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Geotechnical Investigation Report

Proposed Del Rey Avenue Building
4112 Del Rey Avenue
Marina Del Rey, California

Prepared for:
La Terra Development, LLC
1880 Century Park East, Suite 1017
Los Angeles, California 90067

August 30, 2022
Project No.: 220205.1

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August 30, 2022
Project No.: 220205.1

Ms. Alice Anderson
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Subject: **Geotechnical Investigation Report**
Proposed Del Rey Avenue Building
4112 Del Rey Avenue
Marina Del Rey, California

Dear Ms. Anderson,

In accordance with your request and authorization, we are presenting the results of our geotechnical investigation for the proposed Del Rey Avenue Building project located at 4112 Del Rey Avenue in Marina Del Rey, California. The purpose of the study is to characterize subsurface conditions of the site, evaluate seismic and geologic hazards at the site, and provide geotechnical recommendations for the design and construction of the proposed improvement, including recommendations for foundations and earthwork.

This report was prepared in accordance with the requirements of the 2019 California Building Code (2019 CBC) and ASCE 7-16 (ASCE, 2017). Based on our findings, the proposed project is considered geotechnically feasible, provided that the recommendations in this report are incorporated into the design and are implemented during construction of the project.

We appreciate the opportunity to be of service on this project. Should you have any questions regarding this report or if we can be of further service, please do not hesitate to contact the undersigned.

Respectfully submitted,
TWINING CONSULTING, INC.

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1. INTRODUCTION

This report presents the results of the geotechnical investigation performed by Twining Consulting, Inc. (Twining) for the proposed Del Rey Avenue Building project located at 4112 Del Rey Avenue in Marina Del Rey, California (Figure 1 - Site Location Map). The purpose of the study is to characterize subsurface conditions of the site, evaluate seismic and geologic hazards at the site, and provide geotechnical recommendations for the design and construction of the proposed improvement, including recommendations for foundations and earthwork.

Our investigation was performed in conformance with the 2019 California Building Code (2019 CBC) and ASCE 7-16.

2. SITE DESCRIPTION AND PROPOSED DEVELOPMENT

The project site is located at 4112 Del Rey Avenue in Marina Del Rey, California on the Venice, California 7½-Minute Quadrangle, based on the United States Geological Survey (USGS) topographic map (USGS 2021). The approximate site coordinates are latitude 33.98832°N and longitude , 118.44391°W.

The site measures approximately 300 feet by 411 feet or approximately 123,300 square feet in plan dimensions. The site is currently occupied by a surface asphalt-paved parking lot and several one- to two-story-high commercial buildings. The site is relatively flat and gently descends to the southwest with a surface elevation varying from approximately 24 feet to 20 feet above mean sea level (msl).

Based on the project yield study plan, the proposed development will consist of demolition of the existing structures and construction of a 6-story new building. The lower five stories of the new building will consist of a five-level parking structure surrounded by residential units at each parking level. The sixth story of the building will consist of residential units, a clubhouse, a fitness room, and other community facilities. No subterranean levels are proposed. The maximum building height will be approximately 66 feet.

3. SCOPE OF SERVICES

Our scope of services included review of background information, field exploration and laboratory testing programs, engineering analyses and report preparation. These tasks are described in the following subsections.

3.1. Literature Review

We reviewed readily available background data including published geologic maps, topographic maps, seismic hazard maps and literature, and flood hazard maps relevant to the subject site. In particular, we reviewed field and laboratory data collected by Irvine Geotechnical, Inc (IGI) at the site in 2020. Relevant information has been incorporated into this report. The IGI data is presented in Appendix D of this report.

3.2. Field Exploration

Before starting our exploration program, we performed a geotechnical site reconnaissance to observe the general surficial conditions at the site and to select field exploration locations. After exploration locations were delineated, Underground Service Alert (USA) was notified of the planned locations a minimum of 72 hours prior to excavation. The approximate locations of the borings are shown on Figure 2 - Site Plan and Exploration Location Map.

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The field exploration consisted of drilling, testing, sampling, and logging of 7 exploratory borings (B-1 through B-5, P-1, and P-2) and performing 4 cone penetration tests (CPT-1 through CPT-4), as shown on Figure 2. The borings were drilled using 8-inch-diameter hollow-stem-auger (HSA) on a truck-mounted drill rig. Borings B-1 through B-5 were advanced to approximate depths of 26.5 to 51.5 feet below ground surface (bgs). Borings P-1 and P-2 were terminated at 5 feet bgs and converted to percolation test holes. The planned maximum depths for the CPTs were 60 feet bgs. The actual CPT depths ranged from 25 to 32 feet bgs due to CPT probe refusal before the planned termination depth. All exploration locations were first excavated to 5 feet bgs using a hand-auger to clear potential underground utilities and then switched to HSA drilling or CPT.

Drive samples of the soils were obtained using a Standard Penetration Test (SPT) sampler without room for liner and a modified California split spoon sampler. The samplers were driven using a 140-pound automatic hammer falling approximately 30 inches. The blow-counts to drive the samplers were recorded, and subsurface conditions encountered in the borings were logged by a Twining field engineer. Bulk samples were collected from the upper 5-foot soil cuttings. Soil samples obtained from the borings were transported to Twining Laboratories for examination and testing.

Upon completion of drilling or CPTs, the holes were backfilled with neat cement grout and patched with Portland cement concrete dyed black to match the surrounding pavement. Detailed descriptions of the field exploration and soils encountered during drilling are presented in Appendix A – Field Exploration.

3.3. Geotechnical Laboratory Testing

Laboratory tests were performed on selected samples obtained from the field exploration in order to aid in the soil classification and to evaluate the engineering properties of the site soils. The following tests were performed in general accordance with ASTM and Caltrans standards:

- In-situ moisture and density (ASTM D2937),
- #200 Wash (ASTM D1140),
- Atterberg Limits (ASTM D4318),
- Expansion Index (ASTM D4829),
- Consolidation (ASTM D2435),
- Direct shear (ASTM D3080),
- Maximum dry density and optimum moisture content (ASTM D1557),
- Resistance value (R-value) (ASTM D2844), and
- Corrosivity (Caltrans test methods 417, 422, and 643).

Detailed laboratory test procedures and results are presented in Appendix B – Laboratory Testing.

3.4. Engineering Analyses and Report Preparation

We compiled and analyzed the data collected from our field exploration and laboratory testing. We performed engineering analyses based on our literature review and data from field exploration and laboratory testing programs. Specifically, our analyses included the following:

- Evaluation of general subsurface conditions and description of types, distribution, and engineering characteristics of subsurface materials;
- Evaluation of geologic hazards and engineering seismology, including evaluation of fault rupture hazard, seismic shaking hazard, liquefaction and seismic settlement potential;
- Evaluation of current and historical groundwater conditions at the site and potential impact on design and construction;

- Evaluation of seismic design parameters in accordance with the 2019 California Building Code for use in structural design;
- Evaluation of the feasibility of using on-site soils for foundation and fill support;
- Evaluation of expansion potential and collapse potential of site soils;
- Recommendations for retaining walls;
- Development of general recommendations for earthwork, including site preparation and excavation, requirements for placement of compacted fill, and site drainage;
- Recommendations for feasible foundation systems, and provision of allowable bearing capacities, associated settlement estimates, and lateral pressures and resistances;
- Recommendations for below-grade walls, concrete slabs-on-grade, and pavement sections;
- Recommendations for stormwater infiltration systems;
- Recommendations for temporary excavations; and
- Recommendations for temporary shoring.

We prepared this report to present the services performed and data acquired and to summarize our conclusions and geotechnical recommendations developed from this investigation.

4. SITE GEOLOGY AND SUBSURFACE CONDITIONS

This section summarizes site geology, subsurface conditions, and groundwater conditions, based on the results of our data review and field and laboratory testing programs.

4.1. Site Geology

According to the geologic map of the Venice and Inglewood quadrangles compiled by Dibblee and Minch (2007), the site is underlain by Holocene-aged alluvial sediments (geologic map symbol Qa). The sediments are unconsolidated and undissected and consist of gravel, sand, and clay derived mostly from Santa Monica mountains and includes gravel and sand of minor stream channels. A portion of the geologic map is reproduced as Figure 3 - Geologic Map.

4.2. Subsurface Earth Materials

Our subsurface investigation confirmed that the site is underlain by alluvial soils to the maximum depths explored. The borings encountered a pavement section consisting of 3 to 4.5 inches of asphalt concrete over 2 to 6 inches of aggregate base materials.

Based on data from the borings and CPTs, earth materials below the pavement section consisted of approximately 2 to 7 feet of undocumented fill consisting of sandy lean clay and sandy silt underlain by native soils. In general, the native soils consisted of medium stiff to very stiff sandy lean clay and lean clay with sand bedded with medium dense silty sand in the upper 23 feet (approximately above elevation 0 feet msl) underlain by dense to very dense silty sand and poorly graded sand with silt to the maximum exploration depth at approximately 51.5 feet bgs.

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4.3. Groundwater

Groundwater was encountered at 17 to 23.7 feet bgs (or approximate elevations 0.3 to 4 feet msl) in the borings during our field exploration. Based on our review of the Seismic Hazard Zone report (California Department of Conservation, Division of Mines and Geology, 2006), the historically highest groundwater at the project site is approximately 6 feet bgs.

The depth to groundwater can fluctuate with the time of year. However, the groundwater table is likely controlled by the ocean located approximately 2,000 feet to the southwest of the site. For design, a depth of 6 feet to groundwater table may be used.

5. GEOLOGIC HAZARD AND SEISMIC DESIGN CONSIDERATIONS

The site is located in a seismically active area, as is the majority of southern California. The hazards associated with seismic activity in the vicinity of the site area discussed in the following sections.

5.1. Surface Fault Rupture

The site is not located within a State of California Earthquake Fault Zone (formerly known as a Special Studies Zone) (Hart and Bryant, 1997), based on our review of California Seismic Hazard Zones Map prepared by California Geologic Survey (CGS) and the Safety Element of the Los Angeles City General Plan. The closest known active faults to the site are the Santa Monica fault located approximately 3.2 miles to the north and the Newport-Inglewood fault located approximately 4.4 miles to the east. It is our opinion that the potential for surface fault rupture at the site during the life of the proposed project is low.

5.2. Historical Seismicity

The recorded history of earthquakes prior to the seismograph is sparse and inconsistent. The oldest seismographs (or recordable earthquake devices) originated in Italy in the mid-1800s. The modern seismograph was developed in Japan in 1880. Electromagnetic seismometers (calibrated seismographs) were developed between 1928 and 1930. Townley and Allen (1939) documented earthquakes along the Pacific Coast of the U.S. between 1769 and 1928. The systematic recording of large earthquakes in California began in 1932-1933 by the U.S. Coast and Geodetic Survey (Richter, 1958).

As part of this study, we searched and reviewed earthquake data from catalogs maintained by the USGS National Earthquake Information Center (http://neic.usgs.gov/). Based on our review, a total of 38 earthquakes of magnitude $M \geq 5.0$ having epicenters located within about 62 miles (100 km) of the site have occurred from the year 1900 through April 20, 2022.

The largest earthquakes near the site are the 6.3 Mw Long Beach Earthquake that occurred in 1933, the 6.6 Mw Sylmar Earthquake in 1971, and the 6.7 Mw Northridge Earthquake in 1994. The shortest distances from the site to the zone of energy release for these earthquakes are estimated to be 3.73, 5.53, and 11.31 miles, respectively. Based on strong motion recordings located throughout the Los Angeles basin, Stewart et al. (1994) estimated the peak ground acceleration (PGA) in the area of the project site between 0.2 and 0.3 g during the 1994 Northridge Earthquake.

5.3. Landslides

The site is not located within a landslide area mapped by the City of Los Angeles, nor is the site located within a Zone of Required Investigation for Earthquake-Induced Landslides designated by the State of California (Figure 4). Furthermore, the site is relatively flat, and the surrounding areas are fully

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developed and generally characterized by gently sloping topography that would not be susceptible to landslides. There are no known landslides adjacent to the site, and the site is not in the path of any known or potential landslides. It is our opinion that the risk is negligible of earthquake-induced landslides to affect the site.

5.4. Tsunamis, Seiches, and Flooding

Tsunamis are very large waves in the ocean caused by seismic events, landslides, or volcanic eruptions. The site has an elevation of 20 to 24 feet msl and is not located within a Tsunami Inundation Zone mapped by the California Geological Survey (2009) or the City of Los Angeles Safety Element. It is our opinion that the tsunami hazards are insignificant at the Site.

Seiches are large waves generated in enclosed bodies of water in response to ground shaking. No major water-retaining structures or land-locked bodies of water are located immediately up gradient from the site. Therefore, the seiche risk at the site is considered remote.

The Federal Emergency Management Agency (FEMA) has prepared floor insurance rate maps (FIRMs) for use in administering the National Flood Insurance Program. The site is not located within a FEMA flood hazard zone, nor is the site located within the 100-year or 500-year flood plains of the City of Los Angeles Safety Element. However, according to the City of Los Angeles Safety Element, the site is located within a potential inundation area from a specific flood control basin.

5.5. Subsidence

Subsidence can occur when oil and natural gas are extracted from geologic formations or groundwater withdrawn from unconsolidated aquifers. It is our opinion that the potential for subsidence is low, as discussed below.

There is no indication that groundwater withdrawal is currently taking place in areas adjacent to the site. SoCal Gas operates a natural gas storage field below Playa del Rey, about 1.5 miles south of the site. The storage field was originally an oil field that produced in the 1930s. Oil production lasted approximately 10 years. In 1942, the United States government began using the field for natural gas storage. In 1955, a predecessor of SoCal Gas purchased the field, and SoCal Gas has been operating it since 1955. The natural gas storage area is not located below the site. Natural gas is injected and withdrawn from 54 active wells operated by SoCal Gas.

Because the oil extraction stopped 80 years ago, Twining expects that subsidence from oil extraction is complete. SoCal Gas has been monitoring subsidence from the operation of the gas field since 2009. The monitoring has indicated that minor subsidence may occur with the operation of the field. However, the potential damage to surface structures from subsidence is low.

5.6. Liquefaction and Seismic Settlement

Liquefaction is the phenomenon in which loosely deposited granular soils with silt and clay contents of less than approximately 35 percent, and non-plastic silts located below the water table undergo rapid loss of shear strength when subjected to strong earthquake-induced ground shaking. Ground shaking of sufficient duration results in the loss of grain-to-grain contact due to a rapid rise in pore water pressure and causes the soil to behave as a fluid for a short period of time.

Liquefaction is generally known to occur in loose, saturated, relatively clean, fine-grained cohesionless soils at depths shallower than approximately 50 feet. Factors to consider in the evaluation of soil liquefaction potential include groundwater conditions, soil type, grain size distribution, relative density, degree of saturation, and both the intensity and duration of ground motion. Other phenomena

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associated with soil liquefaction include sand boils, ground oscillation, and loss of foundation bearing capacity.

5.6.1. Liquefaction Analysis

The site is located within a liquefiable area mapped by the City of Los Angeles and also within a state-designated Zone of Required Investigation for Liquefaction, according to California Seismic Hazard Zones Map (Figure 4). We performed liquefaction analysis using the NCEER (1998) method and data collected from our CPTs advanced to depths of 25 to 32 feet bgs. We also evaluated liquefaction potential using data from our borings B-1 through B-5 (presented in Appendix A) and IGI borings B1 through B5 (presented in Appendix D). The boring-data-based analysis was performed using the computer program LiqSVs version 2.0 (Geologismiki, 2019), and the CPT-data-based analysis was performed using the computer program CLiq version 3.0 (Geologismiki, 2006).

According to the liquefaction analysis guidelines of the City of Los Angeles, two sets of liquefaction analysis were performed. Ground motion and groundwater parameters used in the two sets of analysis (I and II) are summarized in Table 1. Additional analysis parameters and detailed analysis results are provided in Appendix C of this report. The analysis results indicate that liquefaction is likely to occur at the site in soil layers between 6 and 13 feet bgs and between 17 and 23 feet bgs.

The layers at 45 and 50 feet bgs in our boring B-2 are considered to have negligible liquefaction potential, because the seemingly low SPT resistance was a result of soil heaving during our HSA drilling and the samples are deemed not representative of the undisturbed material at this depth. The immediately adjacent IGI boring B2 confirms the negligible liquefaction potential of these layers.

Our boring B-4 and IGI boring B3 are immediately next to each other at the southern corner of the site. Both borings indicate potentially liquefiable soils at 32.5 to 35 feet bgs. These liquefiable soils are likely just within a small local zone and not horizontally continuous, because no other borings indicate liquefiable soils at similar depths.

Table 1 - Ground Motion and Groundwater Table used in Liquefaction Analyses

Analysis and Parameters	Peak Ground Acceleration (See Section 5.10)	Modal Earthquake Magnitude (See Section 5.8)	Depth to Groundwater Table during Earthquake (See Section 4.3)
I	0.583 g (2/3 PGA_M)	6.35 Mw (475-year return period)	6
II	0.874 g (full PGA_M)	7.31 Mw (2475-year return period)	6

5.6.2. Seismic Settlement

Seismic settlement can occur when loose to medium dense granular materials densify during seismic shaking and liquefaction. Seismic settlement may occur in dry, unsaturated, as well as saturated soils. Seismic settlement was calculated for each layer where the factor of safety against liquefaction is less than 1.1 (in analysis I) and 1.0 (in analysis II), in accordance with the City of Los Angeles guidelines. Seismic settlement is also calculated for the soil layers above the groundwater table due to seismic compression. A summary of the analysis results is provided in Table 2.

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We note that the majority of the potential seismic settlement would occur between 6 and 13 feet bgs of the soil profile. The analysis indicates approximately 0.6 inches or less settlement occurring below 13 feet bgs. For foundation type selection based on the guidelines of the City of Los Angeles, we recommend a total seismic settlement of 1.2 inches when considering Analysis I, and 2.0 inches when considering Analysis II. Considering the horizontal distances among the exploration locations, we estimated a differential seismic settlement up to 1 inch over a horizontal distance of 30 feet for both Analyses I and II. We note that the majority of the settlement will occur in the upper 23 feet of the soil profile. The significance of the estimated seismic settlements is discussed in Section 6.1.

Table 2 – Results of Seismic Settlement Analysis

Location	Approximate Maximum Exploration Depth (ft)	Seismic Settlement (inches) (Settlement above groundwater / liquefaction settlement / total seismic settlement)	
		Analysis I	Analysis II
CPT-1	28	0.04 / 1.15 / 1.19	0.5 / 1.50 / 2.0
CPT-2	32	0 / 1.6 / 1.6	0.0 / 1.73 / 1.73
CPT-3	28	0.01 / 0.78 / 0.79	0.09 / 1.02 / 1.11
CPT-4	25	0.01 / 0.97 / 0.98	0.07 / 1.33 / 1.4
B-1	26.5	0 / 0.60 / 0.60	0 / 1.1 / 1.1
B-2	51.5	0 / 0 / 0	0 / 0 / 0
B-3	31.5	0 / 0 / 0	0 / 0 / 0
B-4	51.5	0 / 1.35 / 1.35	0 / 1.35 / 1.35
B-5	31.5	0 / 1.46 / 1.46	0 / 1.46 / 1.46
IGI B1	50	0 / 1.45 / 1.45	0 / 1.84 / 1.84
IGI B2	50	0 / 0.22 / 0.22	0 / 0.58 / 0.58
IGI B3	60	0 / 1.69 / 1.69	0 / 1.85 / 1.85
IGI B4	40	0 / 1.68 / 1.68	0 / 1.68 / 1.68
IGI B5	20	0 / 0 / 0	0 / 0.83 / 0.83

5.7. Lateral Spreading and Other Liquefaction Effects

Lateral spreading is horizontal/lateral ground movement of relatively flat-lying soil deposits towards a free face such as an excavation, channel, or open body of water. Typically, lateral spreading is associated with liquefaction of one or more subsurface layers near the bottom of exposed slope. Based on the relatively flat nature of the site, the potential for lateral spreading at the site is considered negligible.

During the Northridge Earthquake, relative minor ground failures occurred in Marina del Rey areas (Stewart et al. 1994). Pipe breaks were not reported in the immediate vicinity of the project site, and the closest observed pipe breaks occurred at the corner of Lincoln Boulevard and Washington Boulevard in Marina del Rey (Stewart et al. 1994). Sand boils, sand fissures, and lateral spreads occurred at several beach areas in Marina del Rey, but generally was notably absent from the project site and other inland areas (Stewart et al. 1994). However, as discussed earlier, the area experienced relatively moderate shaking levels on the order of 0.2 to 0.3 g, during the Northridge Earthquake (Stewart et al. 1994). The PGA_M at the project site is much higher, approximately 0.874 g.

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Due to the relatively high ground shaking levels at the site during design earthquake events, the potential is considered moderate for liquefaction surface manifestation to affect the project. Considering the relatively shallow liquefiable soil layers and the expected relatively high foundation bearing pressure due to the relatively tall building, the potential is considered moderate for loss of foundation bearing capacity due to liquefaction-induced soil strength loss of underlying liquefiable soil layers. Such adverse potentials may be mitigated using ground improvement or deep foundations considering liquefaction-induced down-drag.

5.8. Deaggregated Seismic Source Parameters

We performed a seismic hazard de-aggregation analysis for the peak ground acceleration. The analysis used the USGS Unified Hazard Tool based on the 2014 USGS seismic source model. For PGA with a probability of exceedance of 2% in 50 years, the results of the analysis indicate the controlling modal moment magnitude and fault distance are 7.31 Mw and 5.78 miles (i.e., 9.31 kilometers), respectively. For PGA with a probability of exceedance of 10% in 50 years (475-year return period), the results of the analysis indicate the controlling modal moment magnitude and fault distance are 6.35 Mw and 4.81 miles (i.e., 7.74 kilometers), respectively.

5.9. Site Class for Seismic Design

Based on subsurface conditions encountered during our field exploration and assuming a ground improvement program will be implemented for the project, Site Class D may be used for the project seismic design according to Chapter 20 of ASCE 7-16.

5.10. Ground Shaking and CBC Seismic Design Parameters

As with all of Southern California, it is likely that moderate to strong earthquakes will occur on a local or regional fault, and the site will subject to potential strong ground motions during the life of the project. Design of the proposed development in accordance with the provisions of the current California Building Code will mitigate the potential effects of strong ground shaking.

As the site with ground improvement is classified as seismic Site Class D and the mapped spectral acceleration parameter at period 1-second, S_1, is greater than 0.2 g, the 2019 CBC requires a site-specific ground motion hazard analysis following Section 11.4.7 of ASCE 7-16 for new buildings.

Alternatively, Exception 2 in Section 11.4.8 of ASCE 7-16 may be used for the project new buildings in lieu of the site-specific ground motion hazard analysis. For seismic design of new buildings based on this exception, parameters in Table 3 may be used for the project seismic design.

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Table 3 – 2019 California Building Code Seismic Design Parameters for Design Based on Exception 2 in Section 11.4.8 of ASCE 7-16

Design Parameters	Value
Site Class	D
Mapped Spectral Acceleration Parameter at Period of 0.2-Second, S_s (g)	1.863
Mapped Spectral Acceleration Parameter at Period 1-Second, S_1 (g)	0.660
Site Coefficient, F_a	1
Site Coefficient, F_v	1.7
Adjusted MCE_R[1] Spectral Response Acceleration Parameter, S_{MS} (g)	1.863
Adjusted MCE_R[1] Spectral Response Acceleration Parameter, S_{M1} (g)	1.122
Design Spectral Response Acceleration Parameter, S_{DS} (g)	1.242
Design Spectral Response Acceleration Parameter, S_{D1} (g)	0.748
Risk Coefficient, C_{RS}	0.911
Risk Coefficient, C_{R1}	0.904
Peak Ground Acceleration PGA_M (g)[2]	0.874
Seismic Design Category	D
Long-Period Transition Period, T_L (seconds)	8
$T_s = S_{D1} / S_{DS}$, (seconds)	0.602

When using the above parameters for seismic design, the seismic design coefficient C_s should be calculated as follows:

For $T \leq 1.5T_s$, $C_s = S_{DS}/(R/I_e)$

For $T_L \geq T > 1.5T_s$, $C_s = 1.5\ S_{D1}/(T\ R/I_e)$

For $T > T_L$, $C_s = 1.5\ (S_{D1}\ T_L)/(T^2\ R/I_e)$

where:
T = the fundamental period of the structure(s) determined in Section 12.8.2 of ASCE 7-16;
R = the response modification factor determined in Table 12.2-1 of ASCE 7-16; and
I_e = the importance factor determined in accordance with Section 11.5.1 of ASCE 7-16.

Notes:
[1] Risk-Targeted Maximum Considered Earthquake.
[2] PGA_M is PGA adjusted for site effects for liquefaction analysis.
[3] For S_1 greater than or equal to 0.75 g, the Seismic Design Category is E for risk category I, II, and III structures and F for risk category IV structures.

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6. GEOTECHNICAL ENGINEERING RECOMMENDATIONS

Geotechnical engineering recommendations presented in this report for the proposed project are based on our understanding of the proposed development, subsurface conditions encountered during our field exploration, the results of laboratory testing on soil samples taken from the site, and our engineering analyses.

The following sections present our conclusions and recommendations pertaining to the engineering design for this project. If the design substantially changes, then our geotechnical engineering recommendations would be subject to revision based on our evaluation of the changes.

6.1. General Considerations

Geotechnical engineering recommendations presented in this report are based on our understanding of the proposed development, seismic and geohazards identified in this study, our evaluation of subsurface conditions encountered during our field exploration, and our engineering analyses.

Key geotechnical considerations for the project include:

(1) Undocumented fill up to 7 feet was observed in the borings and is required to be removed and replaced as engineering fill in accordance with City of Los Angeles requirements - undocumented fill could be more or less in other areas where borings were not performed;
(2) Groundwater was encountered at 17 feet bgs or deeper feet (approximately 0.3 to 4 feet msl), and the historic high groundwater is approximately 6 feet bgs;
(3) The presence of compressible soil layers consisting of sandy lean clay in the upper 20 feet of the soil profile;
(4) Strong earthquake ground motion at the site and the presence of potentially liquefiable soil layers between 6 and 13 feet bgs and between 18 and 23 feet bgs;
(5) Up to 2 inches of total seismic settlement, the majority of which from the upper 13 feet of the soil profile;
(6) We recommend that ground improvement be performed at the site based on the moderate potential for liquefaction surface manifestation and for loss of foundation bearing capacity due to liquefaction-induced soil strength loss of underlying liquefiable soil layers;
(7) As an alternative to ground improvement, two levels of subterranean structure can be implemented so that potentially liquefiable soils are removed to a depth of at least 23 feet; and
(8) For conventional spread footing and continuous footings, the City of Los Angeles limits the total allowable combined settlement (seismic plus static) to 1½ inches and the total allowable combined differential settlement (seismic plus static) to ¾ inches. For mat foundations, the City of Los Angeles limits the total allowable combined settlement (seismic plus static) to 4 inches and the total allowable combined differential settlement (seismic plus static) to 2 inches. These settlements should be based on Analysis I, using 2/3 PGA_M and the corresponding earthquake magnitude.

The following sections present our conclusions and recommendations pertaining to the design for this project. If the proposed development substantially changes, then our geotechnical engineering recommendations would be subject to revision based on our evaluation of the changes.

6.2. Ground Improvement

Based on the results of our analyses of potential for liquefaction-induced settlement and loss of soil bearing strength due to the presence of relatively shallow liquefiable soils, ground improvement at the project site will be required if the building is constructed at- or near-grade. One option for ground improvement is installation of vibratory stone columns or equivalent. The ground improvement will mitigate liquefaction, reduce seismic and static settlement, and improve the undocumented fill by densifying the fill soils. The ground improvement will thus increase bearing capacity, reduce footing

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size and settlements, avoid deep over-excavation, and allow for use of shallow foundations for support of proposed development.

It is expected that the ground improvement will extend to approximately 23 feet bgs to limit the total allowable combined settlement (seismic plus static) to 1½ inches (e.g., ¾ inches of seismic settlement and ¾ inches of total static settlement, or ½ inches of seismic settlement and 1 inch of total static settlement, or other combinations). The differential settlement is expected to be ½ of the total settlement over a 30-foot span. The ground improvement is expected provide an allowable footing bearing capacity up to 5,000 pounds per square foot (psf), an allowable coefficient of friction of 0.35 against sliding at the bottom of footing, and an allowable passive resistance of 300 psf per foot of depth up to 4,500 psf.

