



January 3, 2020
Project No. 17-0822

Ms. Allison Coburn, Facilities Project Manager
Facility Planning, District Construction and Support Services
2323 North Broadway, Suite 112
Santa Ana, California, 92706-1640

**SUBJECT: Addendum Response to DSA Comments for
Santa Ana College New Health Science Building
1530 W. 17th Street, Santa Ana, CA 92706**

Reference: Response to DSA Comments for Santa Ana College New Health Science Building, 1530 W. 17th Street, Santa Ana, CA 92706, prepared by Koury Engineering & Testing, Inc., report dated November 14, 2019.

Dear Ms. Coburn:

This addendum report is in response to verbal discussions between the Division of State Architect (DSA) reviewer, CGS and the Design Team during a telephone conference on December 10, 2019.

Item 1: The pile cap weight and the pile weight should be subtracted from the pile capacity.

Response to Item 1: It was agreed that the pile weight will be subtracted from the pile side resistance capacity (end bearing is neglected). The pile cap weight will be added to the column loads by the Structural Engineer. It is acceptable to consider the pile cap net weight (concrete weight minus displaced soil weight) for compression, and the pile cap full weight for tension. Since the safety factor against uplift generally exceed 3, there is no need to consider the side friction at the perimeter of the pile cap.

Item 2: The DSA reviewer indicated the need for a safety factor of 2 during a liquefaction event. The California Building Code apparently does not distinguish between a liquefaction event or any other type of event for foundation support.

Response to Item 2: Based on SP117A (page 42, attached), a calculated safety factor greater than 1.5 can be used against potential foundation bearing failure or large foundation settlement during a liquefaction event. The previous pile calculations provided indicate safety factors greater than 1.5. However, Koury agreed to review the design parameters and to adjust the pile length as needed to obtain safety factors of at least 2 as requested by DSA.

Attached is the updated Table 2A. This table summarizes the side resistance, the ultimate capacities up and down, and the calculated safety factors during the design seismic event. The analyses were performed for the worst conditions from the borings and cone penetration tests. The limit of the side resistance factor within the ALLPILE setting was raised slightly as allowed by the software since the worst conditions were analyzed and the residual shear strength resistance were ignored within the liquefiable zone for both side friction and end bearing. The soil layers and parameters, including the unit weights, friction angles and cohesion remained as before except where adjustment had to be done to simulate the liquefaction zones. The pile lengths were increased by 5 feet to meet the safety factor of 2.

Should you have any questions concerning this submittal, please call our office.

Respectfully submitted,

Koury Engineering & Testing, Inc.


Jacques B. Roy, P.E., C.E.

Principal Geotechnical Engineer



Distribution: 1. Addressee (a pdf copy via e-mail)
2. File (B)

Enclosures: 1. Attachment 1, Table 2A
2. Attachment 2, AllPILE Output (18 pages)

ATTACHMENT 1

Table 2A

Localized Liquefaction Hazards

If it can be shown that no significant risk of large translational movements exists, or if suitable mitigation measures can be developed that address such risks, then studies should proceed to consideration of five general types of more localized potential hazards, including:

1. **Potential foundation bearing failure, or large foundation settlements due to ground softening and near-failure in bearing.** To form a basis for concluding that no hazard exists, a high factor of safety ($FS > 1.5$) should be based on a realistic appraisal of the minimum soil strengths likely to be mobilized to resist bearing failure (including residual undrained strengths of soils considered likely to liquefy or to suffer significant strength loss due to cyclic pore pressure generation). If such hazard does exist, then appropriate recommendations for mitigation of this hazard should be developed.
2. **Potential structural and/or site settlements.** Settlements for saturated and unsaturated clean sands can be estimated using simplified empirical procedures (e.g., Tokimatsu and Seed, 1987; Ishihara and Yoshimine, 1992). These procedures, developed for relatively clean, sandy soils, have been found to provide reasonably reliable settlement estimates for sites not prone to significant lateral spreading. Improved relations suitable for spreadsheet analysis are available that are based on fines-corrected penetration resistance (Idriss and Boulanger, 2008).

Any prediction of liquefaction-related settlements is necessarily approximate, and related hazard assessment and/or development of recommendations for mitigation of such hazard should, accordingly, be performed with suitable conservatism. Similarly, it is very difficult to reliably estimate the amount of localized differential settlement likely to occur as part of the overall predicted settlement: localized *differential* settlements on the order of up to two-thirds of the total settlements anticipated should be assumed unless more precise predictions of differential settlements can be made.

3. **Localized lateral displacement; "lateral spreading" and/or lateral compression.** Methods for prediction of lateral ground displacements due to liquefaction-related ground softening are not yet well supported by data from case histories of field performance. As such case history data are now being developed, significant advances in the reliability and utility of techniques for prediction of lateral displacements may be expected over the next few years. Finite element models represent the most sophisticated method currently in use for calculating permanent displacements due to liquefaction lateral spreading. Like the dynamic analysis for landslide displacements, this method evaluates time histories of the stresses and strains for a strong-motion time history. This method is a state-of-the-art approach to liquefaction hazards and will likely take time to become the state-of-the-practice.

Consultants performing liquefaction hazard assessment should do their best to keep abreast of such developments (e.g. Idriss and Boulanger, 2008). At present, lateral ground displacement magnitudes can be predicted with reasonable accuracy and reliability only for cases wherein such displacements are likely to be "small" (e.g., on the order of 15 cm or less). Larger

Table 2A- Breakdown of Piles Capacity & Ultimate Resistance During Earthquake (Jan 2, 2020)

| Based on Soil Profile Boring B-2 (Worst Case) | | | Capacity from ALLPILE Analysis | | | | Project #: 17-0822 | | | |
|-----------------------------------------------|---------------------------------------------|-------------------------------|--------------------------------|-----------------------------|---------------------------|--------------------|--------------------|----------------------------------------------|-----------------------------------------|--------------------|
| 30-in Pile Depth (ft) | Side Friction Ignored from - to Depth (ft) | Ultimate Capacity Down (kips) | Ultimate Capacity Up (kips) | Side Resistance Down (kips) | Side Resistance Up (kips) | Safety Factor Down | Safety Factor Up | Allowable Static Capacity Compression (kips) | Allowable Static Capacity Uplift (kips) | Pile Weight (kips) |
| 54 | 0 - 6.5 36 - 38 48 - 50 | 286 | 338 | 320 | 303 | 2.2 | 4.7 | 130 | 65 | 34 |
| 59 | 0-7, 36-38 48-50, 54.5-57 | 304 | 357 | 340 | 320 | 2.0 | 4.3 | 150 | 75 | 37 |
| 65 | 0-8, 36-38 48-50, 54.5-57 | 352 | 406 | 391 | 367 | 2.1 | 4.5 | 165 | 82 | 39 |
| 69 | 0-8.5, 36-38 48-50, 54.5-57 66 - 68.5 | 362 | 411 | 403 | 369 | 2.0 | 4.1 | 180 | 90 | 41 |

Example: Down: $(320.7-34.4)/(130*1.33)*1.33=2.2$; where Pile Weight=34.4 kips

Example Up: $(303.5)/(65*1.33)*1.33=4.7$

| Based on Soil Profile CPT-2 (Worst Case) | | | Capacity from ALLPILE Analysis | | | | | | | |
|------------------------------------------|---------------------------------------------|-------------------------------|--------------------------------|-----------------------------|---------------------------|--------------------|------------------|----------------------------------------------|-----------------------------------------|--------------------|
| 30-in Pile Depth (ft) | Side Friction Ignored from - to Depth (ft) | Ultimate Capacity Down (kips) | Ultimate Capacity Up (kips) | Side Resistance Down (kips) | Side Resistance Up (kips) | Safety Factor Down | Safety Factor Up | Allowable Static Capacity Compression (kips) | Allowable Static Capacity Uplift (kips) | Pile Weight (kips) |
| 54 | 0 - 6.5 36 - 38 48 - 50 | 286 | 335 | 321 | 301 | 2.2 | 4.6 | 130 | 65 | 34 |
| 59 | 0-7, 36-38 48-50, 54.5-57 | 304 | 335 | 341 | 316 | 2.0 | 4.2 | 150 | 75 | 37 |
| 65 | 0-6, 36-38 48-50, 54.5-57 | 358 | 406 | 397 | 367 | 2.2 | 4.5 | 165 | 82 | 39 |
| 65 | 0-4.5, 36-38 48-50, 54.5-57 | 363 | 412 | 402 | 372 | 2.1 | 4.4 | 170 | 85 | 39 |
| 69 | 0-8.5, 36-38 48-50, 54.5-57 66 - 68.5 | 362 | 411 | 403 | 371 | 2.0 | 4.1 | 180 | 90 | 41 |

