           | 4 | 2 | 32.5             | 38.6           |
| 610.9       | 121.1         | 9.37 9.31              | -0.98          | 5  | 48 | 33.62           | 4 | 2 | 32.6             | 38.7           |
| 589.9       | 101.4         | 9.31 9.25              | -1.08          | 6  | 49 | 33.39           | 4 | 2 | 32.8             | 38.9           |
| 568.9       | 86.5          | 9.27 9.20              | -1.34          | 16 | 27 | 33.24           | 4 | 2 | 32.9             | 39.0           |

Abutment 2 SB H-Pile- Delmag D25-32  
HNTB Corporation

04/02/2020  
GRLWEAP Version 2010

Depth (ft) 83.0 Standard Soil Setup  
Shaft Gain/Loss Factor 1.000 Toe Gain/Loss Factor 1.000

PILE PROFILE:

Toe Area (in2) 203.230 File Type H File  
Pile Size (inch) 14.690

| L b Top | Area  | E-Mod  | Spec Wt | Perim | C Index | Wave Sp | EA/c   |
|---------|-------|--------|---------|-------|---------|---------|--------|
| ft      | in2   | ksi    | lb/ft3  | ft    |         | ft/s    | k/ft/s |
| 0.0     | 26.10 | 29000. | 492.0   | 4.8   | 0       | 16524.  | 45.8   |
| 90.0    | 26.10 | 29000. | 492.0   | 4.8   | 0       | 16524.  | 45.8   |

Wave Travel Time 2L/c (ms) 10.893

| File and Soil Model |        |        |       |       |      | Total Capacity Rut (kips) 674.0 |        |       |       |       |      |
|---------------------|--------|--------|-------|-------|------|---------------------------------|--------|-------|-------|-------|------|
| No.                 | Weight | Stiffn | C-Slk | T-Slk | CoR  | Soil-S                          | Soil-D | Quake | LbTop | Perim | Area |
|                     | kips   | k/in   | ft    | ft    |      | kips                            | s/ft   | inch  | ft    | ft    | in2  |
| 1                   | 0.297  | 18923  | 0.010 | 0.000 | 1.00 | 0.0                             | 0.000  | 0.100 | 3.33  | 4.8   | 26.1 |
| 2                   | 0.297  | 18923  | 0.000 | 0.000 | 1.00 | 0.0                             | 0.000  | 0.100 | 6.67  | 4.8   | 26.1 |
| 3                   | 0.297  | 18922  | 0.000 | 0.000 | 1.00 | 1.7                             | 0.050  | 0.100 | 10.00 | 4.8   | 26.1 |
| 4                   | 0.297  | 18923  | 0.000 | 0.000 | 1.00 | 5.1                             | 0.051  | 0.100 | 13.33 | 4.8   | 26.1 |
| 5                   | 0.297  | 18923  | 0.000 | 0.000 | 1.00 | 7.5                             | 0.171  | 0.100 | 16.67 | 4.8   | 26.1 |
| 6                   | 0.297  | 18922  | 0.000 | 0.000 | 1.00 | 7.9                             | 0.200  | 0.100 | 20.00 | 4.8   | 26.1 |
| 22                  | 0.297  | 18922  | 0.000 | 0.000 | 1.00 | 15.6                            | 0.123  | 0.100 | 73.33 | 4.8   | 26.1 |
| 23                  | 0.297  | 18922  | 0.000 | 0.000 | 1.00 | 27.9                            | 0.050  | 0.100 | 76.67 | 4.8   | 26.1 |
| 24                  | 0.297  | 18922  | 0.000 | 0.000 | 1.00 | 29.2                            | 0.050  | 0.100 | 80.00 | 4.8   | 26.1 |
| 25                  | 0.297  | 18922  | 0.000 | 0.000 | 1.00 | 30.7                            | 0.050  | 0.100 | 83.33 | 4.8   | 26.1 |
| 26                  | 0.297  | 18922  | 0.000 | 0.000 | 1.00 | 58.6                            | 0.050  | 0.100 | 86.67 | 4.8   | 26.1 |
| 27                  | 0.297  | 18923  | 0.000 | 0.000 | 1.00 | 68.9                            | 0.050  | 0.100 | 90.00 | 4.8   | 26.1 |
| Toe                 |        |        |       |       |      | 302.0                           | 0.150  | 0.100 |       |       |      |

8.026 kips total unreduced pile weight (g= 32.17 ft/s2)  
8.026 kips total reduced pile weight (g= 32.17 ft/s2)

| Depth | Stroke | Pressure | Efficy |
|-------|--------|----------|--------|
| ft    | ft     | Ratio    |        |
| 83.00 | 12.04  | 1.00     | 0.800  |

Abutment 2 SB H-Pile- Delmag D25-32  
HNTB Corporation

04/02/2020  
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| Rut<br>kips | Bl Ct<br>b/ft | Stroke (ft)<br>down up | Ten Str<br>ksi | i  | t  | Comp Str<br>ksi | i | t | ENTHRU<br>kip-ft | Bl Rt<br>b/min |
|-------------|---------------|------------------------|----------------|----|----|-----------------|---|---|------------------|----------------|
| 674.0       | 210.3         | 9.53 9.44              | -0.66          | 5  | 46 | 34.14           | 3 | 2 | 32.4             | 38.5           |
| 652.2       | 167.8         | 9.47 9.40              | -0.78          | 5  | 47 | 33.97           | 4 | 2 | 32.5             | 38.5           |
| 630.5       | 137.1         | 9.41 9.36              | -0.93          | 5  | 47 | 33.69           | 3 | 2 | 32.6             | 38.6           |
| 608.7       | 111.8         | 9.37 9.30              | -1.04          | 6  | 48 | 33.56           | 4 | 2 | 32.9             | 38.8           |
| 586.9       | 94.8          | 9.31 9.25              | -1.34          | 19 | 26 | 33.40           | 3 | 2 | 33.0             | 38.8           |

Abutment 2 SB H-Pile- Delmag D25-32  
HNTB Corporation

04/02/2020  
GRLWEAP Version 2010

Depth (ft) 84.0 Standard Soil Setup  
Shaft Gain/Loss Factor 1.000 Toe Gain/Loss Factor 1.000

PILE PROFILE:

Toe Area (in2) 203.230 File Type H Pile  
Pile Size (inch) 14.690

| L b Top | Area  | E-Mod  | Spec Wt | Perim | C Index | Wave Sp | EA/c   |
|---------|-------|--------|---------|-------|---------|---------|--------|
| ft      | in2   | ksi    | lb/ft3  | ft    |         | ft/s    | k/ft/s |
| 0.0     | 26.10 | 29000. | 492.0   | 4.8   | 0       | 16524.  | 45.8   |
| 90.0    | 26.10 | 29000. | 492.0   | 4.8   | 0       | 16524.  | 45.8   |

Wave Travel Time 2L/c (ms) 10.893

| No. | Weight | Stiffn | C-Slk | T-Slk | CoR  | Soil-S | Soil-D | Quake | LbTop | Perim | Area |
|-----|--------|--------|-------|-------|------|--------|--------|-------|-------|-------|------|
|     | kips   | k/in   | ft    | ft    |      | kips   | s/ft   | inch  | ft    | ft    | in2  |
| 1   | 0.297  | 18923  | 0.010 | 0.000 | 1.00 | 0.0    | 0.000  | 0.100 | 3.33  | 4.8   | 26.1 |
| 2   | 0.297  | 18923  | 0.000 | 0.000 | 1.00 | 0.1    | 0.050  | 0.100 | 6.67  | 4.8   | 26.1 |
| 3   | 0.297  | 18922  | 0.000 | 0.000 | 1.00 | 2.9    | 0.050  | 0.100 | 10.00 | 4.8   | 26.1 |
| 4   | 0.297  | 18923  | 0.000 | 0.000 | 1.00 | 5.8    | 0.073  | 0.100 | 13.33 | 4.8   | 26.1 |
| 5   | 0.297  | 18923  | 0.000 | 0.000 | 1.00 | 7.9    | 0.195  | 0.100 | 16.67 | 4.8   | 26.1 |
| 6   | 0.297  | 18922  | 0.000 | 0.000 | 1.00 | 7.9    | 0.200  | 0.100 | 20.00 | 4.8   | 26.1 |
| 22  | 0.297  | 18922  | 0.000 | 0.000 | 1.00 | 21.5   | 0.087  | 0.100 | 73.33 | 4.8   | 26.1 |
| 23  | 0.297  | 18922  | 0.000 | 0.000 | 1.00 | 28.3   | 0.050  | 0.100 | 76.67 | 4.8   | 26.1 |
| 24  | 0.297  | 18922  | 0.000 | 0.000 | 1.00 | 29.6   | 0.050  | 0.100 | 80.00 | 4.8   | 26.1 |
| 25  | 0.297  | 18922  | 0.000 | 0.000 | 1.00 | 35.3   | 0.050  | 0.100 | 83.33 | 4.8   | 26.1 |
| 26  | 0.297  | 18922  | 0.000 | 0.000 | 1.00 | 65.3   | 0.050  | 0.100 | 86.67 | 4.8   | 26.1 |
| 27  | 0.297  | 18923  | 0.000 | 0.000 | 1.00 | 69.9   | 0.050  | 0.100 | 90.00 | 4.8   | 26.1 |
| Toe |        |        |       |       |      | 302.0  | 0.150  | 0.100 |       |       |      |

8.026 kips total unreduced pile weight (g= 32.17 ft/s2)  
8.026 kips total reduced pile weight (g= 32.17 ft/s2)

| Depth | Stroke | Pressure | Efficy |
|-------|--------|----------|--------|
| ft    | ft     | Ratio    |        |
| 84.00 | 12.04  | 1.00     | 0.800  |

Abutment 2 SB H-Pile- Delmag D25-32  
HNTB Corporation

04/02/2020  
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| Rut<br>kips | Bl Ct<br>b/ft | Stroke (ft)<br>down | up   | Ten Str<br>ksi | i  | t  | Comp Str<br>ksi | i | t | ENTHRU<br>kip-ft | Bl Rt<br>b/min |
|-------------|---------------|---------------------|------|----------------|----|----|-----------------|---|---|------------------|----------------|
| 695.3       | 256.6         | 9.46                | 9.46 | -0.60          | 4  | 45 | 34.04           | 3 | 2 | 32.1             | 38.5           |
| 672.8       | 191.5         | 9.51                | 9.43 | -0.70          | 4  | 46 | 34.05           | 4 | 2 | 32.5             | 38.5           |
| 650.4       | 154.1         | 9.47                | 9.40 | -0.86          | 5  | 47 | 33.95           | 3 | 2 | 32.7             | 38.6           |
| 627.9       | 124.9         | 9.41                | 9.35 | -1.00          | 5  | 48 | 33.76           | 3 | 2 | 32.9             | 38.7           |
| 605.4       | 103.5         | 9.36                | 9.30 | -1.39          | 20 | 25 | 33.58           | 3 | 2 | 33.1             | 38.8           |

Abutment 2 SB H-Pile- Delmag D25-32  
HNTB Corporation

04/02/2020  
GRLWEAP Version 2010

Depth (ft) 85.0 Standard Soil Setup  
Shaft Gain/Loss Factor 1.000 Toe Gain/Loss Factor 1.000

PILE PROFILE:

Toe Area (in2) 203.230 File Type H File  
Pile Size (inch) 14.690

| L b Top | Area  | E-Mod  | Spec Wt | Perim | C Index | Wave Sp | EA/c   |
|---------|-------|--------|---------|-------|---------|---------|--------|
| ft      | in2   | ksi    | lb/ft3  | ft    |         | ft/s    | k/ft/s |
| 0.0     | 26.10 | 29000. | 492.0   | 4.8   | 0       | 16524.  | 45.8   |
| 90.0    | 26.10 | 29000. | 492.0   | 4.8   | 0       | 16524.  | 45.8   |

Wave Travel Time 2L/c (ms) 10.893

| No. | Weight | File and Soil Model    | Total Capacity | Rut          | (kips) | 717.0      |
|-----|--------|------------------------|----------------|--------------|--------|------------|
|     | kips   | Stiffn C-Slk T-Slk CoR | Soil-S         | Soil-D Quake | LbTop  | Perim Area |
|     |        | k/in ft ft             | kips           | s/ft inch    | ft     | ft in2     |
| 1   | 0.297  | 18923 0.010 0.000 1.00 | 0.0            | 0.000 0.100  | 3.33   | 4.8 26.1   |
| 2   | 0.297  | 18923 0.000 0.000 1.00 | 0.5            | 0.050 0.100  | 6.67   | 4.8 26.1   |
| 3   | 0.297  | 18922 0.000 0.000 1.00 | 4.0            | 0.050 0.100  | 10.00  | 4.8 26.1   |
| 4   | 0.297  | 18923 0.000 0.000 1.00 | 6.6            | 0.115 0.100  | 13.33  | 4.8 26.1   |
| 5   | 0.297  | 18923 0.000 0.000 1.00 | 7.9            | 0.200 0.100  | 16.67  | 4.8 26.1   |
| 21  | 0.297  | 18922 0.000 0.000 1.00 | 9.4            | 0.185 0.100  | 70.00  | 4.8 26.1   |
| 22  | 0.297  | 18922 0.000 0.000 1.00 | 26.0           | 0.060 0.100  | 73.33  | 4.8 26.1   |
| 23  | 0.297  | 18922 0.000 0.000 1.00 | 28.7           | 0.050 0.100  | 76.67  | 4.8 26.1   |
| 24  | 0.297  | 18922 0.000 0.000 1.00 | 30.0           | 0.050 0.100  | 80.00  | 4.8 26.1   |
| 25  | 0.297  | 18922 0.000 0.000 1.00 | 44.6           | 0.050 0.100  | 83.33  | 4.8 26.1   |
| 26  | 0.297  | 18922 0.000 0.000 1.00 | 67.5           | 0.050 0.100  | 86.67  | 4.8 26.1   |
| 27  | 0.297  | 18923 0.000 0.000 1.00 | 71.0           | 0.050 0.100  | 90.00  | 4.8 26.1   |
| Toe |        |                        | 302.0          | 0.150 0.100  |        |            |

8.026 kips total unreduced pile weight (g= 32.17 ft/s2)  
8.026 kips total reduced pile weight (g= 32.17 ft/s2)

| Depth | Stroke | Pressure | Efficy |
|-------|--------|----------|--------|
| ft    | ft     | Ratio    |        |
| 85.00 | 12.04  | 1.00     | 0.800  |

Abutment 2 SB H-Pile- Delmag D25-32  
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| Rut<br>kips | Bl Ct<br>b/ft | Stroke (ft)<br>down | Ten Str<br>up<br>ksi | i     | t  | Comp Str<br>ksi | i     | t | ENTHRU<br>kip-ft | Bl Rt<br>b/min |      |
|-------------|---------------|---------------------|----------------------|-------|----|-----------------|-------|---|------------------|----------------|------|
| 717.0       | 295.9         | 9.58                | 9.49                 | -0.54 | 4  | 19              | 34.36 | 3 | 2                | 32.4           | 38.4 |
| 693.8       | 220.1         | 9.55                | 9.46                 | -0.63 | 4  | 46              | 34.21 | 3 | 2                | 32.6           | 38.4 |
| 670.7       | 174.0         | 9.51                | 9.43                 | -0.78 | 5  | 47              | 34.06 | 3 | 2                | 32.7           | 38.5 |
| 647.5       | 140.3         | 9.45                | 9.39                 | -0.96 | 6  | 48              | 33.89 | 3 | 2                | 32.9           | 38.6 |
| 624.4       | 114.5         | 9.40                | 9.34                 | -1.45 | 20 | 25              | 33.69 | 3 | 2                | 33.1           | 38.7 |



Abutment 2 SB H-Pile- Delmag D25-32  
HNTB Corporation

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Depth (ft) 86.0 Standard Soil Setup  
Shaft Gain/Loss Factor 1.000 Toe Gain/Loss Factor 1.000

PILE PROFILE:

Toe Area (in2) 203.230 File Type H File  
Pile Size (inch) 14.690

| L b Top | Area  | E-Mod  | Spec Wt | Perim | C Index | Wave Sp | EA/c   |
|---------|-------|--------|---------|-------|---------|---------|--------|
| ft      | in2   | ksi    | lb/ft3  | ft    |         | ft/s    | k/ft/s |
| 0.0     | 26.10 | 29000. | 492.0   | 4.8   | 0       | 16524.  | 45.8   |
| 90.0    | 26.10 | 29000. | 492.0   | 4.8   | 0       | 16524.  | 45.8   |

Wave Travel Time 2L/c (ms) 10.893

| File and Soil Model |        |        |       |       |      | Total Capacity Rut (kips) |        |       | 739.0 |       |      |
|---------------------|--------|--------|-------|-------|------|---------------------------|--------|-------|-------|-------|------|
| No.                 | Weight | Stiffn | C-Slk | T-Slk | CoR  | Soil-S                    | Soil-D | Quake | LbTop | Perim | Area |
|                     | kips   | k/in   | ft    | ft    |      | kips                      | s/ft   | inch  | ft    | ft    | in2  |
| 1                   | 0.297  | 18923  | 0.010 | 0.000 | 1.00 | 0.0                       | 0.000  | 0.100 | 3.33  | 4.8   | 26.1 |
| 2                   | 0.297  | 18923  | 0.000 | 0.000 | 1.00 | 1.3                       | 0.050  | 0.100 | 6.67  | 4.8   | 26.1 |
| 3                   | 0.297  | 18922  | 0.000 | 0.000 | 1.00 | 4.8                       | 0.050  | 0.100 | 10.00 | 4.8   | 26.1 |
| 4                   | 0.297  | 18923  | 0.000 | 0.000 | 1.00 | 7.3                       | 0.157  | 0.100 | 13.33 | 4.8   | 26.1 |
| 5                   | 0.297  | 18923  | 0.000 | 0.000 | 1.00 | 7.9                       | 0.200  | 0.100 | 16.67 | 4.8   | 26.1 |
| 21                  | 0.297  | 18922  | 0.000 | 0.000 | 1.00 | 13.7                      | 0.142  | 0.100 | 70.00 | 4.8   | 26.1 |
| 22                  | 0.297  | 18922  | 0.000 | 0.000 | 1.00 | 27.8                      | 0.050  | 0.100 | 73.33 | 4.8   | 26.1 |
| 23                  | 0.297  | 18922  | 0.000 | 0.000 | 1.00 | 29.1                      | 0.050  | 0.100 | 76.67 | 4.8   | 26.1 |
| 24                  | 0.297  | 18922  | 0.000 | 0.000 | 1.00 | 30.4                      | 0.050  | 0.100 | 80.00 | 4.8   | 26.1 |
| 25                  | 0.297  | 18922  | 0.000 | 0.000 | 1.00 | 55.3                      | 0.050  | 0.100 | 83.33 | 4.8   | 26.1 |
| 26                  | 0.297  | 18922  | 0.000 | 0.000 | 1.00 | 68.5                      | 0.050  | 0.100 | 86.67 | 4.8   | 26.1 |
| 27                  | 0.297  | 18923  | 0.000 | 0.000 | 1.00 | 72.0                      | 0.050  | 0.100 | 90.00 | 4.8   | 26.1 |
| Toe                 |        |        |       |       |      | 302.0                     | 0.150  | 0.100 |       |       |      |

8.026 kips total unreduced pile weight (g= 32.17 ft/s2)

8.026 kips total reduced pile weight (g= 32.17 ft/s2)

| Depth | Stroke | Pressure | Efficy |
|-------|--------|----------|--------|
| ft    | ft     | Ratio    |        |
| 86.00 | 12.04  | 1.00     | 0.800  |

Abutment 2 SB H-Pile- Delmag D25-32  
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| Rut<br>kips | Bl Ct<br>b/ft | Stroke (ft)<br>down up | Ten Str<br>ksi | i  | t  | Comp Str<br>ksi | i | t | ENTHRU<br>kip-ft | Bl Rt<br>b/min |
|-------------|---------------|------------------------|----------------|----|----|-----------------|---|---|------------------|----------------|
| 739.0       | 388.8         | 9.51 9.51              | -0.53          | 4  | 19 | 34.22           | 3 | 2 | 32.0             | 38.4           |
| 715.0       | 270.0         | 9.47 9.48              | -0.55          | 4  | 46 | 34.07           | 4 | 2 | 32.2             | 38.5           |
| 691.1       | 198.5         | 9.54 9.45              | -0.70          | 4  | 46 | 34.18           | 3 | 2 | 32.7             | 38.4           |
| 667.2       | 157.6         | 9.49 9.42              | -0.91          | 5  | 47 | 34.01           | 3 | 2 | 32.9             | 38.5           |
| 643.3       | 126.7         | 9.47 9.38              | -1.48          | 19 | 25 | 33.87           | 3 | 2 | 33.2             | 38.6           |

Abutment 2 SB H-Pile- Delmag D25-32  
HNTB Corporation

04/02/2020  
GRLWEAP Version 2010

Depth (ft) 87.0 Standard Soil Setup  
Shaft Gain/Loss Factor 1.000 Toe Gain/Loss Factor 1.000

PILE PROFILE:

Toe Area (in2) 203.230 File Type H File  
Pile Size (inch) 14.690

| L b Top | Area  | E-Mod  | Spec Wt | Perim | C Index | Wave Sp | EA/c   |
|---------|-------|--------|---------|-------|---------|---------|--------|
| ft      | in2   | ksi    | lb/ft3  | ft    |         | ft/s    | k/ft/s |
| 0.0     | 26.10 | 29000. | 492.0   | 4.8   | 0       | 16524.  | 45.8   |
| 90.0    | 26.10 | 29000. | 492.0   | 4.8   | 0       | 16524.  | 45.8   |

Wave Travel Time 2L/c (ms) 10.893

| File and Soil Model |        |        |       |       |      | Total Capacity Rut (kips) |        |       | 761.3 |       |      |
|---------------------|--------|--------|-------|-------|------|---------------------------|--------|-------|-------|-------|------|
| No.                 | Weight | Stiffn | C-Slk | T-Slk | CoR  | Soil-S                    | Soil-D | Quake | LbTop | Perim | Area |
|                     | kips   | k/in   | ft    | ft    |      | kips                      | s/ft   | inch  | ft    | ft    | in2  |
| 1                   | 0.297  | 18923  | 0.010 | 0.000 | 1.00 | 0.0                       | 0.050  | 0.100 | 3.33  | 4.8   | 26.1 |
| 2                   | 0.297  | 18923  | 0.000 | 0.000 | 1.00 | 2.5                       | 0.050  | 0.100 | 6.67  | 4.8   | 26.1 |
| 3                   | 0.297  | 18922  | 0.000 | 0.000 | 1.00 | 5.6                       | 0.063  | 0.100 | 10.00 | 4.8   | 26.1 |
| 4                   | 0.297  | 18923  | 0.000 | 0.000 | 1.00 | 7.8                       | 0.189  | 0.100 | 13.33 | 4.8   | 26.1 |
| 5                   | 0.297  | 18923  | 0.000 | 0.000 | 1.00 | 7.9                       | 0.200  | 0.100 | 16.67 | 4.8   | 26.1 |
| 21                  | 0.297  | 18922  | 0.000 | 0.000 | 1.00 | 19.5                      | 0.097  | 0.100 | 70.00 | 4.8   | 26.1 |
| 22                  | 0.297  | 18922  | 0.000 | 0.000 | 1.00 | 28.2                      | 0.050  | 0.100 | 73.33 | 4.8   | 26.1 |
| 23                  | 0.297  | 18922  | 0.000 | 0.000 | 1.00 | 29.5                      | 0.050  | 0.100 | 76.67 | 4.8   | 26.1 |
| 24                  | 0.297  | 18922  | 0.000 | 0.000 | 1.00 | 33.2                      | 0.050  | 0.100 | 80.00 | 4.8   | 26.1 |
| 25                  | 0.297  | 18922  | 0.000 | 0.000 | 1.00 | 63.6                      | 0.050  | 0.100 | 83.33 | 4.8   | 26.1 |
| 26                  | 0.297  | 18922  | 0.000 | 0.000 | 1.00 | 69.6                      | 0.050  | 0.100 | 86.67 | 4.8   | 26.1 |
| 27                  | 0.297  | 18923  | 0.000 | 0.000 | 1.00 | 73.1                      | 0.050  | 0.100 | 90.00 | 4.8   | 26.1 |
| Toe                 |        |        |       |       |      | 302.0                     | 0.150  | 0.100 |       |       |      |

8.026 kips total unreduced pile weight (g= 32.17 ft/s2)  
8.026 kips total reduced pile weight (g= 32.17 ft/s2)

| Depth | Stroke | Pressure | Efficy |
|-------|--------|----------|--------|
| ft    | ft     | Ratio    |        |
| 87.00 | 12.04  | 1.00     | 0.800  |

Abutment 2 SB H-Pile- Delmag D25-32  
HNTB Corporation

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| Rut<br>kips | Bl Ct<br>b/ft | Stroke (ft)<br>down | (ft)<br>up | Ten Str<br>ksi | i  | t  | Comp Str<br>ksi | i | t | ENTHRU<br>kip-ft | Bl Rt<br>b/min |
|-------------|---------------|---------------------|------------|----------------|----|----|-----------------|---|---|------------------|----------------|
| 761.3       | 499.4         | 9.53                | 9.51       | -0.50          | 4  | 19 | 34.26           | 2 | 2 | 32.0             | 38.4           |
| 736.6       | 313.7         | 9.60                | 9.50       | -0.46          | 4  | 45 | 34.39           | 3 | 2 | 32.5             | 38.3           |
| 711.9       | 234.0         | 9.48                | 9.46       | -0.63          | 4  | 46 | 34.05           | 2 | 2 | 32.5             | 38.5           |
| 687.2       | 181.7         | 9.44                | 9.44       | -0.86          | 5  | 47 | 33.88           | 3 | 2 | 32.7             | 38.5           |
| 662.6       | 141.3         | 9.50                | 9.42       | -1.53          | 19 | 25 | 33.93           | 3 | 2 | 33.3             | 38.5           |

Abutment 2 SB H-Pile- Delmag D25-32  
HNTB Corporation

04/02/2020  
GRLWEAP Version 2010

Depth (ft) 88.0 Standard Soil Setup  
Shaft Gain/Loss Factor 1.000 Toe Gain/Loss Factor 1.000

PILE PROFILE:

Toe Area (in2) 203.230 File Type H File  
Pile Size (inch) 14.690

| L b Top | Area  | E-Mod  | Spec Wt | Perim | C Index | Wave Sp | EA/c   |
|---------|-------|--------|---------|-------|---------|---------|--------|
| ft      | in2   | ksi    | lb/ft3  | ft    |         | ft/s    | k/ft/s |
| 0.0     | 26.10 | 29000. | 492.0   | 4.8   | 0       | 16524.  | 45.8   |
| 90.0    | 26.10 | 29000. | 492.0   | 4.8   | 0       | 16524.  | 45.8   |

Wave Travel Time 2L/c (ms) 10.893

| File and Soil Model |        |        |       |       |      | Total Capacity Rut (kips) |        |       | 783.9 |       |      |
|---------------------|--------|--------|-------|-------|------|---------------------------|--------|-------|-------|-------|------|
| No.                 | Weight | Stiffn | C-Slk | T-Slk | CoR  | Soil-S                    | Soil-D | Quake | LbTop | Perim | Area |
|                     | kips   | k/in   | ft    | ft    |      | kips                      | s/ft   | inch  | ft    | ft    | in2  |
| 1                   | 0.297  | 18923  | 0.010 | 0.000 | 1.00 | 0.3                       | 0.050  | 0.100 | 3.33  | 4.8   | 26.1 |
| 2                   | 0.297  | 18923  | 0.000 | 0.000 | 1.00 | 3.6                       | 0.050  | 0.100 | 6.67  | 4.8   | 26.1 |
| 3                   | 0.297  | 18922  | 0.000 | 0.000 | 1.00 | 6.4                       | 0.099  | 0.100 | 10.00 | 4.8   | 26.1 |
| 4                   | 0.297  | 18923  | 0.000 | 0.000 | 1.00 | 7.9                       | 0.200  | 0.100 | 13.33 | 4.8   | 26.1 |
| 20                  | 0.297  | 18923  | 0.000 | 0.000 | 1.00 | 8.6                       | 0.194  | 0.100 | 66.67 | 4.8   | 26.1 |
| 21                  | 0.297  | 18922  | 0.000 | 0.000 | 1.00 | 24.8                      | 0.067  | 0.100 | 70.00 | 4.8   | 26.1 |
| 22                  | 0.297  | 18922  | 0.000 | 0.000 | 1.00 | 28.6                      | 0.050  | 0.100 | 73.33 | 4.8   | 26.1 |
| 23                  | 0.297  | 18922  | 0.000 | 0.000 | 1.00 | 29.9                      | 0.050  | 0.100 | 76.67 | 4.8   | 26.1 |
| 24                  | 0.297  | 18922  | 0.000 | 0.000 | 1.00 | 41.1                      | 0.050  | 0.100 | 80.00 | 4.8   | 26.1 |
| 25                  | 0.297  | 18922  | 0.000 | 0.000 | 1.00 | 67.1                      | 0.050  | 0.100 | 83.33 | 4.8   | 26.1 |
| 26                  | 0.297  | 18922  | 0.000 | 0.000 | 1.00 | 70.6                      | 0.050  | 0.100 | 86.67 | 4.8   | 26.1 |
| 27                  | 0.297  | 18923  | 0.000 | 0.000 | 1.00 | 74.2                      | 0.050  | 0.100 | 90.00 | 4.8   | 26.1 |
| Toe                 |        |        |       |       |      | 302.0                     | 0.150  | 0.100 |       |       |      |

8.026 kips total unreduced pile weight (g= 32.17 ft/s2)  
8.026 kips total reduced pile weight (g= 32.17 ft/s2)

| Depth | Stroke | Pressure | Efficy |
|-------|--------|----------|--------|
| ft    | ft     | Ratio    |        |
| 88.00 | 12.04  | 1.00     | 0.800  |

Abutment 2 SB H-Pile- Delmag D25-32  
HNTB Corporation

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| Rut   | Bl Ct | Stroke (ft) | Ten Str | i     | t  | Comp Str | i     | t | ENTHRU | Bl Rt |      |
|-------|-------|-------------|---------|-------|----|----------|-------|---|--------|-------|------|
| kip   | b/ft  | down        | up      | ksi   |    | ksi      |       |   | kip-ft | b/min |      |
| 783.9 | 716.5 | 9.55        | 9.54    | -0.43 | 3  | 19       | 34.29 | 2 | 2      | 31.9  | 38.3 |
| 758.5 | 410.0 | 9.53        | 9.52    | -0.39 | 3  | 45       | 34.25 | 3 | 2      | 32.1  | 38.4 |
| 733.1 | 278.5 | 9.50        | 9.50    | -0.55 | 4  | 46       | 34.12 | 3 | 2      | 32.4  | 38.4 |
| 707.7 | 206.1 | 9.47        | 9.47    | -0.81 | 5  | 47       | 33.97 | 3 | 2      | 32.7  | 38.5 |
| 682.4 | 156.9 | 9.53        | 9.44    | -1.57 | 19 | 24       | 34.07 | 3 | 2      | 33.3  | 38.4 |

Abutment 2 SB H-Pile- Delmag D25-32  
HNTB Corporation

04/02/2020  
GRLWEAP Version 2010

Depth (ft) 89.0 Standard Soil Setup  
Shaft Gain/Loss Factor 1.000 Toe Gain/Loss Factor 1.000

PILE PROFILE:

Toe Area (in2) 203.230 File Type H File  
Pile Size (inch) 14.690

| L b Top | Area  | E-Mod  | Spec Wt | Perim | C Index | Wave Sp | EA/c   |
|---------|-------|--------|---------|-------|---------|---------|--------|
| ft      | in2   | ksi    | lb/ft3  | ft    |         | ft/s    | k/ft/s |
| 0.0     | 26.10 | 29000. | 492.0   | 4.8   | 0       | 16524.  | 45.8   |
| 90.0    | 26.10 | 29000. | 492.0   | 4.8   | 0       | 16524.  | 45.8   |

Wave Travel Time 2L/c (ms) 10.893

| File and Soil Model |        |        |       |       |      | Total Capacity Rut (kips) |        |       | 806.8 |       |      |
|---------------------|--------|--------|-------|-------|------|---------------------------|--------|-------|-------|-------|------|
| No.                 | Weight | Stiffn | C-Slk | T-Slk | CoR  | Soil-S                    | Soil-D | Quake | LbTop | Perim | Area |
|                     | kips   | k/in   | ft    | ft    |      | kips                      | s/ft   | inch  | ft    | ft    | in2  |
| 1                   | 0.297  | 18923  | 0.010 | 0.000 | 1.00 | 1.0                       | 0.050  | 0.100 | 3.33  | 4.8   | 26.1 |
| 2                   | 0.297  | 18923  | 0.000 | 0.000 | 1.00 | 4.6                       | 0.050  | 0.100 | 6.67  | 4.8   | 26.1 |
| 3                   | 0.297  | 18922  | 0.000 | 0.000 | 1.00 | 7.1                       | 0.144  | 0.100 | 10.00 | 4.8   | 26.1 |
| 4                   | 0.297  | 18923  | 0.000 | 0.000 | 1.00 | 7.9                       | 0.200  | 0.100 | 13.33 | 4.8   | 26.1 |
| 20                  | 0.297  | 18923  | 0.000 | 0.000 | 1.00 | 11.9                      | 0.158  | 0.100 | 66.67 | 4.8   | 26.1 |
| 21                  | 0.297  | 18922  | 0.000 | 0.000 | 1.00 | 27.5                      | 0.051  | 0.100 | 70.00 | 4.8   | 26.1 |
| 22                  | 0.297  | 18922  | 0.000 | 0.000 | 1.00 | 28.9                      | 0.050  | 0.100 | 73.33 | 4.8   | 26.1 |
| 23                  | 0.297  | 18922  | 0.000 | 0.000 | 1.00 | 30.2                      | 0.050  | 0.100 | 76.67 | 4.8   | 26.1 |
| 24                  | 0.297  | 18922  | 0.000 | 0.000 | 1.00 | 51.7                      | 0.050  | 0.100 | 80.00 | 4.8   | 26.1 |
| 25                  | 0.297  | 18922  | 0.000 | 0.000 | 1.00 | 68.2                      | 0.050  | 0.100 | 83.33 | 4.8   | 26.1 |
| 26                  | 0.297  | 18922  | 0.000 | 0.000 | 1.00 | 71.7                      | 0.050  | 0.100 | 86.67 | 4.8   | 26.1 |
| 27                  | 0.297  | 18923  | 0.000 | 0.000 | 1.00 | 75.2                      | 0.050  | 0.100 | 90.00 | 4.8   | 26.1 |
| Toe                 |        |        |       |       |      | 302.0                     | 0.150  | 0.100 |       |       |      |

8.026 kips total unreduced pile weight (g= 32.17 ft/s2)  
8.026 kips total reduced pile weight (g= 32.17 ft/s2)

| Depth | Stroke | Pressure | Efficy |
|-------|--------|----------|--------|
| ft    | ft     | Ratio    |        |
| 89.00 | 12.04  | 1.00     | 0.800  |

Abutment 2 SB H-Pile- Delmag D25-32  
HNTB Corporation

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| Rut<br>kips | Bl Ct<br>b/ft | Stroke (ft)<br>down | (ft)<br>up | Ten Str<br>ksi | i  | t  | Comp Str<br>ksi | i | t | ENTHRU<br>kip-ft | Bl Rt<br>b/min |
|-------------|---------------|---------------------|------------|----------------|----|----|-----------------|---|---|------------------|----------------|
| 806.8       | 1222.4        | 9.56                | 9.56       | -0.42          | 3  | 18 | 34.35           | 2 | 2 | 31.8             | 38.3           |
| 780.7       | 555.3         | 9.55                | 9.55       | -0.31          | 3  | 45 | 34.34           | 3 | 2 | 32.0             | 38.3           |
| 754.5       | 326.1         | 9.63                | 9.54       | -0.47          | 4  | 45 | 34.45           | 2 | 2 | 32.6             | 38.3           |
| 728.3       | 231.3         | 9.59                | 9.50       | -0.75          | 5  | 47 | 34.29           | 3 | 2 | 33.0             | 38.3           |
| 702.2       | 182.1         | 9.47                | 9.46       | -1.61          | 20 | 24 | 33.89           | 3 | 2 | 32.9             | 38.5           |



Abutment 2 SB H-Pile- Delmag D25-32  
HNTB Corporation

04/02/2020  
GRLWEAP Version 2010

Depth (ft) 90.0 Standard Soil Setup  
Shaft Gain/Loss Factor 1.000 Toe Gain/Loss Factor 1.000

PILE PROFILE:

Toe Area (in2) 203.230 File Type H File  
Pile Size (inch) 14.690

| L b Top | Area  | E-Mod  | Spec Wt | Perim | C Index | Wave Sp | EA/c   |
|---------|-------|--------|---------|-------|---------|---------|--------|
| ft      | in2   | ksi    | lb/ft3  | ft    |         | ft/s    | k/ft/s |
| 0.0     | 26.10 | 29000. | 492.0   | 4.8   | 0       | 16524.  | 45.8   |
| 90.0    | 26.10 | 29000. | 492.0   | 4.8   | 0       | 16524.  | 45.8   |

Wave Travel Time 2L/c (ms) 10.893

| File and Soil Model |        |        |       |       |      | Total Capacity Rut (kips) |        |       | 830.1 |       |      |
|---------------------|--------|--------|-------|-------|------|---------------------------|--------|-------|-------|-------|------|
| No.                 | Weight | Stiffn | C-Slk | T-Slk | CoR  | Soil-S                    | Soil-D | Quake | LbTop | Perim | Area |
|                     | kips   | k/in   | ft    | ft    |      | kips                      | s/ft   | inch  | ft    | ft    | in2  |
| 1                   | 0.297  | 18923  | 0.010 | 0.000 | 1.00 | 2.1                       | 0.050  | 0.100 | 3.33  | 4.8   | 26.1 |
| 2                   | 0.297  | 18923  | 0.000 | 0.000 | 1.00 | 5.3                       | 0.056  | 0.100 | 6.67  | 4.8   | 26.1 |
| 3                   | 0.297  | 18922  | 0.000 | 0.000 | 1.00 | 7.7                       | 0.181  | 0.100 | 10.00 | 4.8   | 26.1 |
| 4                   | 0.297  | 18923  | 0.000 | 0.000 | 1.00 | 7.9                       | 0.200  | 0.100 | 13.33 | 4.8   | 26.1 |
| 20                  | 0.297  | 18923  | 0.000 | 0.000 | 1.00 | 17.5                      | 0.108  | 0.100 | 66.67 | 4.8   | 26.1 |
| 21                  | 0.297  | 18922  | 0.000 | 0.000 | 1.00 | 28.0                      | 0.050  | 0.100 | 70.00 | 4.8   | 26.1 |
| 22                  | 0.297  | 18922  | 0.000 | 0.000 | 1.00 | 29.3                      | 0.050  | 0.100 | 73.33 | 4.8   | 26.1 |
| 23                  | 0.297  | 18922  | 0.000 | 0.000 | 1.00 | 31.7                      | 0.050  | 0.100 | 76.67 | 4.8   | 26.1 |
| 24                  | 0.297  | 18922  | 0.000 | 0.000 | 1.00 | 61.4                      | 0.050  | 0.100 | 80.00 | 4.8   | 26.1 |
| 25                  | 0.297  | 18922  | 0.000 | 0.000 | 1.00 | 69.2                      | 0.050  | 0.100 | 83.33 | 4.8   | 26.1 |
| 26                  | 0.297  | 18922  | 0.000 | 0.000 | 1.00 | 72.7                      | 0.050  | 0.100 | 86.67 | 4.8   | 26.1 |
| 27                  | 0.297  | 18923  | 0.000 | 0.000 | 1.00 | 76.3                      | 0.050  | 0.100 | 90.00 | 4.8   | 26.1 |
| Toe                 |        |        |       |       |      | 302.0                     | 0.150  | 0.100 |       |       |      |

8.026 kips total unreduced pile weight (g= 32.17 ft/s2)  
8.026 kips total reduced pile weight (g= 32.17 ft/s2)

| Depth | Stroke | Pressure | Efficy |
|-------|--------|----------|--------|
| ft    | ft     | Ratio    |        |
| 90.00 | 12.04  | 1.00     | 0.800  |

Abutment 2 SB H-Pile- Delmag D25-32  
HNTB Corporation

04/02/2020  
GRLWEAP Version 2010

| Rut   | Bl Ct  | Stroke (ft) | Ten Str | i     | t  | Comp Str | i     | t | ENTHRU | Bl Rt |      |
|-------|--------|-------------|---------|-------|----|----------|-------|---|--------|-------|------|
| kip   | b/ft   | down        | up      | ksi   |    | ksi      |       |   | kip-ft | b/min |      |
| 830.1 | 3550.4 | 9.58        | 9.57    | -0.39 | 3  | 18       | 34.52 | 3 | 2      | 31.7  | 38.3 |
| 803.1 | 826.4  | 9.56        | 9.56    | -0.29 | 3  | 18       | 34.40 | 3 | 2      | 31.9  | 38.3 |
| 776.2 | 430.1  | 9.54        | 9.53    | -0.39 | 4  | 45       | 34.22 | 2 | 2      | 32.3  | 38.4 |
| 749.2 | 284.7  | 9.53        | 9.53    | -0.69 | 6  | 46       | 34.16 | 3 | 2      | 32.6  | 38.4 |
| 722.2 | 205.0  | 9.51        | 9.49    | -1.64 | 20 | 24       | 34.07 | 2 | 2      | 33.0  | 38.4 |

SUMMARY OVER DEPTHS

| G/L at Shaft and Toe: 1.000 1.000 |       |        |        |        |         |         |        |        |  |
|-----------------------------------|-------|--------|--------|--------|---------|---------|--------|--------|--|
| Depth                             | Rut   | Frictn | End Bg | Bl Ct  | Com Str | Ten Str | Stroke | ENTHRU |  |
| ft                                | kips  | kips   | kips   | bl/ft  | ksi     | ksi     | ft     | kip-ft |  |
| 76.0                              | 344.4 | 241.1  | 103.3  | 32.5   | 30.480  | -0.410  | 8.39   | 29.1   |  |
| 77.0                              | 416.8 | 253.0  | 163.9  | 46.0   | 31.555  | -0.638  | 8.74   | 30.2   |  |
| 78.0                              | 494.4 | 270.0  | 224.4  | 68.0   | 32.584  | -0.723  | 9.07   | 31.3   |  |
| 79.0                              | 552.9 | 289.7  | 263.2  | 93.4   | 33.230  | -0.861  | 9.25   | 31.9   |  |
| 80.0                              | 611.8 | 309.8  | 302.0  | 137.3  | 33.711  | -0.908  | 9.40   | 32.3   |  |
| 81.0                              | 632.2 | 330.2  | 302.0  | 156.8  | 33.886  | -0.836  | 9.45   | 32.4   |  |
| 82.0                              | 653.0 | 350.9  | 302.0  | 181.3  | 33.994  | -0.754  | 9.48   | 32.4   |  |
| 83.0                              | 674.0 | 372.0  | 302.0  | 210.3  | 34.142  | -0.658  | 9.53   | 32.4   |  |
| 84.0                              | 695.3 | 393.3  | 302.0  | 256.6  | 34.040  | -0.596  | 9.46   | 32.1   |  |
| 85.0                              | 717.0 | 415.0  | 302.0  | 295.9  | 34.364  | -0.538  | 9.58   | 32.4   |  |
| 86.0                              | 739.0 | 436.9  | 302.0  | 388.8  | 34.217  | -0.528  | 9.51   | 32.0   |  |
| 87.0                              | 761.3 | 459.2  | 302.0  | 499.4  | 34.262  | -0.497  | 9.53   | 32.0   |  |
| 88.0                              | 783.9 | 481.9  | 302.0  | 716.5  | 34.288  | -0.426  | 9.55   | 31.9   |  |
| 89.0                              | 806.8 | 504.8  | 302.0  | 1222.4 | 34.354  | -0.416  | 9.56   | 31.8   |  |
| 90.0                              | 830.1 | 528.1  | 302.0  | 3550.4 | 34.521  | -0.394  | 9.58   | 31.7   |  |

Total Driving Time 158 minutes; Total No. of Blows 6062  
Starting at penetration 76.0 ft

| G/L at Shaft and Toe: 0.900 1.000 |       |        |        |       |         |         |        |        |  |
|-----------------------------------|-------|--------|--------|-------|---------|---------|--------|--------|--|
| Depth                             | Rut   | Frictn | End Bg | Bl Ct | Com Str | Ten Str | Stroke | ENTHRU |  |
| ft                                | kips  | kips   | kips   | bl/ft | ksi     | ksi     | ft     | kip-ft |  |
| 76.0                              | 327.0 | 223.7  | 103.3  | 30.0  | 30.074  | -0.121  | 8.25   | 28.8   |  |
| 77.0                              | 399.0 | 235.2  | 163.9  | 41.7  | 31.325  | -0.565  | 8.63   | 30.1   |  |
| 78.0                              | 476.1 | 251.7  | 224.4  | 60.7  | 32.322  | -0.761  | 8.96   | 31.3   |  |
| 79.0                              | 533.9 | 270.7  | 263.2  | 82.1  | 32.912  | -0.941  | 9.16   | 31.8   |  |
| 80.0                              | 592.1 | 290.1  | 302.0  | 114.7 | 33.537  | -0.997  | 9.35   | 32.4   |  |
| 81.0                              | 611.9 | 309.9  | 302.0  | 129.6 | 33.639  | -0.938  | 9.38   | 32.4   |  |
| 82.0                              | 631.9 | 329.9  | 302.0  | 146.1 | 33.843  | -0.866  | 9.44   | 32.5   |  |
| 83.0                              | 652.2 | 350.2  | 302.0  | 167.8 | 33.968  | -0.782  | 9.47   | 32.5   |  |
| 84.0                              | 672.8 | 370.8  | 302.0  | 191.5 | 34.050  | -0.696  | 9.51   | 32.5   |  |
| 85.0                              | 693.8 | 391.8  | 302.0  | 220.1 | 34.213  | -0.625  | 9.55   | 32.6   |  |
| 86.0                              | 715.0 | 413.0  | 302.0  | 270.0 | 34.068  | -0.549  | 9.47   | 32.2   |  |
| 87.0                              | 736.6 | 434.6  | 302.0  | 313.7 | 34.394  | -0.460  | 9.60   | 32.5   |  |
| 88.0                              | 758.5 | 456.5  | 302.0  | 410.0 | 34.255  | -0.386  | 9.53   | 32.1   |  |
| 89.0                              | 780.7 | 478.6  | 302.0  | 555.3 | 34.335  | -0.314  | 9.55   | 32.0   |  |
| 90.0                              | 803.1 | 501.1  | 302.0  | 826.4 | 34.399  | -0.288  | 9.56   | 31.9   |  |

Total Driving Time 81 minutes; Total No. of Blows 3132  
Starting at penetration 76.0 ft

SUMMARY OVER DEPTHS

| G/L at Shaft and Toe: 0.800 1.000 |       |        |        |       |         |         |        |        |  |  |
|-----------------------------------|-------|--------|--------|-------|---------|---------|--------|--------|--|--|
| Depth                             | Rut   | Frictn | End Bg | Bl Ct | Com Str | Ten Str | Stroke | ENTHRU |  |  |
| ft                                | kips  | kips   | kips   | bl/ft | ksi     | ksi     | ft     | kip-ft |  |  |
| 76.0                              | 309.6 | 206.3  | 103.3  | 27.3  | 30.054  | -0.076  | 8.21   | 29.0   |  |  |
| 77.0                              | 381.2 | 217.4  | 163.9  | 38.1  | 30.920  | -0.523  | 8.52   | 29.9   |  |  |
| 78.0                              | 457.7 | 233.3  | 224.4  | 54.4  | 32.065  | -0.813  | 8.87   | 31.2   |  |  |
| 79.0                              | 515.0 | 251.7  | 263.2  | 72.3  | 32.720  | -1.007  | 9.10   | 31.9   |  |  |
| 80.0                              | 572.5 | 270.4  | 302.0  | 98.2  | 33.309  | -1.085  | 9.28   | 32.5   |  |  |
| 81.0                              | 591.6 | 289.5  | 302.0  | 108.4 | 33.488  | -1.031  | 9.33   | 32.5   |  |  |
| 82.0                              | 610.9 | 308.9  | 302.0  | 121.1 | 33.615  | -0.984  | 9.37   | 32.6   |  |  |
| 83.0                              | 630.5 | 328.4  | 302.0  | 137.1 | 33.694  | -0.926  | 9.41   | 32.6   |  |  |
| 84.0                              | 650.4 | 348.3  | 302.0  | 154.1 | 33.951  | -0.856  | 9.47   | 32.7   |  |  |
| 85.0                              | 670.7 | 368.7  | 302.0  | 174.0 | 34.062  | -0.777  | 9.51   | 32.7   |  |  |
| 86.0                              | 691.1 | 389.1  | 302.0  | 198.5 | 34.178  | -0.702  | 9.54   | 32.7   |  |  |
| 87.0                              | 711.9 | 409.9  | 302.0  | 234.0 | 34.051  | -0.632  | 9.48   | 32.5   |  |  |
| 88.0                              | 733.1 | 431.1  | 302.0  | 278.5 | 34.122  | -0.553  | 9.50   | 32.4   |  |  |
| 89.0                              | 754.5 | 452.5  | 302.0  | 326.1 | 34.453  | -0.470  | 9.63   | 32.6   |  |  |
| 90.0                              | 776.2 | 474.1  | 302.0  | 430.1 | 34.224  | -0.392  | 9.54   | 32.3   |  |  |

Total Driving Time 58 minutes; Total No. of Blows 2222  
Starting at penetration 76.0 ft

| G/L at Shaft and Toe: 0.700 1.000 |       |        |        |       |         |         |        |        |  |  |
|-----------------------------------|-------|--------|--------|-------|---------|---------|--------|--------|--|--|
| Depth                             | Rut   | Frictn | End Bg | Bl Ct | Com Str | Ten Str | Stroke | ENTHRU |  |  |
| ft                                | kips  | kips   | kips   | bl/ft | ksi     | ksi     | ft     | kip-ft |  |  |
| 76.0                              | 292.2 | 188.9  | 103.3  | 25.0  | 29.707  | 0.000   | 8.08   | 29.1   |  |  |
| 77.0                              | 363.4 | 199.6  | 163.9  | 34.9  | 30.501  | -0.548  | 8.38   | 29.7   |  |  |
| 78.0                              | 439.4 | 215.0  | 224.4  | 49.1  | 31.704  | -0.834  | 8.76   | 31.1   |  |  |
| 79.0                              | 496.0 | 232.8  | 263.2  | 64.2  | 32.443  | -1.047  | 8.99   | 31.9   |  |  |
| 80.0                              | 552.8 | 250.7  | 302.0  | 84.9  | 33.065  | -1.157  | 9.20   | 32.6   |  |  |
| 81.0                              | 571.2 | 269.2  | 302.0  | 92.9  | 33.251  | -1.116  | 9.26   | 32.6   |  |  |
| 82.0                              | 589.9 | 287.9  | 302.0  | 101.4 | 33.394  | -1.078  | 9.31   | 32.8   |  |  |
| 83.0                              | 608.7 | 306.7  | 302.0  | 111.8 | 33.555  | -1.039  | 9.37   | 32.9   |  |  |
| 84.0                              | 627.9 | 325.9  | 302.0  | 124.9 | 33.762  | -1.003  | 9.41   | 32.9   |  |  |
| 85.0                              | 647.5 | 345.5  | 302.0  | 140.3 | 33.895  | -0.958  | 9.45   | 32.9   |  |  |
| 86.0                              | 667.2 | 365.2  | 302.0  | 157.6 | 34.005  | -0.911  | 9.49   | 32.9   |  |  |
| 87.0                              | 687.2 | 385.2  | 302.0  | 181.7 | 33.880  | -0.863  | 9.44   | 32.7   |  |  |
| 88.0                              | 707.7 | 405.7  | 302.0  | 206.1 | 33.968  | -0.810  | 9.47   | 32.7   |  |  |
| 89.0                              | 728.3 | 426.3  | 302.0  | 231.3 | 34.289  | -0.751  | 9.59   | 33.0   |  |  |
| 90.0                              | 749.2 | 447.2  | 302.0  | 284.7 | 34.161  | -0.693  | 9.53   | 32.6   |  |  |

Total Driving Time 45 minutes; Total No. of Blows 1738  
Starting at penetration 76.0 ft

SUMMARY OVER DEPTHS

| G/L at Shaft and Toe: 0.600 1.000 |       |        |        |       |         |         |        |        |  |
|-----------------------------------|-------|--------|--------|-------|---------|---------|--------|--------|--|
| Depth                             | Rut   | Frictn | End Bg | Bl Ct | Com Str | Ten Str | Stroke | ENTHRU |  |
| ft                                | kip   | kip    | kip    | bl/ft | ksi     | ksi     | ft     | kip-ft |  |
| 76.0                              | 274.8 | 171.5  | 103.3  | 22.9  | 29.260  | -0.535  | 7.95   | 29.2   |  |
| 77.0                              | 345.6 | 181.8  | 163.9  | 31.9  | 30.066  | -0.572  | 8.24   | 29.6   |  |
| 78.0                              | 421.1 | 196.7  | 224.4  | 44.4  | 31.345  | -0.954  | 8.65   | 31.0   |  |
| 79.0                              | 477.0 | 213.8  | 263.2  | 57.3  | 32.154  | -0.956  | 8.91   | 31.9   |  |
| 80.0                              | 533.1 | 231.0  | 302.0  | 74.4  | 32.865  | -1.375  | 9.14   | 32.7   |  |
| 81.0                              | 550.9 | 248.8  | 302.0  | 80.5  | 33.020  | -1.362  | 9.19   | 32.7   |  |
| 82.0                              | 568.9 | 266.9  | 302.0  | 86.5  | 33.245  | -1.339  | 9.27   | 32.9   |  |
| 83.0                              | 586.9 | 284.9  | 302.0  | 94.8  | 33.401  | -1.341  | 9.31   | 33.0   |  |
| 84.0                              | 605.4 | 303.4  | 302.0  | 103.5 | 33.575  | -1.395  | 9.36   | 33.1   |  |
| 85.0                              | 624.4 | 322.4  | 302.0  | 114.5 | 33.688  | -1.446  | 9.40   | 33.1   |  |
| 86.0                              | 643.3 | 341.2  | 302.0  | 126.7 | 33.869  | -1.480  | 9.47   | 33.2   |  |
| 87.0                              | 662.6 | 360.5  | 302.0  | 141.3 | 33.927  | -1.526  | 9.50   | 33.3   |  |
| 88.0                              | 682.4 | 380.3  | 302.0  | 156.9 | 34.066  | -1.566  | 9.53   | 33.3   |  |
| 89.0                              | 702.2 | 400.2  | 302.0  | 182.1 | 33.885  | -1.608  | 9.47   | 32.9   |  |
| 90.0                              | 722.2 | 420.2  | 302.0  | 205.0 | 34.070  | -1.642  | 9.51   | 33.0   |  |

|                         |             |                    |      |
|-------------------------|-------------|--------------------|------|
| Total Driving Time      | 36 minutes; | Total No. of Blows | 1409 |
| Starting at penetration | 76.0 ft     |                    |      |

Table of Depths Analyzed with Driving System Modifiers

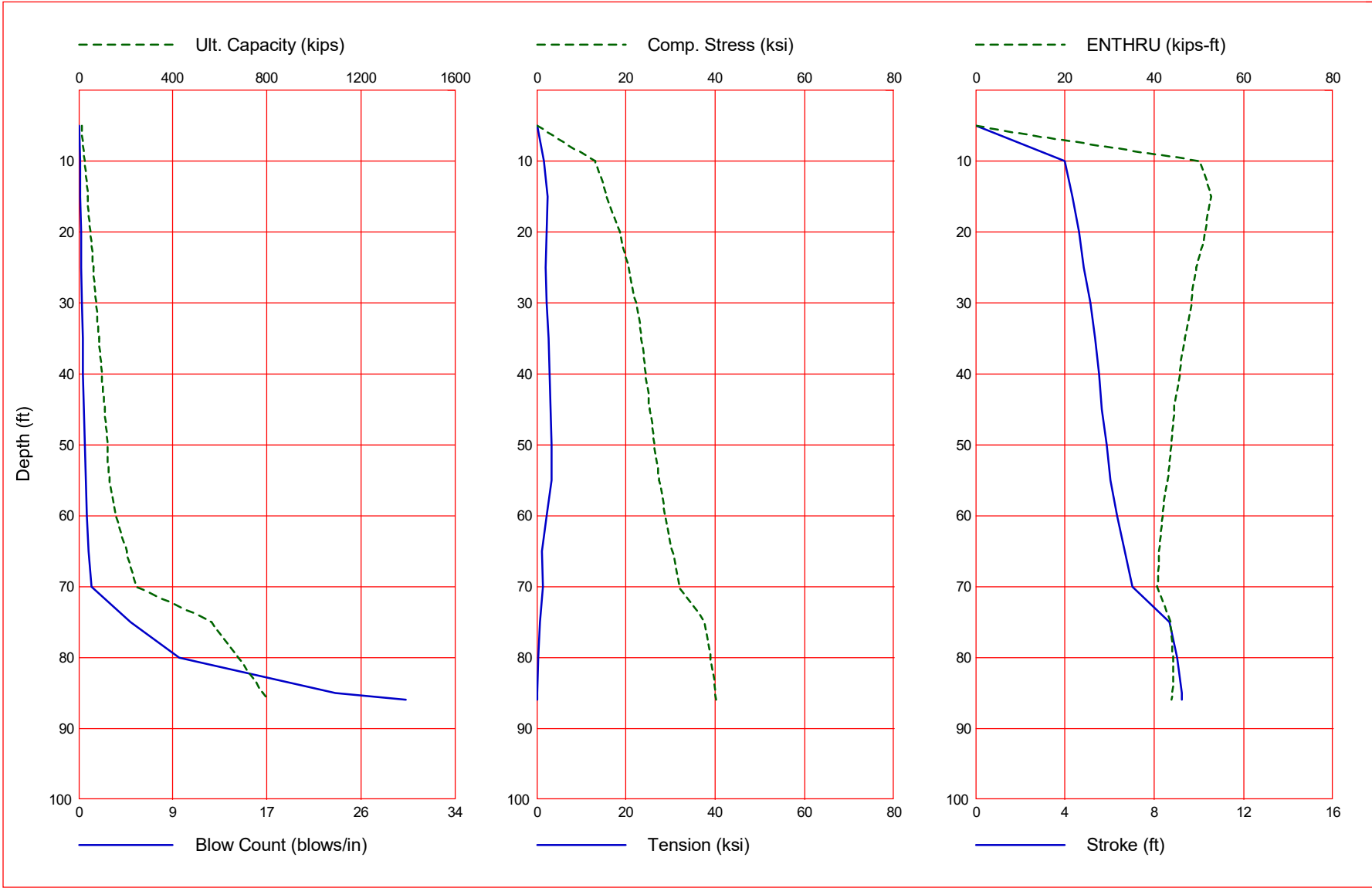
| Depth | Temp.  | Wait | Equivalent | Pressure |         | Stiffn. | Cushion |
|-------|--------|------|------------|----------|---------|---------|---------|
| ft    | Length | Time | Stroke     | Ratio    | Efficy. | Factor  | CoR     |
|       | ft     | hr   | ft         |          |         |         |         |
| 76.00 | 90.00  | 0.00 | 12.04      | 1.00     | 0.80    | 1.00    | 1.00    |
| 77.00 | 90.00  | 0.00 | 12.04      | 1.00     | 0.80    | 1.00    | 1.00    |
| 78.00 | 90.00  | 0.00 | 12.04      | 1.00     | 0.80    | 1.00    | 1.00    |
| 79.00 | 90.00  | 0.00 | 12.04      | 1.00     | 0.80    | 1.00    | 1.00    |
| 80.00 | 90.00  | 0.00 | 12.04      | 1.00     | 0.80    | 1.00    | 1.00    |
| 81.00 | 90.00  | 0.00 | 12.04      | 1.00     | 0.80    | 1.00    | 1.00    |
| 82.00 | 90.00  | 0.00 | 12.04      | 1.00     | 0.80    | 1.00    | 1.00    |
| 83.00 | 90.00  | 0.00 | 12.04      | 1.00     | 0.80    | 1.00    | 1.00    |
| 84.00 | 90.00  | 0.00 | 12.04      | 1.00     | 0.80    | 1.00    | 1.00    |
| 85.00 | 90.00  | 0.00 | 12.04      | 1.00     | 0.80    | 1.00    | 1.00    |
| 86.00 | 90.00  | 0.00 | 12.04      | 1.00     | 0.80    | 1.00    | 1.00    |
| 87.00 | 90.00  | 0.00 | 12.04      | 1.00     | 0.80    | 1.00    | 1.00    |
| 88.00 | 90.00  | 0.00 | 12.04      | 1.00     | 0.80    | 1.00    | 1.00    |
| 89.00 | 90.00  | 0.00 | 12.04      | 1.00     | 0.80    | 1.00    | 1.00    |
| 90.00 | 90.00  | 0.00 | 12.04      | 1.00     | 0.80    | 1.00    | 1.00    |

