November 9, 2022
NewFields Project No. 475.0398.000

HDR Inc.
9805 Double R Boulevard, Suite 101
Reno, Nevada 89521

**Attention:** **Mr. Ruedy Edgington, P.E.**
**Project Manager**

**Re:** **Sound Wall Design Memo, Rev. 1**
**US395 North Valleys Project**
**Washoe County, Nevada**

## 1. INTRODUCTION

This memo presents the results of Newfield's geotechnical analyses for the proposed sound walls in support of the US395 North Valleys Project in Washoe County, Nevada. Based on a review of the Wall Location Plan, Sheet No. MSE01, sound walls will be constructed along the southbound shoulder of US395 beginning near the intersection of Clear Acre Lane and continuing towards the I-1093S bridge structure at North Virginia Street.

## 2. PRECAST SOUND WALL DESIGN

Sound walls SW1, SW2-1, SW2-2, SW3-1, SW3-2, and SW6 will be of precast concrete panel construction. Sound walls SW2-1, SW2-2, SW3-1, and SW3-2 will be built on top of barrier rail and supported by a moment slab with geotechnical recommendations provided by HDR.

Sound walls SW1 and SW6 will be supported on conventional cast-in-place shallow spread foundations. Geotechnical design recommendations for sound walls SW1 and SW6 are provided in the following subsections 2.1.1 through 2.1.3.

### 2.1.1. Shallow Spread Foundation Design

Sound walls SW1 and SW6 will be supported on shallow spread foundations as shown on preliminary typical cross sections as presented in Attachment A. The walls heights, foundation dimensions and loads for sound walls SW1 and SW6 as provided by HDR are presented in Tables 1 and 2 and were used in the bearing resistance calculations.

**Table 1: Sound Walls SW1 and SW6 Dimensions**

| Sound Wall | Maximum Design Height (ft) | Footing Width (ft) | Footing Embedment (ft) |
|---|---|---|---|
| SW1 | 19.0 | 7.4 | 4.0 |
| SW6 | 24.5 | 7.6 | 3.7 |

**Table 2: Sound Walls SW1 and SW6 Design Loads**

| Sound Wall Location | Vertical Weight (kips) | | | Overturning Moment (kip*ft) | | |
|---|---|---|---|---|---|---|
| | Strength Limit | Extreme Limit | Service Limit | Strength Limit | Extreme Limit | Service Limit |
| SW1 | 8 | 6 | 6 | 10 | 13 | 9 |
| SW6 | 9 | 8 | 7 | 14 | 23 | 13 |

Effective footing widths were used in the bearing resistance calculations in accordance with Section 10.6.3.1.1, *AASHTO LRFD Bridge Design Specifications* (2020). Effective footing widths were calculated in accordance with Section 10.6.1.3, *AASHTO LRFD Bridge Design Specifications* (2020) with the eccentric distance computed by dividing the applied moment by the applied vertical load in accordance with Section 6.4.1 of *Geotechnical Engineering Circular No. 6, Shallow Foundations* (FHWA, 2002).

### 2.1.2. Strength and Extreme Bearing Resistance

Nominal bearing resistances under the strength and extreme limit states for sound walls SW1 and SW6 were calculated using Equation 10.6.3.1.2c-1, *AASHTO LRFD Bridge Design Specifications* (2020). Since foundations will be constructed adjacent to sloping ground, a reduction coefficient ($RC_{BC}$) must be applied. An $RC_{BC}$ value was determined using linear interpolation between values provided on Table 10.6.3.1.2c-1, *AASHTO LRFD Bridge Design Specifications* (2020).

A $RC_{BC}$ value of 0.43 was estimated for sound wall SW1 based on a slope height (H) of 15 feet below bottom of foundation, slope angle (β) of 26.6 degrees, and offset (b) of 8 feet. For sound wall SW6, an RCBC value of 0.66 was used for design based on a slope height (H) of 2.9 feet below bottom of foundation, a slope angle (β) of 26.6 degrees, and an offset (b) of 8 feet.

Factored bearing resistances at the strength and extreme limit states were determined in accordance with *AASHTO LRFD Bridge Design Specifications*, Equation 10.6.3.1. A resistance factor of 0.45 per Table 11.5.7-1, *AASHTO LRFD Bridge Design Specifications* (2020) was applied to nominal bearing resistance values to calculate the factored bearing resistance at the strength

limit state. A resistance factor of 1.0 per Section 10.5.5.3, *AASHTO LRFD Bridge Design Specifications* (2020) was applied to nominal bearing resistance values to calculate the factored bearing resistance at the extreme limit states.

Factored bearing resistance values for the strength and extreme limit states are summarized in Table 3. Supporting calculations are provided in Attachment B.

**Table 3: Factored Strength and Extreme Limit State Bearing Resistances**

| Sound Wall Location | Strength Limit (ksf) | Extreme Limit (ksf) |
|---|---|---|
| SW1 (2:1 Toe Slope) | 2.7 | 5.9 |
| SW6 (2:1 Toe Slope) | 3.7 | 8.2 |

The values presented above are maximum estimated values based on the theoretical bearing capacity formulas presented in *AASHTO LRFD Bridge Design Specifications* (2020).

### 2.1.1. Service Limit State Bearing Resistance

The service limit state is related to deformation of a foundation element under an applied vertical bearing stress. This typically includes settlement of foundations and global stability for foundations located adjacent or within sloping embankments.

Additional discussion regarding settlement calculations for service limit state is presented in Subsection 2.1.1.1. Information regarding model development, analysis, and results of global stability calculations are discussed in Subsections 2.1.1.2 through 2.1.1.4.

#### 2.1.1.1. Settlement

Settlement of shallow spread foundations for sound walls were estimated using foundation widths and lengths and elastic theory procedures. To estimate settlement, the elastic modulus value was estimated using N-values in accordance with *AASHTO LRFD Bridge Design Specifications* (2020), a Boussinesq vertical stress distribution, and a rigid foundation in the program Settle3. The depth of the soil profile used in the model to assess potential settlement was developed following guidance for stress influence and test hole depths provided in Section 10.4.2, *AASHTO LRFD Bridge Design Specifications* (2020).

Per Section 10.5.5 of the *AASHTO LRFD Bridge Design Specifications* (2020) a resistance factor of 1.0 should be used for the service limit state. Therefore, the nominal bearing resistance is equal

to the factored bearing resistance. No further reduction was applied. The service limit bearing resistance was limited to a maximum of 2.7 ksf for SW1 and 3.7 for SW6.

Settle3 estimates indicate a maximum settlement of 1 inch or less, with differential settlement estimated to be ½ inch or less across each wall structure. Copies of the Settle3 outputs and reports are provided in Attachment C.

#### 2.1.1.2. Slope Stability Assessment

Sound wall SW1 and SW6 will be founded on a shallow spread foundation adjacent a 2:1 (H:V) embankment slope with an estimated total slope height of 19 feet and 6.4 feet, respectively based on the typical sections provided by HDR. Therefore, a global stability analysis was performed for both static and pseudostatic loading conditions using the Spencer method and the program Slide by Rocscience Inc. Soil layering was simplified and modeled as a single homogenous material based on nearby soil boring information. Due to the depth of groundwater in the vicinity, groundwater was not considered in the slope stability analyses.

For pseudostatic loading conditions, slope stabilities were assessed using one-half of the recommended peak ground acceleration (PGA) per Section 12.3.5 of the NDOT *Structures Manual* (2008).

#### 2.1.1.3. Slope Stability Assessment

The angle of internal shearing resistance (ϕ) for the embankment fill and underlying granular soils was estimated using the Peck, Hanson, and Thornburn correlation (AASHTO, 2020) based on corrected blow counts $(N1)_{60}$. Blow count corrections and angle of internal shearing resistance correlations are provided in Attachment A.

The internal angle of shearing resistance for the subsurface profile of SW1 and SW6 was based on an assumed $(N1)_{60}$ value of 15, yielding a friction angle of 32 degrees. This corresponds to a lower bound relative density of medium dense. Table 4 presents the material properties used in the stability analysis.

**Table 4: Material Properties Used in the Stability Analyses**

| Material | Unit Weight (pcf) | Estimated Friction Angle (degrees) | Cohesion (psf) |
|---|---|---|---|
| Embankment Fill/Clayey Sand (SC) | 120 | 32 | 100 |

A distributed load of 2.7 ksf and 3.7 ksf was applied representing the foundation load from sound wall SW1 and SW6, respectively.

#### 2.1.1.4. Slope Stability Assessment

Results of the stability analysis are shown in Table 5 and the stability outputs are provided in Appendix D.

**Table 5: Sound Wall Stability Results**

| Sound Wall | Minimum Factor of Safety (FOS) | |
|---|---|---|
| | Static | Pseudostatic |
| SW1 | 1.6 | 1.1 |
| SW6 | 1.7 | 1.5 |

Section 11.6.3.7 of the *AASHTO LRFD Bridge Design Specifications* (2020) states a resistance factor of 0.65 should be applied to the evaluation of overall stability of earth slopes under the service limit state, where the geotechnical parameters and subsurface stratigraphy are highly variable or based on limited information. The applied resistance factor is equivalent to a factor of safety of approximately 1.5 using the allowable stress design (ASD) design methodology. Section 6.2.2 of the *LRFD Seismic Analysis and Design of Transportation Geotechnical Features and Structural Foundations Reference Manual* (FHWA, 2011) recommends a minimum factor of safety of 1.1 for pseudostatic (seismic) analyses.

Stability results indicate the walls meet the minimum factors for safety for static and pseudostatic conditions.

## 3. SLIDING RESISTANCE

Sliding resistance between the base of shallow spread foundations/moment slabs and the granular embankment and native soils is determined by the coefficient of friction (tan δ) between the bottom of footing and the soil. For foundations cast against the ground and assuming a ϕ value of 32 degrees, a nominal coefficient of friction of 0.62 is recommended for sliding resistance based on Section 10.6.3.4 of *AASHTO LRFD Bridge Design Specifications* (2020). A strength limit resistance factor of 0.8 should be applied to the sliding resistance in accordance with Table 10.5.5.2.2-1 of *AASHTO LRFD Bridge Design Specifications* (2020).

## 4. LIMITATIONS

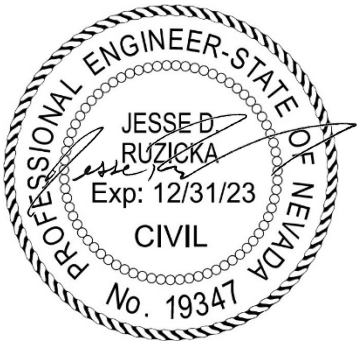
The recommendations contained in this report are based on field exploration, laboratory testing, and our understanding of the proposed construction. The soil data used in the preparation of this report are based on the field explorations performed at the locations referenced in the *Geotechnical Design Report, Phase 1B: US395 North Valleys* (NewFields, 2020). It is possible that variation in the soil conditions may exist between the locations explored. Therefore, if any soil conditions are encountered at the site that are different from those outlined in this report, NewFields should be immediately notified so that we may review and make supplementary recommendations if warranted.

This report has been prepared solely for the use of HDR and their client for design of the US395 North Valleys Project. Our services were performed using generally accepted geotechnical engineering practice common to the area at the time of this report. No other warranties, either expressed or implied, are included or intended.

If you have any questions or require additional information, please contact the undersigned.

Sincerely,

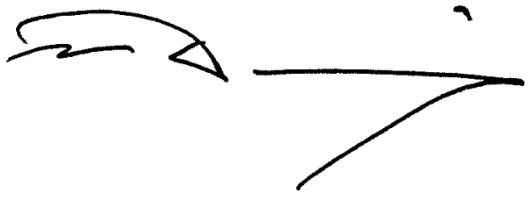
**NewFields Mining Design & Technical Services**




11/9/2022

Jesse Ruzicka, P.E.
Senior Engineer

**Reviewed by:**



Mark Doehring, P.E.
Senior Engineer

JR/MD/ng

**LIST OF ATTACHMENTS:**
Attachment A – Typical Sections and Blow Count Corrections
Attachment B – Bearing Resistance Calculations
Attachment C – Settle3 Results
Attachment D – SLIDE Global Stability Results

Addressee: Electronic

NewFields

# ATTACHMENT A

## Typical Sections and Blow Count Corrections

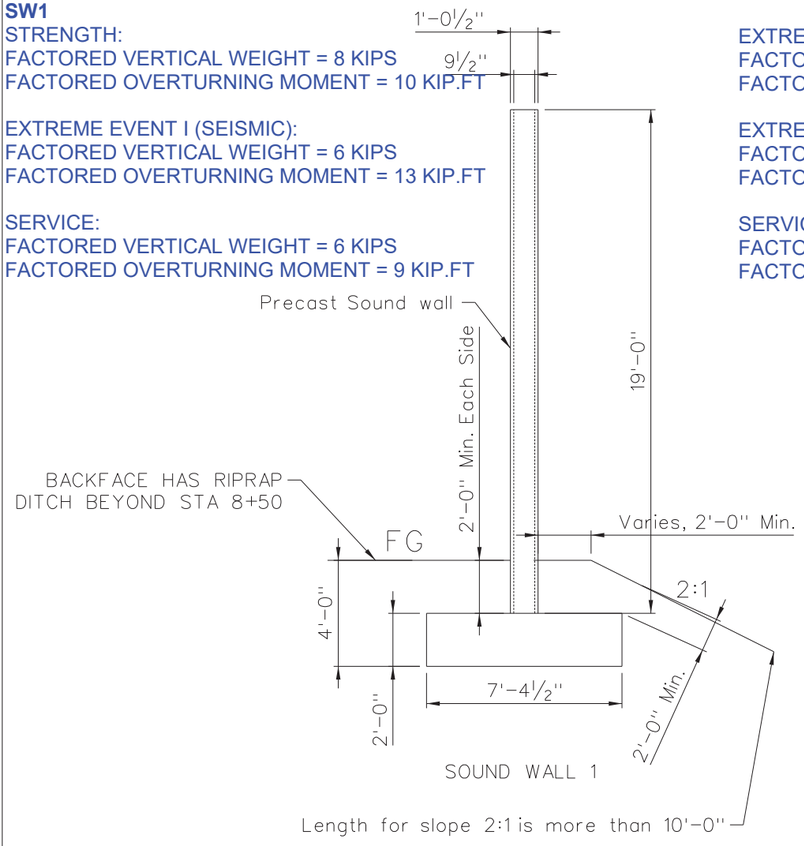
# Typical Sections (Provided by HDR)

# LOADS

**SW1**
STRENGTH:
FACTORED VERTICAL WEIGHT = 8 KIPS
FACTORED OVERTURNING MOMENT = 10 KIP.FT

EXTREME EVENT I (SEISMIC):
FACTORED VERTICAL WEIGHT = 6 KIPS
FACTORED OVERTURNING MOMENT = 13 KIP.FT

SERVICE:
FACTORED VERTICAL WEIGHT = 6 KIPS
FACTORED OVERTURNING MOMENT = 9 KIP.FT

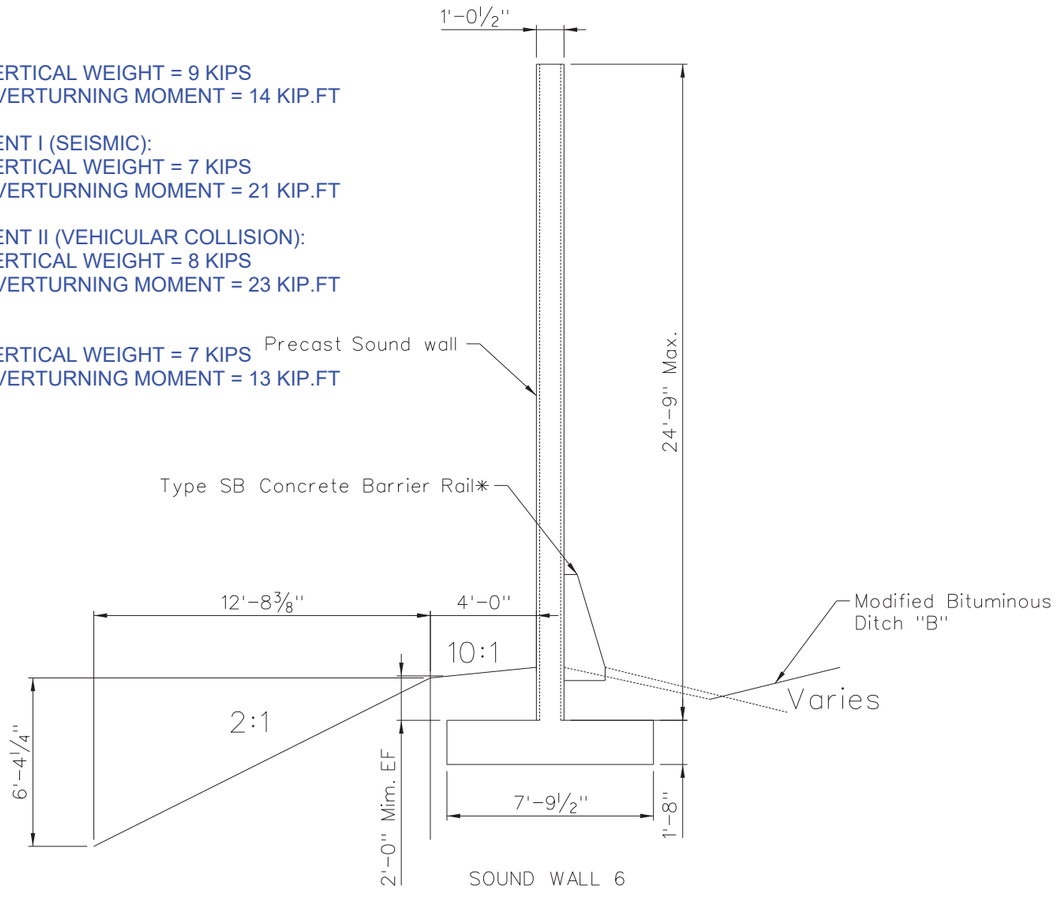



**SW6**
STRENGTH:
FACTORED VERTICAL WEIGHT = 9 KIPS
FACTORED OVERTURNING MOMENT = 14 KIP.FT

EXTREME EVENT I (SEISMIC):
FACTORED VERTICAL WEIGHT = 7 KIPS
FACTORED OVERTURNING MOMENT = 21 KIP.FT

EXTREME EVENT II (VEHICULAR COLLISION):
FACTORED VERTICAL WEIGHT = 8 KIPS
FACTORED OVERTURNING MOMENT = 23 KIP.FT

SERVICE:
FACTORED VERTICAL WEIGHT = 7 KIPS
FACTORED OVERTURNING MOMENT = 13 KIP.FT




Note:
* See Drainage Plans for Location of Type SB Concrete Barrier Rail and Modified Bituminuous Ditch "B".

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# Blow Count Corrections

**CORRECTION OF BLOW COUNTS**

**Project Number** **475.0398.000**
**Project Name** **US395 North Valleys Phase 1B**

**FORMULA:** SW 1

$(N_1)_{corrected}' = C_N * C_s * C_E * N_{field}$

where:

$(N_1)_{corrected}'$ = Corrected blow count for 1 tsf, 60% efficiency
$C_N$ = Overburden correction factor (See Reference 1)
$C_E$ = Energy correction (Efficiency/60%)
$C_s$ = Sampler Correction (Burmister, 1948)
Efficiency = **60%** **Enter Drill** HSA HAZ TECH DRILLING

**CALCULATIONS:**
**Boring:** **BH19-SW1-05** **Boring Elevation (ft msl):** **4680**
**Depth to water (ft bgs):** **0** **Groundwater Elevation (ft msl):** **4680.0**

| Depth (ft bgs) | Elevation (ft msl) | Unit Weight (pcf) | Total Stress (psf) | Effective Stress (psf) | | Sampler SPT = 1 MC = 2 | Uncorrected Blow Count (N)** [1] | Soil Type (1=fine-grained, 2=coarse-grained) | $C_N$ | $C_E$ | $C_s$ | $(N_1)_{corr}$ (for cohesionless behavior) | $(N)_{corr}$ (for cohesive behavior) | Ø' (for cohesionless soils) [2] | Su (psf) [3] | Material Type | tan (phi) | Multiplier Table C10.4.6.3.1 | Es (ksi) [4] | Es (ksf) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 4 | 4676.0 | 120 | 480 | 230 | SPT | 1 | 10 | 2 | 1.51 | 1.00 | 1.00 | 15 | - | 32 | - | SC | 0.883 | 0.139 | 2.10 | 302 |
| 5 | 4675.0 | 120 | 600 | 288 | MC | 2 | 61 | 2 | 1.57 | 1.00 | 0.67 | 64 | - | 43 | - | SC | 1.613 | 0.139 | 8.89 | 1280 |
| 7.5 | 4672.5 | 120 | 900 | 432 | SPT | 1 | 38 | 2 | 1.51 | 1.00 | 1.00 | 58 | - | 42 | - | SC | 1.332 | 0.139 | 8.00 | 1152 |
| 10 | 4670.0 | 120 | 1200 | 576 | MC | 2 | 47 | 1 | 1.42 | 1.00 | 0.67 | - | 31 | - | 4,475 | CH | 1.393 | 0.139 | | |
| 15 | 4665.0 | 120 | 1800 | 864 | SPT | 1 | 100 | 2 | 1.28 | 1.00 | 1.00 | 128 | - | 49 | - | GM | 1.714 | 0.167 | 21.42 | 3084 |
| 20 | 4660.0 | 120 | 2400 | 1152 | MC | 2 | 140 | 2 | 1.19 | 1.00 | 0.67 | 111 | - | 48 | - | GM | 1.841 | 0.167 | 18.50 | 2664 |
| 25 | 4655.0 | 120 | 3000 | 1440 | SPT | 1 | 100 | 2 | 1.11 | 1.00 | 1.00 | 111 | - | 48 | - | GM | 1.581 | 0.167 | 18.56 | 2673 |

[1] Field counts limited to 100 blows for SPT and 140 for California Modified Sampler
[2] Based on Peck, Hanson, Thorton (1974), phi ' = 54°-27.6034*exp(-0.014$(N_1)_{60}$)
[3] Based on Stroud (1974), $S_u = f_1*N_{60}*(Pa/100)$, f1 = 4.5 to 5.5
[4] Based on Bowles 1998, AASHTO Table C10.4.6.2.1: Coarse sands and sands with little gravel 0.139$N1_{60}$ and Coarse Sandy gravel and gravel 0.167$N1_{60}$

**CORRECTION OF BLOW COUNTS**

**Project Number** 475.0398.000
**Project Name** US395 North Valleys Phase 1B

SW-6

**FORMULA:**

$(N_1)_{corrected}' = C_N * C_s * C_E * N_{field}$

where:

$(N_1)_{corrected}'$ = Corrected blow count for 1 tsf, 60% efficiency
$C_N$ = Overburden correction factor (See Reference 1)
$C_E$ = Energy correction (Efficiency/60%)
$C_s$ = Sampler Correction (Burmister, 1948)
Efficiency = 79% **Enter Drill** HSA HAZ TECH DRILLING

**CALCULATIONS:**

**Boring:** BH19-SW7-47
**Depth to water (ft bgs):** 0
**Boring Elevation (ft msl):** 5090
**Groundwater Elevation (ft msl):** 5090.0

| Depth (ft bgs) | Elevation (ft msl) | Unit Weight (pcf) | Total Stress (psf) | Effective Stress (psf) | | Sampler SPT = 1 MC = 2 | Uncorrected Blow Count (N)** [1] | Soil Type (1=fine-grained, 2=coarse-grained) | $C_N$ | $C_E$ | $C_s$ | $(N_1)_{corr}$ (for cohesionless behavior) | $(N)_{corr}$ (for cohesive behavior) | Ø' (for cohesionless soils) [2] | Su (psf) [3] | Material Type | tan (phi) | Multiplier Table C10.4.6.3.1 | Es (ksi) [4] | Es (ksf) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 5090.0 | 120 | 0 | 0 | SPT | 1 | 74 | 2 | 2.00 | 1.32 | 1.00 | 195 | - | 52 | - | FILL | 2.027 | 0.139 | 27.09 | 3900.45 |
| 2.5 | 5087.5 | 120 | 300 | 144 | SPT | 1 | 16 | 2 | 1.42 | 1.32 | 1.00 | 30 | - | 36 | - | FILL | 1.161 | 0.139 | 4.16 | 598.75 |
| 5 | 5085.0 | 120 | 600 | 288 | MC | 2 | 140 | 2 | 1.57 | 1.32 | 0.67 | 193 | - | 52 | - | FILL | 2.349 | 0.139 | 26.86 | 3867.59 |
| 7.5 | 5082.5 | 120 | 900 | 432 | SPT | 1 | 10 | 2 | 1.51 | 1.32 | 1.00 | 20 | - | 33 | - | FILL | 0.929 | 0.139 | 2.77 | 399.08 |
| 10 | 5080.0 | 120 | 1200 | 576 | MC | 2 | 19 | 2 | 1.42 | 1.32 | 0.67 | 24 | - | 34 | - | FILL | 1.124 | 0.167 | 3.95 | 569.02 |
| 15 | 5075.0 | 120 | 1800 | 864 | SPT | 1 | 100 | 2 | 1.28 | 1.32 | 1.00 | 169 | - | 51 | - | SC | 1.882 | 0.167 | 28.20 | 4060.71 |
| 20 | 5070.0 | 130 | 2450 | 1202 | MC | 2 | 140 | 2 | 1.17 | 1.32 | 0.67 | 144 | - | 50 | - | SC | 2.008 | 0.167 | 24.07 | 3465.44 |
| 25 | 5065.0 | 130 | 3100 | 1540 | SPT | 1 | 42 | 2 | 1.09 | 1.32 | 1.00 | 60 | - | 42 | - | SC | 1.276 | 1.167 | 70.29 | 10121.95 |