The ground improvement should be designed and performed on a design-build basis by an experienced contractor. The design and installation of the ground improvement system should conform to the requirements of the 2019 CBC Section 1813. In general, the ground improvement should be installed under the entire building footprint and not under isolated foundation elements only. There should be a minimum of four stone columns under each isolated or continuous/combined footing or equivalent. The stone columns should not be less than 2 feet in diameter, and center-to-center spacing should not exceed 8 feet. Lateral extent beyond the foundation should be half the depth of the stone columns with a minimum of 10 feet. The effectiveness of the ground improvement should be verified by testing methods such as CPT and/or SPT.

The design should prescribe a minimum area replacement ratio, lift thickness, improvement depth, and vibrator or hammer energy. The design should also include clear and complete definition of the verification testing plan and acceptance criteria for satisfaction of the performance objectives of the ground improvement. The contractor's design package, plans, and specifications should be reviewed by the geotechnical engineer to ensure the design conforms to the soil conditions provided in this report.

6.3. Site Preparation and Earthwork

In general, earthwork should be performed in accordance with the recommendations presented in this report. Twining should be contacted for questions regarding the recommendations or guidelines presented herein.

6.3.1. Site Preparation

Site preparation should begin with the removal of utility lines, asphalt, concrete, vegetation, and other deleterious debris from areas to be graded. Tree stumps and roots should be removed to such a depth that organic material is generally not present. Clearing and grubbing should extend to the outside edges of the proposed excavation and fill areas. We recommend that unsuitable materials such as organic matter or oversized material be selectively removed and disposed offsite. The debris and unsuitable material generated during clearing and grubbing should be removed from areas to be graded and disposed at a legal dump site away from the project area.

6.3.2. Excavation and Subgrade Preparation

The proposed building may be supported by conventional shallow footings placed on improved ground recommended in Section 6.2. The recommendations for depth of removal and re-compaction below the footings and/or slab-on-grade, if needed, are referred to and should be provided by the ground improvement design-build contractor. Based on our experience, following ground improvement, excess materials are expected and should be removed. The contractor may require a minimum of the top 12 to 24 inches of materials be excavated and backfilled with engineering fill.

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For minor structures and slabs-on-grade that are structurally separated from the building, the excavation should extend at least 2 feet below the finished grade or at least 2 feet below the bottom of the foundation of the minor structures and slabs-on-grade, whichever is greater. Excavation for pavements and hardscape should be over-excavated at least 1 foot as measured from the bottom of the pavement or hardscape section.

Laterally, foundation excavation should extend beyond the foundation limits a minimum distance equal to 3 feet or the depth of over-excavation, whichever is greater. Excavation for other improvements (e.g., concrete walkways, flatwork, pavement) should extend laterally at least 2 feet beyond the limits of the improvements.

The exposed excavation bottom should be evaluated and approved by the geotechnical engineer. It should then be scarified to a minimum depth of 8 inches and moisture conditioned to achieve generally consistent moisture contents within approximately 2 percent above the optimum moisture content. The scarified bottom should be compacted to at least 90 percent relative compaction in accordance with the latest version of ASTM Test Method D1557 and then evaluated and approved by the geotechnical engineer.

The extent and depths of all removal should be evaluated by the geotechnical engineer's representative in the field based on the materials exposed. Should excavations expose soft or soils considered as unsuitable for use as fill by the geotechnical engineer's representative, additional removals may be recommended. For example, deeper removal may be required in areas where soft, saturated, or organic materials are encountered.

Fill and backfill materials should be compacted fill in accordance with Sections 6.3.3 and 6.3.4 of this report. Prior to placement of any fill, the geotechnical engineer or their representative should review the bottom of the excavation for conformance with the recommendations of this report.

6.3.3. Materials for Fill

All fill soils should be evaluated and approved by the geotechnical engineer's representative prior to importing or filling. In general, on-site soils expected to be excavated consist of sandy lean clay with low expansion and are considered suitable for use as general fill other than foundation and slabs-on-grade (SOGs) backfill. Backfill materials for foundations and SOGs should have a very low expansion potential (i.e., expansion index of 20 or less). On-site soil proposed for use as foundation and SOGs fill should be reviewed by the geotechnical engineer to confirm the very-low-expansive nature of the soil prior to its use.

Any imported fill material should consist of granular soil having a "very low" expansion potential (i.e., expansion index of 20 or less). Import material should also have low corrosion potential (that is, chloride content less than 500 parts per million [ppm], soluble sulfate content of less than 0.1 percent, and pH of 5.5 or higher).

All fill soils should be free of organics, debris, rocks or lumps over three inches in largest dimension, other deleterious material, and not more than 40 percent larger than ¾ inch. Larger chunks, if generated during excavation, may be broken into acceptably sized pieces or may be disposed offsite.

6.3.4. Compacted Fill

Unless otherwise recommended, the exposed excavation bottom to receive fill should be prepared in accordance with Section 6.3.2 of this report. Prior to placement of compacted fill, the contractor should request the geotechnical engineer to evaluate the exposed excavation bottoms.

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Compacted fill should be placed in horizontal lifts of approximately 8 to 10 inches in loose thickness, depending on the equipment used. Prior to compaction, each lift should be moisture conditioned, mixed, and then compacted by mechanical methods. The moisture content should be within approximately 2 percent above the optimum moisture content. Fill materials should be compacted to a minimum relative compaction of 95 percent within the upper one foot below new vehicle trafficked pavement sections, and 90 percent in all other areas, unless indicated otherwise in this report. The relative compaction should be determined by ASTM D1557. Successive lifts should be treated in the same manner until the desired finished grades are achieved.

6.3.5. Temporary Excavations

Temporary excavations for the demolishing, earthwork, footing and utility trench are expected. We anticipate that unsurcharged excavations with vertical side slopes less than 4 feet high will generally be stable.

Where the space is available, temporary, unsurcharged excavation sides over 4 feet in height should be sloped no steeper than an inclination of 1.5H:1V (horizontal:vertical). Where sloped excavations are created, the tops of the slopes should be barricaded so that vehicles and storage loads do not encroach within 10 feet of the top of the excavated slopes. A greater setback may be necessary when considering heavy vehicles, such as concrete trucks and cranes. The geotechnical engineer should be advised of such heavy vehicle loadings so that specific setback requirements can be established. If the temporary construction slopes are to be maintained during the rainy season, berms are recommended to be graded along the tops of the slopes in order to prevent runoff water from entering the excavation and eroding the slope faces.

Excavations shall not undermine the existing adjacent building footings. Where space for sloped excavations is not available, slot-cut or temporary shoring may be utilized. For temporary excavations that are less than 6 feet in height adjacent to existing buildings where the excavation extends deeper than the bottom of the existing footing, slot cuts may be utilized. The excavated slots should not be left open overnight and should be backfilled on the same day it was excavated before the next set of slots are excavated. Shoring recommendations are provided in Section 6.14.

The geotechnical engineer should observe the excavations so that any necessary modifications based on variations in the encountered soil conditions can be made. All applicable safety requirements and regulations, including CalOSHA requirements, should be met.

6.3.6. Excavation Bottom Stability

In general, we anticipate that the bottoms of the excavations will be stable and should provide suitable support to the proposed improvements. Conditions of the subgrade should be evaluated by the project geotechnical engineer during the scarification and re-compaction efforts. Soft bottom conditions can be identified by surface yielding under rubber-tired equipment loading and the inability to achieve proper compaction. Recommendations for stabilizing excavation bottoms should be based on evaluation in the field by the geotechnical consultant at the time of construction.

6.3.7. Backfill for Utility Trench

When parallel to any footings, utility trenches and pipes should be laid above an imaginary 2:1 (H:V) line projected down from a point 9 inches above the bottom edge of the footing, and not closer than 18 inches from the face of such footing. Otherwise, the pipe should be encased to accept the effect from the footing load. Where pipes cross under footings, the footings should be specially designed. Pipe sleeves should be provided where pipes cross through footings or footing walls, and sleeve clearances should provide for possible footing settlement, but not less than 1 inch all around pipe.

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Utility trench excavations to receive backfill should be free of trash, debris or other unsatisfactory materials at the time of backfill placement. At locations where the trench bottom is yielding or otherwise unstable, pipe support may be improved by placing a minimum 8 inches of bedding materials described below. Remedial earthwork at the trench bottom should be performed where oversize materials (rocks or clods greater than 3 inches) are present. Removal of oversize materials to a depth of 8 inches below the bottom of the pipeline and replacement with fill material compacted to at least 90% relative compaction is recommended. The trench should be backfilled with bedding material extending to the full width of the trench and at least one foot over the top of pipe. After placement of the pipe, the bedding should be brought up uniformly on both sides of the pipe to reduce the potential for unbalanced loads. No void or uncompacted areas should be left beneath the pipe haunches.

The bedding materials may consist of clean sand having a minimum sand equivalent (SE) of 30, crushed rock, or 2-sack sand-cement slurry, and should meet the specifications provided in the latest edition of the “Greenbook” Standard Specifications for Public Works Construction. Samples of materials proposed for use as bedding material should be provided to the project geotechnical engineer for inspection and testing before the material is imported for use on the project. The onsite materials can only be used following the requirement of “Greenbook” bedding specification when the SE is not less than 30.

Above pipe bedding, trench backfill may be onsite soils and should not contain rocks or lumps over 3 inches in largest dimension. Larger chunks, if generated during excavation, may be broken into acceptably sized pieces or may be disposed of offsite. The moisture content should be within approximately 2 percent above the optimum moisture content. However, within the upper 12 inches of subgrade in areas of concrete slabs-on-grade, concrete pavement, and concrete flatwork, trench backfill should not consist of onsite soils with expansion potential greater than 20.

Pipe bedding and backfill materials may be placed and compacted by mechanical means and should be compacted to 90 percent of the laboratory maximum dry density as per ASTM Standard D1557. Within pavement areas, the upper 12 inches of subgrade soils and the overlying aggregate base should be compacted to 95 percent.

Jetting or flooding of pipe bedding and backfill material is not recommended.

6.3.8. Rippability

Based on our review of the subsurface exploration of the site, the fill materials should be generally excavatable with heavy-duty earthwork equipment in good working condition.

6.3.9. Construction Dewatering

Groundwater was encountered at 17 feet bgs or deeper during our field exploration. Dewatering measures during excavation may or may not be needed depending on depth of excavation. If needed, considerations for construction dewatering should include anticipated drawdown, volume of pumping, potential for settlement of nearby structures, and groundwater discharge. Disposal of groundwater should be performed in accordance with guidelines of the Regional Water Quality Control Board.

6.4. Foundation Recommendations

For conventional spread footing and continuous footings, the City of Los Angeles limits the total allowable combined settlement (seismic plus static) to 1½ inches and the total allowable combined differential settlement (seismic plus static) to ¾ inches. For mat foundations, the City of Los Angeles

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limits the total allowable combined settlement (seismic plus static) to 4 inches and the total allowable combined differential settlement (seismic plus static) to 2 inches.

Based upon the ground improvement recommendations, the proposed building and auxiliary structures may be supported on continuous strip footings or isolated footings with a minimum width of 12 inches and a minimum embedment of 12 inches. Geotechnical parameters including bearing capacity, lateral resistance, and settlement discussed in Section 6.2 of this report may be used. Structural design of foundations should be performed by the structural engineer and should conform to the 2019 California Building Code.

6.5. Retaining Walls

Recommendations for wall lateral loads, backfill, and drainage are provided below. Foundations for retaining walls may be based on Section 6.4 or 6.12 of this report, depending on project design approach. Foundation walls and retaining walls should be designed to have a factor of safety of 1.5 for static stability and 1.1 for stability due to transient loads from wind or seismic.

6.5.1. Lateral Earth Pressure

The values presented below assume that the supported grade is level and that surcharge loads are not applied. Twining should be contacted for sloping backfill conditions.

Walls that are free to move and rotate at the top (such as cantilevered walls) and have adequate drainage may be designed for the active earth pressure equivalent to a fluid weighting 40 pcf. Without adequate drainage, an equivalent fluid pressure of 82 pcf should be used.

Walls that are restricted to move horizontally at the top (such as by a floor deck) and have adequate drainage may be designed for the “at-rest” earth pressure equivalent to a fluid weighing 60 pcf. Without adequate drainage, an equivalent fluid pressure of 92 pcf should be used.

Vertical surcharge loads within a 1:1 plane projected from the bottom of the wall distributed over retained soils should be considered as additional uniform horizontal pressures acting on the wall. These additional pressures can be estimated as approximately 1/3 and 1/2 of the magnitude of the vertical surcharge pressures for the “active” and “at-rest” conditions, respectively.

6.5.2. Seismic Lateral Earth Pressure

Walls retaining more than 6 feet of backfill height should be designed for seismic lateral earth pressure. The seismic pressure distribution may be considered a triangle with the maximum pressure at the bottom. We estimated the seismic earth pressure increment for walls retaining level ground based on Seed and Whitman (1970) and a horizontal seismic coefficient (k_h) equivalent to one-half of two-thirds of PGAM provided in Table 3. The following combination of static and incremental seismic pressures shown in the following diagram may be used for seismic design for both cantilever and restrained walls.

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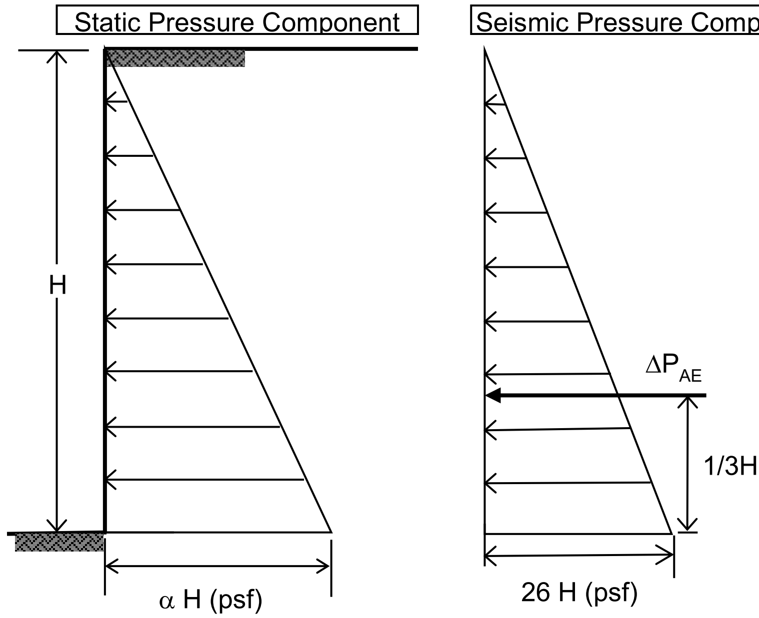

where

H = retained soil height in feet.

α = lateral earth pressure for active conditions provided in Section 6.5.1.

Seismic Earth Pressure Distribution on Walls

6.5.3. Backfill and Drainage of Walls

Backfill behind walls should consist of low expansive material and be approved by the project geotechnical engineer. Based on the materials encountered during our exploration, most on-site soils will meet this requirement; however, removal of debris and particles greater than 3 inches in maximum dimension should be anticipated prior to use of on-site soils as wall backfill.

If walls are designed for lateral earth pressures assuming the walls will have adequate drainage, a drainage system should be installed behind walls to ensure that external hydrostatic pressure will not develop behind the walls. Adequate backfill drainage is essential to provide a free-drained backfill condition and to limit hydrostatic buildup behind walls. Drainage behind walls may be provided by a geosynthetic drainage composite such as TerraDrain, MiraDrain, or equivalent, attached to the outside perimeter of the wall and installed in accordance with the manufacturer's recommendations. The drainage system should meet the minimum requirements of Sections 1805.4.2 and 1805.4.3 of 2019 CBC.

Where wall backfill does not have adequate drainage, the full hydrostatic pressure should be considered in design as described in Section 6.5.1.

In addition, walls sensitive to moisture buildup on the interior sides due to water migration from soils touching the walls should have appropriate waterproofing applied for the full height of the walls and meeting the minimum requirements of Section 1805.3 of 2019 CBC.

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6.6. Modulus of Subgrade Reaction

The modulus of subgrade reaction k for design of combined footings and slabs-on-grade may be obtained from the following equation.

$$K = k_1\left(\frac{2L + B}{3BL}\right)$$

where: k_1 = modulus for a 1-foot by 1-foot plate = 150 pounds per cubic inch (pci);
B = width of foundation or slab in feet; and
L = length of foundation or slab in feet, and L ≥ B.

6.7. Concrete Slabs

Slabs should be supported on at least 12 inches of engineered fill with a very low expansion potential (i.e., expansion index of 20 or less) in accordance with Section 6.3 of this report. For design of concrete slabs, the subgrade modulus k calculated from Section 6.5.3 may be used.

Floor slabs should be designed and reinforced in accordance with the structural engineer's recommendations. However, for slabs not supporting heavy loads, we recommend that the concrete should have a thickness of at least 4 inches, a 28-day compressive strength of at least 3,000 pounds per square inch (psi), a water-cement ratio of 0.50 or less, and a slump of 4 inches or less. Slabs should be reinforced with at least No. 3 reinforcing bars placed longitudinally at 18 inches on center. The reinforcement should be extended through the control joints to reduce the potential for differential movement. Control joints should be constructed in accordance with recommendations from the structural engineer or architect. For slabs supporting equipment, a minimum thickness of 5 inches is recommended. Additional thickness and reinforcement recommendations may be provided by the structural engineer.

All underslab materials should be adequately compacted prior to the placement of concrete. Care should be taken during placement of the concrete to prevent displacement of the underslab materials. The granular material should be dry to moist and should not be wetted or saturated prior to the placement of concrete. The concrete slab should be allowed to cure properly prior to placing vinyl or other moisture-sensitive floor covering.

The project design should provide protection against vapor transmission through concrete floor slabs placed over a properly prepared subgrade to reduce the potential for cracking of slabs; however, even with the incorporation of the protection, slabs may still exhibit some cracking. The occurrence of concrete shrinkage cracks is independent of the supporting soil characteristics.

6.8. Pavement Recommendations

Pavement section should be constructed on top of properly prepared subgrade in accordance with Section 6.4 of this report. The aggregate base (AB) section compacted to 95 percent of the maximum dry density in accordance with ASTM D1557.

Our lab testing indicates the near surface sandy silt soils from boring P-2 have an R value of 40. As the near surface soils in other areas consist of sandy lean clay, we assumed an R value of 30 in our pavement analysis. Sections 6.8.1 and 6.8.2 present our recommendations for design of flexible and rigid pavement sections, respectively. Final pavement design should be based on field observations, R-value tests on expected subgrade soils, and the anticipated traffic index as determined by the project civil engineer.

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6.8.1. Flexible Pavement Design

Our flexible pavement structural design is in accordance with Chapter 630 of the Caltrans Highway Design Manual, which is based on a relationship between the gravel equivalent (GE) of the pavement structural materials, the traffic index (TI), and the R-value of the underlying subgrade soil. For design of flexible pavement section, Table 4 provides recommended minimum thicknesses for hot mix asphalt (HMA) and aggregate base sections for different traffic indices.

Table 4 – Recommended Minimum HMA and Base Section Thicknesses

Traffic Index	4.0	5.0	6.0	7.0
HMA Thickness (in)	4	4	5	6
Aggregate Base Thickness (in)	4	4	5	6

6.8.2. Rigid Pavement Design

For design of rigid pavement section, Table 5 provides recommended minimum thicknesses for Portland cement concrete (PCC) pavement section and Class 2 Aggregate Base (AB) section for different traffic indices. The recommended values are based on a minimum 28-day concrete compressive strength of 3,500 psi. Positive drainage should be provided away from all pavement areas to prevent seepage of surface and/or subsurface water into the pavement base and/or subgrade.

Table 5 – Recommended Minimum Rigid Pavement Thicknesses

Traffic Index	5.0	6.0	7.0
PCC Thickness (in)	4	4.5	5.5
Aggregate Base Thickness (in)	4	4	5

6.9. Stormwater Infiltration Basins

Twining performed percolation testing for the project at two locations (P-1 and P-2) each at a depth of approximately 5 feet bgs. The approximate test locations are shown on Figure 2. The testing was performed in accordance with the County of Los Angeles Department of Public Works guidelines as outlined in the Low Impact Development (LID) Manual. Table 6 summarizes the results of the testing with a factor of safety of 2 to account for subsurface variability, long-term performance, and other factors.

Table 6 - Percolation Test Results

Location	Depth (ft)	Design Infiltration Rate (in/hr)
P-1	5	0.12
P-2	5	0.13

The City of Los Angeles typically requires that infiltration basins are located a minimum of 10 feet above

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the current groundwater table. In addition, proposed infiltration basin should have a minimum setback from property lines and foundations recommended in the table below. We recommend that the project geotechnical engineer review the proposed groundwater infiltration system prior to implementation or finalizing design.

Table 7 - Setback Requirements for Infiltration Basins

Setback from	Distance
Property lines	10 feet
Foundations	15 feet or outside of the 1:1 plane projected up from the bottom of foundation, whichever is greater.

6.10. Soil Expansion and Collapse Potential

Based on our field exploration, the surficial soils consist of lean clay with varying amounts of sand underlain by sandy lean clay and silty sand. Based on our laboratory testing, the site soils have low expansion potential and low collapse potential. The ground improvement if implemented will minimize the soil expansion and collapse potentials.

6.11. Soil Corrosivity

In accordance with the County of Los Angeles (2014) criteria, corrosive soil is defined as the soil has minimum electrical resistivity of 1,000 ohm-centimeters or less than, or chloride concentration of 500 ppm or greater, or sulfate concentration of 2,000 ppm or greater, or a pH of 5.5 or less.

The potential for the on-site materials to corrode buried steel and concrete improvements was evaluated. Laboratory testing was performed on one selected near-surface soil to evaluate pH and electrical resistivity, as well as chloride and sulfate contents. The pH and electrical resistivity tests were performed in accordance with California Test Method (CTM) 643, and the sulfate and chloride tests were performed in accordance with CTM 417 and CTM 422, respectively. Laboratory test results are presented in Appendix B – Laboratory Testing. The results indicate the soils at the proposed culvert locations are not considered corrosive, according to the County of Los Angeles (2014) criteria.

Discussions of corrosion protection for reinforced concrete and buried metal is provided below. Further interpretation of the corrosivity test results and associated corrosion design and construction recommendations are within the purview of a corrosion specialist. It is recommended that a qualified corrosion engineer be retained to review our corrosivity test results, to evaluate the general corrosion potential with respect to construction materials at the site, and to review the proposed design.

6.11.1. Reinforced Concrete

Laboratory tests indicate that the soil has less than 1,000 ppm or 0.1% of water soluble sulfate (SO_4) by weight. Based on ACI 318, concrete in contact with the site soils will have a sulfate exposure class S0. As a minimum, we recommend that Type II cement and a concrete mix design for foundations and building slabs-on-grade that incorporates a maximum water-cement ratio of 0.50.

Test results indicate that the soil has less than 500 ppm of water soluble chlorides by weight and the potential for chloride attack of reinforcing steel in concrete structures and pipes in contact with soil is negligible.

6.11.2. Buried Metal

A factor for evaluating corrosivity to buried metal is electrical resistivity. The electrical resistivity of a soil is a measure of resistance to electrical current. Corrosion of buried metal is directly proportional to the flow of electrical current from the metal into the soil. As resistivity of the soil decreases, the corrosivity generally increases. Test results indicate the site soils have minimum electrical resistivity of 1,034 ohm-centimeters. Based on the County of Los Angeles (2014) criteria, the soils are not considered corrosive to buried metals.

Correlations between resistivity and corrosion potential published by the National Association of Corrosion Engineers (NACE, 1984) indicate that the site soils are moderately corrosive. If needed, a corrosion specialist should be consulted regarding appropriate protection for buried metals and suitable types of piping.

6.12. Underground Parking Option

To mitigate the potential for liquefaction-induced settlement and loss of soil bearing capacity due to relatively shallow liquefiable soils, an option for the project could be to have 2 levels of subterranean structure. With a two-level deep subterranean structure, the potentially liquefiable layers and compressible soil layers in the upper 23 feet would be removed during excavation for the subterranean levels. Geotechnical recommendations for design and construction are as follows.

- Design groundwater should be 6 feet bgs.
- The seismic site class should be D.
- Seismic design parameters in Table 3 may be used.
- The building may be supported on mat foundation, designed with a bearing pressure of 5,000 psf with a total static settlement of 1 inch and differential settlement of ½ inches over a span of 30 feet. The total seismic settlement will be less than 0.5 inches.
- Below grade walls may be designed based on Section 6.5.
- The design and construction should consider hydrostatic buoyant force and waterproofing. The design hydrostatic buoyant force may be estimated using a depth of 6 feet to groundwater from the existing ground surface.
- Excavation will extend approximately 6 feet below the current groundwater table, depending on the thickness of the mat and the bottom elevation of the underground levels. Dewatering is expected to keep the water below the bottom of excavation during construction. A dewatering system should be designed and implemented by a qualified dewatering consultant/contractor.
- A modulus of subgrade reaction of 46 pci may be used assuming the mat foundation measures 280 feet by 380 feet
- No over-excavation for the mat is necessary. However, the exposed excavation bottom should be evaluated and approved by the geotechnical engineer. The excavation bottom is anticipated to be relatively wet and would require stabilization consisting of a layer of geogrid (Tensar TX7

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or equivalent) overlain by 18 inches of aggregate base compacted to at least 90 percent relative compaction in accordance with the latest version of ASTM Test Method D1557.

6.13. Drainage Control

The control of surface water is essential to the satisfactory performance of the building and site improvements. Surface water should be controlled so that conditions of uniform moisture are maintained beneath the improvements, even during periods of heavy rainfall. The following recommendations are considered minimal:

- Ponding and areas of low flow gradients should be avoided.
- If bare soil within 5 feet of the structure is not avoidable, then a gradient of 5 percent or more should be provided sloping away from the structure. Corresponding paved surfaces should be provided with a gradient of at least 1 percent.
- The remainder of the unpaved areas should be provided with a drainage gradient of at least 2 percent.
- Positive drainage devices, such as graded swales, paved ditches, and/or catch basins should be employed to accumulate and to convey water to appropriate discharge points.
- Concrete walks and flatwork should not obstruct the free flow of surface water.
- Brick flatwork should be sealed by mortar or be placed over an impermeable membrane.
- Area drains should be recessed below grade to allow free flow of water into the basin.
- Enclosed raised planters should be sealed at the bottom and provided with an ample flow gradient to a drainage device. Recessed planters and landscaped areas should be provided with area inlet and subsurface drainpipes.
- Planters should not be located adjacent to the structures wherever possible. If planters are to be located adjacent to the structures, the planters should be positively sealed, should incorporate a subdrain, and should be provided with free discharge capacity to a drainage device.
- Planting areas at grade should be provided with positive drainage. Wherever possible, the grade of exposed soil areas should be established above adjacent paved grades. Drainage devices and curbing should be provided to prevent runoff from adjacent pavement or walks into planted areas.
- Gutter and downspout systems should be provided to capture discharge from roof areas. The accumulated roof water should be conveyed to off-site disposal areas by a pipe or concrete swale system.
- Landscape watering should be performed judiciously to preclude either soaking or desiccation of soils. The watering should be such that it just sustains plant growth without excessive watering. Sprinkler systems should be checked periodically to detect leakage and they should be turned off during the rainy season.

6.14. Shoring Recommendations

Temporary shoring may consist of a soldier beam and lagging appropriately designed by a qualified shoring engineer. The shoring should be designed to resist lateral earth pressure from retained soils and any surcharge loads from traffic, adjacent buildings, or construction equipment and materials.

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Lateral earth pressures are provided in Table 8 for design of temporary shoring assuming drained level backfill conditions and no surcharge loading.

Table 8 - Recommended Lateral Earth Pressure and Resistance for Temporary Shoring

Shoring Conditions	Lateral Earth Pressure
Cantilevered Shoring	40 pcf
Braced Shoring	25H psf
Ultimate Passive Resistance	600 pcf

Notes: H = depth of excavation in feet.

The lateral pressure due to a uniform surcharge load located immediately behind the temporary shoring may be calculated by multiplying the vertical surcharge pressure by 33% for cantilevered shoring and 50% for braced-shoring, corresponding to the "active" and "at-rest" conditions, respectively. Lagging may be designed for a maximum lateral pressure of 400 psf in the middle between adjacent soldier piles and zero psf at the soldier piles.

Support of adjacent structures and utilities without distress is the contractor's responsibility.

7. LIMITATIONS

The recommendations and opinions expressed in this report are based on information obtained from our field exploration for the site. In the event that any of our recommendations conflict with recommendations provided by other design professionals, we should be contacted to aid in resolving the discrepancy.