Soil Layer Resistance Values

| Depth | Shaft | End     | Shaft | Toe   | Shaft   | Toe     | Soil    | Limit    | Setup |
|-------|-------|---------|-------|-------|---------|---------|---------|----------|-------|
| ft    | Res.  | Bearing | Quake | Quake | Damping | Damping | Setup   | Distance | Time  |
|       | k/ft2 | kips    | inch  | inch  | s/ft    | s/ft    | Normlzd | ft       | hrs   |
| 0.00  | 0.00  | 3.10    | 0.100 | 0.100 | 0.050   | 0.150   | 0.333   | 6.560    | 1.000 |
| 2.00  | 0.16  | 10.87   | 0.100 | 0.100 | 0.050   | 0.150   | 0.333   | 6.560    | 1.000 |
| 4.00  | 0.30  | 21.03   | 0.100 | 0.100 | 0.050   | 0.150   | 0.333   | 6.560    | 1.000 |
| 6.00  | 0.37  | 21.31   | 0.100 | 0.100 | 0.050   | 0.150   | 0.333   | 6.560    | 1.000 |
| 8.00  | 0.50  | 14.40   | 0.100 | 0.100 | 0.200   | 0.150   | 1.000   | 6.560    | 1.000 |
| 10.00 | 0.50  | 8.89    | 0.100 | 0.100 | 0.200   | 0.150   | 1.000   | 6.560    | 1.000 |
| 12.00 | 0.50  | 8.89    | 0.100 | 0.100 | 0.200   | 0.150   | 1.000   | 6.560    | 1.000 |
| 14.00 | 0.50  | 8.89    | 0.100 | 0.100 | 0.200   | 0.150   | 1.000   | 6.560    | 1.000 |
| 16.00 | 0.50  | 8.89    | 0.100 | 0.100 | 0.200   | 0.150   | 1.000   | 6.560    | 1.000 |
| 18.00 | 0.50  | 8.89    | 0.100 | 0.100 | 0.200   | 0.150   | 1.000   | 6.560    | 1.000 |
| 20.00 | 0.50  | 8.89    | 0.100 | 0.100 | 0.200   | 0.150   | 1.000   | 6.560    | 1.000 |
| 22.00 | 0.50  | 8.89    | 0.100 | 0.100 | 0.200   | 0.150   | 1.000   | 6.560    | 1.000 |
| 24.00 | 0.50  | 8.89    | 0.100 | 0.100 | 0.200   | 0.150   | 1.000   | 6.560    | 1.000 |
| 26.00 | 0.50  | 8.89    | 0.100 | 0.100 | 0.200   | 0.150   | 1.000   | 6.560    | 1.000 |
| 28.00 | 0.50  | 8.89    | 0.100 | 0.100 | 0.200   | 0.150   | 1.000   | 6.560    | 1.000 |
| 30.00 | 0.50  | 8.89    | 0.100 | 0.100 | 0.200   | 0.150   | 1.000   | 6.560    | 1.000 |
| 32.00 | 0.50  | 8.89    | 0.100 | 0.100 | 0.200   | 0.150   | 1.000   | 6.560    | 1.000 |
| 34.00 | 0.50  | 8.89    | 0.100 | 0.100 | 0.200   | 0.150   | 1.000   | 6.560    | 1.000 |
| 36.00 | 0.50  | 8.89    | 0.100 | 0.100 | 0.200   | 0.150   | 1.000   | 6.560    | 1.000 |
| 38.00 | 0.50  | 8.89    | 0.100 | 0.100 | 0.200   | 0.150   | 1.000   | 6.560    | 1.000 |
| 40.00 | 0.50  | 8.89    | 0.100 | 0.100 | 0.200   | 0.150   | 1.000   | 6.560    | 1.000 |
| 42.00 | 0.50  | 8.89    | 0.100 | 0.100 | 0.200   | 0.150   | 1.000   | 6.560    | 1.000 |
| 44.00 | 0.50  | 8.89    | 0.100 | 0.100 | 0.200   | 0.150   | 1.000   | 6.560    | 1.000 |
| 46.00 | 0.50  | 8.89    | 0.100 | 0.100 | 0.200   | 0.150   | 1.000   | 6.560    | 1.000 |
| 48.00 | 0.50  | 8.89    | 0.100 | 0.100 | 0.200   | 0.150   | 1.000   | 6.560    | 1.000 |
| 50.00 | 0.50  | 8.89    | 0.100 | 0.100 | 0.200   | 0.150   | 1.000   | 6.560    | 1.000 |
| 52.00 | 0.50  | 8.89    | 0.100 | 0.100 | 0.200   | 0.150   | 1.000   | 6.560    | 1.000 |
| 54.00 | 0.50  | 8.89    | 0.100 | 0.100 | 0.200   | 0.150   | 1.000   | 6.560    | 1.000 |
| 56.00 | 0.50  | 8.89    | 0.100 | 0.100 | 0.200   | 0.150   | 1.000   | 6.560    | 1.000 |
| 58.00 | 0.50  | 8.89    | 0.100 | 0.100 | 0.200   | 0.150   | 1.000   | 6.560    | 1.000 |
| 60.00 | 0.50  | 8.89    | 0.100 | 0.100 | 0.200   | 0.150   | 1.000   | 6.560    | 1.000 |
| 62.00 | 0.50  | 8.89    | 0.100 | 0.100 | 0.200   | 0.150   | 1.000   | 6.560    | 1.000 |
| 64.00 | 0.50  | 13.83   | 0.100 | 0.100 | 0.200   | 0.150   | 1.000   | 6.560    | 1.000 |
| 66.00 | 1.71  | 21.59   | 0.100 | 0.100 | 0.050   | 0.150   | 0.333   | 6.560    | 1.000 |

|       |      |        |       |       |       |       |       |       |       |
|-------|------|--------|-------|-------|-------|-------|-------|-------|-------|
| 68.00 | 1.76 | 26.53  | 0.100 | 0.100 | 0.050 | 0.150 | 0.333 | 6.560 | 1.000 |
| 70.00 | 1.81 | 26.53  | 0.100 | 0.100 | 0.050 | 0.150 | 0.333 | 6.560 | 1.000 |
| 72.00 | 1.86 | 26.53  | 0.100 | 0.100 | 0.050 | 0.150 | 0.333 | 6.560 | 1.000 |
| 74.00 | 1.91 | 26.53  | 0.100 | 0.100 | 0.050 | 0.150 | 0.333 | 6.560 | 1.000 |
| 76.00 | 1.95 | 103.31 | 0.100 | 0.100 | 0.050 | 0.150 | 0.333 | 6.560 | 1.000 |
| 78.00 | 4.12 | 224.40 | 0.100 | 0.100 | 0.050 | 0.150 | 0.333 | 6.560 | 1.000 |
| 80.00 | 4.26 | 302.02 | 0.100 | 0.100 | 0.050 | 0.150 | 0.333 | 6.560 | 1.000 |
| 82.00 | 4.39 | 302.02 | 0.100 | 0.100 | 0.050 | 0.150 | 0.333 | 6.560 | 1.000 |
| 84.00 | 4.52 | 302.02 | 0.100 | 0.100 | 0.050 | 0.150 | 0.333 | 6.560 | 1.000 |
| 86.00 | 4.66 | 302.02 | 0.100 | 0.100 | 0.050 | 0.150 | 0.333 | 6.560 | 1.000 |
| 88.00 | 4.79 | 302.02 | 0.100 | 0.100 | 0.050 | 0.150 | 0.333 | 6.560 | 1.000 |
| 90.00 | 4.93 | 302.02 | 0.100 | 0.100 | 0.050 | 0.150 | 0.333 | 6.560 | 1.000 |

Gain/Loss 1 at Shaft and Toe 1.000 / 1.000





Gain/Loss 1 at Shaft and Toe 1.000 / 1.000

| Depth<br>ft | Ultimate<br>Capacity<br>kips | Friction<br>kips | End<br>Bearing<br>kips | Blow<br>Count<br>blows/in | Comp.<br>Stress<br>ksi | Tension<br>Stress<br>ksi | Stroke<br>ft | ENTHRU<br>kips-ft |
|-------------|------------------------------|------------------|------------------------|---------------------------|------------------------|--------------------------|--------------|-------------------|
| 5.0         | 15.2                         | 5.8              | 9.3                    | -0.1                      | 0.000                  | 0.000                    | 0.00         | 0.0               |
| 10.0        | 26.6                         | 17.7             | 8.9                    | 0.1                       | 13.147                 | -1.705                   | 3.98         | 50.3              |
| 15.0        | 38.5                         | 29.6             | 8.9                    | 0.2                       | 15.687                 | -2.371                   | 4.35         | 52.8              |
| 20.0        | 50.4                         | 41.5             | 8.9                    | 0.2                       | 18.757                 | -2.247                   | 4.63         | 51.6              |
| 25.0        | 62.3                         | 53.4             | 8.9                    | 0.2                       | 20.555                 | -2.021                   | 4.85         | 49.4              |
| 30.0        | 74.2                         | 65.3             | 8.9                    | 0.3                       | 22.234                 | -2.219                   | 5.13         | 48.3              |
| 35.0        | 86.0                         | 77.2             | 8.9                    | 0.4                       | 23.447                 | -2.636                   | 5.34         | 46.9              |
| 40.0        | 97.9                         | 89.0             | 8.9                    | 0.4                       | 24.506                 | -2.889                   | 5.53         | 45.8              |
| 45.0        | 109.8                        | 100.9            | 8.9                    | 0.5                       | 25.300                 | -3.030                   | 5.67         | 44.4              |
| 50.0        | 121.7                        | 112.8            | 8.9                    | 0.6                       | 26.367                 | -3.234                   | 5.87         | 43.8              |
| 55.0        | 133.6                        | 124.7            | 8.9                    | 0.6                       | 27.388                 | -3.400                   | 6.05         | 43.0              |
| 60.0        | 160.7                        | 139.1            | 21.6                   | 0.7                       | 28.781                 | -2.289                   | 6.35         | 41.9              |
| 65.0        | 204.3                        | 177.8            | 26.5                   | 0.9                       | 30.422                 | -1.177                   | 6.68         | 41.1              |
| 70.0        | 245.9                        | 219.3            | 26.5                   | 1.1                       | 31.788                 | -1.442                   | 7.02         | 40.7              |
| 75.0        | 563.3                        | 278.2            | 285.1                  | 4.7                       | 37.620                 | -0.698                   | 8.68         | 43.6              |
| 80.0        | 679.1                        | 377.0            | 302.0                  | 9.1                       | 38.907                 | -0.417                   | 9.03         | 44.2              |
| 85.0        | 785.8                        | 483.8            | 302.0                  | 23.2                      | 40.088                 | -0.136                   | 9.23         | 44.1              |
| 86.0        | 808.2                        | 506.1            | 302.0                  | 29.6                      | 40.137                 | -0.080                   | 9.22         | 43.8              |

Total Continuous Driving Time 55.00 minutes; Total Number of Blows 2217 (starting at penetration 5.0 ft)

GRLWEAP - Version 2010  
WAVE EQUATION ANALYSIS OF PILE FOUNDATIONS

written by GRL Engineers, Inc. (formerly Goble Rausche Likins  
and Associates, Inc.) with cooperation from Pile Dynamics, Inc.  
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ABOUT THE WAVE EQUATION ANALYSIS RESULTS

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

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

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

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

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

Input File: T:\75297 MAINEDOT\_I-295 VERANDA FINAL DESIGN\GEOTECH\CALCS\DEEP FOUNDATIONS\PILES\2020-02-21 DRIVEABILITY ANALYSIS\GRLWEAP\90 K-FT DELMAG D 36-32 \ABUTMENT 2 SB PILES DRIVEABILITY 2020-02-21.GWW  
 Hammer File: C:\ProgramData\PDI\GRLWEAP\2010\Resource\HAMMER2010.GW  
 Hammer File Version: 2003 (12/4/2018)

# Input File Contents

Abutment 2 SB H-Pile- Delmag D36-32

| OUT  | OSG   | HAM      | STR | FUL       | PEL | N         | SPL | N-U       | P-D       | %SK    | ISM       | 0      | PHI      | RSA    | ITR  | H-D | MXT   | DEx   |
|--|---|----------|-----|-----------|-----|-----------|-----|-----------|-----------|--------|-----------|--------|----------|--------|------|-----|-------|-------|
| -100   | 0   | 20       | 0   | 1         | 0   | 0         | 0   | 0         | 3         | 0      | 0         | 0      | 0        | 0      | 0    | 0   | 0     | 0.000 |
| Pile g   |   | Hammer g |     | Toe Area  |     | Pile Size |     | Pile Type |           |        |           |        |          |        |      |     |       |       |
| 32.170   |   | 32.170   |     | 203.230   |     | 14.690    |     | H Pile    |           |        |           |        |          |        |      |     |       |       |
| W Cp   |   | A Cp     |     | E Cp      |     | T Cp      |     | CoR       |           | ROut   |           | StCp   |          |        |      |     |       |       |
| 1.900  |   | 227.000  |     | 530.0     |     | 2.000     |     | 0.800     |           | 0.010  |           | 0.0    |          |        |      |     |       |       |
| A Cu   |   | E Cu     |     | T Cu      |     | CoR       |     | ROut      |           | StCu   |           |        |          |        |      |     |       |       |
| 0.000  |   | 0.0      |     | 0.000     |     | 0.000     |     | 0.000     |           | 0.0    |           |        |          |        |      |     |       |       |
| LPle   |   | APle     |     | EPle      |     | WPle      |     | Peri      |           | CI     |           | CoR    |          | ROut   |      |     |       |       |
| 86.000   |   | 26.10    |     | 29000.0   |     | 492.000   |     | 4.754     |           | 0      |           | 1.000  |          | 0.010  |      |     |       |       |
| FFatigue   |   | F0       |     | 0-Bottom  |     |           |     |           |           |        |           |        |          |        |      |     |       |       |
| 0  |   | 0.000    |     | 0.000     |     |           |     |           |           |        |           |        |          |        |      |     |       |       |
| Manufac  |   | Hmr Name |     | HmrType   |     | No        |     | Seg-s     |           |        |           |        |          |        |      |     |       |       |
| DELMAG   |   | D 36-32  |     | 1         |     | 4         |     |           |           |        |           |        |          |        |      |     |       |       |
| Ram Wt   |   | Ram L    |     | Ram Dia   |     | MaxStrk   |     | RtdStrk   |           | Efficy |           |        |          |        |      |     |       |       |
| 7.93   |   | 106.90   |     | 19.66     |     | 13.14     |     | 11.42     |           | 0.80   |           |        |          |        |      |     |       |       |
| IB. Wt   |   | IB. L    |     | IB.Dia    |     | IB CoR    |     | IB RO     |           |        |           |        |          |        |      |     |       |       |
| 2.27   |   | 33.30    |     | 19.66     |     | 0.900     |     | 0.010     |           |        |           |        |          |        |      |     |       |       |
| CompStrk   | A   | Chamber  | V   | Chamber   |     | C Delay   |     | C Duratn  | Exp       | Coeff  | VolCStart |        | Vol      | CEnd   |      |     |       |       |
| 14.80  |   | 304.30   |     | 355.80    |     | 0.0010    |     | 0.0020    |           | 1.250  |           | 0.00   |          | 0.00   |      |     |       |       |
| P atm  |   | P1       |     | P2        |     | P3        |     | P4        |           | P5     |           |        |          |        |      |     |       |       |
| 14.70  |   | 1500.00  |     | 1350.00   |     | 1215.00   |     | 1095.00   |           | 0.00   |           |        |          |        |      |     |       |       |
| Stroke   |   | Effic.   |     | Pressure  |     | R-Weight  |     | T-Delay   | Exp-Coeff |        | Eps-Str   |        | Total-AW |        |      |     |       |       |
| 11.4200  |   | 0.8000   |     | 1500.0000 |     | 0.0000    |     | 0.0000    |           | 0.0000 |           | 0.0100 |          | 0.0000 |      |     |       |       |
| Qs   |   | Qt       |     | Js        |     | Jt        |     | Qx        |           | Jx     |           | Rati   |          | Dept   |      |     |       |       |
| 0.000  |   | 0.000    |     | 0.000     |     | 0.000     |     | 0.000     |           | 0.000  |           | 0.000  |          | 0.000  |      |     |       |       |
| Research   | Soil Model: Atoe, Plug, Gap, Q-fac                        |          |     |           |     |           |     |           |           |        |           |        |          |        |      |     |       |       |
| 0.000  |   | 0.000    |     | 0.000     |     | 0.000     |     |           |           |        |           |        |          |        |      |     |       |       |
| Research   | Soil Model: RD-skn: m, d, toe: m, d                       |          |     |           |     |           |     |           |           |        |           |        |          |        |      |     |       |       |
| 0.000  |   | 0.000    |     | 0.000     |     | 0.000     |     |           |           |        |           |        |          |        |      |     |       |       |
| Research   | Toe Plug: Res-int, Q-int, D-int, Res-plug, Q-plug, D-plug |          |     |           |     |           |     |           |           |        |           |        |          |        |      |     |       |       |
| 0.000  |   | 0.000    |     | 0.000     |     | 0.000     |     | 0.000     |           | 0.000  |           |        |          |        |      |     |       |       |
| Research   | Toe Plug: RD plug toe: m, d                               |          |     |           |     |           |     |           |           |        |           |        |          |        |      |     |       |       |
| 0.000  |   | 0.000    |     |           |     |           |     |           |           |        |           |        |          |        |      |     |       |       |
| Research Toe Plug: New Toe Plug Model is NOT applied |   |          |     |           |     |           |     |           |           |        |           |        |          |        |      |     |       |       |
| Res. Distribution                                    |   |          |     |           |     |           |     |           |           |        |           |        |          |        |      |     |       |       |
| Dpth   |   | Rskn     |     | Rtoe      |     | Qs        |     | Qt        |           | Js     |           | Jt     | SU F     |        | LimL |     | TSf0  |       |
| 0.00   |   | 0.00     |     | 3.10      |     | 0.10      |     | 0.10      |           | 0.05   |           | 0.15   | 1.20     |        | 6.56 |     | 1.000 |       |
| 1.00   |   | 0.08     |     | 5.36      |     | 0.10      |     | 0.10      |           | 0.05   |           | 0.15   | 1.20     |        | 6.56 |     | 1.000 |       |
| 2.00   |   | 0.16     |     | 7.34      |     | 0.10      |     | 0.10      |           | 0.05   |           | 0.15   | 1.20     |        | 6.56 |     | 1.000 |       |
| 3.00   |   | 0.24     |     | 9.60      |     | 0.10      |     | 0.10      |           | 0.20   |           | 0.15   | 2.00     |        | 6.56 |     | 1.000 |       |
| 4.00   |   | 0.50     |     | 10.16     |     | 0.10      |     | 0.10      |           | 0.20   |           | 0.15   | 2.00     |        | 6.56 |     | 1.000 |       |
| 5.00   |   | 0.50     |     | 9.31      |     | 0.10      |     | 0.10      |           | 0.20   |           | 0.15   | 2.00     |        | 6.56 |     | 1.000 |       |
| 6.00   |   | 0.50     |     | 8.89      |     | 0.10      |     | 0.10      |           | 0.20   |           | 0.15   | 2.00     |        | 6.56 |     | 1.000 |       |
| 7.00   |   | 0.50     |     | 8.89      |     | 0.10      |     | 0.10      |           | 0.20   |           | 0.15   | 2.00     |        | 6.56 |     | 1.000 |       |
| 8.00   |   | 0.50     |     | 8.89      |     | 0.10      |     | 0.10      |           | 0.20   |           | 0.15   | 2.00     |        | 6.56 |     | 1.000 |       |
| 9.00   |   | 0.50     |     | 8.89      |     | 0.10      |     | 0.10      |           | 0.20   |           | 0.15   | 2.00     |        | 6.56 |     | 1.000 |       |
| 10.00  |   | 0.50     |     | 8.89      |     | 0.10      |     | 0.10      |           | 0.20   |           | 0.15   | 2.00     |        | 6.56 |     | 1.000 |       |
| 11.00  |   | 0.50     |     | 8.89      |     | 0.10      |     | 0.10      |           | 0.20   |           | 0.15   | 2.00     |        | 6.56 |     | 1.000 |       |
| 12.00  |   | 0.50     |     | 8.89      |     | 0.10      |     | 0.10      |           | 0.20   |           | 0.15   | 2.00     |        | 6.56 |     | 1.000 |       |

[illegible]

|       |      |        |      |      |      |      |      |      |       |
|-------|------|--------|------|------|------|------|------|------|-------|
| 72.00 | 1.86 | 103.31 | 0.10 | 0.10 | 0.05 | 0.15 | 1.20 | 6.56 | 1.000 |
| 73.00 | 1.88 | 163.71 | 0.10 | 0.10 | 0.05 | 0.15 | 1.20 | 6.56 | 1.000 |
| 74.00 | 3.92 | 224.40 | 0.10 | 0.10 | 0.05 | 0.15 | 1.20 | 6.56 | 1.000 |
| 75.00 | 3.99 | 285.09 | 0.10 | 0.10 | 0.05 | 0.15 | 1.20 | 6.56 | 1.000 |
| 76.00 | 4.06 | 302.02 | 0.10 | 0.10 | 0.05 | 0.15 | 1.20 | 6.56 | 1.000 |
| 77.00 | 4.12 | 302.02 | 0.10 | 0.10 | 0.05 | 0.15 | 1.20 | 6.56 | 1.000 |
| 78.00 | 4.19 | 302.02 | 0.10 | 0.10 | 0.05 | 0.15 | 1.20 | 6.56 | 1.000 |
| 79.00 | 4.26 | 302.02 | 0.10 | 0.10 | 0.05 | 0.15 | 1.20 | 6.56 | 1.000 |
| 80.00 | 4.32 | 302.02 | 0.10 | 0.10 | 0.05 | 0.15 | 1.20 | 6.56 | 1.000 |
| 81.00 | 4.39 | 302.02 | 0.10 | 0.10 | 0.05 | 0.15 | 1.20 | 6.56 | 1.000 |
| 82.00 | 4.46 | 302.02 | 0.10 | 0.10 | 0.05 | 0.15 | 1.20 | 6.56 | 1.000 |
| 83.00 | 4.53 | 302.02 | 0.10 | 0.10 | 0.05 | 0.15 | 1.20 | 6.56 | 1.000 |
| 84.00 | 4.59 | 302.02 | 0.10 | 0.10 | 0.05 | 0.15 | 1.20 | 6.56 | 1.000 |
| 85.00 | 4.66 | 302.02 | 0.10 | 0.10 | 0.05 | 0.15 | 1.20 | 6.56 | 1.000 |
| 86.00 | 4.73 | 302.02 | 0.10 | 0.10 | 0.05 | 0.15 | 1.20 | 6.56 | 1.000 |

Gain/Loss factors: shaft and toe

|         |         |         |         |         |
|---------|---------|---------|---------|---------|
| 1.00000 | 0.90000 | 0.80000 | 0.70000 | 0.60000 |
| 1.00000 | 1.00000 | 1.00000 | 1.00000 | 1.00000 |

| Dpth  | L    | Wait | Strk  | Pmx% | Eff.  | Stff  | CoR   |
|-------|------|------|-------|------|-------|-------|-------|
| 5.00  | 0.00 | 0.00 | 0.000 | 0.0  | 0.000 | 0.000 | 0.000 |
| 10.00 | 0.00 | 0.00 | 0.000 | 0.0  | 0.000 | 0.000 | 0.000 |
| 15.00 | 0.00 | 0.00 | 0.000 | 0.0  | 0.000 | 0.000 | 0.000 |
| 20.00 | 0.00 | 0.00 | 0.000 | 0.0  | 0.000 | 0.000 | 0.000 |
| 25.00 | 0.00 | 0.00 | 0.000 | 0.0  | 0.000 | 0.000 | 0.000 |
| 30.00 | 0.00 | 0.00 | 0.000 | 0.0  | 0.000 | 0.000 | 0.000 |
| 35.00 | 0.00 | 0.00 | 0.000 | 0.0  | 0.000 | 0.000 | 0.000 |
| 40.00 | 0.00 | 0.00 | 0.000 | 0.0  | 0.000 | 0.000 | 0.000 |
| 45.00 | 0.00 | 0.00 | 0.000 | 0.0  | 0.000 | 0.000 | 0.000 |
| 50.00 | 0.00 | 0.00 | 0.000 | 0.0  | 0.000 | 0.000 | 0.000 |
| 55.00 | 0.00 | 0.00 | 0.000 | 0.0  | 0.000 | 0.000 | 0.000 |
| 60.00 | 0.00 | 0.00 | 0.000 | 0.0  | 0.000 | 0.000 | 0.000 |
| 65.00 | 0.00 | 0.00 | 0.000 | 0.0  | 0.000 | 0.000 | 0.000 |
| 70.00 | 0.00 | 0.00 | 0.000 | 0.0  | 0.000 | 0.000 | 0.000 |
| 75.00 | 0.00 | 0.00 | 0.000 | 0.0  | 0.000 | 0.000 | 0.000 |
| 80.00 | 0.00 | 0.00 | 0.000 | 0.0  | 0.000 | 0.000 | 0.000 |
| 85.00 | 0.00 | 0.00 | 0.000 | 0.0  | 0.000 | 0.000 | 0.000 |
| 86.00 | 0.00 | 0.00 | 0.000 | 0.0  | 0.000 | 0.000 | 0.000 |
| 0.00  | 0.00 | 0.00 | 0.000 | 0.0  | 0.000 | 0.000 | 0.000 |

GRLWEAP: WAVE EQUATION ANALYSIS OF PILE FOUNDATIONS  
Version 2010  
English Units

Abutment 2 SB H-Pile- Delmag D36-32

|                   |                |                  |        |
|-------------------|----------------|------------------|--------|
| Hammer Model:     | D 36-32        | Made by:         | DELMAG |
| No.               | Weight<br>kips | Stiffn<br>k/inch | CoR    |
| 1                 | 1.982          |                  |        |
| 2                 | 1.982          | 329410.3         | 1.000  |
| 3                 | 1.982          | 329410.3         | 1.000  |
| 4                 | 1.982          | 329410.3         | 1.000  |
| Imp Block         | 2.270          | 146663.7         | 0.900  |
| Helmet            | 1.900          | 60155.0          | 0.800  |
| Combined Pile Top |                | 19069.2          |        |

HAMMER OPTIONS:

|                    |           |                          |           |
|--------------------|-----------|--------------------------|-----------|
| Hammer File ID No. | 20        | Hammer Type              | OE Diesel |
| Stroke Option      | FxdP-VarS | Stroke Convergence Crit. | 0.010     |
| Fuel Pump Setting  | Maximum   |                          |           |

HAMMER DATA:

|                      |        |         |                    |        |         |
|----------------------|--------|---------|--------------------|--------|---------|
| Ram Weight           | (kips) | 7.93    | Ram Length         | (inch) | 106.90  |
| Maximum Stroke       | (ft)   | 13.14   |                    |        |         |
| Rated Stroke         | (ft)   | 11.42   | Efficiency         |        | 0.800   |
| Maximum Pressure     | (psi)  | 1500.00 | Actual Pressure    | (psi)  | 1500.00 |
| Compression Exponent |        | 1.350   | Expansion Exponent |        | 1.250   |
| Ram Diameter         | (inch) | 19.66   |                    |        |         |
| Combustion Delay     | (s)    | 0.00100 | Ignition Duration  | (s)    | 0.00200 |

The Hammer Data Includes Estimated (NON-MEASURED) Quantities

HAMMER CUSHION

|                      |           |         |
|----------------------|-----------|---------|
| Cross Sect. Area     | (in2)     | 227.00  |
| Elastic-Modulus      | (ksi)     | 530.0   |
| Thickness            | (inch)    | 2.00    |
| Coeff of Restitution |           | 0.8     |
| RoundOut             | (ft)      | 0.0     |
| Stiffness            | (kips/in) | 60155.0 |

PILE CUSHION

|                      |           |      |
|----------------------|-----------|------|
| Cross Sect. Area     | (in2)     | 0.00 |
| Elastic-Modulus      | (ksi)     | 0.0  |
| Thickness            | (inch)    | 0.00 |
| Coeff of Restitution |           | 1.0  |
| RoundOut             | (ft)      | 0.0  |
| Stiffness            | (kips/in) | 0.0  |

Abutment 2 SB H-Pile- Delmag D36-32  
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Depth (ft) 5.0 Standard Soil Setup  
Shaft Gain/Loss Factor 1.000 Toe Gain/Loss Factor 1.000

PILE PROFILE:

Toe Area (in2) 203.230 Pile Type H Pile  
Pile Size (inch) 14.690

| L b Top | Area  | E-Mod  | Spec Wt | Perim | C Index | Wave Sp | EA/c   |
|---------|-------|--------|---------|-------|---------|---------|--------|
| ft      | in2   | ksi    | lb/ft3  | ft    |         | ft/s    | k/ft/s |
| 0.0     | 26.10 | 29000. | 492.0   | 4.8   | 0       | 16524.  | 45.8   |
| 86.0    | 26.10 | 29000. | 492.0   | 4.8   | 0       | 16524.  | 45.8   |

Wave Travel Time 2L/c (ms) 10.409

| Pile and Soil Model |        |        |       |       |      | Total Capacity Rut (kips) |        |       | 15.2  |       |      |
|---------------------|--------|--------|-------|-------|------|---------------------------|--------|-------|-------|-------|------|
| No.                 | Weight | Stiffn | C-Slk | T-Slk | CoR  | Soil-S                    | Soil-D | Quake | LbTop | Perim | Area |
|                     | kips   | k/in   | ft    | ft    |      | kips                      | s/ft   | inch  | ft    | ft    | in2  |
| 1                   | 0.295  | 19069  | 0.010 | 0.000 | 1.00 | 0.0                       | 0.000  | 0.100 | 3.31  | 4.8   | 26.1 |
| 2                   | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 0.0                       | 0.000  | 0.100 | 6.62  | 4.8   | 26.1 |
| 25                  | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 0.5                       | 0.050  | 0.100 | 82.69 | 4.8   | 26.1 |
| 26                  | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 5.3                       | 0.180  | 0.100 | 86.00 | 4.8   | 26.1 |
| Toe                 |        |        |       |       |      | 9.3                       | 0.150  | 0.100 |       |       |      |

7.669 kips total unreduced pile weight (g= 32.17 ft/s2)

7.669 kips total reduced pile weight (g= 32.17 ft/s2)

PILE, SOIL, ANALYSIS OPTIONS:

Uniform pile  
No. of Slacks/Splices 0  
Pile Segments: Automatic  
Pile Damping (%) 3  
Pile Damping Fact. (k/ft/s) 2.748

Driveability Analysis

Soil Damping Option Smith  
Max No Analysis Iterations 0 Time Increment/Critical 160  
Output Time Interval 1 Analysis Time-Input (ms) 0  
Output Level: Normal

Gravity Mass, Pile, Hammer: 32.170 32.170 32.170

Output Segment Generation: Automatic

| Depth | Stroke | Pressure | Efficy |
|-------|--------|----------|--------|
| ft    | ft     | Ratio    |        |
| 5.00  | 11.42  | 1.00     | 0.800  |

\*\*\* CAUTION: RAM MIGHT BLOW OUT; Combustion pressure was reduced \*\*\*

Abutment 2 SB H-Pile- Delmag D36-32  
HNTB Corporation

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| Rut<br>kips | Bl Ct<br>b/ft | Stroke<br>down | (ft)<br>up | Ten<br>ksi | Str<br>ksi | i | t | Comp | Str<br>ksi | i | t | ENTHRU<br>kip-ft | Bl Rt<br>b/min |
|-------------|---------------|----------------|------------|------------|------------|---|---|------|------------|---|---|------------------|----------------|
| 15.2        | Hammer        | did not        | run        |            |            |   |   |      |            |   |   |                  |                |
| 14.7        | Hammer        | did not        | run        |            |            |   |   |      |            |   |   |                  |                |
| 14.2        | Hammer        | did not        | run        |            |            |   |   |      |            |   |   |                  |                |
| 13.7        | Hammer        | did not        | run        |            |            |   |   |      |            |   |   |                  |                |
| 13.1        | Hammer        | did not        | run        |            |            |   |   |      |            |   |   |                  |                |



Abutment 2 SB H-Pile- Delmag D36-32  
HNTB Corporation

04/02/2020  
GRLWEAP Version 2010

Depth (ft) 10.0 Standard Soil Setup  
Shaft Gain/Loss Factor 1.000 Toe Gain/Loss Factor 1.000

PILE PROFILE:

Toe Area (in2) 203.230 Pile Type H Pile  
Pile Size (inch) 14.690

| L b Top | Area  | E-Mod  | Spec Wt | Perim | C Index | Wave Sp | EA/c   |
|---------|-------|--------|---------|-------|---------|---------|--------|
| ft      | in2   | ksi    | lb/ft3  | ft    |         | ft/s    | k/ft/s |
| 0.0     | 26.10 | 29000. | 492.0   | 4.8   | 0       | 16524.  | 45.8   |
| 86.0    | 26.10 | 29000. | 492.0   | 4.8   | 0       | 16524.  | 45.8   |

Wave Travel Time 2L/c (ms) 10.409

| Pile and Soil Model |        |        |       |       |      | Total Capacity Rut (kips) |        |       | 26.6  |       |      |
|---------------------|--------|--------|-------|-------|------|---------------------------|--------|-------|-------|-------|------|
| No.                 | Weight | Stiffn | C-Slk | T-Slk | CoR  | Soil-S                    | Soil-D | Quake | LbTop | Perim | Area |
|                     | kips   | k/in   | ft    | ft    |      | kips                      | s/ft   | inch  | ft    | ft    | in2  |
| 1                   | 0.295  | 19069  | 0.010 | 0.000 | 1.00 | 0.0                       | 0.000  | 0.100 | 3.31  | 4.8   | 26.1 |
| 2                   | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 0.0                       | 0.000  | 0.100 | 6.62  | 4.8   | 26.1 |
| 23                  | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 0.0                       | 0.050  | 0.100 | 76.08 | 4.8   | 26.1 |
| 24                  | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 2.2                       | 0.117  | 0.100 | 79.38 | 4.8   | 26.1 |
| 25                  | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 7.6                       | 0.200  | 0.100 | 82.69 | 4.8   | 26.1 |
| 26                  | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 7.9                       | 0.200  | 0.100 | 86.00 | 4.8   | 26.1 |
| Toe                 |        |        |       |       |      | 8.9                       | 0.150  | 0.100 |       |       |      |

7.669 kips total unreduced pile weight (g= 32.17 ft/s2)

7.669 kips total reduced pile weight (g= 32.17 ft/s2)

| Depth | Stroke | Pressure | Efficy |
|-------|--------|----------|--------|
| ft    | ft     | Ratio    |        |
| 10.00 | 11.42  | 1.00     | 0.800  |

Abutment 2 SB H-Pile- Delmag D36-32  
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| Rut<br>kips | Bl Ct<br>b/ft | Stroke (ft)<br>down up | Ten Str<br>ksi | i | t  | Comp Str<br>ksi | i | t | ENTHRU<br>kip-ft | Bl Rt<br>b/min |
|-------------|---------------|------------------------|----------------|---|----|-----------------|---|---|------------------|----------------|
| 26.6        | 1.5           | 3.98 4.01              | -1.70          | 5 | 15 | 13.15           | 1 | 5 | 50.3             | 59.2           |
| 24.9        | 1.5           | 3.93 3.95              | -1.47          | 5 | 15 | 12.69           | 1 | 5 | 49.4             | 59.5           |
| 23.2        | Hammer        | did not run            |                |   |    |                 |   |   |                  |                |
| 21.5        | Hammer        | did not run            |                |   |    |                 |   |   |                  |                |
| 19.9        | Hammer        | did not run            |                |   |    |                 |   |   |                  |                |

Abutment 2 SB H-Pile- Delmag D36-32  
HNTB Corporation

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GRLWEAP Version 2010

Depth (ft) 15.0 Standard Soil Setup  
Shaft Gain/Loss Factor 1.000 Toe Gain/Loss Factor 1.000

PILE PROFILE:

Toe Area (in2) 203.230 Pile Type H Pile  
Pile Size (inch) 14.690

| L b Top | Area  | E-Mod  | Spec Wt | Perim | C Index | Wave Sp | EA/c   |
|---------|-------|--------|---------|-------|---------|---------|--------|
| ft      | in2   | ksi    | lb/ft3  | ft    |         | ft/s    | k/ft/s |
| 0.0     | 26.10 | 29000. | 492.0   | 4.8   | 0       | 16524.  | 45.8   |
| 86.0    | 26.10 | 29000. | 492.0   | 4.8   | 0       | 16524.  | 45.8   |

Wave Travel Time 2L/c (ms) 10.409

| Pile and Soil Model |        |        |       |       |      | Total Capacity Rut (kips) |        |       | 38.5  |       |      |
|---------------------|--------|--------|-------|-------|------|---------------------------|--------|-------|-------|-------|------|
| No.                 | Weight | Stiffn | C-Slk | T-Slk | CoR  | Soil-S                    | Soil-D | Quake | LbTop | Perim | Area |
|                     | kips   | k/in   | ft    | ft    |      | kips                      | s/ft   | inch  | ft    | ft    | in2  |
| 1                   | 0.295  | 19069  | 0.010 | 0.000 | 1.00 | 0.0                       | 0.000  | 0.100 | 3.31  | 4.8   | 26.1 |
| 2                   | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 0.0                       | 0.000  | 0.100 | 6.62  | 4.8   | 26.1 |
| 22                  | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 0.6                       | 0.050  | 0.100 | 72.77 | 4.8   | 26.1 |
| 23                  | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 5.4                       | 0.182  | 0.100 | 76.08 | 4.8   | 26.1 |
| 24                  | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 7.9                       | 0.200  | 0.100 | 79.38 | 4.8   | 26.1 |
| 26                  | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 7.9                       | 0.200  | 0.100 | 86.00 | 4.8   | 26.1 |
| Toe                 |        |        |       |       |      | 8.9                       | 0.150  | 0.100 |       |       |      |

7.669 kips total unreduced pile weight (g= 32.17 ft/s2)

7.669 kips total reduced pile weight (g= 32.17 ft/s2)

| Depth | Stroke | Pressure | Efficy |
|-------|--------|----------|--------|
| ft    | ft     | Ratio    |        |
| 15.00 | 11.42  | 1.00     | 0.800  |

Abutment 2 SB H-Pile- Delmag D36-32  
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| Rut  | Bl Ct | Stroke | (ft) | Ten Str | i | t  | Comp Str | i | t | ENTHRU | Bl Rt |
|------|-------|--------|------|---------|---|----|----------|---|---|--------|-------|
| kips | b/ft  | down   | up   | ksi     |   |    | ksi      |   |   | kip-ft | b/min |
| 38.5 | 1.9   | 4.35   | 4.32 | -2.37   | 4 | 14 | 15.69    | 1 | 2 | 52.8   | 56.9  |
| 35.6 | 1.8   | 4.28   | 4.25 | -2.32   | 4 | 14 | 15.16    | 1 | 4 | 53.0   | 57.4  |
| 32.7 | 1.7   | 4.20   | 4.18 | -2.28   | 4 | 14 | 14.74    | 1 | 4 | 52.5   | 57.9  |
| 29.9 | 1.6   | 4.12   | 4.10 | -2.14   | 4 | 15 | 14.15    | 1 | 5 | 51.8   | 58.4  |
| 27.0 | 1.6   | 4.03   | 4.02 | -1.93   | 5 | 15 | 13.42    | 1 | 5 | 50.8   | 59.0  |

Abutment 2 SB H-Pile- Delmag D36-32  
HNTB Corporation

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GRLWEAP Version 2010

Depth (ft) 20.0 Standard Soil Setup  
Shaft Gain/Loss Factor 1.000 Toe Gain/Loss Factor 1.000

PILE PROFILE:

Toe Area (in2) 203.230 Pile Type H Pile  
Pile Size (inch) 14.690

| L b Top | Area  | E-Mod  | Spec Wt | Perim | C Index | Wave Sp | EA/c   |
|---------|-------|--------|---------|-------|---------|---------|--------|
| ft      | in2   | ksi    | lb/ft3  | ft    |         | ft/s    | k/ft/s |
| 0.0     | 26.10 | 29000. | 492.0   | 4.8   | 0       | 16524.  | 45.8   |
| 86.0    | 26.10 | 29000. | 492.0   | 4.8   | 0       | 16524.  | 45.8   |

Wave Travel Time 2L/c (ms) 10.409

| Pile and Soil Model |        |        |       |       |      | Total Capacity Rut (kips) |        |       | 50.4  |       |      |
|---------------------|--------|--------|-------|-------|------|---------------------------|--------|-------|-------|-------|------|
| No.                 | Weight | Stiffn | C-Slk | T-Slk | CoR  | Soil-S                    | Soil-D | Quake | LbTop | Perim | Area |
|                     | kips   | k/in   | ft    | ft    |      | kips                      | s/ft   | inch  | ft    | ft    | in2  |
| 1                   | 0.295  | 19069  | 0.010 | 0.000 | 1.00 | 0.0                       | 0.000  | 0.100 | 3.31  | 4.8   | 26.1 |
| 2                   | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 0.0                       | 0.000  | 0.100 | 6.62  | 4.8   | 26.1 |
| 20                  | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 0.0                       | 0.050  | 0.100 | 66.15 | 4.8   | 26.1 |
| 21                  | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 2.4                       | 0.122  | 0.100 | 69.46 | 4.8   | 26.1 |
| 22                  | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 7.7                       | 0.200  | 0.100 | 72.77 | 4.8   | 26.1 |
| 23                  | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 7.9                       | 0.200  | 0.100 | 76.08 | 4.8   | 26.1 |
| 26                  | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 7.9                       | 0.200  | 0.100 | 86.00 | 4.8   | 26.1 |
| Toe                 |        |        |       |       |      | 8.9                       | 0.150  | 0.100 |       |       |      |

7.669 kips total unreduced pile weight (g= 32.17 ft/s2)

7.669 kips total reduced pile weight (g= 32.17 ft/s2)

| Depth | Stroke | Pressure | Efficy |
|-------|--------|----------|--------|
| ft    | ft     | Ratio    |        |
| 20.00 | 11.42  | 1.00     | 0.800  |

Abutment 2 SB H-Pile- Delmag D36-32  
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| Rut  | Bl Ct | Stroke | (ft) | Ten Str | i | t  | Comp Str | i | t | ENTHRU | Bl Rt |
|------|-------|--------|------|---------|---|----|----------|---|---|--------|-------|
| kip  | b/ft  | down   | up   | ksi     |   |    | ksi      |   |   | kip-ft | b/min |
| 50.4 | 2.3   | 4.63   | 4.59 | -2.25   | 4 | 14 | 18.76    | 1 | 2 | 51.6   | 55.2  |
| 46.3 | 2.1   | 4.54   | 4.50 | -2.30   | 4 | 14 | 17.85    | 1 | 2 | 51.9   | 55.7  |
| 42.3 | 2.0   | 4.44   | 4.41 | -2.31   | 4 | 14 | 16.80    | 1 | 2 | 52.4   | 56.3  |
| 38.2 | 1.8   | 4.35   | 4.32 | -2.32   | 4 | 14 | 15.70    | 1 | 2 | 52.9   | 57.0  |
| 34.1 | 1.7   | 4.24   | 4.22 | -2.32   | 4 | 14 | 14.90    | 1 | 4 | 52.7   | 57.6  |

Abutment 2 SB H-Pile- Delmag D36-32  
HNTB Corporation

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Depth (ft) 25.0 Standard Soil Setup  
Shaft Gain/Loss Factor 1.000 Toe Gain/Loss Factor 1.000

PILE PROFILE:

Toe Area (in2) 203.230 Pile Type H Pile  
Pile Size (inch) 14.690

| L b Top | Area  | E-Mod  | Spec Wt | Perim | C Index | Wave Sp | EA/c   |
|---------|-------|--------|---------|-------|---------|---------|--------|
| ft      | in2   | ksi    | lb/ft3  | ft    |         | ft/s    | k/ft/s |
| 0.0     | 26.10 | 29000. | 492.0   | 4.8   | 0       | 16524.  | 45.8   |
| 86.0    | 26.10 | 29000. | 492.0   | 4.8   | 0       | 16524.  | 45.8   |

Wave Travel Time 2L/c (ms) 10.409

| Pile and Soil Model |        |        |       |       |      | Total Capacity Rut (kips) |        |       | 62.3  |       |      |
|---------------------|--------|--------|-------|-------|------|---------------------------|--------|-------|-------|-------|------|
| No.                 | Weight | Stiffn | C-Slk | T-Slk | CoR  | Soil-S                    | Soil-D | Quake | LbTop | Perim | Area |
|                     | kips   | k/in   | ft    | ft    |      | kips                      | s/ft   | inch  | ft    | ft    | in2  |
| 1                   | 0.295  | 19069  | 0.010 | 0.000 | 1.00 | 0.0                       | 0.000  | 0.100 | 3.31  | 4.8   | 26.1 |
| 2                   | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 0.0                       | 0.000  | 0.100 | 6.62  | 4.8   | 26.1 |
| 19                  | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 0.6                       | 0.050  | 0.100 | 62.85 | 4.8   | 26.1 |
| 20                  | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 5.6                       | 0.184  | 0.100 | 66.15 | 4.8   | 26.1 |
| 21                  | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 7.9                       | 0.200  | 0.100 | 69.46 | 4.8   | 26.1 |
| 26                  | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 7.9                       | 0.200  | 0.100 | 86.00 | 4.8   | 26.1 |
| Toe                 |        |        |       |       |      | 8.9                       | 0.150  | 0.100 |       |       |      |

7.669 kips total unreduced pile weight (g= 32.17 ft/s2)

7.669 kips total reduced pile weight (g= 32.17 ft/s2)

| Depth | Stroke | Pressure | Efficy |
|-------|--------|----------|--------|
| ft    | ft     | Ratio    |        |
| 25.00 | 11.42  | 1.00     | 0.800  |

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| Rut  | Bl Ct | Stroke | (ft) | Ten Str | i | t  | Comp Str | i | t | ENTHRU | Bl Rt |
|------|-------|--------|------|---------|---|----|----------|---|---|--------|-------|
| kip  | b/ft  | down   | up   | ksi     |   |    | ksi      |   |   | kip-ft | b/min |
| 62.3 | 2.9   | 4.85   | 4.87 | -2.02   | 4 | 14 | 20.55    | 2 | 2 | 49.4   | 53.7  |
| 57.0 | 2.6   | 4.79   | 4.74 | -2.04   | 4 | 14 | 20.09    | 1 | 2 | 50.6   | 54.3  |
| 51.8 | 2.4   | 4.67   | 4.63 | -2.12   | 4 | 14 | 19.08    | 1 | 2 | 51.4   | 54.9  |
| 46.5 | 2.1   | 4.54   | 4.51 | -2.25   | 4 | 14 | 17.84    | 1 | 2 | 51.8   | 55.6  |
| 41.3 | 1.9   | 4.42   | 4.39 | -2.28   | 4 | 14 | 16.56    | 1 | 2 | 52.5   | 56.4  |



Abutment 2 SB H-Pile- Delmag D36-32  
HNTB Corporation

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Depth (ft) 30.0 Standard Soil Setup  
Shaft Gain/Loss Factor 1.000 Toe Gain/Loss Factor 1.000

PILE PROFILE:

Toe Area (in2) 203.230 Pile Type H Pile  
Pile Size (inch) 14.690

| L b Top | Area  | E-Mod  | Spec Wt | Perim | C Index | Wave Sp | EA/c   |
|---------|-------|--------|---------|-------|---------|---------|--------|
| ft      | in2   | ksi    | lb/ft3  | ft    |         | ft/s    | k/ft/s |
| 0.0     | 26.10 | 29000. | 492.0   | 4.8   | 0       | 16524.  | 45.8   |
| 86.0    | 26.10 | 29000. | 492.0   | 4.8   | 0       | 16524.  | 45.8   |

Wave Travel Time 2L/c (ms) 10.409

| Pile and Soil Model |        |        |       |       |      | Total Capacity Rut (kips) |        |       | 74.2  |       |      |
|---------------------|--------|--------|-------|-------|------|---------------------------|--------|-------|-------|-------|------|
| No.                 | Weight | Stiffn | C-Slk | T-Slk | CoR  | Soil-S                    | Soil-D | Quake | LbTop | Perim | Area |
|                     | kips   | k/in   | ft    | ft    |      | kips                      | s/ft   | inch  | ft    | ft    | in2  |
| 1                   | 0.295  | 19069  | 0.010 | 0.000 | 1.00 | 0.0                       | 0.000  | 0.100 | 3.31  | 4.8   | 26.1 |
| 2                   | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 0.0                       | 0.000  | 0.100 | 6.62  | 4.8   | 26.1 |
| 17                  | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 0.0                       | 0.050  | 0.100 | 56.23 | 4.8   | 26.1 |
| 18                  | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 2.5                       | 0.126  | 0.100 | 59.54 | 4.8   | 26.1 |
| 19                  | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 7.7                       | 0.200  | 0.100 | 62.85 | 4.8   | 26.1 |
| 20                  | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 7.9                       | 0.200  | 0.100 | 66.15 | 4.8   | 26.1 |
| 26                  | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 7.9                       | 0.200  | 0.100 | 86.00 | 4.8   | 26.1 |
| Toe                 |        |        |       |       |      | 8.9                       | 0.150  | 0.100 |       |       |      |

7.669 kips total unreduced pile weight (g= 32.17 ft/s2)

7.669 kips total reduced pile weight (g= 32.17 ft/s2)

| Depth | Stroke | Pressure | Efficy |
|-------|--------|----------|--------|
| ft    | ft     | Ratio    |        |
| 30.00 | 11.42  | 1.00     | 0.800  |

Abutment 2 SB H-Pile- Delmag D36-32  
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| Rut  | Bl Ct | Stroke | (ft) | Ten Str | i  | t  | Comp Str | i | t | ENTHRU | Bl Rt |
|------|-------|--------|------|---------|----|----|----------|---|---|--------|-------|
| kips | b/ft  | down   | up   | ksi     |    |    | ksi      |   |   | kip-ft | b/min |
| 74.2 | 3.6   | 5.13   | 5.09 | -2.22   | 25 | 8  | 22.23    | 1 | 2 | 48.3   | 52.4  |
| 67.7 | 3.3   | 5.01   | 4.97 | -2.21   | 25 | 8  | 21.52    | 1 | 2 | 49.0   | 53.0  |
| 61.3 | 2.9   | 4.88   | 4.84 | -2.15   | 25 | 8  | 20.74    | 1 | 2 | 49.9   | 53.7  |
| 54.8 | 2.5   | 4.74   | 4.70 | -2.06   | 4  | 14 | 19.74    | 1 | 2 | 50.9   | 54.5  |
| 48.4 | 2.2   | 4.60   | 4.55 | -2.18   | 4  | 14 | 18.39    | 1 | 2 | 51.7   | 55.3  |

Abutment 2 SB H-Pile- Delmag D36-32  
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Depth (ft) 35.0 Standard Soil Setup  
Shaft Gain/Loss Factor 1.000 Toe Gain/Loss Factor 1.000

PILE PROFILE:

Toe Area (in2) 203.230 Pile Type H Pile  
Pile Size (inch) 14.690

| L b Top | Area  | E-Mod  | Spec Wt | Perim | C Index | Wave Sp | EA/c   |
|---------|-------|--------|---------|-------|---------|---------|--------|
| ft      | in2   | ksi    | lb/ft3  | ft    |         | ft/s    | k/ft/s |
| 0.0     | 26.10 | 29000. | 492.0   | 4.8   | 0       | 16524.  | 45.8   |
| 86.0    | 26.10 | 29000. | 492.0   | 4.8   | 0       | 16524.  | 45.8   |

Wave Travel Time 2L/c (ms) 10.409

| Pile and Soil Model |        |        |       |       |      | Total Capacity Rut (kips) |        |       | 86.0  |       |      |
|---------------------|--------|--------|-------|-------|------|---------------------------|--------|-------|-------|-------|------|
| No.                 | Weight | Stiffn | C-Slk | T-Slk | CoR  | Soil-S                    | Soil-D | Quake | LbTop | Perim | Area |
|                     | kips   | k/in   | ft    | ft    |      | kips                      | s/ft   | inch  | ft    | ft    | in2  |
| 1                   | 0.295  | 19069  | 0.010 | 0.000 | 1.00 | 0.0                       | 0.000  | 0.100 | 3.31  | 4.8   | 26.1 |
| 2                   | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 0.0                       | 0.000  | 0.100 | 6.62  | 4.8   | 26.1 |
| 16                  | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 0.7                       | 0.050  | 0.100 | 52.92 | 4.8   | 26.1 |
| 17                  | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 5.7                       | 0.186  | 0.100 | 56.23 | 4.8   | 26.1 |
| 18                  | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 7.9                       | 0.200  | 0.100 | 59.54 | 4.8   | 26.1 |
| 26                  | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 7.9                       | 0.200  | 0.100 | 86.00 | 4.8   | 26.1 |
| Toe                 |        |        |       |       |      | 8.9                       | 0.150  | 0.100 |       |       |      |

7.669 kips total unreduced pile weight (g= 32.17 ft/s2)

7.669 kips total reduced pile weight (g= 32.17 ft/s2)

| Depth | Stroke | Pressure | Efficy |
|-------|--------|----------|--------|
| ft    | ft     | Ratio    |        |
| 35.00 | 11.42  | 1.00     | 0.800  |

Abutment 2 SB H-Pile- Delmag D36-32  
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| Rut  | Bl Ct | Stroke | (ft) | Ten Str | i  | t | Comp Str | i | t | ENTHRU | Bl Rt |
|------|-------|--------|------|---------|----|---|----------|---|---|--------|-------|
| kip  | b/ft  | down   | up   | ksi     |    |   | ksi      |   |   | kip-ft | b/min |
| 86.0 | 4.3   | 5.34   | 5.31 | -2.64   | 25 | 8 | 23.45    | 2 | 2 | 46.9   | 51.3  |
| 78.4 | 3.9   | 5.21   | 5.18 | -2.64   | 25 | 8 | 22.74    | 2 | 2 | 47.7   | 52.0  |
| 70.8 | 3.4   | 5.07   | 5.04 | -2.55   | 25 | 8 | 21.92    | 1 | 2 | 48.6   | 52.7  |
| 63.1 | 3.0   | 4.92   | 4.88 | -2.45   | 25 | 8 | 21.05    | 1 | 2 | 49.6   | 53.5  |
| 55.5 | 2.6   | 4.77   | 4.72 | -2.31   | 25 | 8 | 19.87    | 1 | 2 | 50.7   | 54.4  |

Abutment 2 SB H-Pile- Delmag D36-32  
HNTB Corporation

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Depth (ft) 40.0 Standard Soil Setup  
Shaft Gain/Loss Factor 1.000 Toe Gain/Loss Factor 1.000

PILE PROFILE:

Toe Area (in2) 203.230 Pile Type H Pile  
Pile Size (inch) 14.690

| L b Top | Area  | E-Mod  | Spec Wt | Perim | C Index | Wave Sp | EA/c   |
|---------|-------|--------|---------|-------|---------|---------|--------|
| ft      | in2   | ksi    | lb/ft3  | ft    |         | ft/s    | k/ft/s |
| 0.0     | 26.10 | 29000. | 492.0   | 4.8   | 0       | 16524.  | 45.8   |
| 86.0    | 26.10 | 29000. | 492.0   | 4.8   | 0       | 16524.  | 45.8   |

Wave Travel Time 2L/c (ms) 10.409

| Pile and Soil Model |        |        |       |       |      | Total Capacity Rut (kips) |        |       | 97.9  |       |      |
|---------------------|--------|--------|-------|-------|------|---------------------------|--------|-------|-------|-------|------|
| No.                 | Weight | Stiffn | C-Slk | T-Slk | CoR  | Soil-S                    | Soil-D | Quake | LbTop | Perim | Area |
|                     | kips   | k/in   | ft    | ft    |      | kips                      | s/ft   | inch  | ft    | ft    | in2  |
| 1                   | 0.295  | 19069  | 0.010 | 0.000 | 1.00 | 0.0                       | 0.000  | 0.100 | 3.31  | 4.8   | 26.1 |
| 2                   | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 0.0                       | 0.000  | 0.100 | 6.62  | 4.8   | 26.1 |
| 14                  | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 0.0                       | 0.050  | 0.100 | 46.31 | 4.8   | 26.1 |
| 15                  | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 2.6                       | 0.131  | 0.100 | 49.62 | 4.8   | 26.1 |
| 16                  | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 7.8                       | 0.200  | 0.100 | 52.92 | 4.8   | 26.1 |
| 17                  | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 7.9                       | 0.200  | 0.100 | 56.23 | 4.8   | 26.1 |
| 26                  | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 7.9                       | 0.200  | 0.100 | 86.00 | 4.8   | 26.1 |
| Toe                 |        |        |       |       |      | 8.9                       | 0.150  | 0.100 |       |       |      |

7.669 kips total unreduced pile weight (g= 32.17 ft/s2)

7.669 kips total reduced pile weight (g= 32.17 ft/s2)

| Depth | Stroke | Pressure | Efficy |
|-------|--------|----------|--------|
| ft    | ft     | Ratio    |        |
| 40.00 | 11.42  | 1.00     | 0.800  |

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| Rut  | Bl Ct | Stroke | (ft) | Ten Str | i  | t | Comp Str | i | t | ENTHRU | Bl Rt |
|------|-------|--------|------|---------|----|---|----------|---|---|--------|-------|
| kip  | b/ft  | down   | up   | ksi     |    |   | ksi      |   |   | kip-ft | b/min |
| 97.9 | 5.1   | 5.53   | 5.51 | -2.89   | 25 | 8 | 24.51    | 1 | 2 | 45.8   | 50.4  |
| 89.1 | 4.5   | 5.40   | 5.37 | -2.93   | 25 | 8 | 23.83    | 2 | 2 | 46.6   | 51.1  |
| 80.3 | 4.0   | 5.25   | 5.22 | -2.93   | 25 | 8 | 23.02    | 2 | 2 | 47.4   | 51.8  |
| 71.5 | 3.5   | 5.09   | 5.06 | -2.82   | 25 | 8 | 22.08    | 1 | 2 | 48.4   | 52.6  |
| 62.6 | 3.0   | 4.92   | 4.88 | -2.65   | 25 | 8 | 21.06    | 1 | 2 | 49.7   | 53.5  |

Abutment 2 SB H-Pile- Delmag D36-32  
HNTB Corporation

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Depth (ft) 45.0 Standard Soil Setup  
Shaft Gain/Loss Factor 1.000 Toe Gain/Loss Factor 1.000

PILE PROFILE:

Toe Area (in2) 203.230 Pile Type H Pile  
Pile Size (inch) 14.690

| L b Top | Area  | E-Mod  | Spec Wt | Perim | C Index | Wave Sp | EA/c   |
|---------|-------|--------|---------|-------|---------|---------|--------|
| ft      | in2   | ksi    | lb/ft3  | ft    |         | ft/s    | k/ft/s |
| 0.0     | 26.10 | 29000. | 492.0   | 4.8   | 0       | 16524.  | 45.8   |
| 86.0    | 26.10 | 29000. | 492.0   | 4.8   | 0       | 16524.  | 45.8   |