[1] Field counts limited to 100 blows for SPT and 140 for California Modified Sampler
[2] Based on Peck, Hanson, Thorton (1974), phi ' = 54°-27.6034*exp(-0.014$(N_1)_{60}$)
[3] Based on Stroud (1974), $S_u = f_1 * N_{60} * (Pa/100)$, f1 = 4.5 to 5.5
[4] Based on Bowles 1998, AASHTO Table C10.4.6.2.1: Coarse sands and sands with little gravel $0.139N1_{60}$ and Coarse Sandy gravel and gravel $0.167N1_{60}$

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# ATTACHMENT B

## Bearing Resistance Calculations

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# SW1 Strength Limit State

| | | | |
|---|---|---|---|
| **Project:** | US395 North Valleys, Phase 1B | Project No: | 475.0398.000 |
| **Structure:** | SW 1 | | |
| **Stationing:** | | | |
| **Borings** | BH19-SW1-05 | | |

| | |
|---|---|
| **Ground surface elevation (ft)** | |
| **Footing elevation (ft)** | |
| **Boring elevation (ft)** | |
| **Depth to groundwater (ft)** | 100 |

**Groundwater elevation (ft)**
**Depth of groundwater below footing (ft)**

**Bearing Pressure Calculations (AASHTO LRFDBDS, 2020)**

| Load Case | Calculated Values | | | |
|---|---|---|---|---|
| Strength | $q_n$ | 5.93 | $q_R$ | 2.67 |

| | | | |
|---|---|---|---|
| **10.6.3.1.1-1** | $q_R = \emptyset_R q_n$ | | |
| **10.6.3.1.2a-1** | $q_n = cN_{cm} + \gamma D_f N_{qm} C_{wq} + 0.5\gamma B N_{ym} C_{w\gamma}$ | | |
| **10.6.3.1.2a-2** | $N_{cm} = N_c s_c i_c$ | $N_{cm}$ | 35.58 |
| **10.6.3.1.2a-3** | $N_{qm} = N_q s_q d_q i_q$ | $N_{qm}$ | 27.90 |
| **10.6.3.1.2a-4** | $N_{ym} = N_\gamma s_\gamma i_\gamma$ | $N_{ym}$ | 30.26 |
| **10.6.3.1.2a-6** | $i_c = i_q - [(1-i_q)/(N_q - 1)]$ | $i_c$ | 1 |
| **10.6.3.1.2a-7** | $i_q = [1-H/(V+cBL\cot\emptyset_f)]^{(n)}$ | $i_q$ | 1 |
| **10.6.3.1.2a-8** | $i_\gamma = [1-H/(V+cBL\cot\emptyset_f)]^{(n+1)}$ | $i_\gamma$ | 1 |
| **10.6.3.1.2a-9** | $n = [(2+L/B)/(1+L/B)]\cos^2\theta + [2+B/L)/(1+B/L)]\sin^2\theta$ | n | 1.80 |
| **Table 10.6.3.1.2a-3** | $s_c = 1 + (B/L)(N_q/N_c)$ | $s_c$ | 1.00 |
| | $s_\gamma = 1 - 0.4(B/L)$ | $s_\gamma$ | 1.00 |
| | $s_q = 1 + ((B/L)\tan\emptyset_f)$ | $s_q$ | 1.00 |

| | | | |
|---|---|---|---|
| *Bearing resistance ($q_R$) (ksf)* | | | |
| *Resistance factor ($\emptyset_r$)* | Section 10 5.5.3 | | 0.45 |
| *Nominal bearing resistanc ($q_n$) (ksf)* | | | |
| **Reduction coef. for slope effects ($RC_{BC}$)** | Tables 10.6.3.1.2c-2 | | 0.43 |
| *Cohesion (c) (ksf)* | | | 0 |
| *Cohesion term ($N_c$)* | | | 35.5 |
| *Surcharge/embedment term ($N_q$)* | Table 10.6.3.1.2a-1 | | 23.2 |
| *Unit weight term ($N_\gamma$)* | Table 10.6.3.1.2a-1 | | 30.2 |
| *Total (moist) unit wt (γ) (kcf)* | Table 10.6.3.1.2a-1 | | 0.12 |
| *Footing embedment depth ($D_f$) (ft)* | | | 4 |
| *Effective Footing width (B') (ft)* | Section 10.6.1.3 | | 4.9 |
| *Footing length (L) (ft)(based on stationing)* | | | 1419 |
| *Correction factors for location of groundwater* | | ($C_{wq}$) | 1 |
| | Table 10.6.3.1.2a-2 | ($C_{w\gamma}$) | 1 |
| *Shearing correction factor ($d_q$)* | Table 10.6.3.1.2a-4 | | 1.2 |
| *Load inclination factors* | | ($i_c$) | 1 |
| | | (iq) | 1 |
| | | ($i_\gamma$) | 1 |
| Angle of internal friction ($\emptyset_f$) (degrees) | | | 32 |
| Radians | | | 0.56 |
| Gross Bearing (ksf) | | | 1.1 |
| Factored Overturning moment (k-ft) | | | 10 |
| Factored Vertical Weight (k) | | | 8 |

**Table 10.5.5.2.2-1—Resistance Factors for Geotechnical Resistance of Shallow Foundations at the Strength Limit State**

| Method/Soil/Condition | | | Resistance Factor |
|---|---|---|---|
| Bearing Resistance | $\varphi_b$ | Theoretical method (Munfakh et al., 2001), in clay | 0.50 |
| | | Theoretical method (Munfakh et al., 2001), in sand, using *CPT* | 0.50 |
| | | Theoretical method (Munfakh et al., 2001), in sand, using *SPT* | 0.45 |
| | | Semi-empirical methods (Meyerhof, 1957), all soils | 0.45 |
| | | Footings on rock | 0.45 |
| | | Plate Load Test | 0.55 |
| Sliding | $\varphi_\tau$ | Precast concrete placed on sand | 0.90 |
| | | Cast-in-Place Concrete on sand | 0.80 |
| | | Cast-in-Place or precast Concrete on Clay | 0.85 |
| | | Soil on soil | 0.90 |
| | $\varphi_{ep}$ | Passive earth pressure component of sliding resistance | 0.50 |

**Table 10.6.3.1.2a-2—Coefficients $C_{wq}$ and $C_{w\gamma}$ for Various Groundwater Depths**

| $D_w$ | $C_{wq}$ | $C_{w\gamma}$ |
|---|---|---|
| 0.0 | 0.5 | 0.5 |
| $D_f$ | 1.0 | 0.5 |
| $>1.5B + D_f$ | 1.0 | 1.0 |

**10.6.1.3—Effective Footing Dimensions**

For eccentrically loaded footings, a reduced effective area, $B' \times L'$, within the confines of the physical footing shall be used in geotechnical design for settlement or bearing resistance. The point of load application shall be at the centroid of the reduced effective area.

The reduced dimensions for an eccentrically loaded rectangular footing shall be taken as:

$$B' = B - 2e_B \qquad (10.6.1.3\text{-}1)$$

$$L' = L - 2e_L$$

where:

$e_B$ = eccentricity parallel to dimension $B$ (ft)
$e_L$ = eccentricity parallel to dimension $L$ (ft)

Footings under eccentric loads shall be designed to ensure that the factored bearing resistance is not less than the effects of factored loads at all applicable limit states.

**Table 10.6.3.1.2a-1—Bearing Capacity Factors $N_c$ (Prandtl, 1921), $N_q$ (Reissner, 1924), and $N_\gamma$ (Vesic, 1975)**

| $\phi_f$ | $N_c$ | $N_q$ | $N_\gamma$ | $\phi_f$ | $N_c$ | $N_q$ | $N_\gamma$ |
|---|---|---|---|---|---|---|---|
| 0 | 5.14 | 1.0 | 0.0 | 23 | 18.1 | 8.7 | 8.2 |
| 1 | 5.4 | 1.1 | 0.1 | 24 | 19.3 | 9.6 | 9.4 |
| 2 | 5.6 | 1.2 | 0.2 | 25 | 20.7 | 10.7 | 10.9 |
| 3 | 5.9 | 1.3 | 0.2 | 26 | 22.3 | 11.9 | 12.5 |
| 4 | 6.2 | 1.4 | 0.3 | 27 | 23.9 | 13.2 | 14.5 |
| 5 | 6.5 | 1.6 | 0.5 | 28 | 25.8 | 14.7 | 16.7 |
| 6 | 6.8 | 1.7 | 0.6 | 29 | 27.9 | 16.4 | 19.3 |
| 7 | 7.2 | 1.9 | 0.7 | 30 | 30.1 | 18.4 | 22.4 |
| 8 | 7.5 | 2.1 | 0.9 | 31 | 32.7 | 20.6 | 26.0 |
| 9 | 7.9 | 2.3 | 1.0 | 32 | 35.5 | 23.2 | 30.2 |
| 10 | 8.4 | 2.5 | 1.2 | 33 | 38.6 | 26.1 | 35.2 |
| 11 | 8.8 | 2.7 | 1.4 | 34 | 42.2 | 29.4 | 41.1 |
| 12 | 9.3 | 3.0 | 1.7 | 35 | 46.1 | 33.3 | 48.0 |
| 13 | 9.8 | 3.3 | 2.0 | 36 | 50.6 | 37.8 | 56.3 |
| 14 | 10.4 | 3.6 | 2.3 | 37 | 55.6 | 42.9 | 66.2 |
| 15 | 11.0 | 3.9 | 2.7 | 38 | 61.4 | 48.9 | 78.0 |
| 16 | 11.6 | 4.3 | 3.1 | 39 | 67.9 | 56.0 | 92.3 |
| 17 | 12.3 | 4.8 | 3.5 | 40 | 75.3 | 64.2 | 109.4 |
| 18 | 13.1 | 5.3 | 4.1 | 41 | 83.9 | 73.9 | 130.2 |
| 19 | 13.9 | 5.8 | 4.7 | 42 | 93.7 | 85.4 | 155.6 |
| 20 | 14.8 | 6.4 | 5.4 | 43 | 105.1 | 99.0 | 186.5 |
| 21 | 15.8 | 7.1 | 6.2 | 44 | 118.4 | 115.3 | 224.6 |
| 22 | 16.9 | 7.8 | 7.1 | 45 | 133.9 | 134.9 | 271.8 |

**Table 10.6.3.1.2a-4—Depth Correction Factor $d_q$**

| Friction Angle, $\phi_f$ (degrees) | $D_f/B$ | $d_q$ |
|---|---|---|
| 32 | 1 | 1.20 |
| | 2 | 1.30 |
| | 4 | 1.35 |
| | 8 | 1.40 |
| 37 | 1 | 1.20 |
| | 2 | 1.25 |
| | 4 | 1.30 |
| | 8 | 1.35 |
| 42 | 1 | 1.15 |
| | 2 | 1.20 |
| | 4 | 1.25 |
| | 8 | 1.30 |

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for footings on or adjacent to slopes. Use linear interpolation to obtain reduction coefficients for values not provided. The slope stability factor, $N_z$, in Tables 10.6.3.1.2c-1 and 10.6.3.1.2c-2 shall be taken as:

$$N_z = \frac{\gamma H_z}{c} \qquad (10.6.3.1.2c\text{-}2)$$

where:

$N_z$ = slope stability factor (dim)
$H_z$ = height of sloping ground surface below bottom of footing (ft)

and other variables are as defined in Article 10.6.3.1.2a.

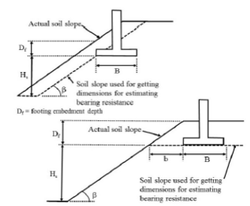


**Figure 10.6.3.1.2c-1—Definition of Footing and Slope Geometric Parameters for Determination of $RC_{BC}$**

NewFields

# SW1 Extreme Limit State

| | | | |
|---|---|---|---|
| **Project:** | US395 North Valleys, Phase 1B | Project No: | 475.0398.000 |
| **Structure:** | SW 1 | | |
| **Stationing:** | | | |
| **Borings** | BH19-SW1-05 | | |

| | |
|---|---|
| **Ground surface elevation (ft)** | |
| **Footing elevation (ft)** | |
| **Boring elevation (ft)** | |
| **Depth to groundwater (ft)** | 100 |

**Groundwater elevation (ft)**
**Depth of groundwater below footing (ft)**

**Bearing Pressure Calculations (AASHTO LRFDBDS, 2020)**

| Load Case | Calculated Values | | | |
|---|---|---|---|---|
| Extreme | $q_n$ | 5.87 | $q_R$ | 5.87 |

| | | | |
|---|---|---|---|
| **10.6.3.1.1-1** | $q_R = \emptyset_R q_n$ | | |
| **10.6.3.1.2a-1** | $q_n = cN_{cm} + \gamma D_f N_{qm} C_{wq} + 0.5\gamma B N_{ym} C_{w\gamma}$ | | |
| **10.6.3.1.2a-2** | $N_{cm} = N_c s_c i_c$ | $N_{cm}$ | 35.55 |
| **10.6.3.1.2a-3** | $N_{qm} = N_q s_q d_q i_q$ | $N_{qm}$ | 27.88 |
| **10.6.3.1.2a-4** | $N_{ym} = N_\gamma s_\gamma i_\gamma$ | $N_{ym}$ | 30.24 |
| **10.6.3.1.2a-6** | $i_c = i_q - [(1-i_q)/(N_q - 1)]$ | $i_c$ | 1 |
| **10.6.3.1.2a-7** | $i_q = [1-H/(V+cBL\cot\emptyset_f)]^{(n)}$ | $i_q$ | 1 |
| **10.6.3.1.2a-8** | $i_\gamma = [1-H/(V+cBL\cot\emptyset_f)]^{(n+1)}$ | $i_\gamma$ | 1 |
| **10.6.3.1.2a-9** | $n = [(2+L/B)/(1+L/B)]\cos^2\theta + [2+B/L)/(1+B/L)]\sin^2\theta$ | n | 1.80 |
| **Table 10.6.3.1.2a-3** | $s_c = 1 + (B/L)(N_q/N_c)$ | $s_c$ | 1.00 |
| | $s_\gamma = 1 - 0.4(B/L)$ | $s_\gamma$ | 1.00 |
| | $s_q = 1 + ((B/L)\tan\emptyset_f)$ | $s_q$ | 1.00 |

| | | | |
|---|---|---|---|
| *Bearing resistance ($q_R$) (ksf)* | | | |
| *Resistance factor ($\emptyset_r$)* | Section 10 5.5.3 | | 1 |
| *Nominal bearing resistanc ($q_n$) (ksf)* | | | |
| **Reduction coef. for slope effects ($RC_{BC}$)** | Tables 10.6.3.1.2c-2 | | 0.43 |
| *Cohesion (c) (ksf)* | | | 0 |
| *Cohesion term ($N_c$)* | | | 35.5 |
| *Surcharge/embedment term ($N_q$)* | Table 10.6.3.1.2a-1 | | 23.2 |
| *Unit weight term ($N_\gamma$)* | Table 10.6.3.1.2a-1 | | 30.2 |
| *Total (moist) unit wt (γ) (kcf)* | Table 10.6.3.1.2a-1 | | 0.12 |
| *Footing embedment depth ($D_f$) (ft)* | | | 4 |
| *Effective Footing width (B') (ft)* | Section 10.6.1.3 | | 3.0 |
| *Footing length (L) (ft)(based on stationing)* | | | 1419 |
| *Correction factors for location of groundwater* | | ($C_{wq}$) | 1 |
| | Table 10.6.3.1.2a-2 | ($C_{w\gamma}$) | 1 |
| *Shearing correction factor ($d_q$)* | Table 10.6.3.1.2a-4 | | 1.2 |
| *Load inclination factors* | | ($i_c$) | 1 |
| | | (iq) | 1 |
| | | ($i_\gamma$) | 1 |
| Angle of internal friction ($\emptyset_f$) (degrees) | | | 32 |
| Radians | | | 0.56 |
| Gross Bearing (ksf) | | | 0.8 |
| Factored Overturning moment (k-ft) | | | 13 |
| Factored Vertical Weight (k) | | | 6 |

**10.6.1.3—Effective Footing Dimensions**

For eccentrically loaded footings, a reduced effective area, $B' \times L'$, within the confines of the physical footing shall be used in geotechnical design for settlement or bearing resistance. The point of load application shall be at the centroid of the reduced effective area.

The reduced dimensions for an eccentrically loaded rectangular footing shall be taken as:

$$B' = B - 2e_B \qquad (10.6.1.3\text{-}1)$$

$$L' = L - 2e_L$$

where:

$e_B$ = eccentricity parallel to dimension $B$ (ft)
$e_L$ = eccentricity parallel to dimension $L$ (ft)

Footings under eccentric loads shall be designed to ensure that the factored bearing resistance is not less than the effects of factored loads at all applicable limit states.

**Table 10.5.5.2.2-1—Resistance Factors for Geotechnical Resistance of Shallow Foundations at the Strength Limit State**

| Method/Soil/Condition | | | Resistance Factor |
|---|---|---|---|
| Bearing Resistance | $\varphi_b$ | Theoretical method (Munfakh et al., 2001), in clay | 0.50 |
| | | Theoretical method (Munfakh et al., 2001), in sand, using *CPT* | 0.50 |
| | | Theoretical method (Munfakh et al., 2001), in sand, using *SPT* | 0.45 |
| | | Semi-empirical methods (Meyerhof, 1957), all soils | 0.45 |
| | | Footings on rock | 0.45 |
| | | Plate Load Test | 0.55 |
| Sliding | $\varphi_\tau$ | Precast concrete placed on sand | 0.90 |
| | | Cast-in-Place Concrete on sand | 0.80 |
| | | Cast-in-Place or precast Concrete on Clay | 0.85 |
| | | Soil on soil | 0.90 |
| | $\varphi_{ep}$ | Passive earth pressure component of sliding resistance | 0.50 |

**Table 10.6.3.1.2a-2—Coefficients $C_{wq}$ and $C_{w\gamma}$ for Various Groundwater Depths**

| $D_w$ | $C_{wq}$ | $C_{w\gamma}$ |
|---|---|---|
| 0.0 | 0.5 | 0.5 |
| $D_f$ | 1.0 | 0.5 |
| $>1.5B + D_f$ | 1.0 | 1.0 |

**Table 10.6.3.1.2a-1—Bearing Capacity Factors $N_c$ (Prandtl, 1921), $N_q$ (Reissner, 1924), and $N_\gamma$ (Vesic, 1975)**

| $\phi_f$ | $N_c$ | $N_q$ | $N_\gamma$ | $\phi_f$ | $N_c$ | $N_q$ | $N_\gamma$ |
|---|---|---|---|---|---|---|---|
| 0 | 5.14 | 1.0 | 0.0 | 23 | 18.1 | 8.7 | 8.2 |
| 1 | 5.4 | 1.1 | 0.1 | 24 | 19.3 | 9.6 | 9.4 |
| 2 | 5.6 | 1.2 | 0.2 | 25 | 20.7 | 10.7 | 10.9 |
| 3 | 5.9 | 1.3 | 0.2 | 26 | 22.3 | 11.9 | 12.5 |
| 4 | 6.2 | 1.4 | 0.3 | 27 | 23.9 | 13.2 | 14.5 |
| 5 | 6.5 | 1.6 | 0.5 | 28 | 25.8 | 14.7 | 16.7 |
| 6 | 6.8 | 1.7 | 0.6 | 29 | 27.9 | 16.4 | 19.3 |
| 7 | 7.2 | 1.9 | 0.7 | 30 | 30.1 | 18.4 | 22.4 |
| 8 | 7.5 | 2.1 | 0.9 | 31 | 32.7 | 20.6 | 26.0 |
| 9 | 7.9 | 2.3 | 1.0 | 32 | 35.5 | 23.2 | 30.2 |
| 10 | 8.4 | 2.5 | 1.2 | 33 | 38.6 | 26.1 | 35.2 |
| 11 | 8.8 | 2.7 | 1.4 | 34 | 42.2 | 29.4 | 41.1 |
| 12 | 9.3 | 3.0 | 1.7 | 35 | 46.1 | 33.3 | 48.0 |
| 13 | 9.8 | 3.3 | 2.0 | 36 | 50.6 | 37.8 | 56.3 |
| 14 | 10.4 | 3.6 | 2.3 | 37 | 55.6 | 42.9 | 66.2 |
| 15 | 11.0 | 3.9 | 2.7 | 38 | 61.4 | 48.9 | 78.0 |
| 16 | 11.6 | 4.3 | 3.1 | 39 | 67.9 | 56.0 | 92.3 |
| 17 | 12.3 | 4.8 | 3.5 | 40 | 75.3 | 64.2 | 109.4 |
| 18 | 13.1 | 5.3 | 4.1 | 41 | 83.9 | 73.9 | 130.2 |
| 19 | 13.9 | 5.8 | 4.7 | 42 | 93.7 | 85.4 | 155.6 |
| 20 | 14.8 | 6.4 | 5.4 | 43 | 105.1 | 99.0 | 186.5 |
| 21 | 15.8 | 7.1 | 6.2 | 44 | 118.4 | 115.3 | 224.6 |
| 22 | 16.9 | 7.8 | 7.1 | 45 | 133.9 | 134.9 | 271.8 |

**Table 10.6.3.1.2a-4—Depth Correction Factor $d_q$**

| Friction Angle, $\phi_f$ (degrees) | $D_f/B$ | $d_q$ |
|---|---|---|
| 32 | 1 | 1.20 |
| | 2 | 1.30 |
| | 4 | 1.35 |
| | 8 | 1.40 |
| 37 | 1 | 1.20 |
| | 2 | 1.25 |
| | 4 | 1.30 |
| | 8 | 1.35 |
| 42 | 1 | 1.15 |
| | 2 | 1.20 |
| | 4 | 1.25 |
| | 8 | 1.30 |

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for footings on or adjacent to slopes. Use linear interpolation to obtain reduction coefficients for values not provided. The slope stability factor, $N_z$, in Tables 10.6.3.1.2c-1 and 10.6.3.1.2c-2 shall be taken as:

$$N_z = \frac{\gamma H_z}{c} \qquad (10.6.3.1.2c\text{-}2)$$

where:

$N_z$ = slope stability factor (dim)
$H_z$ = height of sloping ground surface below bottom of footing (ft)

and other variables are as defined in Article 10.6.3.1.2a.