Notes:

Zero end bearing was used for all piles

Ultimate Capacity Up = Side Resistance Up + Pile Weight

Ultimate Capacity Down = Side Resistance Down - Pile Weight

ATTACHMENT 2

ALLPILE Output

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 VERTICAL ANALYSIS SUMMARY OUTPUT
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 Reports-Certificates\Mehrab Draft\Response to CGS-Pile\Per Jacques\B-2\December Analysis\Pile-B-2-30in-49ft+5ft Dec 2019-Seismic.alp

Title 1: 17-0822-Russel Hall Replacement
 Title 2: Deep Foundation Calculation

ALLPILE INPUT DATA:

* Pile Type Page *

Unit: English
 Diameter more than 24in (61cm). For bell section, select "Belled" in Diameter Variation (Pile Section Screen, Item 4). Recommendation: 2 to 4
 in Item 3 of Page F.
 Pile Type: Drilled Shaft (dia >24 in. or 61 cm)

* Pile Profile *

Foundation Depth: 54.0 -ft
 Top Height: 0.0 -ft
 Slope Angle: 0
 Pile Angle: 0.0

* Pile Properties *

| Zs -ft | Width -in | Area -in ² | Perim. -in | I -in ⁴ | E -kp/i ² | Weight -kp/f | Mix* % | Out Side | In Side | Other Par. | Type |
|-----------|--------------|--------------------------|---------------|-----------------------|-------------------------|-----------------|-----------|-------------|------------|---------------|------------------|
| 0.0 | 30 | 706.9 | 94.2 | 0 | 3000 | 0.736 | 0.0 | 3 | 3 | 30 | Concrete (rough) |
| 54.0 | 30 | 706.9 | 94.2 | | | | | | | | Pile Tip |

Note: Mix = % of Inside material/Outside material

Group Type: 0
 Top Type: 1

Water Table: 36.5 -ft
 No Elevation Input

* Soil Properties *

| Zs -ft | Gamma -lb/f ³ | Phi o | C -kp/f ² | K -lb/i ³ | E50/Dr - % | Nspt | Type | Soil |
|-----------|-----------------------------|----------|-------------------------|-------------------------|---------------|------|------|----------------|
| 0.0 | 126.6 | 15 | 0.33 | 222.9 | 1.00 | 8 | 1 | Soft Clay |
| 5.0 | 128.7 | 30 | 0.2 | 290.1 | 0.90 | 10 | 3 | Silt (Phi + C) |
| 10.0 | 125.5 | 20 | 0.46 | 166.5 | 1.11 | 7 | 1 | Soft Clay |
| 16.0 | 132.0 | 32 | 0.26 | 584.7 | 0.67 | 16 | 3 | Silt (Phi + C) |
| 17.5 | 130.8 | 20 | 0.53 | 407.0 | 0.78 | 12 | 1 | Soft Clay |
| 36.5 | 66.9 | 32 | 0.26 | 317.7 | 0.87 | 10 | 3 | Silt (Phi + C) |
| 40.0 | 63.8 | 20 | 0.53 | 214.1 | 1.01 | 8 | 1 | Soft Clay |
| 45.5 | 75.6 | 31 | 0.15 | 97.1 | 66.4 | 31 | 4 | Sand/Gravel |
| 48.0 | 75.6 | 1 | 0.01 | 97.1 | 66.40 | 31 | 4 | Sand/Gravel |
| 50.0 | 75.6 | 31 | 0.15 | 97.1 | 66.4 | 31 | 4 | Sand/Gravel |

Surcharge Pressure on ground: 0 -kp/f²

* Zero Tip Resistance *

The tip resistance is zero

* Zero Friction *

Zero Friction Start: 0 -ft End: 6.5 -ft
 Zero Friction Start: 36 -ft End: 38 -ft

ALLPILE ANALYSIS AND RESULTS:

TOTAL LOADS:

Vertical Load, Q: 173.0 -kp

Pile-B-2-30in-49ft+5ft Dec 2019-Seismic

Vertical Load with Load Factor, Q: 173.0 -kp
Vertical Load with Load factor and Pile Cap, Q= 173.0 -kp
Load Factor for Vertical Load and Torsion= 1.0
Vertical Loads Supported by Pile Cap: 0 %
Load Factor for Vertical Loads: 1.0

PILE PROFILE:

Pile Length, L= 54.0 -ft
Top Height, H= 0.0 -ft
Slope Angle, As= 0
Batter Angle, Ab= 0.00 Batter Factor, Kbat= 1.00

*To consider the influence of different soils below the pile tip, bearing stratum is defined from pile tip extending to 4 Diameter of pile, which is 10.0-ft (Input Page F, Item 3)

SINGLE PILE:

Kdown= 0.5 Kup= 0.4 Ka= 1.00

Single Pile Vertical Analysis:

Total Ultimate Capacity (Down)= 320.724-kp Total Ultimate Capacity (Up)= 337.915-kp
Total Allowable Capacity (Down)= 320.724-kp Total Allowable Capacity (Up)= 337.915-kp

Weight above Ground= 0.00 Total Weight= 34.41-kp *Soil Weight is not included
Side Resistance (Down)= 320.724-kp Side Resistance (Up)= 303.508-kp
Tip Resistance (Down)= 0.000-kp Tip Resistance (Up)= 0.000-kp
Negative Friction, Qneg= 0.000-kp, which has been subtracted from Total Ultimate Capacity (Down)
Negative friction does not affect Total Ultimate Capacity (Up)

At Work Load= 173.00-kp, Settlement= 0.14824-in
At Work Load= 173.00-kp, Secant Stiffness Kqx= 1167.00-kp/-in
At Allowable Settlement= 0.800000-in, Capacity= 320.65-kp
Work Load, 173.00-kp, OK with the Capacity at Allowable Settlement= 0.80000-in, Capacity= 320.65-kp
Work Load, 173.00-kp, OK with the Allowable Capacity (Down)= 320.72-kp

FACTOR OF SAFETY:

| FSSide | FStip | FSuplif | FSweight |
|--------|-------|---------|----------|
| 1.0 | 1.0 | 1.0 | 1.0 |

Note: If the program cannot find a result or the result exceeds the upper limit. The result will be displayed as 99999.

| | | | | |
|---|---|---|---|---|
| 1 | 1 | 1 | 1 | 1 |
|---|---|---|---|---|

Note:

Due to the limitations of the program for the number of soil layers, we used the negative friction option to simulate some of the liquefaction layers. This option eliminates the pile resistance downward but not upward. We subtracted the upward resistance manually using the output data from the detailed report.