Wave Travel Time 2L/c (ms) 10.409

| Pile and Soil Model |        |        |       |       |      | Total Capacity Rut (kips) |        |       | 109.8 |       |      |
|---------------------|--------|--------|-------|-------|------|---------------------------|--------|-------|-------|-------|------|
| No.                 | Weight | Stiffn | C-Slk | T-Slk | CoR  | Soil-S                    | Soil-D | Quake | LbTop | Perim | Area |
|                     | kips   | k/in   | ft    | ft    |      | kips                      | s/ft   | inch  | ft    | ft    | in2  |
| 1                   | 0.295  | 19069  | 0.010 | 0.000 | 1.00 | 0.0                       | 0.000  | 0.100 | 3.31  | 4.8   | 26.1 |
| 2                   | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 0.0                       | 0.000  | 0.100 | 6.62  | 4.8   | 26.1 |
| 13                  | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 0.8                       | 0.050  | 0.100 | 43.00 | 4.8   | 26.1 |
| 14                  | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 5.8                       | 0.188  | 0.100 | 46.31 | 4.8   | 26.1 |
| 15                  | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 7.9                       | 0.200  | 0.100 | 49.62 | 4.8   | 26.1 |
| 26                  | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 7.9                       | 0.200  | 0.100 | 86.00 | 4.8   | 26.1 |
| Toe                 |        |        |       |       |      | 8.9                       | 0.150  | 0.100 |       |       |      |

7.669 kips total unreduced pile weight (g= 32.17 ft/s2)

7.669 kips total reduced pile weight (g= 32.17 ft/s2)

| Depth | Stroke | Pressure | Efficy |
|-------|--------|----------|--------|
| ft    | ft     | Ratio    |        |
| 45.00 | 11.42  | 1.00     | 0.800  |

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| Rut<br>kips | Bl Ct<br>b/ft | Stroke<br>down | (ft)<br>up | Ten Str<br>ksi | i  | t | Comp Str<br>ksi | i | t | ENTHRU<br>kip-ft | Bl Rt<br>b/min |
|-------------|---------------|----------------|------------|----------------|----|---|-----------------|---|---|------------------|----------------|
| 109.8       | 5.9           | 5.67           | 5.72       | -3.03          | 25 | 8 | 25.30           | 1 | 2 | 44.4             | 49.6           |
| 99.8        | 5.2           | 5.57           | 5.55       | -3.13          | 25 | 8 | 24.81           | 2 | 2 | 45.6             | 50.2           |
| 89.8        | 4.6           | 5.40           | 5.39       | -3.18          | 25 | 8 | 23.95           | 1 | 2 | 46.4             | 51.0           |
| 79.8        | 4.0           | 5.25           | 5.22       | -3.16          | 25 | 8 | 23.06           | 2 | 2 | 47.4             | 51.7           |
| 69.8        | 3.4           | 5.06           | 5.03       | -2.99          | 25 | 8 | 22.00           | 1 | 2 | 48.6             | 52.7           |



Abutment 2 SB H-Pile- Delmag D36-32  
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Depth (ft) 50.0 Standard Soil Setup  
Shaft Gain/Loss Factor 1.000 Toe Gain/Loss Factor 1.000

PILE PROFILE:

Toe Area (in2) 203.230 Pile Type H Pile  
Pile Size (inch) 14.690

| L b Top | Area  | E-Mod  | Spec Wt | Perim | C Index | Wave Sp | EA/c   |
|---------|-------|--------|---------|-------|---------|---------|--------|
| ft      | in2   | ksi    | lb/ft3  | ft    |         | ft/s    | k/ft/s |
| 0.0     | 26.10 | 29000. | 492.0   | 4.8   | 0       | 16524.  | 45.8   |
| 86.0    | 26.10 | 29000. | 492.0   | 4.8   | 0       | 16524.  | 45.8   |

Wave Travel Time 2L/c (ms) 10.409

| Pile and Soil Model |        |        |       |       |      | Total Capacity Rut (kips) |        |       | 121.7 |       |      |
|---------------------|--------|--------|-------|-------|------|---------------------------|--------|-------|-------|-------|------|
| No.                 | Weight | Stiffn | C-Slk | T-Slk | CoR  | Soil-S                    | Soil-D | Quake | LbTop | Perim | Area |
|                     | kips   | k/in   | ft    | ft    |      | kips                      | s/ft   | inch  | ft    | ft    | in2  |
| 1                   | 0.295  | 19069  | 0.010 | 0.000 | 1.00 | 0.0                       | 0.000  | 0.100 | 3.31  | 4.8   | 26.1 |
| 2                   | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 0.0                       | 0.000  | 0.100 | 6.62  | 4.8   | 26.1 |
| 11                  | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 0.0                       | 0.050  | 0.100 | 36.38 | 4.8   | 26.1 |
| 12                  | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 2.8                       | 0.135  | 0.100 | 39.69 | 4.8   | 26.1 |
| 13                  | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 7.8                       | 0.200  | 0.100 | 43.00 | 4.8   | 26.1 |
| 14                  | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 7.9                       | 0.200  | 0.100 | 46.31 | 4.8   | 26.1 |
| 26                  | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 7.9                       | 0.200  | 0.100 | 86.00 | 4.8   | 26.1 |
| Toe                 |        |        |       |       |      | 8.9                       | 0.150  | 0.100 |       |       |      |

7.669 kips total unreduced pile weight (g= 32.17 ft/s2)

7.669 kips total reduced pile weight (g= 32.17 ft/s2)

| Depth | Stroke | Pressure | Efficy |
|-------|--------|----------|--------|
| ft    | ft     | Ratio    |        |
| 50.00 | 11.42  | 1.00     | 0.800  |

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| Rut<br>kips | Bl Ct<br>b/ft | Stroke<br>down | (ft)<br>up | Ten Str<br>ksi | i  | t | Comp Str<br>ksi | i | t | ENTHRU<br>kip-ft | Bl Rt<br>b/min |
|-------------|---------------|----------------|------------|----------------|----|---|-----------------|---|---|------------------|----------------|
| 121.7       | 6.7           | 5.87           | 5.90       | -3.23          | 25 | 8 | 26.37           | 2 | 2 | 43.8             | 48.7           |
| 110.5       | 6.0           | 5.69           | 5.74       | -3.27          | 25 | 8 | 25.53           | 2 | 2 | 44.4             | 49.5           |
| 99.3        | 5.1           | 5.57           | 5.56       | -3.37          | 25 | 8 | 24.88           | 1 | 2 | 45.5             | 50.2           |
| 88.1        | 4.5           | 5.39           | 5.36       | -3.29          | 25 | 8 | 23.95           | 1 | 2 | 46.5             | 51.1           |
| 76.9        | 3.8           | 5.21           | 5.17       | -3.23          | 25 | 8 | 22.93           | 1 | 2 | 47.8             | 52.0           |

Abutment 2 SB H-Pile- Delmag D36-32  
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Depth (ft) 55.0 Standard Soil Setup  
Shaft Gain/Loss Factor 1.000 Toe Gain/Loss Factor 1.000

PILE PROFILE:

Toe Area (in2) 203.230 Pile Type H Pile  
Pile Size (inch) 14.690

| L b Top | Area  | E-Mod  | Spec Wt | Perim | C Index | Wave Sp | EA/c   |
|---------|-------|--------|---------|-------|---------|---------|--------|
| ft      | in2   | ksi    | lb/ft3  | ft    |         | ft/s    | k/ft/s |
| 0.0     | 26.10 | 29000. | 492.0   | 4.8   | 0       | 16524.  | 45.8   |
| 86.0    | 26.10 | 29000. | 492.0   | 4.8   | 0       | 16524.  | 45.8   |

Wave Travel Time 2L/c (ms) 10.409

| Pile and Soil Model |        |        |       |       |      | Total Capacity Rut (kips) |        |       | 133.6 |       |      |
|---------------------|--------|--------|-------|-------|------|---------------------------|--------|-------|-------|-------|------|
| No.                 | Weight | Stiffn | C-Slk | T-Slk | CoR  | Soil-S                    | Soil-D | Quake | LbTop | Perim | Area |
|                     | kips   | k/in   | ft    | ft    |      | kips                      | s/ft   | inch  | ft    | ft    | in2  |
| 1                   | 0.295  | 19069  | 0.010 | 0.000 | 1.00 | 0.0                       | 0.000  | 0.100 | 3.31  | 4.8   | 26.1 |
| 2                   | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 0.0                       | 0.000  | 0.100 | 6.62  | 4.8   | 26.1 |
| 10                  | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 0.8                       | 0.050  | 0.100 | 33.08 | 4.8   | 26.1 |
| 11                  | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 5.9                       | 0.190  | 0.100 | 36.38 | 4.8   | 26.1 |
| 12                  | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 7.9                       | 0.200  | 0.100 | 39.69 | 4.8   | 26.1 |
| 26                  | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 7.9                       | 0.200  | 0.100 | 86.00 | 4.8   | 26.1 |
| Toe                 |        |        |       |       |      | 8.9                       | 0.150  | 0.100 |       |       |      |

7.669 kips total unreduced pile weight (g= 32.17 ft/s2)

7.669 kips total reduced pile weight (g= 32.17 ft/s2)

| Depth | Stroke | Pressure | Efficy |
|-------|--------|----------|--------|
| ft    | ft     | Ratio    |        |
| 55.00 | 11.42  | 1.00     | 0.800  |

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| Rut<br>kips | Bl Ct<br>b/ft | Stroke<br>down | (ft)<br>up | Ten Str<br>ksi | i  | t | Comp Str<br>ksi | i  | t | ENTHRU<br>kip-ft | Bl Rt<br>b/min |
|-------------|---------------|----------------|------------|----------------|----|---|-----------------|----|---|------------------|----------------|
| 133.6       | 7.4           | 6.05           | 6.08       | -3.40          | 25 | 8 | 27.39           | 11 | 4 | 43.0             | 48.0           |
| 121.2       | 6.7           | 5.88           | 5.91       | -3.47          | 25 | 8 | 26.55           | 11 | 4 | 43.8             | 48.7           |
| 108.8       | 5.8           | 5.67           | 5.73       | -3.48          | 25 | 8 | 25.58           | 2  | 2 | 44.5             | 49.6           |
| 96.4        | 5.0           | 5.53           | 5.52       | -3.53          | 25 | 8 | 24.83           | 3  | 2 | 45.8             | 50.3           |
| 84.0        | 4.2           | 5.34           | 5.30       | -3.43          | 25 | 8 | 23.73           | 1  | 2 | 46.9             | 51.4           |

Abutment 2 SB H-Pile- Delmag D36-32  
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Depth (ft) 60.0 Standard Soil Setup  
Shaft Gain/Loss Factor 1.000 Toe Gain/Loss Factor 1.000

PILE PROFILE:

Toe Area (in2) 203.230 Pile Type H Pile  
Pile Size (inch) 14.690

| L b Top | Area  | E-Mod  | Spec Wt | Perim | C Index | Wave Sp | EA/c   |
|---------|-------|--------|---------|-------|---------|---------|--------|
| ft      | in2   | ksi    | lb/ft3  | ft    |         | ft/s    | k/ft/s |
| 0.0     | 26.10 | 29000. | 492.0   | 4.8   | 0       | 16524.  | 45.8   |
| 86.0    | 26.10 | 29000. | 492.0   | 4.8   | 0       | 16524.  | 45.8   |

Wave Travel Time 2L/c (ms) 10.409

| Pile and Soil Model |        |        |       |       |      | Total Capacity Rut (kips) |        |       | 160.7 |       |      |
|---------------------|--------|--------|-------|-------|------|---------------------------|--------|-------|-------|-------|------|
| No.                 | Weight | Stiffn | C-Slk | T-Slk | CoR  | Soil-S                    | Soil-D | Quake | LbTop | Perim | Area |
|                     | kips   | k/in   | ft    | ft    |      | kips                      | s/ft   | inch  | ft    | ft    | in2  |
| 1                   | 0.295  | 19069  | 0.010 | 0.000 | 1.00 | 0.0                       | 0.000  | 0.100 | 3.31  | 4.8   | 26.1 |
| 2                   | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 0.0                       | 0.000  | 0.100 | 6.62  | 4.8   | 26.1 |
| 8                   | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 0.0                       | 0.050  | 0.100 | 26.46 | 4.8   | 26.1 |
| 9                   | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 2.9                       | 0.138  | 0.100 | 29.77 | 4.8   | 26.1 |
| 10                  | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 7.8                       | 0.200  | 0.100 | 33.08 | 4.8   | 26.1 |
| 11                  | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 7.9                       | 0.200  | 0.100 | 36.38 | 4.8   | 26.1 |
| 26                  | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 10.4                      | 0.112  | 0.100 | 86.00 | 4.8   | 26.1 |
| Toe                 |        |        |       |       |      | 21.6                      | 0.150  | 0.100 |       |       |      |

7.669 kips total unreduced pile weight (g= 32.17 ft/s2)

7.669 kips total reduced pile weight (g= 32.17 ft/s2)

| Depth | Stroke | Pressure | Efficy |
|-------|--------|----------|--------|
| ft    | ft     | Ratio    |        |
| 60.00 | 11.42  | 1.00     | 0.800  |

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| Rut<br>kips | Bl Ct<br>b/ft | Stroke<br>down | (ft)<br>up | Ten Str<br>ksi | i  | t | Comp Str<br>ksi | i | t | ENTHRU<br>kip-ft | Bl Rt<br>b/min |
|-------------|---------------|----------------|------------|----------------|----|---|-----------------|---|---|------------------|----------------|
| 160.7       | 8.9           | 6.35           | 6.37       | -2.29          | 25 | 8 | 28.78           | 9 | 3 | 41.9             | 46.9           |
| 147.3       | 8.0           | 6.18           | 6.20       | -2.26          | 25 | 8 | 28.00           | 3 | 2 | 42.5             | 47.5           |
| 133.9       | 7.2           | 6.00           | 6.03       | -2.27          | 25 | 8 | 27.16           | 3 | 2 | 43.2             | 48.2           |
| 120.4       | 6.4           | 5.80           | 5.85       | -2.33          | 25 | 8 | 26.20           | 2 | 2 | 43.9             | 49.0           |
| 107.0       | 5.4           | 5.65           | 5.63       | -2.26          | 25 | 8 | 25.43           | 2 | 2 | 45.3             | 49.8           |

Abutment 2 SB H-Pile- Delmag D36-32  
HNTB Corporation

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Depth (ft) 65.0 Standard Soil Setup  
Shaft Gain/Loss Factor 1.000 Toe Gain/Loss Factor 1.000

PILE PROFILE:

Toe Area (in2) 203.230 Pile Type H Pile  
Pile Size (inch) 14.690

| L b Top | Area  | E-Mod  | Spec Wt | Perim | C Index | Wave Sp | EA/c   |
|---------|-------|--------|---------|-------|---------|---------|--------|
| ft      | in2   | ksi    | lb/ft3  | ft    |         | ft/s    | k/ft/s |
| 0.0     | 26.10 | 29000. | 492.0   | 4.8   | 0       | 16524.  | 45.8   |
| 86.0    | 26.10 | 29000. | 492.0   | 4.8   | 0       | 16524.  | 45.8   |

Wave Travel Time 2L/c (ms) 10.409

| Pile and Soil Model |        |        |       |       |      | Total Capacity Rut (kips) |        |       | 204.3 |       |      |
|---------------------|--------|--------|-------|-------|------|---------------------------|--------|-------|-------|-------|------|
| No.                 | Weight | Stiffn | C-Slk | T-Slk | CoR  | Soil-S                    | Soil-D | Quake | LbTop | Perim | Area |
|                     | kips   | k/in   | ft    | ft    |      | kips                      | s/ft   | inch  | ft    | ft    | in2  |
| 1                   | 0.295  | 19069  | 0.010 | 0.000 | 1.00 | 0.0                       | 0.000  | 0.100 | 3.31  | 4.8   | 26.1 |
| 2                   | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 0.0                       | 0.000  | 0.100 | 6.62  | 4.8   | 26.1 |
| 7                   | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 0.9                       | 0.052  | 0.100 | 23.15 | 4.8   | 26.1 |
| 8                   | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 6.1                       | 0.191  | 0.100 | 26.46 | 4.8   | 26.1 |
| 9                   | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 7.9                       | 0.200  | 0.100 | 29.77 | 4.8   | 26.1 |
| 24                  | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 7.9                       | 0.197  | 0.100 | 79.38 | 4.8   | 26.1 |
| 25                  | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 19.2                      | 0.054  | 0.100 | 82.69 | 4.8   | 26.1 |
| 26                  | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 25.9                      | 0.050  | 0.100 | 86.00 | 4.8   | 26.1 |
| Toe                 |        |        |       |       |      | 26.5                      | 0.150  | 0.100 |       |       |      |

7.669 kips total unreduced pile weight (g= 32.17 ft/s2)

7.669 kips total reduced pile weight (g= 32.17 ft/s2)

| Depth | Stroke | Pressure | Efficy |
|-------|--------|----------|--------|
| ft    | ft     | Ratio    |        |
| 65.00 | 11.42  | 1.00     | 0.800  |

Abutment 2 SB H-Pile- Delmag D36-32  
HNTB Corporation

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| Rut   | Bl Ct | Stroke | (ft) | Ten Str | i  | t  | Comp Str | i | t | ENTHRU | Bl Rt |
|-------|-------|--------|------|---------|----|----|----------|---|---|--------|-------|
| kips  | b/ft  | down   | up   | ksi     |    |    | ksi      |   |   | kip-ft | b/min |
| 204.3 | 11.3  | 6.68   | 6.70 | -1.18   | 25 | 8  | 30.42    | 8 | 3 | 41.1   | 45.7  |
| 189.6 | 10.0  | 6.51   | 6.53 | -1.19   | 25 | 8  | 29.64    | 8 | 3 | 41.4   | 46.3  |
| 174.9 | 8.9   | 6.33   | 6.35 | -1.18   | 25 | 8  | 28.80    | 8 | 3 | 41.9   | 46.9  |
| 160.2 | 7.9   | 6.14   | 6.17 | -1.11   | 25 | 8  | 27.88    | 2 | 2 | 42.5   | 47.6  |
| 145.5 | 7.1   | 5.94   | 5.98 | -1.19   | 4  | 14 | 26.98    | 8 | 3 | 43.4   | 48.4  |



Abutment 2 SB H-Pile- Delmag D36-32  
HNTB Corporation

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Depth (ft) 70.0 Standard Soil Setup  
Shaft Gain/Loss Factor 1.000 Toe Gain/Loss Factor 1.000

PILE PROFILE:

Toe Area (in2) 203.230 Pile Type H Pile  
Pile Size (inch) 14.690

| L b Top | Area  | E-Mod  | Spec Wt | Perim | C Index | Wave Sp | EA/c   |
|---------|-------|--------|---------|-------|---------|---------|--------|
| ft      | in2   | ksi    | lb/ft3  | ft    |         | ft/s    | k/ft/s |
| 0.0     | 26.10 | 29000. | 492.0   | 4.8   | 0       | 16524.  | 45.8   |
| 86.0    | 26.10 | 29000. | 492.0   | 4.8   | 0       | 16524.  | 45.8   |

Wave Travel Time 2L/c (ms) 10.409

| Pile and Soil Model |        |        |       |       |      | Total Capacity Rut (kips) |        |       | 245.9 |       |      |
|---------------------|--------|--------|-------|-------|------|---------------------------|--------|-------|-------|-------|------|
| No.                 | Weight | Stiffn | C-Slk | T-Slk | CoR  | Soil-S                    | Soil-D | Quake | LbTop | Perim | Area |
|                     | kips   | k/in   | ft    | ft    |      | kips                      | s/ft   | inch  | ft    | ft    | in2  |
| 1                   | 0.295  | 19069  | 0.010 | 0.000 | 1.00 | 0.0                       | 0.000  | 0.100 | 3.31  | 4.8   | 26.1 |
| 2                   | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 0.0                       | 0.000  | 0.100 | 6.62  | 4.8   | 26.1 |
| 5                   | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 0.1                       | 0.050  | 0.100 | 16.54 | 4.8   | 26.1 |
| 6                   | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 3.1                       | 0.142  | 0.100 | 19.85 | 4.8   | 26.1 |
| 7                   | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 7.8                       | 0.200  | 0.100 | 23.15 | 4.8   | 26.1 |
| 8                   | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 7.9                       | 0.200  | 0.100 | 26.46 | 4.8   | 26.1 |
| 23                  | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 10.8                      | 0.107  | 0.100 | 76.08 | 4.8   | 26.1 |
| 24                  | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 25.3                      | 0.050  | 0.100 | 79.38 | 4.8   | 26.1 |
| 25                  | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 26.5                      | 0.050  | 0.100 | 82.69 | 4.8   | 26.1 |
| 26                  | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 27.8                      | 0.050  | 0.100 | 86.00 | 4.8   | 26.1 |
| Toe                 |        |        |       |       |      | 26.5                      | 0.150  | 0.100 |       |       |      |

7.669 kips total unreduced pile weight (g= 32.17 ft/s2)  
7.669 kips total reduced pile weight (g= 32.17 ft/s2)

| Depth | Stroke | Pressure | Efficy |
|-------|--------|----------|--------|
| ft    | ft     | Ratio    |        |
| 70.00 | 11.42  | 1.00     | 0.800  |

Abutment 2 SB H-Pile- Delmag D36-32  
HNTB Corporation

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| Rut<br>kips | Bl Ct<br>b/ft | Stroke<br>down | (ft)<br>up | Ten Str<br>ksi | i  | t  | Comp Str<br>ksi | i | t | ENTHRU<br>kip-ft | Bl Rt<br>b/min |
|-------------|---------------|----------------|------------|----------------|----|----|-----------------|---|---|------------------|----------------|
| 245.9       | 13.8          | 7.02           | 6.98       | -1.44          | 7  | 38 | 31.79           | 6 | 3 | 40.7             | 44.7           |
| 229.8       | 12.2          | 6.87           | 6.81       | -1.15          | 7  | 39 | 31.13           | 6 | 3 | 41.2             | 45.2           |
| 213.7       | 10.9          | 6.62           | 6.64       | -0.99          | 25 | 8  | 30.10           | 6 | 3 | 41.3             | 45.9           |
| 197.6       | 9.6           | 6.43           | 6.45       | -0.98          | 25 | 8  | 29.29           | 6 | 3 | 41.8             | 46.6           |
| 181.5       | 8.5           | 6.23           | 6.26       | -0.95          | 25 | 8  | 28.35           | 6 | 3 | 42.3             | 47.3           |

Abutment 2 SB H-Pile- Delmag D36-32  
HNTB Corporation

04/02/2020  
GRLWEAP Version 2010

Depth (ft) 75.0 Standard Soil Setup  
Shaft Gain/Loss Factor 1.000 Toe Gain/Loss Factor 1.000

PILE PROFILE:

Toe Area (in2) 203.230 Pile Type H Pile  
Pile Size (inch) 14.690

| L b Top | Area  | E-Mod  | Spec Wt | Perim | C Index | Wave Sp | EA/c   |
|---------|-------|--------|---------|-------|---------|---------|--------|
| ft      | in2   | ksi    | lb/ft3  | ft    |         | ft/s    | k/ft/s |
| 0.0     | 26.10 | 29000. | 492.0   | 4.8   | 0       | 16524.  | 45.8   |
| 86.0    | 26.10 | 29000. | 492.0   | 4.8   | 0       | 16524.  | 45.8   |

Wave Travel Time 2L/c (ms) 10.409

| Pile and Soil Model |        |        |       |       |      | Total Capacity Rut (kips) |        |       | 563.3 |       |      |
|---------------------|--------|--------|-------|-------|------|---------------------------|--------|-------|-------|-------|------|
| No.                 | Weight | Stiffn | C-Slk | T-Slk | CoR  | Soil-S                    | Soil-D | Quake | LbTop | Perim | Area |
|                     | kips   | k/in   | ft    | ft    |      | kips                      | s/ft   | inch  | ft    | ft    | in2  |
| 1                   | 0.295  | 19069  | 0.010 | 0.000 | 1.00 | 0.0                       | 0.000  | 0.100 | 3.31  | 4.8   | 26.1 |
| 2                   | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 0.0                       | 0.000  | 0.100 | 6.62  | 4.8   | 26.1 |
| 4                   | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 0.9                       | 0.053  | 0.100 | 13.23 | 4.8   | 26.1 |
| 5                   | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 6.2                       | 0.193  | 0.100 | 16.54 | 4.8   | 26.1 |
| 6                   | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 7.9                       | 0.200  | 0.100 | 19.85 | 4.8   | 26.1 |
| 21                  | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 7.9                       | 0.195  | 0.100 | 69.46 | 4.8   | 26.1 |
| 22                  | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 19.6                      | 0.053  | 0.100 | 72.77 | 4.8   | 26.1 |
| 23                  | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 25.9                      | 0.050  | 0.100 | 76.08 | 4.8   | 26.1 |
| 24                  | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 27.2                      | 0.050  | 0.100 | 79.38 | 4.8   | 26.1 |
| 25                  | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 28.4                      | 0.050  | 0.100 | 82.69 | 4.8   | 26.1 |
| 26                  | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 44.2                      | 0.050  | 0.100 | 86.00 | 4.8   | 26.1 |
| Toe                 |        |        |       |       |      | 285.1                     | 0.150  | 0.100 |       |       |      |

7.669 kips total unreduced pile weight (g= 32.17 ft/s2)

7.669 kips total reduced pile weight (g= 32.17 ft/s2)

| Depth | Stroke | Pressure | Efficy |
|-------|--------|----------|--------|
| ft    | ft     | Ratio    |        |
| 75.00 | 11.42  | 1.00     | 0.800  |

Abutment 2 SB H-Pile- Delmag D36-32  
HNTB Corporation

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| Rut<br>kips | Bl Ct<br>b/ft | Stroke<br>down | (ft)<br>up | Ten Str<br>ksi | i | t  | Comp Str<br>ksi | i | t | ENTHRU<br>kip-ft | Bl Rt<br>b/min |
|-------------|---------------|----------------|------------|----------------|---|----|-----------------|---|---|------------------|----------------|
| 563.3       | 56.3          | 8.68           | 8.66       | -0.70          | 5 | 49 | 37.62           | 5 | 2 | 43.6             | 40.1           |
| 545.3       | 50.5          | 8.59           | 8.59       | -0.76          | 5 | 50 | 37.23           | 5 | 2 | 43.5             | 40.3           |
| 527.2       | 45.3          | 8.51           | 8.51       | -0.64          | 5 | 50 | 36.89           | 5 | 2 | 43.6             | 40.5           |
| 509.1       | 40.7          | 8.41           | 8.42       | -0.52          | 5 | 27 | 36.44           | 1 | 2 | 43.7             | 40.7           |
| 491.1       | 36.6          | 8.30           | 8.31       | -0.80          | 5 | 27 | 36.00           | 1 | 2 | 43.8             | 41.0           |

Abutment 2 SB H-Pile- Delmag D36-32  
HNTB Corporation

04/02/2020  
GRLWEAP Version 2010

Depth (ft) 80.0 Standard Soil Setup  
Shaft Gain/Loss Factor 1.000 Toe Gain/Loss Factor 1.000

PILE PROFILE:

Toe Area (in2) 203.230 Pile Type H Pile  
Pile Size (inch) 14.690

| L b Top | Area  | E-Mod  | Spec Wt | Perim | C Index | Wave Sp | EA/c   |
|---------|-------|--------|---------|-------|---------|---------|--------|
| ft      | in2   | ksi    | lb/ft3  | ft    |         | ft/s    | k/ft/s |
| 0.0     | 26.10 | 29000. | 492.0   | 4.8   | 0       | 16524.  | 45.8   |
| 86.0    | 26.10 | 29000. | 492.0   | 4.8   | 0       | 16524.  | 45.8   |

Wave Travel Time 2L/c (ms) 10.409

| Pile and Soil Model |        |        |       |       |      | Total Capacity Rut (kips) |        |       | 679.1 |       |      |
|---------------------|--------|--------|-------|-------|------|---------------------------|--------|-------|-------|-------|------|
| No.                 | Weight | Stiffn | C-Slk | T-Slk | CoR  | Soil-S                    | Soil-D | Quake | LbTop | Perim | Area |
|                     | kips   | k/in   | ft    | ft    |      | kips                      | s/ft   | inch  | ft    | ft    | in2  |
| 1                   | 0.295  | 19069  | 0.010 | 0.000 | 1.00 | 0.0                       | 0.000  | 0.100 | 3.31  | 4.8   | 26.1 |
| 2                   | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 0.1                       | 0.050  | 0.100 | 6.62  | 4.8   | 26.1 |
| 3                   | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 3.2                       | 0.146  | 0.100 | 9.92  | 4.8   | 26.1 |
| 4                   | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 7.9                       | 0.200  | 0.100 | 13.23 | 4.8   | 26.1 |
| 5                   | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 7.9                       | 0.200  | 0.100 | 16.54 | 4.8   | 26.1 |
| 20                  | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 11.2                      | 0.103  | 0.100 | 66.15 | 4.8   | 26.1 |
| 21                  | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 25.3                      | 0.050  | 0.100 | 69.46 | 4.8   | 26.1 |
| 22                  | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 26.6                      | 0.050  | 0.100 | 72.77 | 4.8   | 26.1 |
| 23                  | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 27.8                      | 0.050  | 0.100 | 76.08 | 4.8   | 26.1 |
| 24                  | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 29.8                      | 0.050  | 0.100 | 79.38 | 4.8   | 26.1 |
| 25                  | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 61.0                      | 0.050  | 0.100 | 82.69 | 4.8   | 26.1 |
| 26                  | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 66.2                      | 0.050  | 0.100 | 86.00 | 4.8   | 26.1 |
| Toe                 |        |        |       |       |      | 302.0                     | 0.150  | 0.100 |       |       |      |

7.669 kips total unreduced pile weight (g= 32.17 ft/s2)  
7.669 kips total reduced pile weight (g= 32.17 ft/s2)

| Depth | Stroke | Pressure | Efficy |
|-------|--------|----------|--------|
| ft    | ft     | Ratio    |        |
| 80.00 | 11.42  | 1.00     | 0.800  |

Abutment 2 SB H-Pile- Delmag D36-32  
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| Rut<br>kips | Bl Ct<br>b/ft | Stroke<br>down | (ft)<br>up | Ten Str<br>ksi | i | t  | Comp Str<br>ksi | i | t | ENTHRU<br>kip-ft | Bl Rt<br>b/min |
|-------------|---------------|----------------|------------|----------------|---|----|-----------------|---|---|------------------|----------------|
| 679.1       | 109.4         | 9.03           | 9.03       | -0.42          | 4 | 47 | 38.91           | 3 | 2 | 44.2             | 39.3           |
| 657.7       | 91.0          | 8.99           | 8.98       | -0.53          | 4 | 48 | 38.71           | 3 | 2 | 44.6             | 39.4           |
| 636.4       | 76.7          | 8.93           | 8.92       | -0.60          | 4 | 49 | 38.45           | 3 | 2 | 44.8             | 39.5           |
| 615.0       | 64.9          | 8.85           | 8.83       | -0.66          | 4 | 49 | 38.16           | 3 | 2 | 45.1             | 39.7           |
| 593.6       | 56.0          | 8.77           | 8.74       | -0.61          | 4 | 50 | 37.74           | 3 | 2 | 45.4             | 39.9           |

Abutment 2 SB H-Pile- Delmag D36-32  
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Depth (ft) 85.0 Standard Soil Setup  
Shaft Gain/Loss Factor 1.000 Toe Gain/Loss Factor 1.000

PILE PROFILE:

Toe Area (in2) 203.230 Pile Type H Pile  
Pile Size (inch) 14.690

| L b Top | Area  | E-Mod  | Spec Wt | Perim | C Index | Wave Sp | EA/c   |
|---------|-------|--------|---------|-------|---------|---------|--------|
| ft      | in2   | ksi    | lb/ft3  | ft    |         | ft/s    | k/ft/s |
| 0.0     | 26.10 | 29000. | 492.0   | 4.8   | 0       | 16524.  | 45.8   |
| 86.0    | 26.10 | 29000. | 492.0   | 4.8   | 0       | 16524.  | 45.8   |

Wave Travel Time 2L/c (ms) 10.409

| Pile and Soil Model |        |        |       |       |      | Total Capacity Rut (kips) |        |       | 785.8 |       |      |
|---------------------|--------|--------|-------|-------|------|---------------------------|--------|-------|-------|-------|------|
| No.                 | Weight | Stiffn | C-Slk | T-Slk | CoR  | Soil-S                    | Soil-D | Quake | LbTop | Perim | Area |
|                     | kips   | k/in   | ft    | ft    |      | kips                      | s/ft   | inch  | ft    | ft    | in2  |
| 1                   | 0.295  | 19069  | 0.010 | 0.000 | 1.00 | 1.0                       | 0.056  | 0.100 | 3.31  | 4.8   | 26.1 |
| 2                   | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 6.3                       | 0.194  | 0.100 | 6.62  | 4.8   | 26.1 |
| 3                   | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 7.9                       | 0.200  | 0.100 | 9.92  | 4.8   | 26.1 |
| 18                  | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 7.9                       | 0.193  | 0.100 | 59.54 | 4.8   | 26.1 |
| 19                  | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 20.0                      | 0.052  | 0.100 | 62.85 | 4.8   | 26.1 |
| 20                  | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 25.9                      | 0.050  | 0.100 | 66.15 | 4.8   | 26.1 |
| 21                  | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 27.2                      | 0.050  | 0.100 | 69.46 | 4.8   | 26.1 |
| 22                  | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 28.5                      | 0.050  | 0.100 | 72.77 | 4.8   | 26.1 |
| 23                  | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 45.0                      | 0.050  | 0.100 | 76.08 | 4.8   | 26.1 |
| 24                  | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 64.6                      | 0.050  | 0.100 | 79.38 | 4.8   | 26.1 |
| 25                  | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 68.0                      | 0.050  | 0.100 | 82.69 | 4.8   | 26.1 |
| 26                  | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 71.5                      | 0.050  | 0.100 | 86.00 | 4.8   | 26.1 |
| Toe                 |        |        |       |       |      | 302.0                     | 0.150  | 0.100 |       |       |      |

7.669 kips total unreduced pile weight (g= 32.17 ft/s2)  
7.669 kips total reduced pile weight (g= 32.17 ft/s2)

| Depth | Stroke | Pressure | Efficy |
|-------|--------|----------|--------|
| ft    | ft     | Ratio    |        |
| 85.00 | 11.42  | 1.00     | 0.800  |

Abutment 2 SB H-Pile- Delmag D36-32  
HNTB Corporation

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| Rut<br>kips | Bl Ct<br>b/ft | Stroke<br>down | (ft)<br>up | Ten Str<br>ksi | i | t  | Comp Str<br>ksi | i | t | ENTHRU<br>kip-ft | Bl Rt<br>b/min |
|-------------|---------------|----------------|------------|----------------|---|----|-----------------|---|---|------------------|----------------|
| 785.8       | 278.4         | 9.23           | 9.19       | -0.14          | 2 | 46 | 40.09           | 2 | 2 | 44.1             | 39.0           |
| 760.9       | 190.8         | 9.21           | 9.18       | -0.19          | 2 | 46 | 39.89           | 2 | 2 | 44.6             | 39.0           |
| 736.0       | 139.2         | 9.18           | 9.14       | -0.24          | 3 | 47 | 39.62           | 2 | 2 | 45.2             | 39.1           |
| 711.1       | 111.4         | 9.13           | 9.12       | -0.32          | 3 | 47 | 39.27           | 2 | 2 | 45.3             | 39.1           |
| 686.2       | 88.3          | 9.09           | 9.05       | -0.46          | 7 | 49 | 39.03           | 2 | 2 | 46.1             | 39.2           |



Abutment 2 SB H-Pile- Delmag D36-32  
HNTB Corporation

04/02/2020  
GRLWEAP Version 2010

Depth (ft) 86.0 Standard Soil Setup  
Shaft Gain/Loss Factor 1.000 Toe Gain/Loss Factor 1.000

PILE PROFILE:

Toe Area (in2) 203.230 Pile Type H Pile  
Pile Size (inch) 14.690

| L b Top | Area  | E-Mod  | Spec Wt | Perim | C Index | Wave Sp | EA/c   |
|---------|-------|--------|---------|-------|---------|---------|--------|
| ft      | in2   | ksi    | lb/ft3  | ft    |         | ft/s    | k/ft/s |
| 0.0     | 26.10 | 29000. | 492.0   | 4.8   | 0       | 16524.  | 45.8   |
| 86.0    | 26.10 | 29000. | 492.0   | 4.8   | 0       | 16524.  | 45.8   |

Wave Travel Time 2L/c (ms) 10.409

| Pile and Soil Model |        |        |       |       |      | Total Capacity Rut (kips) |        |       | 808.2 |       |      |
|---------------------|--------|--------|-------|-------|------|---------------------------|--------|-------|-------|-------|------|
| No.                 | Weight | Stiffn | C-Slk | T-Slk | CoR  | Soil-S                    | Soil-D | Quake | LbTop | Perim | Area |
|                     | kips   | k/in   | ft    | ft    |      | kips                      | s/ft   | inch  | ft    | ft    | in2  |
| 1                   | 0.295  | 19069  | 0.010 | 0.000 | 1.00 | 2.1                       | 0.113  | 0.100 | 3.31  | 4.8   | 26.1 |
| 2                   | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 7.6                       | 0.200  | 0.100 | 6.62  | 4.8   | 26.1 |
| 3                   | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 7.9                       | 0.200  | 0.100 | 9.92  | 4.8   | 26.1 |
| 18                  | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 8.6                       | 0.144  | 0.100 | 59.54 | 4.8   | 26.1 |
| 19                  | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 24.5                      | 0.050  | 0.100 | 62.85 | 4.8   | 26.1 |
| 20                  | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 26.3                      | 0.050  | 0.100 | 66.15 | 4.8   | 26.1 |
| 21                  | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 27.6                      | 0.050  | 0.100 | 69.46 | 4.8   | 26.1 |
| 22                  | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 28.9                      | 0.050  | 0.100 | 72.77 | 4.8   | 26.1 |
| 23                  | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 55.3                      | 0.050  | 0.100 | 76.08 | 4.8   | 26.1 |
| 24                  | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 65.6                      | 0.050  | 0.100 | 79.38 | 4.8   | 26.1 |
| 25                  | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 69.1                      | 0.050  | 0.100 | 82.69 | 4.8   | 26.1 |
| 26                  | 0.295  | 19069  | 0.000 | 0.000 | 1.00 | 72.6                      | 0.050  | 0.100 | 86.00 | 4.8   | 26.1 |
| Toe                 |        |        |       |       |      | 302.0                     | 0.150  | 0.100 |       |       |      |

7.669 kips total unreduced pile weight (g= 32.17 ft/s2)  
7.669 kips total reduced pile weight (g= 32.17 ft/s2)

| Depth | Stroke | Pressure | Efficy |
|-------|--------|----------|--------|
| ft    | ft     | Ratio    |        |
| 86.00 | 11.42  | 1.00     | 0.800  |

Abutment 2 SB H-Pile- Delmag D36-32  
HNTB Corporation

04/02/2020  
GRLWEAP Version 2010

| Rut   | Bl Ct | Stroke | (ft) | Ten Str | i | t  | Comp Str | i | t | ENTHRU | Bl Rt |
|-------|-------|--------|------|---------|---|----|----------|---|---|--------|-------|
| kip   | b/ft  | down   | up   | ksi     |   |    | ksi      |   |   | kip-ft | b/min |
| 808.2 | 355.4 | 9.22   | 9.21 | -0.08   | 2 | 45 | 40.14    | 2 | 2 | 43.8   | 39.0  |
| 782.5 | 237.5 | 9.23   | 9.21 | -0.14   | 2 | 46 | 40.00    | 2 | 2 | 44.4   | 38.9  |
| 756.8 | 168.0 | 9.21   | 9.20 | -0.19   | 2 | 46 | 39.73    | 2 | 2 | 44.9   | 39.0  |
| 731.2 | 125.7 | 9.16   | 9.15 | -0.25   | 3 | 47 | 39.51    | 2 | 2 | 45.4   | 39.1  |
| 705.5 | 99.8  | 9.12   | 9.10 | -0.40   | 7 | 48 | 39.16    | 2 | 2 | 45.8   | 39.1  |

SUMMARY OVER DEPTHS

| G/L at Shaft and Toe: 1.000 1.000 |       |        |        |        |         |         |        |        |
|-----------------------------------|-------|--------|--------|--------|---------|---------|--------|--------|
| Depth                             | Rut   | Frictn | End Bg | Bl Ct  | Com Str | Ten Str | Stroke | ENTHRU |
| ft                                | kips  | kips   | kips   | bl/ft  | ksi     | ksi     | ft     | kip-ft |
| 5.0                               | 15.2  | 5.8    | 9.3    | Hammer | did not | run     |        |        |
| 10.0                              | 26.6  | 17.7   | 8.9    | 1.5    | 13.147  | -1.705  | 3.98   | 50.3   |
| 15.0                              | 38.5  | 29.6   | 8.9    | 1.9    | 15.687  | -2.371  | 4.35   | 52.8   |
| 20.0                              | 50.4  | 41.5   | 8.9    | 2.3    | 18.757  | -2.247  | 4.63   | 51.6   |
| 25.0                              | 62.3  | 53.4   | 8.9    | 2.9    | 20.555  | -2.021  | 4.85   | 49.4   |
| 30.0                              | 74.2  | 65.3   | 8.9    | 3.6    | 22.234  | -2.219  | 5.13   | 48.3   |
| 35.0                              | 86.0  | 77.2   | 8.9    | 4.3    | 23.447  | -2.636  | 5.34   | 46.9   |
| 40.0                              | 97.9  | 89.0   | 8.9    | 5.1    | 24.506  | -2.889  | 5.53   | 45.8   |
| 45.0                              | 109.8 | 100.9  | 8.9    | 5.9    | 25.300  | -3.030  | 5.67   | 44.4   |
| 50.0                              | 121.7 | 112.8  | 8.9    | 6.7    | 26.367  | -3.234  | 5.87   | 43.8   |
| 55.0                              | 133.6 | 124.7  | 8.9    | 7.4    | 27.388  | -3.400  | 6.05   | 43.0   |
| 60.0                              | 160.7 | 139.1  | 21.6   | 8.9    | 28.781  | -2.289  | 6.35   | 41.9   |
| 65.0                              | 204.3 | 177.8  | 26.5   | 11.3   | 30.422  | -1.177  | 6.68   | 41.1   |
| 70.0                              | 245.9 | 219.3  | 26.5   | 13.8   | 31.788  | -1.442  | 7.02   | 40.7   |
| 75.0                              | 563.3 | 278.2  | 285.1  | 56.3   | 37.620  | -0.698  | 8.68   | 43.6   |
| 80.0                              | 679.1 | 377.0  | 302.0  | 109.4  | 38.907  | -0.417  | 9.03   | 44.2   |
| 85.0                              | 785.8 | 483.8  | 302.0  | 278.4  | 40.088  | -0.136  | 9.23   | 44.1   |
| 86.0                              | 808.2 | 506.1  | 302.0  | 355.4  | 40.137  | -0.080  | 9.22   | 43.8   |

Total Driving Time 55 minutes; Total No. of Blows 2217  
Starting at penetration 5.0 ft

| G/L at Shaft and Toe: 0.900 1.000 |       |        |        |        |         |         |        |        |
|-----------------------------------|-------|--------|--------|--------|---------|---------|--------|--------|
| Depth                             | Rut   | Frictn | End Bg | Bl Ct  | Com Str | Ten Str | Stroke | ENTHRU |
| ft                                | kips  | kips   | kips   | bl/ft  | ksi     | ksi     | ft     | kip-ft |
| 5.0                               | 14.7  | 5.3    | 9.3    | Hammer | did not | run     |        |        |
| 10.0                              | 24.9  | 16.0   | 8.9    | 1.5    | 12.694  | -1.474  | 3.93   | 49.4   |
| 15.0                              | 35.6  | 26.7   | 8.9    | 1.8    | 15.159  | -2.318  | 4.28   | 53.0   |
| 20.0                              | 46.3  | 37.4   | 8.9    | 2.1    | 17.848  | -2.295  | 4.54   | 51.9   |
| 25.0                              | 57.0  | 48.1   | 8.9    | 2.6    | 20.091  | -2.043  | 4.79   | 50.6   |
| 30.0                              | 67.7  | 58.8   | 8.9    | 3.3    | 21.524  | -2.210  | 5.01   | 49.0   |
| 35.0                              | 78.4  | 69.5   | 8.9    | 3.9    | 22.744  | -2.637  | 5.21   | 47.7   |
| 40.0                              | 89.1  | 80.2   | 8.9    | 4.5    | 23.829  | -2.930  | 5.40   | 46.6   |
| 45.0                              | 99.8  | 90.9   | 8.9    | 5.2    | 24.811  | -3.129  | 5.57   | 45.6   |
| 50.0                              | 110.5 | 101.6  | 8.9    | 6.0    | 25.528  | -3.274  | 5.69   | 44.4   |
| 55.0                              | 121.2 | 112.3  | 8.9    | 6.7    | 26.550  | -3.471  | 5.88   | 43.8   |
| 60.0                              | 147.3 | 125.7  | 21.6   | 8.0    | 28.000  | -2.264  | 6.18   | 42.5   |
| 65.0                              | 189.6 | 163.1  | 26.5   | 10.0   | 29.636  | -1.187  | 6.51   | 41.4   |
| 70.0                              | 229.8 | 203.2  | 26.5   | 12.2   | 31.134  | -1.150  | 6.87   | 41.2   |
| 75.0                              | 545.3 | 260.2  | 285.1  | 50.5   | 37.234  | -0.762  | 8.59   | 43.5   |
| 80.0                              | 657.7 | 355.7  | 302.0  | 91.0   | 38.706  | -0.526  | 8.99   | 44.6   |
| 85.0                              | 760.9 | 458.9  | 302.0  | 190.8  | 39.890  | -0.189  | 9.21   | 44.6   |
| 86.0                              | 782.5 | 480.5  | 302.0  | 237.5  | 40.005  | -0.140  | 9.23   | 44.4   |

Total Driving Time 42 minutes; Total No. of Blows 1736  
Starting at penetration 5.0 ft

SUMMARY OVER DEPTHS

| G/L at Shaft and Toe: 0.800 1.000 |       |        |        |        |         |         |        |        |  |
|-----------------------------------|-------|--------|--------|--------|---------|---------|--------|--------|--|
| Depth                             | Rut   | Frictn | End Bg | Bl Ct  | Com Str | Ten Str | Stroke | ENTHRU |  |
| ft                                | kips  | kips   | kips   | bl/ft  | ksi     | ksi     | ft     | kip-ft |  |
| 5.0                               | 14.2  | 4.8    | 9.3    | Hammer | did not | run     |        |        |  |
| 10.0                              | 23.2  | 14.4   | 8.9    | Hammer | did not | run     |        |        |  |
| 15.0                              | 32.7  | 23.9   | 8.9    | 1.7    | 14.744  | -2.284  | 4.20   | 52.5   |  |
| 20.0                              | 42.3  | 33.4   | 8.9    | 2.0    | 16.798  | -2.310  | 4.44   | 52.4   |  |
| 25.0                              | 51.8  | 42.9   | 8.9    | 2.4    | 19.084  | -2.115  | 4.67   | 51.4   |  |
| 30.0                              | 61.3  | 52.4   | 8.9    | 2.9    | 20.744  | -2.145  | 4.88   | 49.9   |  |
| 35.0                              | 70.8  | 61.9   | 8.9    | 3.4    | 21.918  | -2.549  | 5.07   | 48.6   |  |
| 40.0                              | 80.3  | 71.4   | 8.9    | 4.0    | 23.022  | -2.928  | 5.25   | 47.4   |  |
| 45.0                              | 89.8  | 80.9   | 8.9    | 4.6    | 23.947  | -3.177  | 5.40   | 46.4   |  |
| 50.0                              | 99.3  | 90.4   | 8.9    | 5.1    | 24.883  | -3.372  | 5.57   | 45.5   |  |
| 55.0                              | 108.8 | 99.9   | 8.9    | 5.8    | 25.578  | -3.481  | 5.67   | 44.5   |  |
| 60.0                              | 133.9 | 112.3  | 21.6   | 7.2    | 27.156  | -2.267  | 6.00   | 43.2   |  |
| 65.0                              | 174.9 | 148.4  | 26.5   | 8.9    | 28.805  | -1.180  | 6.33   | 41.9   |  |
| 70.0                              | 213.7 | 187.1  | 26.5   | 10.9   | 30.100  | -0.994  | 6.62   | 41.3   |  |
| 75.0                              | 527.2 | 242.1  | 285.1  | 45.3   | 36.892  | -0.644  | 8.51   | 43.6   |  |
| 80.0                              | 636.4 | 334.3  | 302.0  | 76.7   | 38.450  | -0.600  | 8.93   | 44.8   |  |
| 85.0                              | 736.0 | 434.0  | 302.0  | 139.2  | 39.620  | -0.239  | 9.18   | 45.2   |  |
| 86.0                              | 756.8 | 454.8  | 302.0  | 168.0  | 39.727  | -0.194  | 9.21   | 44.9   |  |

Total Driving Time 34 minutes; Total No. of Blows 1405  
Starting at penetration 5.0 ft

| G/L at Shaft and Toe: 0.700 1.000 |       |        |        |        |         |         |        |        |  |
|-----------------------------------|-------|--------|--------|--------|---------|---------|--------|--------|--|
| Depth                             | Rut   | Frictn | End Bg | Bl Ct  | Com Str | Ten Str | Stroke | ENTHRU |  |
| ft                                | kips  | kips   | kips   | bl/ft  | ksi     | ksi     | ft     | kip-ft |  |
| 5.0                               | 13.7  | 4.3    | 9.3    | Hammer | did not | run     |        |        |  |
| 10.0                              | 21.5  | 12.7   | 8.9    | Hammer | did not | run     |        |        |  |
| 15.0                              | 29.9  | 21.0   | 8.9    | 1.6    | 14.152  | -2.138  | 4.12   | 51.8   |  |
| 20.0                              | 38.2  | 29.3   | 8.9    | 1.8    | 15.702  | -2.319  | 4.35   | 52.9   |  |
| 25.0                              | 46.5  | 37.6   | 8.9    | 2.1    | 17.845  | -2.248  | 4.54   | 51.8   |  |
| 30.0                              | 54.8  | 45.9   | 8.9    | 2.5    | 19.737  | -2.059  | 4.74   | 50.9   |  |
| 35.0                              | 63.1  | 54.3   | 8.9    | 3.0    | 21.048  | -2.446  | 4.92   | 49.6   |  |
| 40.0                              | 71.5  | 62.6   | 8.9    | 3.5    | 22.083  | -2.818  | 5.09   | 48.4   |  |
| 45.0                              | 79.8  | 70.9   | 8.9    | 4.0    | 23.059  | -3.164  | 5.25   | 47.4   |  |
| 50.0                              | 88.1  | 79.2   | 8.9    | 4.5    | 23.947  | -3.290  | 5.39   | 46.5   |  |
| 55.0                              | 96.4  | 87.5   | 8.9    | 5.0    | 24.831  | -3.534  | 5.53   | 45.8   |  |
| 60.0                              | 120.4 | 98.9   | 21.6   | 6.4    | 26.201  | -2.330  | 5.80   | 43.9   |  |
| 65.0                              | 160.2 | 133.6  | 26.5   | 7.9    | 27.882  | -1.108  | 6.14   | 42.5   |  |
| 70.0                              | 197.6 | 171.0  | 26.5   | 9.6    | 29.287  | -0.985  | 6.43   | 41.8   |  |
| 75.0                              | 509.1 | 224.0  | 285.1  | 40.7   | 36.436  | -0.521  | 8.41   | 43.7   |  |
| 80.0                              | 615.0 | 313.0  | 302.0  | 64.9   | 38.160  | -0.658  | 8.85   | 45.1   |  |
| 85.0                              | 711.1 | 409.1  | 302.0  | 111.4  | 39.269  | -0.321  | 9.13   | 45.3   |  |
| 86.0                              | 731.2 | 429.2  | 302.0  | 125.7  | 39.509  | -0.254  | 9.16   | 45.4   |  |

Total Driving Time 28 minutes; Total No. of Blows 1185  
Starting at penetration 5.0 ft

SUMMARY OVER DEPTHS

| G/L at Shaft and Toe: 0.600 1.000 |       |        |        |        |         |         |        |        |  |
|-----------------------------------|-------|--------|--------|--------|---------|---------|--------|--------|--|
| Depth                             | Rut   | Frictn | End Bg | Bl Ct  | Com Str | Ten Str | Stroke | ENTHRU |  |
| ft                                | kips  | kips   | kips   | bl/ft  | ksi     | ksi     | ft     | kip-ft |  |
| 5.0                               | 13.1  | 3.8    | 9.3    | Hammer | did not | run     |        |        |  |
| 10.0                              | 19.9  | 11.0   | 8.9    | Hammer | did not | run     |        |        |  |
| 15.0                              | 27.0  | 18.1   | 8.9    | 1.6    | 13.421  | -1.930  | 4.03   | 50.8   |  |
| 20.0                              | 34.1  | 25.2   | 8.9    | 1.7    | 14.896  | -2.319  | 4.24   | 52.7   |  |
| 25.0                              | 41.3  | 32.4   | 8.9    | 1.9    | 16.560  | -2.281  | 4.42   | 52.5   |  |
| 30.0                              | 48.4  | 39.5   | 8.9    | 2.2    | 18.385  | -2.176  | 4.60   | 51.7   |  |
| 35.0                              | 55.5  | 46.6   | 8.9    | 2.6    | 19.869  | -2.311  | 4.77   | 50.7   |  |
| 40.0                              | 62.6  | 53.8   | 8.9    | 3.0    | 21.062  | -2.654  | 4.92   | 49.7   |  |
| 45.0                              | 69.8  | 60.9   | 8.9    | 3.4    | 22.001  | -2.985  | 5.06   | 48.6   |  |
| 50.0                              | 76.9  | 68.0   | 8.9    | 3.8    | 22.929  | -3.231  | 5.21   | 47.8   |  |
| 55.0                              | 84.0  | 75.1   | 8.9    | 4.2    | 23.728  | -3.434  | 5.34   | 46.9   |  |
| 60.0                              | 107.0 | 85.4   | 21.6   | 5.4    | 25.427  | -2.258  | 5.65   | 45.3   |  |
| 65.0                              | 145.5 | 118.9  | 26.5   | 7.1    | 26.977  | -1.188  | 5.94   | 43.4   |  |
| 70.0                              | 181.5 | 154.9  | 26.5   | 8.5    | 28.349  | -0.954  | 6.23   | 42.3   |  |
| 75.0                              | 491.1 | 206.0  | 285.1  | 36.6   | 35.998  | -0.801  | 8.30   | 43.8   |  |
| 80.0                              | 593.6 | 291.6  | 302.0  | 56.0   | 37.741  | -0.609  | 8.77   | 45.4   |  |
| 85.0                              | 686.2 | 384.2  | 302.0  | 88.3   | 39.034  | -0.465  | 9.09   | 46.1   |  |
| 86.0                              | 705.5 | 403.5  | 302.0  | 99.8   | 39.162  | -0.395  | 9.12   | 45.8   |  |

Total Driving Time 24 minutes;  
Starting at penetration 5.0 ft

Total No. of Blows 1002

Table of Depths Analyzed with Driving System Modifiers

| Depth | Temp.<br>Length | Wait<br>Time | Equivalent<br>Stroke | Pressure<br>Ratio | Efficy. | Stiffn.<br>Factor | Cushion<br>CoR |
|-------|-----------------|--------------|----------------------|-------------------|---------|-------------------|----------------|
| ft    | ft              | hr           | ft                   |                   |         |                   |                |
| 5.00  | 86.00           | 0.00         | 11.42                | 1.00              | 0.80    | 1.00              | 1.00           |
| 10.00 | 86.00           | 0.00         | 11.42                | 1.00              | 0.80    | 1.00              | 1.00           |
| 15.00 | 86.00           | 0.00         | 11.42                | 1.00              | 0.80    | 1.00              | 1.00           |
| 20.00 | 86.00           | 0.00         | 11.42                | 1.00              | 0.80    | 1.00              | 1.00           |
| 25.00 | 86.00           | 0.00         | 11.42                | 1.00              | 0.80    | 1.00              | 1.00           |
| 30.00 | 86.00           | 0.00         | 11.42                | 1.00              | 0.80    | 1.00              | 1.00           |
| 35.00 | 86.00           | 0.00         | 11.42                | 1.00              | 0.80    | 1.00              | 1.00           |
| 40.00 | 86.00           | 0.00         | 11.42                | 1.00              | 0.80    | 1.00              | 1.00           |
| 45.00 | 86.00           | 0.00         | 11.42                | 1.00              | 0.80    | 1.00              | 1.00           |
| 50.00 | 86.00           | 0.00         | 11.42                | 1.00              | 0.80    | 1.00              | 1.00           |
| 55.00 | 86.00           | 0.00         | 11.42                | 1.00              | 0.80    | 1.00              | 1.00           |
| 60.00 | 86.00           | 0.00         | 11.42                | 1.00              | 0.80    | 1.00              | 1.00           |
| 65.00 | 86.00           | 0.00         | 11.42                | 1.00              | 0.80    | 1.00              | 1.00           |
| 70.00 | 86.00           | 0.00         | 11.42                | 1.00              | 0.80    | 1.00              | 1.00           |
| 75.00 | 86.00           | 0.00         | 11.42                | 1.00              | 0.80    | 1.00              | 1.00           |
| 80.00 | 86.00           | 0.00         | 11.42                | 1.00              | 0.80    | 1.00              | 1.00           |
| 85.00 | 86.00           | 0.00         | 11.42                | 1.00              | 0.80    | 1.00              | 1.00           |
| 86.00 | 86.00           | 0.00         | 11.42                | 1.00              | 0.80    | 1.00              | 1.00           |

Soil Layer Resistance Values

| Depth | Shaft<br>Res. | End<br>Bearing | Shaft<br>Quake | Toe<br>Quake | Shaft<br>Damping | Toe<br>Damping | Soil<br>Setup | Limit<br>Distance | Setup<br>Time |
|-------|---------------|----------------|----------------|--------------|------------------|----------------|---------------|-------------------|---------------|
| ft    | k/ft2         | kips           | inch           | inch         | s/ft             | s/ft           | Normlzd       | ft                | hrs           |
| 0.00  | 0.00          | 3.10           | 0.100          | 0.100        | 0.050            | 0.150          | 0.333         | 6.560             | 1.000         |
| 1.00  | 0.08          | 5.36           | 0.100          | 0.100        | 0.050            | 0.150          | 0.333         | 6.560             | 1.000         |
| 2.00  | 0.16          | 7.34           | 0.100          | 0.100        | 0.050            | 0.150          | 0.333         | 6.560             | 1.000         |
| 3.00  | 0.24          | 9.60           | 0.100          | 0.100        | 0.200            | 0.150          | 1.000         | 6.560             | 1.000         |
| 4.00  | 0.50          | 10.16          | 0.100          | 0.100        | 0.200            | 0.150          | 1.000         | 6.560             | 1.000         |
| 5.00  | 0.50          | 9.31           | 0.100          | 0.100        | 0.200            | 0.150          | 1.000         | 6.560             | 1.000         |
| 6.00  | 0.50          | 8.89           | 0.100          | 0.100        | 0.200            | 0.150          | 1.000         | 6.560             | 1.000         |
| 7.00  | 0.50          | 8.89           | 0.100          | 0.100        | 0.200            | 0.150          | 1.000         | 6.560             | 1.000         |
| 8.00  | 0.50          | 8.89           | 0.100          | 0.100        | 0.200            | 0.150          | 1.000         | 6.560             | 1.000         |
| 9.00  | 0.50          | 8.89           | 0.100          | 0.100        | 0.200            | 0.150          | 1.000         | 6.560             | 1.000         |
| 10.00 | 0.50          | 8.89           | 0.100          | 0.100        | 0.200            | 0.150          | 1.000         | 6.560             | 1.000         |
| 11.00 | 0.50          | 8.89           | 0.100          | 0.100        | 0.200            | 0.150          | 1.000         | 6.560             | 1.000         |
| 12.00 | 0.50          | 8.89           | 0.100          | 0.100        | 0.200            | 0.150          | 1.000         | 6.560             | 1.000         |
| 13.00 | 0.50          | 8.89           | 0.100          | 0.100        | 0.200            | 0.150          | 1.000         | 6.560             | 1.000         |
| 14.00 | 0.50          | 8.89           | 0.100          | 0.100        | 0.200            | 0.150          | 1.000         | 6.560             | 1.000         |
| 15.00 | 0.50          | 8.89           | 0.100          | 0.100        | 0.200            | 0.150          | 1.000         | 6.560             | 1.000         |
| 16.00 | 0.50          | 8.89           | 0.100          | 0.100        | 0.200            | 0.150          | 1.000         | 6.560             | 1.000         |
| 17.00 | 0.50          | 8.89           | 0.100          | 0.100        | 0.200            | 0.150          | 1.000         | 6.560             | 1.000         |
| 18.00 | 0.50          | 8.89           | 0.100          | 0.100        | 0.200            | 0.150          | 1.000         | 6.560             | 1.000         |
| 19.00 | 0.50          | 8.89           | 0.100          | 0.100        | 0.200            | 0.150          | 1.000         | 6.560             | 1.000         |
| 20.00 | 0.50          | 8.89           | 0.100          | 0.100        | 0.200            | 0.150          | 1.000         | 6.560             | 1.000         |
| 21.00 | 0.50          | 8.89           | 0.100          | 0.100        | 0.200            | 0.150          | 1.000         | 6.560             | 1.000         |
| 22.00 | 0.50          | 8.89           | 0.100          | 0.100        | 0.200            | 0.150          | 1.000         | 6.560             | 1.000         |
| 23.00 | 0.50          | 8.89           | 0.100          | 0.100        | 0.200            | 0.150          | 1.000         | 6.560             | 1.000         |
| 24.00 | 0.50          | 8.89           | 0.100          | 0.100        | 0.200            | 0.150          | 1.000         | 6.560             | 1.000         |

[illegible]

|       |      |        |       |       |       |       |       |       |       |
|-------|------|--------|-------|-------|-------|-------|-------|-------|-------|
| 84.00 | 4.59 | 302.02 | 0.100 | 0.100 | 0.050 | 0.150 | 0.333 | 6.560 | 1.000 |
| 85.00 | 4.66 | 302.02 | 0.100 | 0.100 | 0.050 | 0.150 | 0.333 | 6.560 | 1.000 |
| 86.00 | 4.73 | 302.02 | 0.100 | 0.100 | 0.050 | 0.150 | 0.333 | 6.560 | 1.000 |



## SOIL ASSUMPTIONS

|         |                                 |            |            |                |         |
|---------|---------------------------------|------------|------------|----------------|---------|
| For     | MEDOT I-295 over Veranda Street | Job no.    | 75297      | Sheet no.      | 1 of 54 |
| Made by | JDZ                             | Checked by | JCJ        | Backchecked by | .       |
| Date    | 09/03/2019                      | Date       | 10/10/2019 | Date           | .       |

# INTERSTATE 295 OVER VERANDA STREET

## SOUTH APPROACH EMBANKMENT

### SETTLEMENT ANALYSIS FOR FINAL DESIGN

## SETTLE3D FOR SETTLEMENT ANALYSIS

## SETTLE3D Analysis Summary

An embankment is proposed consisting almost entirely of lightweight material to carry a portion of roadway where the existing roadway runs over several spans. These spans which are to be filled in with embankment overpass the eastbound lanes of Veranda Street and green space. The new scheme expands the roadway at the current westbound location to have the westbound and eastbound adjacent, eliminating the existing eastbound roadway. The embankment is to extend from an existing embankment on the south, end at an abutment wall for the span over the widened Veranda Street, and 2H:1V sideslopes on the east and west.