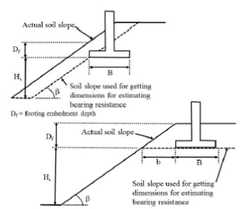


**Figure 10.6.3.1.2c-1—Definition of Footing and Slope Geometric Parameters for Determination of $RC_{BC}$**

NewFields

# SW6 Strength Limit State

| | | | |
|---|---|---|---|
| **Project:** | US395 North Valleys, Phase 1B | Project No: | 475.0398.000 |
| **Structure:** | SW 6 | | |
| **Stationing:** | | | |
| **Borings** | BH19-SW7-47 | | |

| | |
|---|---|
| **Ground surface elevation (ft)** | |
| **Footing elevation (ft)** | |
| **Boring elevation (ft)** | |
| **Depth to groundwater (ft)** | 100 |

**Groundwater elevation (ft)**
**Depth of groundwater below footing (ft)**

**Bearing Pressure Calculations (AASHTO LRFDBDS, 2020)**

| Load Case | Calculated Values | | | |
|---|---|---|---|---|
| Strength | $q_n$ | 8.30 | $q_R$ | 3.74 |

| | | | |
|---|---|---|---|
| **10.6.3.1.1-1** | $q_R = \emptyset_R q_n$ | | |
| **10.6.3.1.2a-1** | $q_n = cN_{cm} + \gamma D_f N_{qm} C_{wq} + 0.5\gamma B N_{\gamma m} C_{w\gamma}$ | | |
| **10.6.3.1.2a-2** | $N_{cm} = N_c s_c i_c$ | $N_{cm}$ | 35.61 |
| **10.6.3.1.2a-3** | $N_{qm} = N_q s_q d_q i_q$ | $N_{qm}$ | 27.92 |
| **10.6.3.1.2a-4** | $N_{\gamma m} = N_\gamma s_\gamma i_\gamma$ | $N_{\gamma m}$ | 30.29 |
| **10.6.3.1.2a-6** | $i_c = i_q - [(1-i_q)/(N_q - 1)]$ | $i_c$ | 1 |
| **10.6.3.1.2a-7** | $i_q = [1-H/(V+cBL\cot\emptyset_f)]^{(n)}$ | $i_q$ | 1 |
| **10.6.3.1.2a-8** | $i_\gamma = [1-H/(V+cBL\cot\emptyset_f)]^{(n+1)}$ | $i_\gamma$ | 1 |
| **10.6.3.1.2a-9** | $n = [(2+L/B)/(1+L/B)]\cos^2\theta + [2+B/L)/(1+B/L)]\sin^2\theta$ | n | 1.80 |
| **Table 10.6.3.1.2a-3** | $s_c = 1 + (B/L)(N_q/N_c)$ | $s_c$ | 1.00 |
| | $s_\gamma = 1 - 0.4(B/L)$ | $s_\gamma$ | 1.00 |
| | $s_q = 1 + ((B/L)\tan\emptyset_f)$ | $s_q$ | 1.00 |

| | | | |
|---|---|---|---|
| *Bearing resistance ($q_R$) (ksf)* | | | |
| *Resistance factor ($\emptyset_r$)* | Section 10 5.5.3 | | 0.45 |
| *Nominal bearing resistanc ($q_n$) (ksf)* | | | |
| **Reduction coef. for slope effects ($RC_{BC}$)** | Tables 10.6.3.1.2c-2 | | 0.66 |
| *Cohesion (c) (ksf)* | | | 0 |
| *Cohesion term ($N_c$)* | | | 35.5 |
| *Surcharge/embedment term ($N_q$)* | Table 10.6.3.1.2a-1 | | 23.2 |
| *Unit weight term ($N_\gamma$)* | Table 10.6.3.1.2a-1 | | 30.2 |
| *Total (moist) unit wt (γ) (kcf)* | Table 10.6.3.1.2a-1 | | 0.12 |
| *Footing embedment depth ($D_f$) (ft)* | | | 3.67 |
| *Effective Footing width (B') (ft)* | Section 10.6.1.3 | | 4.7 |
| *Footing length (L) (ft)(based on stationing)* | | | 1017 |
| *Correction factors for location of groundwater* | | ($C_{wq}$) | 1 |
| | Table 10.6.3.1.2a-2 | ($C_{w\gamma}$) | 1 |
| *Shearing correction factor ($d_q$)* | Table 10.6.3.1.2a-4 | | 1.2 |
| *Load inclination factors* | | ($i_c$) | 1 |
| | | (iq) | 1 |
| | | ($i_\gamma$) | 1 |
| Angle of internal friction ($\emptyset_f$) (degrees) | | | 32 |
| Radians | | | 0.56 |
| Gross Bearing (ksf) | | | 1.2 |
| Factored Overturning moment (k-ft) | | | 14 |
| Factored Vertical Weight (k) | | | 9 |
| eccentricity (ft) | | | 1.6 |

**Table 10.5.5.2.2-1—Resistance Factors for Geotechnical Resistance of Shallow Foundations at the Strength Limit State**

| Method/Soil/Condition | | | Resistance Factor |
|---|---|---|---|
| Bearing Resistance | $\varphi_b$ | Theoretical method (Munfakh et al., 2001), in clay | 0.50 |
| | | Theoretical method (Munfakh et al., 2001), in sand, using *CPT* | 0.50 |
| | | Theoretical method (Munfakh et al., 2001), in sand, using *SPT* | 0.45 |
| | | Semi-empirical methods (Meyerhof, 1957), all soils | 0.45 |
| | | Footings on rock | 0.45 |
| | | Plate Load Test | 0.55 |
| Sliding | $\varphi_\tau$ | Precast concrete placed on sand | 0.90 |
| | | Cast-in-Place Concrete on sand | 0.80 |
| | | Cast-in-Place or precast Concrete on Clay | 0.85 |
| | | Soil on soil | 0.90 |
| | $\varphi_{ep}$ | Passive earth pressure component of sliding resistance | 0.50 |

**Table 10.6.3.1.2a-2—Coefficients $C_{wq}$ and $C_{w\gamma}$ for Various Groundwater Depths**

| $D_w$ | $C_{wq}$ | $C_{w\gamma}$ |
|---|---|---|
| 0.0 | 0.5 | 0.5 |
| $D_f$ | 1.0 | 0.5 |
| $>1.5B + D_f$ | 1.0 | 1.0 |

**10.6.1.3—Effective Footing Dimensions**

For eccentrically loaded footings, a reduced effective area, $B' \times L'$, within the confines of the physical footing shall be used in geotechnical design for settlement or bearing resistance. The point of load application shall be at the centroid of the reduced effective area.

The reduced dimensions for an eccentrically loaded rectangular footing shall be taken as:

$$B' = B - 2e_B \qquad (10.6.1.3\text{-}1)$$

$$L' = L - 2e_L$$

where:

$e_B$ = eccentricity parallel to dimension $B$ (ft)
$e_L$ = eccentricity parallel to dimension $L$ (ft)

Footings under eccentric loads shall be designed to ensure that the factored bearing resistance is not less than the effects of factored loads at all applicable limit states.

**Table 10.6.3.1.2a-1—Bearing Capacity Factors $N_c$ (Prandtl, 1921), $N_q$ (Reissner, 1924), and $N_\gamma$ (Vesic, 1975)**

| $\phi_f$ | $N_c$ | $N_q$ | $N_\gamma$ | $\phi_f$ | $N_c$ | $N_q$ | $N_\gamma$ |
|---|---|---|---|---|---|---|---|
| 0 | 5.14 | 1.0 | 0.0 | 23 | 18.1 | 8.7 | 8.2 |
| 1 | 5.4 | 1.1 | 0.1 | 24 | 19.3 | 9.6 | 9.4 |
| 2 | 5.6 | 1.2 | 0.2 | 25 | 20.7 | 10.7 | 10.9 |
| 3 | 5.9 | 1.3 | 0.2 | 26 | 22.3 | 11.9 | 12.5 |
| 4 | 6.2 | 1.4 | 0.3 | 27 | 23.9 | 13.2 | 14.5 |
| 5 | 6.5 | 1.6 | 0.5 | 28 | 25.8 | 14.7 | 16.7 |
| 6 | 6.8 | 1.7 | 0.6 | 29 | 27.9 | 16.4 | 19.3 |
| 7 | 7.2 | 1.9 | 0.7 | 30 | 30.1 | 18.4 | 22.4 |
| 8 | 7.5 | 2.1 | 0.9 | 31 | 32.7 | 20.6 | 26.0 |
| 9 | 7.9 | 2.3 | 1.0 | 32 | 35.5 | 23.2 | 30.2 |
| 10 | 8.4 | 2.5 | 1.2 | 33 | 38.6 | 26.1 | 35.2 |
| 11 | 8.8 | 2.7 | 1.4 | 34 | 42.2 | 29.4 | 41.1 |
| 12 | 9.3 | 3.0 | 1.7 | 35 | 46.1 | 33.3 | 48.0 |
| 13 | 9.8 | 3.3 | 2.0 | 36 | 50.6 | 37.8 | 56.3 |
| 14 | 10.4 | 3.6 | 2.3 | 37 | 55.6 | 42.9 | 66.2 |
| 15 | 11.0 | 3.9 | 2.7 | 38 | 61.4 | 48.9 | 78.0 |
| 16 | 11.6 | 4.3 | 3.1 | 39 | 67.9 | 56.0 | 92.3 |
| 17 | 12.3 | 4.8 | 3.5 | 40 | 75.3 | 64.2 | 109.4 |
| 18 | 13.1 | 5.3 | 4.1 | 41 | 83.9 | 73.9 | 130.2 |
| 19 | 13.9 | 5.8 | 4.7 | 42 | 93.7 | 85.4 | 155.6 |
| 20 | 14.8 | 6.4 | 5.4 | 43 | 105.1 | 99.0 | 186.5 |
| 21 | 15.8 | 7.1 | 6.2 | 44 | 118.4 | 115.3 | 224.6 |
| 22 | 16.9 | 7.8 | 7.1 | 45 | 133.9 | 134.9 | 271.8 |

**Table 10.6.3.1.2a-4—Depth Correction Factor $d_q$**

| Friction Angle, $\phi_f$ (degrees) | $D_f/B$ | $d_q$ |
|---|---|---|
| 32 | 1 | 1.20 |
| | 2 | 1.30 |
| | 4 | 1.35 |
| | 8 | 1.40 |
| 37 | 1 | 1.20 |
| | 2 | 1.25 |
| | 4 | 1.30 |
| | 8 | 1.35 |
| 42 | 1 | 1.15 |
| | 2 | 1.20 |
| | 4 | 1.25 |
| | 8 | 1.30 |

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for footings on or adjacent to slopes. Use linear interpolation to obtain reduction coefficients for values not provided. The slope stability factor, $N_s$, in Tables 10.6.3.1.2c-1 and 10.6.3.1.2c-2 shall be taken as:

$$N_s = \frac{\gamma H_s}{c} \qquad (10.6.3.1.2c\text{-}2)$$

where:

$N_s$ = slope stability factor (dim)
$H_s$ = height of sloping ground surface below bottom of footing (ft)

and other variables are as defined in Article 10.6.3.1.2a.

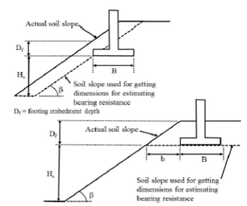


**Figure 10.6.3.1.2c-1—Definition of Footing and Slope Geometric Parameters for Determination of $RC_{BC}$**

NewFields

# SW6 Extreme I Limit State

| | | | |
|---|---|---|---|
| **Project:** | US395 North Valleys, Phase 1B | Project No: | 475.0398.000 |
| **Structure:** | SW 6 | | |
| **Stationing:** | | | |
| **Borings** | BH19-SW7-47 | | |

| | |
|---|---|
| **Ground surface elevation (ft)** | |
| **Footing elevation (ft)** | |
| **Boring elevation (ft)** | |
| **Depth to groundwater (ft)** | 100 |

**Groundwater elevation (ft)**
**Depth of groundwater below footing (ft)**

**Bearing Pressure Calculations (AASHTO LRFDBDS, 2020)**

| Load Case | Calculated Values | | | |
|---|---|---|---|---|
| Extreme I | $q_n$ | 8.17 | $q_R$ | 8.17 |
| | | | | |

| | | | |
|---|---|---|---|
| **10.6.3.1.1-1** | $q_R = \emptyset_R q_n$ | | |
| **10.6.3.1.2a-1** | $q_n = cN_{cm} + \gamma D_f N_{qm} C_{wq} + 0.5\gamma B N_{\gamma m} C_{w\gamma}$ | | |
| **10.6.3.1.2a-2** | $N_{cm} = N_c s_c i_c$ | $N_{cm}$ | 35.54 |
| **10.6.3.1.2a-3** | $N_{qm} = N_q s_q d_q i_q$ | $N_{qm}$ | 27.87 |
| **10.6.3.1.2a-4** | $N_{\gamma m} = N_\gamma s_\gamma i_\gamma$ | $N_{\gamma m}$ | 30.23 |
| **10.6.3.1.2a-6** | $i_c = i_q - [(1-i_q)/(N_q-1)]$ | $i_c$ | 1 |
| **10.6.3.1.2a-7** | $i_q = [1-H/(V+cBL\cot\emptyset_f)]^{(n)}$ | $i_q$ | 1 |
| **10.6.3.1.2a-8** | $i_\gamma = [1-H/(V+cBL\cot\emptyset_f)]^{(n+1)}$ | $i_\gamma$ | 1 |
| **10.6.3.1.2a-9** | $n = [(2+L/B)/(1+L/B)]\cos^2\theta + [2+B/L)/(1+B/L)]\sin^2\theta$ | n | 1.80 |
| **Table 10.6.3.1.2a-3** | $s_c = 1+ (B/L)(N_q/N_c)$ | $s_c$ | 1.00 |
| | $s_\gamma = 1-0.4(B/L)$ | $s_\gamma$ | 1.00 |
| | $s_q = 1+((B/L)\tan\emptyset_f))$ | $s_q$ | 1.00 |

| | | | |
|---|---|---|---|
| *Bearing resistance ($q_R$) (ksf)* | | | |
| *Resistance factor ($\emptyset_r$)* | Section 10 5.5.3 | | 1 |
| *Nominal bearing resistanc ($q_n$) (ksf)* | | | |
| **Reduction coef. for slope effects ($RC_{BC}$)** | Tables 10.6.3.1.2c-2 | | 0.66 |
| *Cohesion (c) (ksf)* | | | 0 |
| *Cohesion term ($N_c$)* | | | 35.5 |
| *Surcharge/embedment term ($N_q$)* | Table 10.6.3.1.2a-1 | | 23.2 |
| *Unit weight term ($N_\gamma$)* | Table 10.6.3.1.2a-1 | | 30.2 |
| *Total (moist) unit wt (γ) (kcf)* | Table 10.6.3.1.2a-1 | | 0.12 |
| *Footing embedment depth ($D_f$) (ft)* | | | 3.67 |
| *Effective Footing width (B') (ft)* | Section 10.6.1.3 | | 1.8 |
| *Footing length (L) (ft)(based on stationing)* | | | 1017 |
| *Correction factors for location of groundwater* | | ($C_{wq}$) | 1 |
| | Table 10.6.3.1.2a-2 | ($C_{w\gamma}$) | 1 |
| *Shearing correction factor ($d_q$)* | Table 10.6.3.1.2a-4 | | 1.2 |
| *Load inclination factors* | | ($i_c$) | 1 |
| | | (iq) | 1 |
| | | ($i_\gamma$) | 1 |
| Angle of internal friction ($\emptyset_f$) (degrees) | | | 32 |
| Radians | | | 0.56 |
| Gross Bearing (ksf) | | | 0.9 |
| Factored Overturning moment (k-ft) | | | 21 |
| Factored Vertical Weight (k) | | | 7 |
| eccentricity (ft) | | | 3.0 |

**10.6.1.3—Effective Footing Dimensions**

For eccentrically loaded footings, a reduced effective area, $B' \times L'$, within the confines of the physical footing shall be used in geotechnical design for settlement or bearing resistance. The point of load application shall be at the centroid of the reduced effective area.

The reduced dimensions for an eccentrically loaded rectangular footing shall be taken as:

$$B' = B - 2e_B \qquad (10.6.1.3\text{-}1)$$

$$L' = L - 2e_L$$

where:

$e_B$ = eccentricity parallel to dimension $B$ (ft)
$e_L$ = eccentricity parallel to dimension $L$ (ft)

Footings under eccentric loads shall be designed to ensure that the factored bearing resistance is not less than the effects of factored loads at all applicable limit states.

**Table 10.5.5.2.2-1—Resistance Factors for Geotechnical Resistance of Shallow Foundations at the Strength Limit State**

| Method/Soil/Condition | | | Resistance Factor |
|---|---|---|---|
| Bearing Resistance | $\varphi_b$ | Theoretical method (Munfakh et al., 2001), in clay | 0.50 |
| | | Theoretical method (Munfakh et al., 2001), in sand, using *CPT* | 0.50 |
| | | Theoretical method (Munfakh et al., 2001), in sand, using *SPT* | 0.45 |
| | | Semi-empirical methods (Meyerhof, 1957), all soils | 0.45 |
| | | Footings on rock | 0.45 |
| | | Plate Load Test | 0.55 |
| Sliding | $\varphi_\tau$ | Precast concrete placed on sand | 0.90 |
| | | Cast-in-Place Concrete on sand | 0.80 |
| | | Cast-in-Place or precast Concrete on Clay | 0.85 |
| | | Soil on soil | 0.90 |
| | $\varphi_{ep}$ | Passive earth pressure component of sliding resistance | 0.50 |

**Table 10.6.3.1.2a-2—Coefficients $C_{wq}$ and $C_{w\gamma}$ for Various Groundwater Depths**

| $D_w$ | $C_{wq}$ | $C_{w\gamma}$ |
|---|---|---|
| 0.0 | 0.5 | 0.5 |
| $D_f$ | 1.0 | 0.5 |
| $>1.5B + D_f$ | 1.0 | 1.0 |

**Table 10.6.3.1.2a-1—Bearing Capacity Factors $N_c$ (Prandtl, 1921), $N_q$ (Reissner, 1924), and $N_\gamma$ (Vesic, 1975)**

| $\phi_f$ | $N_c$ | $N_q$ | $N_\gamma$ | $\phi_f$ | $N_c$ | $N_q$ | $N_\gamma$ |
|---|---|---|---|---|---|---|---|
| 0 | 5.14 | 1.0 | 0.0 | 23 | 18.1 | 8.7 | 8.2 |
| 1 | 5.4 | 1.1 | 0.1 | 24 | 19.3 | 9.6 | 9.4 |
| 2 | 5.6 | 1.2 | 0.2 | 25 | 20.7 | 10.7 | 10.9 |
| 3 | 5.9 | 1.3 | 0.2 | 26 | 22.3 | 11.9 | 12.5 |
| 4 | 6.2 | 1.4 | 0.3 | 27 | 23.9 | 13.2 | 14.5 |
| 5 | 6.5 | 1.6 | 0.5 | 28 | 25.8 | 14.7 | 16.7 |
| 6 | 6.8 | 1.7 | 0.6 | 29 | 27.9 | 16.4 | 19.3 |
| 7 | 7.2 | 1.9 | 0.7 | 30 | 30.1 | 18.4 | 22.4 |
| 8 | 7.5 | 2.1 | 0.9 | 31 | 32.7 | 20.6 | 26.0 |
| 9 | 7.9 | 2.3 | 1.0 | 32 | 35.5 | 23.2 | 30.2 |
| 10 | 8.4 | 2.5 | 1.2 | 33 | 38.6 | 26.1 | 35.2 |
| 11 | 8.8 | 2.7 | 1.4 | 34 | 42.2 | 29.4 | 41.1 |
| 12 | 9.3 | 3.0 | 1.7 | 35 | 46.1 | 33.3 | 48.0 |
| 13 | 9.8 | 3.3 | 2.0 | 36 | 50.6 | 37.8 | 56.3 |
| 14 | 10.4 | 3.6 | 2.3 | 37 | 55.6 | 42.9 | 66.2 |
| 15 | 11.0 | 3.9 | 2.7 | 38 | 61.4 | 48.9 | 78.0 |
| 16 | 11.6 | 4.3 | 3.1 | 39 | 67.9 | 56.0 | 92.3 |
| 17 | 12.3 | 4.8 | 3.5 | 40 | 75.3 | 64.2 | 109.4 |
| 18 | 13.1 | 5.3 | 4.1 | 41 | 83.9 | 73.9 | 130.2 |
| 19 | 13.9 | 5.8 | 4.7 | 42 | 93.7 | 85.4 | 155.6 |
| 20 | 14.8 | 6.4 | 5.4 | 43 | 105.1 | 99.0 | 186.5 |
| 21 | 15.8 | 7.1 | 6.2 | 44 | 118.4 | 115.3 | 224.6 |
| 22 | 16.9 | 7.8 | 7.1 | 45 | 133.9 | 134.9 | 271.8 |

**Table 10.6.3.1.2a-4—Depth Correction Factor $d_q$**

| Friction Angle, $\phi_f$ (degrees) | $D_f/B$ | $d_q$ |
|---|---|---|
| 32 | 1 | 1.20 |
| | 2 | 1.30 |
| | 4 | 1.35 |
| | 8 | 1.40 |
| 37 | 1 | 1.20 |
| | 2 | 1.25 |
| | 4 | 1.30 |
| | 8 | 1.35 |
| 42 | 1 | 1.15 |
| | 2 | 1.20 |
| | 4 | 1.25 |
| | 8 | 1.30 |

**SECTION 10: FOUNDATIONS**

for footings on or adjacent to slopes. Use linear interpolation to obtain reduction coefficients for values not provided. The slope stability factor, $N_s$, in Tables 10.6.3.1.2c-1 and 10.6.3.1.2c-2 shall be taken as:

$$N_s = \frac{\gamma H_s}{c} \qquad (10.6.3.1.2c\text{-}2)$$

where:

$N_s$ = slope stability factor (dim)
$H_s$ = height of sloping ground surface below bottom of footing (ft)

and other variables are as defined in Article 10.6.3.1.2a.

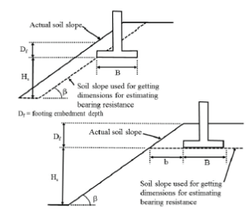


**Figure 10.6.3.1.2c-1—Definition of Footing and Slope Geometric Parameters for Determination of $RC_{BC}$**

NewFields

# SW6 Extreme II Limit State

| | | | |
|---|---|---|---|
| **Project:** | US395 North Valleys, Phase 1B | Project No: | 475.0398.000 |
| **Structure:** | SW 6 | | |
| **Stationing:** | | | |
| **Borings** | BH19-SW6-47 | | |

| | |
|---|---|
| **Ground surface elevation (ft)** | |
| **Footing elevation (ft)** | |
| **Boring elevation (ft)** | |
| **Depth to groundwater (ft)** | 100 |

**Groundwater elevation (ft)**
**Depth of groundwater below footing (ft)**

**Bearing Pressure Calculations (AASHTO LRFDBDS, 2020)**

| Load Case | Calculated Values | | | |
|---|---|---|---|---|
| Extreme II | $q_n$ | 8.18 | $q_R$ | 8.18 |
| | | | | |

| | | | |
|---|---|---|---|
| **10.6.3.1.1-1** | $q_R = \emptyset_R q_n$ | | |
| **10.6.3.1.2a-1** | $q_n = cN_{cm} + \gamma D_f N_{qm} C_{wq} + 0.5\gamma B N_{\gamma m} C_{w\gamma}$ | | |
| **10.6.3.1.2a-2** | $N_{cm} = N_c s_c i_c$ | $N_{cm}$ | 35.55 |
| **10.6.3.1.2a-3** | $N_{qm} = N_q s_q d_q i_q$ | $N_{qm}$ | 27.87 |
| **10.6.3.1.2a-4** | $N_{\gamma m} = N_\gamma s_\gamma i_\gamma$ | $N_{\gamma m}$ | 30.24 |
| **10.6.3.1.2a-6** | $i_c = i_q - [(1-i_q)/(N_q-1)]$ | $i_c$ | 1 |
| **10.6.3.1.2a-7** | $i_q = [1-H/(V+cBL\cot\emptyset_f)]^{(n)}$ | $i_q$ | 1 |
| **10.6.3.1.2a-8** | $i_\gamma = [1-H/(V+cBL\cot\emptyset_f)]^{(n+1)}$ | $i_\gamma$ | 1 |
| **10.6.3.1.2a-9** | $n = [(2+L/B)/(1+L/B)]\cos^2\theta + [2+B/L)/(1+B/L)]\sin^2\theta$ | n | 1.80 |
| **Table 10.6.3.1.2a-3** | $s_c = 1 + (B/L)(N_q/N_c)$ | $s_c$ | 1.00 |
| | $s_\gamma = 1-0.4(B/L)$ | $s_\gamma$ | 1.00 |
| | $s_q = 1+((B/L)\tan\emptyset_f)$ | $s_q$ | 1.00 |

| | | | |
|---|---|---|---|
| *Bearing resistance ($q_R$) (ksf)* | | | |
| *Resistance factor ($\emptyset_r$)* | Section 10 5.5.3 | | 1 |
| *Nominal bearing resistanc ($q_n$) (ksf)* | | | |
| **Reduction coef. for slope effects ($RC_{BC}$)** | Tables 10.6.3.1.2c-2 | | 0.66 |
| *Cohesion (c) (ksf)* | | | 0 |
| *Cohesion term ($N_c$)* | | | 35.5 |
| *Surcharge/embedment term ($N_q$)* | Table 10.6.3.1.2a-1 | | 23.2 |
| *Unit weight term ($N_\gamma$)* | Table 10.6.3.1.2a-1 | | 30.2 |
| *Total (moist) unit wt (γ) (kcf)* | Table 10.6.3.1.2a-1 | | 0.12 |
| *Footing embedment depth ($D_f$) (ft)* | | | 3.67 |
| *Effective Footing width (B') (ft)* | Section 10.6.1.3 | | 2.0 |
| *Footing length (L) (ft)(based on stationing)* | | | 1017 |
| *Correction factors for location of groundwater* | | ($C_{wq}$) | 1 |
| | Table 10.6.3.1.2a-2 | ($C_{w\gamma}$) | 1 |
| *Shearing correction factor ($d_q$)* | Table 10.6.3.1.2a-4 | | 1.2 |
| *Load inclination factors* | | ($i_c$) | 1 |
| | | (iq) | 1 |
| | | ($i_\gamma$) | 1 |
| Angle of internal friction ($\emptyset_f$) (degrees) | | | 32 |
| Radians | | | 0.56 |
| Gross Bearing (ksf) | | | 0.9 |
| Factored Overturning moment (k-ft) | | | 23 |
| Factored Vertical Weight (k) | | | 8 |
| eccentricity (ft) | | | 2.9 |

**10.6.1.3—Effective Footing Dimensions**

For eccentrically loaded footings, a reduced effective area, $B' \times L'$, within the confines of the physical footing shall be used in geotechnical design for settlement or bearing resistance. The point of load application shall be at the centroid of the reduced effective area.

The reduced dimensions for an eccentrically loaded rectangular footing shall be taken as:

$$B' = B - 2e_B \qquad (10.6.1.3\text{-}1)$$

$$L' = L - 2e_L$$

where:

$e_B$ = eccentricity parallel to dimension $B$ (ft)
$e_L$ = eccentricity parallel to dimension $L$ (ft)

Footings under eccentric loads shall be designed to ensure that the factored bearing resistance is not less than the effects of factored loads at all applicable limit states.