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Title 1: 17-0822-Russel Hall Replacement
 Title 2: Deep Foundation Calculation

ALLPILE INPUT DATA:

* Pile Type Page *

Unit: English
 Diameter more than 24in (61cm). For bell section, select "Belled" in Diameter Variation (Pile Section Screen, Item 4). Recommendation: 2 to 4
 in Item 3 of Page F.
 Pile Type: Drilled Shaft (dia >24 in. or 61 cm)

* Pile Profile *

Foundation Depth: 59.0 -ft
 Top Height: 0.0 -ft
 Slope Angle: 0
 Pile Angle: 0.0

* Pile Properties *

| Zs -ft | Width -in | Area -in ² | Perim. -in | I -in ⁴ | E -kp/i ² | Weight -kp/f | Mix* % | Out Side | In Side | Other Par. | Type |
|-----------|--------------|--------------------------|---------------|-----------------------|-------------------------|-----------------|-----------|-------------|------------|---------------|------------------|
| 0.0 | 30 | 706.9 | 94.2 | 0 | 3000 | 0.736 | 0.0 | 3 | 3 | 30 | Concrete (rough) |
| 59.0 | 30 | 706.9 | 94.2 | | | | | | | | Pile Tip |

Note: Mix = % of Inside material/Outside material

Group Type: 0
 Top Type: 1

Water Table: 36.5 -ft
 No Elevation Input

* Soil Properties *

| Zs -ft | Gamma -lb/f ³ | Phi o | C -kp/f ² | K -lb/i ³ | E50/Dr - % | Nspt | Type | Soil |
|-----------|-----------------------------|----------|-------------------------|-------------------------|---------------|------|------|----------------|
| 0.0 | 126.6 | 15 | 0.33 | 222.9 | 1.00 | 8 | 1 | Soft Clay |
| 5.0 | 128.7 | 30 | 0.2 | 290.1 | 0.90 | 10 | 3 | Silt (Phi + C) |
| 10.0 | 125.5 | 20 | 0.46 | 166.5 | 1.11 | 7 | 1 | Soft Clay |
| 16.0 | 132.0 | 32 | 0.26 | 584.7 | 0.67 | 16 | 3 | Silt (Phi + C) |
| 17.5 | 130.8 | 20 | 0.53 | 407.0 | 0.78 | 12 | 1 | Soft Clay |
| 36.5 | 66.9 | 32 | 0.26 | 317.7 | 0.87 | 10 | 3 | Silt (Phi + C) |
| 40.0 | 63.8 | 20 | 0.53 | 214.1 | 1.01 | 8 | 1 | Soft Clay |
| 45.5 | 75.6 | 31 | 0.15 | 97.1 | 1.01 | 31 | 4 | Sand/Gravel |
| 54.5 | 63.8 | 1 | 0.01 | 97.1 | 1.01 | 8 | 4 | Sand/Gravel |
| 57.0 | 63.6 | 15.0 | 0.53 | 214.1 | 1.01 | 8 | 1 | Soft Clay |

Surcharge Pressure on ground: 0 -kp/f²

* Zero Tip Resistance *

The tip resistance is zero

* Zero Friction *

Zero Friction Start: 0 -ft End: 7.0 -ft
 Zero Friction Start: 36 -ft End: 38 -ft

* Negative Friction *

Negative Friction Start: 48 -ft End: 50 -ft with Factor: 0

ALLPILE ANALYSIS AND RESULTS:

TOTAL LOADS:

Vertical Load, Q: 200.0 -kp
Vertical Load with Load Factor, Q: 200.0 -kp
Vertical Load with Load factor and Pile Cap, Q= 200.0 -kp
Load Factor for Vertical Load and Torsion= 1.0
Vertical Loads Supported by Pile Cap: 0 %
Load Factor for Vertical Loads: 1.0

PILE PROFILE:

Pile Length, L= 59.0 -ft
Top Height, H= 0.0 -ft
Slope Angle, As= 0
Batter Angle, Ab= 0.00 Batter Factor, Kbat= 1.00

*To consider the influence of different soils below the pile tip, bearing stratum is defined from pile tip extending to 4 Diameter of pile, which is 10.0-ft (Input Page F, Item 3)

SINGLE PILE:

Kdown= 0.5 Kup= 0.4 Ka= 1.00

Single Pile Vertical Analysis:

Total Ultimate Capacity (Down)= 340.903-kp Total Ultimate Capacity (Up)= 376.343-kp
Total Allowable Capacity (Down)= 340.903-kp Total Allowable Capacity (Up)= 376.343-kp

Weight above Ground= 0.00 Total Weight= 36.54-kp *Soil Weight is not included
Side Resistance (Down)= 340.903-kp Side Resistance (Up)= 339.800-kp
Tip Resistance (Down)= 0.000-kp Tip Resistance (Up)= 0.000-kp
Negative Friction, Qneg= 0.000-kp, which has been subtracted from Total Ultimate Capacity (Down)
Negative friction does not affect Total Ultimate Capacity (Up)

At Work Load= 200.00-kp, Settlement= 0.07879-in
At Work Load= 200.00-kp, Secant Stiffness Kqx= 2538.53-kp/-in
At Allowable Settlement= 0.400000-in, Capacity= 339.26-kp
Work Load, 200.00-kp, OK with the Capacity at Allowable Settlement= 0.40000-in, Capacity= 339.26-kp
Work Load, 200.00-kp, OK with the Allowable Capacity (Down)= 340.90-kp

FACTOR OF SAFETY:

| FSSide | FStip | FSuplif | FSweight |
|--------|-------|---------|----------|
| 1.0 | 1.0 | 1.0 | 1.0 |

Note: If the program cannot find a result or the result exceeds the upper limit. The result will be displayed as 99999.
1 1 1 1 1

Note:

Due to the limitations of the program for the number of soil layers, we used the negative friction option to simulate some of the liquefaction layers. This option eliminates the pile resistance downward but not upward. We subtracted the upward resistance manually using the output data from the detailed report.

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Title 1: 17-0822-Russel Hall Replacement
 Title 2: Deep Foundation Calculation

ALLPILE INPUT DATA:

* Pile Type Page *

Unit: English
 Diameter more than 24in (61cm). For bell section, select "Belled" in Diameter Variation (Pile Section Screen, Item 4). Recommendation: 2 to 4
 in Item 3 of Page F.
 Pile Type: Drilled Shaft (dia >24 in. or 61 cm)

* Pile Profile *

Foundation Depth: 65.0 -ft
 Top Height: 0.0 -ft
 Slope Angle: 0
 Pile Angle: 0.0

* Pile Properties *

| Zs -ft | Width -in | Area -in ² | Perim. -in | I -in ⁴ | E -kp/i ² | Weight -kp/f | Mix* % | Out Side | In Side | Other Par. | Type |
|-----------|--------------|--------------------------|---------------|-----------------------|-------------------------|-----------------|-----------|-------------|------------|---------------|------------------|
| 0.0 | 30 | 706.9 | 94.2 | 0 | 3000 | 0.736 | 0.0 | 3 | 3 | 30 | Concrete (rough) |
| 65.0 | 30 | 706.9 | 94.2 | | | | | | | | Pile Tip |

Note: Mix = % of Inside material/Outside material

Group Type: 0
 Top Type: 1

Water Table: 36.5 -ft
 No Elevation Input

* Soil Properties *

| Zs -ft | Gamma -lb/f ³ | Phi o | C -kp/f ² | K -lb/i ³ | E50/Dr - % | Nspt | Type | Soil |
|-----------|-----------------------------|----------|-------------------------|-------------------------|---------------|------|------|----------------|
| 0.0 | 126.6 | 15 | 0.33 | 222.9 | 1.00 | 8 | 1 | Soft Clay |
| 5.0 | 128.7 | 30 | 0.2 | 290.1 | 0.90 | 10 | 3 | Silt (Phi + C) |
| 10.0 | 125.5 | 20 | 0.46 | 166.5 | 1.11 | 7 | 1 | Soft Clay |
| 16.0 | 132.0 | 32 | 0.26 | 584.7 | 0.67 | 16 | 3 | Silt (Phi + C) |
| 17.5 | 130.8 | 20 | 0.53 | 407.0 | 0.78 | 12 | 1 | Soft Clay |
| 36.5 | 66.9 | 32 | 0.26 | 317.7 | 0.87 | 10 | 3 | Silt (Phi + C) |
| 40.0 | 63.8 | 20 | 0.53 | 214.1 | 1.01 | 8 | 1 | Soft Clay |
| 45.5 | 75.6 | 31 | 0.15 | 97.1 | 1.01 | 31 | 4 | Sand/Gravel |
| 54.5 | 63.8 | 1 | 0.01 | 97.1 | 1.01 | 8 | 4 | Sand/Gravel |
| 57.0 | 63.6 | 15.0 | 0.53 | 214.1 | 1.01 | 8 | 1 | Soft Clay |

Surcharge Pressure on ground: 0 -kp/f²

* Zero Tip Resistance *

The tip resistance is zero

* Zero Friction *

Zero Friction Start: 0 -ft End: 8.0 -ft
 Zero Friction Start: 36 -ft End: 38 -ft

* Negative Friction *

Negative Friction Start: 48 -ft End: 50 -ft with Factor: 0

ALLPILE ANALYSIS AND RESULTS:

TOTAL LOADS:

Vertical Load, Q: 220.0 -kp
Vertical Load with Load Factor, Q: 220.0 -kp
Vertical Load with Load factor and Pile Cap, Q= 220.0 -kp
Load Factor for Vertical Load and Torsion= 1.0
Vertical Loads Supported by Pile Cap: 0 %
Load Factor for Vertical Loads: 1.0

PILE PROFILE:

Pile Length, L= 65.0 -ft
Top Height, H= 0.0 -ft
Slope Angle, As= 0
Batter Angle, Ab= 0.00 Batter Factor, Kbat= 1.00

*To consider the influence of different soils below the pile tip, bearing stratum is defined from pile tip extending to 4 Diameter of pile, which is 10.0-ft (Input Page F, Item 3)

SINGLE PILE:

Kdown= 0.5 Kup= 0.4 Ka= 1.00

Single Pile Vertical Analysis:

Total Ultimate Capacity (Down)= 391.567-kp Total Ultimate Capacity (Up)= 425.172-kp
Total Allowable Capacity (Down)= 391.567-kp Total Allowable Capacity (Up)= 425.172-kp

Weight above Ground= 0.00 Total Weight= 39.14-kp *Soil Weight is not included
Side Resistance (Down)= 391.567-kp Side Resistance (Up)= 386.031-kp
Tip Resistance (Down)= 0.000-kp Tip Resistance (Up)= 0.000-kp
Negative Friction, Qneg= 0.000-kp, which has been subtracted from Total Ultimate Capacity (Down)
Negative friction does not affect Total Ultimate Capacity (Up)

At Work Load= 220.00-kp, Settlement= 0.08481-in
At Work Load= 220.00-kp, Secant Stiffness Kqx= 2594.12-kp/-in
At Allowable Settlement= 0.500000-in, Capacity= 381.99-kp
Work Load, 220.00-kp, OK with the Capacity at Allowable Settlement= 0.50000-in, Capacity= 381.99-kp
Work Load, 220.00-kp, OK with the Allowable Capacity (Down)= 391.57-kp

FACTOR OF SAFETY:

| FSSide | FStip | FSuplif | FSweight |
|--------|-------|---------|----------|
| 1.0 | 1.0 | 1.0 | 1.0 |

Note: If the program cannot find a result or the result exceeds the upper limit. The result will be displayed as 99999.

| | | | | |
|---|---|---|---|---|
| 1 | 1 | 1 | 1 | 1 |
|---|---|---|---|---|

Note:

Due to the limitations of the program for the number of soil layers, we used the negative friction option to simulate some of the liquefaction layers. This option eliminates the pile resistance downward but not upward. We subtracted the upward resistance manually using the output data from the detailed report.

Summary B-2 64+5 Rev

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Title 1: 17-0822-Russel Hall Replacement
 Title 2: Deep Foundation Calculation

ALLPILE INPUT DATA:

* Pile Type Page *

Unit: English
 Diameter more than 24in (61cm). For bell section, select "Belled" in Diameter Variation (Pile Section Screen, Item 4). Recommendation: 2 to 4
 in Item 3 of Page F.
 Pile Type: Drilled Shaft (dia >24 in. or 61 cm)

* Pile Profile *

Foundation Depth: 69.0 -ft
 Top Height: 0.0 -ft
 Slope Angle: 0
 Pile Angle: 0.0

* Pile Properties *

| Zs -ft | Width -in | Area -in ² | Perim. -in | I -in ⁴ | E -kp/i ² | Weight -kp/f | Mix* % | Out Side | In Side | Other Par. | Type |
|-----------|--------------|--------------------------|---------------|-----------------------|-------------------------|-----------------|-----------|-------------|------------|---------------|------------------|
| 0.0 | 30 | 706.9 | 94.2 | 0 | 3000 | 0.736 | 0.0 | 3 | 3 | 30 | Concrete (rough) |
| 69.0 | 30 | 706.9 | 94.2 | | | | | | | | Pile Tip |

Note: Mix = % of Inside material/Outside material

Group Type: 0
 Top Type: 1

Water Table: 36.5 -ft
 No Elevation Input

* Soil Properties *

| Zs -ft | Gamma -lb/f ³ | Phi o | C -kp/f ² | K -lb/i ³ | E50/Dr - % | Nspt | Type | Soil |
|-----------|-----------------------------|----------|-------------------------|-------------------------|---------------|------|------|----------------|
| 0.0 | 126.6 | 15 | 0.33 | 222.9 | 1.00 | 8 | 1 | Soft Clay |
| 5.0 | 128.7 | 30 | 0.2 | 290.1 | 0.90 | 10 | 3 | Silt (Phi + C) |
| 10.0 | 125.5 | 20 | 0.46 | 166.5 | 1.11 | 7 | 1 | Soft Clay |
| 16.0 | 132.0 | 32 | 0.26 | 584.7 | 0.67 | 16 | 3 | Silt (Phi + C) |
| 17.5 | 130.8 | 20 | 0.53 | 407.0 | 0.78 | 12 | 1 | Soft Clay |
| 36.5 | 66.9 | 32 | 0.26 | 317.7 | 0.87 | 10 | 3 | Silt (Phi + C) |
| 40.0 | 63.8 | 20 | 0.53 | 214.1 | 1.01 | 8 | 1 | Soft Clay |
| 45.5 | 75.6 | 31 | 0.15 | 97.1 | 1.01 | 31 | 4 | Sand/Gravel |
| 54.5 | 63.8 | 1 | 0.01 | 97.1 | 1.01 | 8 | 4 | Sand/Gravel |
| 57.0 | 63.6 | 15.0 | 0.53 | 214.1 | 1.01 | 8 | 1 | Soft Clay |

Surcharge Pressure on ground: 0 -kp/f²

* Zero Tip Resistance *

The tip resistance is zero

* Zero Friction *

Zero Friction Start: 0 -ft End: 8.5 -ft
 Zero Friction Start: 36 -ft End: 38 -ft

* Negative Friction *

Negative Friction Start: 48 -ft End: 50 -ft with Factor: 0
 Negative Friction Start: 66 -ft End: 68.5 -ft with Factor: 0

ALLPILE ANALYSIS AND RESULTS:

TOTAL LOADS:

Vertical Load, Q: 240.0 -kp
Vertical Load with Load Factor, Q: 240.0 -kp
Vertical Load with Load factor and Pile Cap, Q= 240.0 -kp
Load Factor for Vertical Load and Torsion= 1.0
Vertical Loads Supported by Pile Cap: 0 %
Load Factor for Vertical Loads: 1.0

PILE PROFILE:

Pile Length, L= 69.0 -ft
Top Height, H= 0.0 -ft
Slope Angle, As= 0
Batter Angle, Ab= 0.00 Batter Factor, Kbat= 1.00

*To consider the influence of different soils below the pile tip, bearing stratum is defined from pile tip extending to 4 Diameter of pile, which is 10.0-ft (Input Page F, Item 3)

SINGLE PILE:

Kdown= 0.5 Kup= 0.4 Ka= 1.00

Single Pile Vertical Analysis:

Total Ultimate Capacity (Down)= 403.040-kp Total Ultimate Capacity (Up)= 457.027-kp
Total Allowable Capacity (Down)= 403.040-kp Total Allowable Capacity (Up)= 457.027-kp

Weight above Ground= 0.00 Total Weight= 40.83-kp *Soil Weight is not included
Side Resistance (Down)= 403.040-kp Side Resistance (Up)= 416.197-kp
Tip Resistance (Down)= 0.000-kp Tip Resistance (Up)= 0.000-kp
Negative Friction, Qneg= 0.000-kp, which has been subtracted from Total Ultimate Capacity (Down)
Negative friction does not affect Total Ultimate Capacity (Up)

At Work Load= 240.00-kp, Settlement= 0.09423-in
At Work Load= 240.00-kp, Secant Stiffness Kqx= 2546.89-kp/-in
At Allowable Settlement= 0.500000-in, Capacity= 393.40-kp
Work Load, 240.00-kp, OK with the Capacity at Allowable Settlement= 0.50000-in, Capacity= 393.40-kp
Work Load, 240.00-kp, OK with the Allowable Capacity (Down)= 403.04-kp

FACTOR OF SAFETY:

| FSside | FStip | FSuplif | FSweight |
|--------|-------|---------|----------|
| 1.0 | 1.0 | 1.0 | 1.0 |

Note: If the program cannot find a result or the result exceeds the upper limit. The result will be displayed as 99999.

| | | | | |
|---|---|---|---|---|
| 1 | 1 | 1 | 1 | 1 |
|---|---|---|---|---|

Note:

Due to the limitations of the program for the number of soil layers, we used the negative friction option to simulate some of the liquefaction layers. This option eliminates the pile resistance downward but not upward. We subtracted the upward resistance manually using the output data from the detailed report.