Due to the compressible Marine Silt & Clay, measures to mitigate settlement were required. A scheme was developed with EPS Geofoam, Lightweight Concrete, and excavation of existing material to compensate for the top few feet of embankment which will consist of common borrow and pavement. The common borrow and pavement box will be constructed during the bridge construction. Repaving is planned at six months after bridge construction. The next repaving is anticipated after ten years. Based on the results of the settlement analysis, it may be deemed unnecessary to perform repaving after 6 months.

Loading was simplified to net pressures to determine design guidance. The depths of excavation for weight compensation and lightweight fill thicknesses can be balanced with the common borrow and pavement weight to provide the net pressures determined to satisfy settlement restrictions. With the ground surface modeled as elevation +14 feet, the acceptable scheme for controlling roadway settlements was determined as:

- 1) a net pressure of 520-psf between embankment crests applied at elevation +11 feet to account for anticipated excavation for lightweight replacement,
- 2) a net pressure of 780-psf from the crest to 15 feet beyond the crest along the slope applied at elevation +11 feet to account for anticipated excavation for lightweight replacement,
- 3) and a net pressure of 1040-psf beyond 15 feet out from the crest applied at the ground surface as minimal to no excavation is anticipated.

These net pressures equate to about 4, 6, and 8 feet of common borrow. Where greater thicknesses above the top of Geofoam are necessary, replacing existing soils with lightweight material can reduce the net pressures to within these tolerances.

The software SETTLE3D by RocScience was utilized for settlement analysis. Queries through the middle of the embankment both in the direction of traffic and perpendicular to the roadway to assess pavement needs. Queries of worst-case conditions near the north edge of the embankment were taken to determine the elevation at which 0.4 inches of settlement has occurred for pile downdrag calculations. The 0.4 inches was determined for 75-years for an assumed 75-year design life.

The maximum settlement within the roadway extents occurs at the right shoulder where the sideslope influence has more influence than farther in. Resulting settlements are provided by **Table 1**.

**TABLE 1: Resulting Estimated Maximum Settlements**

| Time                  | Total Settlement<br>(inch) |
|-----------------------|----------------------------|
| During Construction   | 0.4                        |
| 6 months              | 0.7                        |
| 120 months (10 years) | 1.2                        |

Note the embankment slopes beyond the crests will experience slightly greater settlements.

Based on the Total Settlement vs. Depth plot of Query Point 4 at 75 years it is determined that the 0.4 inches of settlement occurs at elevation -31.8 feet. The 0.4 inches is important for utilizing the AASHTO method for calculating downdrag, where soils above the 0.4-inch settlement elevation are considered to contribute to downdrag forces. The plot can be found with the Graphs/Results portion of the calculation package. Confirmation that this result represents the worst-case is provided by results of a query line taken along the north edge of total settlement at elevation -31.8 feet at 75 years.

The proposed cross-sectional geometry was taken from civil plans provided for 90% design provided in Microstation format. The cross-sectional dimensions of Station 37+75 were utilized, which is approximately in the middle of the proposed embankment. Two feet of lightweight concrete as a minimum is to top the Geofoam between the proposed guardrails. Lightweight concrete is to be used atop of existing piers which do not run perpendicular to the baseline but at a skew. The existing piers will carry the lightweight concrete, making ignoring the existing piers, and instead modeling with the Geofoam, lightweight concrete, and common borrow configuration throughout the supported roadway limits is conservative. As such the existing piers were ignored in the described manner. Unit weights of 3 lb/ft<sup>3</sup> and 30 lb/ft<sup>3</sup> were assumed for the EPS Geofoam and Lightweight Concrete, respectively. The common borrow and pavement box are assumed to have a unit weight of 130 lb/ft<sup>3</sup> on average.

The roadway skew was incorporated into the geometry. Boring points were input at appropriate locations to incorporate subsurface variability. The Marine Silt & Clay increases in thickness from the southeast to northwest. Stratigraphy of borings from records from 1960 and borings from the investigation executed for this project were utilized. Borings utilized from the 1960 records are V-1, V-2, V-3, V-8, V-9, and V-10. Borings utilized from the investigation performed for this project are BB-PVS-101, -105, -201, and -301. While elevations of strata delineation were kept, the ground surface elevation of each boring was set to elevation 14 feet to model a level ground surface. Groundwater was modeled as a phreatic surface at elevation +5 feet. The Marine Silt & Clay was assumed to have drainage allowed at its top and base, as the

layers above and below are considered free-draining material, making the consolidation a double-drained condition.

SETTLE3D performs settlement analyses by determination of distributed stresses under defined loading by the selected stress distribution theory, and computes deformation by user provided stiffness and/or consolidation parameters. Boussinesq stress distribution theory has been utilized for all analyses.

Though elevations have been defined when inputting values, SETTLE3D outputs provide z-axis coordinates as depths instead of elevations, where depth orientation is positive down. Negative depth values are positive elevation values, e.g. a depth of -15 refers to elevation +15.

Soil parameters for cohesionless soils were taken from Table 2-3 of the Preliminary Geotechnical Assessment previously prepared for this project. Compressibility parameters for the Marine Silt & Clay were determined from select laboratory test results and are provided in this package. Properties utilized are presented in **Table 2**.

**Table 2: Engineering Properties of Soils**

| Material           | $\overline{N}_{1,60}$<br>(bpf) | $\gamma$<br>(pcf) | $E_s$ (ksf) | $C_{ce}$ | $C_{re}$ | $C_v$<br>(ft <sup>2</sup> /day) | $P_c$ (ksf) | $C_{ae}$ |
|--------------------|--------------------------------|-------------------|-------------|----------|----------|---------------------------------|-------------|----------|
| Existing Fill      | 7                              | 110               | 350         | ---      | ---      | ---                             | ---         | ---      |
| Marine Silt & Clay | 3                              | 115               | ---         | 0.20     | 0.014    | 0.2                             | 3.8         | 0.003    |
| Marine Sand        | 14                             | 115               | 530         | ---      | ---      | ---                             | ---         | ---      |
| Glacial Till       | 26                             | 120               | 770         | ---      | ---      | ---                             | ---         | ---      |

Where:  $\overline{N}_{1,60}$  = Design SPT-N value of stratum, corrected for hammer efficiency, overburden pressure, borehole diameter, rod length, and sampler inner diameter, in blows per foot.

$\gamma$  = Total unit weight of soil – values taken from the Preliminary Geotechnical Assessment Table 2-3.

$E_s$  = 1D Constrained Modulus, values of Young's Elastic Modulus provided by the Preliminary Geotechnical Assessment Table 2-3 conservatively used

$C_{ce}$  = Compression ratio, estimated from consolidation test results

$C_{re}$  = Recompression ratio, estimated from consolidation test results

$C_v$  = Coefficient of consolidation, based on knowledge of regional materials. Consolidation tests provided similar values.

$P_c$  = Preconsolidation pressure, estimated from consolidation test results

$C_{\alpha\epsilon}$  = Secondary compression index (strain rate), based on consolidation test results of applied stress intervals in recompression (as soils will remain in recompression with the proposed loading)

# VERANDA

## GEOMETRY AND LOADING FIGURES AND TABLES

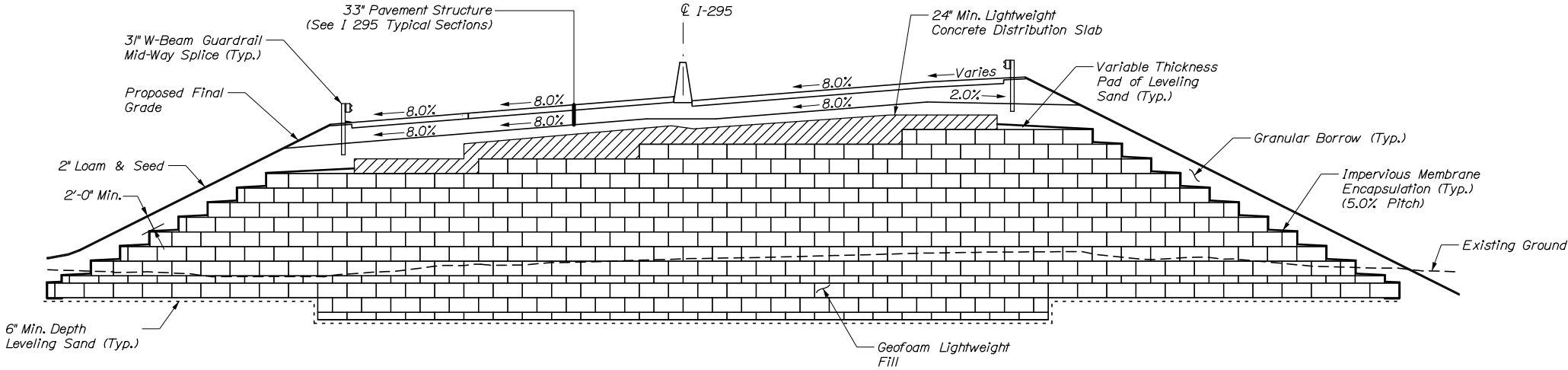
Date: 8/12/2019

Username:

Division:

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60% Plans  
August 23, 2019

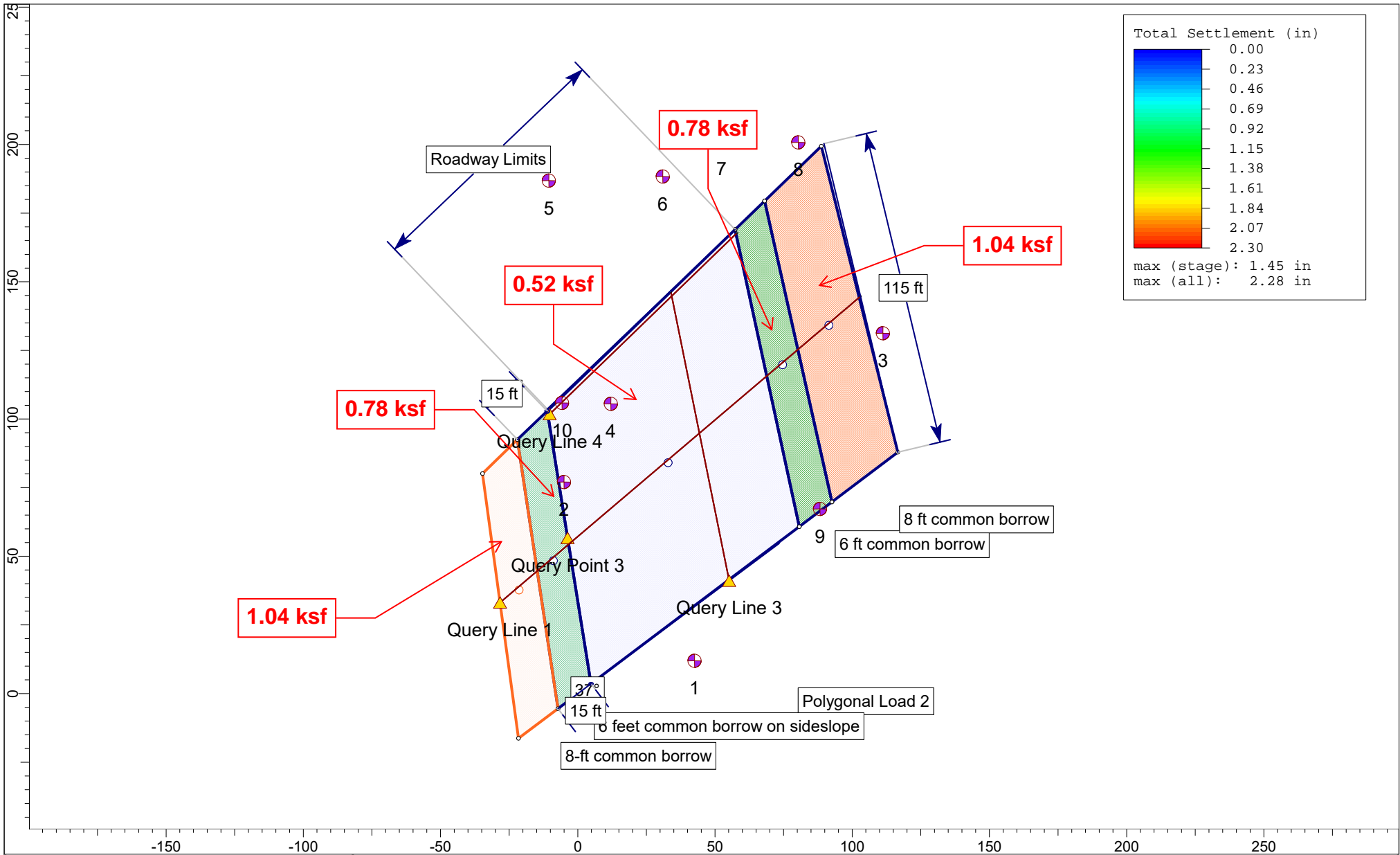


GEOFOAM TYPICAL SECTION

|                                    |  |                              |  |
|------------------------------------|--|------------------------------|--|
| STATE OF MAINE                     |  | DEPARTMENT OF TRANSPORTATION |  |
| PORTLAND                           |  | CUMBERLAND COUNTY            |  |
| INTERSTATE 295 OVER VERANDA STREET |  | GEOFOAM DETAILS              |  |
| SHEET NUMBER                       |  | XX                           |  |
| BRIDGE NO. 5933                    |  | WIN 021745.00                |  |
| BRIDGE PLANS                       |  | NHP-2174(500)                |  |
| PROJ. MANAGER                      |  | DATE                         |  |
| DESIGN-DETAILED                    |  | 08/18                        |  |
| CHECKED-REVIEWED                   |  | 08/18                        |  |
| DESIGN-DETAILED                    |  | SIGNATURE                    |  |
| REVISIONS 1                        |  | P.E. NUMBER                  |  |
| REVISIONS 2                        |  | DATE                         |  |
| REVISIONS 3                        |  |                              |  |
| REVISIONS 4                        |  |                              |  |
| FIELD CHANGES                      |  |                              |  |

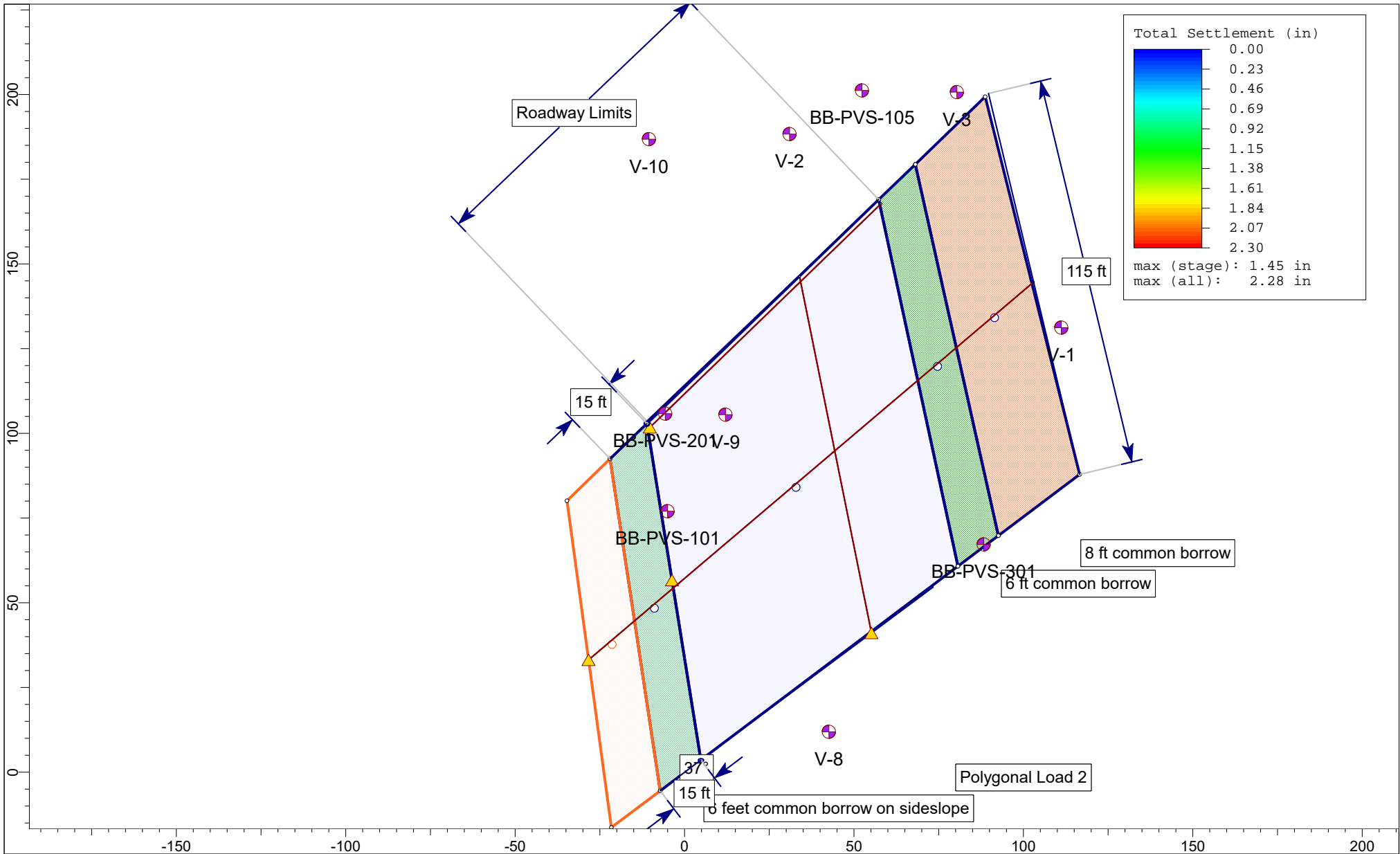






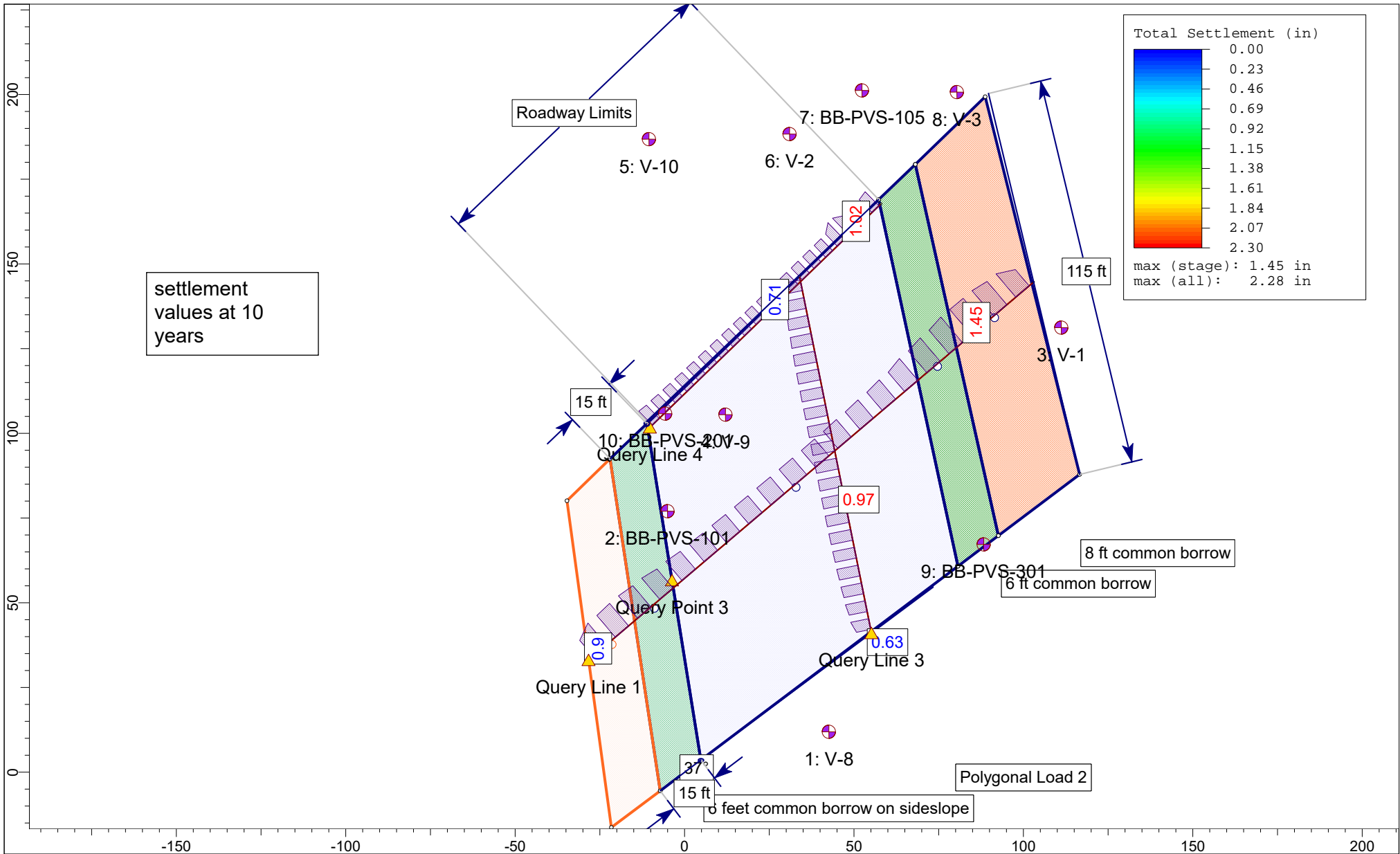
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|----------------------|--------------------------|-----------|-----------------------------|
| Project              | Veranda South Embankment |           |                             |
| Analysis Description | Net Pressure Test        |           |                             |
| Drawn By             | Joseph Zwetchkenbaum     | Company   | HNTB                        |
| Date                 | 8/22/18                  | File Name | Net pressure assessment.s3z |






SETTLE3D 4.019

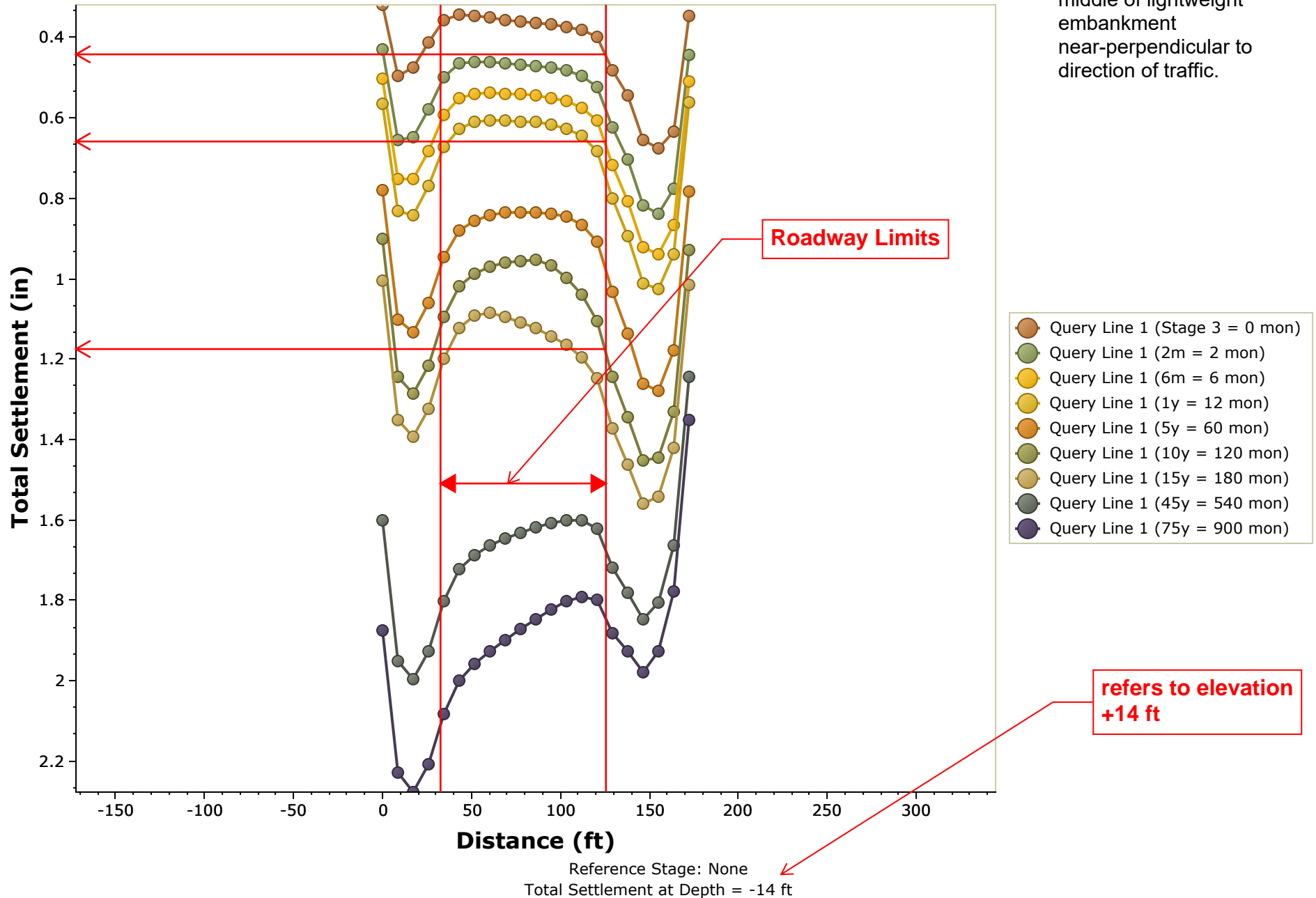
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|----------------------|--------------------------|-----------|-----------------------------|
| Project              | Veranda South Embankment |           |                             |
| Analysis Description | Net Pressure Test        |           |                             |
| Drawn By             | Joseph Zwetchkenbaum     | Company   | HNTB                        |
| Date                 | 8/22/18                  | File Name | Net pressure assessment.s3z |



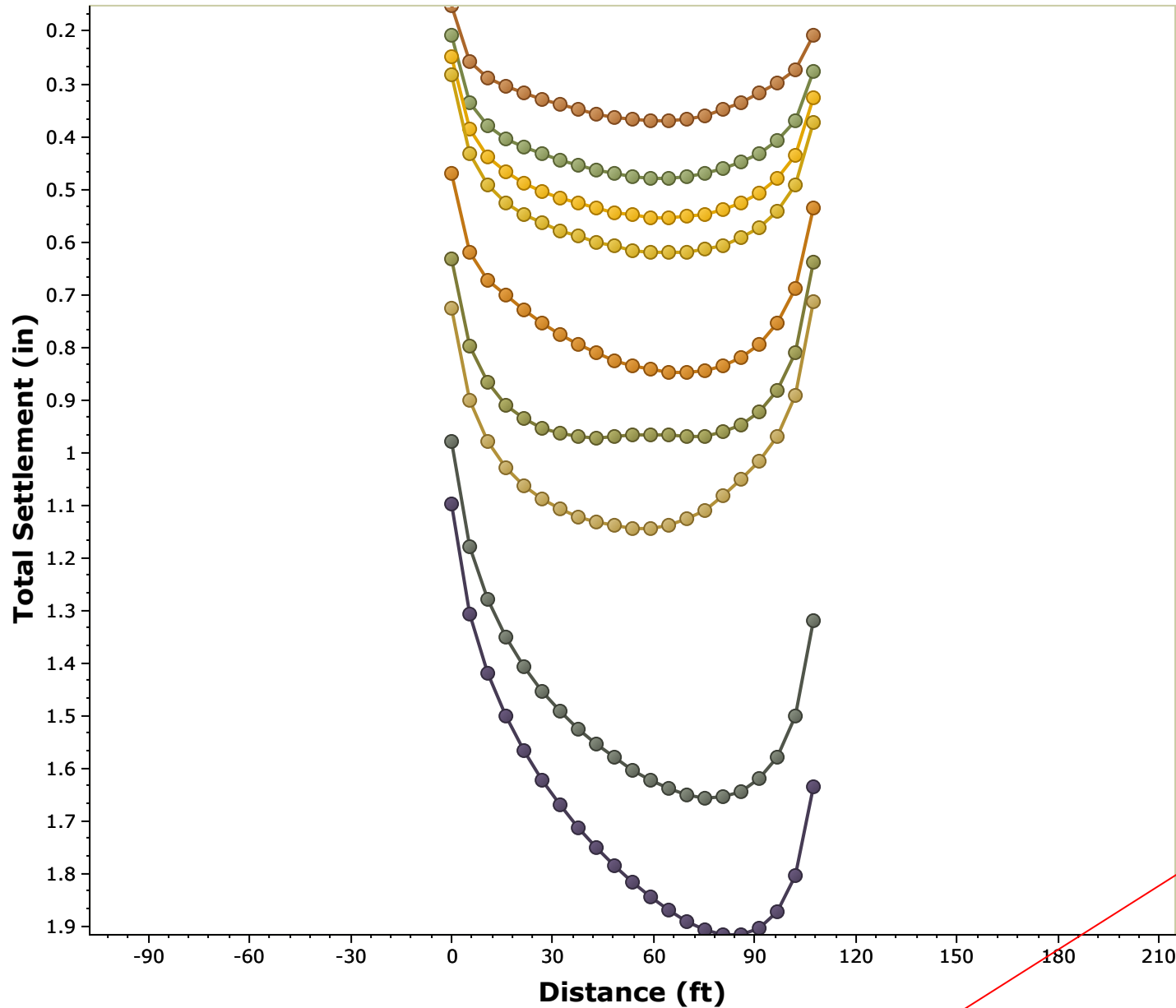
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|  | Project              |  | Veranda South Embankment |  |
|  | Analysis Description |  | Net Pressure Test        |  |
|  | Drawn By             |  | Joseph Zwetchkenbaum     | Company<br>HNTB                          |
|  | Date                 |  | 8/22/18                  | File Name<br>Net pressure assessment.s3z |

## VERANDA GRAPHS/RESULTS

## Distance vs. Total Settlement



## Distance vs. Total Settlement



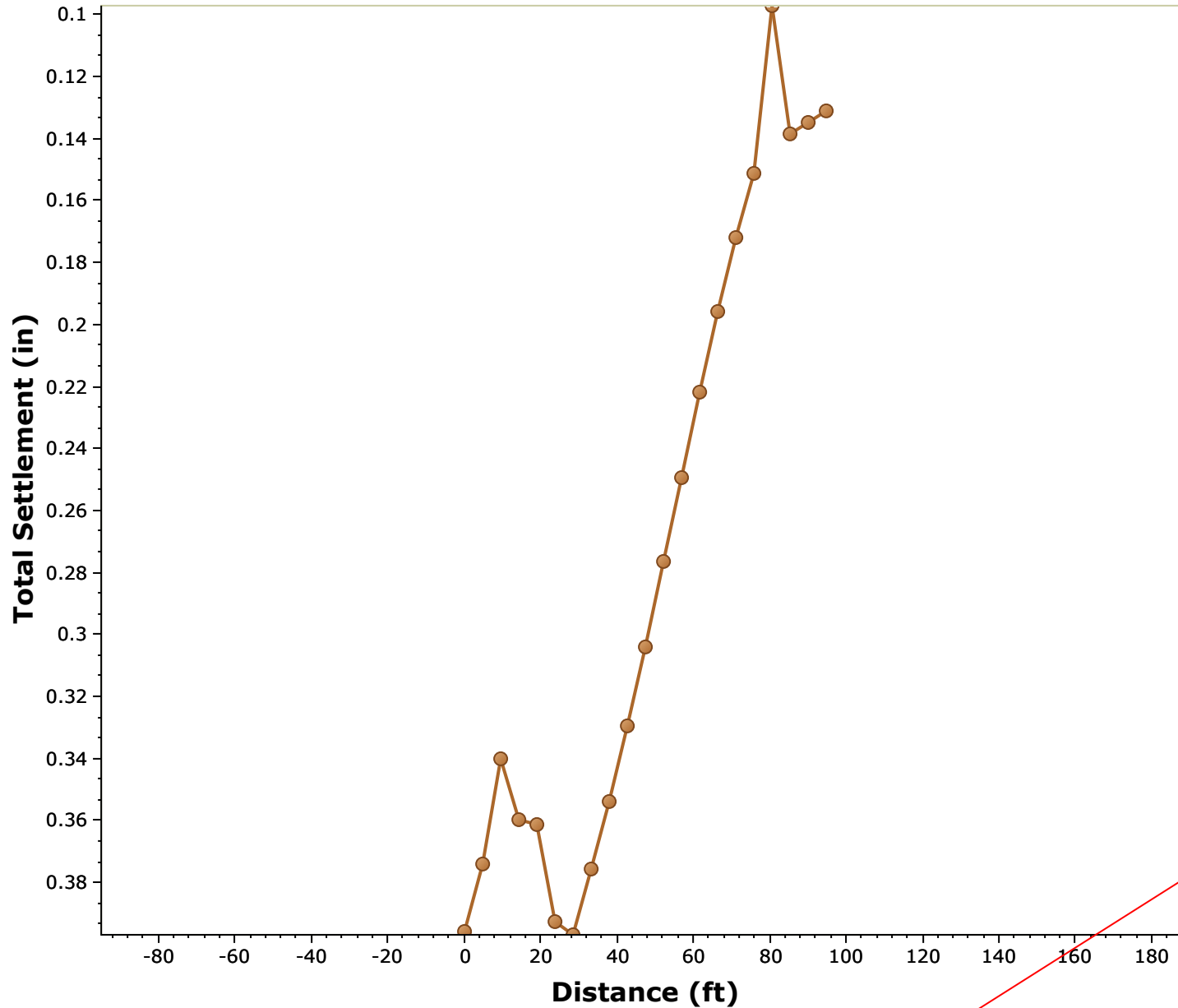
Query line runs through the middle of the proposed roadway in the direction of traffic.

- Query Line 3 (Stage 3 = 0 mon)
- Query Line 3 (2m = 2 mon)
- Query Line 3 (6m = 6 mon)
- Query Line 3 (1y = 12 mon)
- Query Line 3 (5y = 60 mon)
- Query Line 3 (10y = 120 mon)
- Query Line 3 (15y = 180 mon)
- Query Line 3 (45y = 540 mon)
- Query Line 3 (75y = 900 mon)

refers to elevation  
+14 ft

Reference Stage: None  
Total Settlement at Depth = -14 ft

## Distance vs. Total Settlement



Query line across north end of roadway, representative of pile cap conditions, taken at downdrag design depth.

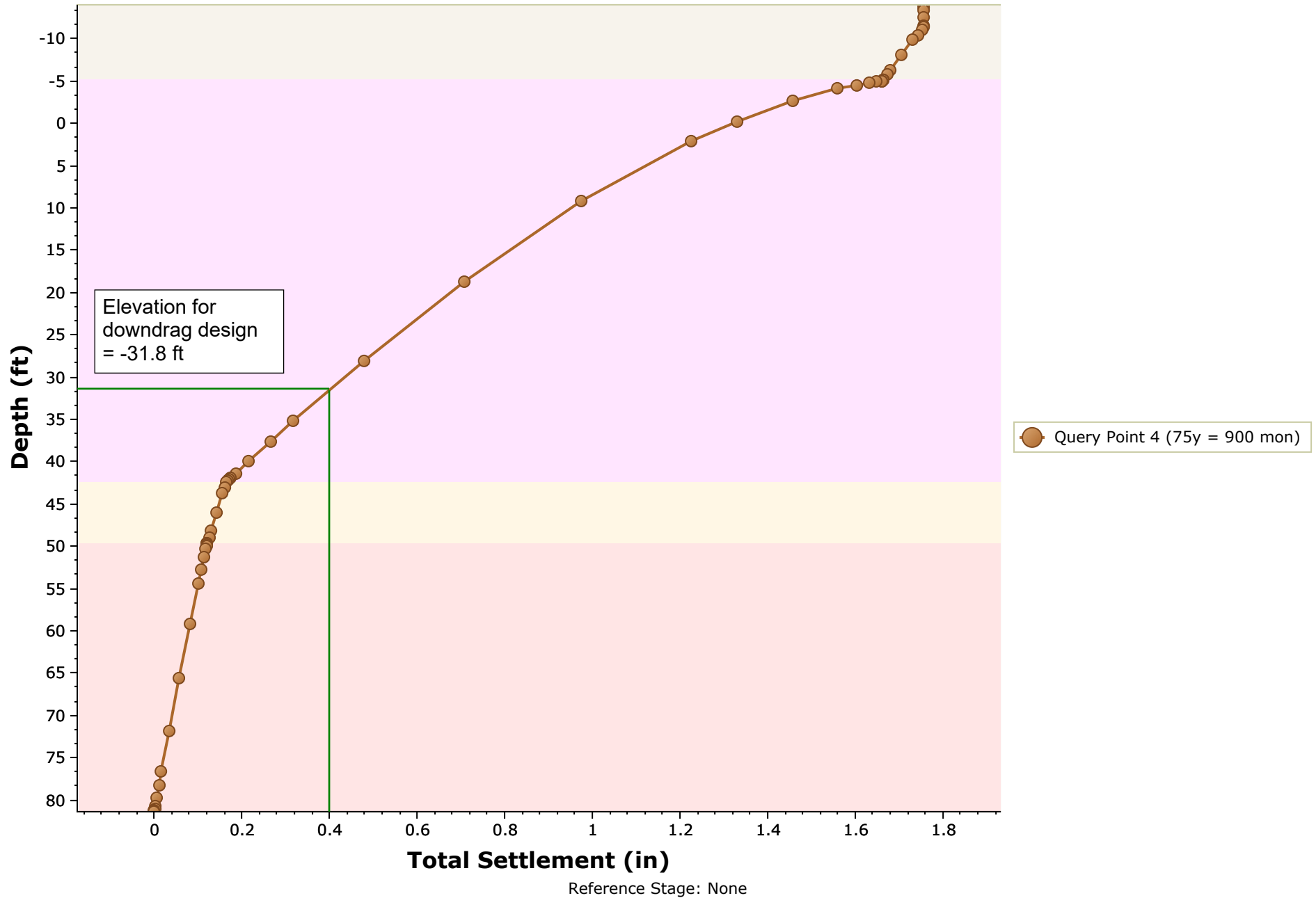
Query Line 4 (75y = 900 mon)

refers to elevation -31.8 ft

Reference Stage: None  
Total Settlement at Depth = 31.8 ft

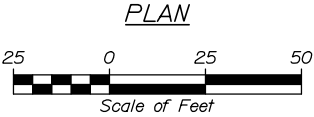
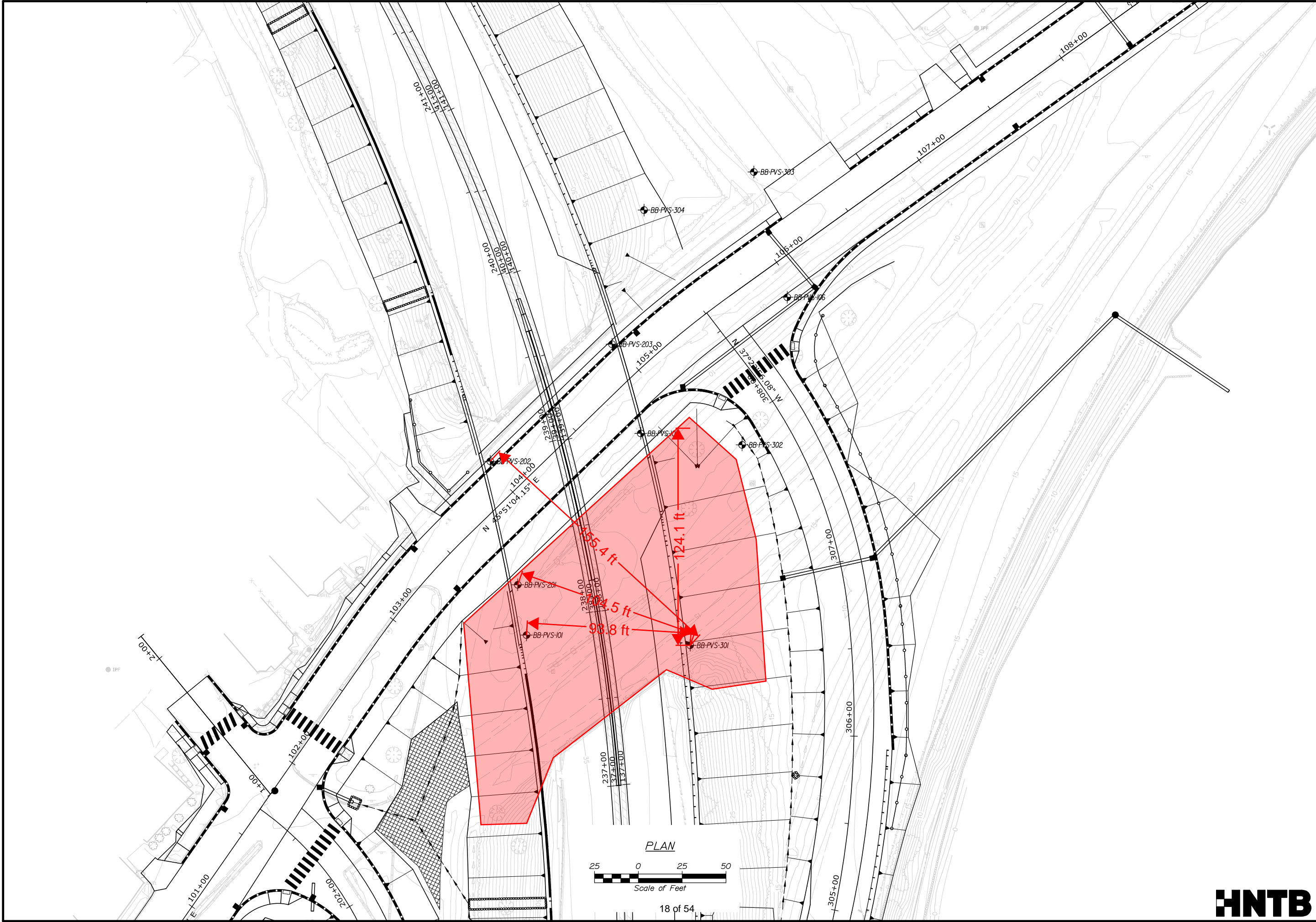


## Total Settlement vs. Depth



## VERANDA

### BORING AND CONSOLIDATION PARAMETER INFO



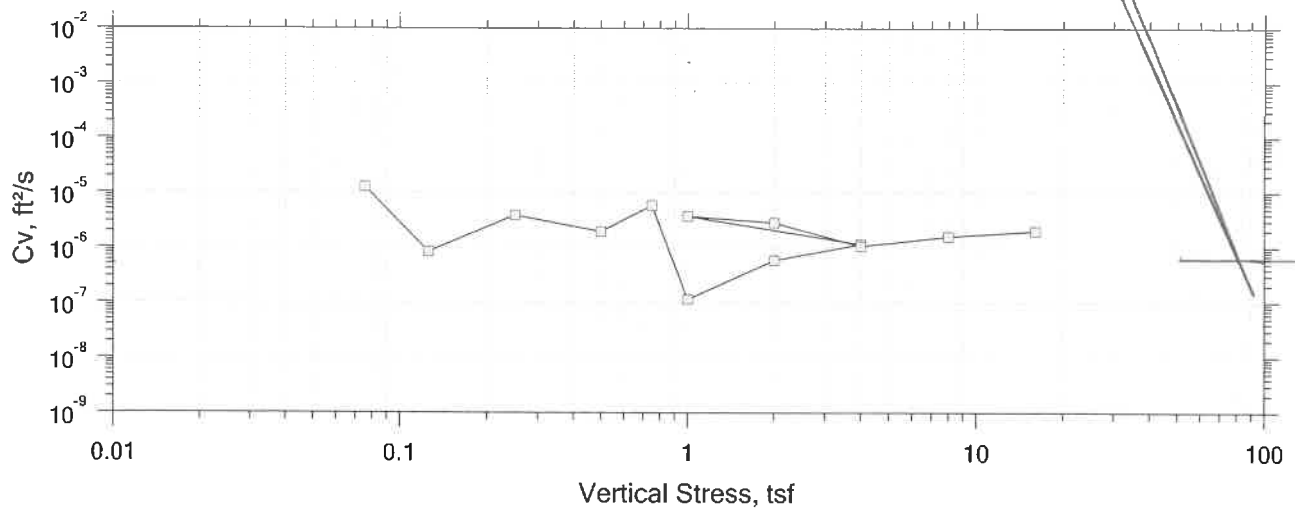
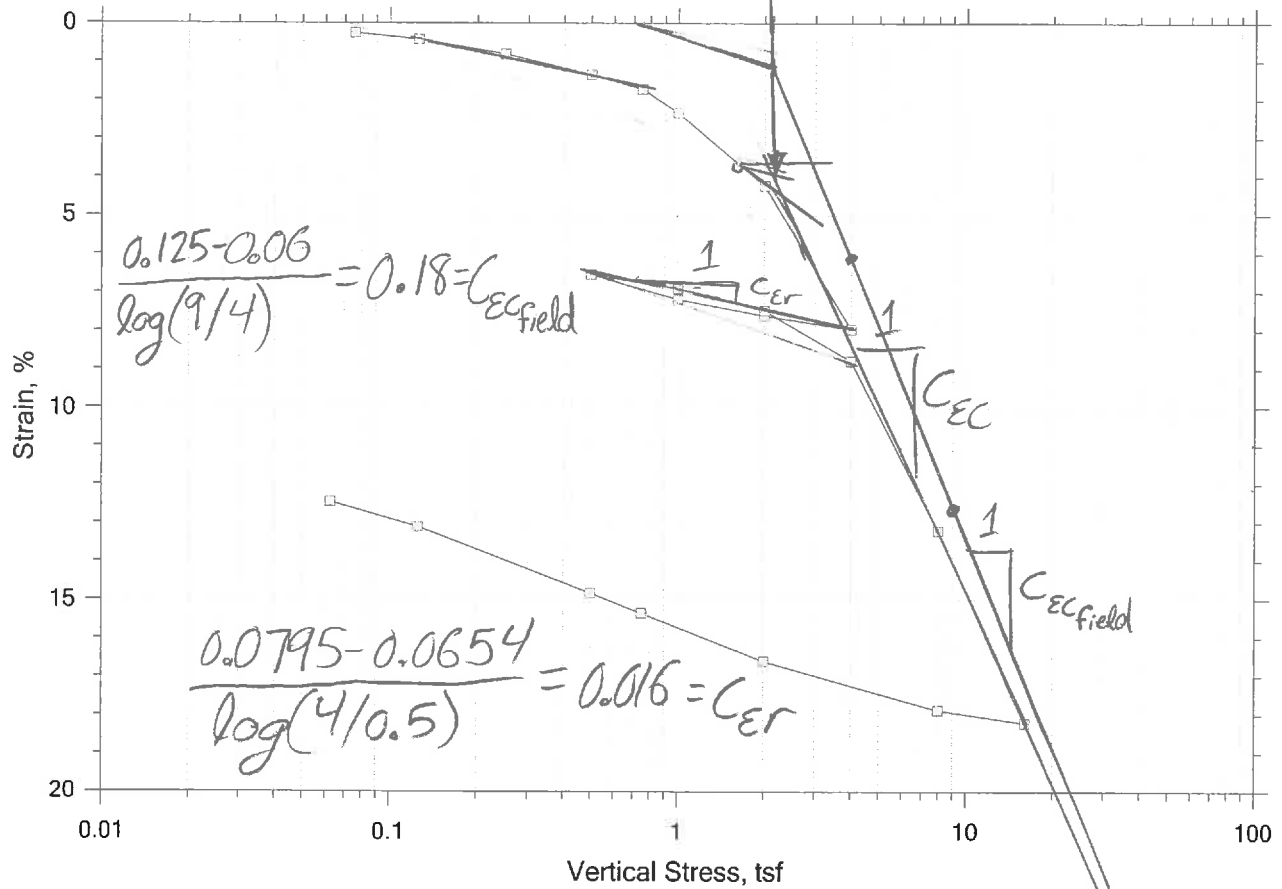
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|------------------------------------|--|---------------|--|
| STATE OF MAINE                     |  | DATE          |  |
| DEPARTMENT OF TRANSPORTATION       |  | 11/18         |  |
| NHP-2174(500)                      |  | SIGNATURE     |  |
| WIN                                |  | P.E. NUMBER   |  |
| BRIDGE NO.5933                     |  | DATE          |  |
| 021745.00                          |  | FIELD CHANGES |  |
| INTERSTATE 295 OVER VERANDA STREET |  | SHEET NUMBER  |  |
| CUMBERLAND COUNTY                  |  | 38            |  |
| BORING LOCATION PLAN               |  | OF 20         |  |

# One-Dimensional Consolidation by ASTM D2435 - Method B

Summary Report

$$\sigma'_{v0} = 1548 \text{ psf}$$

$$p_c \approx 2.05 \text{ tsf} = 4.1 \text{ tsf}$$




|                                  |  |                        |                         |
|----------------------------------|--|------------------------|-------------------------|
|                                  | Project: I-295 over Veranda St                 | Location: Portland, ME | Project No.: GTX-308805 |
|                                  | Boring No.: BB-PVS-105                         | Tested By: md          | Checked By: njh         |
|                                  | Sample No.: U1                                 | Test Date: 09/24/18    | Depth: 25-27 ft         |
|                                  | Test No.: IP-5                                 | Sample Type: intact    | Elevation: -16 ft       |
|                                  | Description: Moist, dark gray clay             |                        | Soft to Medium stiff    |
|                                  | Remarks: System O, Swell Pressure = 0.0757 tsf |                        | stiff                   |
| Displacement at End of Increment |  |                        |                         |

# One-Dimensional Consolidation by ASTM D2435 - Method B

|                            |                                  |                      |
|----------------------------|----------------------------------|----------------------|
| Specimen Diameter: 2.50 in | Estimated Specific Gravity: 2.74 | Liquid Limit: 41     |
| Initial Height: 1.00 in    | Initial Void Ratio: 1.06         | Plastic Limit: 25    |
| Final Height: 0.90 in      | Final Void Ratio: 0.857          | Plasticity Index: 16 |

|                               | Before Test<br>Trimblings | Before Test<br>Specimen | After Test<br>Specimen | After Test<br>Trimblings |
|-------------------------------|---------------------------|-------------------------|------------------------|--------------------------|
| Container ID                  | B-2013                    | RING                    |                        | B2085                    |
| Mass Container, gm            | 8.32                      | 110.51                  | 110.51                 | 8.45                     |
| Mass Container + Wet Soil, gm | 154.88                    | 258.44                  | 250.93                 | 146.92                   |
| Mass Container + Dry Soil, gm | 112.49                    | 217.53                  | 217.53                 | 113.98                   |
| Mass Dry Soil, gm             | 104.17                    | 107.02                  | 107.02                 | 105.53                   |
| Water Content, %              | 40.69                     | 38.23                   | 31.21                  | 31.21                    |
| Void Ratio                    | ---                       | 1.06                    | 0.86                   | ---                      |
| Degree of Saturation, %       | ---                       | 98.71                   | 100.00                 | ---                      |
| Dry Unit Weight, pcf          | ---                       | 83.053                  | 92.282                 | ---                      |

Note: Specific Gravity and Void Ratios are calculated assuming the degree of saturation equals 100% at the end of the test.  
Therefore, values may not represent actual values for the specimen.

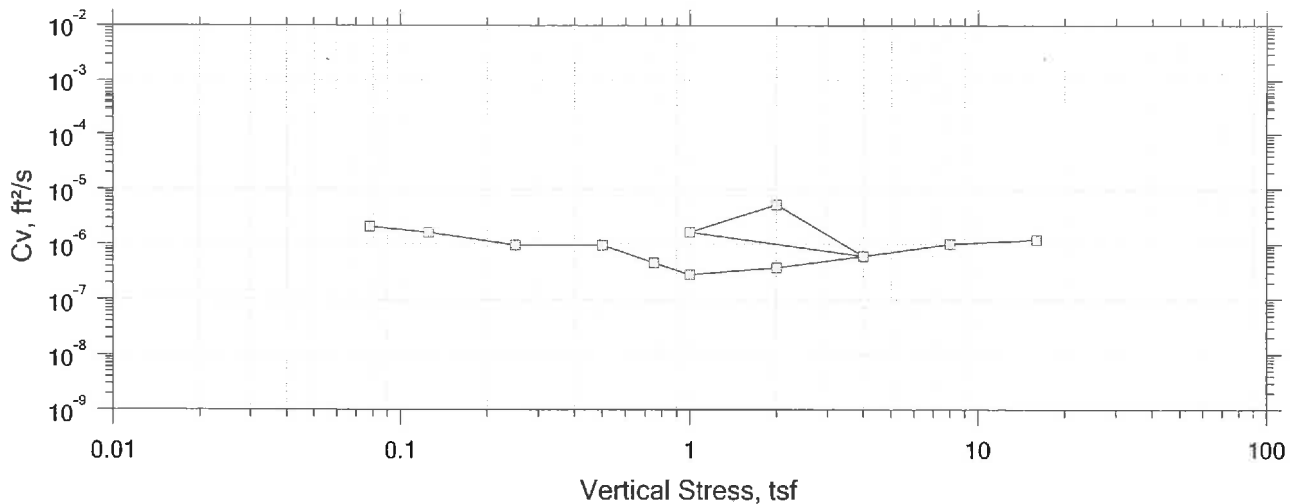
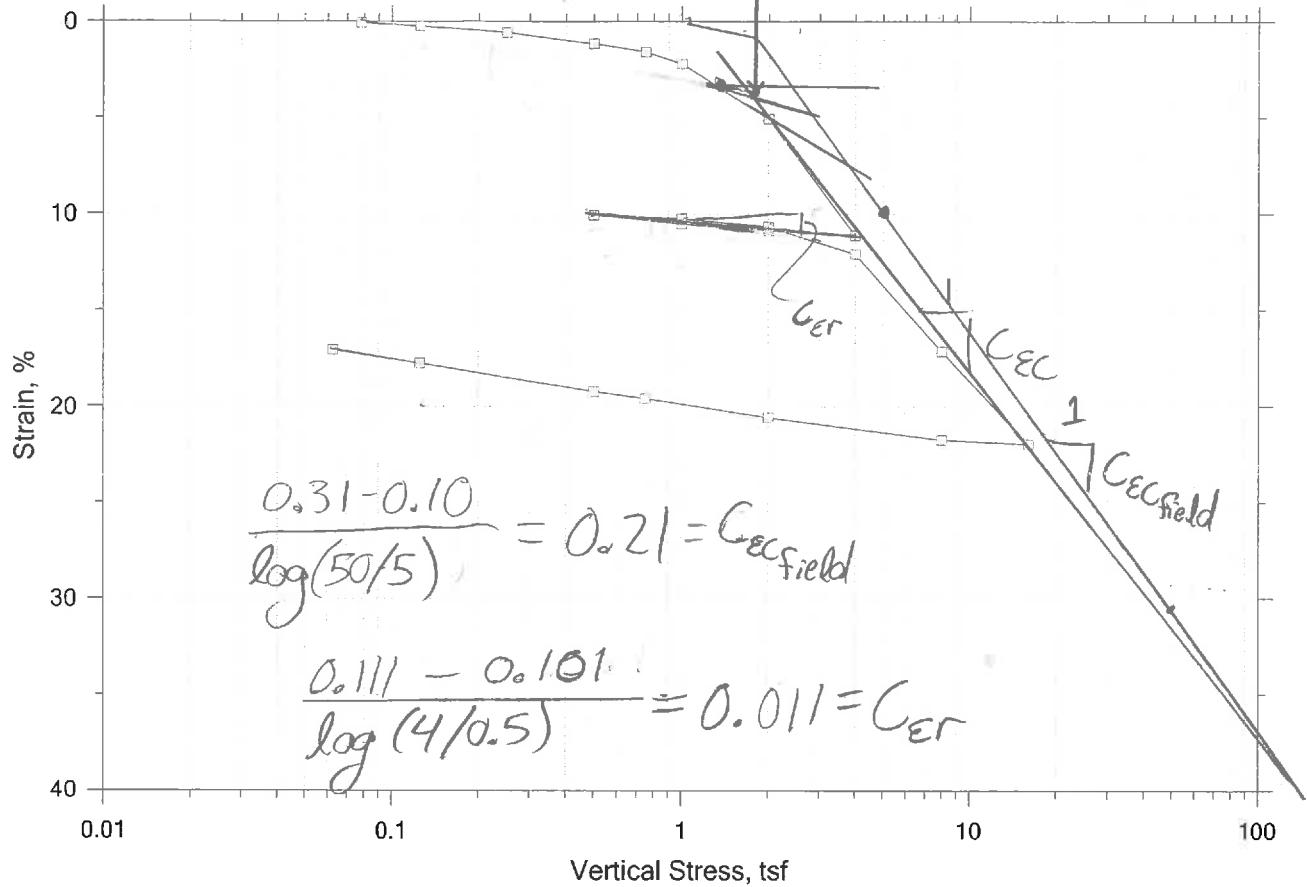
|   |  |                        |                         |
|---|--|------------------------|-------------------------|
|  | Project: I-295 over Veranda St                 | Location: Portland, ME | Project No.: GTX-308805 |
|   | Boring No.: BB-PVS-105                         | Tested By: md          | Checked By: njh         |
|   | Sample No.: U1                                 | Test Date: 09/24/18    | Depth: 25-27 ft         |
|   | Test No.: IP-5                                 | Sample Type: intact    | Elevation: ---          |
|   | Description: Moist, dark gray clay             |                        |                         |
|   | Remarks: System O, Swell Pressure = 0.0757 tsf |                        |                         |

# One-Dimensional Consolidation by ASTM D2435 - Method B

Summary Report

$$\sigma'_{v6} = 2187 \text{ psf}$$

$$P_c = 1.9 \text{ tsf} = 3.8 \text{ ksf}$$



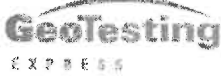
|  |  |                        |                           |
|--|--|------------------------|---------------------------|
|  | Project: I-295 over Veranda St                 | Location: Portland, ME | Project No.: GTX-308805   |
|  | Boring No.: BB-PVS-101                         | Tested By: md          | Checked By: njh           |
|  | Sample No.: U2                                 | Test Date: 09/24/18    | Depth: 35-37 ft           |
|  | Test No.: IP-6                                 | Sample Type: intact    | Elevation: <i>24.5 ft</i> |
|  | Description: Moist, dark gray clay             |                        | <i>Stiff Silt</i>         |
|  | Remarks: System K, Swell Pressure = 0.0782 tsf |                        |                           |
|  | Displacement at End of Increment               |                        |                           |

# One-Dimensional Consolidation by ASTM D2435 - Method B

|                            |                                  |                      |
|----------------------------|----------------------------------|----------------------|
| Specimen Diameter: 2.50 in | Estimated Specific Gravity: 2.75 | Liquid Limit: 40     |
| Initial Height: 1.00 in    | Initial Void Ratio: 1.08         | Plastic Limit: 20    |
| Final Height: 0.86 in      | Final Void Ratio: 0.793          | Plasticity Index: 20 |

|                               | Before Test<br>Trimblings | Before Test<br>Specimen | After Test<br>Specimen | After Test<br>Trimblings |
|-------------------------------|---------------------------|-------------------------|------------------------|--------------------------|
| Container ID                  | D-1245                    | RING                    |                        | C590                     |
| Mass Container, gm            | 8.68                      | 108.94                  | 108.94                 | 8.9                      |
| Mass Container + Wet Soil, gm | 140.35                    | 256.86                  | 245.62                 | 144.76                   |
| Mass Container + Dry Soil, gm | 103.11                    | 215.03                  | 215.03                 | 114.35                   |
| Mass Dry Soil, gm             | 94.43                     | 106.09                  | 106.09                 | 105.45                   |
| Water Content, %              | 39.44                     | 39.43                   | 28.84                  | 28.84                    |
| Void Ratio                    | ---                       | 1.08                    | 0.79                   | ---                      |
| Degree of Saturation, %       | ---                       | 99.95                   | 100.00                 | ---                      |
| Dry Unit Weight, pcf          | ---                       | 82.332                  | 95.735                 | ---                      |

Note: Specific Gravity and Void Ratios are calculated assuming the degree of saturation equals 100% at the end of the test. Therefore, values may not represent actual values for the specimen.