**Table 10.5.5.2.2-1—Resistance Factors for Geotechnical Resistance of Shallow Foundations at the Strength Limit State**

| Method/Soil/Condition | | | Resistance Factor |
|---|---|---|---|
| Bearing Resistance | $\varphi_b$ | Theoretical method (Munfakh et al., 2001), in clay | 0.50 |
| | | Theoretical method (Munfakh et al., 2001), in sand, using *CPT* | 0.50 |
| | | Theoretical method (Munfakh et al., 2001), in sand, using *SPT* | 0.45 |
| | | Semi-empirical methods (Meyerhof, 1957), all soils | 0.45 |
| | | Footings on rock | 0.45 |
| | | Plate Load Test | 0.55 |
| Sliding | $\varphi_\tau$ | Precast concrete placed on sand | 0.90 |
| | | Cast-in-Place Concrete on sand | 0.80 |
| | | Cast-in-Place or precast Concrete on Clay | 0.85 |
| | | Soil on soil | 0.90 |
| | $\varphi_{ep}$ | Passive earth pressure component of sliding resistance | 0.50 |

**Table 10.6.3.1.2a-2—Coefficients $C_{wq}$ and $C_{w\gamma}$ for Various Groundwater Depths**

| $D_w$ | $C_{wq}$ | $C_{w\gamma}$ |
|---|---|---|
| 0.0 | 0.5 | 0.5 |
| $D_f$ | 1.0 | 0.5 |
| $>1.5B + D_f$ | 1.0 | 1.0 |

**Table 10.6.3.1.2a-1—Bearing Capacity Factors $N_c$ (Prandtl, 1921), $N_q$ (Reissner, 1924), and $N_\gamma$ (Vesic, 1975)**

| $\phi_f$ | $N_c$ | $N_q$ | $N_\gamma$ | $\phi_f$ | $N_c$ | $N_q$ | $N_\gamma$ |
|---|---|---|---|---|---|---|---|
| 0 | 5.14 | 1.0 | 0.0 | 23 | 18.1 | 8.7 | 8.2 |
| 1 | 5.4 | 1.1 | 0.1 | 24 | 19.3 | 9.6 | 9.4 |
| 2 | 5.6 | 1.2 | 0.2 | 25 | 20.7 | 10.7 | 10.9 |
| 3 | 5.9 | 1.3 | 0.2 | 26 | 22.3 | 11.9 | 12.5 |
| 4 | 6.2 | 1.4 | 0.3 | 27 | 23.9 | 13.2 | 14.5 |
| 5 | 6.5 | 1.6 | 0.5 | 28 | 25.8 | 14.7 | 16.7 |
| 6 | 6.8 | 1.7 | 0.6 | 29 | 27.9 | 16.4 | 19.3 |
| 7 | 7.2 | 1.9 | 0.7 | 30 | 30.1 | 18.4 | 22.4 |
| 8 | 7.5 | 2.1 | 0.9 | 31 | 32.7 | 20.6 | 26.0 |
| 9 | 7.9 | 2.3 | 1.0 | 32 | 35.5 | 23.2 | 30.2 |
| 10 | 8.4 | 2.5 | 1.2 | 33 | 38.6 | 26.1 | 35.2 |
| 11 | 8.8 | 2.7 | 1.4 | 34 | 42.2 | 29.4 | 41.1 |
| 12 | 9.3 | 3.0 | 1.7 | 35 | 46.1 | 33.3 | 48.0 |
| 13 | 9.8 | 3.3 | 2.0 | 36 | 50.6 | 37.8 | 56.3 |
| 14 | 10.4 | 3.6 | 2.3 | 37 | 55.6 | 42.9 | 66.2 |
| 15 | 11.0 | 3.9 | 2.7 | 38 | 61.4 | 48.9 | 78.0 |
| 16 | 11.6 | 4.3 | 3.1 | 39 | 67.9 | 56.0 | 92.3 |
| 17 | 12.3 | 4.8 | 3.5 | 40 | 75.3 | 64.2 | 109.4 |
| 18 | 13.1 | 5.3 | 4.1 | 41 | 83.9 | 73.9 | 130.2 |
| 19 | 13.9 | 5.8 | 4.7 | 42 | 93.7 | 85.4 | 155.6 |
| 20 | 14.8 | 6.4 | 5.4 | 43 | 105.1 | 99.0 | 186.5 |
| 21 | 15.8 | 7.1 | 6.2 | 44 | 118.4 | 115.3 | 224.6 |
| 22 | 16.9 | 7.8 | 7.1 | 45 | 133.9 | 134.9 | 271.8 |

**Table 10.6.3.1.2a-4—Depth Correction Factor $d_q$**

| Friction Angle, $\phi_f$ (degrees) | $D_f/B$ | $d_q$ |
|---|---|---|
| 32 | 1 | 1.20 |
| | 2 | 1.30 |
| | 4 | 1.35 |
| | 8 | 1.40 |
| 37 | 1 | 1.20 |
| | 2 | 1.25 |
| | 4 | 1.30 |
| | 8 | 1.35 |
| 42 | 1 | 1.15 |
| | 2 | 1.20 |
| | 4 | 1.25 |
| | 8 | 1.30 |

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for footings on or adjacent to slopes. Use linear interpolation to obtain reduction coefficients for values not provided. The slope stability factor, $N_s$, in Tables 10.6.3.1.2c-1 and 10.6.3.1.2c-2 shall be taken as:

$$N_s = \frac{\gamma H_s}{c} \qquad (10.6.3.1.2c\text{-}2)$$

where:

$N_s$ = slope stability factor (dim)
$H_s$ = height of sloping ground surface below bottom of footing (ft)

and other variables are as defined in Article 10.6.3.1.2a.

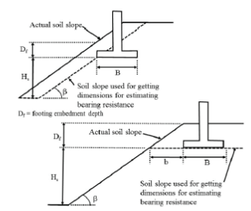



**Figure 10.6.3.1.2c-1—Definition of Footing and Slope Geometric Parameters for Determination of $RC_{BC}$**

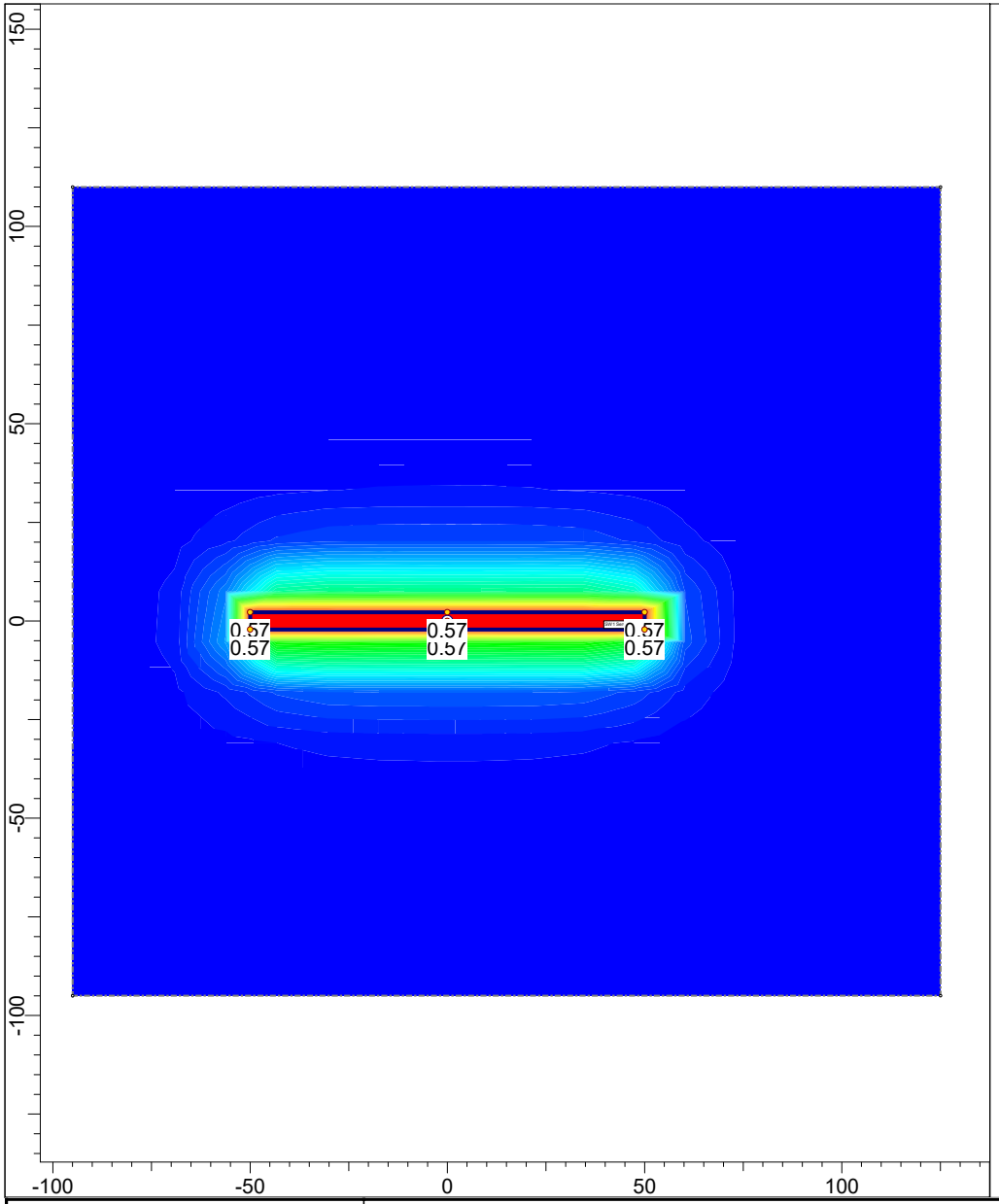
NewFields

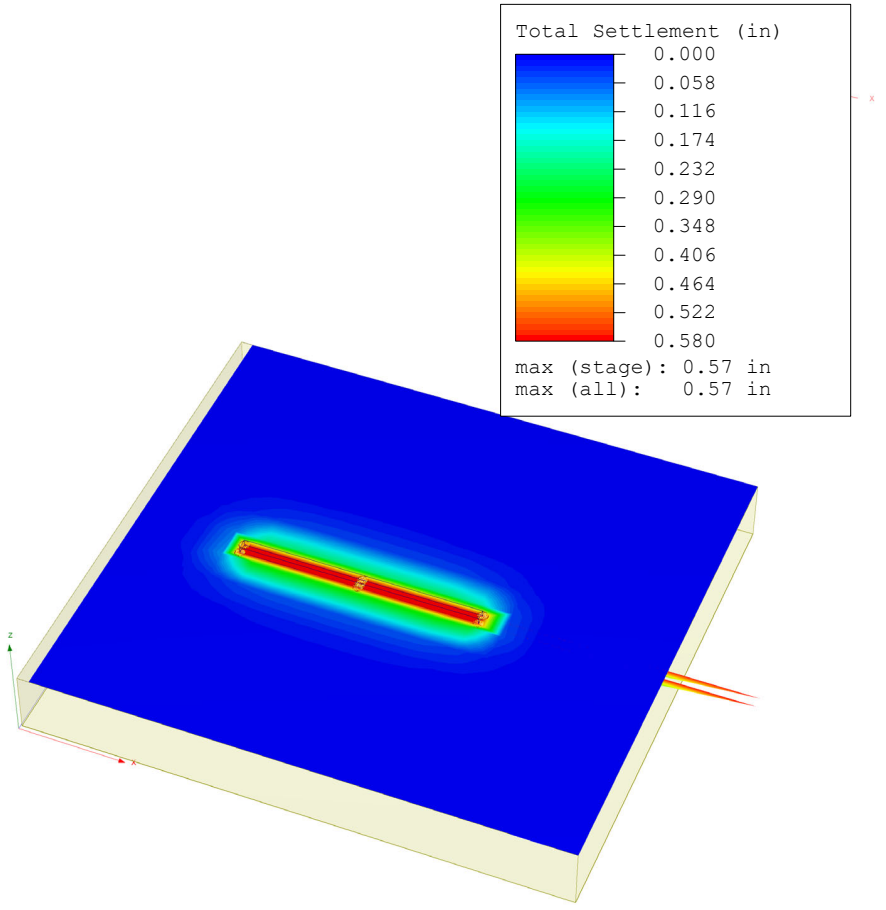
# ATTACHMENT C

## Settle3 Results

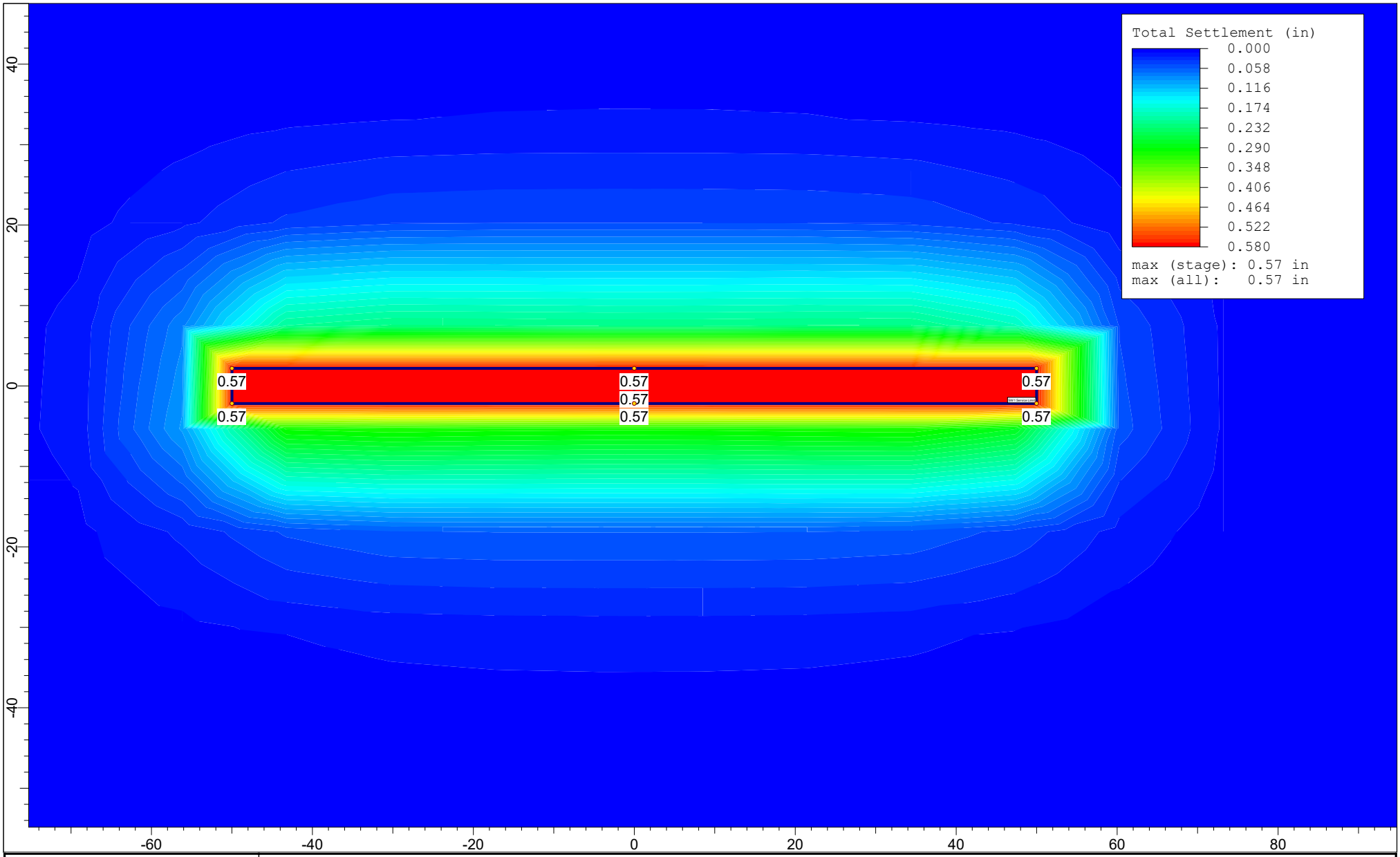
NewFields

# SW1

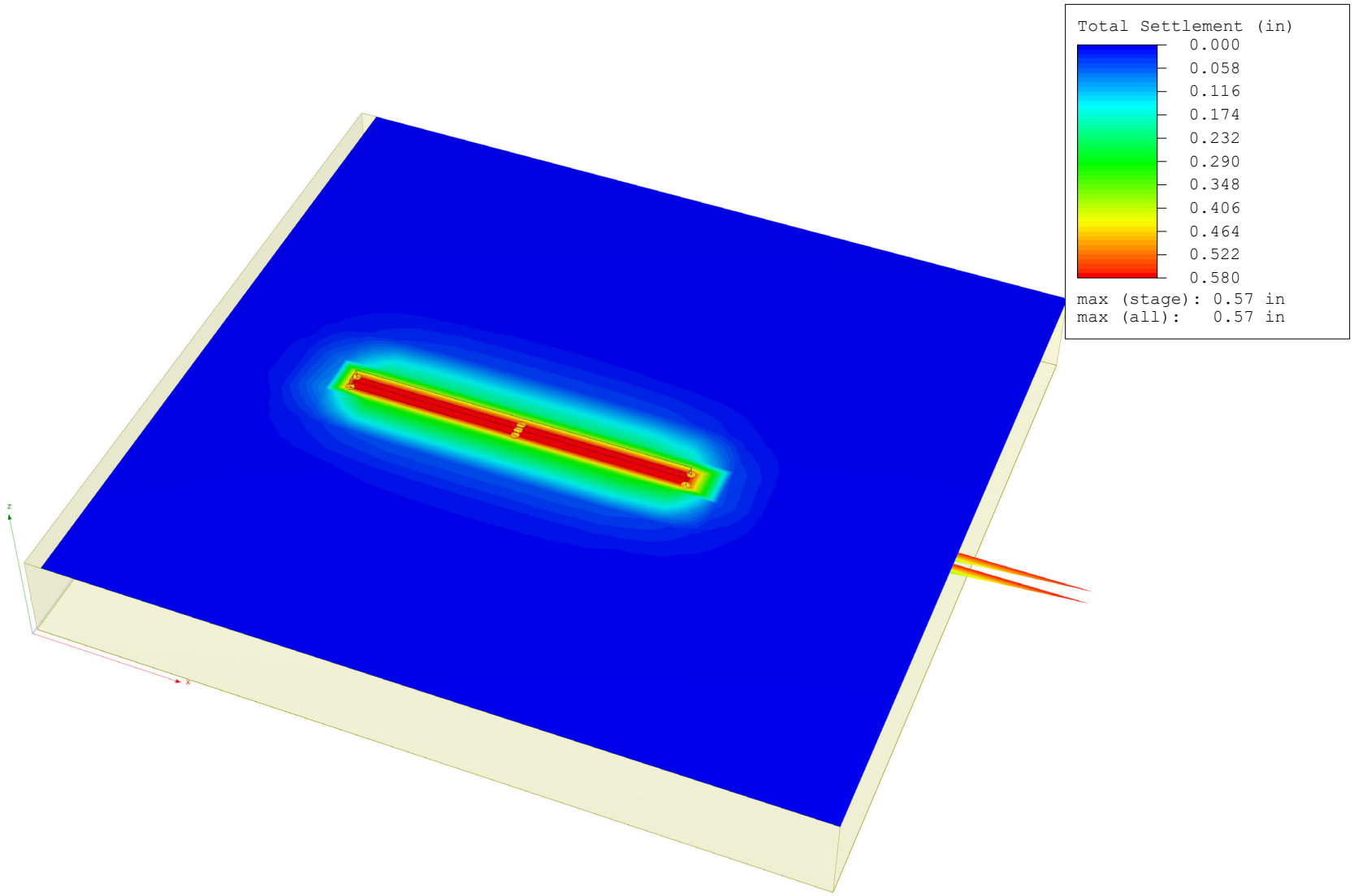



| | | | | |
|---|---|---|---|---|
| NewFields | Project | NDOT US395 North Valleys | | |
| | Analysis Description | SW1: Service Limit | | |
| | Drawn By | T. Sturgeon | Scale $ModelScale | Company NewFields |
| SETTLE3 5.013 | Date | 11/2/2022 | | File Name SW1_REV3.s3z |




| | | | |
|---|---|---|---|
| NewFields | Project: NDOT US395 North Valleys | | |
| | Analysis Description: SW1: Service Limit | | |
| | Drawn By: T. Sturgeon | Scale: $ModelScale | Company: NewFields |
| SETTLE3 5.013 | Date: 11/2/2022 | | File Name: SW1_REV3.s3z |




| | | | |
|---|---|---|---|
| NewFields | Project: NDOT US395 North Valleys | | |
| | Analysis Description: SW1: Service Limit | | |
| | Drawn By: T. Sturgeon | Scale: $ModelScale | Company: NewFields |
| SETTLE3 5.013 | Date: 11/2/2022 | | File Name: SW1_REV3.s3z |

rocscience

NDOT US395 North Valleys
NewFields
Report Creation Date: 2022/11/02, 11:45:26

# Table of Contents

# Settle3 Analysis Information

# NDOT US395 North Valleys

## Project Settings

| | |
|---|---|
| Document Name | SW1_REV3 |
| Project Title | NDOT US395 North Valleys |
| Analysis | SW1: Service Limit |
| Author | T. Sturgeon |
| Company | NewFields |
| Date Created | 11/2/2022 |
| Stress Computation Method | Boussinesq |
| Minimum settlement ratio for subgrade modulus | 0.9 |
| Use average poisson's ratio to calculate layered stresses | |
| Improve consolidation accuracy | |
| Ignore negative effective stresses in settlement calculations | |

# Stage Settings

| Stage # | Name |
|---|---|
| 1 | Stage 1 |

# Results

Time taken to compute: 0.481588 seconds

## Stage: Stage 1

| Data Type | Minimum | Maximum |
|---|---|---|
| Total Settlement [in] | 0 | 0.574768 |
| Total Consolidation Settlement [in] | 0 | 0 |
| Virgin Consolidation Settlement [in] | 0 | 0 |
| Recompression Consolidation Settlement [in] | 0 | 0 |
| Immediate Settlement [in] | 0 | 0.574768 |
| Loading Stress ZZ [ksf] | 6.97958e-13 | 2.83892 |
| Loading Stress XX [ksf] | -1.60879 | 1.89135 |
| Loading Stress YY [ksf] | -0.440427 | 2.33511 |
| Total Stress ZZ [ksf] | 6.97958e-13 | 3.32374 |
| Total Stress XX [ksf] | -0.851359 | 4.5992 |
| Total Stress YY [ksf] | -0.204396 | 3.77359 |
| Modulus of Subgrade Reaction (Total) [ksf/ft] | 0 | 45.2634 |
| Modulus of Subgrade Reaction (Immediate) [ksf/ft] | 0 | 45.2634 |
| Modulus of Subgrade Reaction (Consolidation) [ksf/ft] | 0 | 0 |
| Total Strain | 0 | 0.00946308 |
| Degree of Consolidation [%] | 0 | 0 |
| Pre-consolidation Stress [ksf] | 0.00306 | 3.32235 |
| Over-consolidation Ratio | 1 | 1 |
| Void Ratio | 0 | 0 |
| Hydroconsolidation Settlement [in] | 0 | 0 |
| Undrained Shear Strength | 0 | 0.032303 |

# Loads

## 1. Rectangular Load: "SW1 Service Limit"

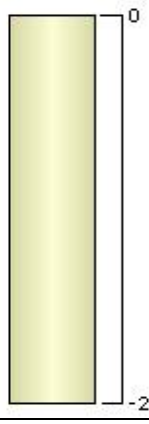
| | |
|---|---|
| Length | 100 ft |
| Width | 4.375 ft |
| Rotation angle | 0 degrees |
| Load Type | Rigid |
| Area of Load | 437.5 ft2 |
| Load | 2.7 ksf |
| Elevation | 0 ft |
| Installation Stage | Stage 1 |

## Coordinates

| X [ft] | Y [ft] |
|---|---|
| -50 | -2.1875 |
| 50 | -2.1875 |
| 50 | 2.1875 |
| -50 | 2.1875 |

# Soil Layers

| Layer # | Type | Thickness [ft] | Elevation [ft] |
|---|---|---|---|
| 1 | Clayey Sand (SC) | 25.5 | 0 |



# Soil Properties

| Property | Clayey Sand (SC) |
|---|---|
| Color | |
| Unit Weight [kips/ft3] | 0.12 |
| K0 | 1 |
| Immediate Settlement | Enabled |
| Es [ksf] | 300 |
| Esur [ksf] | 300 |
| Undrained Su A [kips/ft2] | 0 |
| Undrained Su S | 0.2 |
| Undrained Su m | 0.8 |

# Query Points

| Point # | Query Point Name | (X,Y) Location | Number of Divisions |
|---|---|---|---|
| 1 | Query Point 1 | 0, 0 | Auto: 31 |
| 2 | Query Point 2 | 0, -2.1875 | Auto: 31 |
| 3 | Query Point 3 | 0, 2.1875 | Auto: 31 |
| 4 | Query Point 4 | -50, 2.1875 | Auto: 31 |
| 5 | Query Point 5 | -50, -2.1875 | Auto: 31 |
| 6 | Query Point 6 | 50, 2.1875 | Auto: 31 |
| 7 | Query Point 7 | 50, -2.1875 | Auto: 31 |