Summary of CPT-2 49+5 Rev

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 Date: 12/28/2019 File: G:\Projects\2017\17-0822 Russell Hall Replacement Project Soils Investigation\Soils Folder\Soils
 Reports-Certificates\Mehrab Draft\Response to CGS-Pile\Per Jacques\CPT-2\December Analysis\Pile-CPT-2-30in-49ft+5ft-Rev 2 Dec
 2019-Seismic.alp

Title 1: 17-0822-Russel Hall Replacement
 Title 2: Deep Foundation Calculation

ALLPILE INPUT DATA:

* Pile Type Page *

Unit: English
 Diameter more than 24in (61cm). For bell section, select "Belled" in Diameter Variation (Pile Section Screen, Item 4). Recommendation: 2 to 4
 in Item 3 of Page F.
 Pile Type: Drilled Shaft (dia >24 in. or 61 cm)

* Pile Profile *

Foundation Depth: 54.0 -ft
 Top Height: 0.0 -ft
 Slope Angle: 0
 Pile Angle: 0.0

* Pile Properties *

| Zs -ft | Width -in | Area -in2 | Perim. -in | I -in4 | E -kp/i2 | Weight -kp/f | Mix* % | Out Side | In Side | Other Par. | Type |
|-----------|--------------|--------------|---------------|-----------|-------------|-----------------|-----------|-------------|------------|---------------|------------------|
| 0.0 | 30 | 706.9 | 94.2 | 0 | 3000 | 0.736 | 0.0 | 3 | 3 | 30 | Concrete (rough) |
| 54.0 | 30 | 706.9 | 94.2 | | | | | | | | Pile Tip |

Note: Mix = % of Inside material/Outside material

Group Type: 0
 Top Type: 1

Water Table: 36.5 -ft
 No Elevation Input

* Soil Properties *

| Zs -ft | Gamma -lb/f3 | Phi o | C -kp/f2 | K -lb/i3 | E50/Dr -% | Nspt | Type | Soil |
|-----------|-----------------|----------|-------------|-------------|--------------|------|------|----------------|
| 0.0 | 126.6 | 15 | 0.33 | 222.9 | 1.00 | 8 | 1 | Soft Clay |
| 5.0 | 128.7 | 30 | 0.2 | 290.1 | 0.90 | 10 | 3 | Silt (Phi + C) |
| 10.0 | 125.5 | 20 | 0.46 | 166.5 | 1.11 | 7 | 1 | Soft Clay |
| 16.0 | 127.1 | 32 | 0.26 | 584.7 | 0.67 | 16 | 3 | Silt (Phi + C) |
| 17.5 | 130.8 | 20 | 0.530 | 407.0 | 0.78 | 12 | 1 | Soft Clay |
| 36.5 | 66.9 | 32 | 0.26 | 317.7 | 0.87 | 10 | 3 | Silt (Phi + C) |
| 40.0 | 63.8 | 20 | 0.53 | 214.1 | 1.01 | 8 | 1 | Soft Clay |
| 48.0 | 66.8 | 1 | 0.01 | 97.1 | 1.01 | 8 | 4 | Sand/Gravel |
| 50.0 | 63.8 | 15 | 0.53 | 313.1 | 0.87 | 10 | 1 | Soft Clay |
| 54.5 | 66.8 | 1 | 0.01 | 97.1 | 1.01 | 8 | 4 | Sand/Gravel |

Surcharge Pressure on ground: 0 -kp/f2

* Zero Tip Resistance *
 The tip resistance is zero

* Zero Friction *
 Zero Friction Start: 0 -ft End: 6.5 -ft
 Zero Friction Start: 36 -ft End: 38 -ft

ALLPILE ANALYSIS AND RESULTS:

TOTAL LOADS:

Summary of CPT-2 49+5 Rev

Vertical Load, Q: 173.0 -kp
Vertical Load with Load Factor, Q: 173.0 -kp
Vertical Load with Load factor and Pile Cap, Q= 173.0 -kp
Load Factor for Vertical Load and Torsion= 1.0
Vertical Loads Supported by Pile Cap: 0 %
Load Factor for Vertical Loads: 1.0

PILE PROFILE:

Pile Length, L= 54.0 -ft
Top Height, H= 0.0 -ft
Slope Angle, As= 0
Batter Angle, Ab= 0.00 Batter Factor, Kbat= 1.00

*To consider the influence of different soils below the pile tip, bearing stratum is defined from pile tip extending to 4 Diameter of pile, which is 10.0-ft (Input Page F, Item 3)

SINGLE PILE:

Kdown= 0.5 Kup= 0.4 Ka= 1.00

Single Pile Vertical Analysis:

Total Ultimate Capacity (Down)= 320.597-kp Total Ultimate Capacity (Up)= 334.894-kp
Total Allowable Capacity (Down)= 320.597-kp Total Allowable Capacity (Up)= 334.894-kp

Weight above Ground= 0.00 Total Weight= 34.41-kp *Soil Weight is not included
Side Resistance (Down)= 320.597-kp Side Resistance (Up)= 300.487-kp
Tip Resistance (Down)= 0.000-kp Tip Resistance (Up)= 0.000-kp
Negative Friction, Qneg= 0.000-kp, which has been subtracted from Total Ultimate Capacity (Down)
Negative friction does not affect Total Ultimate Capacity (Up)

At Work Load= 173.00-kp, Settlement= 0.22942-in
At Work Load= 173.00-kp, Secant Stiffness Kqx= 754.08-kp/-in
At Allowable Settlement= 0.800000-in, Capacity= 314.09-kp
Work Load, 173.00-kp, OK with the Capacity at Allowable Settlement= 0.80000-in, Capacity= 314.09-kp
Work Load, 173.00-kp, OK with the Allowable Capacity (Down)= 320.60-kp

FACTOR OF SAFETY:

| FSSide | FStip | FSuplif | FSweight |
|--------|-------|---------|----------|
| 1.0 | 1.0 | 1.0 | 1.0 |

Note: If the program cannot find a result or the result exceeds the upper limit. The result will be displayed as 99999.

1 1 1 1 1

Note:

Due to the limitations of the program for the number of soil layers, we used the negative friction option to simulate some of the liquefaction layers. This option eliminates the pile resistance downward but not upward. We subtracted the upward resistance manually using the output data from the detailed report.