Due to the limited nature of our field explorations, conditions not observed and described in this report may be present on the site. Uncertainties relative to subsurface conditions can be reduced through additional subsurface exploration. Additional subsurface evaluation and laboratory testing can be performed upon request. It should be understood that conditions different from those anticipated in this report may be encountered during excavation operations, for example, the presence of unsuitable soil, and that additional effort may be required to mitigate them.

Site conditions, including groundwater elevation, can change with time as a result of natural processes or the activities of man at the subject site or at nearby sites. Changes to the applicable laws, regulations, codes, and standards of practice may occur as a result of government action or the broadening of knowledge. The findings of this report may, therefore, be invalidated over time, in part or in whole, by changes over which Twining has no control.

Twining's recommendations for this site are, to a high degree, dependent upon appropriate quality control of foundation construction. Accordingly, the recommendations are made contingent upon the opportunity for Twining to observe foundation excavations for the proposed construction. If parties other than Twining are engaged to provide such services, such parties must be notified that they will be required to assume complete responsibility as the geotechnical engineer of record and the engineering geologist of record for the geotechnical phase of the project by concurring with the recommendations in this report and/or by providing alternative recommendations.

This document is intended to be used only in its entirety. No portion of the document, by itself, is designed to completely represent any aspect of the project described herein. Twining should be contacted if the reader requires additional information or has questions regarding the content, interpretations presented, or completeness of this document.

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This report has been prepared for the exclusive use by the client and its agents for specific application to the proposed design and construction of the project described herein. Any party other than the client who wishes to use this report for an adjacent or nearby project, shall notify Twining of such intended use. Land use, site conditions, or other factors may change over time, and additional work may be required with the passage of time. Based on the intended use of this report and the nature of the project, Twining may require that additional work be performed and that an updated report be issued. Non-compliance with any of these requirements by the client or any other party will release Twining from any liability resulting from the use of this report by any unauthorized party.

Twining has endeavored to perform its evaluation using the degree of care and skill ordinarily exercised under similar circumstances by reputable geotechnical professionals with experience in this area in similar soil conditions. No other warranty, either expressed or implied, is made as to the conclusions and recommendations contained in this report.

8. SELECTED REFERENCES

American Society of Civil Engineers, 2017, Minimum Design Loads and Associated Criteria for Buildings and Other Structures: ASCE Standard ASCE/SEI 7-16, 800 pp, ISBN 9780784414248.

ASTM, current latest version, “Soil and Rock: American Society for Testing and Materials,” vol. 4.08 for ASTM test methods D-420 to D-4914; and vol. 4.09 for ASTM test methods D-4943 to highest number.

California Buildings Standards Commission, 2019, 2019 California Building Code, California Code of Regulations, Title 24, Volume 2 of Part 2, Effective January 1, 2020, ISBN 978-1-60983-891-1.

California Geological Survey (CGS), 2008, Guidelines for Evaluating and Mitigating Seismic Hazards in California.

California Geological Survey, 2006, Seismic Hazard Zone Report for the Venice 7.5-Minute Quadrangle, Los Angeles County, California, Seismic Hazard Zone Report 036, 1998 (2006 Revision).

California Geological Survey, 1999, Earthquake Zones of Required Investigation, Venice Quadrangle, Seismic Hazards Zones Official Map released March 25, 1999, scale 1:24,000.

Dibblee, T.W., and Minch, J.A., 2007, Geologic map of the Venice and Inglewood quadrangles, Los Angeles County, California, Dibblee Foundation Map DF-322, Dibblee Geological Foundation, Map Scale: 1:24,000

Public Works Standards, Inc., 2016, The “Greenbook” Standard Specifications for Public Works Construction.

Stewart et al., 1994, Documentation for the 2008 Update of the United States National Seismic Hazard Maps, United States Geological Survey Open-File Report 2008-1128.

United States Geological Survey, 2021, Venice, California Quadrangle: 7.5 Minute Series (Topographic), scale 1:24,000.

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FIGURES

N

APPROXIMATE LOCATION OF PROJECT

SCALE IN FEET

0 2000 4000

REFERENCE: USGS (2021)

TWINING

SITE LOCATION MAP

LATERRA MARINA DEL REY
4112 DEL REY AVENUE
MARINA DEL REY, CA

PROJECT NO.	REPORT DATE	FIGURE 1
220205.1	August 2022	

SCALE IN FEET

0 60 120

NOTE: ALL DIMENSIONS AND LOCATIONS ARE APPROXIMATE

LEGEND

B-1 TD=26.5'	APPROXIMATE LOCATION OF BORING BY TWINING TOTAL DEPTH IN FEET
P-1 TD=5'	APPROXIMATE LOCATION OF PERCOLATION TEST BY TWINING TOTAL DEPTH IN FEET
CPT-1 TD=27.8'	APPROXIMATE LOCATION OF CPT BY TWINING TOTAL DEPTH IN FEET
	APPROXIMATE PROJECT LIMITS

TWINING

N

REFERENCE: GOOGLE EARTH (2022)

SITE PLAN AND BORING LOCATION MAP		
LATERRA MARINA DEL REY 4112 DEL REY AVENUE MARINA DEL REY, CA		
PROJECT No. 220205.1	REPORT DATE August 2022	FIGURE 2

Qa	Alluvial gravel, sand, and clay
Qc	Clay and sand of predeveloped marshlands
Qbs	Beach sand
Qsp	San Pedro Sand
Qoa	Older alluvium

N

SCALE IN FEET

0 2000 4000

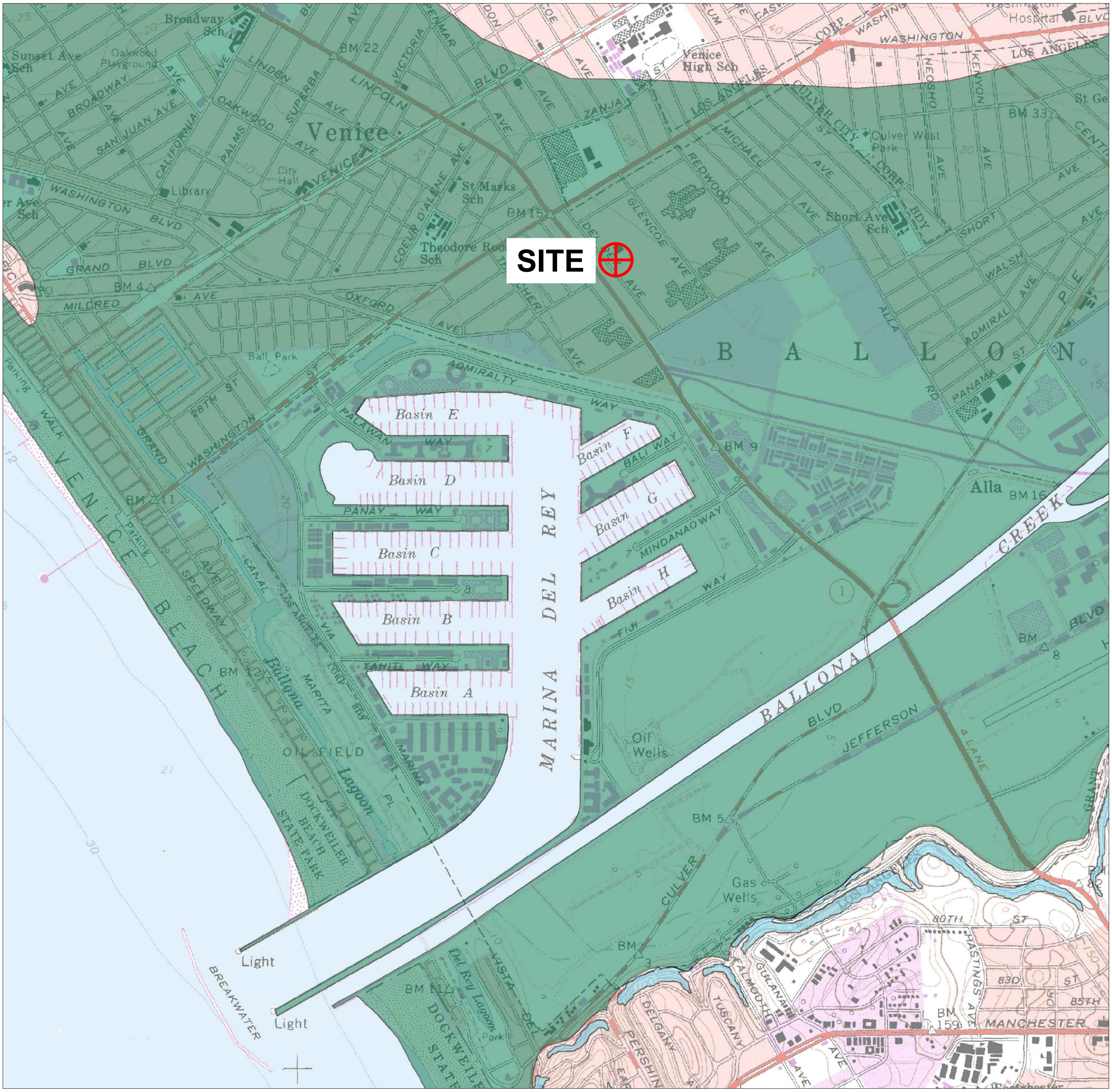
REFERENCE: DIBBLEE AND MINCH (2007)

TWINING

GEOLOGIC MAP

LATERRA MARINA DEL REY
4112 DEL REY AVENUE
MARINA DEL REY, CA

PROJECT NO.	REPORT DATE	FIGURE 3
220205.1	August 2022	



MAP EXPLANATION

EARTHQUAKE FAULT ZONES

Earthquake Fault Zones
Zone boundaries are delineated by straight-line segments; the boundaries define the zone encompassing active faults that constitute a potential hazard to structures from surface faulting or fault creep such that avoidance as described in Public Resources Code Section 2621.5(a) would be required.

Active Fault Traces
Faults considered to have been active during Holocene time and to have potential for surface rupture: Solid Line in Black or Red where Accurately Located; Long Dash in Black or Solid Line in Purple where Approximately Located; Short Dash in Black or Solid Line in Orange where Inferred; Dotted Line in Black or Solid Line in Rose where Concealed; Query (?) indicates additional uncertainty. Evidence of historic offset indicated by year of earthquake-associated event or C for displacement caused by fault creep.

1906 C ? ?

SEISMIC HAZARD ZONES

Liquefaction Zones
Areas where historical occurrence of liquefaction, or local geological, geotechnical and ground water conditions indicate a potential for permanent ground displacements such that mitigation as defined in Public Resources Code Section 2693(c) would be required.

Earthquake-Induced Landslide Zones
Areas where previous occurrence of landslide movement, or local topographic, geological, geotechnical and subsurface water conditions indicate a potential for permanent ground displacements such that mitigation as defined in Public Resources Code Section 2693(c) would be required.

OVERLAPPING EARTHQUAKE FAULT AND SEISMIC HAZARD ZONES

Overlap of Earthquake Fault Zone and Liquefaction Zone
Areas that are covered by both Earthquake Fault Zone and Liquefaction Zone.

Overlap of Earthquake Fault Zone and Earthquake-Induced Landslide Zone
Areas that are covered by both Earthquake Fault Zone and Earthquake-Induced Landslide Zone.

**Note: Mitigation methods differ for each zone –
AP Act only allows avoidance; Seismic Hazard Mapping Act allows mitigation by engineering/geotechnical design as well as avoidance.**

REFERENCE: CGS (1999)

TWINING

SEISMIC HAZARD ZONES MAP		
LATERRA MARINA DEL REY 4112 DEL REY AVENUE MARINA DEL REY, CA		
PROJECT NO. 220205.1	REPORT DATE August 2022	FIGURE 4

APPENDIX A
FIELD EXPLORATION

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Appendix A - Field Exploration

General

The subsurface exploration program for the proposed project was performed at the site on April 7 and 8, 2022. The exploration consisted of drilling and logging 7 hollow-stem-auger (HSA) borings (B-1 through B-5, P-1 and P-2), percolation testing in 2 of the borings (P-1 and P-2) and advancing 4 cone penetration test (CPT) probes (CPT-1 through CPT-4).

All borings and CPTs were first excavated to 5 feet below ground surface (bgs) using a 5-inch diameter hand-auger to clear potential underground utilities.

We obtained permits for the borings and CPTs from the Los Angeles County Department of Public Health (LADPH).

Upon completion of exploration, the borings and CPTs were backfilled using lean cement grout by the drilling subcontractors in accordance with LADPH requirements. The surface of all locations was patched with Portland cement concrete and dyed black as necessary to match existing conditions.

The approximate locations of the exploration are shown on Figure 2.

Exploratory Borings

After hand-angering the upper 5 feet to clear potential underground utilities, drilling operation for the borings (B-1 through B-5, P-1 and P-2) was performed by Baja Exploration of Escondido, California using a CME-75 truck-mounted drill rig equipped with 8-inch diameter hollow-stem-auger. Borings B-1 through B-6 and P-1 through P-3 were advanced to approximate depths of 5 to 51.5 feet bgs.

An explanation of the boring logs is presented as Figure A-1. The boring logs are presented as Figures A-2 through A-8. The boring logs describe the earth materials encountered, samples obtained, and show the field and laboratory tests performed. The logs also show the boring number, drilling date, and the name of the logger and drilling subcontractor. The borings were logged by an engineer using the Unified Soil Classification System. The boundaries between soil types shown on the logs are approximate because the transition between different soil layers may be gradual. Drive and bulk samples of representative earth materials were obtained from the borings.

Disturbed samples were obtained from selected depths using a Standard Penetration Test (SPT) sampler. This sampler consists of a 2-inch O.D., 1.4-inch I.D. split barrel shaft without room for liner. Soil samples obtained by the SPT sampler were retained in plastic bags. A California modified sampler was also used to obtain drive samples of the soils from selected depths. This sampler consists of a 3-inch outside diameter (O.D.), 2.4-inch inside diameter (I.D.) split barrel shaft. The samples were retained in brass rings for laboratory testing.

When a boring was drilled to a selected depth, the sampler was lowered to the bottom of the boring and then driven a total of 18-inches into the soil using an automatic hammer weighing 140 pounds dropped from a height of approximately 30 inches. The number of blows required to drive the samplers the final 12 inches is presented on the boring logs. Where sampler refusal is encountered and the sampler does not advance 18 inches, the total number of blows per number of inches advanced is presented. The blow counts given are field raw blow counts that have not been modified to account for field and/or depth conditions.

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Cone Penetration Testing

Cone penetration testing (CPT) operation was performed by Kehoe Testing & Engineering of Huntington Beach, California using a 30-ton CPT rig equipped with a 15 cm^2 cone. A total of four CPTs (CPT-1 through CPT-4) were performed on April 7, 2022. The planned maximum depths for the CPTs were 60 feet bgs. The actual depths of the CPTs ranged from 25 to 32 feet bgs due to CPT probe refusal before the planned termination depth. Detailed information of the CPTs is included in this appendix.

Percolation Testing

Percolation testing was performed on April 7, 2022, in the two of the 5-foot-deep borings (P-1 and P-2) using the falling head method. The testing was performed in accordance with the County of Los Angeles Department of Public Works guidelines as outlined in the Low Impact Development (LID) Manual.

After the borings were drilled, a 2-inch-thick layer of gravel was placed at the bottom of the boring. A 3-inch diameter perforated pipe was installed on top of the gravel layer in the boring. Gravel was used to backfill between the perforated pipes and the boring sidewall. The boreholes were then filled with water near the ground surface and presoaked for two consecutive 30-minute sessions prior to testing.

After presoaking, the boreholes were filled with water to near the ground surface, and measurements were recorded at 10-minute time intervals. The average of the last three readings was used to determine the percolation rate at each test location.

Our calculated design infiltration rates are presented in Table A-1 with a factor safety of 2. Detailed test data is attached to this appendix.

Table A-1 - Percolation Test Results

Location	Depth (ft)	Design Infiltration Rate (in/hr)
P-1	5	0.12
P-2	5	0.13

UNIFIED SOIL CLASSIFICATION CHART

MAJOR DIVISIONS			SYMBOLS GRAPH	SYMBOLS LETTER	TYPICAL DESCRIPTIONS
COARSE GRAINED SOILS MORE THAN 50% OF MATERIAL IS LARGER THAN NO. 200 SIEVE SIZE	**GRAVEL AND GRAVELLY SOILS** MORE THAN 50% OF COARSE FRACTION RETAINED ON NO. 4 SIEVE	**CLEAN GRAVELS** (LITTLE OR NO FINES)		GW	WELL-GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES
				GP	POORLY-GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES
		GRAVELS WITH FINES (APPRECIABLE AMOUNT OF FINES)		GM	SILTY GRAVELS, GRAVEL - SAND - SILT MIXTURES
				GC	CLAYEY GRAVELS, GRAVEL - SAND - CLAY MIXTURES
	SAND AND SANDY SOILS MORE THAN 50% OF COARSE FRACTION PASSING ON NO. 4 SIEVE	**CLEAN SANDS** (LITTLE OR NO FINES)		SW	WELL-GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES
				SP	POORLY-GRADED SANDS, GRAVELLY SAND, LITTLE OR NO FINES
		SANDS WITH FINES (APPRECIABLE AMOUNT OF FINES)		SM	SILTY SANDS, SAND - SILT MIXTURES
				SC	CLAYEY SANDS, SAND - CLAY MIXTURES
FINE GRAINED SOILS MORE THAN 50% OF MATERIAL IS SMALLER THAN NO. 200 SIEVE SIZE	**SILTS AND CLAYS**	LIQUID LIMIT LESS THAN 50		ML	INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY OR CLAYEY FINE SANDS OR CLAYEY SILTS WITH SLIGHT PLASTICITY
				CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS
				OL	ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY
	SILTS AND CLAYS	LIQUID LIMIT GREATER THAN 50		MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SAND OR SILTY SOILS
				CH	INORGANIC CLAYS OF HIGH PLASTICITY
				OH	ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY, ORGANIC SILTS
HIGHLY ORGANIC SOILS				PT	PEAT, HUMUS, SWAMP SOILS WITH HIGH ORGANIC CONTENTS

NOTE: DUAL SYMBOLS ARE USED TO INDICATE BORDERLINE SOIL CLASSIFICATIONS

COARSE-GRAINED SOILS / FINE-GRAINED SOILS

Relative Density	SPT (blows/ft)	Relative Density (%)	Consistency	SPT (blows/ft)
Very Loose	<4	0 - 15	Very Soft	<2
Loose	4 - 10	15 - 35	Soft	2 - 4
Medium Dense	10 - 30	35 - 65	Medium Stiff	4 - 8
Dense	30 - 50	65 - 85	Stiff	8 - 15
Very Dense	>50	85 - 100	Very Stiff	15 - 30
			Hard	>30

NOTE: SPT blow counts based on 140 lb. hammer falling 30 inches

Sample Symbol	Sample Type	Description
	SPT	1.4 in I.D., 2.0 in. O.D. driven sampler
	California Modified	2.4 in. I.D., 3.0 in. O.D. driven sampler
	Bulk	Retrieved from soil cuttings
	Thin-Walled Tube	Pitcher or Shelby Tube

LABORATORY TESTING ABBREVIATIONS

ATT	Atterberg Limits
C	Consolidation
CORR	Corrosivity Series
DS	Direct Shear
EI	Expansion Index
GS	Grain Size Distribution
K	Permeability
MAX	Moisture/Density (Modified Proctor)
O	Organic Content
RV	Resistance Value
SE	Sand Equivalent
SG	Specific Gravity
TX	Triaxial Compression
UC	Unconfined Compression

TWINING

EXPLANATION FOR LOG OF BORINGS

Del Rey Avenue Building Project
4112 Del Rey Avenue
Marina Del Rey, California

PROJECT NO.	REPORT DATE	
220205.1	August 2022	FIGURE A-1

STANDARD LOG EXPLANATION 220205.1 - LATERRA DEL REY AVENUE.GPJ TWINING LABS.GDT 8/30/22

DATE DRILLED	4/8/2022	LOGGED BY	DHC	**BORING NO.**	**B-1**
DRIVE WEIGHT	140 lbs.	DROP	30 inches	DEPTH TO GROUNDWATER (ft.)	17
DRILLING METHOD	8" HSA	DRILLER	Baja Exploration	SURFACE ELEVATION (ft.)	21 ±(MSL)

ELEVATION (feet)	DEPTH (feet)	SAMPLES (Bulk / Driven)	BLOWS / FOOT	MOISTURE (%)	DRY DENSITY (pcf)	ADDITIONAL TESTS	GRAPHIC LOG	U.S.C.S. CLASSIFICATION	DESCRIPTION
	0								3 inches of asphalt concrete with 6 inches of base
								ML	ARTIFICIAL FILL: Sandy SILT; dark brown; slightly moist
								CL	Sandy lean CLAY; dark brown; slightly moist
16	5	Driven	18					CL	ALLUVIUM: Sandy lean CLAY; very stiff; dark brown; slightly moist
11	10	Driven	18	4.6	98.2	DS		SM	Silty SAND; medium dense; brown; slightly moist; mostly fine sand
6	15	Driven	17					CL	Sandy lean CLAY; very stiff; brown; slightly moist
	17								▼
1	20	Driven	49	10.2	126.1			SM	Silty SAND; dense; brown; wet; mostly coarse sand with approximately 5% gravel
-4	25	Driven	14/50 for 6"					SM	-- same; very dense
									Total Depth = 26.5 feet Backfilled on 4/8/2022 Groundwater encountered at 17 feet. Backfilled with neat cement grout. Surface patched with PCC.
-9	30								
-14	35								

BORING LOG 220205.1 - LATERRA DEL REY AVENUE.GPJ TWINING LABS.GDT 8/30/22

TWINING

LOG OF BORING

Del Rey Avenue Building Project
4112 Del Rey Avenue
Marina Del Rey, California

PROJECT NO.	REPORT DATE	
220205.1	August 2022	FIGURE A - 2

DATE DRILLED	4/7/2022	LOGGED BY	DHC	**BORING NO.**	**B-2**
DRIVE WEIGHT	140 lbs.	DROP	30 inches	DEPTH TO GROUNDWATER (ft.)	23.7
DRILLING METHOD	8" HSA	DRILLER	Baja Exploration	SURFACE ELEVATION (ft.)	24 ±(MSL)

ELEVATION (feet)	DEPTH (feet)	SAMPLES (Bulk / Driven)	BLOWS / FOOT	MOISTURE (%)	DRY DENSITY (pcf)	ADDITIONAL TESTS	GRAPHIC LOG	U.S.C.S. CLASSIFICATION	DESCRIPTION
		Bulk				DS, MAX			4.5 inches of asphalt concrete over 3 inches of base
								CL	ARTIFICIAL FILL: Sandy lean CLAY; black to dark brown to light brown; slightly moist; with some silty sand
19	5	Driven	10					CL	-- same; stiff; dark brown; slightly moist; with some pieces of asphalt and brick
								CL	ALLUVIUM: Sandy lean CLAY; medium brown; some fine gravel
14	10	Driven	21	11.3	117.4	C		CL	-- same; stiff
9	15	Driven	22			#200, ATT		CL	Lean CLAY with sand; very stiff; medium brown; slightly moist to moist
4	20	Driven	32	16.1	113.4			SM	Silty SAND; medium dense; dark brown; moist to wet
-1	25	Driven	47			#200		SP-SM	Poorly graded SAND with silt; dense; medium brown; moist to wet; mostly fine to medium sand with some coarse sand
-6	30	Driven	50 for 4"	11.8	116.0			SP-SM	-- same; very dense; light brown; wet; mostly coarse sand
-11	35								

TWINING

LOG OF BORING

Del Rey Avenue Building Project
4112 Del Rey Avenue
Marina Del Rey, California

PROJECT NO.	REPORT DATE	
220205.1	August 2022	FIGURE A - 3

DATE DRILLED	4/7/2022	LOGGED BY	DHC	**BORING NO.**	**B-2**
DRIVE WEIGHT	140 lbs.	DROP	30 inches	DEPTH TO GROUNDWATER (ft.)	23.7
DRILLING METHOD	8" HSA	DRILLER	Baja Exploration	SURFACE ELEVATION (ft.)	24 ±(MSL)

ELEVATION (feet)	DEPTH (feet)	SAMPLES Bulk	SAMPLES Driven	BLOWS / FOOT	MOISTURE (%)	DRY DENSITY (pcf)	ADDITIONAL TESTS	GRAPHIC LOG	U.S.C.S. CLASSIFICATION	DESCRIPTION
				26			#200		SP-SM SP-SM	Poorly graded SAND with silt; dense; medium brown; moist to wet; mostly fine to medium sand with some coarse sand *(continued)* -- same; medium dense; brown; wet; fine to coarse sand; with some fine to medium gravel
-16	40			50 for 5"	13.1	120.5			SM	Silty SAND; very dense; yellowish-orangish brown; wet; with approximately 5% gravel
-21	45			8					SM	-- same; loose; brown with some oxidation staining; wet; with some clay and no gravel
-26	50			33	18.6	110.6			SP-SM	Poorly graded SAND with silt; medium dense; brown; wet; with approximately 5% gravel
										Total Depth = 51.5 feet Backfilled on 4/7/2022 Groundwater encountered at 23.7 feet. Backfilled with neat cement grout. Surface patched with PCC.
-31	55									
-36	60									
-41	65									
-46	70									

TWINING

LOG OF BORING

Del Rey Avenue Building Project
4112 Del Rey Avenue
Marina Del Rey, California

PROJECT NO.	REPORT DATE	
220205.1	August 2022	FIGURE A - 3

DATE DRILLED	4/7/2022	LOGGED BY	DHC	**BORING NO.**	**B-3**
DRIVE WEIGHT	140 lbs.	DROP	30 inches	DEPTH TO GROUNDWATER (ft.)	19.5
DRILLING METHOD	8" HSA	DRILLER	Baja Exploration	SURFACE ELEVATION (ft.)	22 ±(MSL)

ELEVATION (feet)	DEPTH (feet)	SAMPLES Bulk	SAMPLES Driven	BLOWS / FOOT	MOISTURE (%)	DRY DENSITY (pcf)	ADDITIONAL TESTS	GRAPHIC LOG	U.S.C.S. CLASSIFICATION	DESCRIPTION
										3 inches of asphalt concrete over 4 inches of base
									CL	ARTIFICIAL FILL: Sandy lean CLAY; dark brown; slightly moist; some clayey sand
17	5		X	37	11.0	124.3	C		CL	ALLUVIUM: Sandy lean CLAY; very stiff; dark brown; moist; with some black gravel
12	10			17					SM	Silty SAND; medium dense; brown; slightly moist; with approximately 10% gravel
7	15		X	29	18.8	111.5	C		CL	Lean CLAY with sand; very stiff; brown; slightly moist; with approximately 5% fine gravel
2	20			28					SM	Silty SAND; medium dense; medium brown; wet
-3	25		X	50 for 3"	11.1	120.4			SM	-- same; very dense; brown; wet; with some clay and fine gravel
-8	30			44/50 for 3"					SP-SM	Poorly graded SAND with silt; very dense; light brown with some orangish brown; wet; with approximately 10% gravel
										Total Depth = 31.5 feet Backfilled on 4/7/2022 Groundwater encountered at 19.5 feet. Backfilled with neat cement grout. Surface patched with PCC.
-13	35									

TWINING

LOG OF BORING

Del Rey Avenue Building Project
4112 Del Rey Avenue
Marina Del Rey, California

PROJECT NO.	REPORT DATE	
220205.1	August 2022	FIGURE A - 4

DATE DRILLED	4/8/2022	LOGGED BY	DHC	BORING NO.	B-4
DRIVE WEIGHT	140 lbs.	DROP	30 inches	DEPTH TO GROUNDWATER (ft.)	17.75
DRILLING METHOD	8" HSA	DRILLER	Baja Exploration	SURFACE ELEVATION (ft.)	20 ±(MSL)

ELEVATION (feet)	DEPTH (feet)	SAMPLES Bulk	SAMPLES Driven	BLOWS / FOOT	MOISTURE (%)	DRY DENSITY (pcf)	ADDITIONAL TESTS	GRAPHIC LOG	U.S.C.S. CLASSIFICATION	DESCRIPTION
	0								CL	4 inches of asphalt concrete over 4 inches of base ARTIFICIAL FILL: Sandy lean CLAY; brown; slightly moist
15	5			20	11.4	117.7	DS		SM	ALLUVIUM: Silty SAND; medium dense; dark brown; slightly moist
10	10			5			#200, ATT		CL	Lean CLAY with sand; medium stiff; dark brown; slightly moist to moist
5	15			32	16.0	115.8	C		CL	-- same; very stiff; some fine black gravel; moist
0	20			42			#200		SP-SM	Poorly graded SAND with silt; dense; brown; wet; mostly coarse sand with approximately 10% gravel
-5	25			50 for 5"	10.3	125.4			SP-SM	-- same; very dense; no gravel
-10	30			22			#200, ATT		CL	Sandy lean CLAY; very stiff; grayish brown with orange oxidation staining; wet
-15	35									