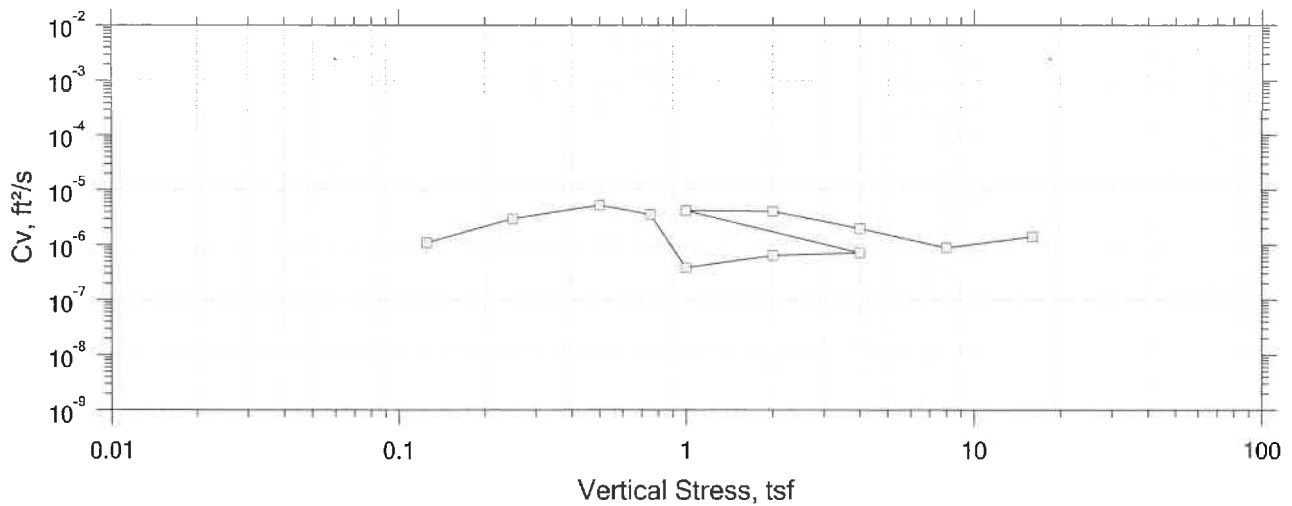
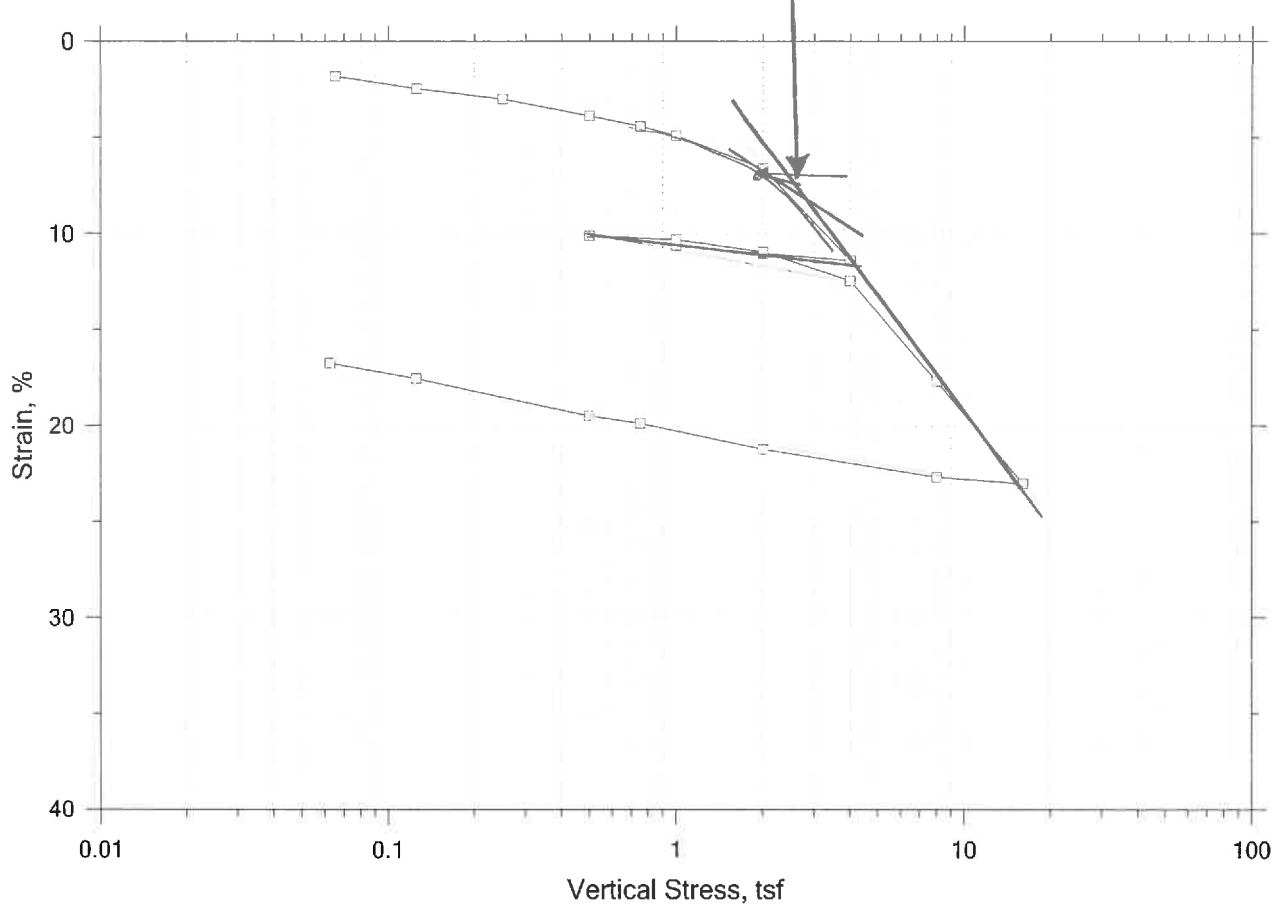
|   |  |                        |                         |
|---|--|------------------------|-------------------------|
|  | Project: I-295 over Veranda St                 | Location: Portland, ME | Project No.: GTX-308805 |
|   | Boring No.: BB-PVS-101                         | Tested By: md          | Checked By: njh         |
|   | Sample No.: U2                                 | Test Date: 09/24/18    | Depth: 35-37 ft         |
|   | Test No.: IP-6                                 | Sample Type: intact    | Elevation: ---          |
|   | Description: Moist, dark gray clay             |                        |                         |
|   | Remarks: System K, Swell Pressure = 0.0782 tsf |                        |                         |


# One-Dimensional Consolidation by ASTM D2435 - Method B

Summary Report

$$\sigma'_{v0} = 1640 \text{ psf}$$

$$P_c = 2.5 \text{ tsf} \approx 5 \text{ ksf}$$



|   |  |                        |                         |
|---|--|------------------------|-------------------------|
|  | Project: I-295 over Veranda St                 | Location: Portland, ME | Project No.: GTX-308805 |
|   | Boring No.: BB-PVS-201                         | Tested By: md          | Checked By: njh         |
|   | Sample No.: U1                                 | Test Date: 09/20/18    | Depth: 25-27 ft         |
|   | Test No.: IP-1                                 | Sample Type: intact    | Elevation: ---          |
|   | Description: Moist, olive gray clay            | <i>Soft to Medium</i>  |                         |
|   | Remarks: System S, Swell Pressure = 0.0652 tsf |                        |                         |
| Displacement at End of Increment  |  | 23 of 54               | 338                     |

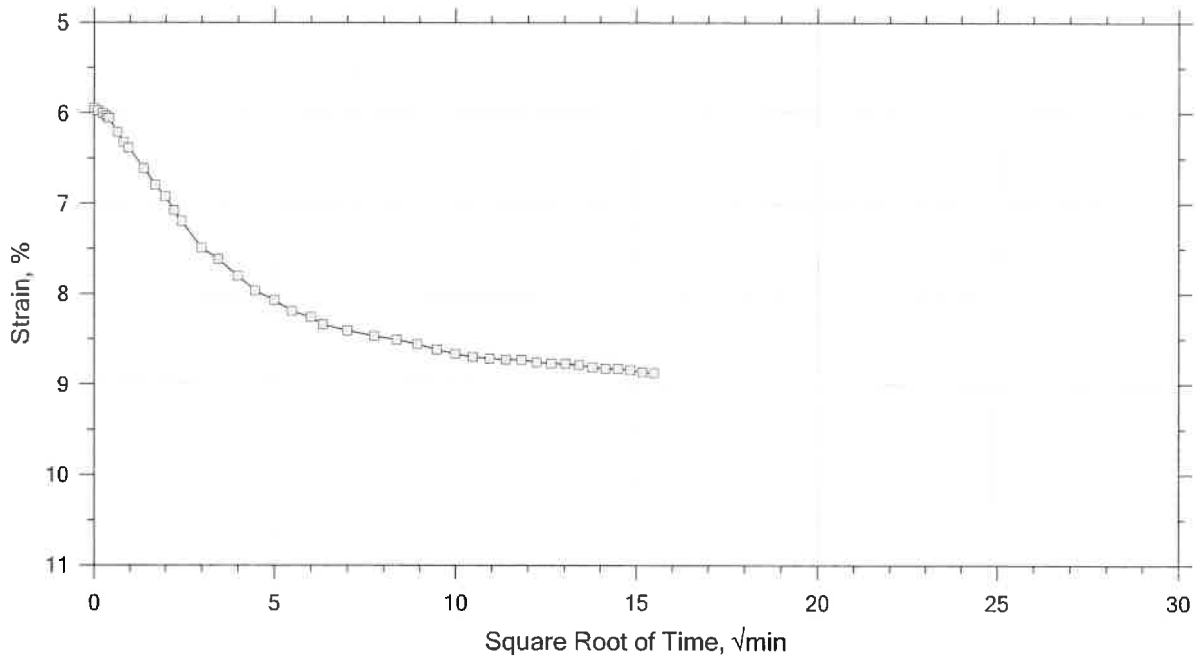
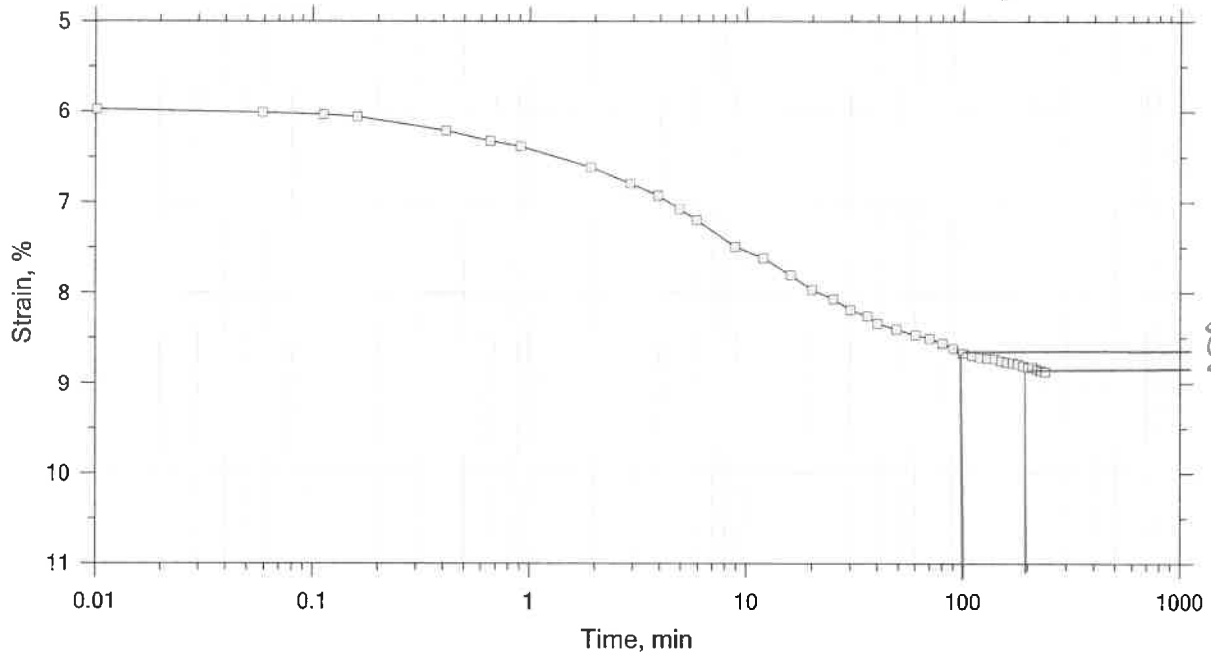


Secondary  
in virgin compression,

# One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 8 of 22  
Constant Load Step  
Stress: 4 tsf

$$\frac{0.088 - 0.086}{\log(200/100)} = 0.007$$



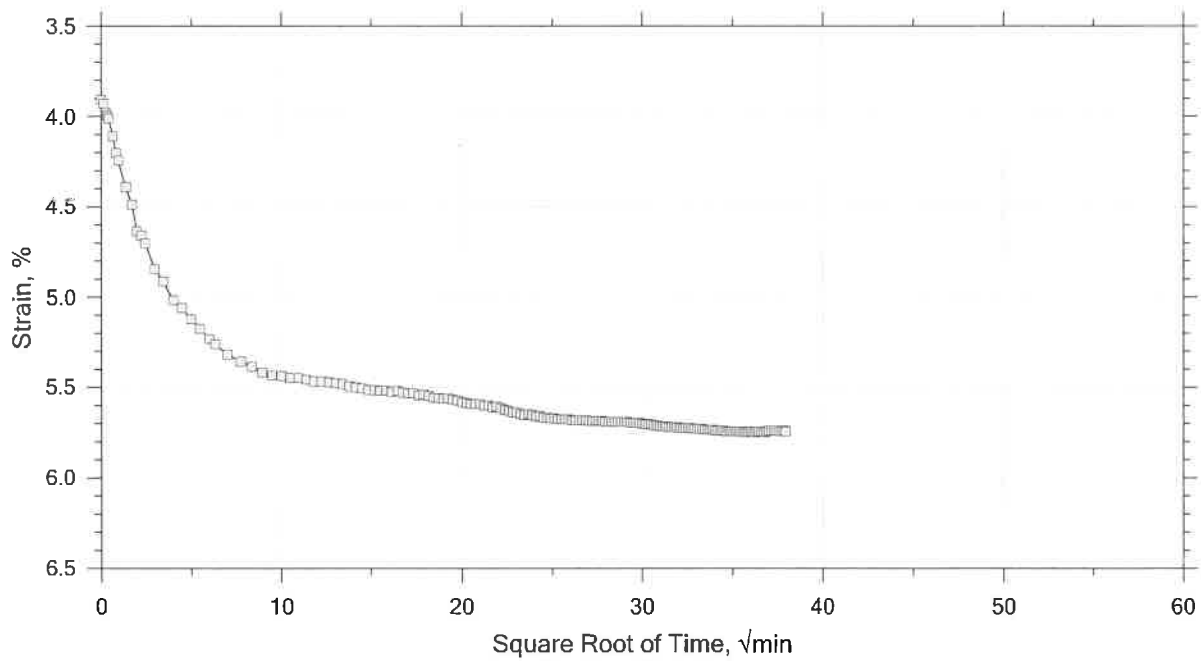
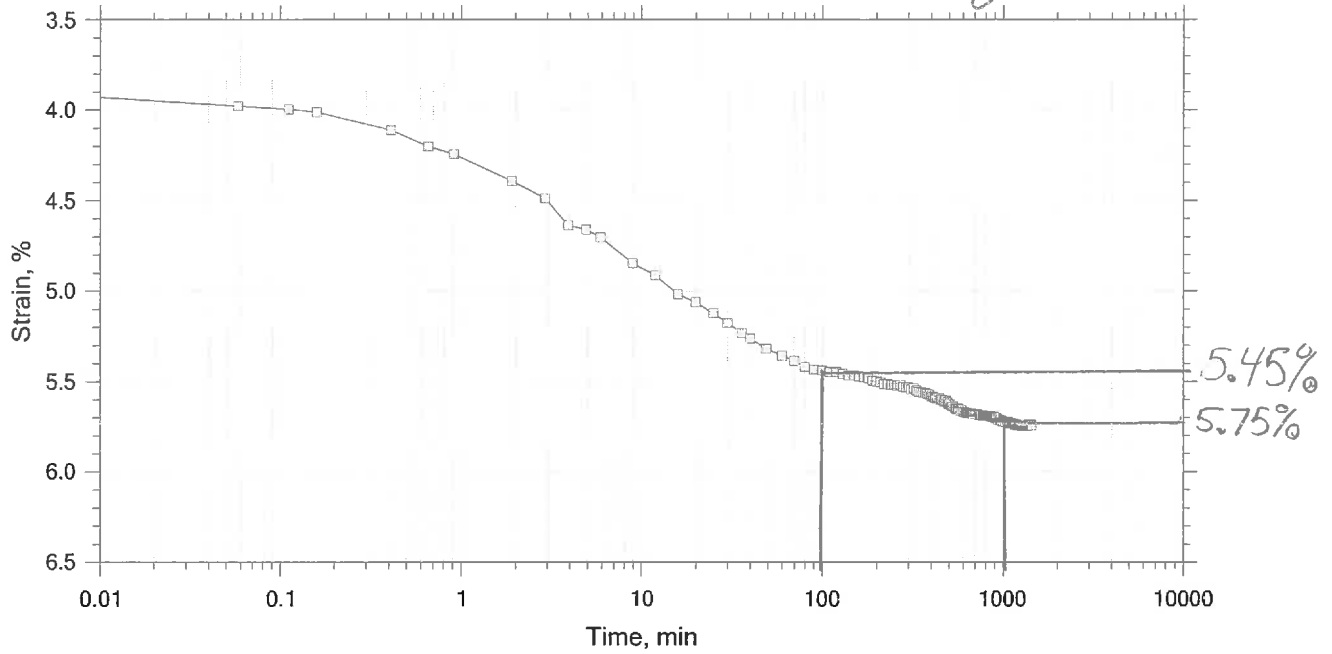
|  |  |                        |                         |
|--|--|------------------------|-------------------------|
|  | Project: I-295 over Veranda St                 | Location: Portland, ME | Project No.: GTX-308805 |
|  | Boring No.: BB-PVS-201                         | Tested By: md          | Checked By: njh         |
|  | Sample No.: U3                                 | Test Date: 09/21/18    | Depth: 45-47 ft         |
|  | Test No.: IP-3                                 | Sample Type: intact    | Elevation: ---          |
|  | Description: Moist, dark gray clay             |                        |                         |
|  | Remarks: System E, Swell Pressure = 0.0668 tsf |                        |                         |


# One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 7 of 22  
Constant Load Step  
Stress: 2 tsf

Secondary in recompression

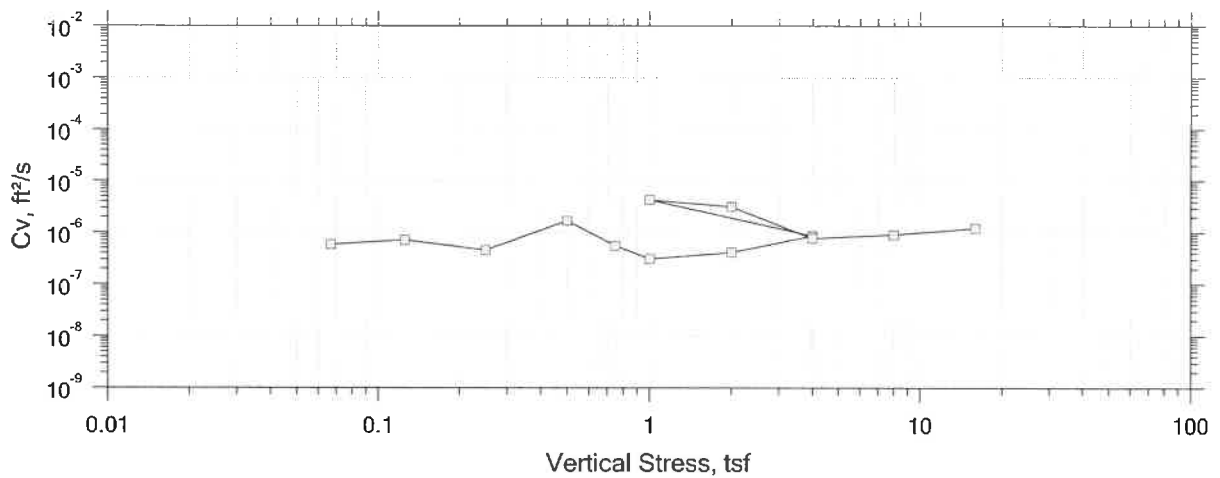
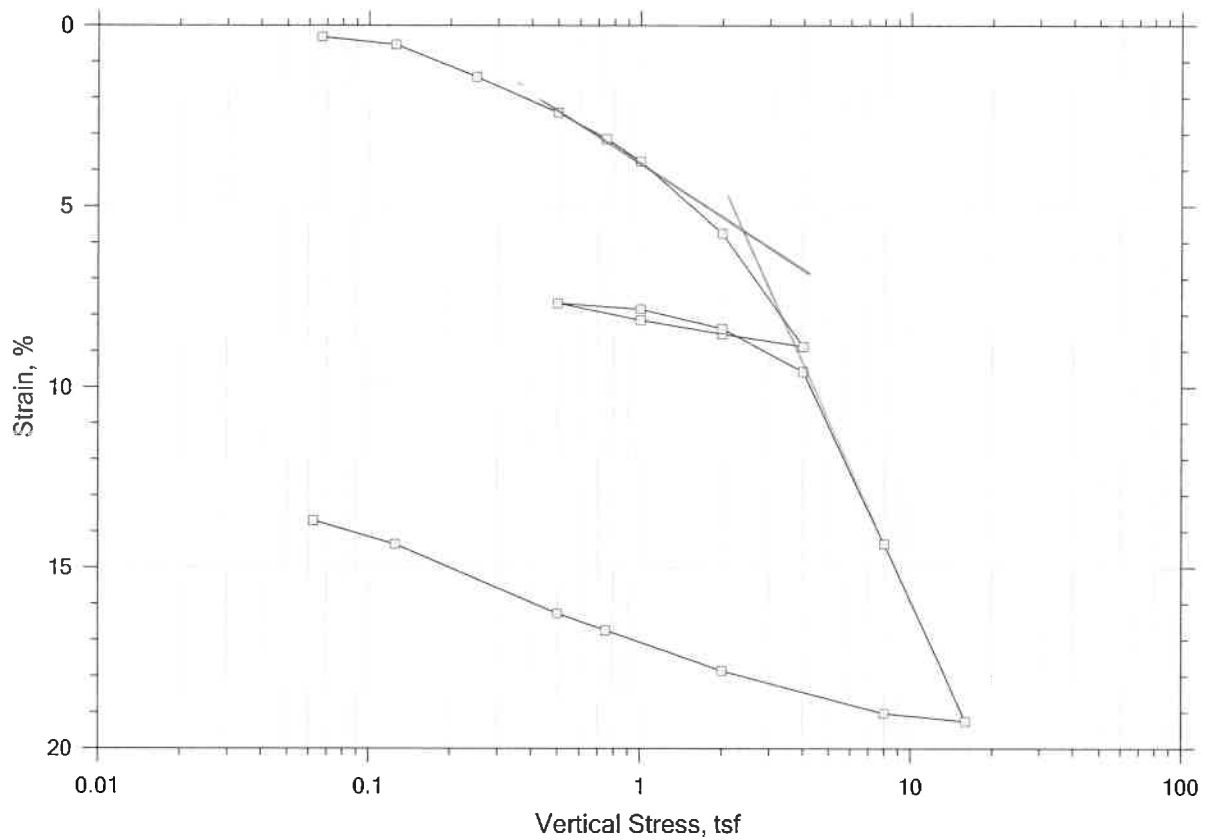
$$\frac{0.0575 - 0.0545}{\log(1000/100)} = 0.003$$




|   |  |                        |                         |
|---|--|------------------------|-------------------------|
|  | Project: I-295 over Veranda St                 | Location: Portland, ME | Project No.: GTX-308805 |
|   | Boring No.: BB-PVS-201                         | Tested By: md          | Checked By: njh         |
|   | Sample No.: U3                                 | Test Date: 09/21/18    | Depth: 45-47 ft         |
|   | Test No.: IP-3                                 | Sample Type: intact    | Elevation: ---          |
|   | Description: Moist, dark gray clay             |                        |                         |
|   | Remarks: System E, Swell Pressure = 0.0668 tsf |                        |                         |

# One-Dimensional Consolidation by ASTM D2435 - Method B

## Summary Report



|   |  |                        |                         |
|---|--|------------------------|-------------------------|
|  | Project: I-295 over Veranda St                 | Location: Portland, ME | Project No.: GTX-308805 |
|   | Boring No.: BB-PVS-201                         | Tested By: md          | Checked By: njh         |
|   | Sample No.: U3                                 | Test Date: 09/21/18    | Depth: 45-47 ft         |
|   | Test No.: IP-3                                 | Sample Type: intact    | Elevation: ---          |
|   | Description: Moist, dark gray clay             |                        |                         |
|   | Remarks: System E, Swell Pressure = 0.0668 tsf |                        |                         |
| Displacement at End of Increment  |  |                        |                         |

secondary - virgin  
compression

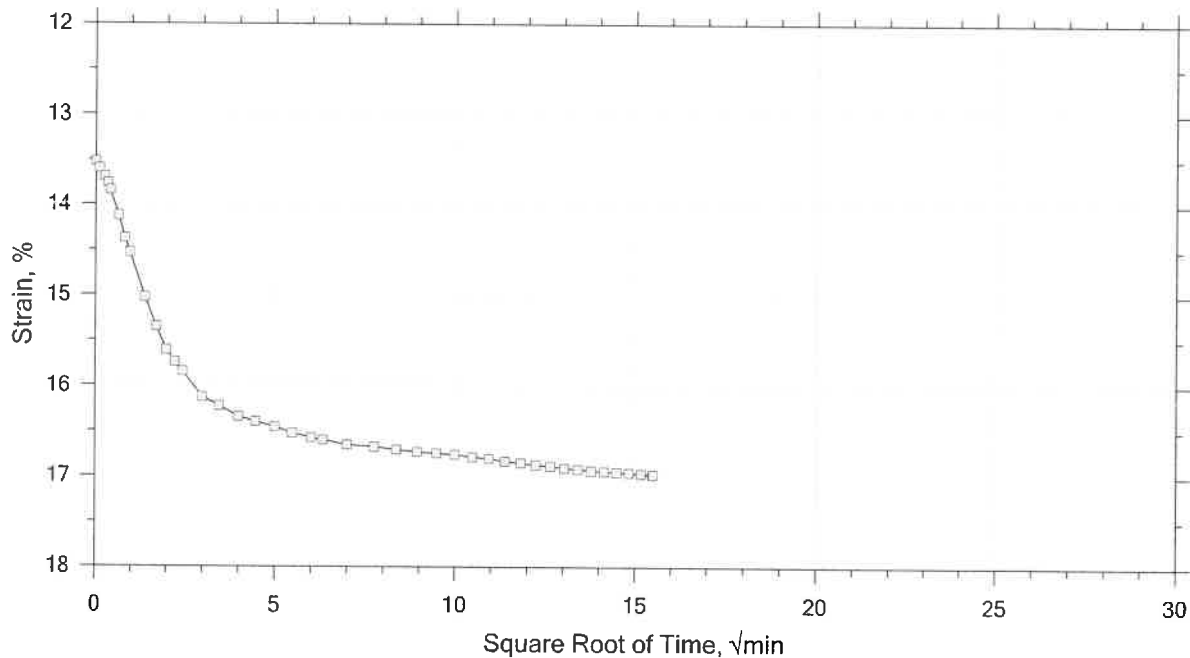
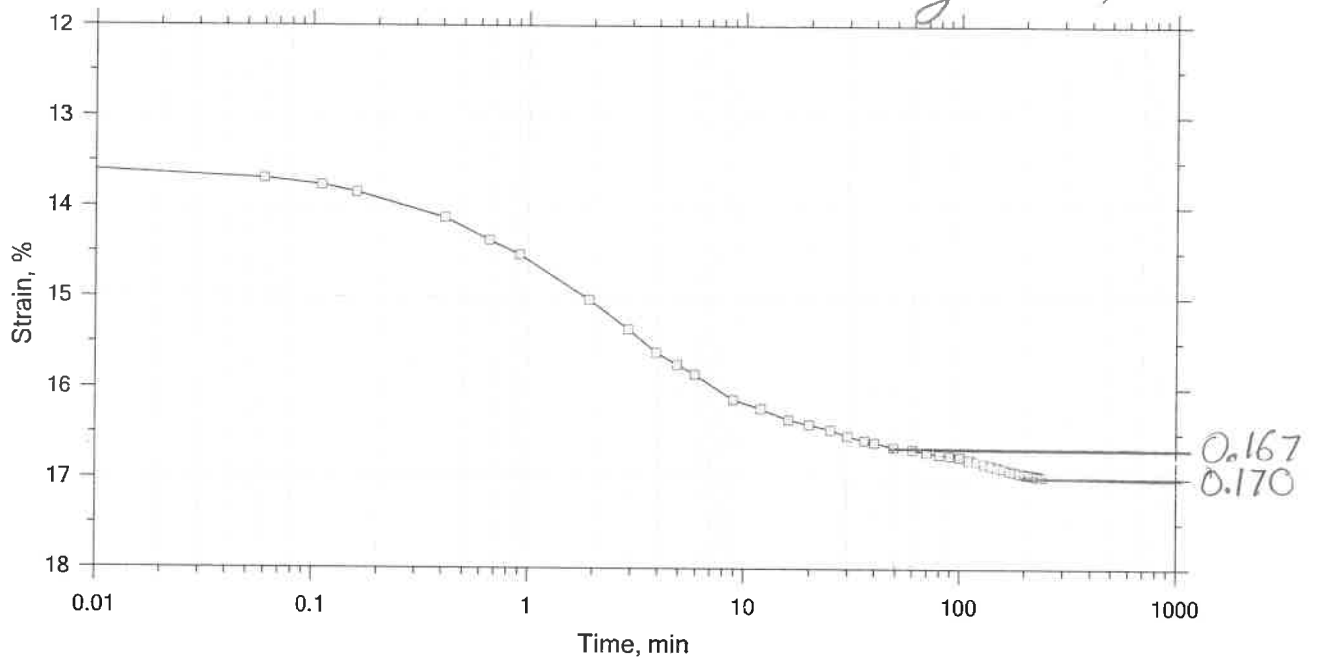
# One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 16 of 22

Constant Load Step

Stress: 16 tsf

$$\frac{0.170 - 0.167}{\log(200/50)} = 0.005$$

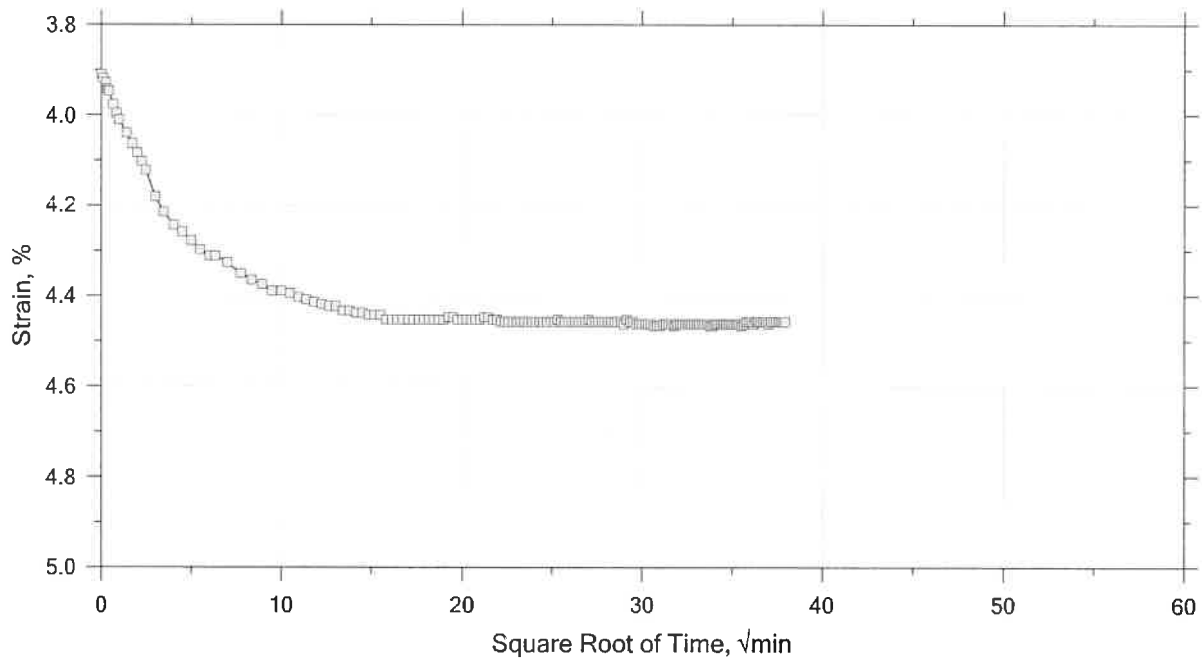
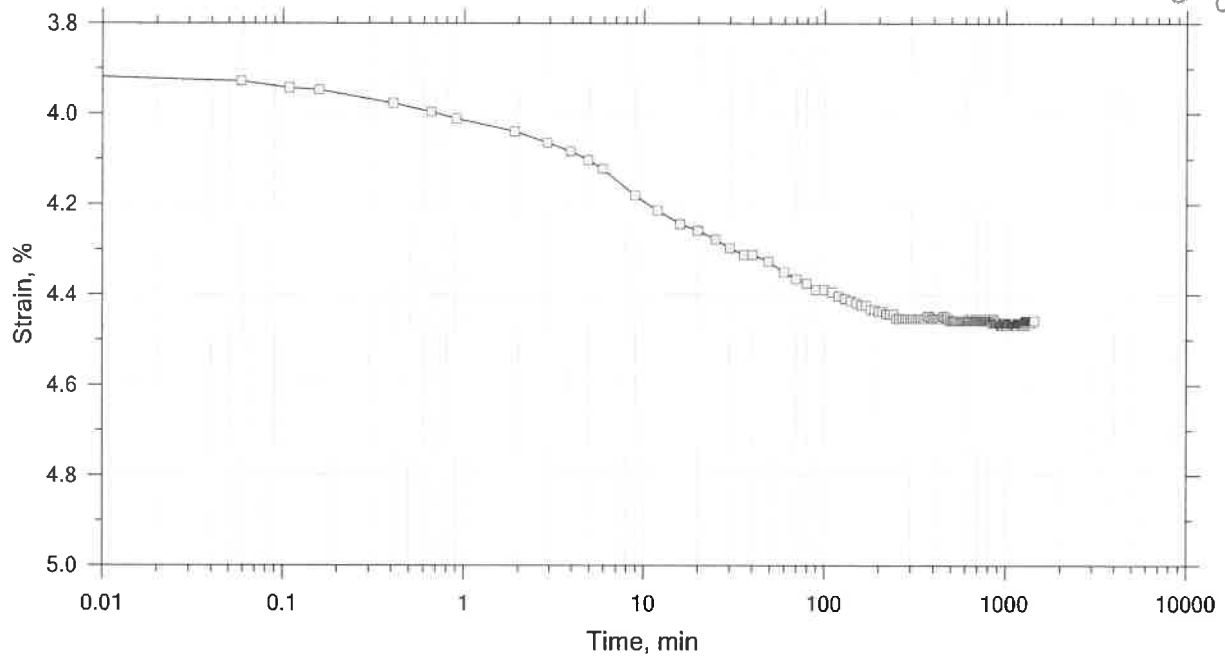



|  |   |                        |                         |
|--|---|------------------------|-------------------------|
|  | Project: I-295 over Veranda St                  | Location: Portland, ME | Project No.: GTX-308805 |
|  | Boring No.: BB-PVS-201                          | Tested By: md          | Checked By: njh         |
|  | Sample No.: U4                                  | Test Date: 09/21/18    | Depth: 55-57 ft         |
|  | Test No.: IP-4                                  | Sample Type: intact    | Elevation: ---          |
|  | Description: Moist, dark gray clay              |                        |                         |
|  | Remarks: System JJ, Swell Pressure = 0.0668 tsf |                        |                         |

# One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 6 of 22  
Constant Load Step  
Stress: 1 tsf

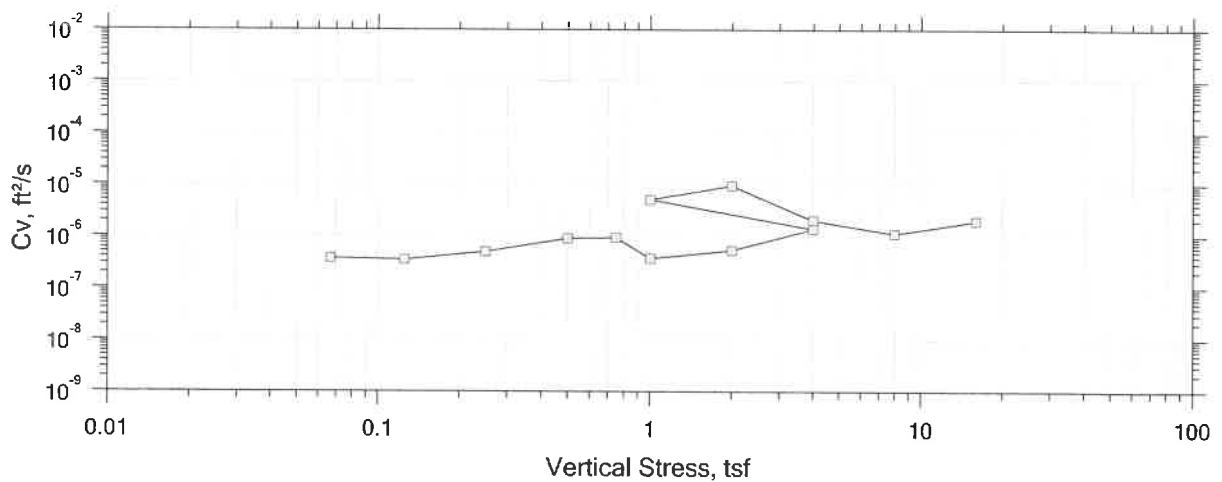
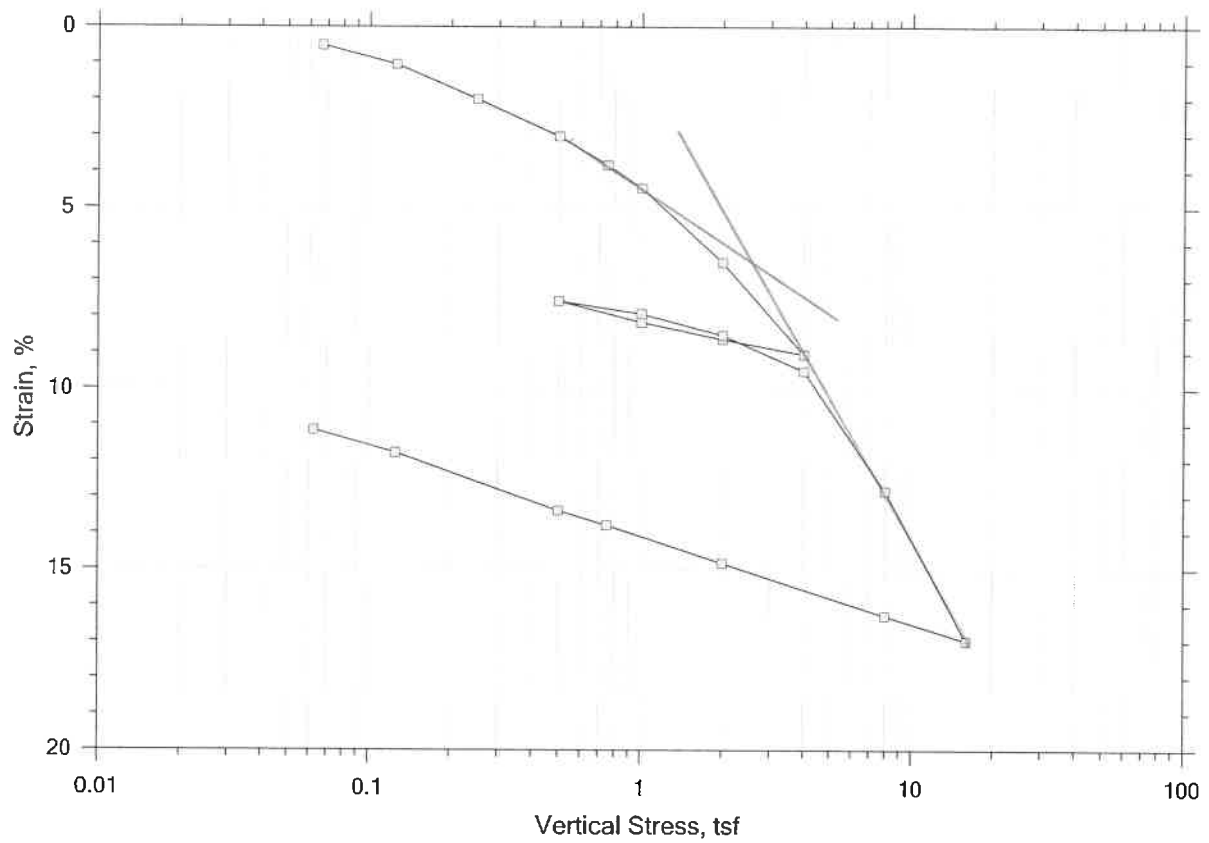
*Recompression  
Secondary negligible*




|   |   |                        |                         |
|---|---|------------------------|-------------------------|
|  | Project: I-295 over Veranda St                  | Location: Portland, ME | Project No.: GTX-308805 |
|   | Boring No.: BB-PVS-201                          | Tested By: md          | Checked By: njh         |
|   | Sample No.: U4                                  | Test Date: 09/21/18    | Depth: 55-57 ft         |
|   | Test No.: IP-4                                  | Sample Type: intact    | Elevation: ---          |
|   | Description: Moist, dark gray clay              |                        |                         |
|   | Remarks: System JJ, Swell Pressure = 0.0668 tsf |                        |                         |

# One-Dimensional Consolidation by ASTM D2435 - Method B

## Summary Report



|   |   |                        |                         |
|---|---|------------------------|-------------------------|
|  | Project: I-295 over Veranda St                  | Location: Portland, ME | Project No.: GTX-308805 |
|   | Boring No.: BB-PVS-201                          | Tested By: md          | Checked By: njh         |
|   | Sample No.: U4                                  | Test Date: 09/21/18    | Depth: 55-57 ft         |
|   | Test No.: IP-4                                  | Sample Type: intact    | Elevation: ---          |
|   | Description: Moist, dark gray clay              |                        |                         |
|   | Remarks: System JJ, Swell Pressure = 0.0668 tsf |                        |                         |
| Displacement at End of Increment  |   |                        |                         |

# VERANDA SETTLE3D ANALYSIS INFO REPORT

# Settle3D Analysis Information

## Veranda South Embankment

### Project Settings

|               |   |
|---------------|---|
| Document Name | Net pressure assessment.s3z                       |
| Project Title | Veranda South Embankment                          |
| Analysis      | Net Pressure Assessment for EPS Filled Embankment |
| Author        | Joseph Zwetchkenbaum                              |
| Company       | HNTB  |
| Date Created  | 8/30/18   |

#### Comments

Check net fill pressures which results in approximately 1 inch of settlement over 10 years.

Stress Computation Method Boussinesq

Time-dependent Consolidation Analysis

Time Units months

Permeability Units feet/day

Minimum settlement ratio for subgrade modulus 0.9

Use average properties to calculate layered stresses

Improve consolidation accuracy

Ignore negative effective stresses in settlement calculations

### Stage Settings

| Stage # | Name    | Time [months] |
|---------|---------|---------------|
| 1       | Stage 1 | 0             |
| 2       | Stage 2 | 0             |
| 3       | Stage 3 | 0             |
| 4       | 1m      | 1             |
| 5       | 2m      | 2             |
| 6       | 4m      | 4             |
| 7       | 6m      | 6             |
| 8       | 8m      | 8             |
| 9       | 1y      | 12            |
| 10      | 5y      | 60            |
| 11      | 10y     | 120           |
| 12      | 15y     | 180           |
| 13      | 30y     | 360           |
| 14      | 45y     | 540           |
| 15      | 60y     | 720           |
| 16      | 75y     | 900           |

### Results

Time taken to compute: 1.12942 seconds

**Stage: Stage 1 = 0 mon**



| Data Type   | Minimum | Maximum     |
|---|---------|-------------|
| Total Settlement [in]                                 | 0       | 0           |
| Total Consolidation Settlement [in]                   | 0       | 0           |
| Virgin Consolidation Settlement [in]                  | 0       | 0           |
| Recompression Consolidation Settlement [in]           | 0       | 0           |
| Immediate Settlement [in]                             | 0       | 0           |
| Secondary Settlement [in]                             | 0       | 0           |
| Loading Stress ZZ [ksf]                               | 0       | 0           |
| Loading Stress XX [ksf]                               | 0       | 0           |
| Loading Stress YY [ksf]                               | 0       | 0           |
| Effective Stress ZZ [ksf]                             | 0       | 6.20651     |
| Effective Stress XX [ksf]                             | 0       | 6.20651     |
| Effective Stress YY [ksf]                             | 0       | 6.20651     |
| Total Stress ZZ [ksf]                                 | 0       | 12.2905     |
| Total Stress XX [ksf]                                 | 0       | 12.2905     |
| Total Stress YY [ksf]                                 | 0       | 12.2905     |
| Modulus of Subgrade Reaction (Total) [ksf/ft]         | 0       | 0           |
| Modulus of Subgrade Reaction (Immediate) [ksf/ft]     | 0       | 0           |
| Modulus of Subgrade Reaction (Consolidation) [ksf/ft] | 0       | 0           |
| Total Strain  | 0       | 0           |
| Pore Water Pressure [ksf]                             | 0       | 6.084       |
| Excess Pore Water Pressure [ksf]                      | 0       | 0           |
| Degree of Consolidation [%]                           | 0       | 0           |
| Pre-consolidation Stress [ksf]                        | 0.00099 | 6.20452     |
| Over-consolidation Ratio                              | 1       | 6.03141     |
| Void Ratio  | 0       | 1.1         |
| Permeability [ft/d]                                   | 0       | 0.000287786 |
| Coefficient of Consolidation [ft <sup>2</sup> /d]     | 0       | 0.2         |
| Hydroconsolidation Settlement [in]                    | 0       | 0           |
| Average Degree of Consolidation [%]                   | 0       | 100         |
| Undrained Shear Strength                              | 0       | 0           |

**Stage: Stage 2 = 0 mon**

| Data Type   | Minimum | Maximum     |
|---|---------|-------------|
| Total Settlement [in]                                 | 0       | 0           |
| Total Consolidation Settlement [in]                   | 0       | 0           |
| Virgin Consolidation Settlement [in]                  | 0       | 0           |
| Recompression Consolidation Settlement [in]           | 0       | 0           |
| Immediate Settlement [in]                             | 0       | 0           |
| Secondary Settlement [in]                             | 0       | 0           |
| Loading Stress ZZ [ksf]                               | 0       | 0           |
| Loading Stress XX [ksf]                               | 0       | 0           |
| Loading Stress YY [ksf]                               | 0       | 0           |
| Effective Stress ZZ [ksf]                             | 0       | 6.20651     |
| Effective Stress XX [ksf]                             | 0       | 6.20651     |
| Effective Stress YY [ksf]                             | 0       | 6.20651     |
| Total Stress ZZ [ksf]                                 | 0       | 12.2905     |
| Total Stress XX [ksf]                                 | 0       | 12.2905     |
| Total Stress YY [ksf]                                 | 0       | 12.2905     |
| Modulus of Subgrade Reaction (Total) [ksf/ft]         | 0       | 0           |
| Modulus of Subgrade Reaction (Immediate) [ksf/ft]     | 0       | 0           |
| Modulus of Subgrade Reaction (Consolidation) [ksf/ft] | 0       | 0           |
| Total Strain  | 0       | 0           |
| Pore Water Pressure [ksf]                             | 0       | 6.084       |
| Excess Pore Water Pressure [ksf]                      | 0       | 0           |
| Degree of Consolidation [%]                           | 0       | 0           |
| Pre-consolidation Stress [ksf]                        | 0.00099 | 6.20452     |
| Over-consolidation Ratio                              | 1       | 6.03141     |
| Void Ratio  | 0       | 1.1         |
| Permeability [ft/d]                                   | 0       | 0.000287786 |
| Coefficient of Consolidation [ft <sup>2</sup> /d]     | 0       | 0.2         |
| Hydroconsolidation Settlement [in]                    | 0       | 0           |
| Average Degree of Consolidation [%]                   | 0       | 100         |
| Undrained Shear Strength                              | 0       | 0           |

**Stage: Stage 3 = 0 mon**

| Data Type   | Minimum       | Maximum     |
|---|---------------|-------------|
| Total Settlement [in]                                 | 0             | 0.677002    |
| Total Consolidation Settlement [in]                   | 0             | 0.125093    |
| Virgin Consolidation Settlement [in]                  | 0             | 0           |
| Recompression Consolidation Settlement [in]           | 0             | 0.125093    |
| Immediate Settlement [in]                             | 0             | 0.677002    |
| Secondary Settlement [in]                             | 0             | 0           |
| Loading Stress ZZ [ksf]                               | 0             | 1.04        |
| Loading Stress XX [ksf]                               | -0.0954056    | 0.966635    |
| Loading Stress YY [ksf]                               | -0.0188638    | 0.601395    |
| Effective Stress ZZ [ksf]                             | 0             | 6.20651     |
| Effective Stress XX [ksf]                             | -0.0954056    | 6.2183      |
| Effective Stress YY [ksf]                             | -0.0188638    | 6.21666     |
| Total Stress ZZ [ksf]                                 | 0             | 12.4852     |
| Total Stress XX [ksf]                                 | -0.0954056    | 12.497      |
| Total Stress YY [ksf]                                 | -0.0188638    | 12.4954     |
| Modulus of Subgrade Reaction (Total) [ksf/ft]         | 0             | 36.4439     |
| Modulus of Subgrade Reaction (Immediate) [ksf/ft]     | 0             | 37.865      |
| Modulus of Subgrade Reaction (Consolidation) [ksf/ft] | 0             | 7065.57     |
| Total Strain  | 0             | 0.00334052  |
| Pore Water Pressure [ksf]                             | 0             | 6.2787      |
| Excess Pore Water Pressure [ksf]                      | 0             | 0.961641    |
| Degree of Consolidation [%]                           | 0             | 16.0022     |
| Pre-consolidation Stress [ksf]                        | 0.00668395    | 6.20452     |
| Over-consolidation Ratio                              | 1             | 3.82039     |
| Void Ratio  | 0             | 1.1         |
| Permeability [ft/d]                                   | 0             | 0.000287786 |
| Coefficient of Consolidation [ft <sup>2</sup> /d]     | 0             | 0.2         |
| Hydroconsolidation Settlement [in]                    | 0             | 0           |
| Average Degree of Consolidation [%]                   | 0             | 0           |
| Undrained Shear Strength                              | -1.11022e-016 | 0.0414067   |

**Stage: 1m = 1 mon**

| Data Type   | Minimum       | Maximum     |
|---|---------------|-------------|
| Total Settlement [in]                                 | 0             | 0.795212    |
| Total Consolidation Settlement [in]                   | -0.00286527   | 0.199993    |
| Virgin Consolidation Settlement [in]                  | 0             | 0           |
| Recompression Consolidation Settlement [in]           | -0.00286527   | 0.199993    |
| Immediate Settlement [in]                             | 0             | 0.677002    |
| Secondary Settlement [in]                             | 0             | 0           |
| Loading Stress ZZ [ksf]                               | 0             | 1.04        |
| Loading Stress XX [ksf]                               | -0.0954056    | 0.966635    |
| Loading Stress YY [ksf]                               | -0.0188638    | 0.601395    |
| Effective Stress ZZ [ksf]                             | 0             | 6.13472     |
| Effective Stress XX [ksf]                             | -0.0954056    | 6.14652     |
| Effective Stress YY [ksf]                             | -0.0188638    | 6.14487     |
| Total Stress ZZ [ksf]                                 | 0             | 12.4852     |
| Total Stress XX [ksf]                                 | -0.0954056    | 12.497      |
| Total Stress YY [ksf]                                 | -0.0188638    | 12.4954     |
| Modulus of Subgrade Reaction (Total) [ksf/ft]         | 0             | 27.5856     |
| Modulus of Subgrade Reaction (Immediate) [ksf/ft]     | 0             | 37.865      |
| Modulus of Subgrade Reaction (Consolidation) [ksf/ft] | 0             | 119.848     |
| Total Strain  | -0.000104147  | 0.00346608  |
| Pore Water Pressure [ksf]                             | 0             | 6.35049     |
| Excess Pore Water Pressure [ksf]                      | 0             | 0.77408     |
| Degree of Consolidation [%]                           | 0             | 27.978      |
| Pre-consolidation Stress [ksf]                        | 0.00668395    | 6.20452     |
| Over-consolidation Ratio                              | 1             | 3.62966     |
| Void Ratio  | 0             | 1.10022     |
| Permeability [ft/d]                                   | 0             | 0.000287786 |
| Coefficient of Consolidation [ft <sup>2</sup> /d]     | 0             | 0.2         |
| Hydroconsolidation Settlement [in]                    | 0             | 0           |
| Average Degree of Consolidation [%]                   | 0             | 20.0788     |
| Undrained Shear Strength                              | -1.11022e-016 | 0.0508162   |

**Stage: 2m = 2 mon**

| Data Type   | Minimum       | Maximum     |
|---|---------------|-------------|
| Total Settlement [in]                                 | 0             | 0.840116    |
| Total Consolidation Settlement [in]                   | -0.00495609   | 0.236375    |
| Virgin Consolidation Settlement [in]                  | 0             | 0           |
| Recompression Consolidation Settlement [in]           | -0.00495609   | 0.236375    |
| Immediate Settlement [in]                             | 0             | 0.677002    |
| Secondary Settlement [in]                             | 0             | 0.00272892  |
| Loading Stress ZZ [ksf]                               | 0             | 1.04        |
| Loading Stress XX [ksf]                               | -0.0954056    | 0.966635    |
| Loading Stress YY [ksf]                               | -0.0188638    | 0.601395    |
| Effective Stress ZZ [ksf]                             | 0             | 6.13345     |
| Effective Stress XX [ksf]                             | -0.0954056    | 6.14525     |
| Effective Stress YY [ksf]                             | -0.0188638    | 6.1436      |
| Total Stress ZZ [ksf]                                 | 0             | 12.4852     |
| Total Stress XX [ksf]                                 | -0.0954056    | 12.497      |
| Total Stress YY [ksf]                                 | -0.0188638    | 12.4954     |
| Modulus of Subgrade Reaction (Total) [ksf/ft]         | 0             | 25.2303     |
| Modulus of Subgrade Reaction (Immediate) [ksf/ft]     | 0             | 37.865      |
| Modulus of Subgrade Reaction (Consolidation) [ksf/ft] | 0             | 88.4187     |
| Total Strain  | -0.000132552  | 0.00436154  |
| Pore Water Pressure [ksf]                             | 0             | 6.35175     |
| Excess Pore Water Pressure [ksf]                      | 0             | 0.742993    |
| Degree of Consolidation [%]                           | 0             | 37.923      |
| Pre-consolidation Stress [ksf]                        | 0.00668395    | 6.20452     |
| Over-consolidation Ratio                              | 1             | 3.62966     |
| Void Ratio  | 0             | 1.10028     |
| Permeability [ft/d]                                   | 0             | 0.000287786 |
| Coefficient of Consolidation [ft <sup>2</sup> /d]     | 0             | 0.2         |
| Hydroconsolidation Settlement [in]                    | 0             | 0           |
| Average Degree of Consolidation [%]                   | 0             | 29.2696     |
| Undrained Shear Strength                              | -1.11022e-016 | 0.0508162   |