Summary of CPT-2 54+5

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 Reports-Certificates\Mehrab Draft\Response to CGS-Pile\Per Jacques\CPT-2\December Analysis\Pile-CPT-2-30in-54ft+5ft Rev Dec
 2019-Seismic.alp

Title 1: 17-0822-Russel Hall Replacement
 Title 2: Deep Foundation Calculation

ALLPILE INPUT DATA:

* Pile Type Page *

Unit: English
 Diameter more than 24in (61cm). For bell section, select "Belled" in Diameter Variation (Pile Section Screen, Item 4). Recommendation: 2 to 4
 in Item 3 of Page F.
 Pile Type: Drilled Shaft (dia >24 in. or 61 cm)

* Pile Profile *

Foundation Depth: 59.0 -ft
 Top Height: 0.0 -ft
 Slope Angle: 0
 Pile Angle: 0.0

* Pile Properties *

| Zs -ft | Width -in | Area -in2 | Perim. -in | I -in4 | E -kp/i2 | Weight -kp/f | Mix* % | Out Side | In Side | Other Par. | Type |
|-----------|--------------|--------------|---------------|-----------|-------------|-----------------|-----------|-------------|------------|---------------|------------------|
| 0.0 | 30 | 706.9 | 94.2 | 0 | 3000 | 0.736 | 0.0 | 3 | 3 | 30 | Concrete (rough) |
| 59.0 | 30 | 706.9 | 94.2 | | | | | | | | Pile Tip |

Note: Mix = % of Inside material/Outside material

Group Type: 0
 Top Type: 1

Water Table: 36.5 -ft
 No Elevation Input

* Soil Properties *

| Zs -ft | Gamma -lb/f3 | Phi o | C -kp/f2 | K -lb/i3 | E50/Dr -% | Nspt | Type | Soil |
|-----------|-----------------|----------|-------------|-------------|--------------|------|------|----------------|
| 0.0 | 126.6 | 15 | 0.33 | 222.9 | 1.00 | 8 | 1 | Soft Clay |
| 5.0 | 128.7 | 30 | 0.2 | 290.1 | 0.90 | 10 | 3 | Silt (Phi + C) |
| 10.0 | 125.5 | 20 | 0.46 | 166.5 | 1.11 | 7 | 1 | Soft Clay |
| 16.0 | 127.1 | 32 | 0.26 | 584.7 | 0.67 | 16 | 3 | Silt (Phi + C) |
| 17.5 | 130.8 | 20 | 0.53 | 407 | 0.78 | 12 | 1 | Soft Clay |
| 36.5 | 66.9 | 32 | 0.26 | 317.7 | 0.87 | 10 | 3 | Silt (Phi + C) |
| 40.0 | 63.8 | 20 | 0.53 | 214.1 | 1.01 | 8 | 1 | Soft Clay |
| 48.0 | 66.8 | 1 | .01 | 97.1 | 1.01 | 8 | 4 | Sand/Gravel |
| 50.0 | 63.8 | 15. | 0.53 | 214.1 | 0.87 | 10 | 1 | Soft Clay |
| 66.0 | 66.8 | 1.0 | 0.01 | 214.1 | 1.01 | 8 | 4 | Sand/Gravel |

Surcharge Pressure on ground: 0 -kp/f2

* Zero Tip Resistance *

The tip resistance is zero

* Zero Friction *

Zero Friction Start: 0 -ft End: 7 -ft
 Zero Friction Start: 36 -ft End: 38 -ft

* Negative Friction *

Negative Friction Start: 54.5 -ft End: 57 -ftwith Factor: 0

ALLPILE ANALYSIS AND RESULTS:

Summary of CPT-2 54+5

TOTAL LOADS:

Vertical Load, Q: 200.0 -kp
Vertical Load with Load Factor, Q: 200.0 -kp
Vertical Load with Load factor and Pile Cap, Q= 200.0 -kp
Load Factor for Vertical Load and Torsion= 1.0
Vertical Loads Supported by Pile Cap: 0 %
Load Factor for Vertical Loads: 1.0

PILE PROFILE:

Pile Length, L= 59.0 -ft
Top Height, H= 0.0 -ft
Slope Angle, As= 0
Batter Angle, Ab= 0.00 Batter Factor, Kbat= 1.00

*To consider the influence of different soils below the pile tip, bearing stratum is defined from pile tip extending to 4 Diameter of pile, which is 10.0-ft (Input Page F, Item 3)

SINGLE PILE:

Kdown= 0.5 Kup= 0.4 Ka= 1.00

Single Pile Vertical Analysis:

Total Ultimate Capacity (Down)= 340.539-kp Total Ultimate Capacity (Up)= 375.748-kp
Total Allowable Capacity (Down)= 340.539-kp Total Allowable Capacity (Up)= 375.748-kp

Weight above Ground= 0.00 Total Weight= 36.54-kp *Soil Weight is not included
Side Resistance (Down)= 340.539-kp Side Resistance (Up)= 339.206-kp
Tip Resistance (Down)= 0.000-kp Tip Resistance (Up)= 0.000-kp
Negative Friction, Qneg= 0.000-kp, which has been subtracted from Total Ultimate Capacity (Down)
Negative friction does not affect Total Ultimate Capacity (Up)

At Work Load= 200.00-kp, Settlement= 0.10183-in
At Work Load= 200.00-kp, Secant Stiffness Kqx= 1964.11-kp/-in
At Allowable Settlement= 0.600000-in, Capacity= 338.13-kp
Work Load, 200.00-kp, OK with the Capacity at Allowable Settlement= 0.600000-in, Capacity= 338.13-kp
Work Load, 200.00-kp, OK with the Allowable Capacity (Down)= 340.54-kp

FACTOR OF SAFETY:

| FSside | FStip | FSuplif | FSweight |
|--------|-------|---------|----------|
| 1.0 | 1.0 | 1.0 | 1.0 |

Note: If the program cannot find a result or the result exceeds the upper limit. The result will be displayed as 99999.

| | | | | |
|---|---|---|---|---|
| 1 | 1 | 1 | 1 | 1 |
|---|---|---|---|---|

Note:

Due to the limitations of the program for the number of soil layers, we used the negative friction option to simulate some of the liquefaction layers. This option eliminates the pile resistance downward but not upward. We subtracted the upward resistance manually using the output data from the detailed report.

Summary of CPT-2 60+5 Rev

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 Reports-Certificates\Mehrab Draft\Response to CGS-Pile\Per Jacques\CPT-2\December Analysis\Pile-CPT-2-30in-60ft+5ft Rev Dec
 2019-Seismic.alp 1.0

Title 1: 17-0822-Russel Hall Replacement
 Title 2: Deep Foundation Calculation

ALLPILE INPUT DATA:

* Pile Type Page *

Unit: English
 Diameter more than 24in (61cm). For bell section, select "Belled" in Diameter Variation (Pile Section Screen, Item 4). Recommendation: 2 to 4
 in Item 3 of Page F.
 Pile Type: Drilled Shaft (dia >24 in. or 61 cm)

* Pile Profile *

Foundation Depth: 65.0 -ft
 Top Height: 0.0 -ft
 Slope Angle: 0
 Pile Angle: 0.0

* Pile Properties *

| Zs -ft | Width -in | Area -in2 | Perim. -in | I -in4 | E -kp/i2 | Weight -kp/f | Mix* % | Out Side | In Side | Other Par. | Type |
|-----------|--------------|--------------|---------------|-----------|-------------|-----------------|-----------|-------------|------------|---------------|------------------|
| 0.0 | 30 | 706.9 | 94.2 | 0 | 3000 | 0.736 | 0.0 | 3 | 3 | 30 | Concrete (rough) |
| 65.0 | 30 | 706.9 | 94.2 | | | | | | | | Pile Tip |

Note: Mix = % of Inside material/Outside material

Group Type: 0
 Top Type: 1

Water Table: 36.5 -ft
 No Elevation Input

* Soil Properties *

| Zs -ft | Gamma -lb/f3 | Phi o | C -kp/f2 | K -lb/i3 | E50/Dr -% | Nspt | Type | Soil |
|-----------|-----------------|----------|-------------|-------------|--------------|------|------|----------------|
| 0.0 | 126.6 | 15 | 0.33 | 222.9 | 1.00 | 8 | 1 | Soft Clay |
| 5.0 | 128.7 | 30 | .2 | 290.1 | 0.90 | 10 | 3 | Silt (Phi + C) |
| 10.0 | 125.5 | 20 | .46 | 166.5 | 1.11 | 7 | 1 | Soft Clay |
| 16.0 | 127.1 | 32 | 0.26 | 584.7 | 0.67 | 8 | 3 | Silt (Phi + C) |
| 17.5 | 130.8 | 20 | 0.53 | 407 | 0.78 | 16 | 1 | Soft Clay |
| 36.5 | 66.9 | 32 | 0.26 | 317.7 | 0.87 | 12 | 3 | Silt (Phi + C) |
| 40.0 | 63.8 | 20 | 0.53 | 214.1 | 1.01 | 10 | 1 | Soft Clay |
| 48.0 | 66.8 | 1 | 0.01 | 97.1 | 1.01 | 8 | 4 | Sand/Gravel |
| 50.0 | 63.8 | 15 | 0.53 | 214.1 | 0.87 | 10 | 1 | Soft Clay |
| 66.0 | 66.8 | 1 | 0.01 | 214.1 | 1.01 | 8 | 4 | Sand/Gravel |