TWINING

LOG OF BORING

Del Rey Avenue Building Project
4112 Del Rey Avenue
Marina Del Rey, California

PROJECT NO.	REPORT DATE	
220205.1	August 2022	FIGURE A - 5

DATE DRILLED	4/8/2022	LOGGED BY	DHC	**BORING NO.**	**B-4**
DRIVE WEIGHT	140 lbs.	DROP	30 inches	DEPTH TO GROUNDWATER (ft.)	17.75
DRILLING METHOD	8" HSA	DRILLER	Baja Exploration	SURFACE ELEVATION (ft.)	20 ±(MSL)

ELEVATION (feet)	DEPTH (feet)	SAMPLES Bulk	SAMPLES Driven	BLOWS / FOOT	MOISTURE (%)	DRY DENSITY (pcf)	ADDITIONAL TESTS	GRAPHIC LOG	U.S.C.S. CLASSIFICATION	DESCRIPTION
			X	21	9.7	115.0			SP-SM	Poorly graded SAND with silt; medium dense; brown; wet
-20	40		|	21			#200		SM	Silty SAND; medium dense; grayish brown; with orange oxidation staining; wet
-25	45		X	26/50 for 3"	15.1	114.0			SM	-- same; very dense
-30	50		|	56					SP-SM	Poorly graded SAND with silt; very dense; light brown; wet
										Total Depth = 51.5 feet Backfilled on 4/8/2022 Groundwater encountered at 17.75 feet. Backfilled with neat cement grout. Surface patched with PCC.
-35	55									
-40	60									
-45	65									
-50	70									

TWINING

LOG OF BORING

Del Rey Avenue Building Project
4112 Del Rey Avenue
Marina Del Rey, California

PROJECT NO.	REPORT DATE	FIGURE A - 5
220205.1	August 2022	

DATE DRILLED	4/7/2022	LOGGED BY	DHC	**BORING NO.**	**B-5**
DRIVE WEIGHT	140 lbs.	DROP	30 inches	DEPTH TO GROUNDWATER (ft.)	19.8
DRILLING METHOD	8" HSA	DRILLER	Baja Exploration	SURFACE ELEVATION (ft.)	23 ±(MSL)

ELEVATION (feet)	DEPTH (feet)	SAMPLES Bulk	SAMPLES Driven	BLOWS / FOOT	MOISTURE (%)	DRY DENSITY (pcf)	ADDITIONAL TESTS	GRAPHIC LOG	U.S.C.S. CLASSIFICATION	DESCRIPTION
										3 inches of asphalt concrete over 2 inches of base
							#200, ATT, CORR, EI		CL	ARTIFICIAL FILL: Sandy lean CLAY; dark brown; moist
										-- increased moisture
18	5			13					CL	ALLUVIUM: Sandy lean CLAY; stiff; brown; moist
13	10			15	7.1	106.2			SM	Silty SAND; brown; slightly moist; mostly fine sand
8	15			20					CL	Lean CLAY with sand; medium dense; brown; slightly moist
3	20			67	12.1	119.5			SM	Silty SAND; dense; brown; wet; with approximately 10% gravel
-2	25			38					SP-SM	Poorly graded SAND with silt; dense; light brown; wet; with some fine gravel
-7	30			26/50 for 3"	8.1	134.6			SP-SM	-- same; very dense
										Total Depth = 31.5 feet Backfilled on 4/7/2022 Groundwater encountered at 19.8 feet. Backfilled with neat cement grout. Surface patched with PCC.
-12	35									

TWINING

LOG OF BORING

Del Rey Avenue Building Project
4112 Del Rey Avenue
Marina Del Rey, California

PROJECT NO.	REPORT DATE	
220205.1	August 2022	FIGURE A - 6

DATE DRILLED	4/7/2022	LOGGED BY	CDD	**BORING NO.**	**P-1**
DRIVE WEIGHT	N/A	DROP	N/A	DEPTH TO GROUNDWATER (ft.)	NE
DRILLING METHOD	Hand Auger	DRILLER	Baja Exploration	SURFACE ELEVATION (ft.)	21 ±(MSL)

ELEVATION (feet)	DEPTH (feet)	SAMPLES Bulk	SAMPLES Driven	BLOWS / FOOT	MOISTURE (%)	DRY DENSITY (pcf)	ADDITIONAL TESTS	GRAPHIC LOG	U.S.C.S. CLASSIFICATION	DESCRIPTION
										3.5 inches of asphalt concrete with 4.5 inches of base
							#200, ATT		CL	ARTIFICIAL FILL: Sandy lean CLAY; dark brown; slightly moist; very fine sand
16	5									Total Depth = 5.0 feet Backfilled on 4/7/2022 Backfilled with cuttings. Surface patched with PCC.
11	10									
6	15									
1	20									
-4	25									
-9	30									
-14	35									

BORING LOG 220205.1 - LATERRA DEL REY AVENUE.GPJ TWINING LABS.GDT 8/30/22

TWINING

LOG OF BORING

Del Rey Avenue Building Project
4112 Del Rey Avenue
Marina Del Rey, California

PROJECT NO.	REPORT DATE	FIGURE A - 7
220205.1	August 2022	

DATE DRILLED	4/7/2022	LOGGED BY	CDD	**BORING NO.**	**P-2**
DRIVE WEIGHT	N/A	DROP	N/A	DEPTH TO GROUNDWATER (ft.)	NE
DRILLING METHOD	Hand Auger	DRILLER	Baja Exploration	SURFACE ELEVATION (ft.)	20 ±(MSL)

ELEVATION (feet)	DEPTH (feet)	SAMPLES Bulk	SAMPLES Driven	BLOWS / FOOT	MOISTURE (%)	DRY DENSITY (pcf)	ADDITIONAL TESTS	GRAPHIC LOG	U.S.C.S. CLASSIFICATION	DESCRIPTION
										3 inches of asphalt concrete with 7 inches of base
							RV		ML	ARTIFICIAL FILL: Sandy SILT; medium brown; slightly moist; some debris, brick, fine gravel
15	5									Total Depth = 5.0 feet Backfilled on 4/7/2022 Backfilled with cuttings. Surface patched with PCC.
10	10									
5	15									
0	20									
-5	25									
-10	30									
-15	35									

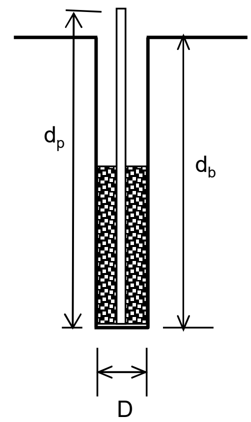
TWINING

LOG OF BORING

Del Rey Avenue Building Project
4112 Del Rey Avenue
Marina Del Rey, California

PROJECT NO.	REPORT DATE	
220205.1	August 2022	FIGURE A - 8

BORING PERCOLATION FIELD Log



Project No.: 220205.1
Project Name: 4112 Del Rey Ave

Boring No.: **P-1**
Diameter of Boring (D): 8.0 inches
Depth of Boring (d_b): 5.0 feet = 60 inches
Diameter of Perc. Pipe : 3.0 inches
Length of Pipe (d_p) : 5.0 feet = 60 inches

PRE-SOAK

Date: 4/7/2022
Start Time: 8:05 AM
Elapsed Time: 60.00 minutes

REDUCTION FACTORS

Boring method: RF_t = 2
Site variability: RF_v = 1 (1 ~ 3)
Long-term siltation: RF_s = 1 (1 ~ 3)
Total Reduction Factor: $RF = RF_t \times RF_v \times RF_s$ = **2**

PERCOLATION TEST **Test Date:** 4/7/2022 **Test Performer:** CD **Calculated by:** CD

Reading Number	Initial Time T_i	Final Time T_f	Elapsed Time ΔT (min)	Initial depth to water surface dw_i (inches)	Final depth to water surface dw_f (inches)	Initial height of water column d_i (inches)	Drop of water column Δd (inches)	Water height drop rate $k_i = \Delta d / \Delta T$ (inch/hr)	Surface area factor S_f	Raw Percolation Rate $k = k_i / S_f$ (inch/hr)
1	9:05 AM	9:35 AM	30	0.0	5.25	60.0	5.3	10.50	29.7	0.35
2	9:40 AM	10:10 AM	30	0.0	4.88	60.0	4.9	9.75	29.8	0.33
3	10:12 AM	10:42 AM	30	0.0	4.08	60.0	4.1	8.16	30.0	0.27
4	10:48 AM	11:18 AM	30	0.0	3.75	60.0	3.8	7.50	30.1	0.25
5	11:20 AM	11:50 AM	30	0.0	3.75	60.0	3.8	7.50	30.1	0.25
6	11:51 AM	12:21 PM	30	0.0	3.75	60.0	3.8	7.50	30.1	0.25

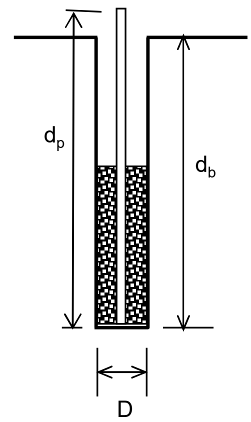
Measured Percolation Rate $k_{measured}$ (inch/hr) = **0.25**

Design Infiltration rate (inch/hr) = $k_{measured}$/RF = **0.12**

County Guidelines For Geotechnical Investigation and Reporting Low Impact Development Stormwater Infiltration, GS200.1, dated 06/30/21

BORING PERCOLATION FIELD Log

Project No.: 220205.1
Project Name: 4112 Del Rey Ave



Boring No.: P-2
Diameter of Boring (D): 8.0 inches
Depth of Boring (d_b): 5.0 feet = 60 inches
Diameter of Perc. Pipe : 3.0 inches
Length of Pipe (d_p) : 5.0 feet = 60 inches

PRE-SOAK
Date: 4/7/2022
Start Time: 8:35 AM
Elapsed Time: 60.00 minutes

REDUCTION FACTORS
Boring method: RF_t = 2
Site variability: RF_v = 1 (1 ~ 3)
Long-term siltation: RF_s = 1 (1 ~ 3)
Total Reduction Factor: $RF = RF_t \times RF_v \times RF_s$ = **2**

PERCOLATION TEST **Test Date:** 4/7/2022 **Test Performer:** CD **Calculated by:** CD

Reading Number	Initial Time T_i	Final Time T_f	Elapsed Time ΔT (min)	Initial depth to water surface dw_i (inches)	Final depth to water surface dw_f (inches)	Initial height of water column d_i (inches)	Drop of water column Δd (inches)	Water height drop rate $k_i = \Delta d / \Delta T$ (inch/hr)	Surface area factor S_f	Raw Percolation Rate $k = k_i / S_f$ (inch/hr)
1	9:45 AM	10:15 AM	30	6.0	13.9	54.0	7.9	15.84	26.0	0.61
2	10:18 AM	10:48 AM	30	0.0	11.4	60.0	11.4	22.80	28.2	0.81
3	10:52 AM	11:22 AM	30	6.0	10.2	54.0	4.2	8.40	27.0	0.31
4	11:24 AM	11:54 AM	30	6.0	9.6	54.0	3.6	7.20	27.1	0.27
5	11:55 AM	12:25 PM	30	6.0	9.6	54.0	3.6	7.20	27.1	0.27
6	12:28 PM	12:58 PM	30	6.0	9.6	54.0	3.6	7.20	27.1	0.27

Measured Percolation Rate $k_{measured}$ (inch/hr) = **0.27**

Design Infiltration rate (inch/hr) = $k_{measured}$/RF = **0.13**

County Guidelines For Geotechnical Investigation and Reporting Low Impact Development Stormwater Infiltration, GS200.1, dated 06/30/21

TWINING CONSULTING

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APPENDIX B
LABORATORY TESTING

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Appendix B - Laboratory Testing

Laboratory Moisture Content and Density Tests

The moisture content and dry densities of driven samples obtained from the exploratory borings were evaluated in general accordance with the latest version of ASTM D 2937. The results are shown on the boring logs in Appendix A and Table B-1 in this appendix.

Wash Sieve

The amount of fines passing the No. 200 sieve was evaluated by the wash sieve on selected soil samples. The test procedure was in general accordance with ASTM D 1140. The test results are presented in Table B-2.

Atterberg Limits

Tests were performed on selected representative fine-grained soil samples to evaluate the liquid limit, plastic limit, and plasticity index in general accordance with ASTM D4318. These test results were utilized to evaluate the soil classification in accordance with the Unified Soil Classification System. The test results are summarized in on Figure B-1 and Table B-3.

Expansion Index

The expansion index of a select soil sample was evaluated in general accordance with ASTM D 4829. The specimen was molded under a specified compactive energy at approximately 50 percent saturation. The prepared 1-inch thick by 4-inch diameter specimen was loaded with a surcharge of 144 pounds per square foot and was inundated with tap water. Readings of volumetric swell were made for a period of 24 hours. The result of Expansion Index test is presented in Table B-4.

Maximum Dry Density-Optimum Moisture Content

A Modified Proctor test was performed on near-surface soils to evaluate the maximum dry density and optimum water content for compaction. The test was performed in accordance with ASTM D 1557 Method A. The result is summarized in Table B-5 and a copy of the curve is presented as Figure B-2.

Direct Shear

Direct shear tests were performed on a remolded sample and select modified-California soil samples in general accordance with the latest version of ASTM D 3080 to evaluate the shear strength characteristics of the selected materials. The remolded sample was prepared to a relative compaction of 90% according to the maximum density as determined by ASTM D1557. The samples were inundated during shearing to represent adverse field conditions. Test results are presented on Figures B-3 through B-5.

Consolidation Test

Consolidation tests were performed on select modified-California soil samples in general accordance with the latest version of ASTM D2435. The samples were inundated during testing to represent adverse field conditions. The percent consolidation for each load cycle was recorded as a ratio of the amount of vertical compression to the original height of the sample. The results of testing are presented on Figures B-6 through B-9.

Resistance Value (R-value)

R-value testing was performed on a select bulk sample of the near-surface soils encountered at the site. The test was performed in general accordance with ASTM D2844. The result is summarized in Table B-5.

TWINING CONSULTING

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Table B-1 Moisture Content and Dry Density

Boring No.	Depth (feet)	Moisture Content (%)	Dry Density (pcf)
B-1	10	4.6	98.2
B-1	20	10.2	126.1
B-2	10	11.3	117.4
B-2	20	16.1	113.4
B-2	30	11.8	116.0
B-2	40	13.1	120.5
B-2	50	18.6	110.6
B-3	5	11.0	124.3
B-3	15	18.8	111.5
B-3	25	11.1	120.4
B-4	5	11.4	117.7
B-4	15	16.0	115.8
B-4	25	10.3	125.4
B-4	35	9.7	115.0
B-4	45	15.1	114.0

Table B-2 Number 200 Wash Results

Boring No.	Depth (feet)	Percent Passing #200
B-2	15	74.2
B-2	25	8.7
B-2	35	5.3
B-4	10	79.8
B-4	20	8.9
B-4	30	51.7
B-4	40	46.3
B-5	0-5	51.2

Table B-3 Atterberg Limits Results

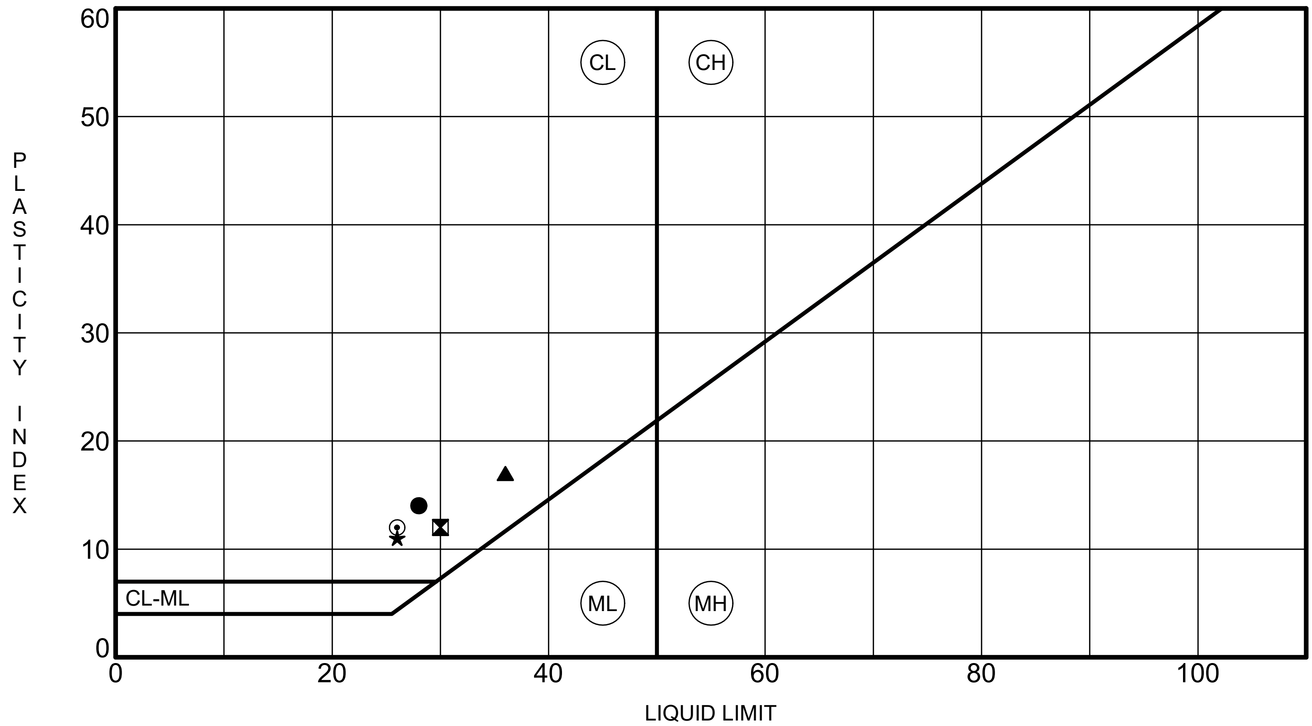
Boring No.	Depth (feet)	Liquid Limit	Plastic Limit	Plasticity Index	U.S.C.S. Classification
B-2	15	28	14	14	Lean Clay with Sand (CL)
B-4	10	30	18	12	Lean Clay with Sand (CL)
B-4	30	36	19	17	Sandy Lean Clay (CL)
B-5	0-5	26	15	11	Sandy Lean Clay (CL)

Table B-4 Expansion Index

Boring No.	Depth (feet)	Expansion Index	Expansion Potential
B-5	0 - 5	50	Low

Table B-5 - Resistance Value (R-value)

Boring No.	Depth (feet)	R Value
P-2	0-5	40



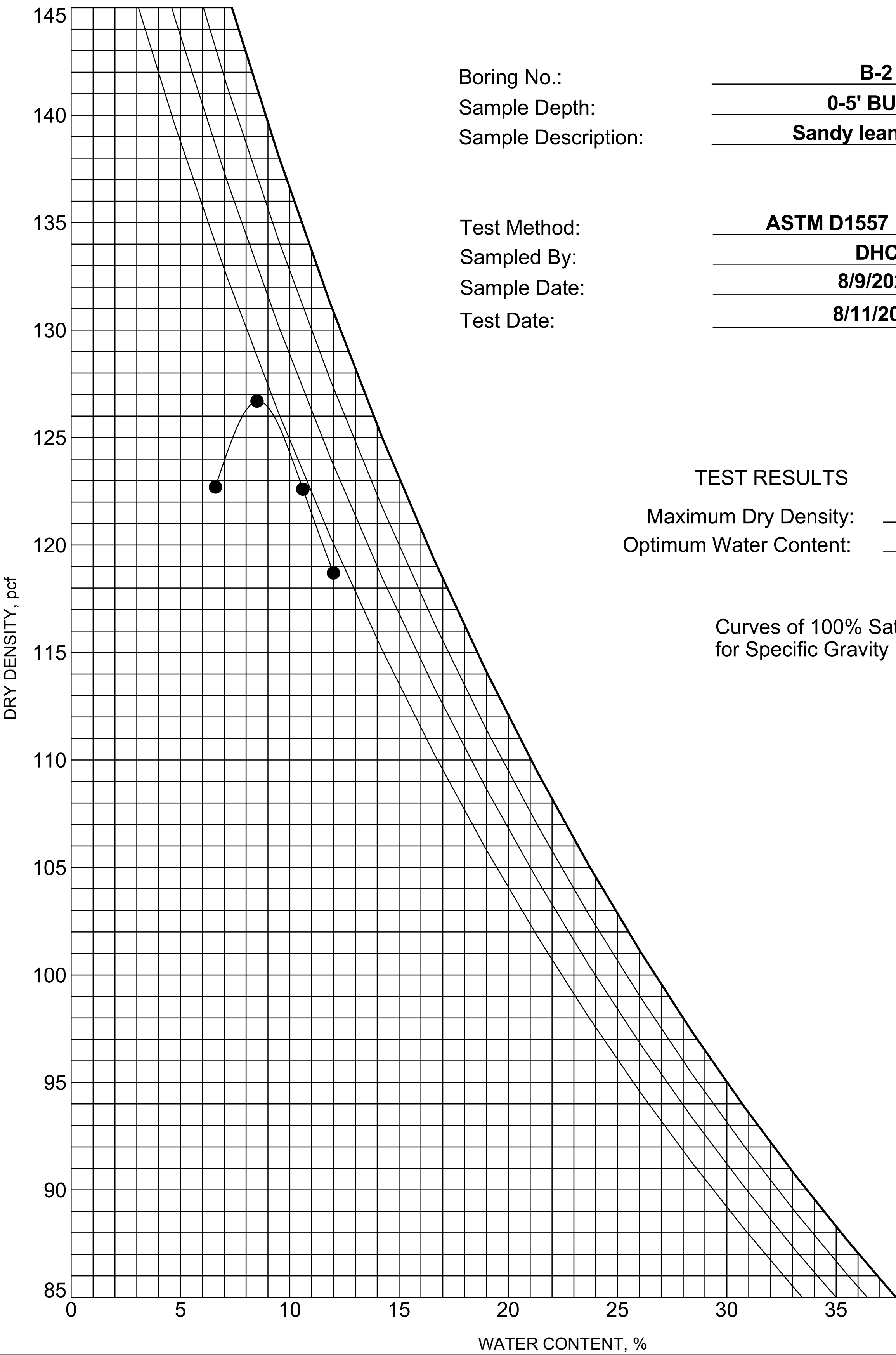
	Sample Location	LL	PL	PI	U.S.C.S. Classification
●	**B-2 at 15 ft**	**28**	**14**	**14**	**Lean CLAY with sand**
⧗	**B-4 at 10 ft**	**30**	**18**	**12**	**Lean CLAY with sand**
▲	**B-4 at 30 ft**	**36**	**19**	**17**	**Sandy lean CLAY**
★	**B-5 at 0-5' BULK**	**26**	**15**	**11**	**Sandy lean CLAY**
⊙	**P-1 at 0-5' BULK**	**26**	**14**	**12**	**Sandy lean CLAY**

TWINING

ATTERBERG LIMITS

Del Rey Avenue Building Project
4112 Del Rey Avenue
Marina Del Rey, California

PROJECT NO.	REPORT DATE	FIGURE B-1
220205.1	August 2022	



Boring No.:	**B-2**
Sample Depth:	**0-5' BULK**
Sample Description:	**Sandy lean CLAY**
Test Method:	**ASTM D1557 Method A**
Sampled By:	**DHC**
Sample Date:	**8/9/2022**
Test Date:	**8/11/2022**

TEST RESULTS

Maximum Dry Density: **126.5 pcf**

Optimum Water Content: **8.5 %**

Curves of 100% Saturation
for Specific Gravity Equal to:

2.80

2.70

2.60

2.50

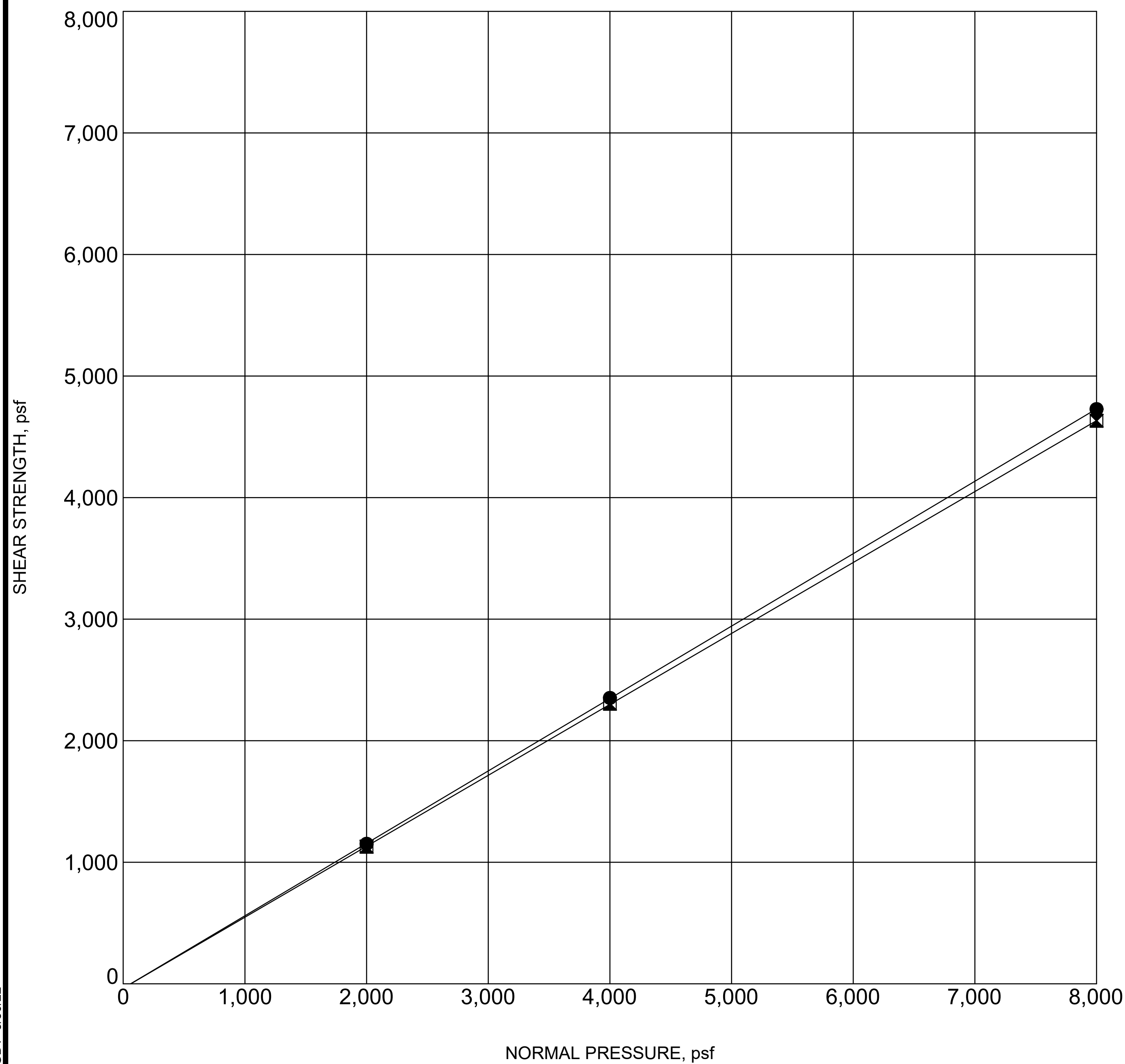
COMPACTION (MODIFIED BY PAUL) 220205.1 - LATERRA DEL REY AVENUE.GPJ TWINING LABS.GDT 8/30/22

TWINING

MOISTURE-DENSITY RELATIONSHIP

Del Rey Avenue Building Project
4112 Del Rey Avenue
Marina Del Rey, California

PROJECT NO.	REPORT DATE	FIGURE B-2
220205.1	August 2022	



Shear Strength Parameters

Boring No.:	B-1		
Sample Depth (ft):	10		
Sample Description:	Silty SAND		
Strain Rate (in./min):	0.005		
Dry Density (pcf):	98.2		