# Field Point Grid

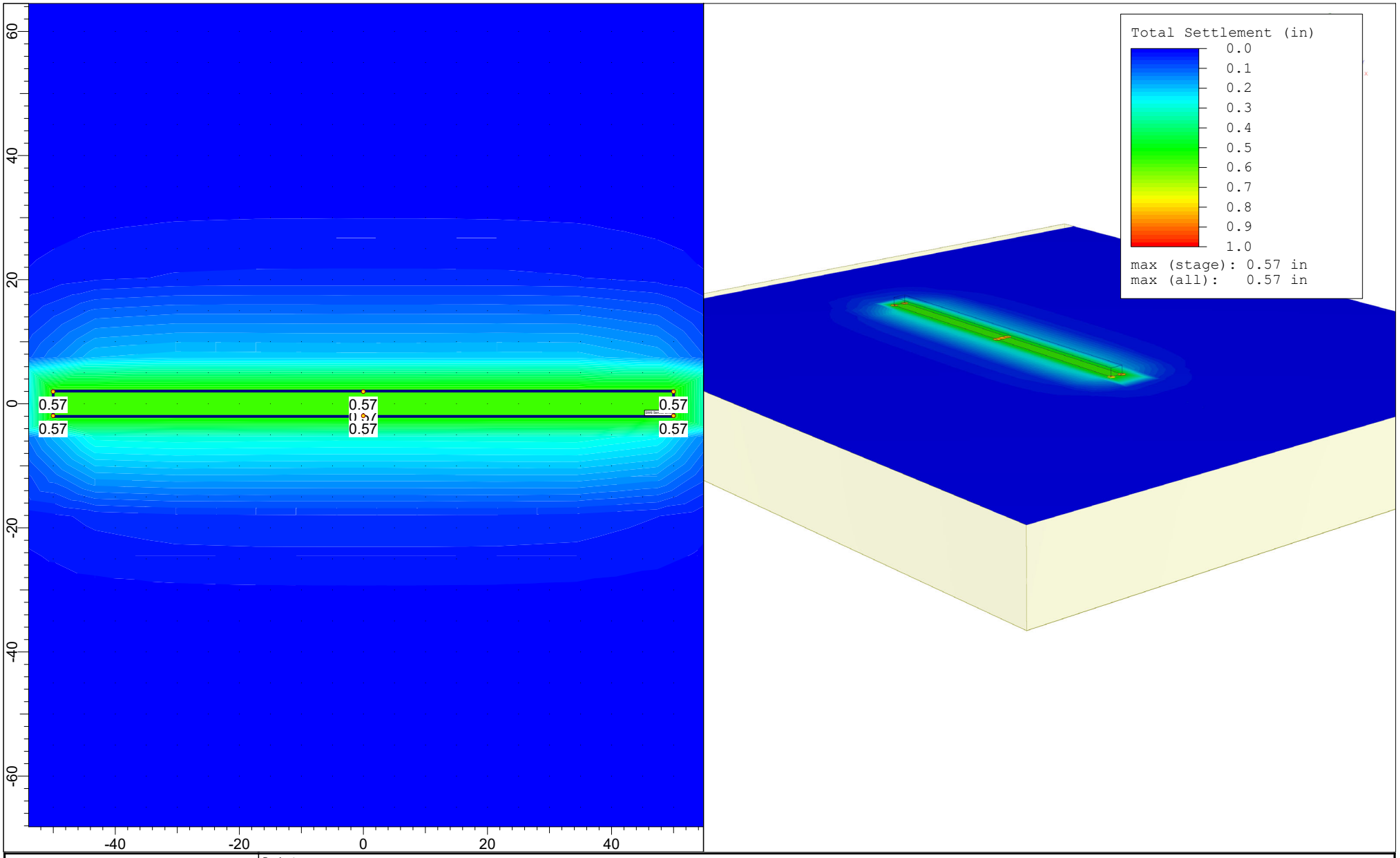
| | |
|---|---|
| Number of points | 326 |
| Expansion Factor | 2 |

## Grid Coordinates

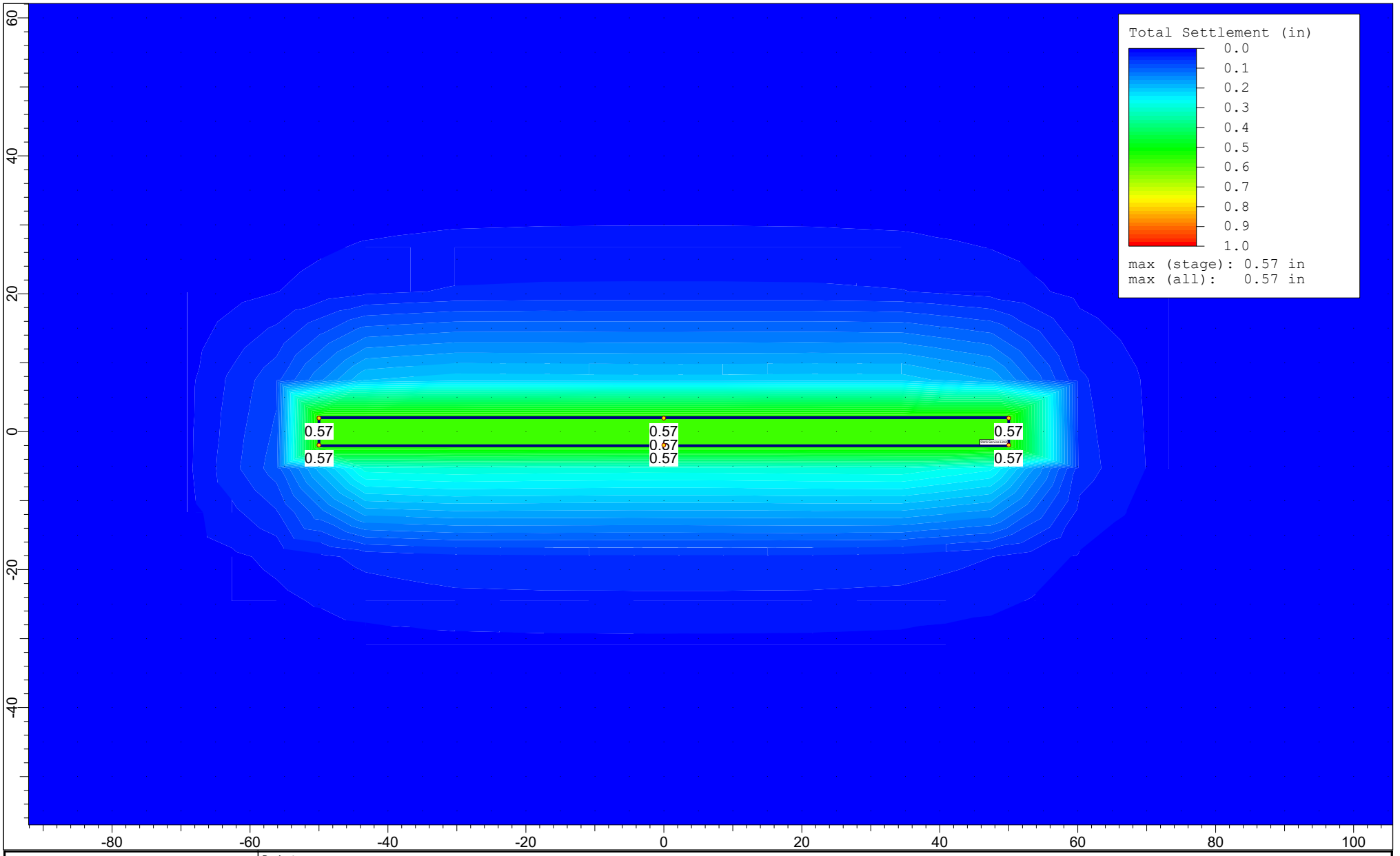
| X [ft] | Y [ft] |
|---|---|
| 125 | 110 |
| 125 | -95 |
| -100 | -95 |
| -100 | 110 |

NewFields

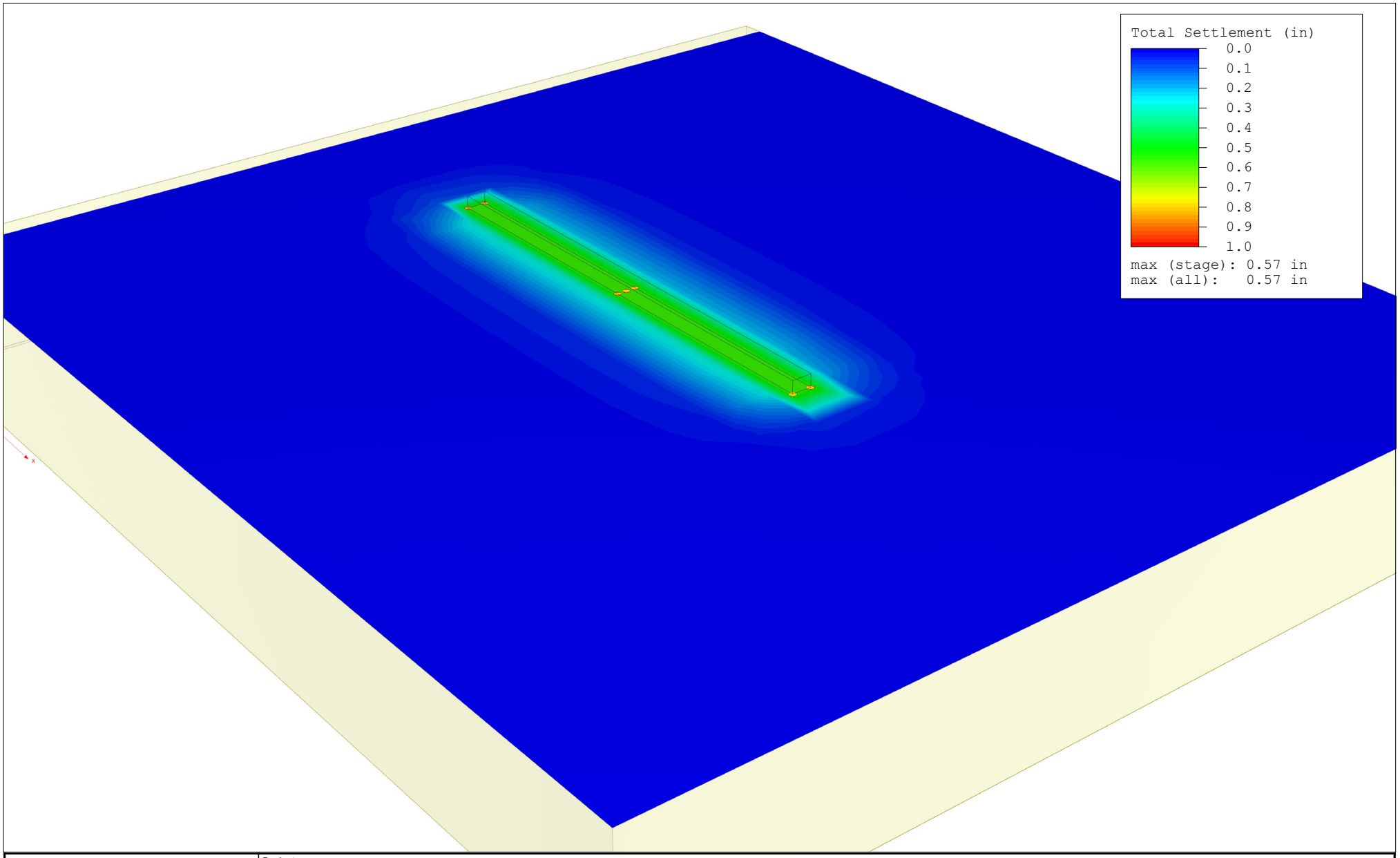
# SW6




| | | | | |
|---|---|---|---|---|
| NewFields | Project | NDOT US395 North Valleys | | |
| | Analysis Description | SW6: Service Limit | | |
| | Drawn By | A. Gonzalez | Scale $ModelScale | Company NewFields |
| SETTLE3 5.017 | Date | 11/2/2022, 10:17:23 AM | | File Name SW6_Rev3.s3z |




| | | | |
|---|---|---|---|
| NewFields | Project: NDOT US395 North Valleys | | |
| | Analysis Description: SW6: Service Limit | | |
| | Drawn By: A. Gonzalez | Scale: $ModelScale | Company: NewFields |
| SETTLE3 5.017 | Date: 11/2/2022, 10:17:23 AM | | File Name: SW6_Rev3.s3z |




NewFields

SETTLE3 5.017

| | | | |
|---|---|---|---|
| Project | NDOT US395 North Valleys | | |
| Analysis Description | SW6: Service Limit | | |
| Drawn By | A. Gonzalez | Scale $ModelScale | Company NewFields |
| Date | 11/2/2022, 10:17:23 AM | | File Name SW6_Rev3.s3z |

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NDOT US395 North Valleys
NewFields
Report Creation Date: 2022/11/07, 15:33:19

# Table of Contents

# Settle3 Analysis Information

# NDOT US395 North Valleys

## Project Settings

| | |
|---|---|
| Document Name | SW6_Rev3.s3z |
| Project Title | NDOT US395 North Valleys |
| Analysis | SW6: Service Limit |
| Author | A. Gonzalez |
| Company | NewFields |
| Date Created | 11/2/2022, 10:17:23 AM |
| Last saved with Settle3 version | 5.017 |
| Stress Computation Method | Boussinesq |
| Stress Units | Imperial, stress as ksf |
| Settlement Units | inches |

### Advanced Settings

| | |
|---|---|
| Start of secondary consolidation (% of primary) | 95 |
| Min. stress for secondary consolidation (% of initial) | 1 |
| Reset time when load changes for secondary consolidation | No |
| Minimum settlement ratio for subgrade modulus | 0.9 |
| Use average poisson's ratio to calculate layered stresses | |
| Update Cv in each time step (improves consolidation accuracy) | |
| Ignore negative effective stresses in settlement calculations | |
| Add field points to load edges | |

### Soil Profile

| | |
|---|---|
| Layer Option | Horizontal Soil Layers |
| Vertical Axis | Elevation |
| Ground Elevation (ft) | 0 |

# Stage Settings

| Stage # | Name |
|---|---|
| 1 | Stage 1 |

# Results

Time taken to compute: 0.880669 seconds

## Stage: Stage 1

| Data Type | Minimum | Maximum |
|---|---|---|
| Total Settlement [in] | 0 | 0.569646 |
| Total Consolidation Settlement [in] | 0 | 0 |
| Virgin Consolidation Settlement [in] | 0 | 0 |
| Recompression Consolidation Settlement [in] | 0 | 0 |
| Immediate Settlement [in] | 0 | 0.569646 |
| Loading Stress ZZ [ksf] | 8.89342e-13 | 3.87095 |
| Loading Stress XX [ksf] | -2.12719 | 2.54033 |
| Loading Stress YY [ksf] | -0.559607 | 3.19907 |
| Total Stress ZZ [ksf] | 8.89342e-13 | 3.89548 |
| Total Stress XX [ksf] | -1.33241 | 5.41692 |
| Total Stress YY [ksf] | -0.257028 | 3.97902 |
| Modulus of Subgrade Reaction (Total) [ksf/ft] | 0 | 80.5758 |
| Modulus of Subgrade Reaction (Immediate) [ksf/ft] | 0 | 80.5758 |
| Modulus of Subgrade Reaction (Consolidation) [ksf/ft] | 0 | 0 |
| Total Strain | 0 | 0.00970163 |
| Degree of Consolidation [%] | 0 | 0 |
| Pre-consolidation Stress [ksf] | 0.00306 | 3.89143 |
| Over-consolidation Ratio | 1 | 1 |
| Void Ratio | 0 | 0 |
| Hydroconsolidation Settlement [in] | 0 | 0 |
| Undrained Shear Strength | 0 | 0.038125 |

# Loads

## 1. Rectangular Load: "SW6 Service Limit"

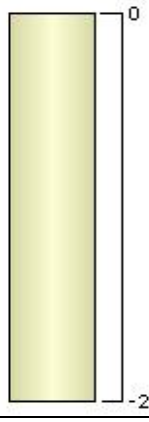
| | |
|---|---|
| Length | 100 ft |
| Width | 4.07 ft |
| Rotation angle | 0 degrees |
| Load Type | Rigid |
| Area of Load | 407 ft2 |
| Load | 3.7 ksf |
| Elevation | 0 ft |
| Installation Stage | Stage 1 |

## Coordinates

| X [ft] | Y [ft] |
|---|---|
| -50 | -2.035 |
| 50 | -2.035 |
| 50 | 2.035 |
| -50 | 2.035 |

# Soil Layers

| Layer # | Type | Thickness [ft] | Elevation [ft] |
|---|---|---|---|
| 1 | Clayey Sand (SC) | 25.5 | 0 |



# Soil Properties

| Property | Clayey Sand (SC) |
|---|---|
| Color | |
| Unit Weight [kips/ft3] | 0.12 |
| K0 | 1 |
| Immediate Settlement | Enabled |
| Es [ksf] | 399 |
| Esur [ksf] | 399 |
| Undrained Su A [kips/ft2] | 0 |
| Undrained Su S | 0.2 |
| Undrained Su m | 0.8 |

# Query

## Query Points

| Point # | Query Point Name | (X,Y) Location | Number of Divisions |
|---|---|---|---|
| 1 | Query Point 1 | 0, 0 | Auto: 31 |
| 2 | Query Point 2 | 0, -1.955 | Auto: 31 |
| 3 | Query Point 3 | 0, 1.955 | Auto: 31 |
| 4 | Query Point 4 | -50, 1.955 | Auto: 31 |
| 5 | Query Point 5 | -50, -1.955 | Auto: 31 |
| 6 | Query Point 6 | 50, 1.955 | Auto: 31 |
| 7 | Query Point 7 | 50, -1.955 | Auto: 31 |

## Field Point Grid

| | |
|---|---|
| Number of points | 326 |
| Expansion Factor | 2 |

### Grid Coordinates

| X [ft] | Y [ft] |
|---|---|
| 125 | 110 |
| 125 | -95 |
| -100 | -95 |
| -100 | 110 |

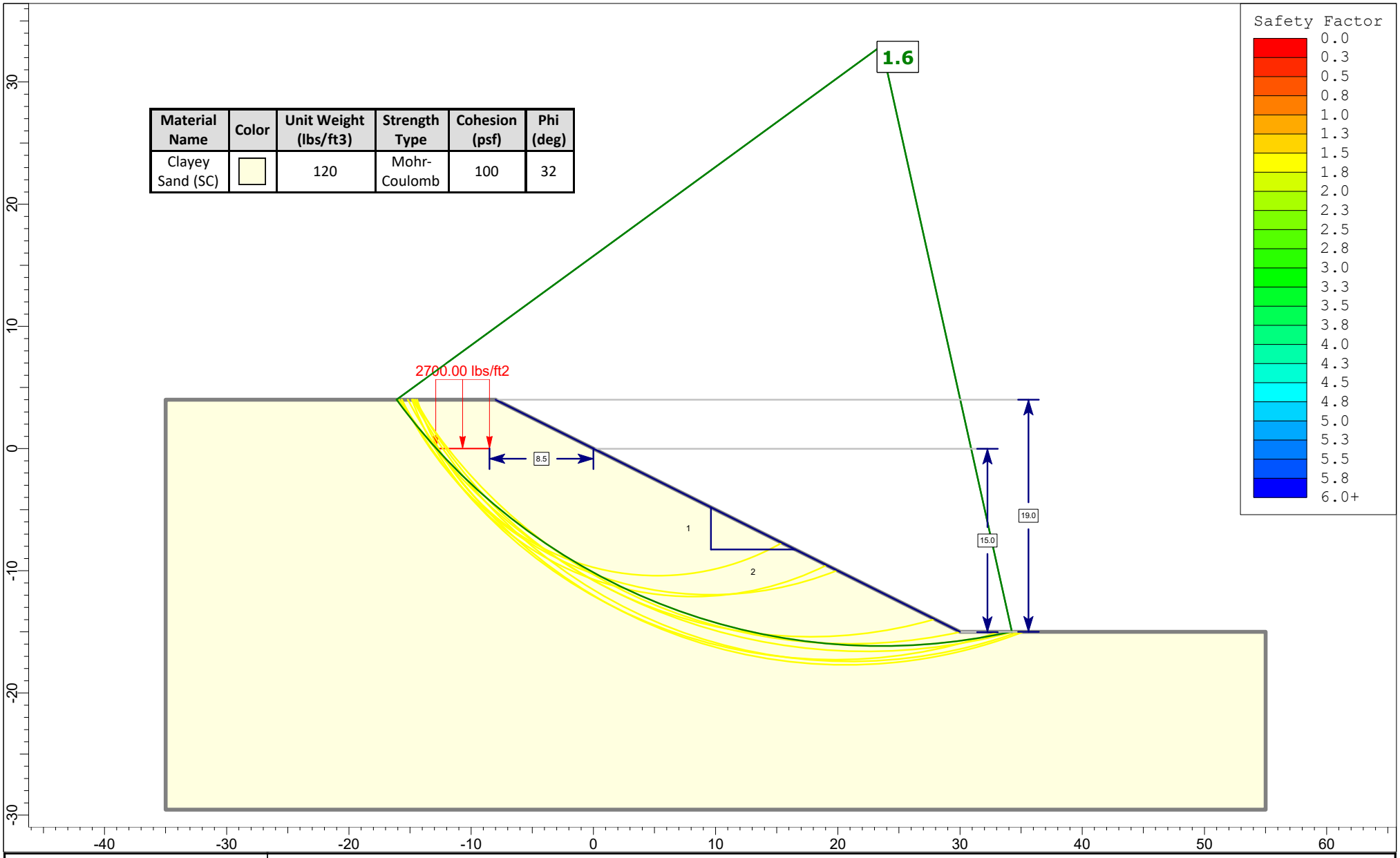
NewFields

# ATTACHMENT D

## SLIDE Global Stability Results

NewFields

# SW1




NewFields

SLIDEINTERPRET 9.020

# Sound Wall SW1 - Static Condition

| | | | |
|---|---|---|---|
| *Analysis Description* | | | |
| *Drawn By* | T. Sturgeon | *Scale* | 1:130 |
| *Company* | Newfields | | |
| *Date Printed* | 11/2/2022 | *File Name* | SW1 Service Limit Static_Rev3.slmd |

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SW1 Service Limit Static_Rev3
Sound Wall SW1 - Static Condition
Newfields
Date Created: 11/01/2022
Software Version: 9.02

# Table of Contents

# Slide Analysis Information

# SW1 Service Limit Static_Rev3

## Project Summary

| | |
|---|---|
| File Name: | SW1 Service Limit Static_Rev3.slmd |
| Last saved with Slide version: | 9.02 |
| Project Title: | Sound Wall SW1 - Static Condition |
| Author: | T. Sturgeon |
| Company: | Newfields |
| Date Created: | 11/01/2022 |

# General Settings

| | |
|---|---|
| Units of Measurement: | Imperial Units |
| Time Units: | days |
| Permeability Units: | feet/second |
| Data Output: | Standard |
| Failure Direction: | Left to Right |

# Analysis Options

| | |
|---|---|
| Slices Type: | Vertical |
| **Analysis Methods Used** | |
| | Spencer |
| Number of slices: | 50 |
| Tolerance: | 0.005 |
| Maximum number of iterations: | 75 |
| Check malpha < 0.2: | Yes |
| Create Interslice boundaries at intersections with water tables and piezos: | Yes |
| Initial trial value of FS: | 1 |
| Steffensen Iteration: | Yes |

# Groundwater Analysis

| | |
|---|---|
| Groundwater Method: | Water Surfaces |
| Pore Fluid Unit Weight [lbs/ft3]: | 62.4 |
| Use negative pore pressure cutoff: | Yes |
| Maximum negative pore pressure [psf]: | 0 |
| Advanced Groundwater Method: | None |

# Random Numbers

| | |
|---|---|
| Pseudo-random Seed: | 10116 |
| Random Number Generation Method: | Park and Miller v.3 |

# Surface Options

| | |
|---|---|
| Surface Type: | Circular |
| Search Method: | Slope Search |
| Number of Surfaces: | 5000 |
| Upper Angle [deg]: | Not Defined |
| Lower Angle [deg]: | Not Defined |
| Composite Surfaces: | Disabled |
| Reverse Curvature: | Invalid Surfaces |
| Minimum Elevation: | Not Defined |
| Minimum Depth [ft]: | 10 |
| Minimum Area: | Not Defined |
| Minimum Weight: | Not Defined |

# Seismic Loading

| | |
|---|---|
| Advanced seismic analysis: | No |
| Staged pseudostatic analysis: | No |

# Loading

1 Distributed Load present

| Distributed Load 1 | |
|---|---|
| Distribution: | Constant |
| Magnitude [psf]: | 2700 |
| Orientation: | Vertical |

# Materials

| Clayey Sand (SC) | |
|---|---|
| Color | |
| Strength Type | Mohr-Coulomb |
| Unit Weight [lbs/ft3] | 120 |
| Cohesion [psf] | 100 |
| Friction Angle [deg] | 32 |
| Water Surface | None |
| Ru Value | 0 |