**Stage: 4m = 4 mon**

| Data Type   | Minimum       | Maximum     |
|---|---------------|-------------|
| Total Settlement [in]                                 | 0             | 0.898707    |
| Total Consolidation Settlement [in]                   | -0.0077928    | 0.281985    |
| Virgin Consolidation Settlement [in]                  | 0             | 0           |
| Recompression Consolidation Settlement [in]           | -0.0077928    | 0.281985    |
| Immediate Settlement [in]                             | 0             | 0.677002    |
| Secondary Settlement [in]                             | 0             | 0.00633628  |
| Loading Stress ZZ [ksf]                               | 0             | 1.04        |
| Loading Stress XX [ksf]                               | -0.0954056    | 0.966635    |
| Loading Stress YY [ksf]                               | -0.0188638    | 0.601395    |
| Effective Stress ZZ [ksf]                             | 0             | 6.1314      |
| Effective Stress XX [ksf]                             | -0.0954056    | 6.1432      |
| Effective Stress YY [ksf]                             | -0.0188638    | 6.14155     |
| Total Stress ZZ [ksf]                                 | 0             | 12.4852     |
| Total Stress XX [ksf]                                 | -0.0954056    | 12.497      |
| Total Stress YY [ksf]                                 | -0.0188638    | 12.4954     |
| Modulus of Subgrade Reaction (Total) [ksf/ft]         | 0             | 22.5834     |
| Modulus of Subgrade Reaction (Immediate) [ksf/ft]     | 0             | 37.865      |
| Modulus of Subgrade Reaction (Consolidation) [ksf/ft] | 0             | 65.8897     |
| Total Strain  | -9.7218e-005  | 0.0052746   |
| Pore Water Pressure [ksf]                             | 0             | 6.35381     |
| Excess Pore Water Pressure [ksf]                      | 0             | 0.722954    |
| Degree of Consolidation [%]                           | 0             | 50.9065     |
| Pre-consolidation Stress [ksf]                        | 0.00668395    | 6.20452     |
| Over-consolidation Ratio                              | 1             | 3.62966     |
| Void Ratio  | 0             | 1.10021     |
| Permeability [ft/d]                                   | 0             | 0.000287786 |
| Coefficient of Consolidation [ft <sup>2</sup> /d]     | 0             | 0.2         |
| Hydroconsolidation Settlement [in]                    | 0             | 0           |
| Average Degree of Consolidation [%]                   | 0             | 42.8102     |
| Undrained Shear Strength                              | -1.11022e-016 | 0.0508162   |

**Stage: 6m = 6 mon**

| Data Type   | Minimum      | Maximum     |
|---|--------------|-------------|
| Total Settlement [in]                                 | 0            | 0.940065    |
| Total Consolidation Settlement [in]                   | -0.00941009  | 0.315831    |
| Virgin Consolidation Settlement [in]                  | 0            | 0           |
| Recompression Consolidation Settlement [in]           | -0.00941009  | 0.315831    |
| Immediate Settlement [in]                             | 0            | 0.677002    |
| Secondary Settlement [in]                             | 0            | 0.00967985  |
| Loading Stress ZZ [ksf]                               | 0            | 1.04        |
| Loading Stress XX [ksf]                               | -0.0954056   | 0.966635    |
| Loading Stress YY [ksf]                               | -0.0188638   | 0.601395    |
| Effective Stress ZZ [ksf]                             | 0            | 6.12949     |
| Effective Stress XX [ksf]                             | -0.0954056   | 6.14129     |
| Effective Stress YY [ksf]                             | -0.0188638   | 6.13964     |
| Total Stress ZZ [ksf]                                 | 0            | 12.4852     |
| Total Stress XX [ksf]                                 | -0.0954056   | 12.497      |
| Total Stress YY [ksf]                                 | -0.0188638   | 12.4954     |
| Modulus of Subgrade Reaction (Total) [ksf/ft]         | 0            | 21.0417     |
| Modulus of Subgrade Reaction (Immediate) [ksf/ft]     | 0            | 37.865      |
| Modulus of Subgrade Reaction (Consolidation) [ksf/ft] | 0            | 55.806      |
| Total Strain  | -0.000123666 | 0.00580735  |
| Pore Water Pressure [ksf]                             | 0            | 6.35571     |
| Excess Pore Water Pressure [ksf]                      | 0            | 0.673516    |
| Degree of Consolidation [%]                           | 0            | 60.5655     |
| Pre-consolidation Stress [ksf]                        | 0.00668395   | 6.20452     |
| Over-consolidation Ratio                              | 1            | 3.62966     |
| Void Ratio  | 0            | 1.10026     |
| Permeability [ft/d]                                   | 0            | 0.000286816 |
| Coefficient of Consolidation [ft <sup>2</sup> /d]     | 0            | 0.2         |
| Hydroconsolidation Settlement [in]                    | 0            | 0           |
| Average Degree of Consolidation [%]                   | 0            | 53.231      |
| Undrained Shear Strength                              | -0.000302238 | 0.0508162   |

**Stage: 8m = 8 mon**

| Data Type   | Minimum      | Maximum     |
|---|--------------|-------------|
| Total Settlement [in]                                 | 0            | 0.974508    |
| Total Consolidation Settlement [in]                   | -0.0109785   | 0.343859    |
| Virgin Consolidation Settlement [in]                  | 0            | 0           |
| Recompression Consolidation Settlement [in]           | -0.0109785   | 0.343859    |
| Immediate Settlement [in]                             | 0            | 0.677002    |
| Secondary Settlement [in]                             | 0            | 0.0128155   |
| Loading Stress ZZ [ksf]                               | 0            | 1.04        |
| Loading Stress XX [ksf]                               | -0.0954056   | 0.966635    |
| Loading Stress YY [ksf]                               | -0.0188638   | 0.601395    |
| Effective Stress ZZ [ksf]                             | 0            | 6.12753     |
| Effective Stress XX [ksf]                             | -0.0954056   | 6.13932     |
| Effective Stress YY [ksf]                             | -0.0188638   | 6.13768     |
| Total Stress ZZ [ksf]                                 | 0            | 12.4852     |
| Total Stress XX [ksf]                                 | -0.0954056   | 12.497      |
| Total Stress YY [ksf]                                 | -0.0188638   | 12.4954     |
| Modulus of Subgrade Reaction (Total) [ksf/ft]         | 0            | 19.9114     |
| Modulus of Subgrade Reaction (Immediate) [ksf/ft]     | 0            | 37.865      |
| Modulus of Subgrade Reaction (Consolidation) [ksf/ft] | 0            | 49.8725     |
| Total Strain  | -0.000144887 | 0.00618469  |
| Pore Water Pressure [ksf]                             | 0            | 6.35768     |
| Excess Pore Water Pressure [ksf]                      | 0            | 0.635536    |
| Degree of Consolidation [%]                           | 0            | 68.0614     |
| Pre-consolidation Stress [ksf]                        | 0.00668395   | 6.20452     |
| Over-consolidation Ratio                              | 1            | 3.62966     |
| Void Ratio  | 0            | 1.10031     |
| Permeability [ft/d]                                   | 0            | 0.000286816 |
| Coefficient of Consolidation [ft <sup>2</sup> /d]     | 0            | 0.2         |
| Hydroconsolidation Settlement [in]                    | 0            | 0           |
| Average Degree of Consolidation [%]                   | 0            | 61.6431     |
| Undrained Shear Strength                              | -0.000106416 | 0.0508162   |

**Stage: 1y = 12 mon**



| Data Type   | Minimum      | Maximum     |
|---|--------------|-------------|
| Total Settlement [in]                                 | 0            | 1.02561     |
| Total Consolidation Settlement [in]                   | -0.011181    | 0.389437    |
| Virgin Consolidation Settlement [in]                  | 0            | 0           |
| Recompression Consolidation Settlement [in]           | -0.011181    | 0.389437    |
| Immediate Settlement [in]                             | 0            | 0.677002    |
| Secondary Settlement [in]                             | 0            | 0.0172351   |
| Loading Stress ZZ [ksf]                               | 0            | 1.04        |
| Loading Stress XX [ksf]                               | -0.0954056   | 0.966635    |
| Loading Stress YY [ksf]                               | -0.0188638   | 0.601395    |
| Effective Stress ZZ [ksf]                             | 0            | 6.12465     |
| Effective Stress XX [ksf]                             | -0.0954056   | 6.13645     |
| Effective Stress YY [ksf]                             | -0.0188638   | 6.1348      |
| Total Stress ZZ [ksf]                                 | 0            | 12.4852     |
| Total Stress XX [ksf]                                 | -0.0954056   | 12.497      |
| Total Stress YY [ksf]                                 | -0.0188638   | 12.4954     |
| Modulus of Subgrade Reaction (Total) [ksf/ft]         | 0            | 18.3859     |
| Modulus of Subgrade Reaction (Immediate) [ksf/ft]     | 0            | 37.865      |
| Modulus of Subgrade Reaction (Consolidation) [ksf/ft] | 0            | 43.1888     |
| Total Strain  | -0.000168222 | 0.00671575  |
| Pore Water Pressure [ksf]                             | 0            | 6.36056     |
| Excess Pore Water Pressure [ksf]                      | 0            | 0.623098    |
| Degree of Consolidation [%]                           | 0            | 78.8445     |
| Pre-consolidation Stress [ksf]                        | 0.00668395   | 6.20452     |
| Over-consolidation Ratio                              | 1            | 3.62966     |
| Void Ratio  | 0            | 1.10035     |
| Permeability [ft/d]                                   | 0            | 0.000286816 |
| Coefficient of Consolidation [ft <sup>2</sup> /d]     | 0            | 0.2         |
| Hydroconsolidation Settlement [in]                    | 0            | 0           |
| Average Degree of Consolidation [%]                   | 0            | 74.1537     |
| Undrained Shear Strength                              | -0.0143852   | 0.0508162   |

**Stage: 5y = 60 mon**

| Data Type   | Minimum     | Maximum      |
|---|-------------|--------------|
| Total Settlement [in]                                 | 0           | 1.27758      |
| Total Consolidation Settlement [in]                   | 0           | 0.639208     |
| Virgin Consolidation Settlement [in]                  | 0           | 4.46238e-005 |
| Recompression Consolidation Settlement [in]           | 0           | 0.639208     |
| Immediate Settlement [in]                             | 0           | 0.677002     |
| Secondary Settlement [in]                             | 0           | 0.183041     |
| Loading Stress ZZ [ksf]                               | 0           | 1.04         |
| Loading Stress XX [ksf]                               | -0.0954056  | 0.966635     |
| Loading Stress YY [ksf]                               | -0.0188638  | 0.601395     |
| Effective Stress ZZ [ksf]                             | 0           | 6.15009      |
| Effective Stress XX [ksf]                             | -0.0954056  | 6.16188      |
| Effective Stress YY [ksf]                             | -0.0188638  | 6.16024      |
| Total Stress ZZ [ksf]                                 | 0           | 12.4852      |
| Total Stress XX [ksf]                                 | -0.0954056  | 12.497       |
| Total Stress YY [ksf]                                 | -0.0188638  | 12.4954      |
| Modulus of Subgrade Reaction (Total) [ksf/ft]         | 0           | 12.9161      |
| Modulus of Subgrade Reaction (Immediate) [ksf/ft]     | 0           | 37.865       |
| Modulus of Subgrade Reaction (Consolidation) [ksf/ft] | 0           | 33.6282      |
| Total Strain  | 0           | 0.00881836   |
| Pore Water Pressure [ksf]                             | 0           | 6.34233      |
| Excess Pore Water Pressure [ksf]                      | 0           | 0.293806     |
| Degree of Consolidation [%]                           | 0           | 99.8201      |
| Pre-consolidation Stress [ksf]                        | 0.00668395  | 6.20452      |
| Over-consolidation Ratio                              | 1           | 3.62966      |
| Void Ratio  | 0           | 1.09998      |
| Permeability [ft/d]                                   | 0           | 0.000288475  |
| Coefficient of Consolidation [ft <sup>2</sup> /d]     | 0           | 0.2          |
| Hydroconsolidation Settlement [in]                    | 0           | 0            |
| Average Degree of Consolidation [%]                   | 0           | 99.7729      |
| Undrained Shear Strength                              | -0.00112861 | 0.0508162    |

**Stage: 10y = 120 mon**

| Data Type   | Minimum       | Maximum     |
|---|---------------|-------------|
| Total Settlement [in]                                 | 0             | 1.45141     |
| Total Consolidation Settlement [in]                   | 0             | 0.737285    |
| Virgin Consolidation Settlement [in]                  | 0             | 0.0100693   |
| Recompression Consolidation Settlement [in]           | 0             | 0.737285    |
| Immediate Settlement [in]                             | 0             | 0.677002    |
| Secondary Settlement [in]                             | 0             | 0.328482    |
| Loading Stress ZZ [ksf]                               | 0             | 1.04        |
| Loading Stress XX [ksf]                               | -0.0954056    | 0.966635    |
| Loading Stress YY [ksf]                               | -0.0188638    | 0.601395    |
| Effective Stress ZZ [ksf]                             | 0             | 6.20999     |
| Effective Stress XX [ksf]                             | -0.0954056    | 6.22179     |
| Effective Stress YY [ksf]                             | -0.0188638    | 6.22014     |
| Total Stress ZZ [ksf]                                 | 0             | 12.4852     |
| Total Stress XX [ksf]                                 | -0.0954056    | 12.497      |
| Total Stress YY [ksf]                                 | -0.0188638    | 12.4954     |
| Modulus of Subgrade Reaction (Total) [ksf/ft]         | 0             | 11.0032     |
| Modulus of Subgrade Reaction (Immediate) [ksf/ft]     | 0             | 37.865      |
| Modulus of Subgrade Reaction (Consolidation) [ksf/ft] | 0             | 33.5315     |
| Total Strain  | 0             | 0.00972275  |
| Pore Water Pressure [ksf]                             | 0             | 6.2849      |
| Excess Pore Water Pressure [ksf]                      | 0             | 0.201881    |
| Degree of Consolidation [%]                           | 0             | 99.9995     |
| Pre-consolidation Stress [ksf]                        | 0.00668395    | 6.20805     |
| Over-consolidation Ratio                              | 1             | 3.62966     |
| Void Ratio  | 0             | 1.09976     |
| Permeability [ft/d]                                   | 0             | 0.000296066 |
| Coefficient of Consolidation [ft <sup>2</sup> /d]     | 0             | 0.2         |
| Hydroconsolidation Settlement [in]                    | 0             | 0           |
| Average Degree of Consolidation [%]                   | 0             | 99.9994     |
| Undrained Shear Strength                              | -4.88522e-005 | 0.0508162   |

**Stage: 15y = 180 mon**

| Data Type   | Minimum    | Maximum     |
|---|------------|-------------|
| Total Settlement [in]                                 | 0          | 1.55809     |
| Total Consolidation Settlement [in]                   | 0          | 0.767636    |
| Virgin Consolidation Settlement [in]                  | 0          | 0.0209474   |
| Recompression Consolidation Settlement [in]           | 0          | 0.767636    |
| Immediate Settlement [in]                             | 0          | 0.677002    |
| Secondary Settlement [in]                             | 0          | 0.417926    |
| Loading Stress ZZ [ksf]                               | 0          | 1.04        |
| Loading Stress XX [ksf]                               | -0.0954056 | 0.966635    |
| Loading Stress YY [ksf]                               | -0.0188638 | 0.601395    |
| Effective Stress ZZ [ksf]                             | 0          | 6.24568     |
| Effective Stress XX [ksf]                             | -0.0954056 | 6.25747     |
| Effective Stress YY [ksf]                             | -0.0188638 | 6.25583     |
| Total Stress ZZ [ksf]                                 | 0          | 12.4852     |
| Total Stress XX [ksf]                                 | -0.0954056 | 12.497      |
| Total Stress YY [ksf]                                 | -0.0188638 | 12.4954     |
| Modulus of Subgrade Reaction (Total) [ksf/ft]         | 0          | 9.91315     |
| Modulus of Subgrade Reaction (Immediate) [ksf/ft]     | 0          | 37.865      |
| Modulus of Subgrade Reaction (Consolidation) [ksf/ft] | 0          | 33.531      |
| Total Strain  | 0          | 0.0102515   |
| Pore Water Pressure [ksf]                             | 0          | 6.25011     |
| Excess Pore Water Pressure [ksf]                      | 0          | 0.166139    |
| Degree of Consolidation [%]                           | 0          | 100         |
| Pre-consolidation Stress [ksf]                        | 0.00668395 | 6.24374     |
| Over-consolidation Ratio                              | 1          | 3.62966     |
| Void Ratio  | 0          | 1.0996      |
| Permeability [ft/d]                                   | 0          | 0.000302335 |
| Coefficient of Consolidation [ft <sup>2</sup> /d]     | 0          | 0.2         |
| Hydroconsolidation Settlement [in]                    | 0          | 0           |
| Average Degree of Consolidation [%]                   | 0          | 100         |
| Undrained Shear Strength                              | 0          | 0.0508162   |

**Stage: 30y = 360 mon**

| Data Type   | Minimum       | Maximum     |
|---|---------------|-------------|
| Total Settlement [in]                                 | 0             | 1.77275     |
| Total Consolidation Settlement [in]                   | 0             | 0.781271    |
| Virgin Consolidation Settlement [in]                  | 0             | 0.0746917   |
| Recompression Consolidation Settlement [in]           | 0             | 0.781271    |
| Immediate Settlement [in]                             | 0             | 0.677002    |
| Secondary Settlement [in]                             | 0             | 0.607844    |
| Loading Stress ZZ [ksf]                               | 0             | 1.04        |
| Loading Stress XX [ksf]                               | -0.0954056    | 0.966635    |
| Loading Stress YY [ksf]                               | -0.0188638    | 0.601395    |
| Effective Stress ZZ [ksf]                             | 0             | 6.31837     |
| Effective Stress XX [ksf]                             | -0.0954056    | 6.33016     |
| Effective Stress YY [ksf]                             | -0.0188638    | 6.32852     |
| Total Stress ZZ [ksf]                                 | 0             | 12.4852     |
| Total Stress XX [ksf]                                 | -0.0954056    | 12.497      |
| Total Stress YY [ksf]                                 | -0.0188638    | 12.4954     |
| Modulus of Subgrade Reaction (Total) [ksf/ft]         | 0             | 8.39175     |
| Modulus of Subgrade Reaction (Immediate) [ksf/ft]     | 0             | 37.865      |
| Modulus of Subgrade Reaction (Consolidation) [ksf/ft] | 0             | 33.531      |
| Total Strain  | 0             | 0.0111548   |
| Pore Water Pressure [ksf]                             | 0             | 6.17519     |
| Excess Pore Water Pressure [ksf]                      | -3.56431e-019 | 0.0913562   |
| Degree of Consolidation [%]                           | 0             | 100         |
| Pre-consolidation Stress [ksf]                        | 0.00668395    | 6.31642     |
| Over-consolidation Ratio                              | 1             | 3.62966     |
| Void Ratio  | 0             | 1.09935     |
| Permeability [ft/d]                                   | 0             | 0.000307717 |
| Coefficient of Consolidation [ft <sup>2</sup> /d]     | 0             | 0.2         |
| Hydroconsolidation Settlement [in]                    | 0             | 0           |
| Average Degree of Consolidation [%]                   | 0             | 100         |
| Undrained Shear Strength                              | 0             | 0.0508162   |

**Stage: 45y = 540 mon**

| Data Type   | Minimum       | Maximum     |
|---|---------------|-------------|
| Total Settlement [in]                                 | 0             | 1.99654     |
| Total Consolidation Settlement [in]                   | 0             | 0.781714    |
| Virgin Consolidation Settlement [in]                  | 0             | 0.0957814   |
| Recompression Consolidation Settlement [in]           | 0             | 0.781714    |
| Immediate Settlement [in]                             | 0             | 0.677002    |
| Secondary Settlement [in]                             | 0             | 0.774929    |
| Loading Stress ZZ [ksf]                               | 0             | 1.04        |
| Loading Stress XX [ksf]                               | -0.0954056    | 0.966635    |
| Loading Stress YY [ksf]                               | -0.0188638    | 0.601395    |
| Effective Stress ZZ [ksf]                             | 0             | 6.34777     |
| Effective Stress XX [ksf]                             | -0.0954056    | 6.35957     |
| Effective Stress YY [ksf]                             | -0.0188638    | 6.35792     |
| Total Stress ZZ [ksf]                                 | 0             | 12.4852     |
| Total Stress XX [ksf]                                 | -0.0954056    | 12.497      |
| Total Stress YY [ksf]                                 | -0.0188638    | 12.4954     |
| Modulus of Subgrade Reaction (Total) [ksf/ft]         | 0             | 7.96751     |
| Modulus of Subgrade Reaction (Immediate) [ksf/ft]     | 0             | 37.865      |
| Modulus of Subgrade Reaction (Consolidation) [ksf/ft] | 0             | 33.531      |
| Total Strain  | 0             | 0.0116831   |
| Pore Water Pressure [ksf]                             | 0             | 6.14501     |
| Excess Pore Water Pressure [ksf]                      | -4.47897e-016 | 0.061042    |
| Degree of Consolidation [%]                           | 0             | 100         |
| Pre-consolidation Stress [ksf]                        | 0.00668395    | 6.34583     |
| Over-consolidation Ratio                              | 1             | 3.62966     |
| Void Ratio  | 0             | 1.09925     |
| Permeability [ft/d]                                   | 0             | 0.000307717 |
| Coefficient of Consolidation [ft <sup>2</sup> /d]     | 0             | 0.2         |
| Hydroconsolidation Settlement [in]                    | 0             | 0           |
| Average Degree of Consolidation [%]                   | 0             | 100         |
| Undrained Shear Strength                              | 0             | 0.0508162   |

**Stage: 60y = 720 mon**

| Data Type   | Minimum       | Maximum     |
|---|---------------|-------------|
| Total Settlement [in]                                 | 0             | 2.15478     |
| Total Consolidation Settlement [in]                   | 0             | 0.781728    |
| Virgin Consolidation Settlement [in]                  | 0             | 0.123927    |
| Recompression Consolidation Settlement [in]           | 0             | 0.781728    |
| Immediate Settlement [in]                             | 0             | 0.677002    |
| Secondary Settlement [in]                             | 0             | 0.931713    |
| Loading Stress ZZ [ksf]                               | 0             | 1.04        |
| Loading Stress XX [ksf]                               | -0.0954056    | 0.966635    |
| Loading Stress YY [ksf]                               | -0.0188638    | 0.601395    |
| Effective Stress ZZ [ksf]                             | 0             | 6.36558     |
| Effective Stress XX [ksf]                             | -0.0954056    | 6.37737     |
| Effective Stress YY [ksf]                             | -0.0188638    | 6.37573     |
| Total Stress ZZ [ksf]                                 | 0             | 12.4852     |
| Total Stress XX [ksf]                                 | -0.0954056    | 12.497      |
| Total Stress YY [ksf]                                 | -0.0188638    | 12.4954     |
| Modulus of Subgrade Reaction (Total) [ksf/ft]         | 0             | 7.64488     |
| Modulus of Subgrade Reaction (Immediate) [ksf/ft]     | 0             | 37.865      |
| Modulus of Subgrade Reaction (Consolidation) [ksf/ft] | 0             | 33.531      |
| Total Strain  | 0             | 0.0120579   |
| Pore Water Pressure [ksf]                             | 0             | 6.12488     |
| Excess Pore Water Pressure [ksf]                      | -4.60677e-016 | 0.0409149   |
| Degree of Consolidation [%]                           | 0             | 100         |
| Pre-consolidation Stress [ksf]                        | 0.00668395    | 6.36364     |
| Over-consolidation Ratio                              | 1             | 3.62966     |
| Void Ratio  | 0             | 1.09911     |
| Permeability [ft/d]                                   | 0             | 0.000307717 |
| Coefficient of Consolidation [ft <sup>2</sup> /d]     | 0             | 0.2         |
| Hydroconsolidation Settlement [in]                    | 0             | 0           |
| Average Degree of Consolidation [%]                   | 0             | 100         |
| Undrained Shear Strength                              | 0             | 0.0508162   |

## Stage: 75y = 900 mon

| Data Type   | Minimum       | Maximum     |
|---|---------------|-------------|
| Total Settlement [in]                                 | 0             | 2.2775      |
| Total Consolidation Settlement [in]                   | 0             | 0.781728    |
| Virgin Consolidation Settlement [in]                  | 0             | 0.143059    |
| Recompression Consolidation Settlement [in]           | 0             | 0.781728    |
| Immediate Settlement [in]                             | 0             | 0.677002    |
| Secondary Settlement [in]                             | 0             | 1.05332     |
| Loading Stress ZZ [ksf]                               | 0             | 1.04        |
| Loading Stress XX [ksf]                               | -0.0954056    | 0.966635    |
| Loading Stress YY [ksf]                               | -0.0188638    | 0.601395    |
| Effective Stress ZZ [ksf]                             | 0             | 6.37746     |
| Effective Stress XX [ksf]                             | -0.0954056    | 6.38926     |
| Effective Stress YY [ksf]                             | -0.0188638    | 6.38761     |
| Total Stress ZZ [ksf]                                 | 0             | 12.4852     |
| Total Stress XX [ksf]                                 | -0.0954056    | 12.497      |
| Total Stress YY [ksf]                                 | -0.0188638    | 12.4954     |
| Modulus of Subgrade Reaction (Total) [ksf/ft]         | 0             | 7.41208     |
| Modulus of Subgrade Reaction (Immediate) [ksf/ft]     | 0             | 37.865      |
| Modulus of Subgrade Reaction (Consolidation) [ksf/ft] | 0             | 33.531      |
| Total Strain  | 0             | 0.0123486   |
| Pore Water Pressure [ksf]                             | 0             | 6.11139     |
| Excess Pore Water Pressure [ksf]                      | -4.59201e-016 | 0.0274225   |
| Degree of Consolidation [%]                           | 0             | 100         |
| Pre-consolidation Stress [ksf]                        | 0.00668395    | 6.37552     |
| Over-consolidation Ratio                              | 1             | 3.62966     |
| Void Ratio  | 0             | 1.09909     |
| Permeability [ft/d]                                   | 0             | 0.000307717 |
| Coefficient of Consolidation [ft <sup>2</sup> /d]     | 0             | 0.2         |
| Hydroconsolidation Settlement [in]                    | 0             | 0           |
| Average Degree of Consolidation [%]                   | 0             | 100         |
| Undrained Shear Strength                              | 0             | 0.0508162   |

## Loads

### 1. Polygonal Load: "Polygonal Load 2"

|                    |                         |
|--------------------|-------------------------|
| Label              | Polygonal Load 2        |
| Load Type          | Flexible                |
| Area of Load       | 8696.99 ft <sup>2</sup> |
| Load               | 0.52 ksf                |
| Depth              | -11 ft                  |
| Installation Stage | Stage 3 = 0 mon         |

#### Coordinates

| X [ft] | Y [ft] |
|--------|--------|
| -11.1  | 102.9  |
| 4.8    | 3.6    |
| 80.7   | 60.8   |
| 57.3   | 169    |

### 2. Polygonal Load: "6 feet common borrow on sideslope"



Label 6 feet common borrow on sideslope  
 Load Type Flexible  
 Area of Load 1279.21 ft<sup>2</sup>  
 Load 0.78 ksf  
 Depth -11 ft  
 Installation Stage Stage 3 = 0 mon

#### Coordinates

| X [ft] | Y [ft] |
|--------|--------|
| -22    | 92.5   |
| -7.2   | -5.5   |
| 4.8    | 3.6    |
| -11.1  | 102.9  |

### 3. Polygonal Load: "8-ft common borrow"

Label 8-ft common borrow  
 Load Type Flexible  
 Area of Load 1478.88 ft<sup>2</sup>  
 Load 1.04 ksf  
 Depth -14 ft  
 Installation Stage Stage 3 = 0 mon

#### Coordinates

| X [ft] | Y [ft] |
|--------|--------|
| -34.7  | 80.1   |
| -21.6  | -16.3  |
| -7.2   | -5.5   |
| -22    | 92.5   |

### 4. Polygonal Load: "6 ft common borrow"

Label 6 ft common borrow  
 Load Type Flexible  
 Area of Load 1468.33 ft<sup>2</sup>  
 Load 0.78 ksf  
 Depth -11 ft  
 Installation Stage Stage 3 = 0 mon

#### Coordinates

| X [ft] | Y [ft] |
|--------|--------|
| 80.7   | 60.8   |
| 92.6   | 69.8   |
| 68.1   | 179.4  |
| 57.3   | 169    |

## 5. Polygonal Load: "8 ft common borrow"

Label 8 ft common borrow  
 Load Type Flexible  
 Area of Load 2965.07 ft<sup>2</sup>  
 Load 1.04 ksf  
 Depth -14 ft  
 Installation Stage Stage 3 = 0 mon

### Coordinates

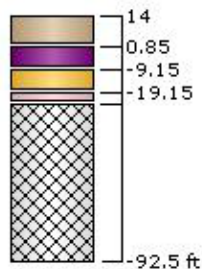
| X [ft]  | Y [ft]  |
|---------|---------|
| 68.1    | 179.4   |
| 92.6    | 69.8    |
| 116.6   | 87.9    |
| 88.7333 | 199.366 |

## Soil Layers

Ground Surface Drained: Yes

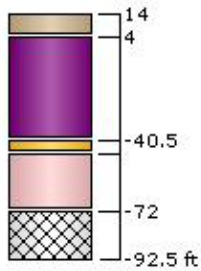
### V-8: (42.6, 11.9)

| Layer # | Type               | Thickness [ft] | Depth [ft] | Drained at Bottom |
|---------|--------------------|----------------|------------|-------------------|
| 1       | FILL               | 13.15          | -14        | Yes               |
| 2       | Marine Silt & Clay | 10             | -0.85      | No                |
| 3       | Marine Silty Sand  | 10             | 9.15       | No                |
| 4       | Glacial Till       | 5.5            | 19.15      | No                |

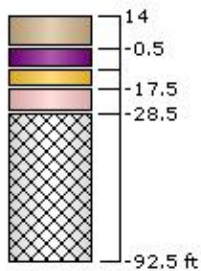


### BB-PVS-101: (-5, 77)

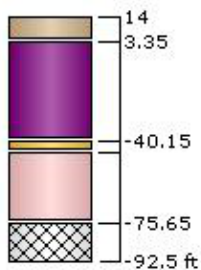
| Layer # | Type               | Thickness [ft] | Depth [ft] | Drained at Bottom |
|---------|--------------------|----------------|------------|-------------------|
| 1       | FILL               | 10             | -14        | Yes               |
| 2       | Marine Silt & Clay | 44.5           | -4         | No                |
| 3       | Marine Silty Sand  | 6.5            | 40.5       | No                |
| 4       | Glacial Till       | 25             | 47         | No                |

**V-1: (111.2, 131.2)**

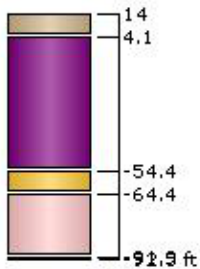
| Layer # | Type               | Thickness [ft] | Depth [ft] | Drained at Bottom |
|---------|--------------------|----------------|------------|-------------------|
| 1       | FILL               | 14.5           | -14        | Yes               |
| 2       | Marine Silt & Clay | 8.5            | 0.5        | No                |
| 3       | Marine Silty Sand  | 8.5            | 9          | No                |
| 4       | Glacial Till       | 11             | 17.5       | No                |

**V-9: (12.1, 105.5)**

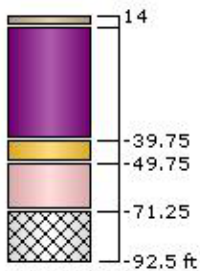
| Layer # | Type               | Thickness [ft] | Depth [ft] | Drained at Bottom |
|---------|--------------------|----------------|------------|-------------------|
| 1       | FILL               | 10.65          | -14        | Yes               |
| 2       | Marine Silt & Clay | 43.5           | -3.35      | No                |
| 3       | Marine Silty Sand  | 5              | 40.15      | No                |
| 4       | Glacial Till       | 30.5           | 45.15      | No                |

**V-10: (-10.5, 186.8)**

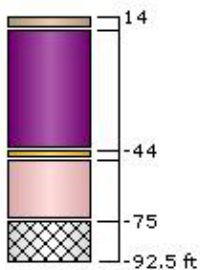
| Layer # | Type               | Thickness [ft] | Depth [ft] | Drained at Bottom |
|---------|--------------------|----------------|------------|-------------------|
| 1       | FILL               | 9.9            | -14        | Yes               |
| 2       | Marine Silt & Clay | 58.5           | -4.1       | No                |
| 3       | Marine Silty Sand  | 10             | 54.4       | No                |
| 4       | Glacial Till       | 27.5           | 64.4       | No                |

**V-2: (31, 188.3)**

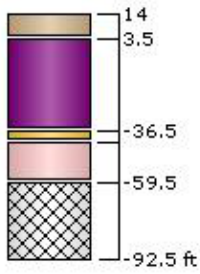
| Layer # | Type               | Thickness [ft] | Depth [ft] | Drained at Bottom |
|---------|--------------------|----------------|------------|-------------------|
| 1       | FILL               | 5.25           | -14        | Yes               |
| 2       | Marine Silt & Clay | 48.5           | -8.75      | No                |
| 3       | Marine Silty Sand  | 10             | 39.75      | No                |
| 4       | Glacial Till       | 21.5           | 49.75      | No                |

**BB-PVS-105: (52.4, 201.2)**

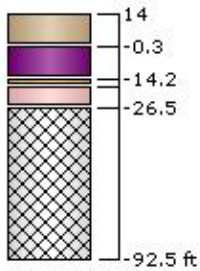
| Layer # | Type               | Thickness [ft] | Depth [ft] | Drained at Bottom |
|---------|--------------------|----------------|------------|-------------------|
| 1       | FILL               | 6              | -14        | Yes               |
| 2       | Marine Silt & Clay | 52             | -8         | No                |
| 3       | Marine Silty Sand  | 4.5            | 44         | No                |
| 4       | Glacial Till       | 26.5           | 48.5       | No                |

**V-3: (80.4, 200.7)**

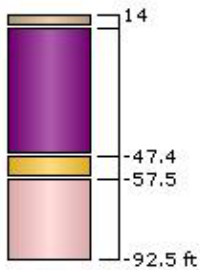
| Layer # | Type               | Thickness [ft] | Depth [ft] | Drained at Bottom |
|---------|--------------------|----------------|------------|-------------------|
| 1       | FILL               | 10.5           | -14        | Yes               |
| 2       | Marine Silt & Clay | 40             | -3.5       | No                |
| 3       | Marine Silty Sand  | 5              | 36.5       | No                |
| 4       | Glacial Till       | 18             | 41.5       | No                |

**BB-PVS-301: (88.3, 67.2)**





| Layer # | Type               | Thickness [ft] | Depth [ft] | Drained at Bottom |
|---------|--------------------|----------------|------------|-------------------|
| 1       | FILL               | 14.3           | -14        | Yes               |
| 2       | Marine Silt & Clay | 13.9           | 0.3        | No                |
| 3       | Marine Silty Sand  | 3.2            | 14.2       | No                |
| 4       | Glacial Till       | 9.1            | 17.4       | No                |

**BB-PVS-201: (-5.7, 105.8)**

| Layer # | Type               | Thickness [ft] | Depth [ft] | Drained at Bottom |
|---------|--------------------|----------------|------------|-------------------|
| 1       | FILL               | 5.6            | -14        | Yes               |
| 2       | Marine Silt & Clay | 55.8           | -8.4       | No                |
| 3       | Marine Silty Sand  | 10.1           | 47.4       | No                |
| 4       | Glacial Till       | 35             | 57.5       | No                |



## Soil Properties

| Property                                      | FILL  | Marine Silt & Clay  | Marine Silty Sand   | Glacial Till  |
|---|---|---|---|---|
| Color   |  |  |  |  |
| Unit Weight [kips/ft <sup>3</sup> ]           | 0.11  | 0.115   | 0.105   | 0.12  |
| Saturated Unit Weight [kips/ft <sup>3</sup> ] | 0.11  | 0.115   | 0.105   | 0.12  |
| K0  | 1   | 1   | 1   | 1   |
| Immediate Settlement                          | Enabled   | Disabled  | Enabled   | Enabled   |
| Es [ksf]                                      | 350   | -   | 530   | 770   |
| E <sub>sur</sub> [ksf]                        | 1000  | -   | 1000  | 1000  |
| Primary Consolidation                         | Disabled  | Enabled   | Disabled  | Disabled  |
| Material Type                                 |   | Non-Linear  |   |   |
| C <sub>ce</sub>                               | -   | 0.2   | -   | -   |
| C <sub>re</sub>                               | -   | 0.014   | -   | -   |
| e <sub>0</sub>                                | -   | 1.1   | -   | -   |
| P <sub>c</sub> [ksf]                          | -   | 3.8   | -   | -   |
| C <sub>v</sub> [ft <sup>2</sup> /d]           | -   | 0.2   | -   | -   |
| C <sub>vr</sub> [ft <sup>2</sup> /d]          | -   | 0.2   | -   | -   |
| B-bar   | -   | 1   | -   | -   |
| Secondary Consolidation                       | Disabled  | Standard  | Disabled  | Disabled  |
| C <sub>ae</sub>                               | -   | 0.003   | -   | -   |
| C <sub>are</sub>                              | -   | 0.003   | -   | -   |
| Undrained Su A [kips/ft <sup>2</sup> ]        | 0   | 0   | 0   | 0   |
| Undrained Su S                                | 0.2   | 0.2   | 0.2   | 0.2   |
| Undrained Su m                                | 0.8   | 0.8   | 0.8   | 0.8   |
| Piezo Line ID                                 | 1   | 1   | 1   | 1   |

## Groundwater

Groundwater method Piezometric Lines  
 Water Unit Weight 0.0624 kips/ft<sup>3</sup>

### Piezometric Line Entities

| ID | Depth (ft) |
|----|------------|
| 1  | -5 ft      |

### Query Points

| Point # | Query Point Name | (X,Y) Location    | Number of Divisions |
|---------|------------------|-------------------|---------------------|
| 3       | Query Point 3    | -3.70108, 56.6916 | Auto: 61            |

### Query Lines

| Line # | Query Line Name | Start Location    | End Location     | Horizontal Divisions | Vertical Divisions |
|--------|-----------------|-------------------|------------------|----------------------|--------------------|
| 1      | Query Line 1    | -28.3184, 33.1392 | 103.014, 144.667 | 20                   | Auto: 63           |
| 3      | Query Line 3    | 55.1605, 41.0947  | 33.925, 146.351  | 20                   | Auto: 75           |
| 4      | Query Line 4    | -10.239, 101.781  | 58.021, 167.806  | 20                   | Auto: 61           |

|         |                                 |            |            |                |         |
|---------|---------------------------------|------------|------------|----------------|---------|
| For     | MEDOT I-295 over Veranda Street | Job no.    | 75297      | Sheet no.      | 1 of 38 |
| Made by | JDZ                             | Checked by | JCJ        | Backchecked by | .       |
| Date    | 09/30/2019                      | Date       | 10/11/2019 | Date           | .       |



# MAINEDOT I-295 OVER VERANDA STREET

## GLOBAL STABILITY ANALYSIS FOR FINAL DESIGN

### SLOPE/W ANALYSIS FOR GLOBAL STABILITY



## SLOPE/W Analysis Summary

The Interstate 295 crossing over Veranda Street is to be modified during replacement to have a shorter span while the eastbound lane, currently separated from the westbound lane, will be relocated north to adjoin the westbound lane. A portion of the existing bridge will be replaced by embankment with the majority of the embankment being built of EPS Geofoam to satisfy settlement and stability needs. The embankment will be built with 2:1 slopes to the left and right transverse directions. The existing roadway is also being widened in this effort. Portions of the embankment which will be built out with minimal to no EPS Geofoam (as proposed to meet needs in mitigating settlement) have been checked to determine whether additional EPS Geofoam will be required to satisfy global stability. North of the crossing the roadway is being expanded with material being added to the left and right transverse slopes. Sections north of the crossing were assessed to determine EPS Geofoam needs to satisfy global stability. In consideration of cohesive soil strength, stability was checked for long-term drained conditions and short-term undrained conditions. Undrained conditions tend to result in lower factors of safety. AASHTO LRFD Bridge Design Specifications, 8<sup>th</sup> edition 2017 requires a resistance factor of 0.75 to be satisfied for global stability, which roughly equates to a 1.3 factor of safety. Table 1 provides the resulting minimum factor of safety for each transverse case assessed.

**TABLE 1: Results for Analyzed Transverse Sections – Assessed for Circular Failure Surfaces**

| Analyzed Cross-Section Station | Location with respect to crossing | Minimum Factor of Safety – Right Transverse (left to right failure) |              | Minimum Factor of Safety – Left Transverse (right to left failure) |           |
|--------------------------------|-----------------------------------|---|--------------|--|-----------|
|                                |                                   | Drained   | Undrained    | Drained  | Undrained |
| 37+00                          | South                             | 1.43  | 1.30         | 1.62   | 1.41      |
| 37+50                          | South                             | 1.48  | 1.39         | 3.10   | 2.10      |
| 39+92                          | North                             | 1.82  | 1.31 (1.21)* | 1.65   | 1.65      |
| 40+08                          | North                             | 1.45  | 1.31         | 1.52   | 1.52      |
| 40+16                          | North                             | 1.53  | 1.35         | 1.61   | 1.53      |

\*Condition required additional Geofoam to meet factor of safety requirements. The second value in parentheses gives the inadequate factor of safety achieved before incorporating additional EPS Geofoam. Analyses of the other conditions for the section incorporate the Geofoam required for the controlling condition.

Global stability of the abutments in the direction of traffic (longitudinal) is critical as such failures would cause significant damage to the bridge, approach roadways, and Veranda Street. With the majority of the material to be placed on the south side being lightweight (Geofoam or Lightweight Concrete), the minimum factor of safety for global stability along the south was well above the minimum required. For the north abutment, the reaction to the active earth pressure was incorporated for the exposed height of abutment wall as a 5,175 lbf (per foot of wall length) horizontal point load located one-third the exposed height from the base of the exposed height of the wall. On the south end this was not considered necessary to incorporate given the significant Geofoam and Lightweight Concrete which minimizes the active earth pressure imposed on the abutment wall as well as it being conservative to neglect the reaction force. On the north end the undrained case was shown to result in an insufficient factor of safety when the abutments and pile supported material were assumed to not impose weight on the underlying soils due to the stresses being transferred through the end bearing piles. However, the shear surfaces associated with these failures, which

pass just beneath the proposed abutment footing and daylight shortly after, would act to upheave the pile supported structures. The uplift force on the base of the pile caps that would be imposed by the soils in upheaval would need to overcome the weight of the pile supported structures, thus neglecting the weight of the pile supported materials due to end bearing would not be appropriate. The pile supported materials were reassessed with the full weight of the materials accounted for, which provided the necessary resistance to meet factor of safety requirements. Though none of the conditions at the south abutment showed insufficient factors of safety, the condition in which the weight of the pile supported structures/materials was also assessed on the south end for the undrained case. The geometry of the longitudinal models was based upon the profile through the center of the proposed southbound roadway, selected as the clay soils on towards the west tend to occur at shallower depths and in thicker deposits than to the east. While both a circular and an optimized non-circular failure surface were assessed for each condition, the minimum factor of safety criteria is applied to the minimum factor of safety achieved with circular failure surfaces. The non-circular failure surface was assessed as a check for the designer to judge whether the difference in shape and the reduction to the minimal factor of safety when compared to the results of the circular surface were reasonable. If the reduction to the minimum factor of safety was considered significant, the designer would deem that the results for the circular failure surfaces were inappropriate to assume for the design. The worst-case circular failure surface is optimized to a non-circular failure surface by the software performing iterations in which it continually makes adjustments and checks the factor of safety with each adjustment. The number of iterations was set to two thousand. Table 2 provides the resulting minimum factor of safety for each longitudinal case assessed.

**TABLE 2: Results for Analyzed Longitudinal Sections - Assessed for Circular and Optimized Failure Surfaces**

| Analyzed Cross-Section            | Minimum Factor of Safety – included weight of pile supported materials |                    |
|-----------------------------------|--|--------------------|
|                                   | Drained  | Undrained          |
| South Abutment (southbound lanes) | <u>4.95</u> (4.16)   | <u>2.49</u> (2.12) |
| North Abutment (southbound lanes) | <u>2.69</u> (2.21)   | <u>1.46</u> (1.26) |

Note the values in parentheses are the minimum factors of safety given for the optimized failure surface.

Engineering properties used for the modeling of soils and other materials are provided by Table 3. For more information regarding the selected soil properties, the Design Geotechnical Report should be referred to.

**Table 3: Modeled Engineering Properties of Soil and Materials**

| Material                        | $\gamma$<br>(pcf) | $\phi'$<br>(deg.) | c<br>(psf)               | $\Delta c/\Delta z$<br>(psf/ft) |
|---------------------------------|-------------------|-------------------|--------------------------|---------------------------------|
| Common Borrow<br>(to be placed) | 130               | 34                | ---                      | ---                             |
| Existing Fill                   | 110               | 32                | ---                      | ---                             |
| Marine Silt & Clay<br>Crust     | 115               | 33                | 500                      | ---                             |
| Marine Silt & Clay              | 115               | 34                | 500 (at top<br>of layer) | 15 to 20                        |
| Marine Sand                     | 115               | 34                | ---                      | ---                             |
| Glacial Till                    | 120               | 36                | ---                      | ---                             |
| EPS Geofoam (to<br>be placed)   | 3                 | 34                | ---                      | ---                             |
| Lightweight<br>Concrete         | 30                | High<br>strength  | High<br>strength         | ---                             |
| Concrete                        | 150               | High<br>strength  | High<br>strength         | ---                             |

Where:  $\gamma$  = Total unit weight of soil,  
 $\gamma'$  = Effective/buoyant unit weight of submerged soil,  
 $\phi'$  = Effective internal friction angle of soil,  
c = Undrained shear strength of soil,  
 $\Delta c/\Delta z$  = Increase in undrained shear strength of soil per foot of depth from top of layer, selected by examination of localized vane shear test results.

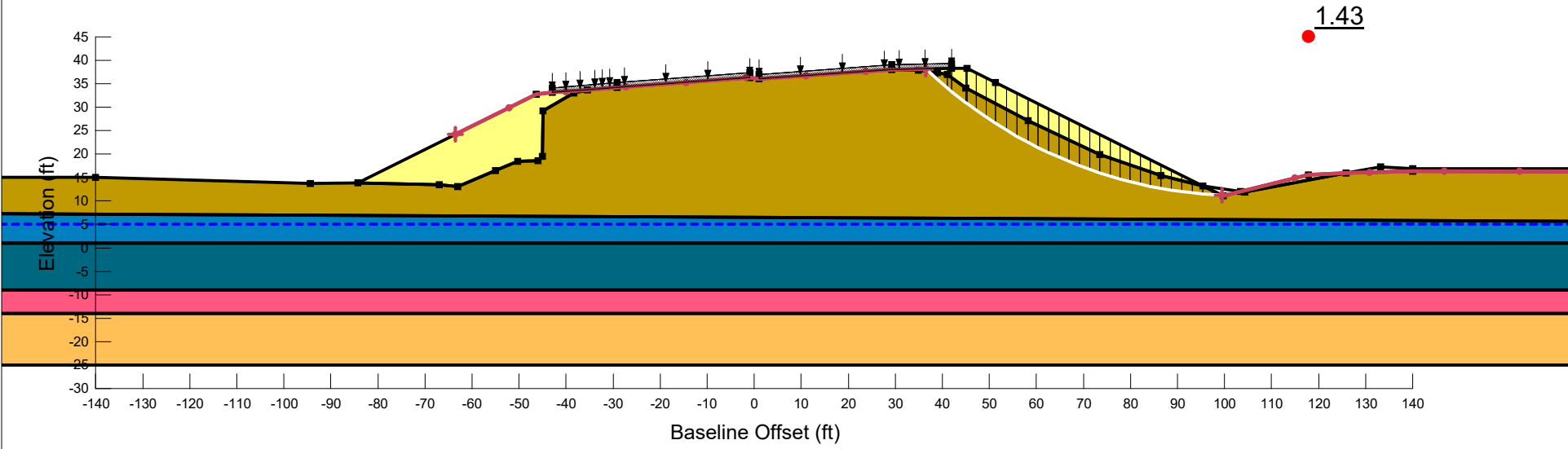
The global stability was analyzed using Spencer's method. Spencer's method is more complete than most other global stability methods for determining factor of safety in that all three conditions of static equilibrium in a two-dimensional plane (horizontal force, vertical force, and moment) are solved for where several other methods do not solve for all three. The entry-exit search criteria were utilized and, in the case of checking the longitudinal stability at the abutments, the circular slip surface which showed the lowest factor of safety was optimized for the critical non-circular slip surface.

AASHTO requires live loads from roadway traffic be incorporated as a 250-psf pressure distributed across the roadway. This was modeled as a 1-foot high, 250-pcf surcharge. The groundwater was incorporated into the models as a piezometric line at an elevation of +5 feet and applied to drained materials.

**MAINEDOT I-295 OVER VERANDA STREET  
SLOPE/W RESULT FIGURES**

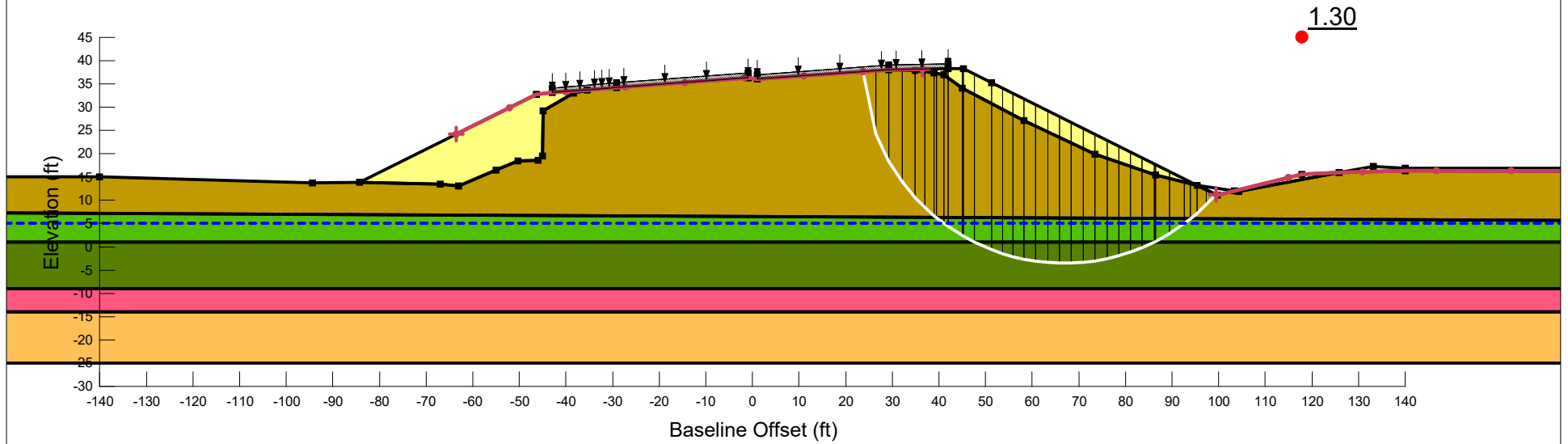
| Color   | Name                               | Model        | Unit Weight (pcf) | Phi' (°) | Piezometric Line |
|---|------------------------------------|--------------|-------------------|----------|------------------|
| <span style="display:inline-block; width:15px; height:15px; background-color:yellow; border:1px solid black;"></span> | Common Borrow                      | Mohr-Coulomb | 130               | 34       | 1                |
| <span style="display:inline-block; width:15px; height:15px; background-color:olive; border:1px solid black;"></span>  | Existing Fill                      | Mohr-Coulomb | 110               | 32       | 1                |
| <span style="display:inline-block; width:15px; height:15px; background-color:orange; border:1px solid black;"></span> | Glacial Till                       | Mohr-Coulomb | 120               | 36       | 1                |
| <span style="display:inline-block; width:15px; height:15px; background-color:yellow; border:1px solid black;"></span> | Marine Sand                        | Mohr-Coulomb | 115               | 34       | 1                |
| <span style="display:inline-block; width:15px; height:15px; background-color:blue; border:1px solid black;"></span>   | Marine Silt & Clay Crust - Drained | Mohr-Coulomb | 115               | 33       | 1                |
| <span style="display:inline-block; width:15px; height:15px; background-color:teal; border:1px solid black;"></span>   | Marine Silt and Clay - Drained     | Mohr-Coulomb | 115               | 34       | 1                |

Title: Veranda I-295, STA 37+00  
Name: Proposed-LR Drained  
Slip Surface Option: Entry and Exit  
Method: Spencer  
Surcharge (Unit Weight): 250 pcf



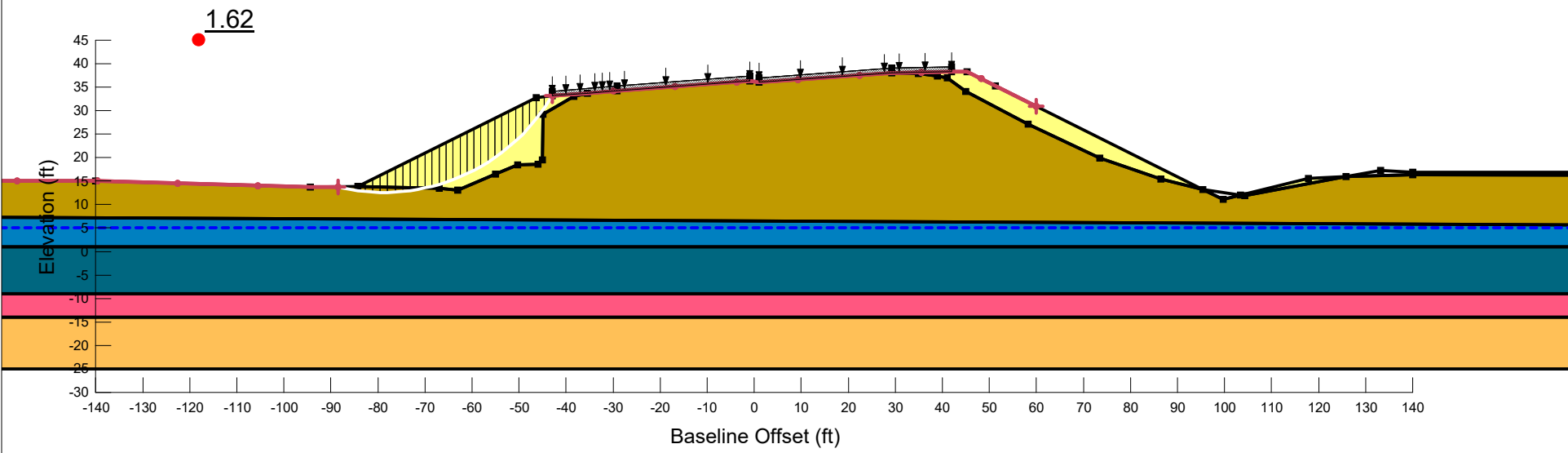
| Color | Name                     | Model             | Unit Weight (pcf) | Cohesion (psf) | C-Top of Layer (psf) | C-Rate of Change ((lb/ft <sup>2</sup> )/ft) | C-Maximum (psf) | Phi' (°) | Piezometric Line |
|-------|--------------------------|-------------------|-------------------|----------------|----------------------|---|-----------------|----------|------------------|
|       | Common Borrow            | Mohr-Coulomb      | 130               |                |                      |   |                 | 34       | 1                |
|       | Existing Fill            | Mohr-Coulomb      | 110               |                |                      |   |                 | 32       | 1                |
|       | Glacial Till             | Mohr-Coulomb      | 120               |                |                      |   |                 | 36       | 1                |
|       | Marine Sand              | Mohr-Coulomb      | 115               |                |                      |   |                 | 34       | 1                |
|       | Marine Silt & Clay       | S=f(depth)        | 115               |                | 500                  | 20  | 1,500           |          |                  |
|       | Marine Silt & Clay Crust | Undrained (Phi=0) | 115               | 500            |                      |   |                 |          |                  |

Title: Veranda I-295, STA 37+00  
 Name: Proposed-LR Undrained  
 Slip Surface Option: Entry and Exit  
 Method: Spencer  
 Surcharge (Unit Weight): 250 pcf



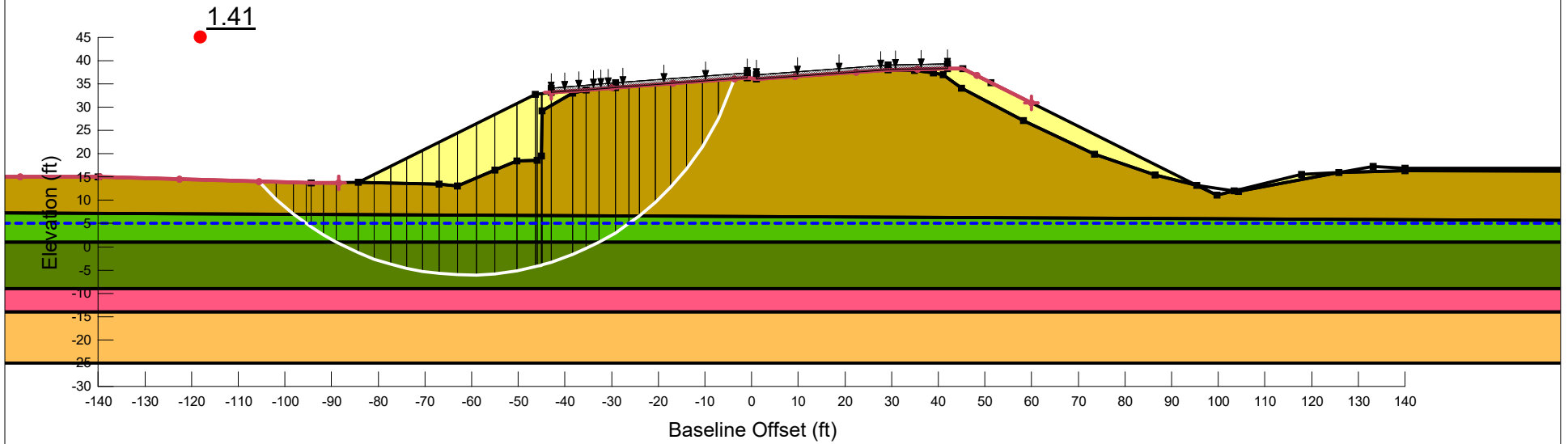
| Color                                 | Name                               | Model        | Unit Weight (pcf) | Phi' (°) | Piezometric Line |
|---------------------------------------|------------------------------------|--------------|-------------------|----------|------------------|
| <span style="color: yellow;">■</span> | Common Borrow                      | Mohr-Coulomb | 130               | 34       | 1                |
| <span style="color: brown;">■</span>  | Existing Fill                      | Mohr-Coulomb | 110               | 32       | 1                |
| <span style="color: orange;">■</span> | Glacial Till                       | Mohr-Coulomb | 120               | 36       | 1                |
| <span style="color: pink;">■</span>   | Marine Sand                        | Mohr-Coulomb | 115               | 34       | 1                |
| <span style="color: blue;">■</span>   | Marine Silt & Clay Crust - Drained | Mohr-Coulomb | 115               | 33       | 1                |
| <span style="color: teal;">■</span>   | Marine Silt and Clay - Drained     | Mohr-Coulomb | 115               | 34       | 1                |

Title: Veranda I-295, STA 37+00  
Name: Proposed-RL Drained  
Slip Surface Option: Entry and Exit  
Method: Spencer  
Surcharge (Unit Weight): 250 pcf



| Color | Name                     | Model             | Unit Weight (pcf) | Cohesion (psf) | C-Top of Layer (psf) | C-Rate of Change ((lb/ft <sup>2</sup> )/ft) | C-Maximum (psf) | Phi' (°) | Piezometric Line |
|-------|--------------------------|-------------------|-------------------|----------------|----------------------|---|-----------------|----------|------------------|
|       | Common Borrow            | Mohr-Coulomb      | 130               |                |                      |   |                 | 34       | 1                |
|       | Existing Fill            | Mohr-Coulomb      | 110               |                |                      |   |                 | 32       | 1                |
|       | Glacial Till             | Mohr-Coulomb      | 120               |                |                      |   |                 | 36       | 1                |
|       | Marine Sand              | Mohr-Coulomb      | 115               |                |                      |   |                 | 34       | 1                |
|       | Marine Silt & Clay       | S=f(depth)        | 115               |                | 500                  | 20  | 1,500           |          |                  |
|       | Marine Silt & Clay Crust | Undrained (Phi=0) | 115               | 500            |                      |   |                 |          |                  |