Surcharge Pressure on ground: 0 -kp/f2

* Zero Tip Resistance *
 The tip resistance is zero

* Zero Friction *
 Zero Friction Start: 0 -ft End: 6 -ft
 Zero Friction Start: 36 -ft End: 38 -ft

* Negative Friction *
 Negative Friction Start: 54.5 -ft End: 57 -ftwith Factor: 0

ALLPILE ANALYSIS AND RESULTS:

Summary of CPT-2 60+5 Rev

TOTAL LOADS:

Vertical Load, Q: 220.0 -kp
Vertical Load with Load Factor, Q: 220.0 -kp
Vertical Load with Load factor and Pile Cap, Q= 220.0 -kp
Load Factor for Vertical Load and Torsion= 1.0
Vertical Loads Supported by Pile Cap: 0 %
Load Factor for Vertical Loads: 1.0

PILE PROFILE:

Pile Length, L= 65.0 -ft
Top Height, H= 0.0 -ft
Slope Angle, As= 0
Batter Angle, Ab= 0.00 Batter Factor, Kbat= 1.00

*To consider the influence of different soils below the pile tip, bearing stratum is defined from pile tip extending to 4 Diameter of pile, which is 10.0-ft (Input Page F, Item 3)

SINGLE PILE:

Kdown= 0.5 Kup= 0.4 Ka= 1.00

Single Pile Vertical Analysis:

Total Ultimate Capacity (Down)= 397.379-kp Total Ultimate Capacity (Up)= 429.381-kp
Total Allowable Capacity (Down)= 397.379-kp Total Allowable Capacity (Up)= 429.381-kp

Weight above Ground= 0.00 Total Weight= 39.14-kp *Soil Weight is not included
Side Resistance (Down)= 397.379-kp Side Resistance (Up)= 390.240-kp
Tip Resistance (Down)= 0.000-kp Tip Resistance (Up)= 0.000-kp
Negative Friction, Qneg= 0.000-kp, which has been subtracted from Total Ultimate Capacity (Down)
Negative friction does not affect Total Ultimate Capacity (Up)

At Work Load= 220.00-kp, Settlement= 0.20003-in
At Work Load= 220.00-kp, Secant Stiffness Kqx= 1099.86-kp/-in
At Allowable Settlement= 0.600000-in, Capacity= 385.16-kp
Work Load, 220.00-kp, OK with the Capacity at Allowable Settlement= 0.60000-in, Capacity= 385.16-kp
Work Load, 220.00-kp, OK with the Allowable Capacity (Down)= 397.38-kp

FACTOR OF SAFETY:

| FSside | FStip | FSuplif | FSweight |
|--------|-------|---------|----------|
| 1.0 | 1.0 | 1.0 | 1.0 |

Note: If the program cannot find a result or the result exceeds the upper limit. The result will be displayed as 99999.

| | | | | |
|---|---|---|---|---|
| 1 | 1 | 1 | 1 | 1 |
|---|---|---|---|---|

Note:

Due to the limitations of the program for the number of soil layers, we used the negative friction option to simulate some of the liquefaction layers. This option eliminates the pile resistance downward but not upward. We subtracted the upward resistance manually using the output data from the detailed report.

Summary of CPT-2 60+5 -4.5' of free surface

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 Date: 12/29/2019 File: G:\Projects\2017\17-0822 Russell Hall Replacement Project Soils Investigation\Soils Folder\Soils
 Reports-Certificates\Mehrab Draft\Response to CGS-Pile\Per Jacques\CPT-2\December Analysis\Pile-CPT-2-30in-60ft+5ft -4.5 of free
 surfaceRev Dec 2019-Seismic.alp 1.0

Title 1: 17-0822-Russel Hall Replacement
 Title 2: Deep Foundation Calculation

ALLPILE INPUT DATA:

* Pile Type Page *

Unit: English
 Diameter more than 24in (61cm). For bell section, select "Belled" in Diameter Variation (Pile Section Screen, Item 4). Recommendation: 2 to 4
 in Item 3 of Page F.
 Pile Type: Drilled Shaft (dia >24 in. or 61 cm)

* Pile Profile *

Foundation Depth: 65.0 -ft
 Top Height: 0.0 -ft
 Slope Angle: 0
 Pile Angle: 0.0

* Pile Properties *

| Zs -ft | Width -in | Area -in2 | Perim. -in | I -in4 | E -kp/i2 | Weight -kp/f | Mix* % | Out Side | In Side | Other Par. | Type |
|-----------|--------------|--------------|---------------|-----------|-------------|-----------------|-----------|-------------|------------|---------------|------------------|
| 0.0 | 30 | 706.9 | 94.2 | 0 | 3000 | 0.736 | 0.0 | 3 | 3 | 30 | Concrete (rough) |
| 65.0 | 30 | 706.9 | 94.2 | | | | | | | | Pile Tip |

Note: Mix = % of Inside material/Outside material

Group Type: 0
 Top Type: 1

Water Table: 36.5 -ft
 No Elevation Input

* Soil Properties *

| Zs -ft | Gamma -lb/f3 | Phi o | C -kp/f2 | K -lb/i3 | E50/Dr -% | Nspt | Type | Soil |
|-----------|-----------------|----------|-------------|-------------|--------------|------|------|----------------|
| 0.0 | 126.6 | 15 | 0.33 | 222.9 | 1.00 | 8 | 1 | Soft Clay |
| 5.0 | 128.7 | 30 | .2 | 290.1 | 0.90 | 10 | 3 | Silt (Phi + C) |
| 10.0 | 125.5 | 20 | .46 | 166.5 | 1.11 | 7 | 1 | Soft Clay |
| 16.0 | 127.1 | 32 | 0.26 | 584.7 | 0.67 | 8 | 3 | Silt (Phi + C) |
| 17.5 | 130.8 | 20 | 0.53 | 407 | 0.78 | 16 | 1 | Soft Clay |
| 36.5 | 66.9 | 32 | 0.26 | 317.7 | 0.87 | 12 | 3 | Silt (Phi + C) |
| 40.0 | 63.8 | 20 | 0.53 | 214.1 | 1.01 | 10 | 1 | Soft Clay |
| 48.0 | 66.8 | 1 | 0.01 | 97.1 | 1.01 | 8 | 4 | Sand/Gravel |
| 50.0 | 63.8 | 15 | 0.53 | 214.1 | 0.87 | 10 | 1 | Soft Clay |
| 66.0 | 66.8 | 1 | 0.01 | 214.1 | 1.01 | 8 | 4 | Sand/Gravel |

Surcharge Pressure on ground: 0 -kp/f2

* Zero Tip Resistance *
 The tip resistance is zero

* Zero Friction *
 Zero Friction Start: 0 -ft End: 4.5 -ft
 Zero Friction Start: 36 -ft End: 38 -ft

* Negative Friction *
 Negative Friction Start: 54.5 -ft End: 57 -ftwith Factor: 0

ALLPILE ANALYSIS AND RESULTS:

Summary of CPT-2 60+5 -4.5' of free surface

TOTAL LOADS:

Vertical Load, Q: 227.0 -kp
Vertical Load with Load Factor, Q: 227.0 -kp
Vertical Load with Load factor and Pile Cap, Q= 227.0 -kp
Load Factor for Vertical Load and Torsion= 1.0
Vertical Loads Supported by Pile Cap: 0 %
Load Factor for Vertical Loads: 1.0

PILE PROFILE:

Pile Length, L= 65.0 -ft
Top Height, H= 0.0 -ft
Slope Angle, As= 0
Batter Angle, Ab= 0.00 Batter Factor, Kbat= 1.00

*To consider the influence of different soils below the pile tip, bearing stratum is defined from pile tip extending to 4 Diameter of pile, which is 10.0-ft (Input Page F, Item 3)

SINGLE PILE:

Kdown= 0.5 Kup= 0.4 Ka= 1.00

Single Pile Vertical Analysis:

Total Ultimate Capacity (Down)= 401.923-kp Total Ultimate Capacity (Up)= 433.614-kp
Total Allowable Capacity (Down)= 401.923-kp Total Allowable Capacity (Up)= 433.614-kp