# Entity Information

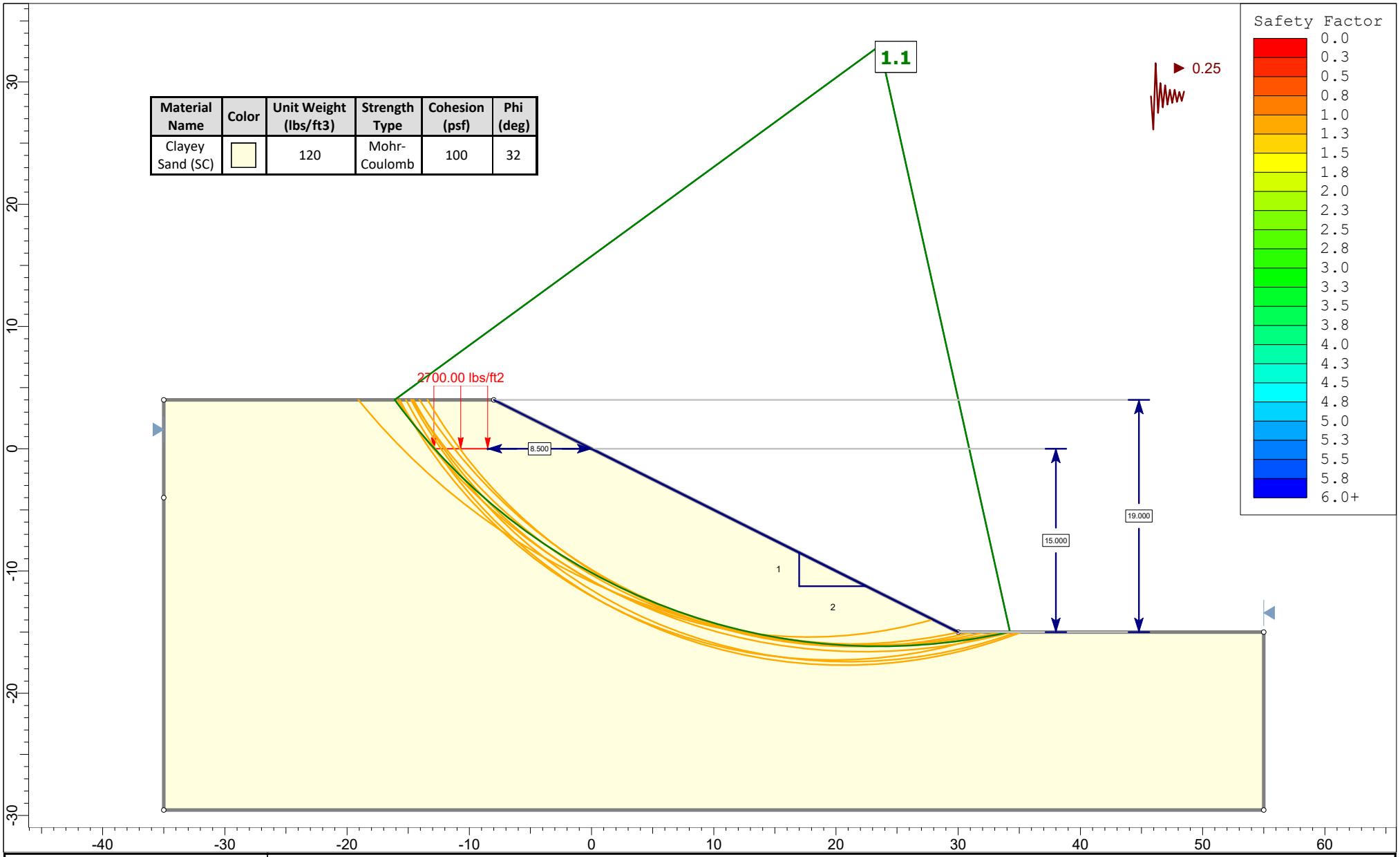
## Group 1

### Shared Entities

| Type | Coordinates (x,y) |
|---|---|
| External Boundary | -8, 4<br>-35, 4<br>-35, -4<br>-35, -29.5521<br>55, -29.5521<br>55, -15<br>30, -15 |

### Scenario-based Entities

| Type | Coordinates (x,y) | Master Scenario |
|---|---|---|
| Distributed Load | -8.5, 0<br>-12.9, 0 | Constant<br>DistributionOrientation: VerticalMagnitude: 2700 lbs/ft2Creates Excess Pore Pressure: No |




NewFields

SLIDEINTERPRET 9.020

# Sound Wall SW1 - Seismic Condition

| | | | |
|---|---|---|---|
| *Analysis Description* | | | |
| *Drawn By* | T. Sturgeon | *Scale* | 1:130 |
| *Company* | Newfields | | |
| *Date Printed* | 11/2/2022 | *File Name* | SW1 Service Limit Seismic_Rev4_.slmd |

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SW1 Service Limit Seismic_Rev4_
Sound Wall SW1 - Seismic Condition
Newfields
Date Created: 11/01/2022
Software Version: 9.02

# Table of Contents

# Slide Analysis Information

# SW1 Service Limit Seismic_Rev4_

## Project Summary

| | |
|---|---|
| File Name: | SW1 Service Limit Seismic_Rev4_.slmd |
| Slide Modeler Version: | 9.02 |
| Compute Time: | 00h:00m:00.582s |
| Project Title: | Sound Wall SW1 - Seismic Condition |
| Author: | T. Sturgeon |
| Company: | Newfields |
| Date Created: | 11/01/2022 |

# General Settings

| | |
|---|---|
| Units of Measurement: | Imperial Units |
| Time Units: | days |
| Permeability Units: | feet/second |
| Data Output: | Standard |
| Failure Direction: | Left to Right |

# Analysis Options

| | |
|---|---|
| Slices Type: | Vertical |
| **Analysis Methods Used** | |
| | Spencer |
| Number of slices: | 50 |
| Tolerance: | 0.005 |
| Maximum number of iterations: | 75 |
| Check malpha < 0.2: | Yes |
| Create Interslice boundaries at intersections with water tables and piezos: | Yes |
| Initial trial value of FS: | 1 |
| Steffensen Iteration: | Yes |

# Groundwater Analysis

| | |
|---|---|
| Groundwater Method: | Water Surfaces |
| Pore Fluid Unit Weight [lbs/ft3]: | 62.4 |
| Use negative pore pressure cutoff: | Yes |
| Maximum negative pore pressure [psf]: | 0 |
| Advanced Groundwater Method: | None |

# Random Numbers

| | |
|---|---|
| Pseudo-random Seed: | 10116 |
| Random Number Generation Method: | Park and Miller v.3 |

# Surface Options

| | |
|---|---|
| Surface Type: | Circular |
| Search Method: | Slope Search |
| Number of Surfaces: | 5000 |
| Upper Angle [deg]: | Not Defined |
| Lower Angle [deg]: | Not Defined |
| Composite Surfaces: | Disabled |
| Reverse Curvature: | Invalid Surfaces |
| Minimum Elevation: | Not Defined |
| Minimum Depth [ft]: | 10 |
| Minimum Area: | Not Defined |
| Minimum Weight: | Not Defined |

# Seismic Loading

| | |
|---|---|
| Advanced seismic analysis: | No |
| Staged pseudostatic analysis: | No |
| Seismic Load Coefficient (Horizontal): | 0.25 |

# Loading

1 Distributed Load present

| Distributed Load 1 | |
|---|---|
| Distribution: | Constant |
| Magnitude [psf]: | 2700 |
| Orientation: | Vertical |

# Materials

| Clayey Sand (SC) | |
|---|---|
| Color | |
| Strength Type | Mohr-Coulomb |
| Unit Weight [lbs/ft3] | 120 |
| Cohesion [psf] | 100 |
| Friction Angle [deg] | 32 |
| Water Surface | None |
| Ru Value | 0 |

# Global Minimums

## Method: spencer

| FS | 1.102640 |
|---|---|
| Center: | 23.577, 32.959 |
| Radius: | 49.130 |
| Left Slip Surface Endpoint: | -16.111, 4.000 |
| Right Slip Surface Endpoint: | 34.238, -15.000 |
| Resisting Moment: | 1.66659e+06 lb-ft |
| Driving Moment: | 1.51146e+06 lb-ft |
| Resisting Horizontal Force: | 29890.7 lb |
| Driving Horizontal Force: | 27108.4 lb |
| Total Slice Area: | 329.564 ft2 |
| Surface Horizontal Width: | 50.3491 ft |
| Surface Average Height: | 6.54557 ft |

# Global Minimum Support Data

No Supports Present

# Valid and Invalid Surfaces

## Method: spencer

| | |
|---|---|
| Number of Valid Surfaces: | 1851 |
| Number of Invalid Surfaces: | 3149 |

**Error Codes**

Error Code -103 reported for 22 surfaces
Error Code -106 reported for 27 surfaces
Error Code -111 reported for 4 surfaces
Error Code -114 reported for 576 surfaces
Error Code -115 reported for 2520 surfaces

### Error Code Descriptions

The following errors were encountered during the computation:
-103 = Two surface / slope intersections, but one or more surface / nonslope external polygon intersections lie between them. This usually occurs when the slip surface extends past the bottom of the soil region, but may also occur on a benched slope model with two sets of Slope Limits.
-106 = Average slice width is less than 0.0001 * (maximum horizontal extent of soil region). This limitation is imposed to avoid numerical errors which may result from too many slices, or too small a slip region.
-111 = Safety factor equation did not converge
-114 = Surface with Reverse Curvature.
-115 = Surface too shallow, below the minimum depth.

# Slice Data

### Global Minimum Query (spencer) - Safety Factor: 1.10264

| Slice Number | Width [ft] | Weight [lbs] | Angle of Slice Base [deg] | Base Material | Base Cohesion [psf] | Base Friction Angle [deg] | Shear Stress [psf] | Shear Strength [psf] | Base Normal Stress [psf] | Pore Pressure [psf] | Effective Normal Stress [psf] | Base Vertical Stress [psf] | Effective Vertical Stress [psf] |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 1.00698 | 80.4727 | -52.9092 | Clayey Sand (SC) | 100 | 32 | 90.5663 | 99.862 | -0.220816 | 0 | -0.220816 | 119.569 | 119.569 |
| 2 | 1.00698 | 236.084 | -51.0024 | Clayey Sand (SC) | 100 | 32 | 129.039 | 142.283 | 67.6675 | 0 | 67.6675 | 227.031 | 227.031 |
| 3 | 1.00698 | 381.635 | -49.1711 | Clayey Sand (SC) | 100 | 32 | 168.262 | 185.533 | 136.881 | 0 | 136.881 | 331.616 | 331.616 |
| 4 | 1.00698 | 518.225 | -47.4054 | Clayey Sand (SC) | 100 | 32 | 820.951 | 905.213 | 1288.61 | 0 | 1288.61 | 2181.56 | 2181.56 |
| 5 | 1.00698 | 646.74 | -45.697 | Clayey Sand (SC) | 100 | 32 | 1082.17 | 1193.24 | 1749.55 | 0 | 1749.55 | 2858.37 | 2858.37 |
| 6 | 1.00698 | 767.914 | -44.0395 | Clayey Sand (SC) | 100 | 32 | 1153.33 | 1271.71 | 1875.13 | 0 | 1875.13 | 2990.42 | 2990.42 |
| 7 | 1.00698 | 882.357 | -42.4271 | Clayey Sand (SC) | 100 | 32 | 1224.37 | 1350.04 | 2000.49 | 0 | 2000.49 | 3119.55 | 3119.55 |
| 8 | 1.00698 | 990.584 | -40.8553 | Clayey Sand (SC) | 100 | 32 | 886.798 | 977.819 | 1404.8 | 0 | 1404.8 | 2171.76 | 2171.76 |
| 9 | 1.00698 | 1065.84 | -39.3199 | Clayey Sand (SC) | 100 | 32 | 404.39 | 445.897 | 553.55 | 0 | 553.55 | 884.774 | 884.774 |
| 10 | 1.00698 | 1102.14 | -37.8176 | Clayey Sand (SC) | 100 | 32 | 426.831 | 470.641 | 593.149 | 0 | 593.149 | 924.443 | 924.443 |
| 11 | 1.00698 | 1133.29 | -36.3452 | Clayey Sand (SC) | 100 | 32 | 448.285 | 494.297 | 631.007 | 0 | 631.007 | 960.85 | 960.85 |
| 12 | 1.00698 | 1159.66 | -34.9002 | Clayey Sand (SC) | 100 | 32 | 468.763 | 516.877 | 667.143 | 0 | 667.143 | 994.16 | 994.16 |
| 13 | 1.00698 | 1181.5 | -33.4803 | Clayey Sand (SC) | 100 | 32 | 488.252 | 538.366 | 701.531 | 0 | 701.531 | 1024.46 | 1024.46 |
| 14 | 1.00698 | 1199.04 | -32.0832 | Clayey Sand (SC) | 100 | 32 | 506.732 | 558.743 | 734.143 | 0 | 734.143 | 1051.81 | 1051.81 |
| 15 | 1.00698 | 1212.48 | -30.7072 | Clayey Sand (SC) | 100 | 32 | 524.188 | 577.991 | 764.945 | 0 | 764.945 | 1076.28 | 1076.28 |
| 16 | 1.00698 | 1221.98 | -29.3506 | Clayey Sand (SC) | 100 | 32 | 540.6 | 596.087 | 793.904 | 0 | 793.904 | 1097.9 | 1097.9 |
| 17 | 1.00698 | 1227.72 | -28.0118 | Clayey Sand (SC) | 100 | 32 | 555.945 | 613.007 | 820.983 | 0 | 820.983 | 1116.73 | 1116.73 |
| 18 | 1.00698 | 1229.83 | -26.6895 | Clayey Sand (SC) | 100 | 32 | 570.201 | 628.726 | 846.138 | 0 | 846.138 | 1132.79 | 1132.79 |
| 19 | 1.00698 | 1228.44 | -25.3824 | Clayey Sand (SC) | 100 | 32 | 583.34 | 643.214 | 869.324 | 0 | 869.324 | 1146.09 | 1146.09 |
| 20 | 1.00698 | 1223.67 | -24.0892 | Clayey Sand (SC) | 100 | 32 | 595.333 | 656.438 | 890.486 | 0 | 890.486 | 1156.66 | 1156.66 |
| 21 | 1.00698 | 1215.62 | -22.809 | Clayey Sand (SC) | 100 | 32 | 606.148 | 668.363 | 909.57 | 0 | 909.57 | 1164.48 | 1164.48 |
| 22 | 1.00698 | 1204.38 | -21.5407 | Clayey Sand (SC) | 100 | 32 | 615.748 | 678.948 | 926.506 | 0 | 926.506 | 1169.56 | 1169.56 |
| 23 | 1.00698 | 1190.04 | -20.2834 | Clayey Sand (SC) | 100 | 32 | 624.091 | 688.148 | 941.238 | 0 | 941.238 | 1171.89 | 1171.89 |
| 24 | 1.00698 | 1172.68 | -19.0363 | Clayey Sand (SC) | 100 | 32 | 631.135 | 695.915 | 953.665 | 0 | 953.665 | 1171.43 | 1171.43 |
| 25 | 1.00698 | 1152.36 | -17.7984 | Clayey Sand (SC) | 100 | 32 | 636.83 | 702.194 | 963.709 | 0 | 963.709 | 1168.15 | 1168.15 |
| 26 | 1.00698 | 1129.15 | -16.5691 | Clayey Sand (SC) | 100 | 32 | 641.118 | 706.922 | 971.277 | 0 | 971.277 | 1162.03 | 1162.03 |
| 27 | 1.00698 | 1103.11 | -15.3475 | Clayey Sand (SC) | 100 | 32 | 643.939 | 710.033 | 976.259 | 0 | 976.259 | 1152.99 | 1152.99 |
| 28 | 1.00698 | 1074.29 | -14.1331 | Clayey Sand (SC) | 100 | 32 | 645.225 | 711.451 | 978.521 | 0 | 978.521 | 1140.99 | 1140.99 |
| 29 | 1.00698 | 1042.73 | -12.9251 | Clayey Sand (SC) | 100 | 32 | 644.899 | 711.091 | 977.952 | 0 | 977.952 | 1125.95 | 1125.95 |
| 30 | 1.00698 | 1008.48 | -11.723 | Clayey Sand (SC) | 100 | 32 | 642.876 | 708.861 | 974.384 | 0 | 974.384 | 1107.79 | 1107.79 |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 31 | 1.00698 | 971.567 | -10.526 | Clayey Sand (SC) | 100 | 32 | 639.063 | 704.656 | 967.652 | 0 | 967.652 | 1086.4 | 1086.4 |
| 32 | 1.00698 | 932.03 | -9.33374 | Clayey Sand (SC) | 100 | 32 | 633.354 | 698.361 | 957.577 | 0 | 957.577 | 1061.68 | 1061.68 |
| 33 | 1.00698 | 889.898 | -8.1455 | Clayey Sand (SC) | 100 | 32 | 625.628 | 689.843 | 943.947 | 0 | 943.947 | 1033.49 | 1033.49 |
| 34 | 1.00698 | 845.193 | -6.96077 | Clayey Sand (SC) | 100 | 32 | 615.758 | 678.959 | 926.528 | 0 | 926.528 | 1001.71 | 1001.71 |
| 35 | 1.00698 | 797.938 | -5.77903 | Clayey Sand (SC) | 100 | 32 | 603.591 | 665.544 | 905.06 | 0 | 905.06 | 966.147 | 966.147 |
| 36 | 1.00698 | 748.149 | -4.59976 | Clayey Sand (SC) | 100 | 32 | 588.963 | 649.414 | 879.247 | 0 | 879.247 | 926.631 | 926.631 |
| 37 | 1.00698 | 695.842 | -3.42243 | Clayey Sand (SC) | 100 | 32 | 571.684 | 630.362 | 848.757 | 0 | 848.757 | 882.946 | 882.946 |
| 38 | 1.00698 | 641.026 | -2.24655 | Clayey Sand (SC) | 100 | 32 | 551.543 | 608.153 | 813.215 | 0 | 813.215 | 834.852 | 834.852 |
| 39 | 1.00698 | 583.711 | -1.07162 | Clayey Sand (SC) | 100 | 32 | 528.297 | 582.521 | 772.196 | 0 | 772.196 | 782.078 | 782.078 |
| 40 | 1.00698 | 523.899 | 0.102865 | Clayey Sand (SC) | 100 | 32 | 501.672 | 553.164 | 725.215 | 0 | 725.215 | 724.314 | 724.314 |
| 41 | 1.00698 | 461.592 | 1.27739 | Clayey Sand (SC) | 100 | 32 | 471.358 | 519.738 | 671.721 | 0 | 671.721 | 661.21 | 661.21 |
| 42 | 1.00698 | 396.789 | 2.45245 | Clayey Sand (SC) | 100 | 32 | 436.994 | 481.847 | 611.082 | 0 | 611.082 | 592.366 | 592.366 |
| 43 | 1.00698 | 329.484 | 3.62855 | Clayey Sand (SC) | 100 | 32 | 398.17 | 439.038 | 542.575 | 0 | 542.575 | 517.325 | 517.325 |
| 44 | 1.00698 | 259.669 | 4.80618 | Clayey Sand (SC) | 100 | 32 | 354.414 | 390.791 | 465.363 | 0 | 465.363 | 435.564 | 435.564 |
| 45 | 1.00698 | 187.333 | 5.98585 | Clayey Sand (SC) | 100 | 32 | 305.178 | 336.502 | 378.482 | 0 | 378.482 | 346.483 | 346.483 |
| 46 | 1.00698 | 113.791 | 7.16808 | Clayey Sand (SC) | 100 | 32 | 250.988 | 276.749 | 282.858 | 0 | 282.858 | 251.293 | 251.293 |
| 47 | 1.00698 | 78.1742 | 8.35338 | Clayey Sand (SC) | 100 | 32 | 226.866 | 250.151 | 240.292 | 0 | 240.292 | 206.98 | 206.98 |
| 48 | 1.00698 | 59.0132 | 9.54229 | Clayey Sand (SC) | 100 | 32 | 216.285 | 238.484 | 221.62 | 0 | 221.62 | 185.263 | 185.263 |
| 49 | 1.00698 | 37.2508 | 10.7354 | Clayey Sand (SC) | 100 | 32 | 202.175 | 222.926 | 196.724 | 0 | 196.724 | 158.393 | 158.393 |
| 50 | 1.00698 | 12.858 | 11.9332 | Clayey Sand (SC) | 100 | 32 | 197.994 | 218.316 | 189.345 | 0 | 189.345 | 147.502 | 147.502 |

# Interslice Data

### Global Minimum Query (spencer) - Safety Factor: 1.10264

| Slice Number | X coordinate [ft] | Y coordinate - Bottom [ft] | Interslice Normal Force [lbs] | Interslice Shear Force [lbs] | Interslice Force Angle [deg] |
|---|---|---|---|---|---|
| 1 | -16.1107 | 4 | 0 | 0 | 0 |
| 2 | -15.1037 | 2.66809 | -71.6667 | -39.5297 | 28.8801 |
| 3 | -14.0967 | 1.42446 | -58.8486 | -32.4595 | 28.8801 |
| 4 | -13.0897 | 0.259051 | 26.1031 | 14.3979 | 28.8802 |
| 5 | -12.0828 | -0.83624 | 737.731 | 406.915 | 28.8801 |
| 6 | -11.0758 | -1.86803 | 1611.36 | 888.791 | 28.8802 |
| 7 | -10.0688 | -2.8418 | 2464.19 | 1359.19 | 28.8801 |
| 8 | -9.06181 | -3.76217 | 3289.1 | 1814.19 | 28.8801 |
| 9 | -8.05483 | -4.63307 | 3864.34 | 2131.48 | 28.8801 |
| 10 | -7.04785 | -5.45786 | 4178.85 | 2304.95 | 28.88 |
| 11 | -6.04087 | -6.23945 | 4486.79 | 2474.81 | 28.8801 |
| 12 | -5.03388 | -6.98038 | 4784.79 | 2639.18 | 28.8801 |
| 13 | -4.0269 | -7.68287 | 5069.81 | 2796.39 | 28.8801 |
| 14 | -3.01992 | -8.34888 | 5339.18 | 2944.97 | 28.8801 |
| 15 | -2.01294 | -8.98014 | 5590.47 | 3083.58 | 28.8802 |
| 16 | -1.00595 | -9.57822 | 5821.55 | 3211.03 | 28.8801 |
| 17 | 0.0010287 | -10.1445 | 6030.48 | 3326.28 | 28.8802 |
| 18 | 1.00801 | -10.6802 | 6215.59 | 3428.37 | 28.8801 |
| 19 | 2.01499 | -11.1864 | 6375.36 | 3516.5 | 28.8801 |
| 20 | 3.02198 | -11.6642 | 6508.52 | 3589.95 | 28.8801 |
| 21 | 4.02896 | -12.1144 | 6613.94 | 3648.09 | 28.8801 |
| 22 | 5.03594 | -12.5379 | 6690.7 | 3690.43 | 28.8801 |
| 23 | 6.04292 | -12.9354 | 6738.03 | 3716.54 | 28.8801 |
| 24 | 7.04991 | -13.3075 | 6755.38 | 3726.11 | 28.8801 |
| 25 | 8.05689 | -13.655 | 6742.31 | 3718.9 | 28.8801 |
| 26 | 9.06387 | -13.9782 | 6698.62 | 3694.8 | 28.8801 |
| 27 | 10.0709 | -14.2778 | 6624.24 | 3653.78 | 28.8801 |
| 28 | 11.0778 | -14.5542 | 6519.32 | 3595.91 | 28.8801 |
| 29 | 12.0848 | -14.8078 | 6384.19 | 3521.37 | 28.8801 |
| 30 | 13.0918 | -15.0389 | 6219.39 | 3430.47 | 28.8801 |
| 31 | 14.0988 | -15.2478 | 6025.68 | 3323.62 | 28.8801 |
| 32 | 15.1058 | -15.4349 | 5804.04 | 3201.37 | 28.8801 |
| 33 | 16.1127 | -15.6004 | 5555.72 | 3064.4 | 28.8801 |
| 34 | 17.1197 | -15.7446 | 5282.23 | 2913.55 | 28.8801 |
| 35 | 18.1267 | -15.8675 | 4985.39 | 2749.83 | 28.8801 |
| 36 | 19.1337 | -15.9694 | 4667.36 | 2574.41 | 28.8801 |
| 37 | 20.1407 | -16.0504 | 4330.65 | 2388.69 | 28.8801 |
| 38 | 21.1477 | -16.1107 | 3978.21 | 2194.29 | 28.8801 |
| 39 | 22.1546 | -16.1502 | 3613.42 | 1993.08 | 28.8801 |
| 40 | 23.1616 | -16.169 | 3240.2 | 1787.22 | 28.8801 |
| 41 | 24.1686 | -16.1672 | 2863.07 | 1579.2 | 28.8801 |
| 42 | 25.1756 | -16.1447 | 2487.22 | 1371.89 | 28.8801 |
| 43 | 26.1826 | -16.1016 | 2118.6 | 1168.57 | 28.8801 |
| 44 | 27.1896 | -16.0378 | 1764.09 | 973.033 | 28.8802 |
| 45 | 28.1965 | -15.9531 | 1431.58 | 789.624 | 28.88 |
| 46 | 29.2035 | -15.8475 | 1130.15 | 623.367 | 28.8802 |
| 47 | 30.2105 | -15.7209 | 869.23 | 479.447 | 28.8801 |
| 48 | 31.2175 | -15.573 | 624.063 | 344.219 | 28.8801 |
| 49 | 32.2245 | -15.4037 | 382.809 | 211.149 | 28.8802 |
| 50 | 33.2314 | -15.2128 | 150.326 | 82.9162 | 28.8801 |
| 51 | 34.2384 | -15 | 0 | 0 | 0 |