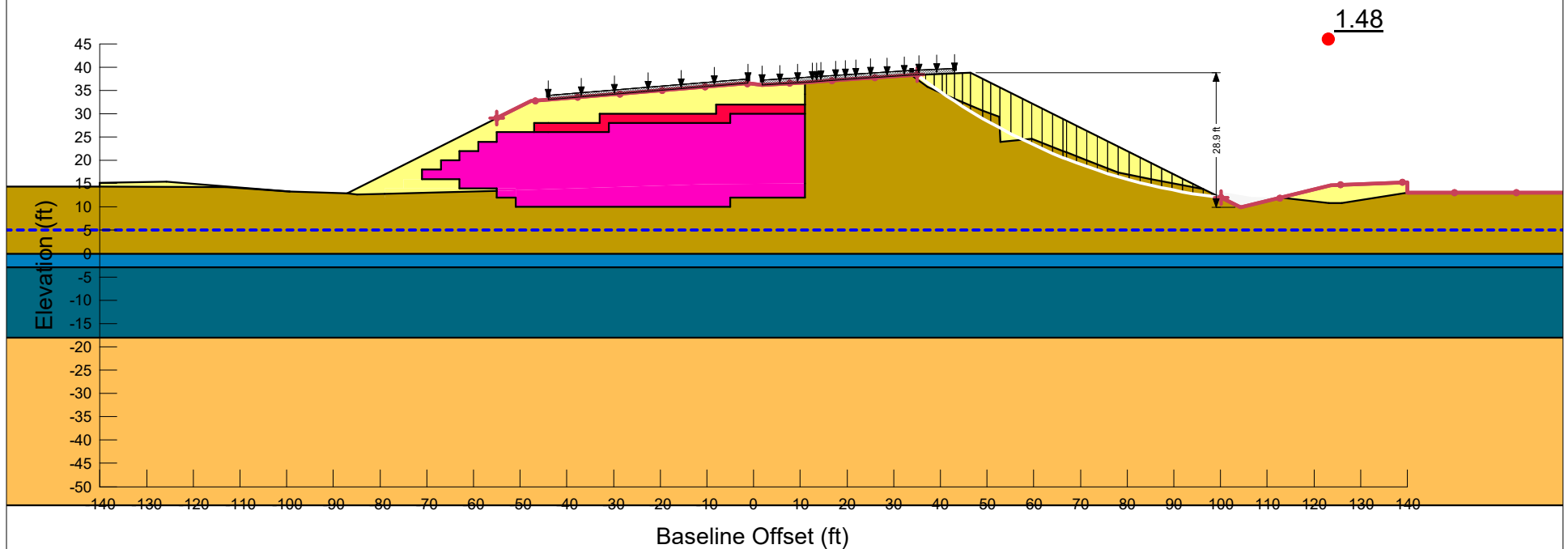
Title: Veranda I-295, STA 37+00  
 Name: Proposed-RL Undrained  
 Slip Surface Option: Entry and Exit  
 Method: Spencer  
 Surcharge (Unit Weight): 250 pcf





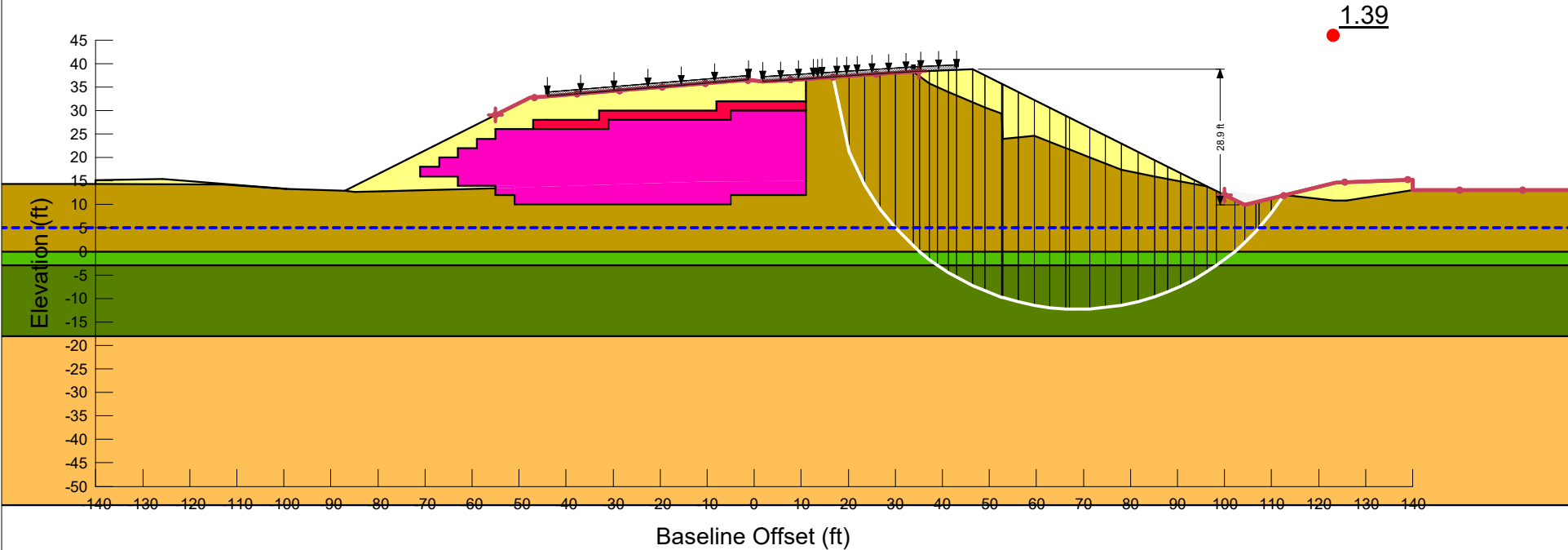
| Color | Name                               | Model         | Unit Weight (pcf) | Phi' (°) | Piezometric Line |
|-------|------------------------------------|---------------|-------------------|----------|------------------|
|       | Common Borrow                      | Mohr-Coulomb  | 130               | 34       | 1                |
|       | Existing Fill                      | Mohr-Coulomb  | 110               | 32       | 1                |
|       | Geofoam(1)                         | Mohr-Coulomb  | 3                 | 34       | 1                |
|       | Glacial Till                       | Mohr-Coulomb  | 120               | 36       | 1                |
|       | LW Concrete                        | High Strength | 30                |          | 1                |
|       | Marine Silt & Clay Crust - Drained | Mohr-Coulomb  | 115               | 33       | 1                |
|       | Marine Silt and Clay - Drained     | Mohr-Coulomb  | 115               | 34       | 1                |

Title: Veranda I-295, STA 37+50  
 Name: Proposed-LR Drained  
 Method: Spencer  
 Slip Surface Option: Entry and Exit  
 Surcharge (Unit Weight): 250 pcf



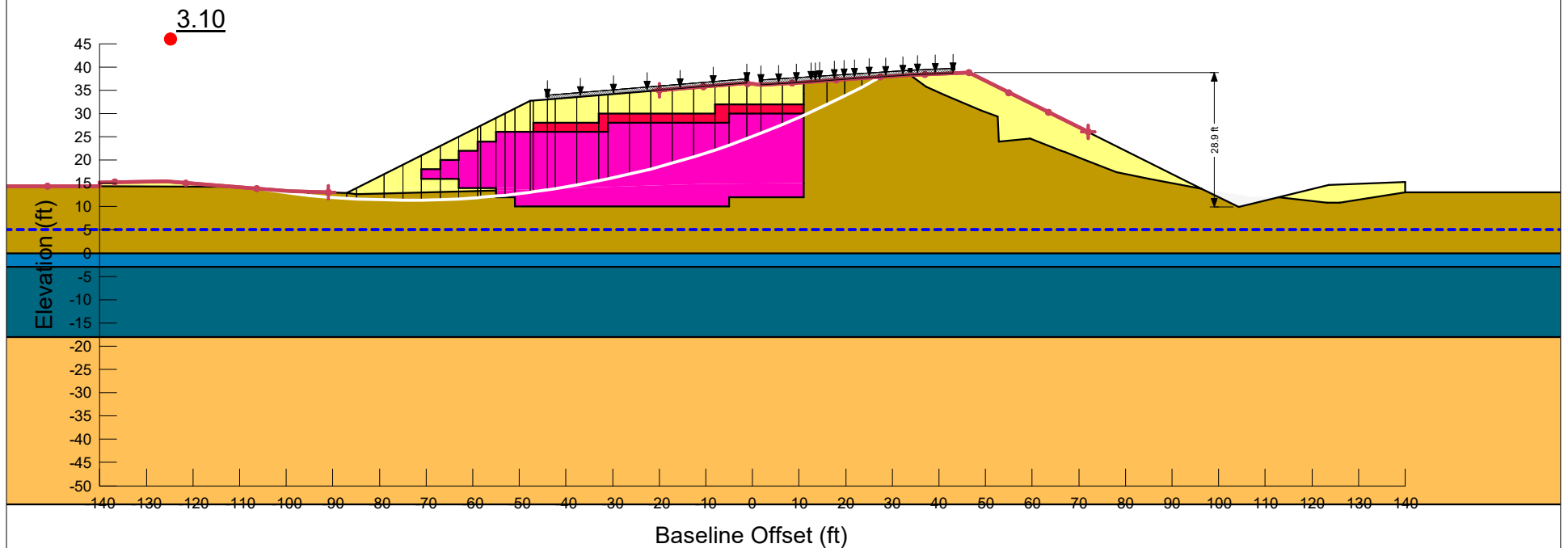
| Color | Name                     | Model             | Unit Weight (pcf) | Cohesion (psf) | C-Top of Layer (psf) | C-Rate of Change ((lb/ft <sup>2</sup> )/ft) | C-Maximum (psf) | Phi' (°) | Piezometric Line |
|-------|--------------------------|-------------------|-------------------|----------------|----------------------|---|-----------------|----------|------------------|
|       | Common Borrow            | Mohr-Coulomb      | 130               |                |                      |   |                 | 34       | 1                |
|       | Existing Fill            | Mohr-Coulomb      | 110               |                |                      |   |                 | 32       | 1                |
|       | Geofoam(1)               | Mohr-Coulomb      | 3                 |                |                      |   |                 | 34       | 1                |
|       | Glacial Till             | Mohr-Coulomb      | 120               |                |                      |   |                 | 36       | 1                |
|       | LW Concrete              | High Strength     | 30                |                |                      |   |                 |          | 1                |
|       | Marine Silt & Clay       | S=f(depth)        | 115               |                | 500                  | 15  | 1,500           |          |                  |
|       | Marine Silt & Clay Crust | Undrained (Phi=0) | 115               | 500            |                      |   |                 |          |                  |

Title: Veranda I-295, STA 37+50  
Name: Proposed-LR Undrained  
Method: Spencer  
Slip Surface Option: Entry and Exit  
Surcharge (Unit Weight): 250 pcf



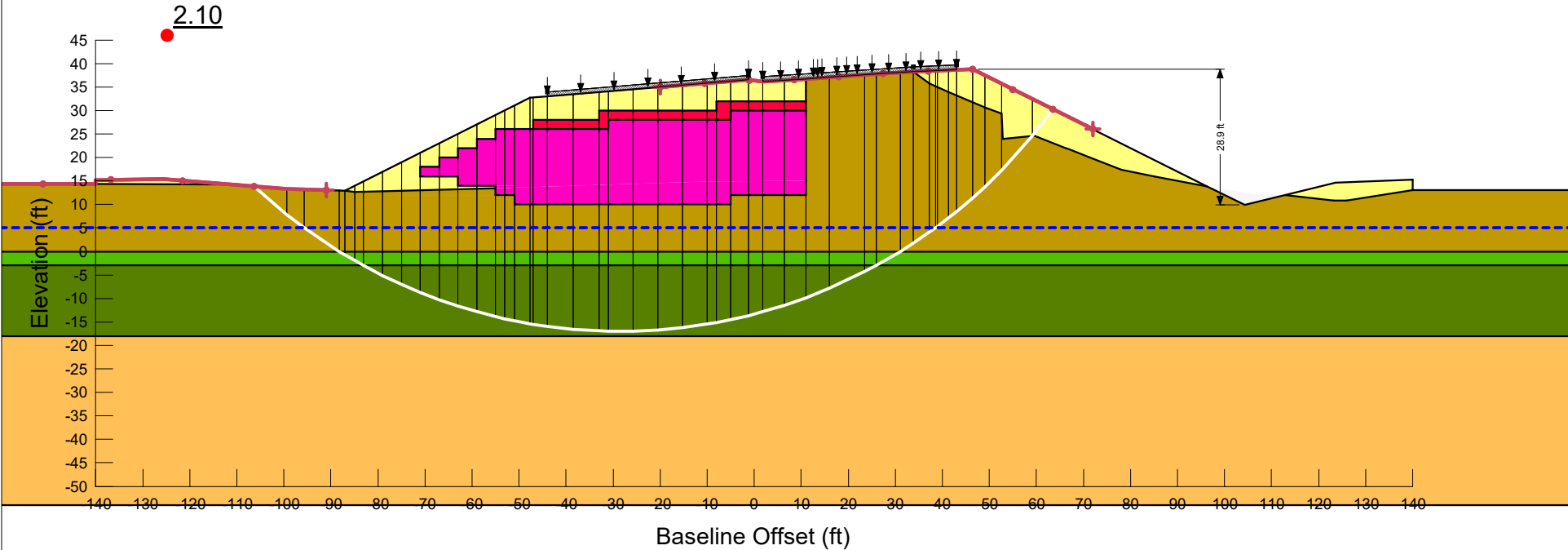
| Color | Name                               | Model         | Unit Weight (pcf) | Phi' (°) | Piezometric Line |
|-------|------------------------------------|---------------|-------------------|----------|------------------|
|       | Common Borrow                      | Mohr-Coulomb  | 130               | 34       | 1                |
|       | Existing Fill                      | Mohr-Coulomb  | 110               | 32       | 1                |
|       | Geofoam(1)                         | Mohr-Coulomb  | 3                 | 34       | 1                |
|       | Glacial Till                       | Mohr-Coulomb  | 120               | 36       | 1                |
|       | LW Concrete                        | High Strength | 30                |          | 1                |
|       | Marine Silt & Clay Crust - Drained | Mohr-Coulomb  | 115               | 33       | 1                |
|       | Marine Silt and Clay - Drained     | Mohr-Coulomb  | 115               | 34       | 1                |

Title: Veranda I-295, STA 37+50  
 Name: Proposed-RL Drained  
 Method: Spencer  
 Slip Surface Option: Entry and Exit  
 Surcharge (Unit Weight): 250 pcf



| Color | Name                     | Model             | Unit Weight (pcf) | Cohesion (psf) | C-Top of Layer (psf) | C-Rate of Change ((lb/ft <sup>2</sup> )/ft) | C-Maximum (psf) | Phi' (°) | Piezometric Line |
|-------|--------------------------|-------------------|-------------------|----------------|----------------------|---|-----------------|----------|------------------|
|       | Common Borrow            | Mohr-Coulomb      | 130               |                |                      |   |                 | 34       | 1                |
|       | Existing Fill            | Mohr-Coulomb      | 110               |                |                      |   |                 | 32       | 1                |
|       | Geofoam(1)               | Mohr-Coulomb      | 3                 |                |                      |   |                 | 34       | 1                |
|       | Glacial Till             | Mohr-Coulomb      | 120               |                |                      |   |                 | 36       | 1                |
|       | LW Concrete              | High Strength     | 30                |                |                      |   |                 |          | 1                |
|       | Marine Silt & Clay       | S=f(depth)        | 115               |                | 500                  | 15  | 1,500           |          |                  |
|       | Marine Silt & Clay Crust | Undrained (Phi=0) | 115               | 500            |                      |   |                 |          |                  |

Title: Veranda I-295, STA 37+50  
Name: Proposed-RL Undrained  
Method: Spencer  
Slip Surface Option: Entry and Exit  
Surcharge (Unit Weight): 250 pcf



| Color | Name                               | Model         | Unit Weight (pcf) | Phi' (°) | Piezometric Line |
|-------|------------------------------------|---------------|-------------------|----------|------------------|
|       | Common Borrow                      | Mohr-Coulomb  | 130               | 34       | 1                |
|       | Existing Fill                      | Mohr-Coulomb  | 110               | 32       | 1                |
|       | Geofoam(1)                         | Mohr-Coulomb  | 3                 | 34       | 1                |
|       | Glacial Till                       | Mohr-Coulomb  | 120               | 36       | 1                |
|       | LW Concrete                        | High Strength | 30                |          | 1                |
|       | Marine Sand                        | Mohr-Coulomb  | 115               | 34       | 1                |
|       | Marine Silt & Clay Crust - Drained | Mohr-Coulomb  | 115               | 33       | 1                |
|       | Marine Silt and Clay - Drained     | Mohr-Coulomb  | 115               | 34       | 1                |

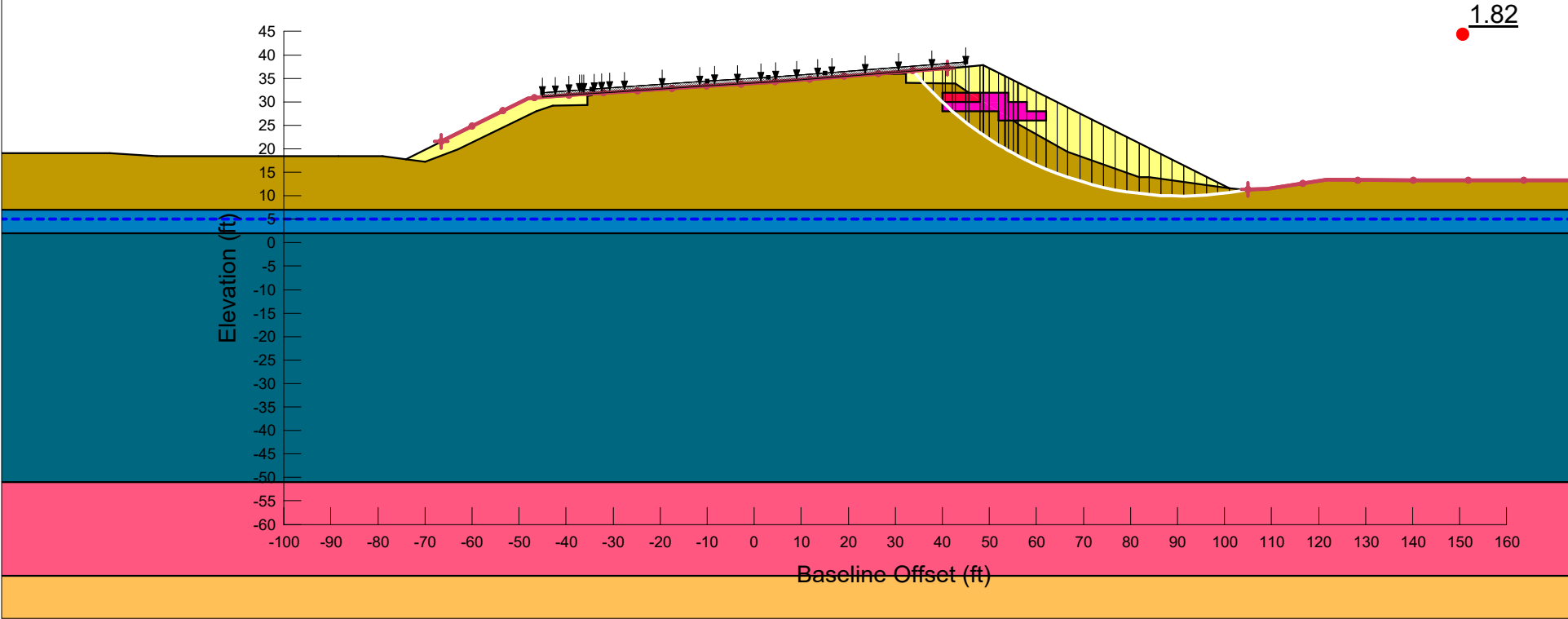
Title: Veranda I-295, STA 39+92

Name: Proposed-LR Drained w/ Geofoam

Method: Spencer

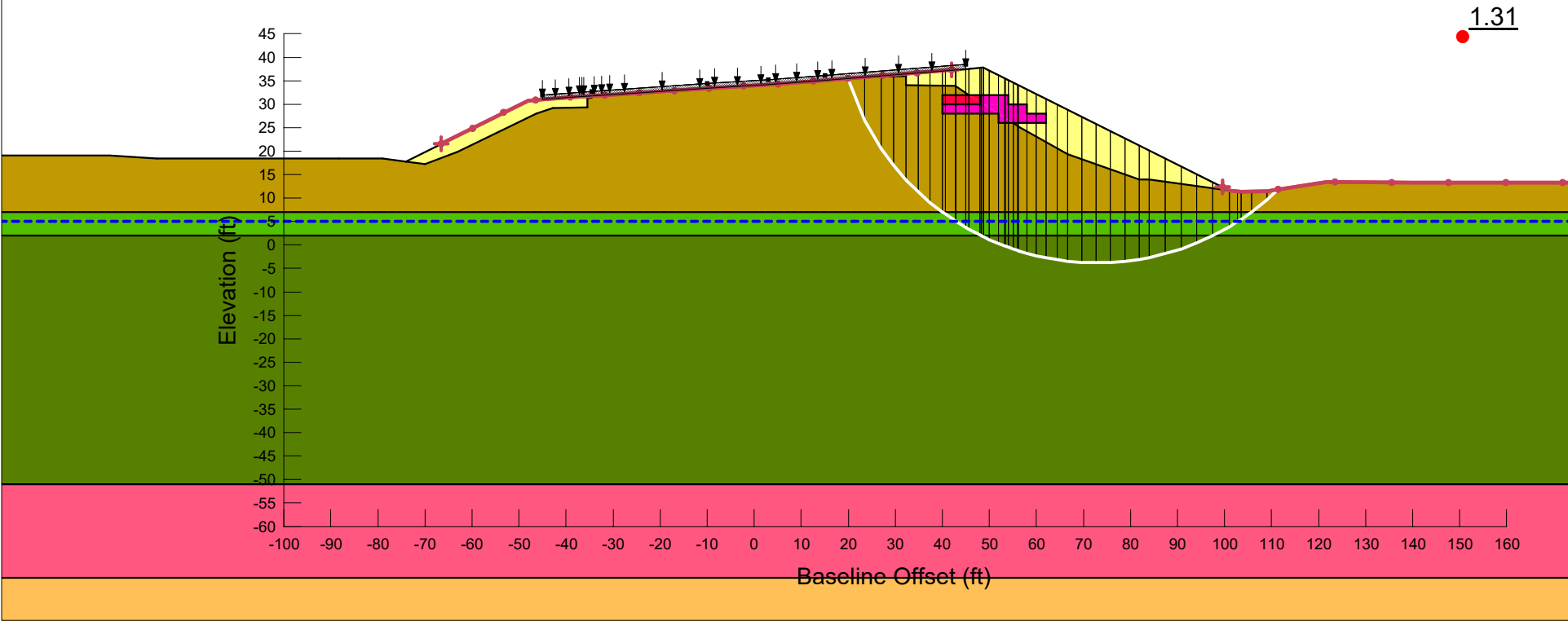
Slip Surface Option: Entry and Exit

Surcharge (Unit Weight): 250 pcf



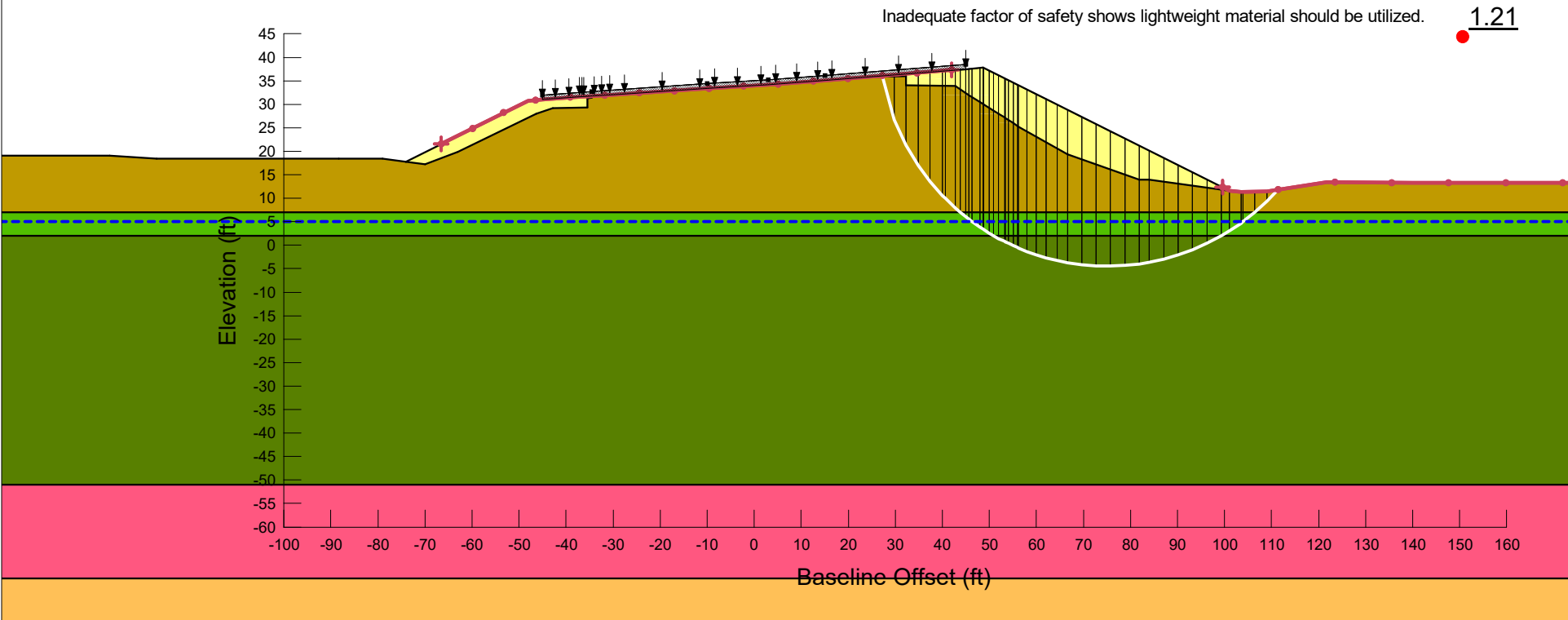
| Color | Name                     | Model             | Unit Weight (pcf) | Cohesion (psf) | C-Top of Layer (psf) | C-Rate of Change ((lb/ft <sup>2</sup> )/ft) | C-Maximum (psf) | Phi' (°) | Piezometric Line |
|-------|--------------------------|-------------------|-------------------|----------------|----------------------|---|-----------------|----------|------------------|
|       | Common Borrow            | Mohr-Coulomb      | 130               |                |                      |   |                 | 34       | 1                |
|       | Existing Fill            | Mohr-Coulomb      | 110               |                |                      |   |                 | 32       | 1                |
|       | Geofoam(1)               | Mohr-Coulomb      | 3                 |                |                      |   |                 | 34       | 1                |
|       | Glacial Till             | Mohr-Coulomb      | 120               |                |                      |   |                 | 36       | 1                |
|       | LW Concrete              | High Strength     | 30                |                |                      |   |                 |          | 1                |
|       | Marine Sand              | Mohr-Coulomb      | 115               |                |                      |   |                 | 34       | 1                |
|       | Marine Silt & Clay       | S=f(depth)        | 115               |                | 500                  | 20  | 1,500           |          |                  |
|       | Marine Silt & Clay Crust | Undrained (Phi=0) | 115               | 500            |                      |   |                 |          |                  |

Title: Veranda I-295, STA 39+92  
 Name: Proposed-LR Undrained w/ Geofoam  
 Method: Spencer  
 Slip Surface Option: Entry and Exit  
 Surcharge (Unit Weight): 250 pcf



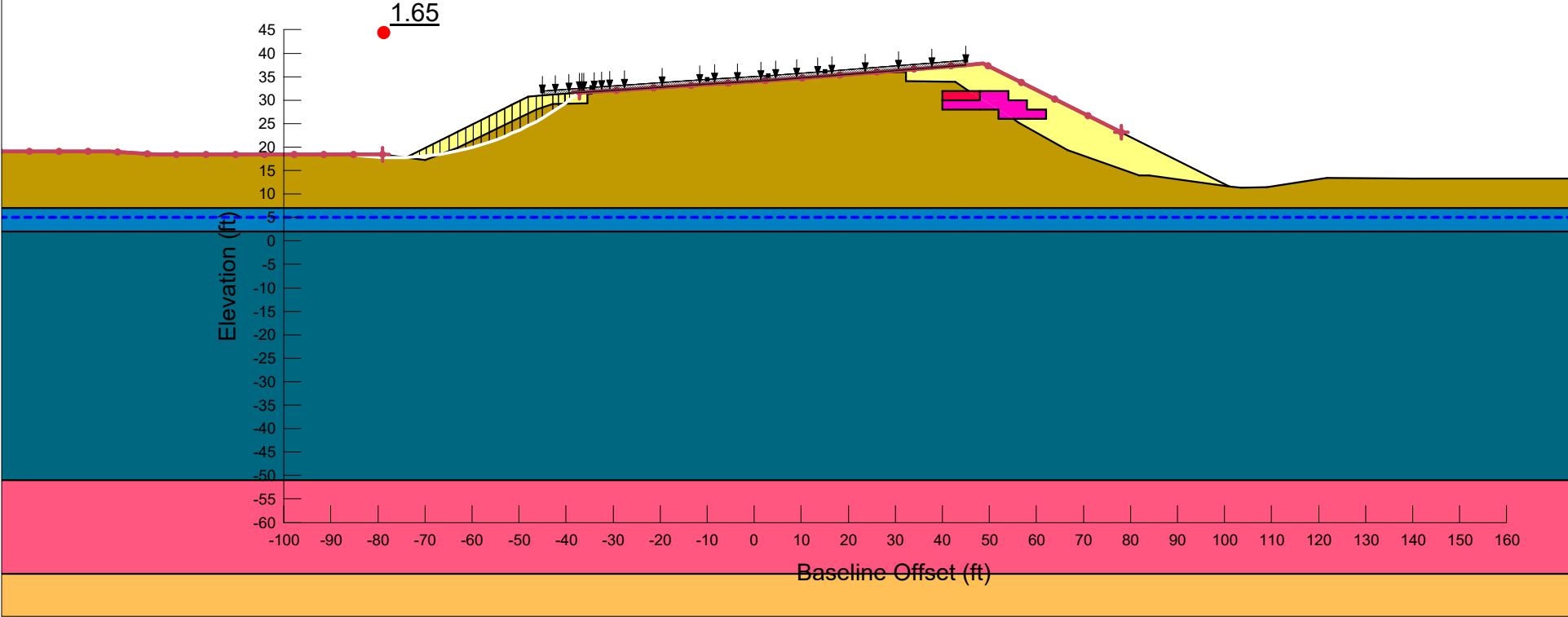
| Color | Name                     | Model             | Unit Weight (pcf) | Cohesion (psf) | C-Top of Layer (psf) | C-Rate of Change ((lb/ft <sup>2</sup> )/ft) | C-Maximum (psf) | Phi' (°) | Piezometric Line |
|-------|--------------------------|-------------------|-------------------|----------------|----------------------|---|-----------------|----------|------------------|
|       | Common Borrow            | Mohr-Coulomb      | 130               |                |                      |   |                 | 34       | 1                |
|       | Existing Fill            | Mohr-Coulomb      | 110               |                |                      |   |                 | 32       | 1                |
|       | Glacial Till             | Mohr-Coulomb      | 120               |                |                      |   |                 | 36       | 1                |
|       | Marine Sand              | Mohr-Coulomb      | 115               |                |                      |   |                 | 34       | 1                |
|       | Marine Silt & Clay       | S=f(depth)        | 115               |                | 500                  | 20  | 1,500           |          |                  |
|       | Marine Silt & Clay Crust | Undrained (Phi=0) | 115               | 500            |                      |   |                 |          |                  |

Title: Veranda I-295, STA 39+92  
 Name: Proposed-LR Undrained-fails  
 Method: Spencer  
 Slip Surface Option: Entry and Exit  
 Surcharge (Unit Weight): 250 pcf



| Color   | Name                               | Model         | Unit Weight (pcf) | Phi' (°) | Piezometric Line |
|---|------------------------------------|---------------|-------------------|----------|------------------|
| <span style="background-color: yellow;"> </span>  | Common Borrow                      | Mohr-Coulomb  | 130               | 34       | 1                |
| <span style="background-color: brown;"> </span>   | Existing Fill                      | Mohr-Coulomb  | 110               | 32       | 1                |
| <span style="background-color: magenta;"> </span> | Geofoam(1)                         | Mohr-Coulomb  | 3                 | 34       | 1                |
| <span style="background-color: orange;"> </span>  | Glacial Till                       | Mohr-Coulomb  | 120               | 36       | 1                |
| <span style="background-color: red;"> </span>     | LW Concrete                        | High Strength | 30                |          | 1                |
| <span style="background-color: pink;"> </span>    | Marine Sand                        | Mohr-Coulomb  | 115               | 34       | 1                |
| <span style="background-color: blue;"> </span>    | Marine Silt & Clay Crust - Drained | Mohr-Coulomb  | 115               | 33       | 1                |
| <span style="background-color: teal;"> </span>    | Marine Silt and Clay - Drained     | Mohr-Coulomb  | 115               | 34       | 1                |

Title: Veranda I-295, STA 39+92  
Name: Proposed-RL Drained  
Method: Spencer  
Slip Surface Option: Entry and Exit  
Surcharge (Unit Weight): 250 pcf

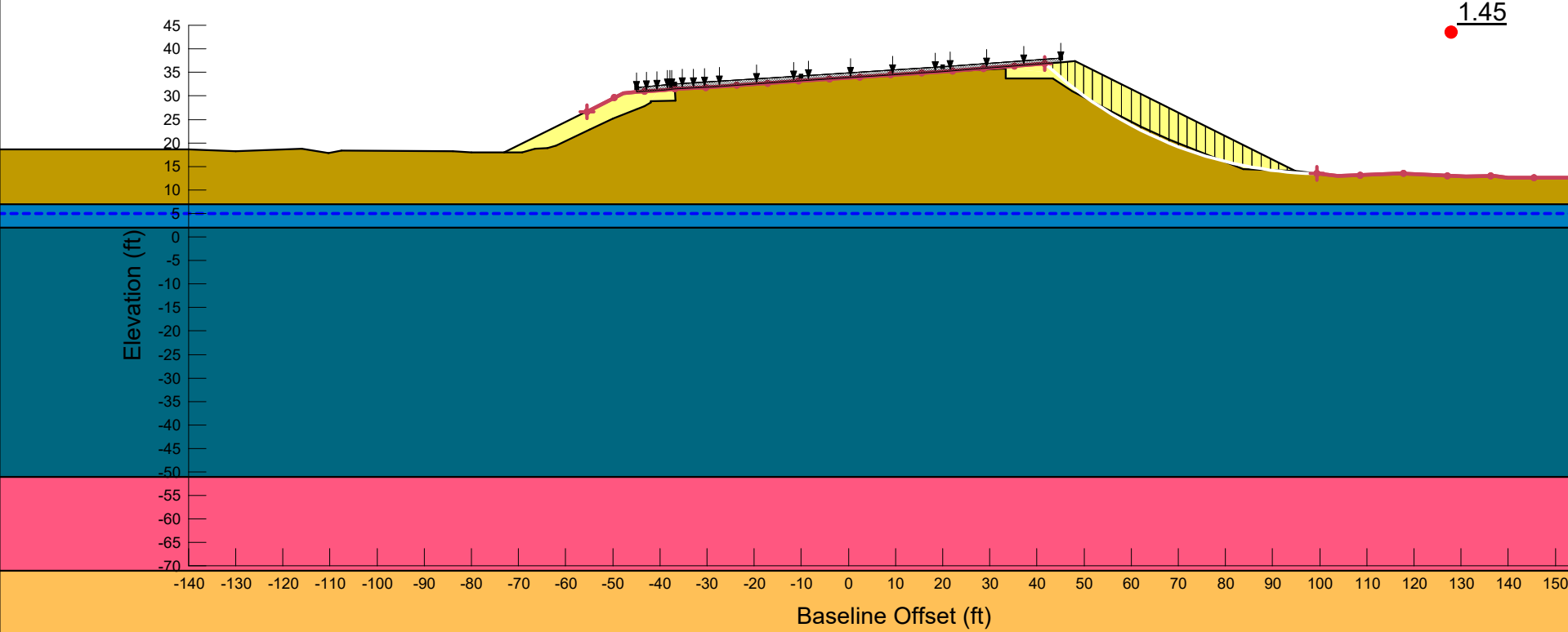






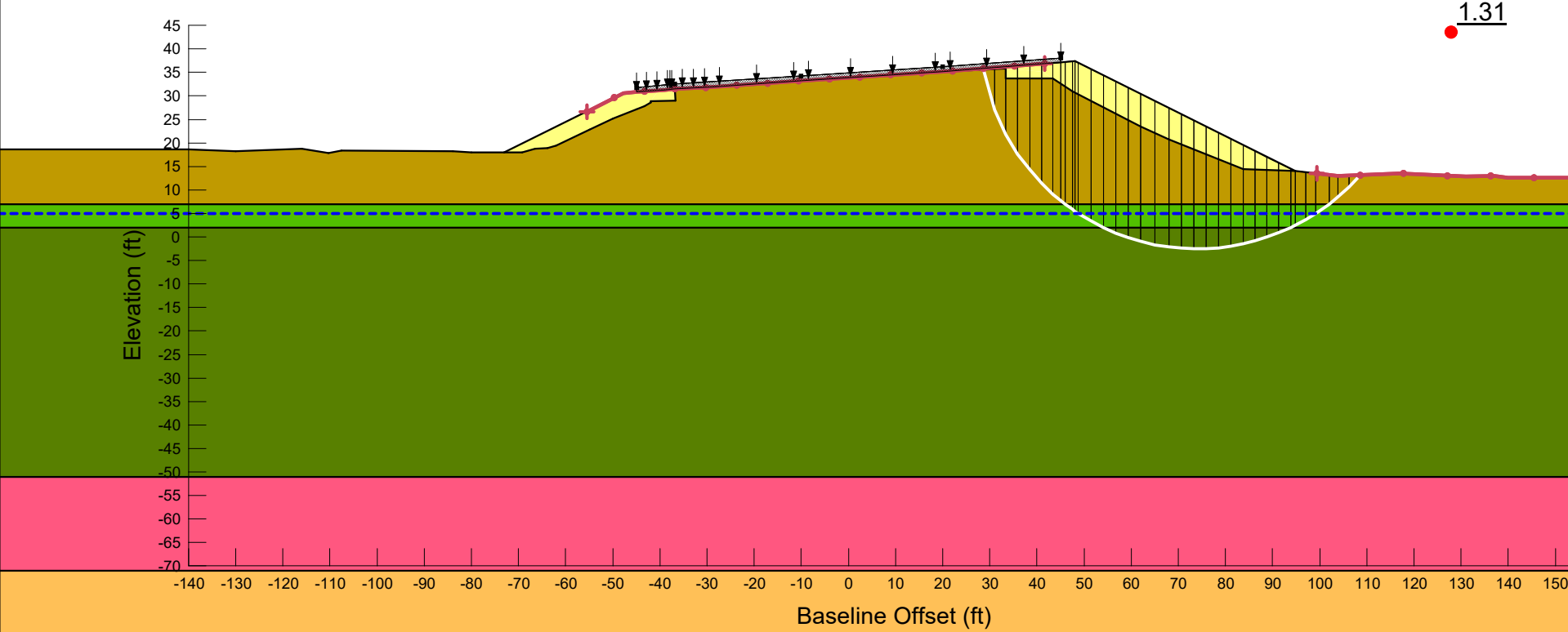
| Color   | Name                               | Model        | Unit Weight (pcf) | Phi' (°) | Piezometric Line |
|---|------------------------------------|--------------|-------------------|----------|------------------|
| <span style="display:inline-block; width:15px; height:15px; background-color:yellow; border:1px solid black;"></span> | Common Borrow                      | Mohr-Coulomb | 130               | 34       | 1                |
| <span style="display:inline-block; width:15px; height:15px; background-color:gold; border:1px solid black;"></span>   | Existing Fill                      | Mohr-Coulomb | 110               | 32       | 1                |
| <span style="display:inline-block; width:15px; height:15px; background-color:orange; border:1px solid black;"></span> | Glacial Till                       | Mohr-Coulomb | 120               | 36       | 1                |
| <span style="display:inline-block; width:15px; height:15px; background-color:yellow; border:1px solid black;"></span> | Marine Sand                        | Mohr-Coulomb | 115               | 34       | 1                |
| <span style="display:inline-block; width:15px; height:15px; background-color:blue; border:1px solid black;"></span>   | Marine Silt & Clay Crust - Drained | Mohr-Coulomb | 115               | 33       | 1                |
| <span style="display:inline-block; width:15px; height:15px; background-color:teal; border:1px solid black;"></span>   | Marine Silt and Clay - Drained     | Mohr-Coulomb | 115               | 34       | 1                |

Title: Veranda I-295, STA 40+08  
Name: Proposed-LR Drained  
Method: Spencer  
Slip Surface Option: Entry and Exit  
Surcharge (Unit Weight): 250 pcf



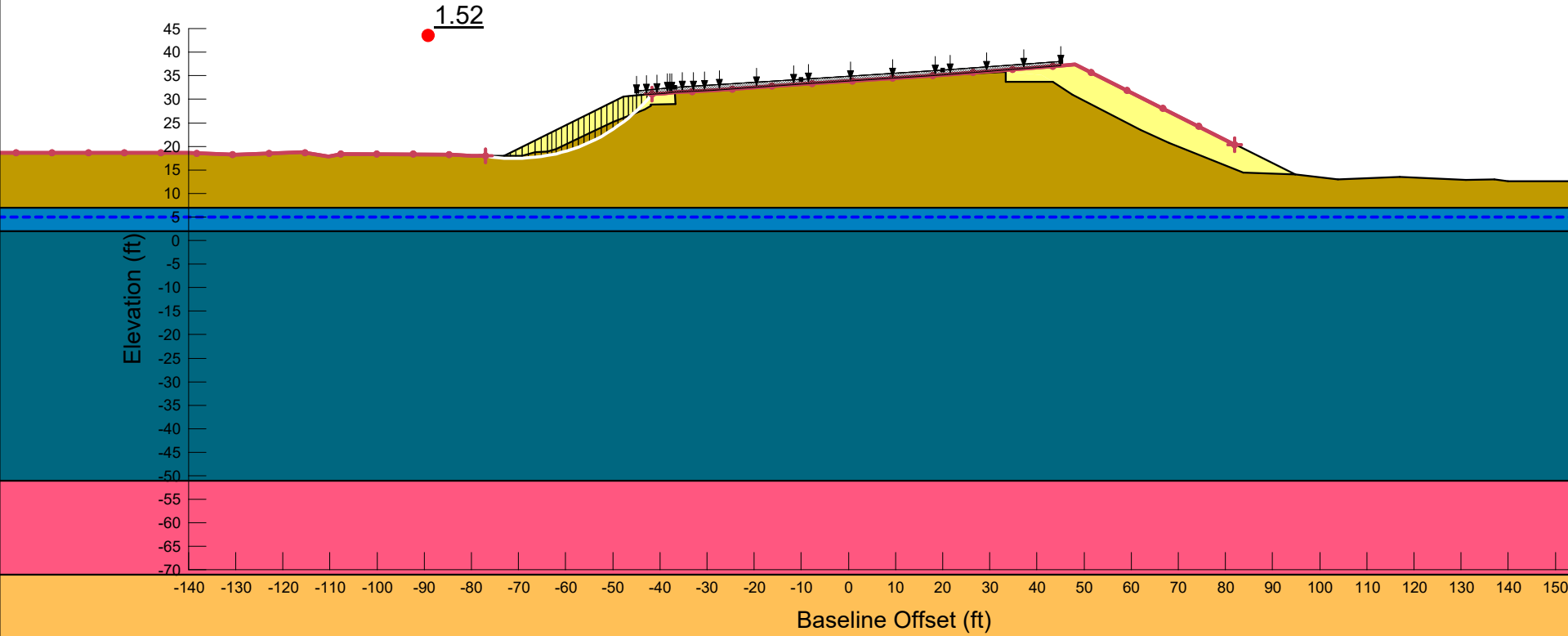
| Color       | Name                     | Model             | Unit Weight (pcf) | Cohesion (psf) | C-Top of Layer (psf) | C-Rate of Change ((lb/ft <sup>2</sup> )/ft) | C-Maximum (psf) | Phi' (°) | Piezometric Line |
|-------------|--------------------------|-------------------|-------------------|----------------|----------------------|---|-----------------|----------|------------------|
| <div></div> | Common Borrow            | Mohr-Coulomb      | 130               |                |                      |   |                 | 34       | 1                |
| <div></div> | Existing Fill            | Mohr-Coulomb      | 110               |                |                      |   |                 | 32       | 1                |
| <div></div> | Glacial Till             | Mohr-Coulomb      | 120               |                |                      |   |                 | 36       | 1                |
| <div></div> | Marine Sand              | Mohr-Coulomb      | 115               |                |                      |   |                 | 34       | 1                |
| <div></div> | Marine Silt & Clay       | S=f(depth)        | 115               |                | 500                  | 20  | 1,500           |          |                  |
| <div></div> | Marine Silt & Clay Crust | Undrained (Phi=0) | 115               | 500            |                      |   |                 |          |                  |

Title: Veranda I-295, STA 40+08  
Name: Proposed-LR Undrained  
Method: Spencer  
Slip Surface Option: Entry and Exit  
Surcharge (Unit Weight): 250 pcf



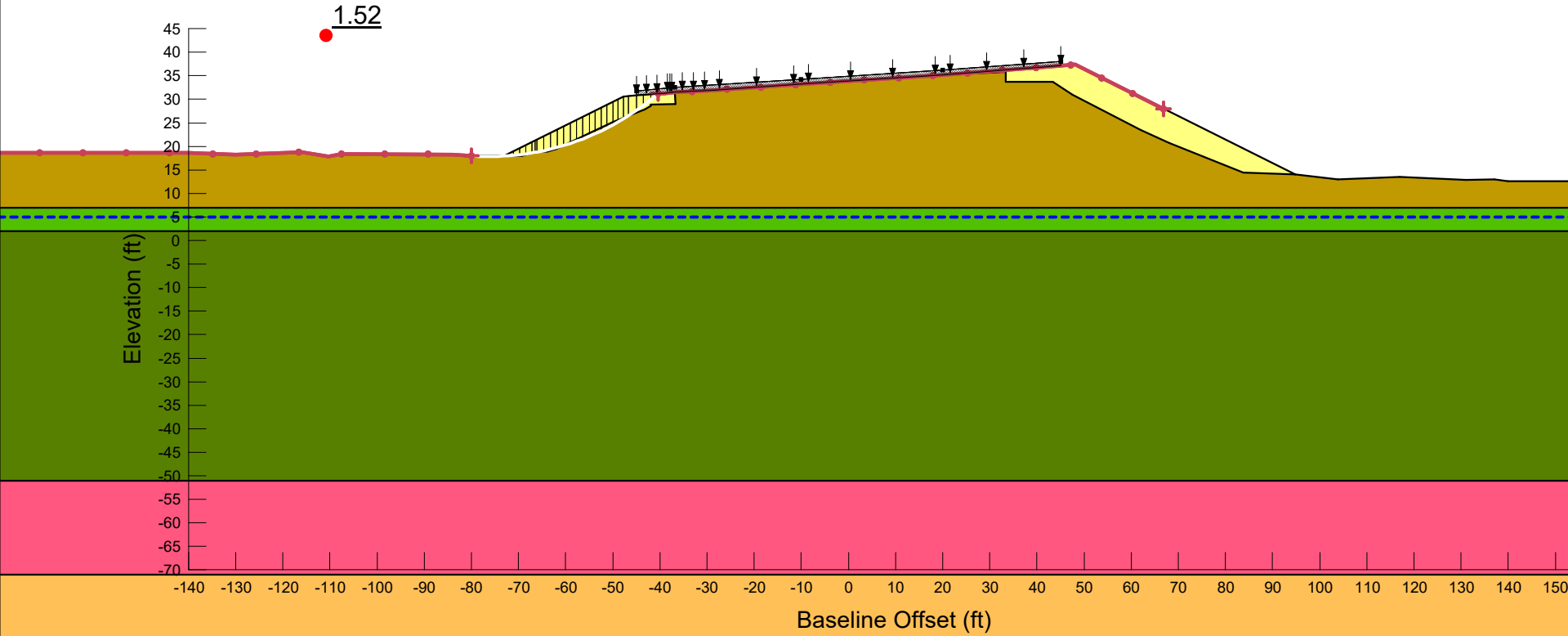
| Color       | Name                               | Model        | Unit Weight (pcf) | Phi' (°) | Piezometric Line |
|-------------|------------------------------------|--------------|-------------------|----------|------------------|
| <div></div> | Common Borrow                      | Mohr-Coulomb | 130               | 34       | 1                |
| <div></div> | Existing Fill                      | Mohr-Coulomb | 110               | 32       | 1                |
| <div></div> | Glacial Till                       | Mohr-Coulomb | 120               | 36       | 1                |
| <div></div> | Marine Sand                        | Mohr-Coulomb | 115               | 34       | 1                |
| <div></div> | Marine Silt & Clay Crust - Drained | Mohr-Coulomb | 115               | 33       | 1                |
| <div></div> | Marine Silt and Clay - Drained     | Mohr-Coulomb | 115               | 34       | 1                |

Title: Veranda I-295, STA 40+08  
Name: Proposed-RL Drained  
Method: Spencer  
Slip Surface Option: Entry and Exit  
Surcharge (Unit Weight): 250 pcf



| Color   | Name                     | Model             | Unit Weight (pcf) | Cohesion (psf) | C-Top of Layer (psf) | C-Rate of Change ((lb/ft <sup>2</sup> )/ft) | C-Maximum (psf) | Phi' (°) | Piezometric Line |
|---|--------------------------|-------------------|-------------------|----------------|----------------------|---|-----------------|----------|------------------|
| <span style="display:inline-block; width:15px; height:15px; background-color:yellow; border:1px solid black;"></span>     | Common Borrow            | Mohr-Coulomb      | 130               |                |                      |   |                 | 34       | 1                |
| <span style="display:inline-block; width:15px; height:15px; background-color:gold; border:1px solid black;"></span>       | Existing Fill            | Mohr-Coulomb      | 110               |                |                      |   |                 | 32       | 1                |
| <span style="display:inline-block; width:15px; height:15px; background-color:orange; border:1px solid black;"></span>     | Glacial Till             | Mohr-Coulomb      | 120               |                |                      |   |                 | 36       | 1                |
| <span style="display:inline-block; width:15px; height:15px; background-color:yellow; border:1px solid black;"></span>     | Marine Sand              | Mohr-Coulomb      | 115               |                |                      |   |                 | 34       | 1                |
| <span style="display:inline-block; width:15px; height:15px; background-color:darkgreen; border:1px solid black;"></span>  | Marine Silt & Clay       | S=f(depth)        | 115               |                | 500                  | 20  | 1,500           |          |                  |
| <span style="display:inline-block; width:15px; height:15px; background-color:lightgreen; border:1px solid black;"></span> | Marine Silt & Clay Crust | Undrained (Phi=0) | 115               | 500            |                      |   |                 |          |                  |

Title: Veranda I-295, STA 40+08  
Name: Proposed-RL Undrained  
Method: Spencer  
Slip Surface Option: Entry and Exit  
Surcharge (Unit Weight): 250 pcf



| Color   | Name                               | Model        | Unit Weight (pcf) | Phi' (°) | Piezometric Line |
|---|------------------------------------|--------------|-------------------|----------|------------------|
| <span style="display:inline-block; width:15px; height:15px; background-color:yellow; border:1px solid black;"></span> | Common Borrow                      | Mohr-Coulomb | 130               | 34       | 1                |
| <span style="display:inline-block; width:15px; height:15px; background-color:gold; border:1px solid black;"></span>   | Existing Fill                      | Mohr-Coulomb | 110               | 32       | 1                |
| <span style="display:inline-block; width:15px; height:15px; background-color:orange; border:1px solid black;"></span> | Glacial Till                       | Mohr-Coulomb | 120               | 36       | 1                |
| <span style="display:inline-block; width:15px; height:15px; background-color:yellow; border:1px solid black;"></span> | Marine Sand                        | Mohr-Coulomb | 115               | 34       | 1                |
| <span style="display:inline-block; width:15px; height:15px; background-color:blue; border:1px solid black;"></span>   | Marine Silt & Clay Crust - Drained | Mohr-Coulomb | 115               | 33       | 1                |
| <span style="display:inline-block; width:15px; height:15px; background-color:teal; border:1px solid black;"></span>   | Marine Silt and Clay - Drained     | Mohr-Coulomb | 115               | 34       | 1                |

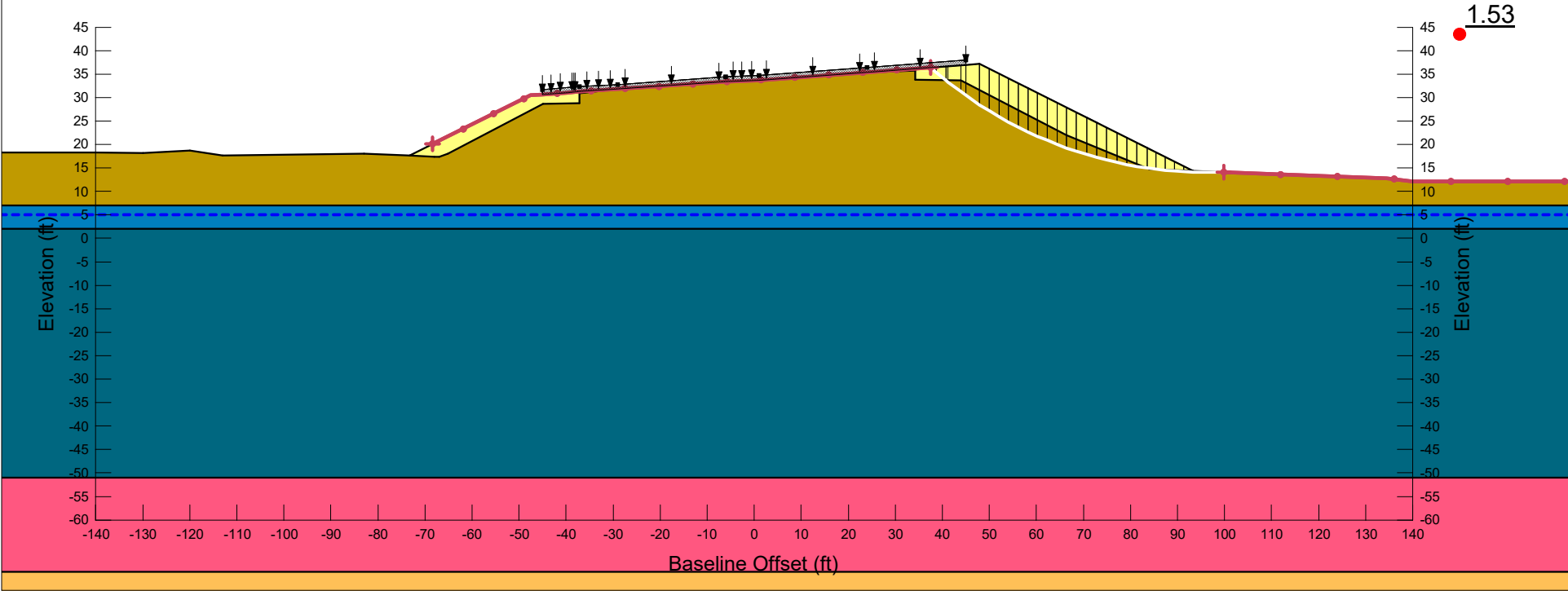
Title: Veranda I-295, STA 40+16

Name: Proposed-LR Drained

Method: Spencer

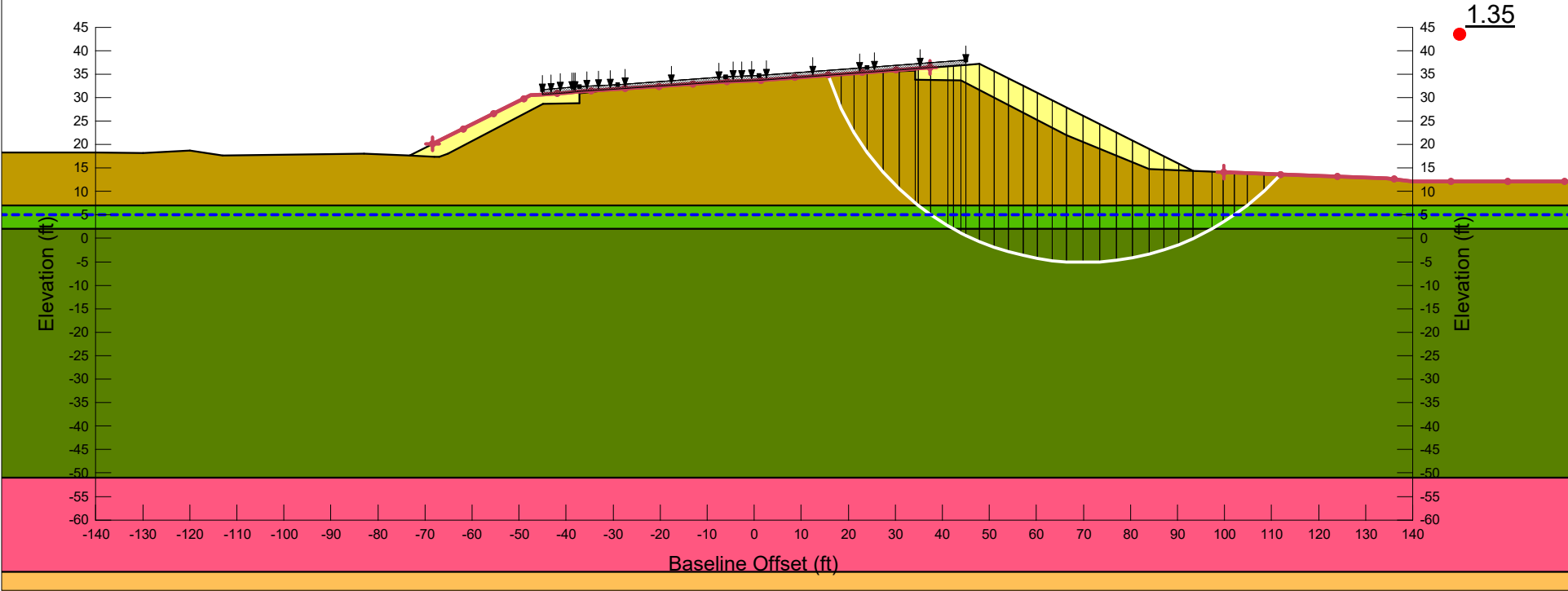
Slip Surface Option: Entry and Exit

Surcharge (Unit Weight): 250 pcf



| Color | Name                     | Model             | Unit Weight (pcf) | Cohesion (psf) | C-Top of Layer (psf) | C-Rate of Change ((lbf/ft²)/ft) | C-Maximum (psf) | Phi' (°) | Piezometric Line |
|-------|--------------------------|-------------------|-------------------|----------------|----------------------|---------------------------------|-----------------|----------|------------------|
|       | Common Borrow            | Mohr-Coulomb      | 130               |                |                      |                                 |                 | 34       | 1                |
|       | Existing Fill            | Mohr-Coulomb      | 110               |                |                      |                                 |                 | 32       | 1                |
|       | Glacial Till             | Mohr-Coulomb      | 120               |                |                      |                                 |                 | 36       | 1                |
|       | Marine Sand              | Mohr-Coulomb      | 115               |                |                      |                                 |                 | 34       | 1                |
|       | Marine Silt & Clay       | S=f(depth)        | 115               |                | 500                  | 20                              | 1,500           |          |                  |
|       | Marine Silt & Clay Crust | Undrained (Phi=0) | 115               | 500            |                      |                                 |                 |          |                  |