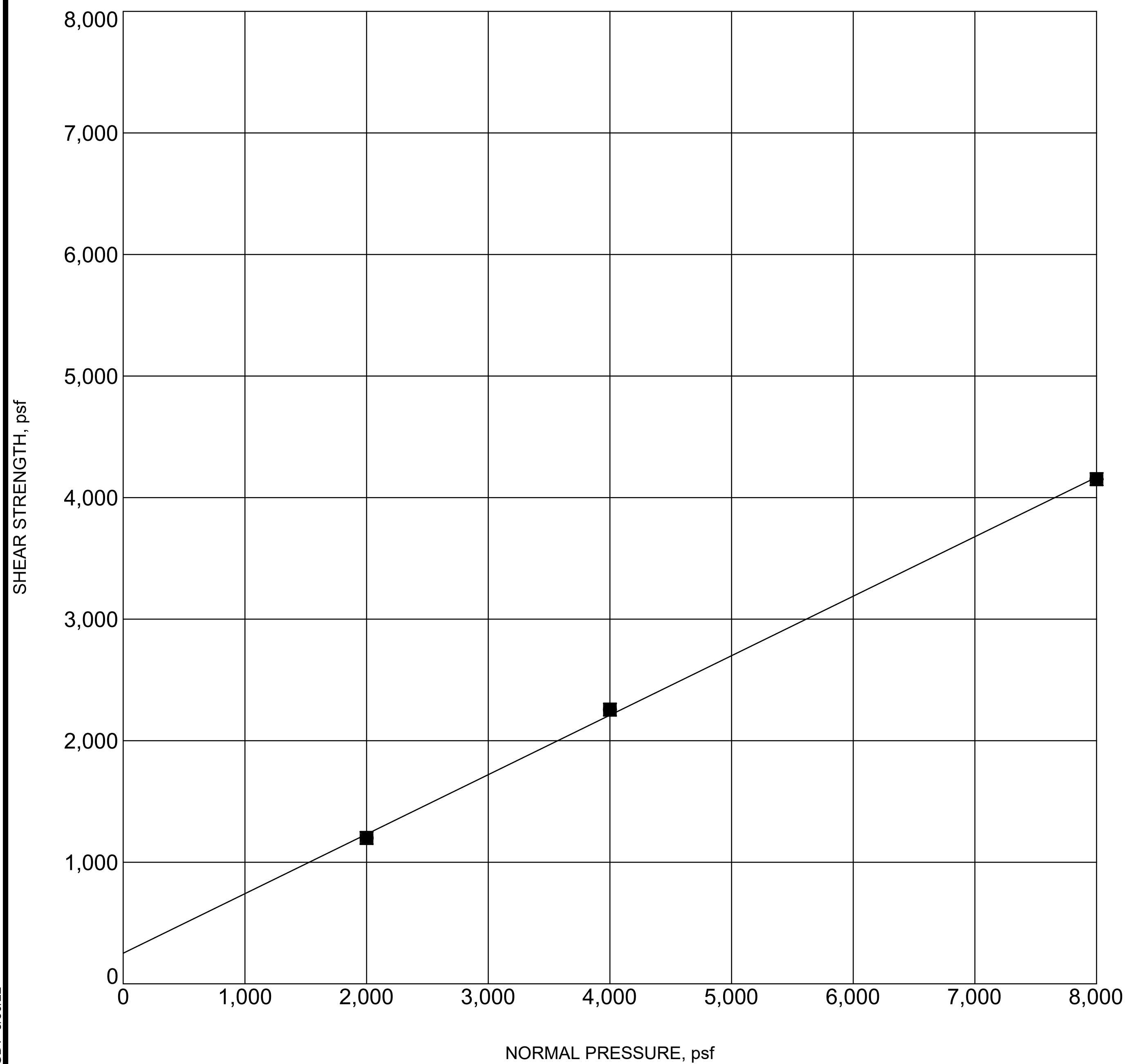
	Peak	**Ultimate**
Cohesion, C (psf):	0	0
Friction Angle, Ø (deg):	31	30
Initial Moisture (%):	4.6	
Final Moisture (%):	16.8	

TWINING

DIRECT SHEAR TEST

Del Rey Avenue Building Project
4112 Del Rey Avenue
Marina Del Rey, California

PROJECT NO.	REPORT DATE	FIGURE B-3
220205.1	August 2022	



Boring No.: B-2
Sample Depth (ft): 0-5' BULK
Sample Description: Sandy lean CLAY
Strain Rate (in./min): 0.005
Dry Density (pcf): 114.0

Shear Strength Parameters

	Peak	Ultimate
Cohesion, C (psf):	252	252
Friction Angle, Ø (deg):	26	26

Initial Moisture (%): 8.5
Final Moisture (%): 11.4

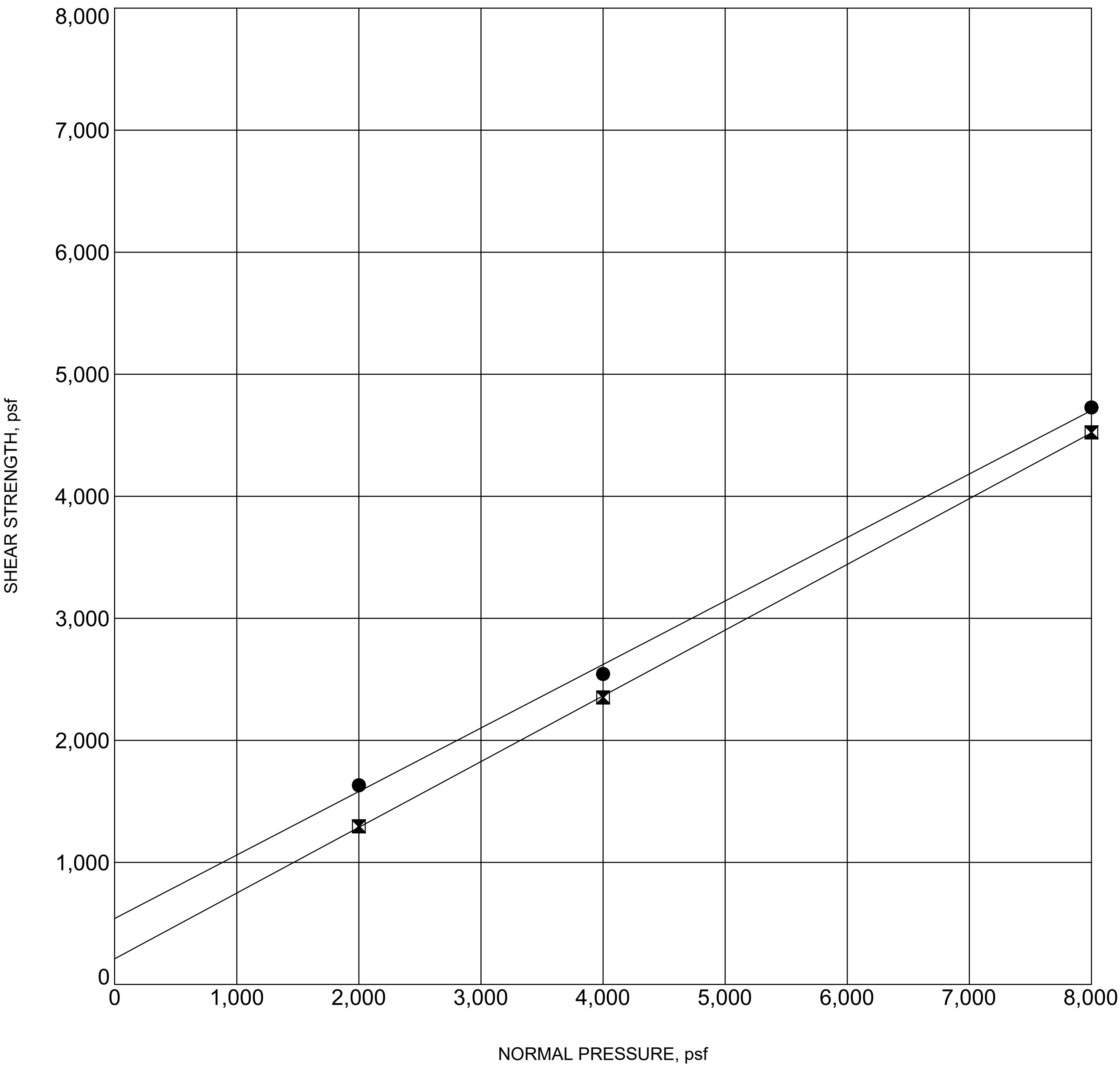
Recompacted to 90% Relative Compaction

TWINING

DIRECT SHEAR TEST

Del Rey Avenue Building Project
4112 Del Rey Avenue
Marina Del Rey, California

PROJECT NO.	REPORT DATE	FIGURE B-4
220205.1	August 2022	



Boring No.:	B-4
Sample Depth (ft):	5
Sample Description:	Silty SAND
Strain Rate (in./min):	0.005
Dry Density (pcf):	117.7

Shear Strength Parameters

	Peak	Ultimate
Cohesion, C (psf):	540	210
Friction Angle, Ø (deg):	27	28

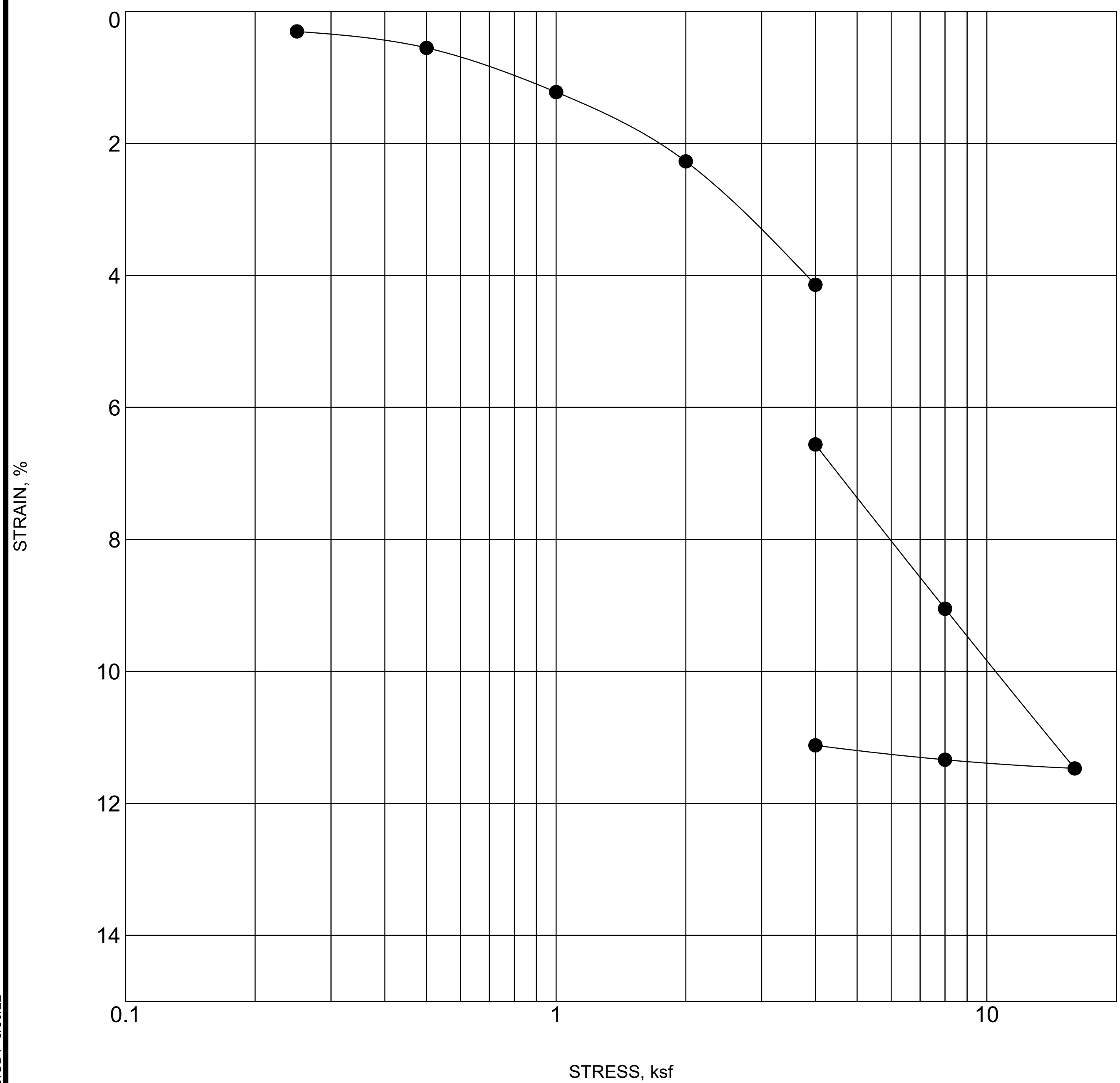
Initial Moisture (%): 11.4
Final Moisture (%): 10.1

TWINING

DIRECT SHEAR TEST

Del Rey Avenue Building Project
4112 Del Rey Avenue
Marina Del Rey, California

PROJECT NO.	REPORT DATE	FIGURE B-5
220205.1	August 2022	



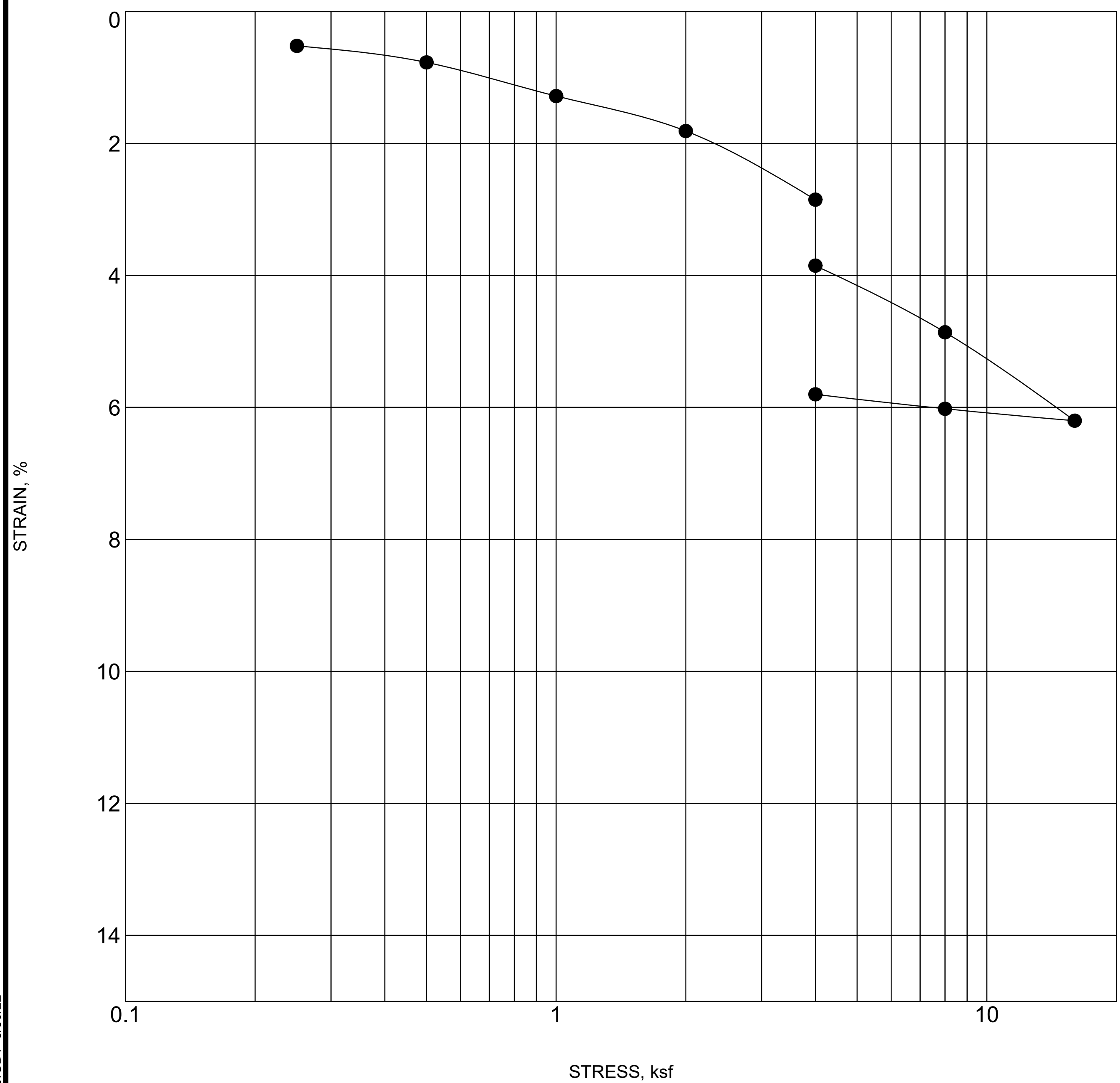
	Sample Location	Soil Description	Dry Density (pcf)	Moisture Content (%)
●	**B-2 at 10 ft**	**Sandy lean CLAY**	**117.4**	**11.3**

TWINING

CONSOLIDATION TEST

Del Rey Avenue Building Project
4112 Del Rey Avenue
Marina Del Rey, California

PROJECT NO.	REPORT DATE	FIGURE B-6
220205.1	August 2022	



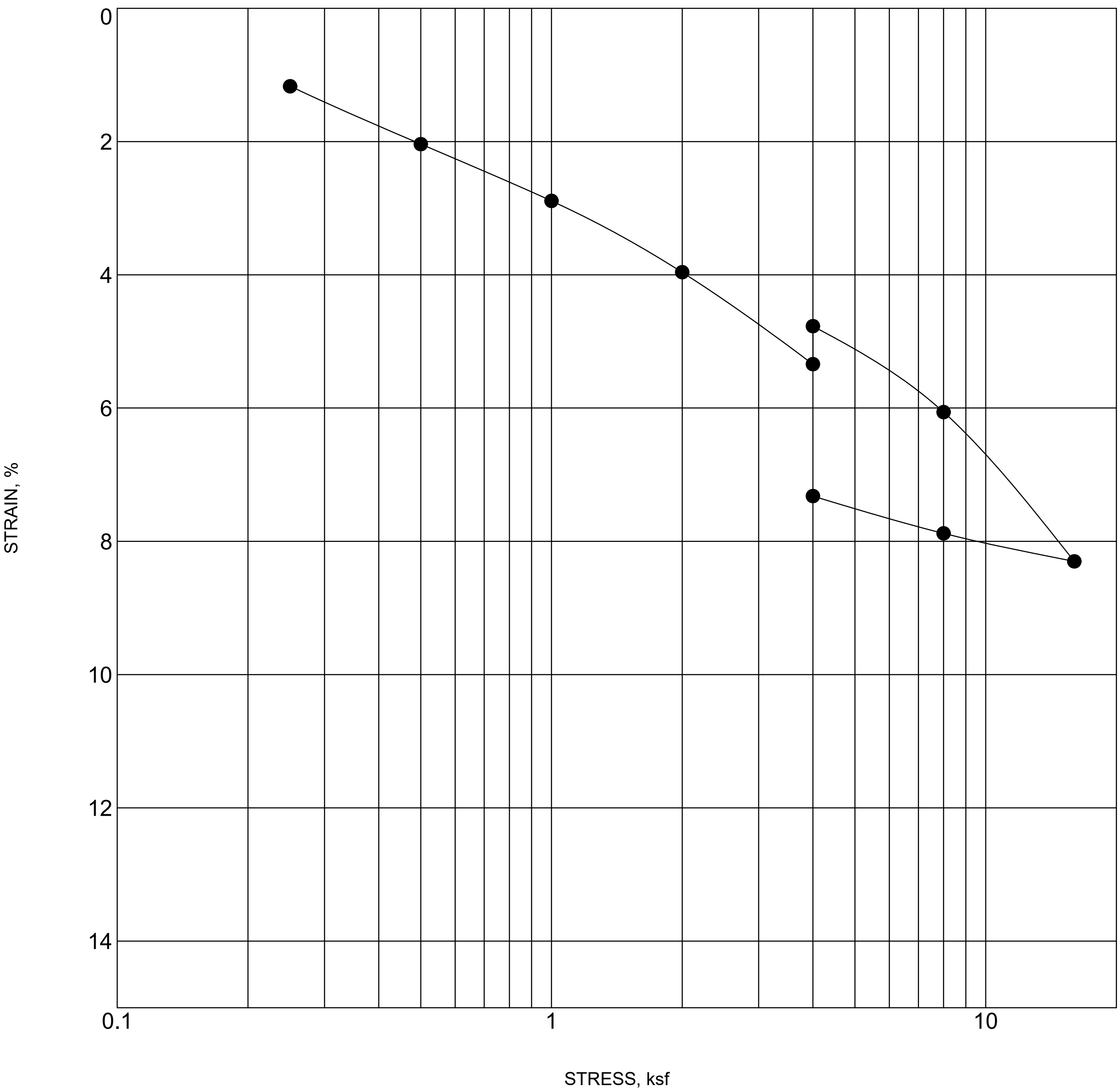
	Sample Location	Soil Description	Dry Density (pcf)	Moisture Content (%)
●	**B-3 at 5 ft**	**Sandy lean CLAY**	**124.3**	**11.0**

TWINING

CONSOLIDATION TEST

Del Rey Avenue Building Project
4112 Del Rey Avenue
Marina Del Rey, California

PROJECT NO.	REPORT DATE	FIGURE B-7
220205.1	August 2022	



	Sample Location	Soil Description	Dry Density (pcf)	Moisture Content (%)
●	**B-3 at 15 ft**	**Lean CLAY with sand**	**111.5**	**18.8**

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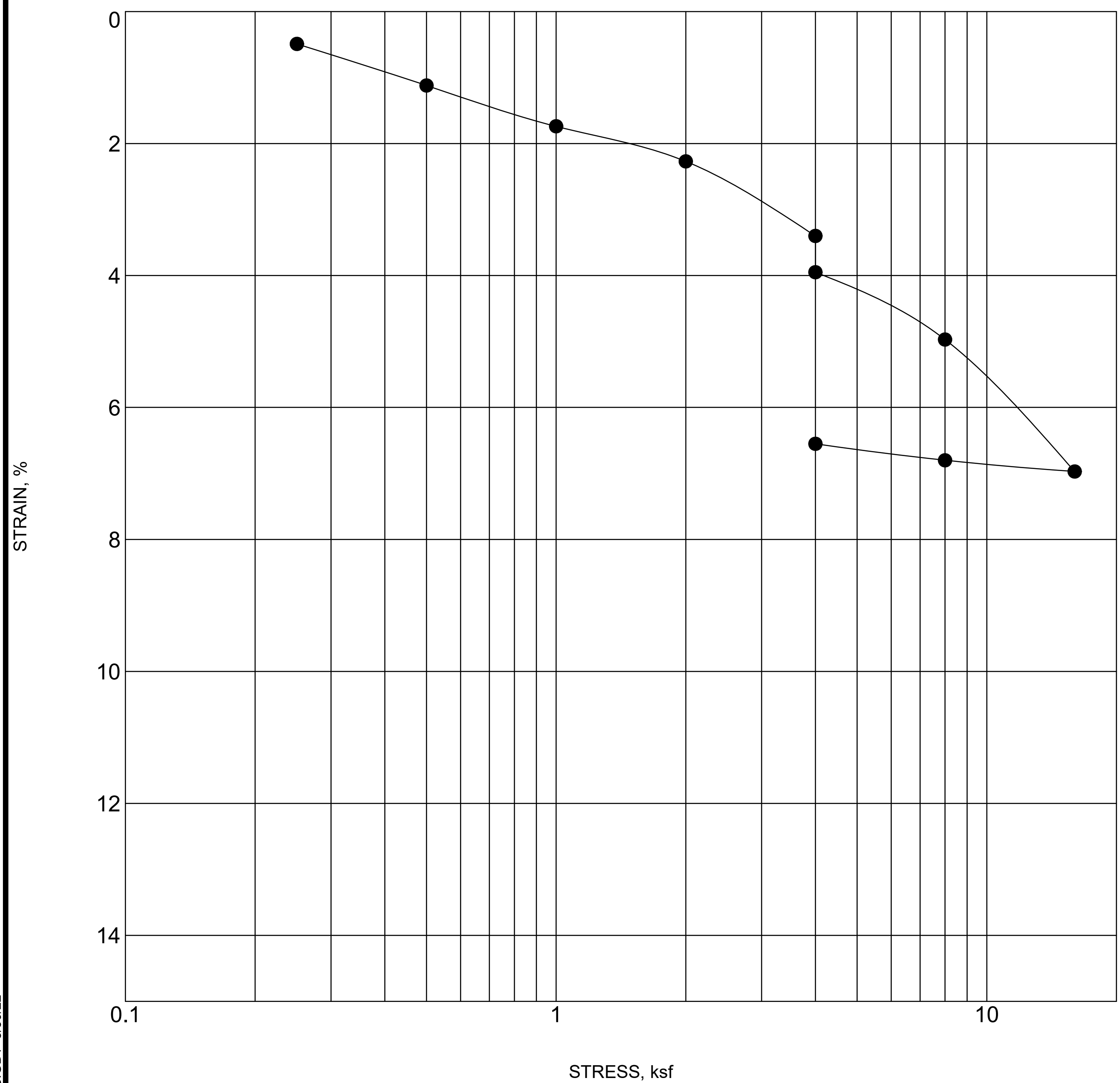
TWINING

CONSOLIDATION TEST

Del Rey Avenue Building Project
4112 Del Rey Avenue
Marina Del Rey, California

PROJECT NO.	REPORT DATE	FIGURE B-8
220205.1	August 2022	



	Sample Location	Soil Description	Dry Density (pcf)	Moisture Content (%)
●	**B-4 at 15 ft**	**Lean CLAY with sand**	**115.8**	**16.0**

TWINING

CONSOLIDATION TEST

Del Rey Avenue Building Project
4112 Del Rey Avenue
Marina Del Rey, California

PROJECT NO.	REPORT DATE	
220205.1	August 2022	FIGURE B-9

CONSOL STRAIN 220205.1 - LATERRA DEL REY AVENUE.GPJ TWINING LABS.GDT 8/30/22

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APPENDIX C

LIQUEFACTION ANALYSIS

TABLE OF CONTENTS

Kehoe Testing and Engineering
714-901-7270
steve@kehoetesting.com
www.kehoetesting.com