# Discharge Sections

# Entity Information

## Group 1

### Shared Entities

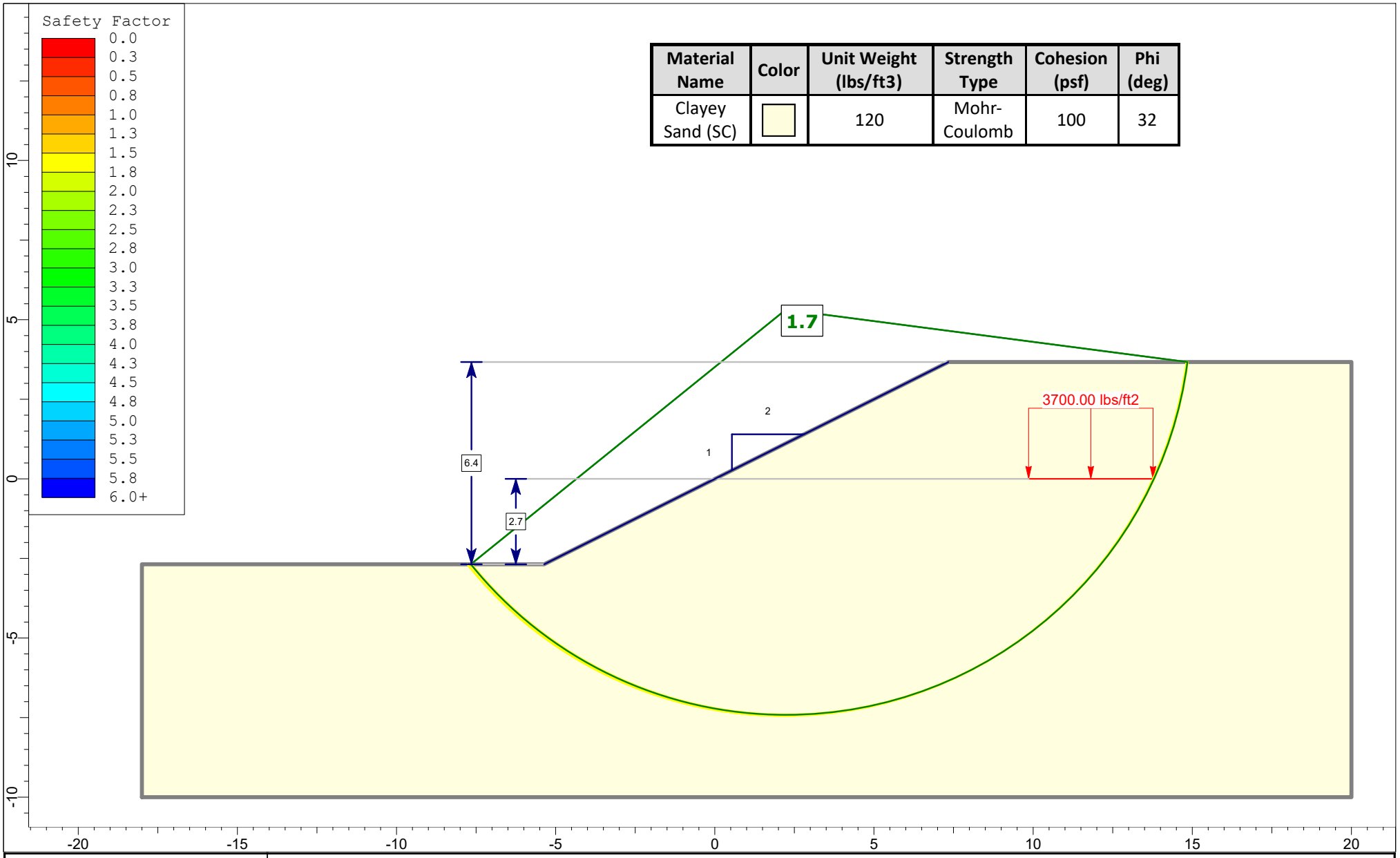
| Type | Coordinates (x,y) |
|---|---|
| External Boundary | -8, 4<br>-35, 4<br>-35, -4<br>-35, -29.5521<br>55, -29.5521<br>55, -15<br>30, -15 |

### Scenario-based Entities

| Type | Coordinates (x,y) | Master Scenario |
|---|---|---|
| Distributed Load | -8.5, 0<br>-12.9, 0 | Constant<br>DistributionOrientation: VerticalMagnitude: 2700 lbs/ft2Creates Excess Pore Pressure: No |

NewFields

# SW6




| Material Name | Color | Unit Weight (lbs/ft3) | Strength Type | Cohesion (psf) | Phi (deg) |
|---|---|---|---|---|---|
| Clayey Sand (SC) | | 120 | Mohr-Coulomb | 100 | 32 |

NewFields

SLIDEINTERPRET 9.025

Sound Wall SW6 - Static Condition

| | | | | | |
|---|---|---|---|---|---|
| *Analysis Description* | | | | | |
| *Drawn By* | A. Gonzalez | *Scale* | 1:50 | *Company* | Newfields |
| *Date Printed* | 11/7/2022 | | | *File Name* | SW6 Service Limit Static_Rev1.slmd |

rocscience

SW6 Service Limit Static_Rev1
Sound Wall SW6 - Static Condition
Newfields
Date Created: 10/31/2022, 10:49:40 AM
Software Version: 9.025

# Table of Contents

# Slide2 Analysis Information

# SW6 Service Limit Static_Rev1

## Project Summary

| | |
|---|---|
| File Name: | SW6 Service Limit Static_Rev1.slmd |
| Slide2 Modeler Version: | 9.025 |
| Compute Time: | 00h:00m:00.678s |
| Project Title: | Sound Wall SW6 - Static Condition |
| Author: | A. Gonzalez |
| Company: | Newfields |
| Date Created: | 10/31/2022, 10:49:40 AM |

# General Settings

| | |
|---|---|
| Units of Measurement: | Imperial Units |
| Time Units: | days |
| Permeability Units: | feet/second |
| Data Output: | Standard |
| Failure Direction: | Right to Left |

# Analysis Options

| | |
|---|---|
| Slices Type: | Vertical |
| **Analysis Methods Used** | |
| | Spencer |
| Number of slices: | 50 |
| Tolerance: | 0.005 |
| Maximum number of iterations: | 75 |
| Check malpha < 0.2: | Yes |
| Create Interslice boundaries at intersections with water tables and piezos: | Yes |
| Initial trial value of FS: | 1 |
| Steffensen Iteration: | Yes |

# Groundwater Analysis

| | |
|---|---|
| Groundwater Method: | Water Surfaces |
| Pore Fluid Unit Weight [lbs/ft3]: | 62.4 |
| Use negative pore pressure cutoff: | Yes |
| Maximum negative pore pressure [psf]: | 0 |
| Advanced Groundwater Method: | None |

# Random Numbers

| | |
|---|---|
| Pseudo-random Seed: | 10116 |
| Random Number Generation Method: | Park and Miller v.3 |

# Surface Options

| | |
|---|---|
| Surface Type: | Circular |
| Search Method: | Auto Refine Search |
| Divisions along slope: | 20 |
| Circles per division: | 10 |
| Number of iterations: | 10 |
| Divisions to use in next iteration: | 50% |
| Composite Surfaces: | Disabled |
| Minimum Elevation: | Not Defined |
| Minimum Depth [ft]: | 10 |
| Minimum Area: | Not Defined |
| Minimum Weight: | Not Defined |

# Seismic Loading

| | |
|---|---|
| Advanced seismic analysis: | No |
| Staged pseudostatic analysis: | No |

# Loading

1 Distributed Load present

| Distributed Load 1 | |
|---|---|
| Distribution: | Constant |
| Magnitude [psf]: | 3700 |
| Orientation: | Vertical |

# Materials

| Clayey Sand (SC) | |
|---|---|
| Color | |
| Strength Type | Mohr-Coulomb |
| Unit Weight [lbs/ft3] | 120 |
| Cohesion [psf] | 100 |
| Friction Angle [deg] | 32 |
| Water Surface | None |
| Ru Value | 0 |

# Global Minimums

## Method: spencer

| FS | 1.717540 |
|---|---|
| Center: | 2.230, 5.314 |
| Radius: | 12.726 |
| Left Slip Surface Endpoint: | -7.669, -2.684 |
| Right Slip Surface Endpoint: | 14.850, 3.670 |
| Resisting Moment: | 316682 lb-ft |
| Driving Moment: | 184381 lb-ft |
| Resisting Horizontal Force: | 19484.5 lb |
| Driving Horizontal Force: | 11344.4 lb |
| Total Slice Area: | 146.657 ft2 |
| Surface Horizontal Width: | 22.5185 ft |
| Surface Average Height: | 6.51272 ft |

# Global Minimum Support Data

No Supports Present

# Valid and Invalid Surfaces

## Method: spencer

| | |
|---|---|
| Number of Valid Surfaces: | 1064 |
| Number of Invalid Surfaces: | 0 |

# Slice Data

### Global Minimum Query (spencer) - Safety Factor: 1.71754

| Slice Number | Width [ft] | Weight [lbs] | Angle of Slice Base [deg] | Base Material | Base Cohesion [psf] | Base Friction Angle [deg] | Shear Stress [psf] | Shear Strength [psf] | Base Normal Stress [psf] | Pore Pressure [psf] | Effective Normal Stress [psf] | Base Vertical Stress [psf] | Effective Vertical Stress [psf] |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 0.450371 | 14.2489 | -49.4992 | Clayey Sand (SC) | 100 | 32 | 243.853 | 418.828 | 510.232 | 0 | 510.232 | 224.724 | 224.724 |
| 2 | 0.450371 | 41.307 | -46.466 | Clayey Sand (SC) | 100 | 32 | 270.367 | 464.366 | 583.108 | 0 | 583.108 | 298.539 | 298.539 |
| 3 | 0.450371 | 65.7032 | -43.594 | Clayey Sand (SC) | 100 | 32 | 286.733 | 492.475 | 628.091 | 0 | 628.091 | 355.097 | 355.097 |
| 4 | 0.450371 | 87.8149 | -40.8536 | Clayey Sand (SC) | 100 | 32 | 298.172 | 512.123 | 659.534 | 0 | 659.534 | 401.672 | 401.672 |
| 5 | 0.450371 | 107.924 | -38.2225 | Clayey Sand (SC) | 100 | 32 | 306.675 | 526.727 | 682.907 | 0 | 682.907 | 441.382 | 441.382 |
| 6 | 0.450371 | 130.9 | -35.6837 | Clayey Sand (SC) | 100 | 32 | 320.981 | 551.298 | 722.227 | 0 | 722.227 | 491.717 | 491.717 |
| 7 | 0.450371 | 159.691 | -33.2235 | Clayey Sand (SC) | 100 | 32 | 344.2 | 591.177 | 786.048 | 0 | 786.048 | 560.608 | 560.608 |
| 8 | 0.450371 | 187.104 | -30.8307 | Clayey Sand (SC) | 100 | 32 | 364.034 | 625.243 | 840.565 | 0 | 840.565 | 623.292 | 623.292 |
| 9 | 0.450371 | 213.152 | -28.4964 | Clayey Sand (SC) | 100 | 32 | 381.106 | 654.565 | 887.49 | 0 | 887.49 | 680.598 | 680.598 |
| 10 | 0.450371 | 237.929 | -26.2126 | Clayey Sand (SC) | 100 | 32 | 395.936 | 680.036 | 928.253 | 0 | 928.253 | 733.32 | 733.32 |
| 11 | 0.450371 | 261.51 | -23.973 | Clayey Sand (SC) | 100 | 32 | 408.885 | 702.277 | 963.844 | 0 | 963.844 | 782.028 | 782.028 |
| 12 | 0.450371 | 283.96 | -21.7716 | Clayey Sand (SC) | 100 | 32 | 420.213 | 721.733 | 994.982 | 0 | 994.982 | 827.15 | 827.15 |
| 13 | 0.450371 | 305.333 | -19.6037 | Clayey Sand (SC) | 100 | 32 | 430.114 | 738.738 | 1022.19 | 0 | 1022.19 | 869.007 | 869.007 |
| 14 | 0.450371 | 325.674 | -17.4645 | Clayey Sand (SC) | 100 | 32 | 438.734 | 753.544 | 1045.89 | 0 | 1045.89 | 907.856 | 907.856 |
| 15 | 0.450371 | 345.022 | -15.3503 | Clayey Sand (SC) | 100 | 32 | 446.189 | 766.347 | 1066.38 | 0 | 1066.38 | 943.894 | 943.894 |
| 16 | 0.450371 | 363.408 | -13.2573 | Clayey Sand (SC) | 100 | 32 | 452.568 | 777.304 | 1083.91 | 0 | 1083.91 | 977.285 | 977.285 |
| 17 | 0.450371 | 380.859 | -11.1822 | Clayey Sand (SC) | 100 | 32 | 457.945 | 786.538 | 1098.69 | 0 | 1098.69 | 1008.16 | 1008.16 |
| 18 | 0.450371 | 397.396 | -9.12189 | Clayey Sand (SC) | 100 | 32 | 462.376 | 794.149 | 1110.87 | 0 | 1110.87 | 1036.63 | 1036.63 |
| 19 | 0.450371 | 413.038 | -7.07341 | Clayey Sand (SC) | 100 | 32 | 465.909 | 800.218 | 1120.58 | 0 | 1120.58 | 1062.77 | 1062.77 |
| 20 | 0.450371 | 427.798 | -5.03399 | Clayey Sand (SC) | 100 | 32 | 468.585 | 804.813 | 1127.94 | 0 | 1127.94 | 1086.66 | 1086.66 |
| 21 | 0.450371 | 441.686 | -3.00095 | Clayey Sand (SC) | 100 | 32 | 470.432 | 807.986 | 1133.01 | 0 | 1133.01 | 1108.35 | 1108.35 |
| 22 | 0.450371 | 454.709 | -0.971696 | Clayey Sand (SC) | 100 | 32 | 471.476 | 809.779 | 1135.89 | 0 | 1135.89 | 1127.89 | 1127.89 |
| 23 | 0.450371 | 466.869 | 1.05634 | Clayey Sand (SC) | 100 | 32 | 471.737 | 810.228 | 1136.6 | 0 | 1136.6 | 1145.3 | 1145.3 |
| 24 | 0.450371 | 478.166 | 3.0857 | Clayey Sand (SC) | 100 | 32 | 471.23 | 809.357 | 1135.21 | 0 | 1135.21 | 1160.61 | 1160.61 |
| 25 | 0.450371 | 488.598 | 5.11895 | Clayey Sand (SC) | 100 | 32 | 469.966 | 807.185 | 1131.73 | 0 | 1131.73 | 1173.83 | 1173.83 |
| 26 | 0.450371 | 498.157 | 7.1587 | Clayey Sand (SC) | 100 | 32 | 467.95 | 803.723 | 1126.19 | 0 | 1126.19 | 1184.97 | 1184.97 |
| 27 | 0.450371 | 506.833 | 9.20762 | Clayey Sand (SC) | 100 | 32 | 465.188 | 798.979 | 1118.6 | 0 | 1118.6 | 1194.01 | 1194.01 |
| 28 | 0.450371 | 514.613 | 11.2685 | Clayey Sand (SC) | 100 | 32 | 461.678 | 792.95 | 1108.95 | 0 | 1108.95 | 1200.94 | 1200.94 |
| 29 | 0.450371 | 521.48 | 13.3443 | Clayey Sand (SC) | 100 | 32 | 457.416 | 785.63 | 1097.24 | 0 | 1097.24 | 1205.74 | 1205.74 |
| 30 | 0.450371 | 527.41 | 15.4381 | Clayey Sand (SC) | 100 | 32 | 452.395 | 777.007 | 1083.44 | 0 | 1083.44 | 1208.37 | 1208.37 |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 31 | 0.450371 | 532.377 | 17.5533 | Clayey Sand (SC) | 100 | 32 | 446.604 | 767.061 | 1067.52 | 0 | 1067.52 | 1208.79 | 1208.79 |
| 32 | 0.450371 | 536.349 | 19.6935 | Clayey Sand (SC) | 100 | 32 | 440.029 | 755.767 | 1049.44 | 0 | 1049.44 | 1206.94 | 1206.94 |
| 33 | 0.450371 | 539.288 | 21.8628 | Clayey Sand (SC) | 100 | 32 | 432.648 | 743.09 | 1029.16 | 0 | 1029.16 | 1202.76 | 1202.76 |
| 34 | 0.450371 | 538.376 | 24.0656 | Clayey Sand (SC) | 100 | 32 | 422.543 | 725.735 | 1001.38 | 0 | 1001.38 | 1190.09 | 1190.09 |
| 35 | 0.450371 | 527.568 | 26.307 | Clayey Sand (SC) | 100 | 32 | 405.823 | 697.018 | 955.427 | 0 | 955.427 | 1156.06 | 1156.06 |
| 36 | 0.450371 | 514.918 | 28.5927 | Clayey Sand (SC) | 100 | 32 | 388.167 | 666.693 | 906.898 | 0 | 906.898 | 1118.47 | 1118.47 |
| 37 | 0.450371 | 500.993 | 30.9294 | Clayey Sand (SC) | 100 | 32 | 369.981 | 635.458 | 856.913 | 0 | 856.913 | 1078.6 | 1078.6 |
| 38 | 0.450371 | 485.699 | 33.3247 | Clayey Sand (SC) | 100 | 32 | 351.226 | 603.244 | 805.359 | 0 | 805.359 | 1036.29 | 1036.29 |
| 39 | 0.450371 | 468.924 | 35.788 | Clayey Sand (SC) | 100 | 32 | 416.645 | 715.605 | 985.174 | 0 | 985.174 | 1285.54 | 1285.54 |
| 40 | 0.450371 | 450.529 | 38.3304 | Clayey Sand (SC) | 100 | 32 | 1280.7 | 2199.65 | 3360.14 | 0 | 3360.14 | 4372.68 | 4372.68 |
| 41 | 0.450371 | 430.341 | 40.9656 | Clayey Sand (SC) | 100 | 32 | 1228.35 | 2109.74 | 3216.25 | 0 | 3216.25 | 4282.75 | 4282.75 |
| 42 | 0.450371 | 408.14 | 43.711 | Clayey Sand (SC) | 100 | 32 | 1173.47 | 2015.48 | 3065.41 | 0 | 3065.41 | 4187.23 | 4187.23 |
| 43 | 0.450371 | 383.641 | 46.5891 | Clayey Sand (SC) | 100 | 32 | 1115.47 | 1915.86 | 2905.99 | 0 | 2905.99 | 4085.12 | 4085.12 |
| 44 | 0.450371 | 356.461 | 49.6298 | Clayey Sand (SC) | 100 | 32 | 1053.54 | 1809.5 | 2735.76 | 0 | 2735.76 | 3974.97 | 3974.97 |
| 45 | 0.450371 | 326.069 | 52.8752 | Clayey Sand (SC) | 100 | 32 | 986.551 | 1694.44 | 2551.63 | 0 | 2551.63 | 3854.91 | 3854.91 |
| 46 | 0.450371 | 291.684 | 56.3868 | Clayey Sand (SC) | 100 | 32 | 912.794 | 1567.76 | 2348.91 | 0 | 2348.91 | 3722.09 | 3722.09 |
| 47 | 0.450371 | 252.072 | 60.2628 | Clayey Sand (SC) | 100 | 32 | 829.506 | 1424.71 | 2119.97 | 0 | 2119.97 | 3572.06 | 3572.06 |
| 48 | 0.450371 | 205.047 | 64.6781 | Clayey Sand (SC) | 100 | 32 | 483.386 | 830.234 | 1168.62 | 0 | 1168.62 | 2190.22 | 2190.22 |
| 49 | 0.450371 | 145.859 | 70.0171 | Clayey Sand (SC) | 100 | 32 | 83.4217 | 143.28 | 69.2626 | 0 | 69.2626 | 298.674 | 298.674 |
| 50 | 0.450371 | 56.1954 | 77.7804 | Clayey Sand (SC) | 100 | 32 | 45.2315 | 77.6869 | -35.7084 | 0 | -35.7084 | 173.149 | 173.149 |

# Interslice Data

### Global Minimum Query (spencer) - Safety Factor: 1.71754

| Slice Number | X coordinate [ft] | Y coordinate - Bottom [ft] | Interslice Normal Force [lbs] | Interslice Shear Force [lbs] | Interslice Force Angle [deg] |
|---|---|---|---|---|---|
| 1 | -7.66874 | -2.68415 | 0 | 0 | 0 |
| 2 | -7.21837 | -3.21145 | 378.639 | 90.9906 | 13.5125 |
| 3 | -6.768 | -3.68548 | 776.556 | 186.614 | 13.5125 |
| 4 | -6.31763 | -4.11427 | 1174.74 | 282.302 | 13.5125 |
| 5 | -5.86726 | -4.50375 | 1565.62 | 376.235 | 13.5126 |
| 6 | -5.41688 | -4.85845 | 1945.67 | 467.565 | 13.5126 |
| 7 | -4.96651 | -5.18188 | 2323.52 | 558.365 | 13.5125 |
| 8 | -4.51614 | -5.47686 | 2710.08 | 651.258 | 13.5125 |
| 9 | -4.06577 | -5.74566 | 3099.63 | 744.871 | 13.5125 |
| 10 | -3.6154 | -5.99015 | 3487.89 | 838.175 | 13.5125 |
| 11 | -3.16503 | -6.21189 | 3871.66 | 930.398 | 13.5125 |
| 12 | -2.71466 | -6.41215 | 4248.44 | 1020.94 | 13.5125 |
| 13 | -2.26429 | -6.59203 | 4616.27 | 1109.34 | 13.5126 |
| 14 | -1.81392 | -6.75243 | 4973.53 | 1195.19 | 13.5125 |
| 15 | -1.36355 | -6.89412 | 5318.91 | 1278.19 | 13.5126 |
| 16 | -0.913177 | -7.01776 | 5651.27 | 1358.06 | 13.5126 |
| 17 | -0.462806 | -7.12387 | 5969.68 | 1434.57 | 13.5125 |
| 18 | -0.0124355 | -7.2129 | 6273.31 | 1507.54 | 13.5125 |
| 19 | 0.437935 | -7.28521 | 6561.44 | 1576.78 | 13.5125 |
| 20 | 0.888306 | -7.34109 | 6833.45 | 1642.15 | 13.5126 |
| 21 | 1.33868 | -7.38077 | 7088.79 | 1703.51 | 13.5125 |
| 22 | 1.78905 | -7.40438 | 7326.97 | 1760.74 | 13.5125 |
| 23 | 2.23942 | -7.41202 | 7547.53 | 1813.75 | 13.5125 |
| 24 | 2.68979 | -7.40371 | 7750.11 | 1862.43 | 13.5125 |
| 25 | 3.14016 | -7.37943 | 7934.32 | 1906.7 | 13.5126 |
| 26 | 3.59053 | -7.33909 | 8099.88 | 1946.48 | 13.5125 |
| 27 | 4.0409 | -7.28252 | 8246.48 | 1981.71 | 13.5125 |
| 28 | 4.49127 | -7.20952 | 8373.88 | 2012.33 | 13.5125 |
| 29 | 4.94164 | -7.11978 | 8481.86 | 2038.27 | 13.5125 |
| 30 | 5.39201 | -7.01295 | 8570.21 | 2059.51 | 13.5125 |
| 31 | 5.84238 | -6.88858 | 8638.78 | 2075.98 | 13.5125 |
| 32 | 6.29275 | -6.74611 | 8687.41 | 2087.67 | 13.5125 |
| 33 | 6.74313 | -6.58492 | 8716 | 2094.54 | 13.5125 |
| 34 | 7.1935 | -6.40421 | 8724.46 | 2096.57 | 13.5125 |
| 35 | 7.64387 | -6.20307 | 8712.95 | 2093.81 | 13.5125 |
| 36 | 8.09424 | -5.98041 | 8682.6 | 2086.51 | 13.5125 |
| 37 | 8.54461 | -5.73494 | 8634.43 | 2074.94 | 13.5125 |
| 38 | 8.99498 | -5.46508 | 8569.46 | 2059.33 | 13.5125 |
| 39 | 9.44535 | -5.16897 | 8488.83 | 2039.95 | 13.5125 |
| 40 | 9.89572 | -4.84429 | 8356.22 | 2008.08 | 13.5125 |
| 41 | 10.3461 | -4.48822 | 7735.35 | 1858.88 | 13.5125 |
| 42 | 10.7965 | -4.0972 | 7029.76 | 1689.32 | 13.5125 |
| 43 | 11.2468 | -3.66665 | 6237.33 | 1498.89 | 13.5125 |
| 44 | 11.6972 | -3.19058 | 5355.19 | 1286.9 | 13.5125 |
| 45 | 12.1476 | -2.66083 | 4379.42 | 1052.42 | 13.5125 |
| 46 | 12.5979 | -2.06587 | 3304.67 | 794.146 | 13.5125 |
| 47 | 13.0483 | -1.38835 | 2123.46 | 510.289 | 13.5125 |
| 48 | 13.4987 | -0.599955 | 824.883 | 198.227 | 13.5125 |
| 49 | 13.9491 | 0.351871 | -70.1949 | -16.8685 | 13.5125 |
| 50 | 14.3994 | 1.5904 | -118.487 | -28.4737 | 13.5126 |
| 51 | 14.8498 | 3.67 | 0 | 0 | 0 |