Weight above Ground= 0.00 Total Weight= 39.14-kp *Soil Weight is not included
Side Resistance (Down)= 401.923-kp Side Resistance (Up)= 394.472-kp
Tip Resistance (Down)= 0.000-kp Tip Resistance (Up)= 0.000-kp
Negative Friction, Qneg= 0.000-kp, which has been subtracted from Total Ultimate Capacity (Down)
Negative friction does not affect Total Ultimate Capacity (Up)

At Work Load= 227.00-kp, Settlement= 0.20733-in
At Work Load= 227.00-kp, Secant Stiffness Kqx= 1094.86-kp/-in
At Allowable Settlement= 0.600000-in, Capacity= 389.02-kp
Work Load, 227.00-kp, OK with the Capacity at Allowable Settlement= 0.600000-in, Capacity= 389.02-kp
Work Load, 227.00-kp, OK with the Allowable Capacity (Down)= 401.92-kp

FACTOR OF SAFETY:

| FSside | FStip | FSuplif | FSweight |
|--------|-------|---------|----------|
| 1.0 | 1.0 | 1.0 | 1.0 |

Note: If the program cannot find a result or the result exceeds the upper limit. The result will be displayed as 99999.

| | | | | |
|---|---|---|---|---|
| 1 | 1 | 1 | 1 | 1 |
|---|---|---|---|---|

Note:

Due to the limitations of the program for the number of soil layers, we used the negative friction option to simulate some of the liquefaction layers. This option eliminates the pile resistance downward but not upward. We subtracted the upward resistance manually using the output data from the detailed report.

Summary of CPT-2 64+5

ALLPILE 7
 VERTICAL ANALYSIS SUMMARY OUTPUT
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 Date: 12/30/2019 File: G:\Projects\2017\17-0822 Russell Hall Replacement Project Soils Investigation\Soils Folder\Soils Reports-Certificates\Mehrab Draft\Response to CGS-Pile\Per Jacques\CPT-2\December Analysis\Pile-CPT-2-30in-64ft+5ft Dec 2019-Seismic.alp 1.0

Title 1: 17-0822-Russel Hall Replacement
 Title 2: Deep Foundation Calculation

ALLPILE INPUT DATA:

* Pile Type Page *

Unit: English
 Diameter more than 24in (61cm). For bell section, select "Belled" in Diameter Variation (Pile Section Screen, Item 4). Recommendation: 2 to 4 in Item 3 of Page F.
 Pile Type: Drilled Shaft (dia >24 in. or 61 cm)

* Pile Profile *

Foundation Depth: 69.0 -ft
 Top Height: 0.0 -ft
 Slope Angle: 0
 Pile Angle: 0.0

* Pile Properties *

| Zs -ft | Width -in | Area -in2 | Perim. -in | I -in4 | E -kp/i2 | Weight -kp/f | Mix* % | Out Side | In Side | Other Par. | Type |
|-----------|--------------|--------------|---------------|-----------|-------------|-----------------|-----------|-------------|------------|---------------|------------------|
| 0.0 | 30 | 706.9 | 94.2 | 0 | 3000 | 0.736 | 0.0 | 3 | 3 | 30 | Concrete (rough) |
| 69.0 | 30 | 706.9 | 94.2 | | | | | | | | Pile Tip |

Note: Mix = % of Inside material/Outside material

Group Type: 0
 Top Type: 1

Water Table: 36.5 -ft
 No Elevation Input

* Soil Properties *

| Zs -ft | Gamma -lb/f3 | Phi o | C -kp/f2 | K -lb/i3 | E50/Dr -% | Nspt | Type | Soil |
|-----------|-----------------|----------|-------------|-------------|--------------|------|------|----------------|
| 0.0 | 126.6 | 15 | 0.33 | 222.9 | 1.00 | 8 | 1 | Soft Clay |
| 5.0 | 128.7 | 30 | .2 | 290.1 | 0.90 | 10 | 3 | Silt (Phi + C) |
| 10.0 | 125.5 | 20 | .46 | 166.5 | 1.11 | 7 | 1 | Soft Clay |
| 16.0 | 127.1 | 32 | 0.26 | 584.7 | 0.67 | 8 | 3 | Silt (Phi + C) |
| 17.5 | 130.8 | 20 | 0.53 | 407 | 0.78 | 16 | 1 | Soft Clay |
| 36.5 | 66.9 | 32 | 0.26 | 317.7 | 0.87 | 12 | 3 | Silt (Phi + C) |
| 40.0 | 63.8 | 20 | 0.53 | 214.1 | 1.01 | 10 | 1 | Soft Clay |
| 48.0 | 66.8 | 1 | 0.01 | 97.1 | 1.01 | 8 | 4 | Sand/Gravel |
| 50.0 | 63.8 | 15 | 0.53 | 214.1 | 0.87 | 10 | 1 | Soft Clay |
| 71.0 | 63.6 | 15 | 0.53 | 214.1 | 0.87 | 10 | 1 | Soft Clay |

Surcharge Pressure on ground: 0 -kp/f2

* Zero Tip Resistance *
 The tip resistance is zero

* Zero Friction *
 Zero Friction Start: 0 -ft End: 8.5 -ft
 Zero Friction Start: 36 -ft End: 38 -ft

* Negative Friction *
 Negative Friction Start: 54.5 -ft End: 57 -ft with Factor: 0
 Negative Friction Start: 66 -ft End: 68.5 -ft with Factor: 0

ALLPILE ANALYSIS AND RESULTS:

TOTAL LOADS:

Vertical Load, Q: 240.0 -kp
 Vertical Load with Load Factor, Q: 240.0 -kp
 Vertical Load with Load factor and Pile Cap, Q= 240.0 -kp
 Load Factor for Vertical Load and Torsion= 1.0
 Vertical Loads Supported by Pile Cap: 0 %
 Load Factor for Vertical Loads: 1.0

PILE PROFILE:

Pile Length, L= 69.0 -ft
 Top Height, H= 0.0 -ft
 Slope Angle, As= 0
 Batter Angle, Ab= 0.00 Batter Factor, Kbat= 1.00

*To consider the influence of different soils below the pile tip, bearing stratum is defined from pile tip extending to 4 Diameter of pile, which is 10.0-ft (Input Page F, Item 3)

SINGLE PILE:

Kdown= 0.5 Kup= 0.4 Ka= 1.00

Single Pile Vertical Analysis:

Total Ultimate Capacity (Down)= 402.692-kp Total Ultimate Capacity (Up)= 455.803-kp
 Total Allowable Capacity (Down)= 402.692-kp Total Allowable Capacity (Up)= 455.803-kp

Weight above Ground= 0.00 Total Weight= 40.83-kp *Soil Weight is not included
 Side Resistance (Down)= 402.692-kp Side Resistance (Up)= 414.973-kp
 Tip Resistance (Down)= 0.000-kp Tip Resistance (Up)= 0.000-kp
 Negative Friction, Qneg= 0.000-kp, which has been subtracted from Total Ultimate Capacity (Down)
 Negative friction does not affect Total Ultimate Capacity (Up)

At Work Load= 240.00-kp, Settlement= 0.09187-in
 At Work Load= 240.00-kp, Secant Stiffness Kqx= 2612.38-kp/-in
 At Allowable Settlement= 0.400000-in, Capacity= 401.22-kp
 Work Load, 240.00-kp, OK with the Capacity at Allowable Settlement= 0.40000-in, Capacity= 401.22-kp
 Work Load, 240.00-kp, OK with the Allowable Capacity (Down)= 402.69-kp

FACTOR OF SAFETY:

| | | | |
|--------|-------|---------|----------|
| FSSide | FStip | FSuplif | FSweight |
| 1.0 | 1.0 | 1.0 | 1.0 |

Note: If the program cannot find a result or the result exceeds the upper limit. The result will be displayed as 99999.

| | | | | |
|---|---|---|---|---|
| 1 | 1 | 1 | 1 | 1 |
|---|---|---|---|---|

Note:

Due to the limitations of the program for the number of soil layers, we used the negative friction option to simulate some of the liquefaction layers. This option eliminates the pile resistance downward but not upward. We subtracted the upward resistance manually using the output data from the detailed report.