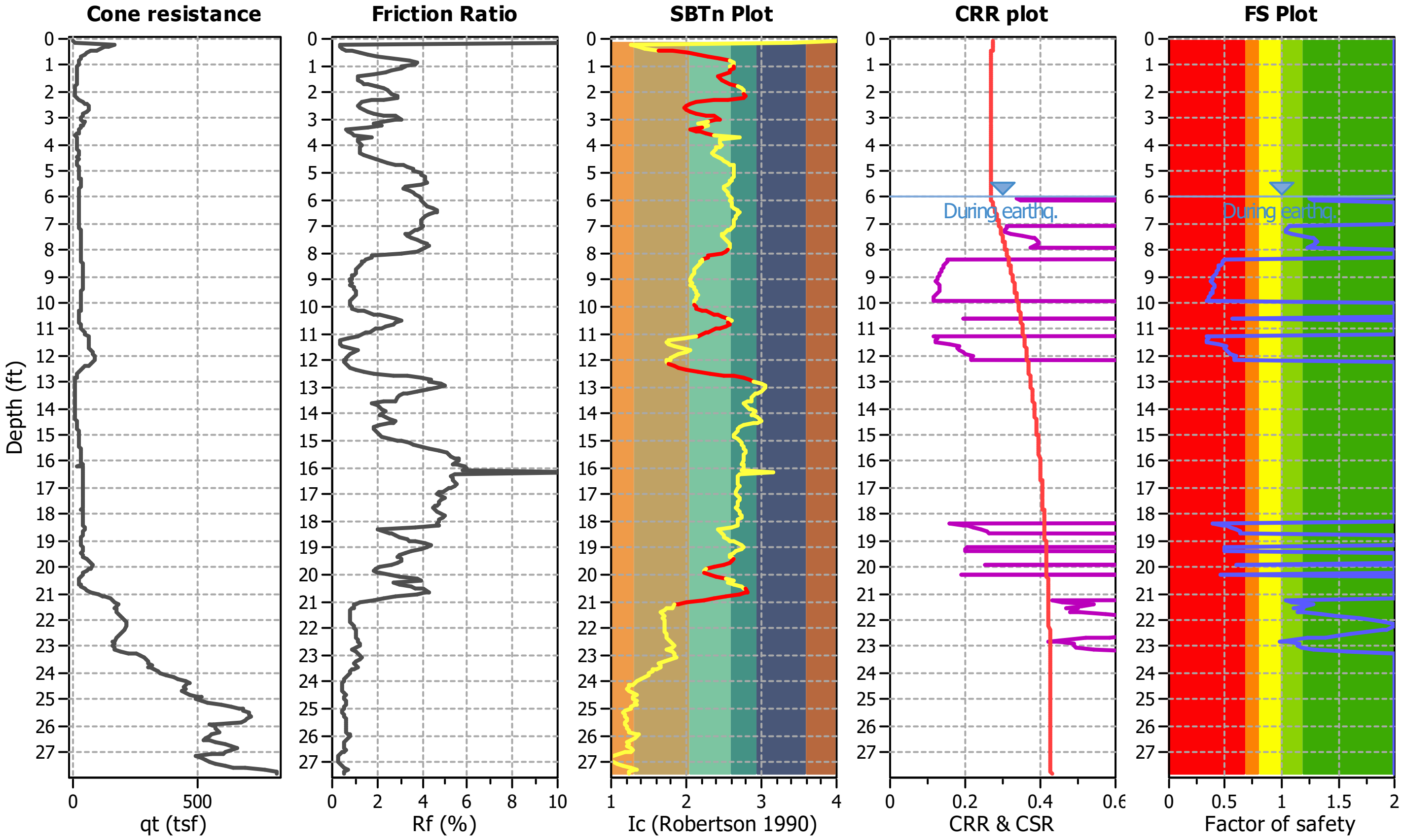
LIQUEFACTION ANALYSIS REPORT

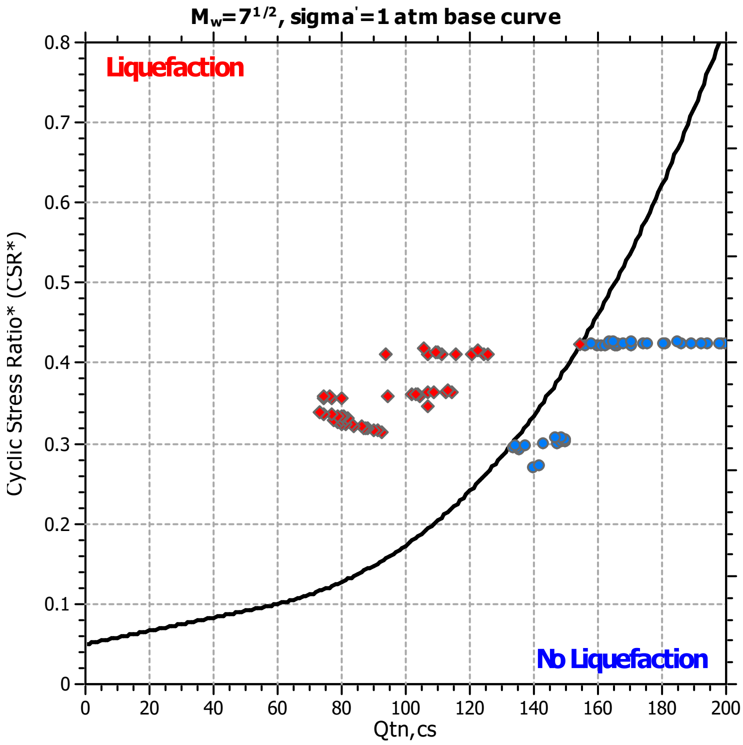
Project title : Twining Consulting **Location : 4112 Del Rey Ave, Marina Del Rey, CA**

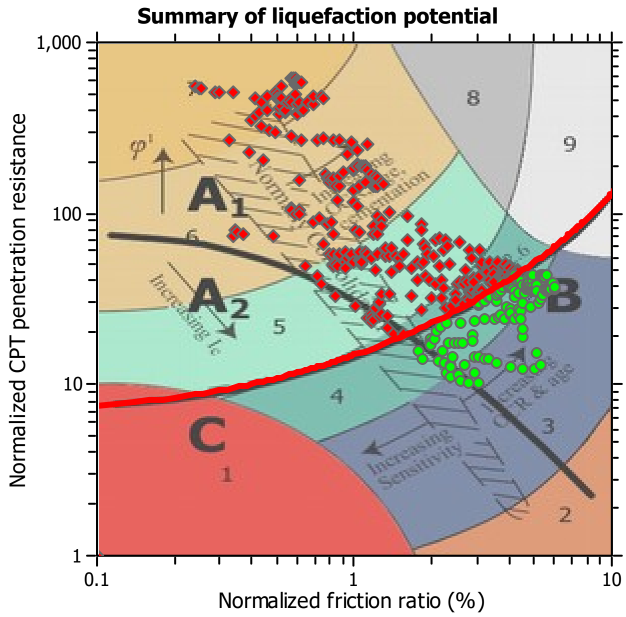
CPT file : CPT-1

Input parameters and analysis data

Analysis method:	NCEER (1998)	G.W.T. (in-situ):	17.40 ft	Use fill:	No	Clay like behavior applied:	Sands only
Fines correction method:	NCEER (1998)	G.W.T. (earthq.):	6.00 ft	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	1	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	6.35	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.58	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

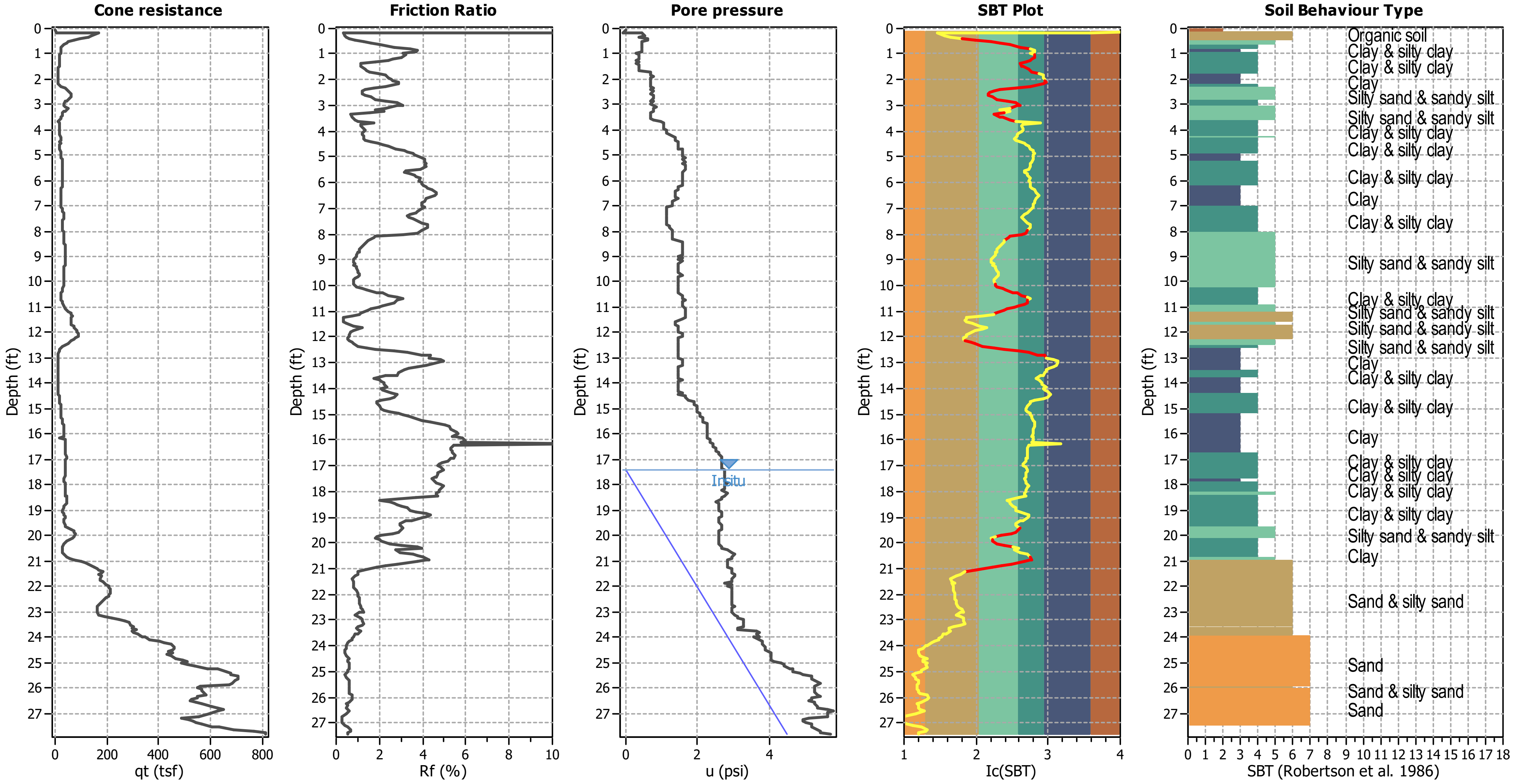






Zone A_1: Cyclic liquefaction likely depending on size and duration of cyclic loading
Zone A_2: Cyclic liquefaction and strength loss likely depending on loading and ground geometry
Zone B: Liquefaction and post-earthquake strength loss unlikely, check cyclic softening
Zone C: Cyclic liquefaction and strength loss possible depending on soil plasticity, brittleness/sensitivity, strain to peak undrained strength and ground geometry

CPT basic interpretation plots



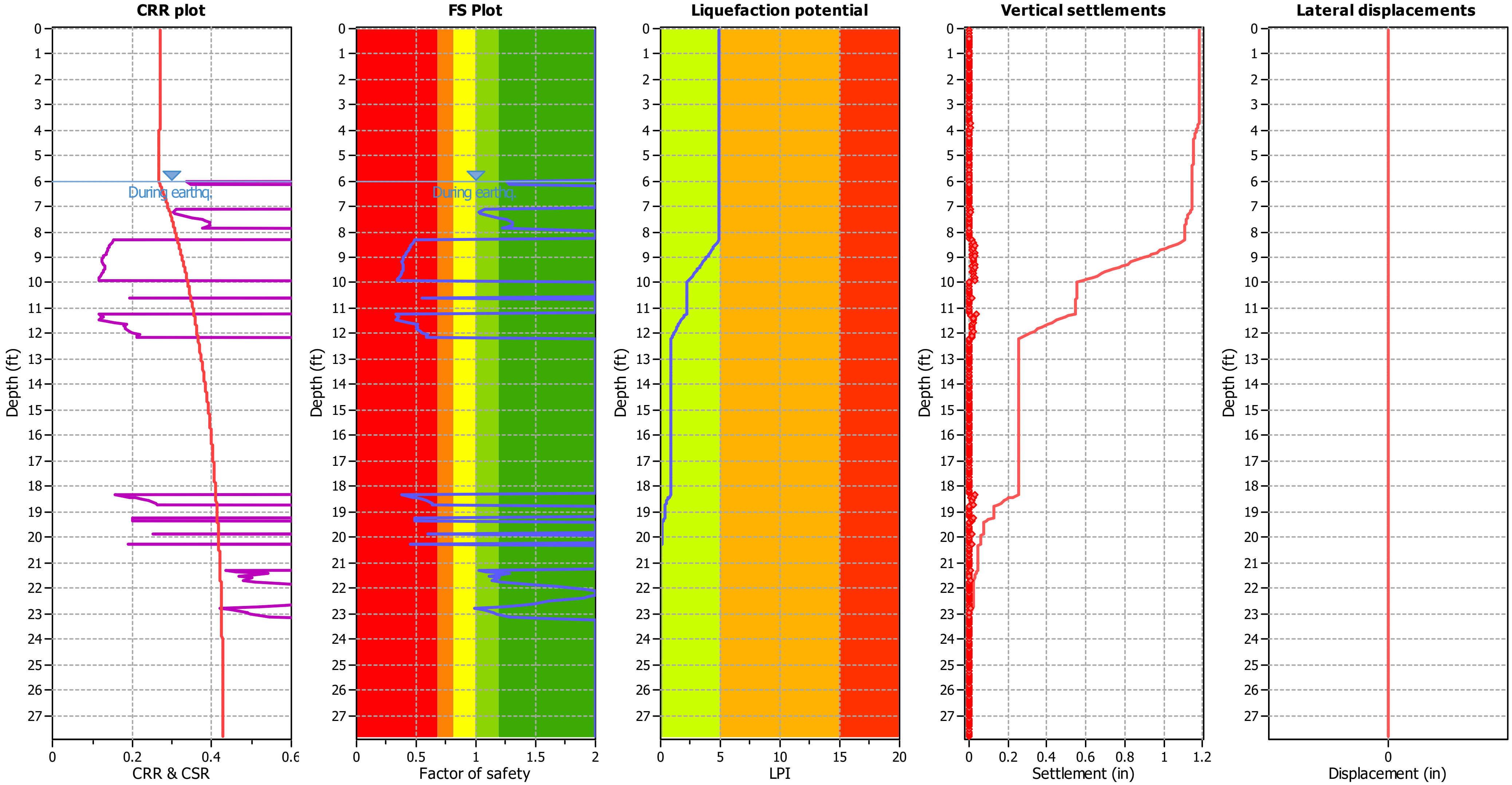
Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	6.00 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	1	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	6.35	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.58	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	17.40 ft	Fill height:	N/A	Limit depth:	N/A

SBT legend

1. Sensitive fine grained
2. Organic material
3. Clay to silty clay
4. Clayey silt to silty
5. Silty sand to sandy silt
6. Clean sand to silty sand
7. Gravely sand to sand
8. Very stiff sand to
9. Very stiff fine grained

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	6.00 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	1	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	6.35	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.58	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	17.40 ft	Fill height:	N/A	Limit depth:	N/A

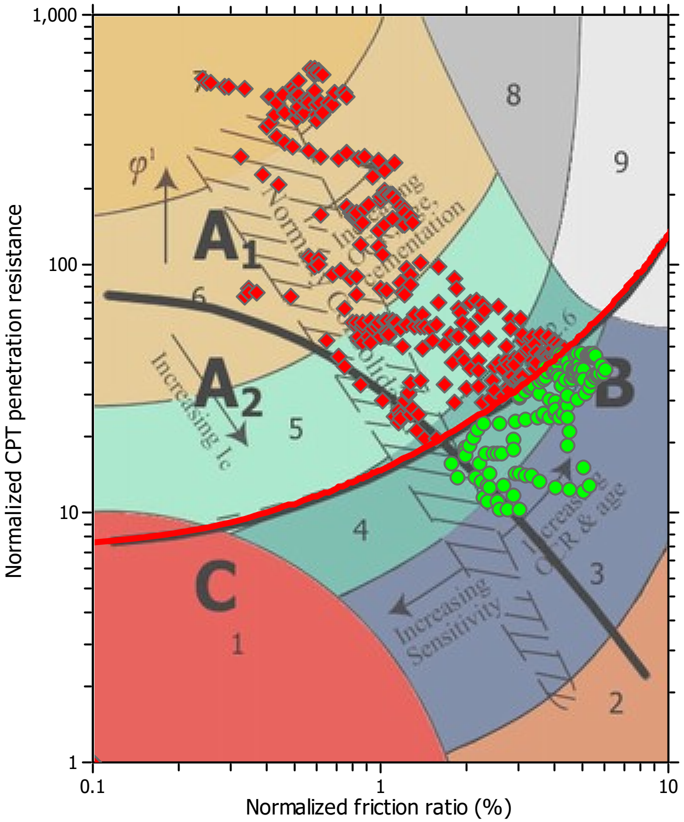
F.S. color scheme

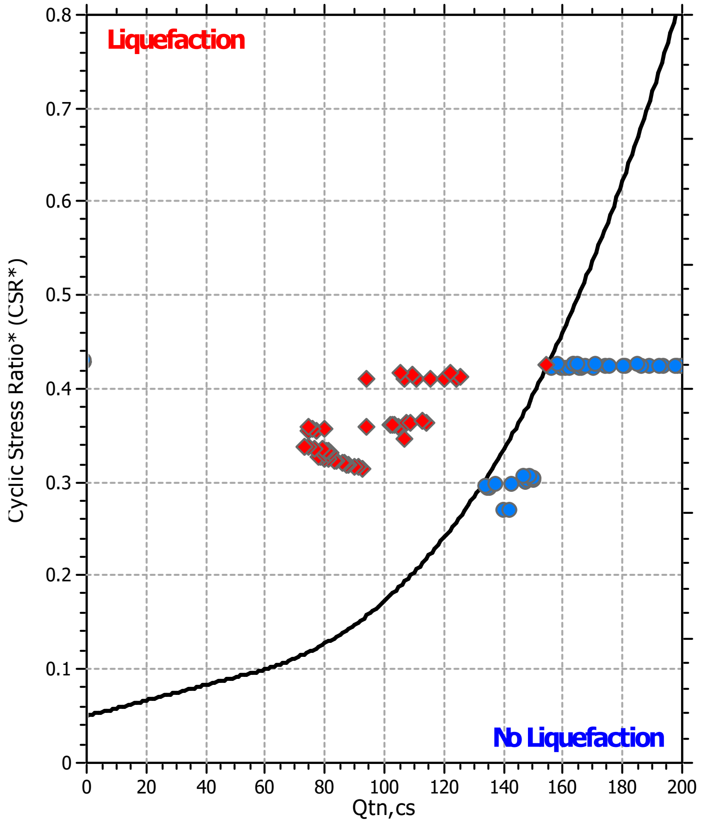
- Almost certain it will liquefy
- Very likely to liquefy
- Liquefaction and no liq. are equally likely
- Unlike to liquefy
- Almost certain it will not liquefy

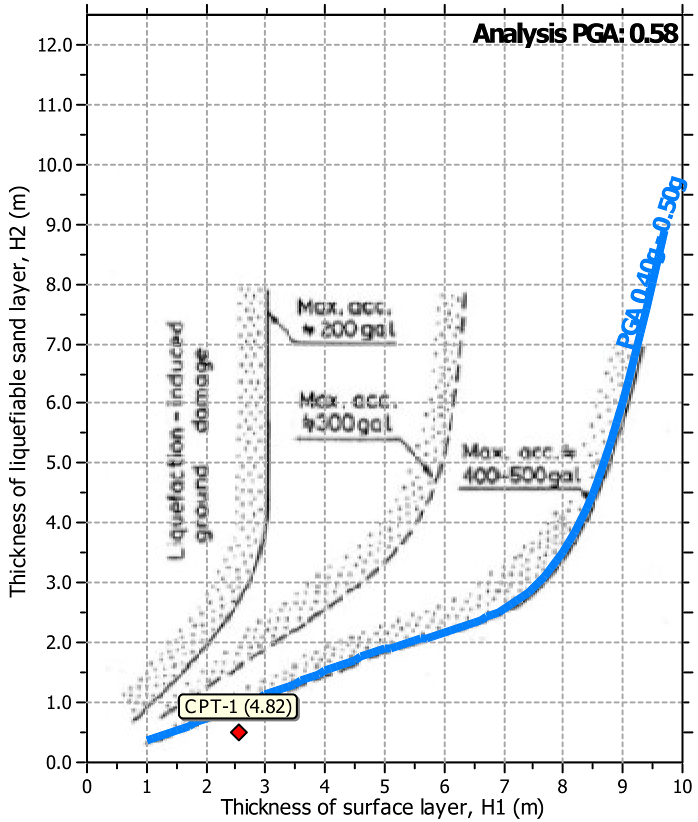
LPI color scheme

- Very high risk
- High risk
- Low risk

Liquefaction analysis summary plots







Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	6.00 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	1	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	6.35	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.58	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	17.40 ft	Fill height:	N/A	Limit depth:	N/A

:: Field input data ::

Point ID	Depth (ft)	q_c (tsf)	f_s (tsf)	u (tsf)	Fines content (%)	Unit weight (pcf)
1	0.08	0.43	0.51	0.00	100.00	103.24
2	0.16	5.18	0.56	-0.09	90.26	110.09
3	0.21	166.86	0.55	0.43	0.15	118.31
4	0.29	142.08	0.56	0.52	1.24	118.05
5	0.33	128.34	0.57	0.35	2.08	117.97
6	0.41	97.51	0.60	0.61	4.80	117.71
7	0.48	74.02	0.63	0.61	8.30	117.41
8	0.54	51.91	0.66	0.43	14.00	116.87
9	0.61	43.96	0.70	0.43	17.60	116.91
10	0.66	35.07	0.72	0.43	22.60	116.51
11	0.73	28.93	0.79	0.43	28.38	116.71
12	0.79	23.84	0.81	0.43	34.20	116.49
13	0.88	21.51	0.80	0.43	37.16	116.16
14	0.93	21.07	0.78	0.43	37.27	115.85
15	1.00	22.20	0.69	0.26	34.02	115.11
16	1.06	19.09	0.62	0.35	36.99	113.92
17	1.13	18.31	0.56	0.35	36.89	113.10
18	1.19	18.40	0.49	0.35	34.82	112.09
19	1.25	18.05	0.43	0.26	33.82	111.16
20	1.33	17.27	0.31	0.35	31.10	108.67
21	1.39	16.24	0.19	0.26	27.35	104.79
22	1.46	15.29	0.17	0.35	27.99	103.97
23	1.51	14.51	0.17	0.35	29.13	103.68
24	1.59	13.39	0.18	0.35	31.93	103.95
25	1.66	12.52	0.18	0.35	33.73	103.72
26	1.73	12.55	0.19	0.69	34.77	104.45
27	1.78	11.31	0.22	0.69	39.57	105.17
28	1.85	10.88	0.25	0.69	42.56	106.01
29	1.91	10.88	0.27	0.78	43.34	106.41
30	1.99	10.88	0.28	0.69	43.94	106.71
31	2.04	10.88	0.29	0.69	44.35	106.92
32	2.12	11.23	0.32	0.69	45.08	107.90
33	2.17	12.18	0.35	0.69	43.46	108.68
34	2.25	17.45	0.39	0.69	33.71	110.41
35	2.31	25.31	0.44	0.69	25.25	112.22
36	2.38	39.21	0.52	0.78	17.13	114.37
37	2.44	47.07	0.57	0.69	14.62	115.59
38	2.50	52.86	0.62	0.78	13.28	116.49
39	2.57	59.77	0.73	0.69	12.44	117.94
40	2.63	63.31	0.86	0.78	12.82	119.33
41	2.69	60.46	0.96	0.78	14.52	120.01
42	2.76	54.58	0.98	0.78	16.59	119.91
43	2.86	43.27	0.98	0.69	21.35	119.33
44	2.90	37.83	1.06	0.78	25.38	119.57
45	2.99	32.56	1.01	0.69	28.55	118.82
46	3.03	34.72	0.98	0.78	26.54	118.77
47	3.13	40.59	0.93	0.87	22.24	118.80
48	3.17	49.49	0.90	0.78	17.67	119.03

:: Field input data :: (continued)

Point ID	Depth (ft)	q_c (tsf)	f_s (tsf)	u (tsf)	Fines content (%)	Unit weight (pcf)
49	3.25	38.61	0.85	0.78	22.34	117.99
50	3.29	35.84	0.55	0.78	19.63	114.69
51	3.35	31.09	0.20	0.69	14.42	106.91
52	3.44	26.77	0.19	0.69	16.78	106.18
53	3.48	24.44	0.18	0.69	18.15	105.58
54	3.55	20.64	0.17	0.69	21.31	104.86
55	3.62	17.88	0.18	0.78	24.79	104.72
56	3.68	9.93	0.17	0.95	41.00	103.07
57	3.75	15.20	0.18	1.04	28.74	104.26
58	3.81	15.55	0.18	1.04	28.26	104.39
59	3.89	15.81	0.20	1.04	28.76	105.11
60	3.96	15.81	0.21	1.04	29.48	105.63
61	4.02	16.50	0.21	1.13	28.28	105.67
62	4.07	17.79	0.21	1.13	26.53	105.97
63	4.15	18.74	0.23	1.13	26.01	106.67
64	4.20	19.35	0.24	1.21	25.66	107.08
65	4.29	21.07	0.26	1.39	24.51	107.97
66	4.34	21.25	0.29	1.39	25.20	108.66
67	4.40	20.73	0.34	1.39	27.49	109.78
68	4.47	19.95	0.39	1.47	30.09	110.72
69	4.54	20.21	0.44	1.47	31.00	111.53
70	4.60	19.61	0.48	1.47	33.05	112.15
71	4.67	19.61	0.54	1.47	34.69	113.06
72	4.74	19.35	0.61	1.47	36.78	113.91
73	4.79	19.95	0.66	1.56	36.97	114.56
74	4.87	20.99	0.75	1.56	37.13	115.56
75	4.92	21.94	0.80	1.56	36.71	116.14
76	5.01	23.23	0.92	1.56	37.15	117.36
77	5.06	24.18	0.96	1.56	36.53	117.76
78	5.12	25.05	1.02	1.65	36.39	118.31
79	5.19	26.17	1.08	1.56	35.85	118.80
80	5.28	27.47	1.13	1.65	35.12	119.28
81	5.33	28.42	1.17	1.56	34.58	119.59
82	5.39	28.67	1.20	1.65	34.71	119.81
83	5.46	28.93	1.13	1.65	33.54	119.38
84	5.54	28.59	0.93	1.65	31.07	117.88
85	5.59	28.33	0.90	1.65	30.97	117.67
86	5.66	27.55	0.94	1.56	32.40	117.94
87	5.73	27.29	0.98	1.56	33.23	118.20
88	5.78	27.21	1.01	1.56	33.69	118.39
89	5.85	26.69	1.03	1.56	34.60	118.51
90	5.92	27.29	1.05	1.56	34.25	118.71
91	5.98	26.77	1.07	1.56	35.04	118.77
92	6.04	27.38	1.08	1.56	34.53	118.91
93	6.12	27.29	1.11	1.56	34.99	119.08
94	6.17	27.21	1.13	1.56	35.37	119.21
95	6.24	26.69	1.14	1.47	36.08	119.22
96	6.30	25.39	1.13	1.47	37.52	119.04

:: Field input data :: (continued)

Point ID	Depth (ft)	q_c (tsf)	f_s (tsf)	u (tsf)	Fines content (%)	Unit weight (pcf)
97	6.37	23.66	1.10	1.47	39.46	118.72
98	6.44	22.46	1.04	1.39	40.27	118.17
99	6.51	21.59	0.99	1.39	40.69	117.67
100	6.58	21.68	0.94	1.39	39.76	117.32
101	6.64	21.94	0.91	1.39	38.89	117.12
102	6.70	22.28	0.91	1.47	38.33	117.13
103	6.76	23.06	0.92	1.39	37.46	117.31
104	6.83	23.66	0.94	1.30	36.99	117.54
105	6.89	24.10	0.96	1.30	36.74	117.74
106	6.98	24.61	1.00	1.30	36.73	118.09
107	7.03	25.39	1.01	1.13	35.95	118.26
108	7.11	26.86	1.01	1.13	34.26	118.40
109	7.15	27.55	1.01	1.13	33.43	118.42
110	7.25	29.88	1.02	1.13	31.20	118.67
111	7.30	31.52	1.04	1.13	29.98	118.94
112	7.36	32.47	1.08	1.13	29.78	119.34
113	7.43	32.73	1.16	1.13	30.53	119.88
114	7.52	32.13	1.22	1.13	31.76	120.21
115	7.57	31.18	1.23	1.13	32.73	120.19
116	7.65	29.11	1.24	1.13	34.83	120.06
117	7.70	29.11	1.24	1.13	34.82	120.05
118	7.74	29.02	1.24	1.13	34.91	120.04
119	7.82	29.71	1.22	1.21	34.04	120.01
120	7.87	30.40	1.20	1.21	33.13	119.95
121	7.95	30.92	1.16	1.30	32.13	119.73
122	8.01	31.27	0.96	1.30	29.22	118.36
123	8.10	32.22	0.58	1.30	22.58	114.74
124	8.15	32.65	0.56	1.30	21.96	114.55
125	8.24	34.98	0.52	1.30	19.67	114.13
126	8.28	35.32	0.50	1.30	19.13	113.89
127	8.34	35.45	0.48	1.30	18.68	113.59
128	8.41	35.58	0.46	1.56	18.27	113.32
129	8.47	36.27	0.44	1.56	17.51	113.05
130	8.56	36.97	0.41	1.56	16.60	112.60
131	8.60	37.31	0.40	1.56	16.33	112.48
132	8.68	38.00	0.40	1.56	15.93	112.36
133	8.73	38.00	0.39	1.56	15.87	112.26
134	8.82	38.00	0.37	1.56	15.50	111.81
135	8.86	38.87	0.36	1.56	14.97	111.66
136	8.95	38.69	0.33	1.56	14.65	111.13
137	9.00	38.78	0.32	1.47	14.33	110.77
138	9.07	38.95	0.31	1.56	14.10	110.54
139	9.14	37.57	0.32	1.47	15.04	110.82
140	9.19	37.57	0.30	1.56	14.73	110.41
141	9.27	37.05	0.34	1.47	15.78	111.23
142	9.32	37.40	0.36	1.47	15.99	111.61
143	9.41	36.19	0.37	1.47	16.88	111.80
144	9.48	35.93	0.37	1.47	17.09	111.81

:: Field input data :: (continued)