# Discharge Sections

# Entity Information

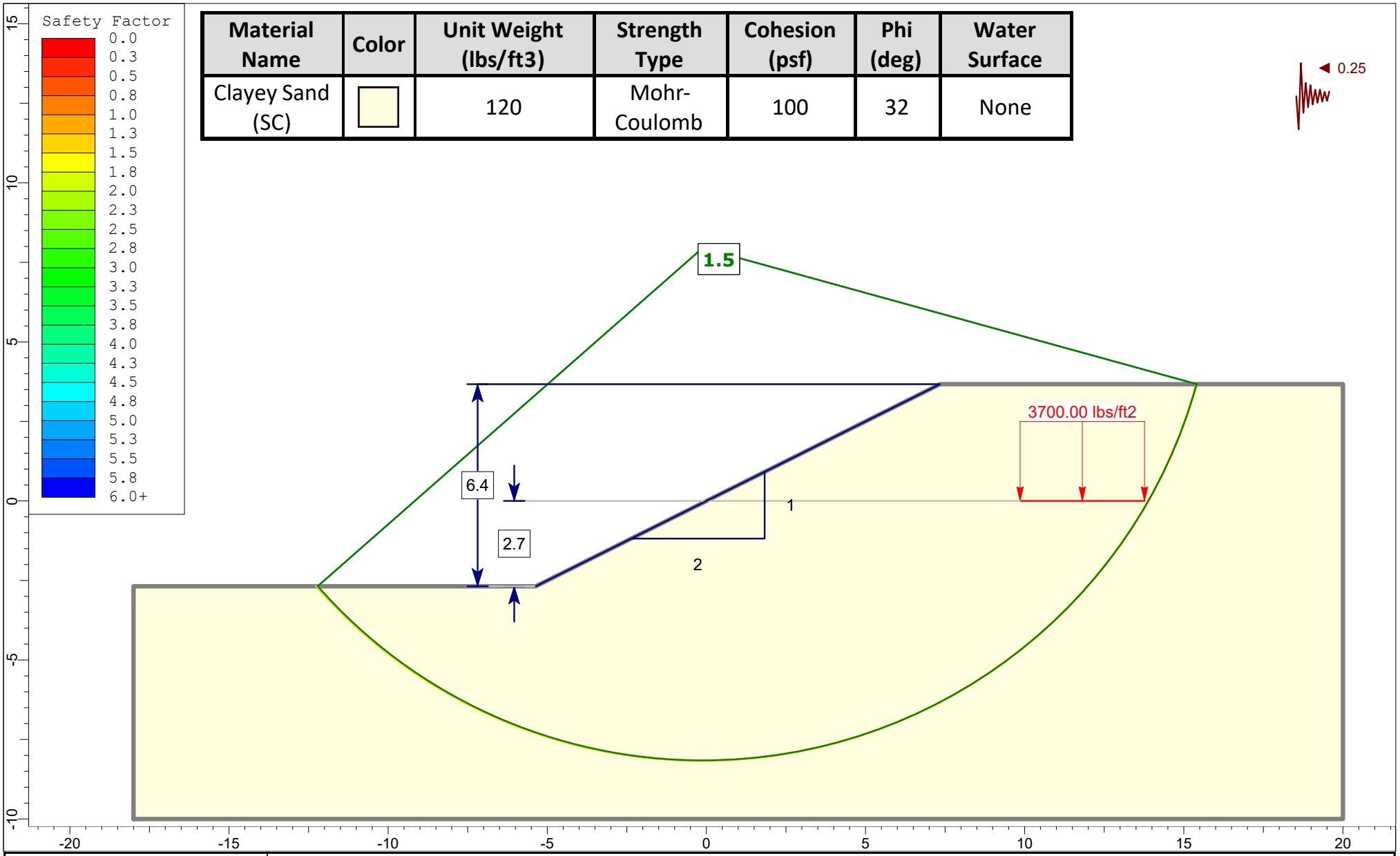
## Group 1

### Shared Entities

| Type | Coordinates (x,y) |
|---|---|
| External Boundary | -18, -10<br>20, -10<br>20, 0<br>20, 3.67<br>7.34, 3.67<br>0.00472243, 0<br>-5.36012, -2.68415<br>-18, -2.68415 |

### Scenario-based Entities

| Type | Coordinates (x,y) | Master Scenario |
|---|---|---|
| Distributed Load | 9.8575, 0<br>13.7675, 0 | Constant DistributionOrientation: VerticalMagnitude: 3700 lbs/ft2Creates Excess Pore Pressure: No |




| Material Name | Color | Unit Weight (lbs/ft3) | Strength Type | Cohesion (psf) | Phi (deg) | Water Surface |
|---|---|---|---|---|---|---|
| Clayey Sand (SC) | | 120 | Mohr-Coulomb | 100 | 32 | None |

| | | | |
|---|---|---|---|
| NewFields | Sound Wall SW6 - Seismic Condition | | |
| | Analysis Description | | |
| | Drawn By: A. Gonzalez | Scale: 1:50 | Company: Newfields |
| | Date Printed: 11/7/2022 | | File Name: SW6 Service Limit Seismic_Rev1.slmd |

SLIDEINTERPRET 9.025

rocscience

SW6 Service Limit Seismic_Rev1
Sound Wall SW6 - Seismic Condition
Newfields
Date Created: 10/31/2022, 10:49:40 AM
Software Version: 9.025

# Table of Contents

# Slide2 Analysis Information

# SW6 Service Limit Seismic_Rev1

## Project Summary

| | |
|---|---|
| File Name: | SW6 Service Limit Seismic_Rev1.slmd |
| Slide2 Modeler Version: | 9.025 |
| Compute Time: | 00h:00m:00.581s |
| Project Title: | Sound Wall SW6 - Seismic Condition |
| Author: | A. Gonzalez |
| Company: | Newfields |
| Date Created: | 10/31/2022, 10:49:40 AM |

# General Settings

| | |
|---|---|
| Units of Measurement: | Imperial Units |
| Time Units: | days |
| Permeability Units: | feet/second |
| Data Output: | Standard |
| Failure Direction: | Right to Left |

# Analysis Options

| | |
|---|---|
| Slices Type: | Vertical |
| **Analysis Methods Used** | |
| | Spencer |
| Number of slices: | 50 |
| Tolerance: | 0.005 |
| Maximum number of iterations: | 75 |
| Check malpha < 0.2: | Yes |
| Create Interslice boundaries at intersections with water tables and piezos: | Yes |
| Initial trial value of FS: | 1 |
| Steffensen Iteration: | Yes |

# Groundwater Analysis

| | |
|---|---|
| Groundwater Method: | Water Surfaces |
| Pore Fluid Unit Weight [lbs/ft3]: | 62.4 |
| Use negative pore pressure cutoff: | Yes |
| Maximum negative pore pressure [psf]: | 0 |
| Advanced Groundwater Method: | None |

# Random Numbers

| | |
|---|---|
| Pseudo-random Seed: | 10116 |
| Random Number Generation Method: | Park and Miller v.3 |

# Surface Options

| | |
|---|---|
| Surface Type: | Circular |
| Search Method: | Auto Refine Search |
| Divisions along slope: | 20 |
| Circles per division: | 10 |
| Number of iterations: | 10 |
| Divisions to use in next iteration: | 50% |
| Composite Surfaces: | Disabled |
| Minimum Elevation: | Not Defined |
| Minimum Depth [ft]: | 10 |
| Minimum Area: | Not Defined |
| Minimum Weight: | Not Defined |

# Seismic Loading

| | |
|---|---|
| Advanced seismic analysis: | No |
| Staged pseudostatic analysis: | No |
| Seismic Load Coefficient (Horizontal): | 0.25 |

# Loading

1 Distributed Load present

| Distributed Load 1 | |
|---|---|
| Distribution: | Constant |
| Magnitude [psf]: | 3700 |
| Orientation: | Vertical |

# Materials

| Clayey Sand (SC) | |
|---|---|
| Color | |
| Strength Type | Mohr-Coulomb |
| Unit Weight [lbs/ft3] | 120 |
| Cohesion [psf] | 100 |
| Friction Angle [deg] | 32 |
| Water Surface | None |
| Ru Value | 0 |

# Global Minimums

## Method: spencer

| FS | 1.469640 |
|---|---|
| Center: | -0.116, 7.950 |
| Radius: | 16.108 |
| Left Slip Surface Endpoint: | -12.214, -2.684 |
| Right Slip Surface Endpoint: | 15.413, 3.670 |
| Resisting Moment: | 438147 lb-ft |
| Driving Moment: | 298132 lb-ft |
| Resisting Horizontal Force: | 22024.6 lb |
| Driving Horizontal Force: | 14986.3 lb |
| Total Slice Area: | 174.416 ft2 |
| Surface Horizontal Width: | 27.6272 ft |
| Surface Average Height: | 6.3132 ft |

# Global Minimum Support Data

No Supports Present

# Valid and Invalid Surfaces

## Method: spencer

| | |
|---|---|
| Number of Valid Surfaces: | 609 |
| Number of Invalid Surfaces: | 0 |

# Slice Data

### Global Minimum Query (spencer) - Safety Factor: 1.46964

| Slice Number | Width [ft] | Weight [lbs] | Angle of Slice Base [deg] | Base Material | Base Cohesion [psf] | Base Friction Angle [deg] | Shear Stress [psf] | Shear Strength [psf] | Base Normal Stress [psf] | Pore Pressure [psf] | Effective Normal Stress [psf] | Base Vertical Stress [psf] | Effective Vertical Stress [psf] |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 0.552544 | 19.8082 | -47.2379 | Clayey Sand (SC) | 100 | 32 | 413.667 | 607.942 | 812.877 | 0 | 812.877 | 365.564 | 365.564 |
| 2 | 0.552544 | 57.5641 | -44.4144 | Clayey Sand (SC) | 100 | 32 | 430.313 | 632.405 | 852.027 | 0 | 852.027 | 430.421 | 430.421 |
| 3 | 0.552544 | 91.8453 | -41.7218 | Clayey Sand (SC) | 100 | 32 | 436.848 | 642.009 | 867.396 | 0 | 867.396 | 477.881 | 477.881 |
| 4 | 0.552544 | 123.086 | -39.138 | Clayey Sand (SC) | 100 | 32 | 440.398 | 647.227 | 875.747 | 0 | 875.747 | 517.36 | 517.36 |
| 5 | 0.552544 | 151.62 | -36.646 | Clayey Sand (SC) | 100 | 32 | 442.665 | 650.558 | 881.077 | 0 | 881.077 | 551.774 | 551.774 |
| 6 | 0.552544 | 177.712 | -34.2324 | Clayey Sand (SC) | 100 | 32 | 444.077 | 652.633 | 884.399 | 0 | 884.399 | 582.238 | 582.238 |
| 7 | 0.552544 | 201.572 | -31.8863 | Clayey Sand (SC) | 100 | 32 | 444.74 | 653.608 | 885.958 | 0 | 885.958 | 609.279 | 609.279 |
| 8 | 0.552544 | 223.374 | -29.5986 | Clayey Sand (SC) | 100 | 32 | 444.677 | 653.515 | 885.81 | 0 | 885.81 | 633.213 | 633.213 |
| 9 | 0.552544 | 243.259 | -27.3617 | Clayey Sand (SC) | 100 | 32 | 443.896 | 652.367 | 883.972 | 0 | 883.972 | 654.254 | 654.254 |
| 10 | 0.552544 | 261.347 | -25.1693 | Clayey Sand (SC) | 100 | 32 | 442.405 | 650.176 | 880.465 | 0 | 880.465 | 672.575 | 672.575 |
| 11 | 0.552544 | 277.736 | -23.0157 | Clayey Sand (SC) | 100 | 32 | 440.215 | 646.957 | 875.314 | 0 | 875.314 | 688.312 | 688.312 |
| 12 | 0.552544 | 292.511 | -20.896 | Clayey Sand (SC) | 100 | 32 | 437.341 | 642.734 | 868.556 | 0 | 868.556 | 701.587 | 701.587 |
| 13 | 0.552544 | 308.99 | -18.8058 | Clayey Sand (SC) | 100 | 32 | 437.395 | 642.813 | 868.683 | 0 | 868.683 | 719.732 | 719.732 |
| 14 | 0.552544 | 337.567 | -16.7414 | Clayey Sand (SC) | 100 | 32 | 450.926 | 662.699 | 900.507 | 0 | 900.507 | 764.867 | 764.867 |
| 15 | 0.552544 | 366.213 | -14.6991 | Clayey Sand (SC) | 100 | 32 | 464.014 | 681.934 | 931.29 | 0 | 931.29 | 809.566 | 809.566 |
| 16 | 0.552544 | 393.468 | -12.6758 | Clayey Sand (SC) | 100 | 32 | 475.231 | 698.418 | 957.67 | 0 | 957.67 | 850.783 | 850.783 |
| 17 | 0.552544 | 419.369 | -10.6685 | Clayey Sand (SC) | 100 | 32 | 484.76 | 712.422 | 980.08 | 0 | 980.08 | 888.761 | 888.761 |
| 18 | 0.552544 | 443.945 | -8.67428 | Clayey Sand (SC) | 100 | 32 | 492.747 | 724.16 | 998.865 | 0 | 998.865 | 923.69 | 923.69 |
| 19 | 0.552544 | 467.219 | -6.69066 | Clayey Sand (SC) | 100 | 32 | 499.31 | 733.806 | 1014.3 | 0 | 1014.3 | 955.728 | 955.728 |
| 20 | 0.552544 | 489.209 | -4.71507 | Clayey Sand (SC) | 100 | 32 | 504.545 | 741.5 | 1026.61 | 0 | 1026.61 | 984.999 | 984.999 |
| 21 | 0.552544 | 509.928 | -2.7451 | Clayey Sand (SC) | 100 | 32 | 508.531 | 747.358 | 1035.99 | 0 | 1035.99 | 1011.61 | 1011.61 |
| 22 | 0.552544 | 529.385 | -0.778367 | Clayey Sand (SC) | 100 | 32 | 511.333 | 751.475 | 1042.58 | 0 | 1042.58 | 1035.63 | 1035.63 |
| 23 | 0.552544 | 547.584 | 1.18745 | Clayey Sand (SC) | 100 | 32 | 513 | 753.926 | 1046.5 | 0 | 1046.5 | 1057.13 | 1057.13 |
| 24 | 0.552544 | 564.525 | 3.15466 | Clayey Sand (SC) | 100 | 32 | 513.579 | 754.776 | 1047.86 | 0 | 1047.86 | 1076.17 | 1076.17 |
| 25 | 0.552544 | 580.203 | 5.12561 | Clayey Sand (SC) | 100 | 32 | 513.102 | 754.075 | 1046.74 | 0 | 1046.74 | 1092.76 | 1092.76 |
| 26 | 0.552544 | 594.607 | 7.10266 | Clayey Sand (SC) | 100 | 32 | 511.597 | 751.864 | 1043.2 | 0 | 1043.2 | 1106.95 | 1106.95 |
| 27 | 0.552544 | 607.724 | 9.08827 | Clayey Sand (SC) | 100 | 32 | 509.087 | 748.175 | 1037.3 | 0 | 1037.3 | 1118.73 | 1118.73 |
| 28 | 0.552544 | 619.535 | 11.085 | Clayey Sand (SC) | 100 | 32 | 505.586 | 743.029 | 1029.06 | 0 | 1029.06 | 1128.12 | 1128.12 |
| 29 | 0.552544 | 630.015 | 13.0954 | Clayey Sand (SC) | 100 | 32 | 501.104 | 736.442 | 1018.52 | 0 | 1018.52 | 1135.09 | 1135.09 |
| 30 | 0.552544 | 639.134 | 15.1224 | Clayey Sand (SC) | 100 | 32 | 495.646 | 728.421 | 1005.68 | 0 | 1005.68 | 1139.63 | 1139.63 |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 31 | 0.552544 | 646.854 | 17.169 | Clayey Sand (SC) | 100 | 32 | 489.214 | 718.968 | 990.555 | 0 | 990.555 | 1141.7 | 1141.7 |
| 32 | 0.552544 | 653.131 | 19.2385 | Clayey Sand (SC) | 100 | 32 | 481.802 | 708.075 | 973.123 | 0 | 973.123 | 1141.27 | 1141.27 |
| 33 | 0.552544 | 657.914 | 21.3345 | Clayey Sand (SC) | 100 | 32 | 473.4 | 695.727 | 953.364 | 0 | 953.364 | 1138.26 | 1138.26 |
| 34 | 0.552544 | 661.139 | 23.4608 | Clayey Sand (SC) | 100 | 32 | 463.995 | 681.905 | 931.243 | 0 | 931.243 | 1132.62 | 1132.62 |
| 35 | 0.552544 | 662.734 | 25.6221 | Clayey Sand (SC) | 100 | 32 | 453.565 | 666.577 | 906.713 | 0 | 906.713 | 1124.24 | 1124.24 |
| 36 | 0.552544 | 659.196 | 27.8233 | Clayey Sand (SC) | 100 | 32 | 440.125 | 646.826 | 875.104 | 0 | 875.104 | 1107.38 | 1107.38 |
| 37 | 0.552544 | 640.313 | 30.0702 | Clayey Sand (SC) | 100 | 32 | 418.168 | 614.557 | 823.464 | 0 | 823.464 | 1065.58 | 1065.58 |
| 38 | 0.552544 | 618.096 | 32.3693 | Clayey Sand (SC) | 100 | 32 | 394.876 | 580.325 | 768.68 | 0 | 768.68 | 1018.98 | 1018.98 |
| 39 | 0.552544 | 593.787 | 34.7287 | Clayey Sand (SC) | 100 | 32 | 371.008 | 545.248 | 712.546 | 0 | 712.546 | 969.719 | 969.719 |
| 40 | 0.552544 | 567.206 | 37.1577 | Clayey Sand (SC) | 100 | 32 | 406.971 | 598.101 | 797.129 | 0 | 797.129 | 1105.56 | 1105.56 |
| 41 | 0.552544 | 538.132 | 39.6675 | Clayey Sand (SC) | 100 | 32 | 1398.43 | 2055.19 | 3128.95 | 0 | 3128.95 | 4288.61 | 4288.61 |
| 42 | 0.552544 | 506.289 | 42.2725 | Clayey Sand (SC) | 100 | 32 | 1333.25 | 1959.4 | 2975.65 | 0 | 2975.65 | 4187.65 | 4187.65 |
| 43 | 0.552544 | 471.325 | 44.9903 | Clayey Sand (SC) | 100 | 32 | 1265.32 | 1859.56 | 2815.89 | 0 | 2815.89 | 4080.78 | 4080.78 |
| 44 | 0.552544 | 432.779 | 47.8444 | Clayey Sand (SC) | 100 | 32 | 1193.98 | 1754.72 | 2648.1 | 0 | 2648.1 | 3966.93 | 3966.93 |
| 45 | 0.552544 | 390.032 | 50.866 | Clayey Sand (SC) | 100 | 32 | 1118.32 | 1643.53 | 2470.17 | 0 | 2470.17 | 3844.59 | 3844.59 |
| 46 | 0.552544 | 342.213 | 54.0993 | Clayey Sand (SC) | 100 | 32 | 1037.09 | 1524.15 | 2279.12 | 0 | 2279.12 | 3711.77 | 3711.77 |
| 47 | 0.552544 | 288.032 | 57.6103 | Clayey Sand (SC) | 100 | 32 | 948.362 | 1393.75 | 2070.43 | 0 | 2070.43 | 3565.4 | 3565.4 |
| 48 | 0.552544 | 225.41 | 61.5054 | Clayey Sand (SC) | 100 | 32 | 137.945 | 202.73 | 164.403 | 0 | 164.403 | 418.524 | 418.524 |
| 49 | 0.552544 | 150.558 | 65.9807 | Clayey Sand (SC) | 100 | 32 | 88.9684 | 130.751 | 49.2126 | 0 | 49.2126 | 248.858 | 248.858 |
| 50 | 0.552544 | 54.7257 | 71.4931 | Clayey Sand (SC) | 100 | 32 | 54.9622 | 80.7747 | -30.7669 | 0 | -30.7669 | 133.432 | 133.432 |

# Interslice Data

### Global Minimum Query (spencer) - Safety Factor: 1.46964

| Slice Number | X coordinate [ft] | Y coordinate - Bottom [ft] | Interslice Normal Force [lbs] | Interslice Shear Force [lbs] | Interslice Force Angle [deg] |
|---|---|---|---|---|---|
| 1 | -12.2143 | -2.68415 | 0 | 0 | 0 |
| 2 | -11.6618 | -3.28163 | 708.899 | 191.201 | 15.0944 |
| 3 | -11.1092 | -3.823 | 1393.11 | 375.745 | 15.0944 |
| 4 | -10.5567 | -4.31567 | 2038.45 | 549.802 | 15.0944 |
| 5 | -10.0041 | -4.76532 | 2644.37 | 713.228 | 15.0944 |
| 6 | -9.45159 | -5.17637 | 3212.79 | 866.54 | 15.0944 |
| 7 | -8.89905 | -5.55233 | 3745.81 | 1010.3 | 15.0943 |
| 8 | -8.3465 | -5.89608 | 4245.26 | 1145.01 | 15.0944 |
| 9 | -7.79396 | -6.20995 | 4712.72 | 1271.09 | 15.0943 |
| 10 | -7.24141 | -6.49589 | 5149.52 | 1388.9 | 15.0943 |
| 11 | -6.68887 | -6.75554 | 5556.81 | 1498.76 | 15.0944 |
| 12 | -6.13632 | -6.99026 | 5935.64 | 1600.93 | 15.0943 |
| 13 | -5.58378 | -7.20121 | 6286.96 | 1695.69 | 15.0944 |
| 14 | -5.03124 | -7.38937 | 6614.42 | 1784.01 | 15.0944 |
| 15 | -4.47869 | -7.55558 | 6928.42 | 1868.7 | 15.0944 |
| 16 | -3.92615 | -7.70053 | 7227.79 | 1949.45 | 15.0944 |
| 17 | -3.3736 | -7.8248 | 7510.57 | 2025.72 | 15.0944 |
| 18 | -2.82106 | -7.92889 | 7775.12 | 2097.07 | 15.0944 |
| 19 | -2.26851 | -8.01319 | 8020.12 | 2163.15 | 15.0944 |
| 20 | -1.71597 | -8.07801 | 8244.47 | 2223.66 | 15.0944 |
| 21 | -1.16343 | -8.12358 | 8447.25 | 2278.35 | 15.0944 |
| 22 | -0.610882 | -8.15008 | 8627.7 | 2327.03 | 15.0944 |
| 23 | -0.0583379 | -8.15758 | 8785.22 | 2369.51 | 15.0944 |
| 24 | 0.494206 | -8.14613 | 8919.3 | 2405.67 | 15.0944 |
| 25 | 1.04675 | -8.11568 | 9029.53 | 2435.41 | 15.0944 |
| 26 | 1.59929 | -8.06611 | 9115.62 | 2458.62 | 15.0944 |
| 27 | 2.15184 | -7.99726 | 9177.33 | 2475.27 | 15.0944 |
| 28 | 2.70438 | -7.90888 | 9214.51 | 2485.3 | 15.0944 |
| 29 | 3.25693 | -7.80062 | 9227.09 | 2488.69 | 15.0944 |
| 30 | 3.80947 | -7.67209 | 9215.07 | 2485.45 | 15.0944 |
| 31 | 4.36202 | -7.52277 | 9178.5 | 2475.59 | 15.0944 |
| 32 | 4.91456 | -7.35206 | 9117.53 | 2459.14 | 15.0944 |
| 33 | 5.4671 | -7.15922 | 9032.34 | 2436.16 | 15.0944 |
| 34 | 6.01965 | -6.94341 | 8923.23 | 2406.74 | 15.0944 |
| 35 | 6.57219 | -6.70361 | 8790.56 | 2370.95 | 15.0944 |
| 36 | 7.12474 | -6.43861 | 8634.78 | 2328.93 | 15.0944 |
| 37 | 7.67728 | -6.147 | 8457.55 | 2281.13 | 15.0944 |
| 38 | 8.22983 | -5.82709 | 8264.68 | 2229.11 | 15.0944 |
| 39 | 8.78237 | -5.47684 | 8058.74 | 2173.57 | 15.0944 |
| 40 | 9.33491 | -5.09384 | 7842.02 | 2115.12 | 15.0944 |
| 41 | 9.88746 | -4.67507 | 7590.89 | 2047.38 | 15.0944 |
| 42 | 10.44 | -4.21687 | 6794 | 1832.45 | 15.0944 |
| 43 | 10.9925 | -3.71458 | 5908.16 | 1593.52 | 15.0944 |
| 44 | 11.5451 | -3.16222 | 4932.87 | 1330.47 | 15.0944 |
| 45 | 12.0976 | -2.5519 | 3867.05 | 1043.01 | 15.0945 |
| 46 | 12.6502 | -1.87282 | 2708.94 | 730.644 | 15.0944 |
| 47 | 13.2027 | -1.10953 | 1455.79 | 392.65 | 15.0944 |
| 48 | 13.7553 | -0.238515 | 103.495 | 27.9143 | 15.0944 |
| 49 | 14.3078 | 0.779374 | -44.114 | -11.8982 | 15.0943 |
| 50 | 14.8604 | 2.01928 | -93.7 | -25.2723 | 15.0944 |
| 51 | 15.4129 | 3.67 | 0 | 0 | 0 |

# Discharge Sections

# Entity Information

## Group 1

### Shared Entities

| Type | Coordinates (x,y) |
|---|---|
| External Boundary | -18, -10<br>20, -10<br>20, 0<br>20, 3.67<br>7.34, 3.67<br>0.00472243, 0<br>-5.36012, -2.68415<br>-18, -2.68415 |

### Scenario-based Entities

| Type | Coordinates (x,y) | Master Scenario |
|---|---|---|
| Distributed Load | 9.8575, 0<br>13.7675, 0 | Constant DistributionOrientation: VerticalMagnitude: 3700 lbs/ft2Creates Excess Pore Pressure: No |