Title: Veranda I-295, STA 40+16  
Name: Proposed-LR Undrained  
Method: Spencer  
Slip Surface Option: Entry and Exit  
Surcharge (Unit Weight): 250 pcf



| Color   | Name                               | Model        | Unit Weight (pcf) | Phi' (°) | Piezometric Line |
|---|------------------------------------|--------------|-------------------|----------|------------------|
| <span style="display:inline-block; width:15px; height:15px; background-color:yellow; border:1px solid black;"></span> | Common Borrow                      | Mohr-Coulomb | 130               | 34       | 1                |
| <span style="display:inline-block; width:15px; height:15px; background-color:gold; border:1px solid black;"></span>   | Existing Fill                      | Mohr-Coulomb | 110               | 32       | 1                |
| <span style="display:inline-block; width:15px; height:15px; background-color:orange; border:1px solid black;"></span> | Glacial Till                       | Mohr-Coulomb | 120               | 36       | 1                |
| <span style="display:inline-block; width:15px; height:15px; background-color:yellow; border:1px solid black;"></span> | Marine Sand                        | Mohr-Coulomb | 115               | 34       | 1                |
| <span style="display:inline-block; width:15px; height:15px; background-color:blue; border:1px solid black;"></span>   | Marine Silt & Clay Crust - Drained | Mohr-Coulomb | 115               | 33       | 1                |
| <span style="display:inline-block; width:15px; height:15px; background-color:teal; border:1px solid black;"></span>   | Marine Silt and Clay - Drained     | Mohr-Coulomb | 115               | 34       | 1                |

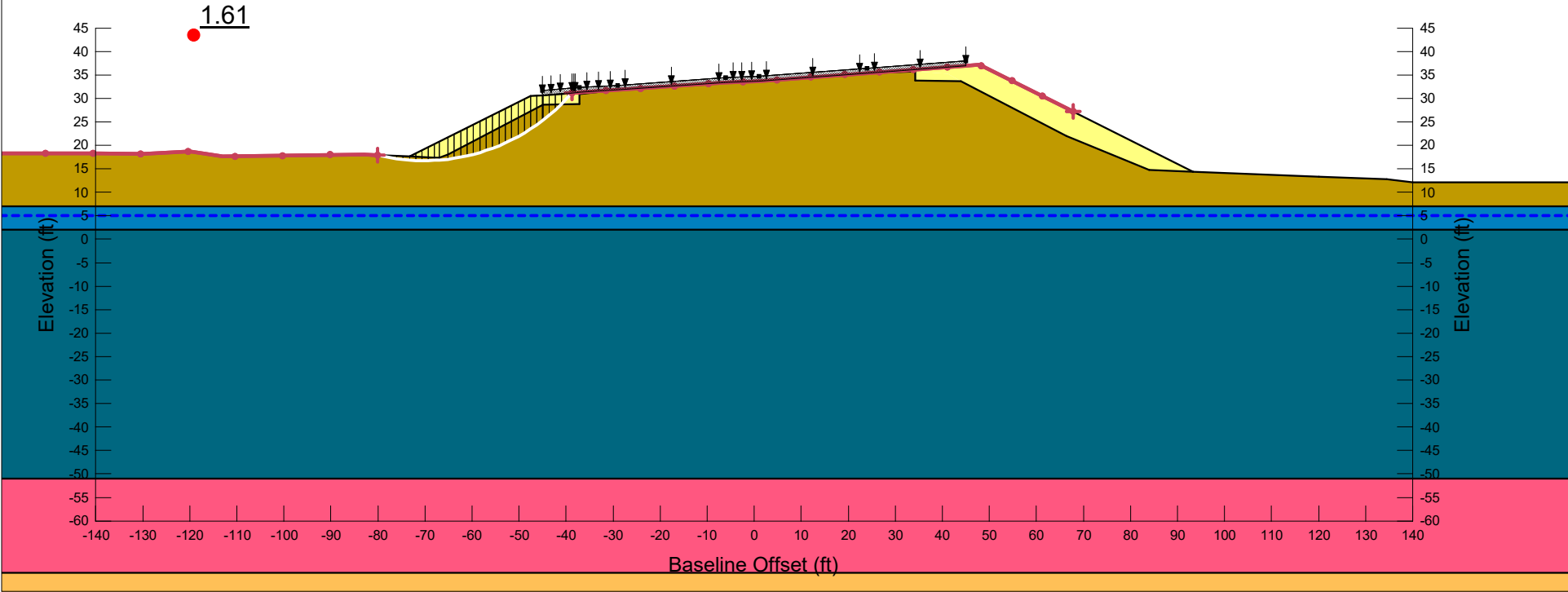
Title: Veranda I-295, STA 40+16

Name: Proposed-RL Drained

Method: Spencer

Slip Surface Option: Entry and Exit

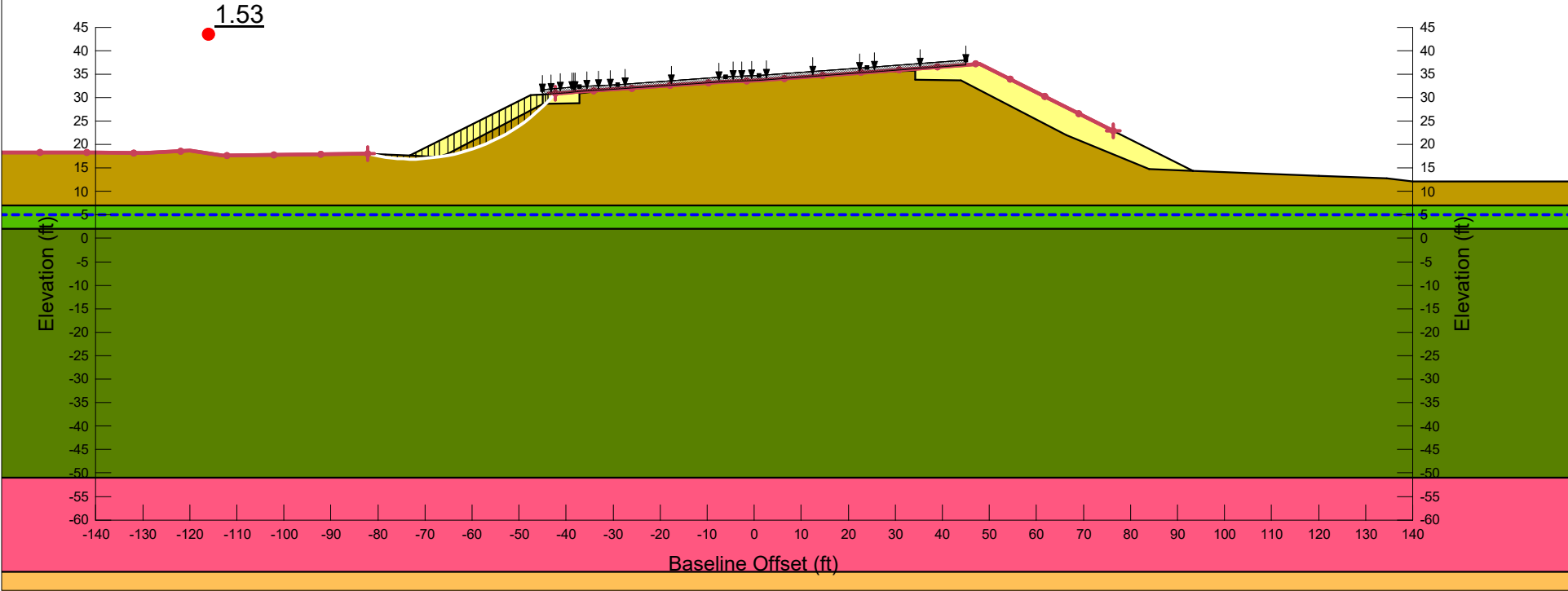
Surcharge (Unit Weight): 250 pcf





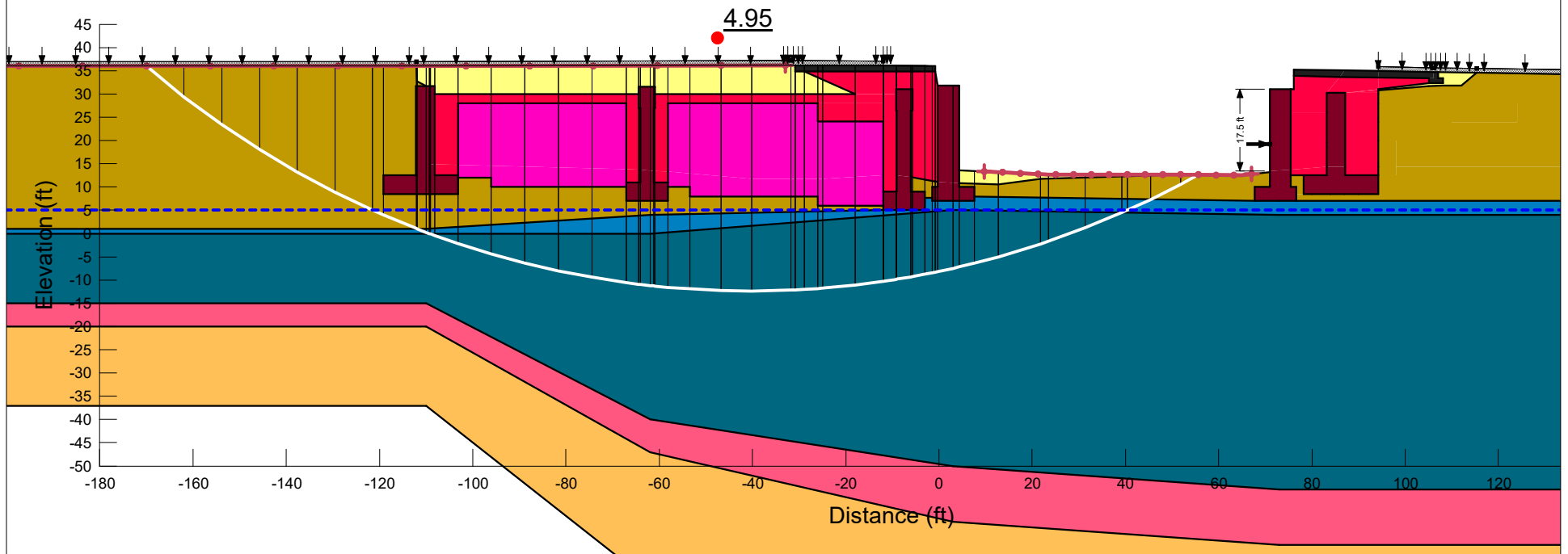
| Color | Name                     | Model             | Unit Weight (pcf) | Cohesion (psf) | C-Top of Layer (psf) | C-Rate of Change ((lbf/ft²)/ft) | C-Maximum (psf) | Phi' (°) | Piezometric Line |
|-------|--------------------------|-------------------|-------------------|----------------|----------------------|---------------------------------|-----------------|----------|------------------|
|       | Common Borrow            | Mohr-Coulomb      | 130               |                |                      |                                 |                 | 34       | 1                |
|       | Existing Fill            | Mohr-Coulomb      | 110               |                |                      |                                 |                 | 32       | 1                |
|       | Glacial Till             | Mohr-Coulomb      | 120               |                |                      |                                 |                 | 36       | 1                |
|       | Marine Sand              | Mohr-Coulomb      | 115               |                |                      |                                 |                 | 34       | 1                |
|       | Marine Silt & Clay       | S=f(depth)        | 115               |                | 500                  | 20                              | 1,500           |          |                  |
|       | Marine Silt & Clay Crust | Undrained (Phi=0) | 115               | 500            |                      |                                 |                 |          |                  |

Title: Veranda I-295, STA 40+16  
Name: Proposed-RL Undrained  
Method: Spencer  
Slip Surface Option: Entry and Exit  
Surcharge (Unit Weight): 250 pcf



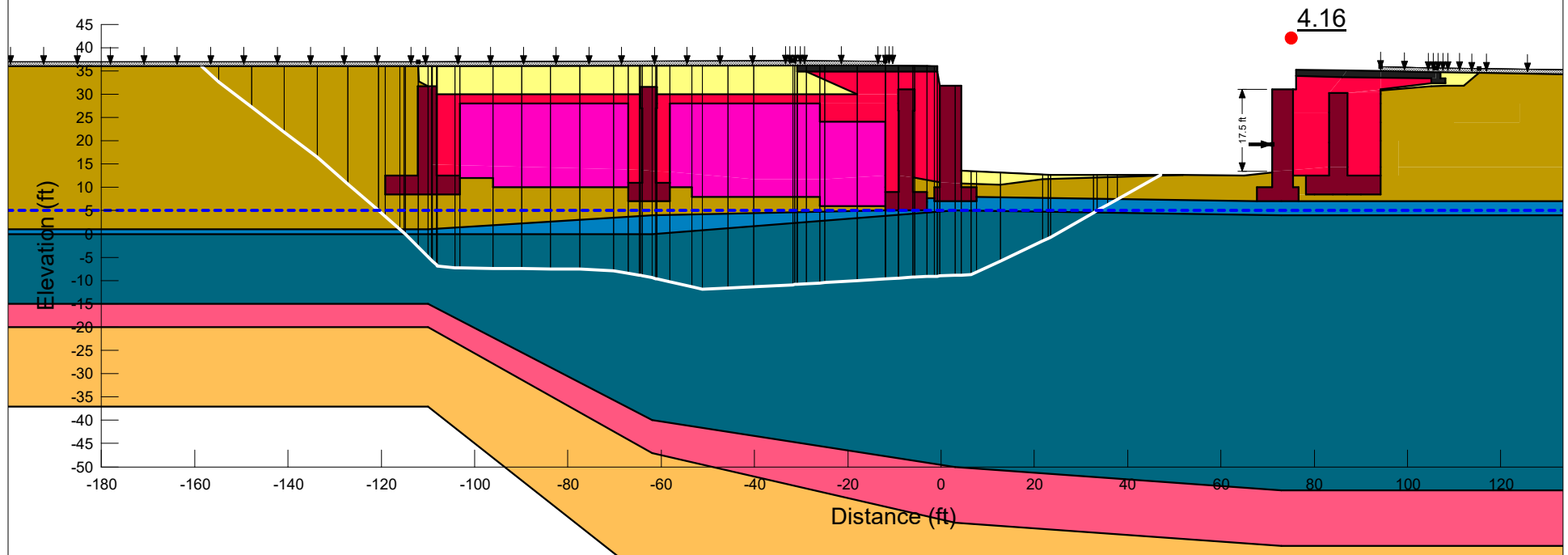
| Color | Name                               | Model         | Unit Weight (pcf) | Phi' (°) | Piezometric Line |
|-------|------------------------------------|---------------|-------------------|----------|------------------|
|       | Common Borrow                      | Mohr-Coulomb  | 130               | 34       | 1                |
|       | Concrete Slab                      | High Strength | 150               |          | 1                |
|       | Concrete weight                    | High Strength | 150               |          | 1                |
|       | Existing Fill                      | Mohr-Coulomb  | 110               | 32       | 1                |
|       | Geofoam(1)                         | Mohr-Coulomb  | 3                 | 34       | 1                |
|       | Glacial Till                       | Mohr-Coulomb  | 120               | 36       | 1                |
|       | LW Concrete                        | High Strength | 30                |          | 1                |
|       | Marine Sand                        | Mohr-Coulomb  | 115               | 34       | 1                |
|       | Marine Silt & Clay Crust - Drained | Mohr-Coulomb  | 115               | 33       | 1                |
|       | Marine Silt and Clay - Drained     | Mohr-Coulomb  | 115               | 34       | 1                |

Title: Veranda I-295, SB Profile, Longitudinal  
 Name: South Abutment Drained (circular)  
 Method: Spencer  
 Slip Surface Option: Entry and Exit  
 Surcharge (Unit Weight): 250 pcf  
 Magnitude: 5,175 lbf



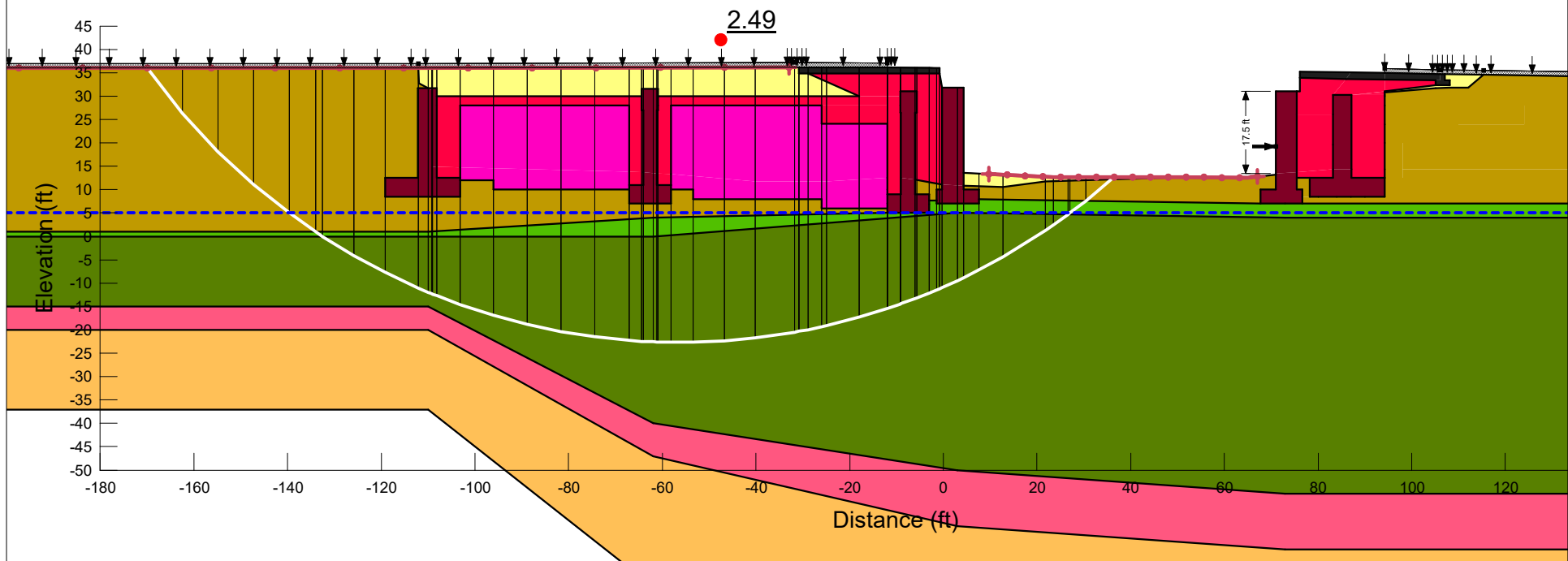
| Color | Name                               | Model         | Unit Weight (pcf) | Phi' (°) | Piezometric Line |
|-------|------------------------------------|---------------|-------------------|----------|------------------|
|       | Common Borrow                      | Mohr-Coulomb  | 130               | 34       | 1                |
|       | Concrete Slab                      | High Strength | 150               |          | 1                |
|       | Concrete weight                    | High Strength | 150               |          | 1                |
|       | Existing Fill                      | Mohr-Coulomb  | 110               | 32       | 1                |
|       | Geofoam(1)                         | Mohr-Coulomb  | 3                 | 34       | 1                |
|       | Glacial Till                       | Mohr-Coulomb  | 120               | 36       | 1                |
|       | LW Concrete                        | High Strength | 30                |          | 1                |
|       | Marine Sand                        | Mohr-Coulomb  | 115               | 34       | 1                |
|       | Marine Silt & Clay Crust - Drained | Mohr-Coulomb  | 115               | 33       | 1                |
|       | Marine Silt and Clay - Drained     | Mohr-Coulomb  | 115               | 34       | 1                |

Title: Veranda I-295, SB Profile, Longitudinal  
 Name: South Abutment Drained (non-circular)  
 Method: Spencer  
 Slip Surface Option: Critical Slip Surfaces from Other  
 Surcharge (Unit Weight): 250 pcf  
 Magnitude: 5,175 lbf



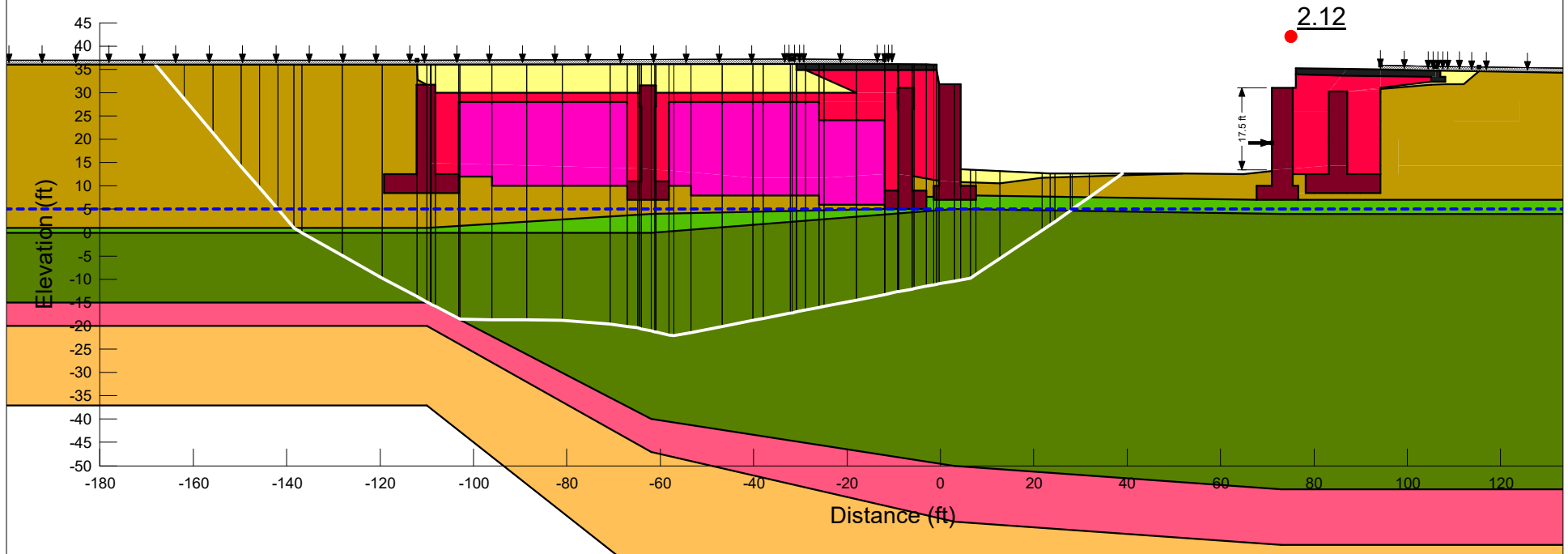
| Color | Name                     | Model             | Unit Weight (pcf) | Cohesion (psf) | C-Top of Layer (psf) | C-Rate of Change ((lbf/ft²)/ft) | C-Maximum (psf) | Phi' (°) | Piezometric Line |
|-------|--------------------------|-------------------|-------------------|----------------|----------------------|---------------------------------|-----------------|----------|------------------|
|       | Common Borrow            | Mohr-Coulomb      | 130               |                |                      |                                 |                 | 34       | 1                |
|       | Concrete Slab            | High Strength     | 150               |                |                      |                                 |                 |          | 1                |
|       | Concrete weight          | High Strength     | 150               |                |                      |                                 |                 |          | 1                |
|       | Existing Fill            | Mohr-Coulomb      | 110               |                |                      |                                 |                 | 32       | 1                |
|       | Geofoam(1)               | Mohr-Coulomb      | 3                 |                |                      |                                 |                 | 34       | 1                |
|       | Glacial Till             | Mohr-Coulomb      | 120               |                |                      |                                 |                 | 36       | 1                |
|       | LW Concrete              | High Strength     | 30                |                |                      |                                 |                 |          | 1                |
|       | Marine Sand              | Mohr-Coulomb      | 115               |                |                      |                                 |                 | 34       | 1                |
|       | Marine Silt & Clay       | S=f(depth)        | 115               |                | 500                  | 20                              | 1,500           |          |                  |
|       | Marine Silt & Clay Crust | Undrained (Phi=0) | 115               | 500            |                      |                                 |                 |          |                  |

Title: Veranda I-295, SB Profile, Longitudinal  
 Name: South Abutment Undrained (circular)  
 Method: Spencer  
 Slip Surface Option: Entry and Exit  
 Surcharge (Unit Weight): 250 pcf  
 Magnitude: 5,175 lbf



| Color | Name                     | Model             | Unit Weight (pcf) | Cohesion (psf) | C-Top of Layer (psf) | C-Rate of Change ((lbf/ft²)/ft) | C-Maximum (psf) | Phi' (°) | Piezometric Line |
|-------|--------------------------|-------------------|-------------------|----------------|----------------------|---------------------------------|-----------------|----------|------------------|
|       | Common Borrow            | Mohr-Coulomb      | 130               |                |                      |                                 |                 | 34       | 1                |
|       | Concrete Slab            | High Strength     | 150               |                |                      |                                 |                 |          | 1                |
|       | Concrete weight          | High Strength     | 150               |                |                      |                                 |                 |          | 1                |
|       | Existing Fill            | Mohr-Coulomb      | 110               |                |                      |                                 |                 | 32       | 1                |
|       | Geofoam(1)               | Mohr-Coulomb      | 3                 |                |                      |                                 |                 | 34       | 1                |
|       | Glacial Till             | Mohr-Coulomb      | 120               |                |                      |                                 |                 | 36       | 1                |
|       | LW Concrete              | High Strength     | 30                |                |                      |                                 |                 |          | 1                |
|       | Marine Sand              | Mohr-Coulomb      | 115               |                |                      |                                 |                 | 34       | 1                |
|       | Marine Silt & Clay       | S=f(depth)        | 115               |                | 500                  | 20                              | 1,500           |          |                  |
|       | Marine Silt & Clay Crust | Undrained (Phi=0) | 115               | 500            |                      |                                 |                 |          |                  |

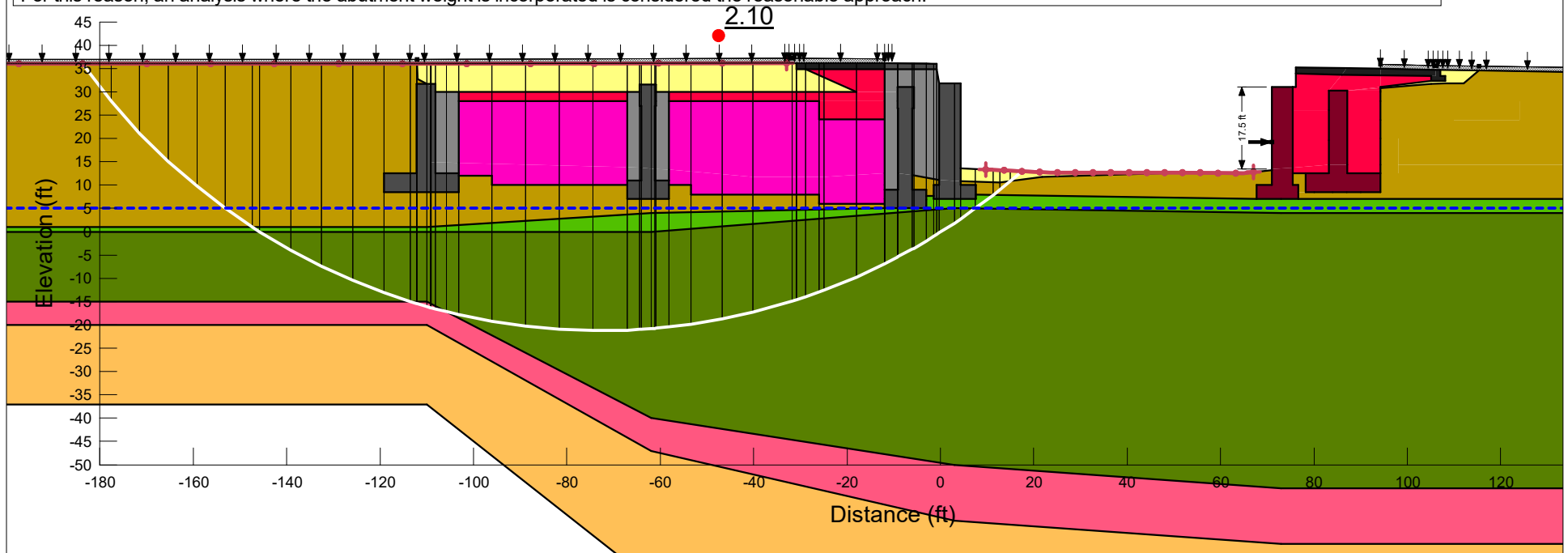
Title: Veranda I-295, SB Profile, Longitudinal  
 Name: South Abutment Undrained (non-circular)  
 Method: Spencer  
 Slip Surface Option: Critical Slip Surfaces from Other  
 Surcharge (Unit Weight): 250 pcf  
 Magnitude: 5,175 lbf



| Color | Name                       | Model             | Unit Weight (pcf) | Cohesion (psf) | C-Top of Layer (psf) | C-Rate of Change ((lb/ft <sup>2</sup> )/ft) | C-Maximum (psf) | Phi' (°) | Piezometric Line |
|-------|----------------------------|-------------------|-------------------|----------------|----------------------|---|-----------------|----------|------------------|
|       | Common Borrow              | Mohr-Coulomb      | 130               |                |                      |   |                 | 34       | 1                |
|       | Concrete Slab              | High Strength     | 150               |                |                      |   |                 |          | 1                |
|       | Concrete weight            | High Strength     | 150               |                |                      |   |                 |          | 1                |
|       | Existing Fill              | Mohr-Coulomb      | 110               |                |                      |   |                 | 32       | 1                |
|       | Geofoam(1)                 | Mohr-Coulomb      | 3                 |                |                      |   |                 | 34       | 1                |
|       | Glacial Till               | Mohr-Coulomb      | 120               |                |                      |   |                 | 36       | 1                |
|       | LW Concrete                | High Strength     | 30                |                |                      |   |                 |          | 1                |
|       | Marine Sand                | Mohr-Coulomb      | 115               |                |                      |   |                 | 34       | 1                |
|       | Marine Silt & Clay         | S=f(depth)        | 115               |                | 500                  | 20  | 1,500           |          |                  |
|       | Marine Silt & Clay Crust   | Undrained (Phi=0) | 115               | 500            |                      |   |                 |          |                  |
|       | Pier supported LW Concrete | High Strength     | 0.1               |                |                      |   |                 |          | 1                |
|       | Pile Supported             | High Strength     | 0.1               |                |                      |   |                 |          | 1                |

Title: Veranda I-295, SB Profile, Longitudinal  
Name: South Abutment Undrained (circular) (2)  
Method: Spencer  
Slip Surface Option: Entry and Exit  
Surcharge (Unit Weight): 250 pcf  
Magnitude: 5,175 lbf

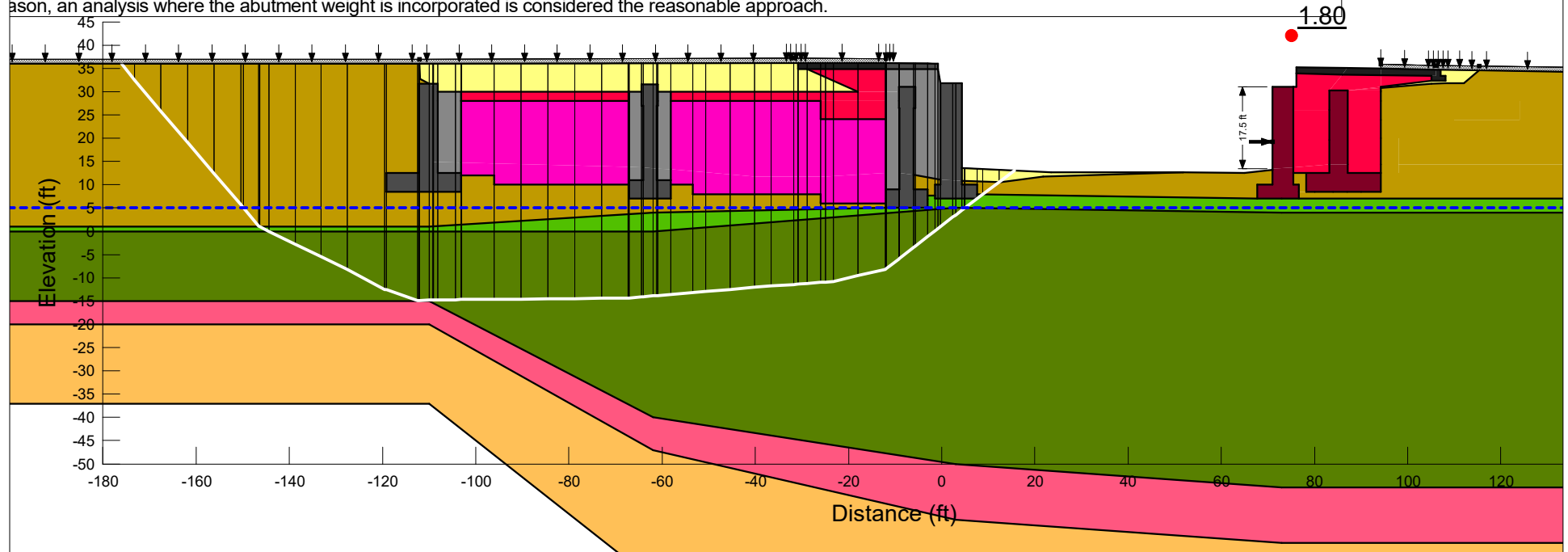
Though it satisfies factor of safety requirements, this failure surface is unrealistic for a condition where the weight of the abutment is neglected due to end bearing pile support. The weight of the abutment and material supported by it would act to resist upheaval. For this reason, an analysis where the abutment weight is incorporated is considered the reasonable approach.



| Color | Name                       | Model             | Unit Weight (pcf) | Cohesion (psf) | C-Top of Layer (psf) | C-Rate of Change ((lb/ft <sup>2</sup> )/ft) | C-Maximum (psf) | Phi' (°) | Piezometric Line |
|-------|----------------------------|-------------------|-------------------|----------------|----------------------|---|-----------------|----------|------------------|
|       | Common Borrow              | Mohr-Coulomb      | 130               |                |                      |   |                 | 34       | 1                |
|       | Concrete Slab              | High Strength     | 150               |                |                      |   |                 |          | 1                |
|       | Concrete weight            | High Strength     | 150               |                |                      |   |                 |          | 1                |
|       | Existing Fill              | Mohr-Coulomb      | 110               |                |                      |   |                 | 32       | 1                |
|       | Geofoam(1)                 | Mohr-Coulomb      | 3                 |                |                      |   |                 | 34       | 1                |
|       | Glacial Till               | Mohr-Coulomb      | 120               |                |                      |   |                 | 36       | 1                |
|       | LW Concrete                | High Strength     | 30                |                |                      |   |                 |          | 1                |
|       | Marine Sand                | Mohr-Coulomb      | 115               |                |                      |   |                 | 34       | 1                |
|       | Marine Silt & Clay         | S=f(depth)        | 115               |                | 500                  | 20  | 1,500           |          |                  |
|       | Marine Silt & Clay Crust   | Undrained (Phi=0) | 115               | 500            |                      |   |                 |          |                  |
|       | Pier supported LW Concrete | High Strength     | 0.1               |                |                      |   |                 |          | 1                |
|       | Pile Supported             | High Strength     | 0.1               |                |                      |   |                 |          | 1                |

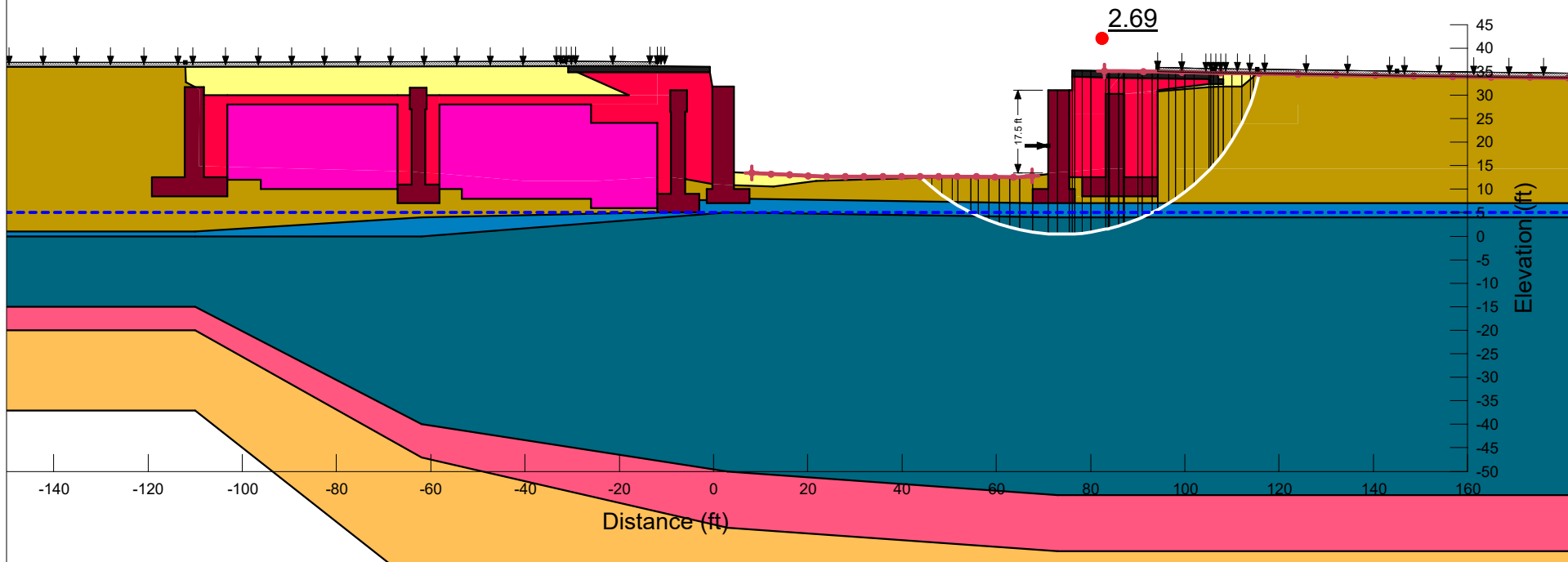
Title: Veranda I-295, SB Profile, Longitudinal  
Name: South Abutment Undrained (non-circular) (2)  
Method: Spencer  
Slip Surface Option: Critical Slip Surfaces from Other  
Surcharge (Unit Weight): 250 pcf  
Magnitude: 5,175 lbf

satisfies factor of safety requirements, this failure surface is unrealistic for a condition where the weight of the abutment is neglected due to end bearing pile support. t of the abutment and material supported by it would act to resist upheaval. ason, an analysis where the abutment weight is incorporated is considered the reasonable approach.



| Color | Name                               | Model         | Unit Weight (pcf) | Phi' (°) | Piezometric Line |
|-------|------------------------------------|---------------|-------------------|----------|------------------|
|       | Common Borrow                      | Mohr-Coulomb  | 130               | 34       | 1                |
|       | Concrete Slab                      | High Strength | 150               |          | 1                |
|       | Concrete weight                    | High Strength | 150               |          | 1                |
|       | Existing Fill                      | Mohr-Coulomb  | 110               | 32       | 1                |
|       | Geofoam(1)                         | Mohr-Coulomb  | 3                 | 34       | 1                |
|       | Glacial Till                       | Mohr-Coulomb  | 120               | 36       | 1                |
|       | LW Concrete                        | High Strength | 30                |          | 1                |
|       | Marine Sand                        | Mohr-Coulomb  | 115               | 34       | 1                |
|       | Marine Silt & Clay Crust - Drained | Mohr-Coulomb  | 115               | 33       | 1                |
|       | Marine Silt and Clay - Drained     | Mohr-Coulomb  | 115               | 34       | 1                |

Title: Veranda I-295, SB Profile, Longitudinal  
 Name: North Abutment Drained (circular)  
 Method: Spencer  
 Slip Surface Option: Entry and Exit  
 Surcharge (Unit Weight): 250 pcf  
 Magnitude: 5,175 lbf





| Color | Name                               | Model         | Unit Weight (pcf) | Phi' (°) | Piezometric Line |
|-------|------------------------------------|---------------|-------------------|----------|------------------|
|       | Common Borrow                      | Mohr-Coulomb  | 130               | 34       | 1                |
|       | Concrete Slab                      | High Strength | 150               |          | 1                |
|       | Concrete weight                    | High Strength | 150               |          | 1                |
|       | Existing Fill                      | Mohr-Coulomb  | 110               | 32       | 1                |
|       | Geofoam(1)                         | Mohr-Coulomb  | 3                 | 34       | 1                |
|       | Glacial Till                       | Mohr-Coulomb  | 120               | 36       | 1                |
|       | LW Concrete                        | High Strength | 30                |          | 1                |
|       | Marine Sand                        | Mohr-Coulomb  | 115               | 34       | 1                |
|       | Marine Silt & Clay Crust - Drained | Mohr-Coulomb  | 115               | 33       | 1                |
|       | Marine Silt and Clay - Drained     | Mohr-Coulomb  | 115               | 34       | 1                |

Title: Veranda I-295, SB Profile, Longitudinal

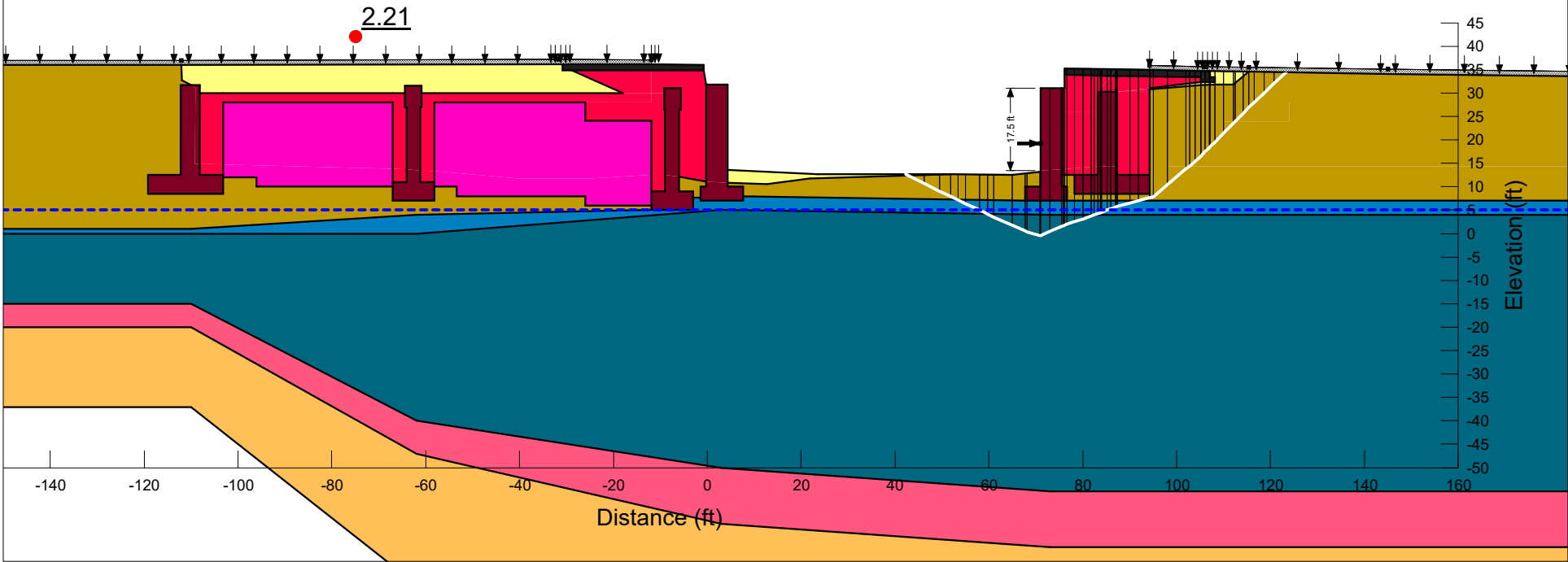
Name: North Abutment Drained (non-circular)

Method: Spencer

Slip Surface Option: Critical Slip Surfaces from Other

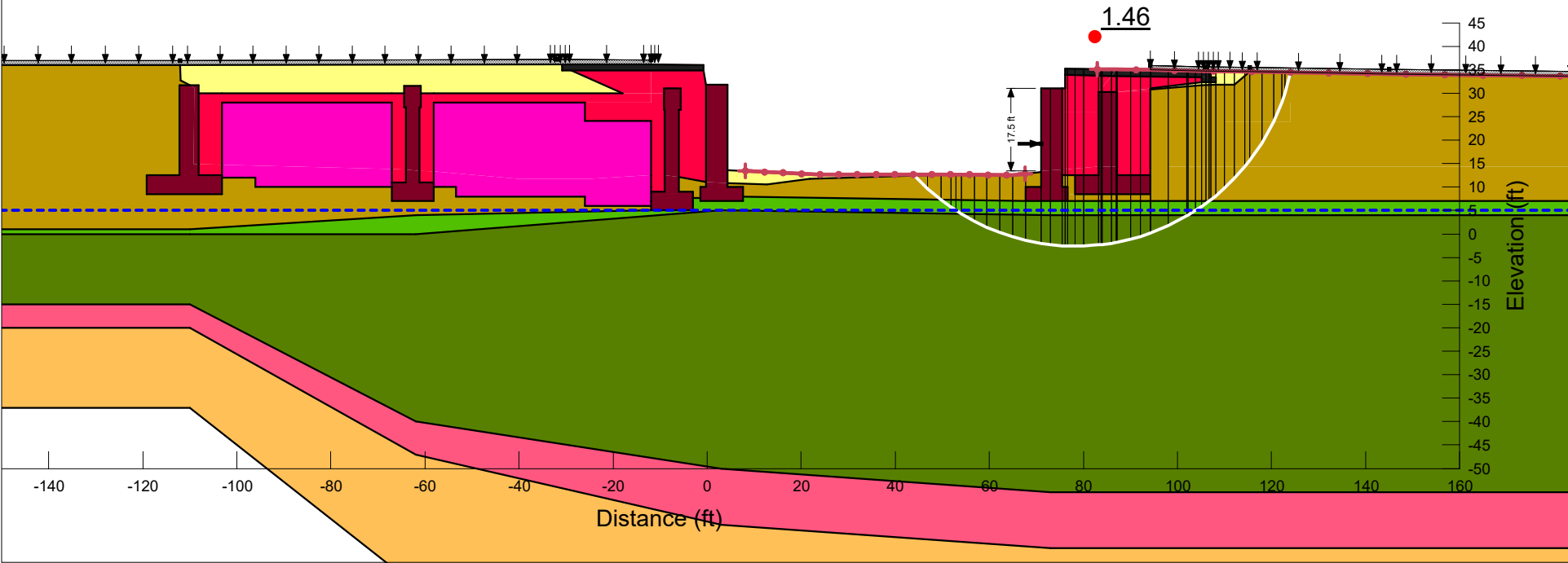
Surcharge (Unit Weight): 250 pcf

Magnitude: 5,175 lbf



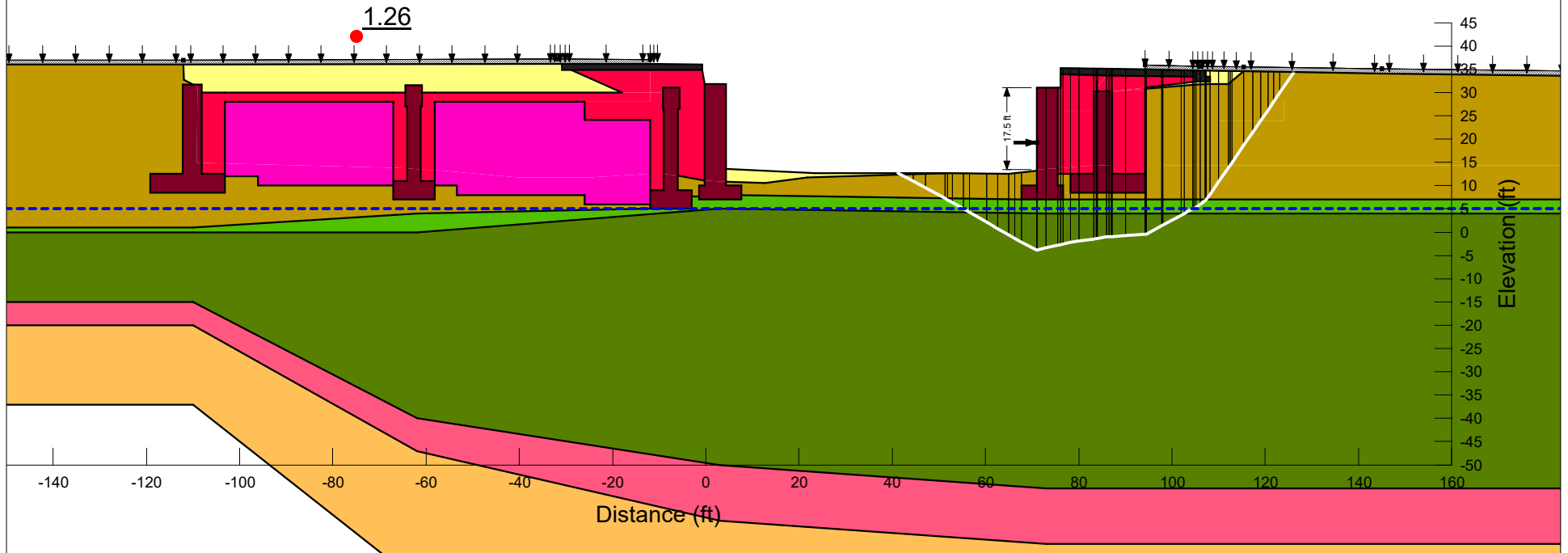
| Color | Name                     | Model             | Unit Weight (pcf) | Cohesion (psf) | C-Top of Layer (psf) | C-Rate of Change ((lbf/ft²)/ft) | C-Maximum (psf) | Phi' (°) | Piezometric Line |
|-------|--------------------------|-------------------|-------------------|----------------|----------------------|---------------------------------|-----------------|----------|------------------|
|       | Common Borrow            | Mohr-Coulomb      | 130               |                |                      |                                 |                 | 34       | 1                |
|       | Concrete Slab            | High Strength     | 150               |                |                      |                                 |                 |          | 1                |
|       | Concrete weight          | High Strength     | 150               |                |                      |                                 |                 |          | 1                |
|       | Existing Fill            | Mohr-Coulomb      | 110               |                |                      |                                 |                 | 32       | 1                |
|       | Geofoam(1)               | Mohr-Coulomb      | 3                 |                |                      |                                 |                 | 34       | 1                |
|       | Glacial Till             | Mohr-Coulomb      | 120               |                |                      |                                 |                 | 36       | 1                |
|       | LW Concrete              | High Strength     | 30                |                |                      |                                 |                 |          | 1                |
|       | Marine Sand              | Mohr-Coulomb      | 115               |                |                      |                                 |                 | 34       | 1                |
|       | Marine Silt & Clay       | S=f(depth)        | 115               |                | 500                  | 20                              | 1,500           |          |                  |
|       | Marine Silt & Clay Crust | Undrained (Phi=0) | 115               | 500            |                      |                                 |                 |          |                  |

Title: Veranda I-295, SB Profile, Longitudinal  
 Name: North Abutment Undrained (circular)  
 Method: Spencer  
 Slip Surface Option: Entry and Exit  
 Surcharge (Unit Weight): 250 pcf  
 Magnitude: 5,175 lbf



| Color | Name                     | Model             | Unit Weight (pcf) | Cohesion (psf) | C-Top of Layer (psf) | C-Rate of Change ((lbf/ft²)/ft) | C-Maximum (psf) | Phi' (°) | Piezometric Line |
|-------|--------------------------|-------------------|-------------------|----------------|----------------------|---------------------------------|-----------------|----------|------------------|
|       | Common Borrow            | Mohr-Coulomb      | 130               |                |                      |                                 |                 | 34       | 1                |
|       | Concrete Slab            | High Strength     | 150               |                |                      |                                 |                 |          | 1                |
|       | Concrete weight          | High Strength     | 150               |                |                      |                                 |                 |          | 1                |
|       | Existing Fill            | Mohr-Coulomb      | 110               |                |                      |                                 |                 | 32       | 1                |
|       | Geofoam(1)               | Mohr-Coulomb      | 3                 |                |                      |                                 |                 | 34       | 1                |
|       | Glacial Till             | Mohr-Coulomb      | 120               |                |                      |                                 |                 | 36       | 1                |
|       | LW Concrete              | High Strength     | 30                |                |                      |                                 |                 |          | 1                |
|       | Marine Sand              | Mohr-Coulomb      | 115               |                |                      |                                 |                 | 34       | 1                |
|       | Marine Silt & Clay       | S=f(depth)        | 115               |                | 500                  | 20                              | 1,500           |          |                  |
|       | Marine Silt & Clay Crust | Undrained (Phi=0) | 115               | 500            |                      |                                 |                 |          |                  |

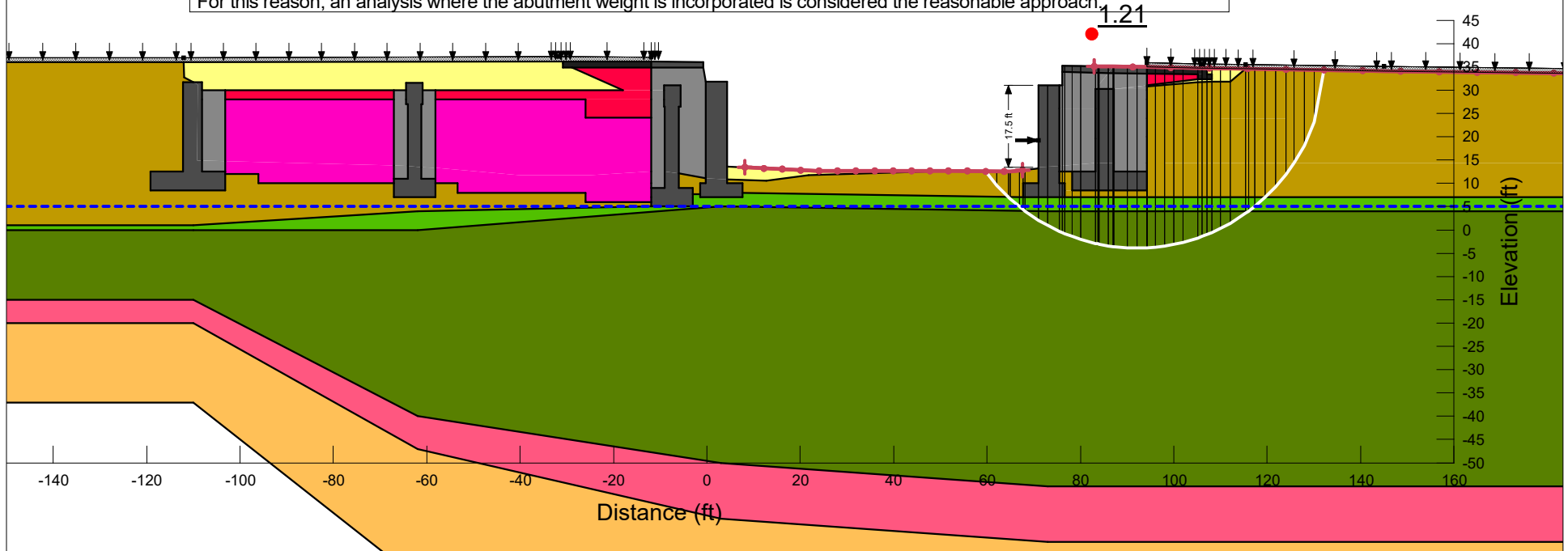
Title: Veranda I-295, SB Profile, Longitudinal  
 Name: North Abutment Undrained (non-circular)  
 Method: Spencer  
 Slip Surface Option: Critical Slip Surfaces from Other  
 Surcharge (Unit Weight): 250 pcf  
 Magnitude: 5,175 lbf



| Color | Name                       | Model             | Unit Weight (pcf) | Cohesion (psf) | C-Top of Layer (psf) | C-Rate of Change ((lbf/ft²)/ft) | C-Maximum (psf) | Phi' (°) | Piezometric Line |
|-------|----------------------------|-------------------|-------------------|----------------|----------------------|---------------------------------|-----------------|----------|------------------|
|       | Common Borrow              | Mohr-Coulomb      | 130               |                |                      |                                 |                 | 34       | 1                |
|       | Concrete Slab              | High Strength     | 150               |                |                      |                                 |                 |          | 1                |
|       | Existing Fill              | Mohr-Coulomb      | 110               |                |                      |                                 |                 | 32       | 1                |
|       | Geofoam(1)                 | Mohr-Coulomb      | 3                 |                |                      |                                 |                 | 34       | 1                |
|       | Glacial Till               | Mohr-Coulomb      | 120               |                |                      |                                 |                 | 36       | 1                |
|       | LW Concrete                | High Strength     | 30                |                |                      |                                 |                 |          | 1                |
|       | Marine Sand                | Mohr-Coulomb      | 115               |                |                      |                                 |                 | 34       | 1                |
|       | Marine Silt & Clay         | S=f(depth)        | 115               |                | 500                  | 20                              | 1,500           |          |                  |
|       | Marine Silt & Clay Crust   | Undrained (Phi=0) | 115               | 500            |                      |                                 |                 |          |                  |
|       | Pier supported LW Concrete | High Strength     | 0.1               |                |                      |                                 |                 |          | 1                |
|       | Pile Supported             | High Strength     | 0.1               |                |                      |                                 |                 |          | 1                |

Title: Veranda I-295, SB Profile, Longitudinal  
 Name: North Abutment Undrained (circular) (2)  
 Method: Spencer  
 Slip Surface Option: Entry and Exit  
 Surcharge (Unit Weight): 250 pcf  
 Magnitude: 5,175 lbf

This failure surface is unrealistic for a condition where the weight of the abutment is neglected due to end bearing pile support.  
 The weight of the abutment and material supported by it would act to resist upheaval.  
 For this reason, an analysis where the abutment weight is incorporated is considered the reasonable approach.



| Color | Name                       | Model             | Unit Weight (pcf) | Cohesion (psf) | C-Top of Layer (psf) | C-Rate of Change ((lbf/ft²)/ft) | C-Maximum (psf) | Phi' (°) | Piezometric Line |
|-------|----------------------------|-------------------|-------------------|----------------|----------------------|---------------------------------|-----------------|----------|------------------|
|       | Common Borrow              | Mohr-Coulomb      | 130               |                |                      |                                 |                 | 34       | 1                |
|       | Concrete Slab              | High Strength     | 150               |                |                      |                                 |                 |          | 1                |
|       | Existing Fill              | Mohr-Coulomb      | 110               |                |                      |                                 |                 | 32       | 1                |
|       | Geofoam(1)                 | Mohr-Coulomb      | 3                 |                |                      |                                 |                 | 34       | 1                |
|       | Glacial Till               | Mohr-Coulomb      | 120               |                |                      |                                 |                 | 36       | 1                |
|       | LW Concrete                | High Strength     | 30                |                |                      |                                 |                 |          | 1                |
|       | Marine Sand                | Mohr-Coulomb      | 115               |                |                      |                                 |                 | 34       | 1                |
|       | Marine Silt & Clay         | S=f(depth)        | 115               |                | 500                  | 20                              | 1,500           |          |                  |
|       | Marine Silt & Clay Crust   | Undrained (Phi=0) | 115               | 500            |                      |                                 |                 |          |                  |
|       | Pier supported LW Concrete | High Strength     | 0.1               |                |                      |                                 |                 |          | 1                |
|       | Pile Supported             | High Strength     | 0.1               |                |                      |                                 |                 |          | 1                |

Title: Veranda I-295, SB Profile, Longitudinal  
 Name: North Abutment Undrained (non-circular) (2)  
 Method: Spencer  
 Slip Surface Option: Critical Slip Surfaces from Other  
 Surcharge (Unit Weight): 250 pcf  
 Magnitude: 5,175 lbf

This failure surface is unrealistic for a condition where the weight of the abutment is neglected due to end bearing pile support.  
 The weight of the abutment and material supported by it would act to resist upheaval.  
 For this reason, an analysis where the abutment weight is incorporated is considered the reasonable approach.