Point ID	Depth (ft)	q_c (tsf)	f_s (tsf)	u (tsf)	Fines content (%)	Unit weight (pcf)
145	9.54	34.98	0.37	1.47	17.50	111.62
146	9.59	34.63	0.36	1.47	17.63	111.51
147	9.66	35.24	0.35	1.47	17.02	111.20
148	9.72	35.50	0.32	1.56	16.38	110.64
149	9.80	35.58	0.29	1.47	15.85	110.04
150	9.86	35.07	0.29	1.47	15.97	109.83
151	9.94	34.63	0.28	1.47	16.18	109.72
152	9.99	34.20	0.29	1.47	16.56	109.83
153	10.04	33.86	0.31	1.47	17.17	110.23
154	10.13	32.56	0.38	1.47	19.65	111.77
155	10.17	31.35	0.43	1.47	21.44	112.55
156	10.26	29.28	0.54	1.47	25.10	114.02
157	10.31	27.72	0.59	1.47	27.38	114.54
158	10.38	26.08	0.64	1.47	29.81	114.94
159	10.44	23.41	0.66	1.47	33.19	114.94
160	10.53	21.33	0.66	1.56	35.95	114.72
161	10.57	23.28	0.65	1.56	33.32	114.81
162	10.67	21.59	0.58	1.56	34.12	113.80
163	10.71	23.15	0.55	1.65	31.68	113.63
164	10.78	25.82	0.56	1.56	28.95	113.91
165	10.84	29.02	0.56	1.56	26.19	114.21
166	10.93	34.29	0.56	1.56	22.53	114.64
167	10.96	35.67	0.53	1.56	21.22	114.34
168	11.07	41.46	0.48	1.65	17.50	113.96
169	11.11	43.96	0.48	1.65	16.57	114.20
170	11.16	51.39	0.38	1.65	12.43	112.84
171	11.26	60.37	0.20	1.65	5.00	108.57
172	11.29	62.62	0.22	1.65	5.00	109.17
173	11.36	65.29	0.22	1.65	5.00	109.52
174	11.43	62.18	0.23	1.65	5.00	109.56
175	11.49	60.37	0.29	1.56	5.00	111.24
176	11.56	60.16	0.49	1.39	11.76	115.03
177	11.63	59.94	0.71	1.39	14.32	117.71
178	11.69	63.22	0.63	1.39	12.66	116.97
179	11.76	71.25	0.55	1.47	10.16	116.35
180	11.82	74.02	0.50	1.47	9.16	115.75
181	11.89	81.53	0.48	1.47	7.73	115.63
182	11.96	83.00	0.50	1.47	7.77	116.03
183	12.01	90.69	0.51	1.56	6.80	116.31
184	12.08	89.13	0.50	1.56	6.99	116.21
185	12.15	88.27	0.53	1.56	7.36	116.56
186	12.22	78.42	0.57	1.47	9.19	116.76
187	12.27	74.54	0.61	1.47	10.28	117.13
188	12.35	63.91	0.66	1.47	13.15	117.36
189	12.41	51.13	0.70	1.47	17.58	117.31
190	12.47	40.94	0.75	1.47	22.75	117.23
191	12.55	30.75	0.83	1.47	30.93	117.27
192	12.60	24.87	0.82	1.47	36.92	116.69

:: Field input data :: (continued)

Point ID	Depth (ft)	q_c (tsf)	f_s (tsf)	u (tsf)	Fines content (%)	Unit weight (pcf)
193	12.68	19.17	0.76	1.47	44.14	115.43
194	12.74	16.15	0.70	1.47	49.15	114.48
195	12.81	14.34	0.61	1.47	51.51	113.21
196	12.86	11.83	0.57	1.47	58.09	112.19
197	12.93	10.19	0.51	1.47	62.76	110.99
198	13.00	9.76	0.46	1.47	62.88	110.12
199	13.08	9.85	0.41	1.56	60.68	109.40
200	13.13	10.10	0.38	1.56	58.18	108.86
201	13.20	10.71	0.36	1.56	54.85	108.60
202	13.27	11.31	0.35	1.56	52.50	108.60
203	13.32	11.40	0.34	1.47	51.74	108.36
204	13.39	11.66	0.34	1.47	50.72	108.29
205	13.49	11.83	0.33	1.47	50.06	108.20
206	13.52	11.92	0.27	1.47	46.88	106.72
207	13.62	11.66	0.20	1.47	44.10	104.61
208	13.67	11.57	0.23	1.47	46.12	105.54
209	13.72	11.31	0.24	1.47	47.39	105.69
210	13.79	10.88	0.24	1.47	49.06	105.66
211	13.85	10.71	0.24	1.56	49.63	105.57
212	13.92	9.59	0.23	1.47	53.35	104.95
213	14.02	10.02	0.21	1.47	50.70	104.51
214	14.05	9.59	0.21	1.47	52.34	104.34
215	14.11	8.98	0.21	1.47	55.37	104.31
216	14.18	8.98	0.23	1.47	56.55	104.81
217	14.24	8.98	0.25	1.47	58.36	105.56
218	14.32	10.19	0.28	1.47	54.51	106.52
219	14.38	11.23	0.28	1.56	51.04	106.91
220	14.44	13.73	0.29	1.47	43.93	107.49
221	14.51	14.94	0.28	1.65	40.96	107.58
222	14.57	15.46	0.29	1.65	40.30	107.89
223	14.64	16.41	0.32	1.73	39.68	108.76
224	14.71	17.96	0.36	1.91	38.49	109.92
225	14.77	19.35	0.40	1.91	37.55	110.88
226	14.83	20.38	0.45	1.91	37.41	111.81
227	14.90	20.47	0.52	1.99	39.07	112.79
228	14.97	20.90	0.60	1.99	40.50	113.92
229	15.03	21.25	0.66	1.99	41.36	114.64
230	15.10	21.68	0.73	1.99	42.41	115.51
231	15.16	22.63	0.81	2.08	42.52	116.34
232	15.23	23.32	0.92	2.08	43.61	117.37
233	15.30	24.36	1.06	2.08	44.30	118.46
234	15.36	25.56	1.20	2.17	44.83	119.54
235	15.44	27.29	1.38	2.17	44.86	120.68
236	15.50	28.85	1.51	2.17	44.49	121.47
237	15.56	30.66	1.63	2.25	43.76	122.19
238	15.63	32.04	1.74	2.25	43.47	122.80
239	15.69	33.08	1.85	2.25	43.48	123.32
240	15.76	33.17	1.87	2.25	43.64	123.40

:: Field input data :: (continued)

Point ID	Depth (ft)	q_c (tsf)	f_s (tsf)	u (tsf)	Fines content (%)	Unit weight (pcf)
241	15.86	33.17	1.79	2.25	42.99	123.08
242	15.89	33.17	1.84	2.25	43.44	123.26
243	15.95	33.51	1.96	2.25	44.29	123.77
244	16.04	35.07	2.09	2.25	43.89	124.34
245	16.09	36.62	2.12	2.25	42.76	124.57
246	16.15	19.00	2.14	2.25	69.96	123.03
247	16.22	39.73	2.16	2.34	40.44	124.89
248	16.30	40.85	2.16	2.34	39.63	124.96
249	16.35	40.94	2.16	2.43	39.62	124.97
250	16.43	41.02	2.19	2.43	39.85	125.07
251	16.47	41.20	2.22	2.43	39.98	125.19
252	16.55	42.06	2.28	2.51	39.82	125.43
253	16.61	41.72	2.29	2.51	40.21	125.44
254	16.69	41.37	2.26	2.51	40.32	125.31
255	16.74	42.32	2.23	2.60	39.45	125.29
256	16.80	42.23	2.19	2.60	39.25	125.14
257	16.88	42.75	2.10	2.69	38.24	124.85
258	16.94	43.10	2.04	2.69	37.61	124.68
259	17.00	42.32	1.98	2.69	37.75	124.40
260	17.07	40.07	1.93	2.69	39.16	124.08
261	17.16	37.66	1.88	2.69	40.85	123.73
262	17.21	37.70	1.83	2.69	40.42	123.54
263	17.30	37.70	1.77	2.69	40.01	123.31
264	17.34	37.74	1.77	2.69	40.02	123.32
265	17.42	38.17	1.77	2.77	39.72	123.35
266	17.46	38.35	1.76	2.77	39.48	123.31
267	17.52	39.04	1.74	2.77	38.69	123.24
268	17.61	37.40	1.71	2.77	39.89	123.03
269	17.66	36.79	1.71	2.77	40.47	122.99
270	17.75	36.10	1.75	2.77	41.51	123.11
271	17.79	35.67	1.78	2.77	42.25	123.21
272	17.85	36.19	1.78	2.77	41.80	123.26
273	17.93	38.61	1.84	2.86	40.14	123.63
274	18.01	39.04	1.86	2.77	40.00	123.74
275	18.05	39.73	1.85	2.77	39.38	123.75
276	18.14	40.25	1.88	2.77	39.25	123.90
277	18.20	39.30	1.86	2.69	39.86	123.75
278	18.24	40.38	1.49	2.77	35.63	122.21
279	18.34	40.51	0.81	2.86	27.70	117.78
280	18.42	42.15	1.06	2.77	29.87	119.84
281	18.46	43.44	1.15	2.77	30.09	120.51
282	18.51	44.13	1.25	2.69	30.70	121.14
283	18.58	45.17	1.36	2.69	31.17	121.81
284	18.64	43.36	1.43	2.51	33.09	122.09
285	18.73	42.58	1.45	2.60	33.84	122.14
286	18.77	38.87	1.45	2.60	36.64	121.91
287	18.84	34.81	1.44	2.60	40.16	121.60
288	18.91	31.78	1.39	2.60	42.75	121.13

:: Field input data :: (continued)

Point ID	Depth (ft)	q_c (tsf)	f_s (tsf)	u (tsf)	Fines content (%)	Unit weight (pcf)
289	18.99	29.54	1.25	2.60	43.64	120.18
290	19.05	29.97	1.18	2.69	42.18	119.77
291	19.11	32.56	1.13	2.69	38.78	119.66
292	19.16	34.55	1.11	2.69	36.69	119.71
293	19.26	37.31	1.10	2.69	34.21	119.82
294	19.32	37.57	1.10	2.60	33.97	119.80
295	19.36	35.93	1.09	2.60	35.22	119.63
296	19.44	34.37	1.07	2.60	36.40	119.40
297	19.50	34.98	1.06	2.60	35.78	119.39
298	19.56	36.88	1.07	2.69	34.26	119.56
299	19.63	41.80	1.08	2.69	30.80	119.96
300	19.69	53.03	1.11	2.69	24.79	120.69
301	19.77	63.05	1.19	2.69	21.56	121.67
302	19.82	70.99	1.31	2.60	19.91	122.63
303	19.90	75.57	1.53	2.60	20.15	123.92
304	19.95	77.73	1.64	2.60	20.32	124.52
305	20.04	73.84	1.86	2.60	22.84	125.29
306	20.09	66.24	2.00	2.60	26.43	125.58
307	20.17	55.88	2.11	2.60	31.78	125.56
308	20.22	43.62	1.73	2.60	36.27	123.48
309	20.28	38.61	1.05	2.60	33.02	119.58
310	20.35	32.47	0.96	2.60	37.02	118.43
311	20.42	27.47	0.97	2.69	42.89	118.13
312	20.48	27.34	1.02	2.69	43.89	118.49
313	20.54	27.34	1.11	2.86	45.30	119.11
314	20.65	27.21	1.17	2.95	46.43	119.49
315	20.68	28.33	1.18	2.95	45.09	119.65
316	20.74	32.04	1.21	3.03	41.11	120.11
317	20.82	44.22	1.26	2.95	31.61	121.20
318	20.88	55.97	1.29	2.95	25.60	121.96
319	20.95	70.39	1.30	2.86	20.33	122.59
320	21.03	99.32	1.24	2.86	13.23	123.08
321	21.10	120.40	1.22	2.86	10.05	123.41
322	21.14	128.86	1.26	2.86	9.28	123.80
323	21.22	149.50	1.47	2.86	8.22	125.28
324	21.28	159.87	1.38	2.95	7.00	125.00
325	21.34	167.99	1.33	2.95	6.21	124.85
326	21.41	184.14	1.40	2.95	5.44	125.45
327	21.48	177.31	1.40	2.95	5.86	125.35
328	21.55	169.11	1.38	3.03	6.36	125.15
329	21.59	176.75	1.38	3.03	5.86	125.28
330	21.68	171.53	1.39	2.95	6.23	125.22
331	21.74	176.19	1.44	2.95	6.14	125.57
332	21.81	184.14	1.61	2.95	6.24	126.49
333	21.86	191.91	1.74	2.77	6.20	127.15
334	21.94	198.91	1.96	2.95	6.48	128.12
335	22.00	204.95	2.04	2.86	6.34	128.46
336	22.07	209.18	2.15	2.95	6.44	128.91

:: Field input data :: (continued)

Point ID	Depth (ft)	q_c (tsf)	f_s (tsf)	u (tsf)	Fines content (%)	Unit weight (pcf)
337	22.13	211.34	2.22	2.95	6.51	129.16
338	22.21	211.95	2.29	2.95	6.68	129.40
339	22.27	211.69	2.31	2.95	6.75	129.46
340	22.35	208.84	2.27	2.95	6.83	129.31
341	22.38	206.77	2.26	2.95	6.92	129.26
342	22.45	198.73	2.24	2.95	7.35	129.07
343	22.53	189.41	2.21	2.95	7.89	128.85
344	22.59	180.94	2.19	2.95	8.46	128.69
345	22.67	173.00	2.19	2.95	9.08	128.57
346	22.71	169.80	1.85	2.95	8.19	127.29
347	22.80	162.03	1.36	3.03	6.92	124.93
348	22.85	160.39	1.65	2.95	8.23	126.32
349	22.93	162.24	1.91	2.95	9.05	127.40
350	22.98	161.25	1.93	2.95	9.24	127.50
351	23.04	162.46	1.96	2.95	9.25	127.62
352	23.12	167.21	2.16	3.03	9.52	128.38
353	23.18	188.54	2.26	3.12	8.18	129.01
354	23.24	220.84	2.26	3.12	6.20	129.41
355	23.30	249.00	2.33	3.29	5.02	129.92
356	23.37	266.36	2.73	3.29	5.19	131.24
357	23.43	285.62	3.20	3.29	5.37	132.58
358	23.52	291.93	2.84	3.29	4.46	131.76
359	23.56	303.33	2.65	3.29	3.72	131.34
360	23.63	297.80	2.48	3.12	3.56	130.80
361	23.69	313.69	2.38	3.12	2.91	130.64
362	23.77	299.09	2.13	3.64	2.84	129.71
363	23.83	304.02	1.88	3.73	2.18	128.83
364	23.89	320.77	1.81	3.64	1.61	128.68
365	23.97	337.01	1.66	3.73	0.96	128.18
366	24.02	346.51	1.60	3.55	0.66	127.97
367	24.10	366.63	1.60	3.73	0.30	128.12
368	24.15	401.96	1.61	3.81	0.00	128.36
369	24.23	418.80	1.73	3.81	0.00	129.01
370	24.28	447.22	1.90	3.81	0.00	129.85
371	24.37	461.64	2.13	3.90	0.00	130.75
372	24.42	460.00	2.49	3.90	0.28	131.91
373	24.49	451.79	2.81	3.90	0.81	132.75
374	24.55	438.23	2.22	3.99	0.22	130.95
375	24.61	450.89	2.42	4.07	0.31	131.64
376	24.69	432.01	2.59	4.07	0.82	132.03
377	24.75	449.98	2.69	4.07	0.68	132.40
378	24.82	464.49	2.93	4.07	0.78	133.11
379	24.88	494.55	2.98	4.07	0.44	133.39
380	24.94	508.88	2.87	4.16	0.14	133.20
381	25.00	487.98	2.52	4.33	0.00	132.12
382	25.07	511.73	2.23	4.42	0.00	131.37
383	25.14	537.90	2.21	4.42	0.00	131.41
384	25.22	588.60	2.92	4.59	0.00	133.66

:: Field input data :: (continued)

Point ID	Depth (ft)	q_c (tsf)	f_s (tsf)	u (tsf)	Fines content (%)	Unit weight (pcf)
385	25.27	628.33	3.28	4.68	0.00	134.67
386	25.35	662.79	3.87	4.68	0.00	136.02
387	25.40	675.23	4.00	4.85	0.00	136.30
388	25.47	677.73	4.09	4.94	0.00	136.48
389	25.54	704.25	4.03	5.20	0.00	136.46
390	25.60	704.94	4.05	5.20	0.00	136.50
391	25.67	705.63	4.13	5.20	0.00	136.64
392	25.72	693.62	4.18	5.29	0.00	136.70
393	25.81	682.22	4.14	5.46	0.00	136.58
394	25.86	669.61	4.17	5.37	0.00	136.60
395	25.93	562.26	4.17	5.29	0.88	136.16
396	25.99	546.71	4.16	5.29	1.06	136.07
397	26.06	564.07	4.21	5.29	0.90	136.24
398	26.13	565.89	3.88	5.29	0.57	135.65
399	26.18	573.40	3.37	5.29	0.00	134.66
400	26.27	581.35	2.91	5.37	0.00	133.62
401	26.33	551.12	2.83	5.46	0.00	133.27
402	26.40	547.06	2.75	5.20	0.00	133.04
403	26.45	528.83	2.87	5.20	0.00	133.29
404	26.52	519.59	3.18	5.11	0.42	133.99
405	26.59	541.27	3.03	5.29	0.01	133.74
406	26.64	564.42	2.58	5.29	0.00	132.65
407	26.73	604.75	1.74	5.37	0.00	129.93
408	26.78	626.52	1.56	5.37	0.00	129.25
409	26.84	650.01	1.56	5.63	0.00	129.34
410	26.91	627.55	1.60	5.80	0.00	129.43
411	26.97	609.07	1.81	5.63	0.00	130.27
412	27.05	595.42	2.00	5.63	0.00	130.92
413	27.11	552.15	2.26	5.63	0.00	131.64
414	27.17	485.74	2.49	5.11	0.06	132.03
415	27.25	514.24	3.52	4.94	0.88	134.71
416	27.30	529.78	3.49	4.94	0.65	134.71
417	27.37	543.43	2.80	5.03	0.00	133.16
418	27.43	565.11	2.94	5.20	0.00	133.62
419	27.52	603.72	0.00	5.20	N/A	87.36
420	27.56	634.72	0.00	5.20	N/A	87.36
421	27.63	686.02	0.00	5.37	N/A	87.36
422	27.70	766.78	0.00	5.46	N/A	87.36
423	27.76	809.44	0.00	5.46	N/A	87.36
424	27.82	811.43	0.00	5.72	N/A	87.36

Abbreviations

Depth: Depth from free surface, at which CPT was performed (ft)
q_c: Measured cone resistance (tsf)
f_s: Sleeve friction resistance (tsf)
u: Pore pressure (tsf)
Fines content: Percentage of fines in soil (%)
Unit weight: Bulk soil unit weight (pcf)

:: Post-earthquake settlement of dry sands ::

Depth (ft)	Ic	Q_{tn}	Kc	$Q_{tn,cs}$	$N_{1,60}$ (blows)	G_{max} (tsf)	CSR	Shear, γ (%)	$e_{vol(15)}$ (%)	N_c	e_v (%)	Settle. (in)
0.08	4.06	0.68	26.61	18.21	0	0	0.27	0.000	0.00	0.00	0.00	0.000
0.16	3.41	8.31	12.43	103.29	0	0	0.27	0.000	0.00	0.00	0.00	0.000
0.21	1.27	268.07	1.00	268.07	44	754	0.27	0.001	0.00	6.39	0.00	0.000
0.29	1.38	228.26	1.00	228.26	38	731	0.27	0.001	0.00	6.39	0.00	0.000
0.33	1.44	206.17	1.00	206.17	35	719	0.27	0.001	0.00	6.39	0.00	0.000
0.41	1.63	156.64	1.00	156.64	29	688	0.27	0.001	0.00	6.39	0.00	0.000
0.48	1.81	118.89	1.11	132.31	0	0	0.27	0.000	0.00	13.43	0.00	0.000
0.54	2.04	83.36	1.35	112.80	0	0	0.27	0.000	0.00	13.43	0.00	0.000
0.61	2.16	70.58	1.57	110.73	0	0	0.27	0.000	0.00	13.43	0.00	0.000
0.66	2.30	56.29	1.96	110.08	0	0	0.27	0.000	0.00	13.43	0.00	0.000
0.73	2.45	46.42	2.52	116.77	0	0	0.27	0.000	0.00	13.43	0.00	0.000
0.79	2.58	38.24	3.18	121.73	0	0	0.27	0.000	0.00	13.43	0.00	0.000
0.88	2.64	34.49	3.56	122.68	0	0	0.27	0.000	0.00	0.00	0.00	0.000
0.93	2.64	33.77	3.57	120.63	0	0	0.27	0.000	0.00	0.00	0.00	0.000
1.00	2.57	35.58	3.16	112.46	30	518	0.27	0.006	0.00	6.39	0.00	0.000
1.06	2.63	30.58	3.53	108.08	0	0	0.27	0.000	0.00	0.00	0.00	0.000
1.13	2.63	29.32	3.52	103.24	0	0	0.27	0.000	0.00	0.00	0.00	0.000
1.19	2.59	29.46	3.26	96.01	0	0	0.27	0.000	0.00	13.43	0.00	0.000
1.25	2.57	28.89	3.14	90.61	0	0	0.27	0.000	0.00	13.43	0.00	0.000
1.33	2.51	27.63	2.82	77.81	0	0	0.27	0.000	0.00	13.43	0.00	0.000
1.39	2.42	25.97	2.41	62.54	0	0	0.27	0.000	0.00	13.43	0.00	0.000
1.46	2.44	24.44	2.47	60.48	0	0	0.27	0.000	0.00	13.43	0.00	0.000
1.51	2.46	23.18	2.60	60.19	0	0	0.27	0.000	0.00	13.43	0.00	0.000
1.59	2.53	21.38	2.91	62.25	0	0	0.27	0.000	0.00	13.43	0.00	0.000
1.66	2.57	19.97	3.13	62.43	0	0	0.27	0.000	0.00	13.43	0.00	0.000
1.73	2.59	20.02	3.25	65.14	0	0	0.27	0.000	0.00	13.43	0.00	0.000
1.78	2.68	18.02	3.88	69.87	0	0	0.27	0.000	0.00	0.00	0.00	0.000
1.85	2.74	17.33	4.29	74.33	0	0	0.27	0.000	0.00	0.00	0.00	0.000
1.91	2.75	17.32	4.40	76.21	0	0	0.27	0.000	0.00	0.00	0.00	0.000
1.99	2.76	17.32	4.48	77.66	0	0	0.27	0.000	0.00	0.00	0.00	0.000
2.04	2.77	17.31	4.54	78.66	0	0	0.27	0.000	0.00	0.00	0.00	0.000
2.12	2.78	17.87	4.65	83.08	0	0	0.27	0.000	0.00	0.00	0.00	0.000
2.17	2.76	19.39	4.42	85.63	0	0	0.27	0.000	0.00	0.00	0.00	0.000
2.25	2.57	27.85	3.12	86.98	0	0	0.27	0.000	0.00	13.43	0.00	0.000
2.31	2.37	40.47	2.20	88.96	0	0	0.27	0.000	0.00	13.43	0.00	0.000
2.38	2.14	62.80	1.54	96.57	0	0	0.27	0.000	0.00	13.43	0.00	0.000
2.44	2.06	75.42	1.39	104.55	0	0	0.27	0.000	0.00	13.43	0.00	0.000
2.50	2.01	84.72	1.32	111.51	0	0	0.27	0.000	0.00	13.43	0.00	0.000
2.57	1.98	95.81	1.28	122.27	0	0	0.27	0.000	0.00	13.43	0.00	0.000
2.63	2.00	101.50	1.29	131.34	0	0	0.27	0.000	0.00	13.43	0.00	0.000
2.69	2.06	96.91	1.38	133.82	0	0	0.27	0.000	0.00	13.43	0.00	0.000
2.76	2.13	87.46	1.50	131.43	0	0	0.27	0.000	0.00	13.43	0.00	0.000
2.86	2.27	69.27	1.85	128.18	0	0	0.27	0.000	0.00	13.43	0.00	0.000
2.90	2.37	60.53	2.21	133.82	0	0	0.27	0.000	0.00	13.43	0.00	0.000
2.99	2.45	52.06	2.53	131.91	0	0	0.27	0.000	0.00	13.43	0.00	0.000
3.03	2.40	55.52	2.33	129.09	0	0	0.27	0.000	0.00	13.43	0.00	0.000
3.13	2.29	64.95	1.92	124.97	0	0	0.27	0.000	0.00	13.43	0.00	0.000
3.17	2.16	79.24	1.57	124.68	0	0	0.27	0.000	0.00	13.43	0.00	0.000

:: Post-earthquake settlement of dry sands :: (continued)

Depth (ft)	Ic	Q_{tn}	Kc	$Q_{tn,cs}$	$N_{1,60}$ (blows)	G_{max} (tsf)	CSR	Shear, γ (%)	$e_{vol(15)}$ (%)	N_c	e_v (%)	Settle. (in)
3.25	2.30	61.75	1.93	119.39	28	633	0.27	0.019	0.01	6.39	0.01	0.000
3.29	2.22	57.30	1.71	98.22	22	533	0.27	0.028	0.02	6.39	0.02	0.000
3.35	2.05	49.66	1.38	68.31	0	0	0.27	0.000	0.00	13.43	0.00	0.000
3.44	2.13	42.71	1.51	64.70	0	0	0.27	0.000	0.00	13.43	0.00	0.000
3.48	2.17	38.96	1.61	62.61	0	0	0.27	0.000	0.00	13.43	0.00	0.000
3.55	2.27	32.85	1.85	60.66	0	0	0.27	0.000	0.00	13.43	0.00	0.000
3.62	2.36	28.42	2.15	61.22	0	0	0.27	0.000	0.00	13.43	0.00	0.000
3.68	2.71	15.64	4.07	63.68	0	0	0.27	0.000	0.00	0.00	0.00	0.000
3.75	2.46	24.10	2.55	61.57	16	303	0.27	0.267	0.36	6.39	0.25	0.004
3.81	2.44	24.66	2.50	61.74	16	305	0.27	0.266	0.36	6.39	0.25	0.004
3.89	2.46	25.07	2.56	64.09	16	315	0.27	0.239	0.31	6.39	0.21	0.004
3.96	2.47	25.07	2.63	66.04	17	322	0.27	0.227	0.28	6.39	0.19	0.004
4.02	2.44	26.17	2.50	65.56	16	324	0.27	0.225	0.28	6.39	0.19	0.002
4.07	2.40	28.24	2.32	65.64	16	332	0.27	0.209	0.27	6.39	0.18	0.003
4.15	2.39	29.76	2.27	67.64	17	344	0.27	0.184	0.23	6.39	0.16	0.003
4.20	2.38	30.74	2.24	68.80	17	351	0.27	0.173	0.21	6.39	0.15	0.002
4.29	2.35	33.50	2.13	71.28	17	369	0.27	0.146	0.18	6.39	0.12	0.002
4.34	2.37	33.78	2.19	74.09	18	380	0.27	0.132	0.15	6.39	0.10	0.001
4.40	2.43	32.94	2.42	79.78	20	398	0.27	0.113	0.11	6.39	0.08	0.001
4.47	2.49	31.68	2.70	85.59	22	414	0.27	0.101	0.09	6.39	0.06	0.001
4.54	2.51	32.09	2.80	90.02	23	430	0.27	0.091	0.08	6.39	0.05	0.001
4.60	2.55	31.12	3.04	94.76	25	441	0.27	0.085	0.06	6.39	0.04	0.001
4.67	2.59	31.12	3.24	100.94	27	461	0.27	0.076	0.05	6.39	0.04	0.001
4.74	2.63	30.69	3.51	107.67	0	0	0.27	0.000	0.00	0.00	0.00	0.000
4.79	2.63	31.65	3.53	111.82	0	0	0.27	0.000	0.00	0.00	0.00	0.000
4.87	2.64	33.32	3.55	118.37	0	0	0.27	0.000	0.00	0.00	0.00	0.000
4.92	2.63	34.84	3.50	121.89	0	0	0.27	0.000	0.00	0.00	0.00	0.000
5.01	2.64	36.90	3.56	131.21	0	0	0.27	0.000	0.00	0.00	0.00	0.000
5.06	2.62	38.43	3.48	133.53	0	0	0.27	0.000	0.00	0.00	0.00	0.000
5.12	2.62	39.82	3.46	137.68	0	0	0.27	0.000	0.00	0.00	0.00	0.000
5.19	2.61	41.61	3.39	141.02	0	0	0.27	0.000	0.00	0.00	0.00	0.000
5.28	2.60	43.69	3.30	144.05	39	655	0.27	0.035	0.02	6.39	0.01	0.000
5.33	2.58	45.21	3.23	146.02	39	668	0.27	0.034	0.02	6.39	0.01	0.000
5.39	2.59	45.61	3.25	148.05	40	676	0.27	0.034	0.01	6.39	0.01	0.000
5.46	2.56	46.02	3.10	142.78	38	661	0.27	0.036	0.02	6.39	0.01	0.000
5.54	2.51	45.47	2.81	127.88	33	610	0.27	0.045	0.02	6.39	0.02	0.000
5.59	2.51	45.04	2.80	126.15	33	603	0.27	0.048	0.03	6.39	0.02	0.000
5.66	2.54	43.78	2.97	129.89	34	610	0.27	0.047	0.02	6.39	0.02	0.000
5.73	2.56	43.36	3.07	132.93	35	618	0.27	0.047	0.02	6.39	0.02	0.000
5.78	2.57	43.23	3.12	134.91	36	624	0.27	0.046	0.02	6.39	0.02	0.000
5.85	2.58	42.38	3.23	137.02	37	626	0.27	0.047	0.02	6.39	0.02	0.000
5.92	2.58	43.34	3.19	138.20	37	635	0.27	0.046	0.02	6.39	0.01	0.000
5.98	2.59	42.50	3.29	139.69	38	635	0.27	0.047	0.02	6.39	0.01	0.000

:: Post-earthquake settlement of dry sands :: (continued)

Depth (ft)	Ic	Q_{tn}	Kc	$Q_{tn,cs}$	$N_{1,60}$ (blows)	G_{max} (tsf)	CSR	Shear, γ (%)	$e_{vol(15)}$ (%)	N_c	e_v (%)	Settle. (in)

Total estimated settlement: 0.04

Abbreviations

Q_{tn}: Equivalent clean sand normalized cone resistance
K_c: Fines correction factor
$Q_{tn,cs}$: Post-liquefaction volumentric strain
G_{max}: Small strain shear modulus
CSR: Soil cyclic stress ratio
γ: Cyclic shear strain
$e_{vol(15)}$: Volumetric strain after 15 cycles
N_c: Equivalent number of cycles
e_v: Volumetric strain
Settle.: Calculated settlement

:: Post-earthquake settlement due to soil liquefaction ::

Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)
6.04	140.14	1.25	0.23	1.00	0.00
6.17	143.76	2.00	0.00	1.00	0.00
6.30	145.02	2.00	0.00	1.00	0.00
6.44	141.06	2.00	0.00	1.00	0.00
6.58	133.68	2.00	0.00	1.00	0.00
6.70	130.66	2.00	0.00	1.00	0.00
6.83	132.24	2.00	0.00	1.00	0.00
6.98	136.29	2.00	0.00	1.00	0.00
7.11	135.70	1.07	0.45	1.00	0.00
7.25	133.93	1.03	0.67	1.00	0.01
7.36	137.41	1.08	0.45	1.00	0.00
7.52	147.34	1.26	0.22	1.00	0.00
7.65	150.31	1.31	0.22	1.00	0.00
7.74	150.24	1.30	0.22	1.00	0.00
7.87	146.99	1.23	0.31	1.00	0.00
8.01	129.06	2.00	0.00	1.00	0.00
8.15	98.32	2.00	0.00	1.00	0.00
8.28	93.93	2.00	0.00	1.00	0.00
8.41	91.10	0.48	2.52	1.00	0.02
8.56	88.04	0.45	2.59	1.00	0.03
8.68	86.61	0.44	2.63	1.00	0.03
8.82	83.87	0.42	2.70	1.00	0.03
8.95	81.07	0.40	2.78	1.00	0.03
9.07	78.79	0.38	2.84	1.00	0.02
9.19	77.59	0.38	2.88	1.00	0.02
9.32	81.53	0.40	2.76	1.00	0.01
9.48	81.78	0.39	2.76	1.00	0.02
9.59	80.27	0.38	2.80	1.00	0.02
9.72	76.59	0.36	2.91	1.00	0.02
9.86	73.43	0.35	3.01	1.00	0.02
9.99	73.03	2.00	0.00	1.00	0.00
10.13	80.41	2.00	0.00	1.00	0.00
10.26	94.15	2.00	0.00	1.00	0.00
10.38	103.93	2.00	0.00	1.00	0.00
10.53	109.44	2.00	0.00	1.00	0.00

Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)
6.12	142.13	1.28	0.23	1.00	0.00
6.24	144.73	2.00	0.00	1.00	0.00
6.37	144.67	2.00	0.00	1.00	0.00
6.51	137.45	2.00	0.00	1.00	0.00
6.64	131.21	2.00	0.00	1.00	0.00
6.76	131.10	2.00	0.00	1.00	0.00
6.89	133.49	2.00	0.00	1.00	0.00
7.03	136.64	2.00	0.00	1.00	0.00
7.15	134.83	1.05	0.45	1.00	0.00
7.30	134.49	1.04	0.67	1.00	0.00
7.43	142.86	1.18	0.32	1.00	0.00
7.57	148.58	1.28	0.22	1.00	0.00
7.70	150.24	1.30	0.22	1.00	0.00
7.82	148.81	1.27	0.22	1.00	0.00
7.95	143.75	2.00	0.00	1.00	0.00
8.10	99.73	2.00	0.00	1.00	0.00
8.24	95.24	2.00	0.00	1.00	0.00
8.34	92.44	0.49	2.49	1.00	0.02
8.47	89.92	0.47	2.55	1.00	0.02
8.60	87.35	0.45	2.61	1.00	0.01
8.73	86.00	0.43	2.64	1.00	0.02
8.86	83.33	0.41	2.71	1.00	0.01
9.00	79.72	0.39	2.81	1.00	0.02
9.14	79.17	0.39	2.83	1.00	0.02
9.27	80.18	0.39	2.80	1.00	0.03
9.41	81.94	0.40	2.75	1.00	0.03
9.54	80.89	0.39	2.78	1.00	0.02
9.66	78.86	0.38	2.84	1.00	0.02
9.80	74.33	0.35	2.98	1.00	0.03
9.94	72.83	0.34	3.03	1.00	0.03
10.04	74.27	2.00	0.00	1.00	0.00
10.17	84.47	2.00	0.00	1.00	0.00
10.31	99.13	2.00	0.00	1.00	0.00
10.44	107.81	2.00	0.00	1.00	0.00
10.57	106.62	0.55	2.22	1.00	0.01

:: Post-earthquake settlement due to soil liquefaction :: (continued)

Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)	Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)
10.67	101.39	2.00	0.00	1.00	0.00	10.71	97.53	2.00	0.00	1.00	0.00
10.78	95.71	2.00	0.00	1.00	0.00	10.84	94.11	2.00	0.00	1.00	0.00
10.93	92.53	2.00	0.00	1.00	0.00	10.96	90.01	2.00	0.00	1.00	0.00
11.07	86.52	2.00	0.00	1.00	0.00	11.11	87.51	2.00	0.00	1.00	0.00
11.16	84.40	2.00	0.00	1.00	0.00	11.26	74.33	0.33	2.98	1.00	0.04
11.29	76.92	0.34	2.90	1.00	0.01	11.36	79.75	0.36	2.81	1.00	0.02
11.43	76.12	0.34	2.92	1.00	0.02	11.49	74.51	0.33	2.97	1.00	0.02
11.56	94.09	0.44	2.46	1.00	0.02	11.63	104.49	0.52	2.25	1.00	0.02
11.69	102.06	0.50	2.30	1.00	0.02	11.76	103.45	0.51	2.27	1.00	0.02
11.82	103.01	0.50	2.28	1.00	0.02	11.89	107.06	0.54	2.21	1.00	0.02
11.96	108.82	0.55	2.18	1.00	0.02	12.01	114.22	0.60	2.10	1.00	0.01
12.08	112.71	0.58	2.12	1.00	0.02	12.15	112.93	0.59	2.11	1.00	0.02
12.22	107.20	2.00	0.00	1.00	0.00	12.27	105.94	2.00	0.00	1.00	0.00
12.35	101.65	2.00	0.00	1.00	0.00	12.41	98.99	2.00	0.00	1.00	0.00
12.47	101.10	2.00	0.00	1.00	0.00	12.55	109.99	2.00	0.00	1.00	0.00
12.60	113.21	2.00	0.00	1.00	0.00	12.68	112.28	2.00	0.00	1.00	0.00
12.74	110.30	2.00	0.00	1.00	0.00	12.81	104.04	2.00	0.00	1.00	0.00
12.86	101.30	2.00	0.00	1.00	0.00	12.93	95.92	2.00	0.00	1.00	0.00
13.00	91.32	2.00	0.00	1.00	0.00	13.08	87.10	2.00	0.00	1.00	0.00
13.13	83.90	2.00	0.00	1.00	0.00	13.20	81.60	2.00	0.00	1.00	0.00
13.27	80.44	2.00	0.00	1.00	0.00	13.32	78.99	2.00	0.00	1.00	0.00
13.39	78.12	2.00	0.00	1.00	0.00	13.49	77.16	2.00	0.00	1.00	0.00
13.52	70.24	2.00	0.00	1.00	0.00	13.62	62.13	2.00	0.00	1.00	0.00
13.67	65.71	2.00	0.00	1.00	0.00	13.72	66.59	2.00	0.00	1.00	0.00
13.79	66.96	2.00	0.00	1.00	0.00	13.85	66.73	2.00	0.00	1.00	0.00
13.92	65.79	2.00	0.00	1.00	0.00	14.02	63.41	2.00	0.00	1.00	0.00
14.05	63.33	2.00	0.00	1.00	0.00	14.11	63.92	2.00	0.00	1.00	0.00
14.18	65.58	2.00	0.00	1.00	0.00	14.24	68.29	2.00	0.00	1.00	0.00
14.32	70.56	2.00	0.00	1.00	0.00	14.38	70.68	2.00	0.00	1.00	0.00
14.44	69.67	2.00	0.00	1.00	0.00	14.51	68.40	2.00	0.00	1.00	0.00
14.57	68.98	2.00	0.00	1.00	0.00	14.64	71.53	2.00	0.00	1.00	0.00
14.71	74.93	2.00	0.00	1.00	0.00	14.77	77.89	2.00	0.00	1.00	0.00
14.83	81.46	2.00	0.00	1.00	0.00	14.90	86.74	2.00	0.00	1.00	0.00
14.97	92.96	2.00	0.00	1.00	0.00	15.03	97.14	2.00	0.00	1.00	0.00
15.10	102.41	2.00	0.00	1.00	0.00	15.16	107.04	2.00	0.00	1.00	0.00
15.23	114.05	2.00	0.00	1.00	0.00	15.30	121.57	2.00	0.00	1.00	0.00
15.36	129.54	2.00	0.00	1.00	0.00	15.44	138.04	2.00	0.00	1.00	0.00
15.50	143.80	2.00	0.00	1.00	0.00	15.56	148.78	2.00	0.00	1.00	0.00
15.63	153.49	2.00	0.00	1.00	0.00	15.69	157.99	2.00	0.00	1.00	0.00
15.76	158.58	2.00	0.00	1.00	0.00	15.86	154.16	2.00	0.00	1.00	0.00
15.89	156.22	2.00	0.00	1.00	0.00	15.95	161.76	2.00	0.00	1.00	0.00
16.04	166.32	2.00	0.00	1.00	0.00	16.09	166.83	2.00	0.00	1.00	0.00
16.15	171.80	2.00	0.00	1.00	0.00	16.22	166.03	2.00	0.00	1.00	0.00
16.30	165.15	2.00	0.00	1.00	0.00	16.35	164.90	2.00	0.00	1.00	0.00
16.43	165.77	2.00	0.00	1.00	0.00	16.47	166.86	2.00	0.00	1.00	0.00
16.55	168.67	2.00	0.00	1.00	0.00	16.61	168.93	2.00	0.00	1.00	0.00
16.69	167.35	2.00	0.00	1.00	0.00	16.74	165.59	2.00	0.00	1.00	0.00
16.80	163.40	2.00	0.00	1.00	0.00	16.88	158.81	2.00	0.00	1.00	0.00

:: Post-earthquake settlement due to soil liquefaction :: (continued)

Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)	Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)
16.94	155.97	2.00	0.00	1.00	0.00	17.00	153.32	2.00	0.00	1.00	0.00
17.07	151.96	2.00	0.00	1.00	0.00	17.16	150.53	2.00	0.00	1.00	0.00
17.21	148.07	2.00	0.00	1.00	0.00	17.30	145.15	2.00	0.00	1.00	0.00
17.34	145.02	2.00	0.00	1.00	0.00	17.42	144.61	2.00	0.00	1.00	0.00
17.46	143.93	2.00	0.00	1.00	0.00	17.52	142.25	2.00	0.00	1.00	0.00
17.61	141.69	2.00	0.00	1.00	0.00	17.66	141.96	2.00	0.00	1.00	0.00
17.75	143.93	2.00	0.00	1.00	0.00	17.79	145.51	2.00	0.00	1.00	0.00
17.85	145.24	2.00	0.00	1.00	0.00	17.93	146.34	2.00	0.00	1.00	0.00
18.01	146.95	2.00	0.00	1.00	0.00	18.05	146.20	2.00	0.00	1.00	0.00
18.14	147.11	2.00	0.00	1.00	0.00	18.20	146.42	2.00	0.00	1.00	0.00
18.24	128.96	2.00	0.00	1.00	0.00	18.34	93.66	0.38	2.47	1.00	0.03
18.42	106.68	0.47	2.22	1.00	0.02	18.46	110.95	0.50	2.15	1.00	0.01
18.51	115.51	0.54	2.08	1.00	0.01	18.58	120.38	0.59	2.01	1.00	0.02
18.64	124.44	0.63	1.95	1.00	0.02	18.73	125.50	0.64	1.94	1.00	0.02
18.77	126.97	2.00	0.00	1.00	0.00	18.84	128.35	2.00	0.00	1.00	0.00
18.91	127.23	2.00	0.00	1.00	0.00	18.99	121.16	2.00	0.00	1.00	0.00
19.05	117.07	2.00	0.00	1.00	0.00	19.11	113.30	2.00	0.00	1.00	0.00
19.16	111.55	2.00	0.00	1.00	0.00	19.26	109.69	0.49	2.17	1.00	0.03
19.32	109.29	0.49	2.17	1.00	0.01	19.36	109.37	0.49	2.17	1.00	0.01
19.44	108.99	2.00	0.00	1.00	0.00	19.50	108.31	2.00	0.00	1.00	0.00
19.56	107.79	2.00	0.00	1.00	0.00	19.63	106.71	2.00	0.00	1.00	0.00
19.69	105.35	2.00	0.00	1.00	0.00	19.77	108.76	2.00	0.00	1.00	0.00
19.82	113.87	2.00	0.00	1.00	0.00	19.90	122.46	0.60	1.98	1.00	0.02
19.95	126.79	2.00	0.00	1.00	0.00	20.04	134.33	2.00	0.00	1.00	0.00
20.09	140.57	2.00	0.00	1.00	0.00	20.17	147.45	2.00	0.00	1.00	0.00
20.22	135.78	2.00	0.00	1.00	0.00	20.28	105.69	0.45	2.23	1.00	0.02
20.35	102.63	2.00	0.00	1.00	0.00	20.42	105.35	2.00	0.00	1.00	0.00
20.48	108.11	2.00	0.00	1.00	0.00	20.54	112.83	2.00	0.00	1.00	0.00
20.65	115.94	2.00	0.00	1.00	0.00	20.68	115.95	2.00	0.00	1.00	0.00
20.74	115.68	2.00	0.00	1.00	0.00	20.82	113.49	2.00	0.00	1.00	0.00
20.88	112.25	2.00	0.00	1.00	0.00	20.95	112.37	2.00	0.00	1.00	0.00
21.03	118.66	2.00	0.00	1.00	0.00	21.10	129.10	2.00	0.00	1.00	0.00
21.14	134.89	2.00	0.00	1.00	0.00	21.22	151.55	2.00	0.00	1.00	0.00
21.28	156.11	1.03	0.58	1.00	0.00	21.34	159.83	1.09	0.41	1.00	0.00
21.41	170.43	1.28	0.20	1.00	0.00	21.48	166.44	1.21	0.28	1.00	0.00
21.55	161.21	1.11	0.40	1.00	0.00	21.59	165.63	1.19	0.29	1.00	0.00
21.68	162.51	1.13	0.40	1.00	0.00	21.74	166.29	1.20	0.28	1.00	0.00
21.81	174.27	1.35	0.00	1.00	0.00	21.86	181.27	1.50	0.00	1.00	0.00
21.94	189.41	1.68	0.00	1.00	0.00	22.00	194.18	1.80	0.00	1.00	0.00
22.07	198.61	1.91	0.00	1.00	0.00	22.13	200.90	2.00	0.00	1.00	0.00
22.21	202.33	2.00	0.00	1.00	0.00	22.27	202.36	2.00	0.00	1.00	0.00
22.35	199.77	1.94	0.00	1.00	0.00	22.38	198.30	1.90	0.00	1.00	0.00
22.45	192.79	1.76	0.00	1.00	0.00	22.53	186.40	1.61	0.00	1.00	0.00
22.59	180.80	1.48	0.00	1.00	0.00	22.67	175.81	1.38	0.00	1.00	0.00
22.71	167.92	1.23	0.28	1.00	0.00	22.80	154.08	0.99	0.59	1.00	0.01
22.85	158.42	1.06	0.41	1.00	0.00	22.93	163.90	1.15	0.29	1.00	0.00
22.98	163.71	1.15	0.40	1.00	0.00	23.04	164.83	1.17	0.29	1.00	0.00
23.12	170.83	1.28	0.20	1.00	0.00	23.18	185.16	1.58	0.00	1.00	0.00

:: Post-earthquake settlement due to soil liquefaction :: (continued)

Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)	Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)
23.24	204.46	2.00	0.00	1.00	0.00	23.30	221.96	2.00	0.00	1.00	0.00
23.37	237.78	2.00	0.00	1.00	0.00	23.43	256.57	2.00	0.00	1.00	0.00
23.52	259.61	2.00	0.00	1.00	0.00	23.56	269.61	2.00	0.00	1.00	0.00
23.63	264.43	2.00	0.00	1.00	0.00	23.69	278.34	2.00	0.00	1.00	0.00
23.77	265.05	2.00	0.00	1.00	0.00	23.83	269.19	2.00	0.00	1.00	0.00
23.89	283.84	2.00	0.00	1.00	0.00	23.97	297.97	2.00	0.00	1.00	0.00
24.02	306.19	2.00	0.00	1.00	0.00	24.10	323.67	2.00	0.00	1.00	0.00
24.15	354.72	2.00	0.00	1.00	0.00	24.23	369.23	2.00	0.00	1.00	0.00
24.28	394.06	2.00	0.00	1.00	0.00	24.37	406.31	2.00	0.00	1.00	0.00
24.42	404.57	2.00	0.00	1.00	0.00	24.49	396.95	2.00	0.00	1.00	0.00
24.55	384.63	2.00	0.00	1.00	0.00	24.61	395.43	2.00	0.00	1.00	0.00
24.69	378.41	2.00	0.00	1.00	0.00	24.75	393.88	2.00	0.00	1.00	0.00
24.82	406.17	2.00	0.00	1.00	0.00	24.88	432.19	2.00	0.00	1.00	0.00
24.94	444.36	2.00	0.00	1.00	0.00	25.00	425.68	2.00	0.00	1.00	0.00
25.07	446.02	2.00	0.00	1.00	0.00	25.14	468.46	2.00	0.00	1.00	0.00
25.22	512.08	2.00	0.00	1.00	0.00	25.27	546.39	2.00	0.00	1.00	0.00
25.35	575.69	2.00	0.00	1.00	0.00	25.40	586.14	2.00	0.00	1.00	0.00
25.47	587.63	2.00	0.00	1.00	0.00	25.54	610.11	2.00	0.00	1.00	0.00
25.60	610.16	2.00	0.00	1.00	0.00	25.67	610.14	2.00	0.00	1.00	0.00
25.72	599.23	2.00	0.00	1.00	0.00	25.81	588.61	2.00	0.00	1.00	0.00
25.86	577.30	2.00	0.00	1.00	0.00	25.93	484.00	2.00	0.00	1.00	0.00
25.99	470.17	2.00	0.00	1.00	0.00	26.06	484.68	2.00	0.00	1.00	0.00
26.13	485.73	2.00	0.00	1.00	0.00	26.18	491.81	2.00	0.00	1.00	0.00
26.27	498.09	2.00	0.00	1.00	0.00	26.33	471.72	2.00	0.00	1.00	0.00
26.40	467.78	2.00	0.00	1.00	0.00	26.45	451.80	2.00	0.00	1.00	0.00
26.52	443.46	2.00	0.00	1.00	0.00	26.59	461.55	2.00	0.00	1.00	0.00
26.64	481.01	2.00	0.00	1.00	0.00	26.73	514.89	2.00	0.00	1.00	0.00
26.78	533.15	2.00	0.00	1.00	0.00	26.84	552.74	2.00	0.00	1.00	0.00
26.91	533.14	2.00	0.00	1.00	0.00	26.97	516.97	2.00	0.00	1.00	0.00
27.05	504.83	2.00	0.00	1.00	0.00	27.11	467.64	2.00	0.00	1.00	0.00
27.17	410.90	2.00	0.00	1.00	0.00	27.25	434.61	2.00	0.00	1.00	0.00
27.30	447.46	2.00	0.00	1.00	0.00	27.37	458.63	2.00	0.00	1.00	0.00
27.43	476.59	2.00	0.00	1.00	0.00	27.52	-1.00	2.00	0.00	1.00	0.00
27.56	-1.00	2.00	0.00	1.00	0.00	27.63	-1.00	2.00	0.00	1.00	0.00
27.70	-1.00	2.00	0.00	1.00	0.00	27.76	-1.00	2.00	0.00	1.00	0.00
27.82	-1.00	2.00	0.00	1.00	0.00						

Total estimated settlement: 1.15

Abbreviations

$Q_{tn,cs}$: Equivalent dean sand normalized cone resistance
FS: Factor of safety against liquefaction
e_v (%): Post-liquefaction volumentric strain
DF: e_v depth weighting factor
Settlement: Calculated settlement

:: Strength loss calculation (Robertson (2009) ::

Depth (ft)	q_t (tsf)	Q_{tn}	K_c	$Q_{tn,cs}$	I_c	$S_{u(liq)}/\sigma'_v$	$S_{u(peak)}/\sigma'_v$
0.08	0.43	0.68	26.61	18.21	4.06	N/A	N/A
0.16	5.18	8.31	12.43	103.29	3.41	N/A	N/A
0.21	166.87	268.07	1.00	268.07	1.27	N/A	N/A
0.29	142.09	228.26	1.00	228.26	1.38	N/A	N/A
0.33	128.34	206.17	1.00	206.17	1.44	N/A	N/A
0.41	97.52	156.64	1.00	156.64	1.63	N/A	N/A
0.48	74.03	118.89	1.11	132.31	1.81	N/A	N/A
0.54	51.92	83.36	1.35	112.80	2.04	N/A	N/A
0.61	43.97	70.58	1.57	110.73	2.16	N/A	N/A
0.66	35.08	56.29	1.96	110.08	2.30	N/A	N/A
0.73	28.94	46.42	2.52	116.77	2.45	N/A	N/A
0.79	23.85	38.24	3.18	121.73	2.58	N/A	N/A
0.88	21.52	34.49	3.56	122.68	2.64	N/A	N/A
0.93	21.08	33.77	3.57	120.63	2.64	N/A	N/A
1.00	22.20	35.58	3.16	112.46	2.57	N/A	N/A
1.06	19.09	30.58	3.53	108.08	2.63	N/A	N/A
1.13	18.31	29.32	3.52	103.24	2.63	N/A	N/A
1.19	18.40	29.46	3.26	96.01	2.59	N/A	N/A
1.25	18.05	28.89	3.14	90.61	2.57	N/A	N/A
1.33	17.27	27.63	2.82	77.81	2.51	N/A	N/A
1.39	16.24	25.97	2.41	62.54	2.42	N/A	N/A
1.46	15.29	24.44	2.47	60.48	2.44	N/A	N/A
1.51	14.51	23.18	2.60	60.19	2.46	N/A	N/A
1.59	13.39	21.38	2.91	62.25	2.53	N/A	N/A
1.66	12.52	19.97	3.13	62.43	2.57	N/A	N/A
1.73	12.56	20.02	3.25	65.14	2.59	N/A	N/A
1.78	11.32	18.02	3.88	69.87	2.68	N/A	N/A
1.85	10.89	17.33	4.29	74.33	2.74	N/A	N/A
1.91	10.89	17.32	4.40	76.21	2.75	N/A	N/A
1.99	10.89	17.32	4.48	77.66	2.76	N/A	N/A
2.04	10.89	17.31	4.54	78.66	2.77	N/A	N/A
2.12	11.24	17.87	4.65	83.08	2.78	N/A	N/A
2.17	12.19	19.39	4.42	85.63	2.76	N/A	N/A
2.25	17.46	27.85	3.12	86.98	2.57	N/A	N/A
2.31	25.32	40.47	2.20	88.96	2.37	N/A	N/A
2.38	39.22	62.80	1.54	96.57	2.14	N/A	N/A
2.44	47.08	75.42	1.39	104.55	2.06	N/A	N/A
2.50	52.87	84.72	1.32	111.51	2.01	N/A	N/A
2.57	59.78	95.81	1.28	122.27	1.98	N/A	N/A
2.63	63.32	101.50	1.29	131.34	2.00	N/A	N/A
2.69	60.47	96.91	1.38	133.82	2.06	N/A	N/A
2.76	54.59	87.46	1.50	131.43	2.13	N/A	N/A
2.86	43.28	69.27	1.85	128.18	2.27	N/A	N/A
2.90	37.84	60.53	2.21	133.82	2.37	N/A	N/A
2.99	32.57	52.06	2.53	131.91	2.45	N/A	N/A
3.03	34.73	55.52	2.33	129.09	2.40	N/A	N/A
3.13	40.60	64.95	1.92	124.97	2.29	N/A	N/A
3.17	49.50	79.24	1.57	124.68	2.16	N/A	N/A

:: Strength loss calculation (Robertson (2009) :: (continued)

Depth (ft)	q_t (tsf)	Q_{tn}	K_c	$Q_{tn,cs}$	I_c	$S_{u(liq)}/\sigma'_v$	$S_{u(peak)}/\sigma'_v$
3.25	38.62	61.75	1.93	119.39	2.30	N/A	N/A
3.29	35.85	57.30	1.71	98.22	2.22	N/A	N/A
3.35	31.10	49.66	1.38	68.31	2.05	N/A	N/A
3.44	26.78	42.71	1.51	64.70	2.13	N/A	N/A
3.48	24.45	38.96	1.61	62.61	2.17	N/A	N/A
3.55	20.65	32.85	1.85	60.66	2.27	N/A	N/A
3.62	17.89	28.42	2.15	61.22	2.36	N/A	N/A
3.68	9.94	15.64	4.07	63.68	2.71	N/A	N/A
3.75	15.21	24.10	2.55	61.57	2.46	N/A	N/A
3.81	15.56	24.66	2.50	61.74	2.44	N/A	N/A
3.89	15.82	25.07	2.56	64.09	2.46	N/A	N/A
3.96	15.82	25.07	2.63	66.04	2.47	N/A	N/A
4.02	16.51	26.17	2.50	65.56	2.44	N/A	N/A
4.07	17.80	28.24	2.32	65.64	2.40	N/A	N/A
4.15	18.75	29.76	2.27	67.64	2.39	N/A	N/A
4.20	19.36	30.74	2.24	68.80	2.38	N/A	N/A
4.29	21.09	33.50	2.13	71.28	2.35	N/A	N/A
4.34	21.27	33.78	2.19	74.09	2.37	N/A	N/A
4.40	20.75	32.94	2.42	79.78	2.43	N/A	N/A
4.47	19.97	31.68	2.70	85.59	2.49	N/A	N/A
4.54	20.23	32.09	2.80	90.02	2.51	N/A	N/A
4.60	19.63	31.12	3.04	94.76	2.55	N/A	N/A
4.67	19.63	31.12	3.24	100.94	2.59	N/A	N/A
4.74	19.37	30.69	3.51	107.67	2.63	N/A	N/A
4.79	19.97	31.65	3.53	111.82	2.63	N/A	N/A
4.87	21.01	33.32	3.55	118.37	2.64	N/A	N/A
4.92	21.96	34.84	3.50	121.89	2.63	N/A	N/A
5.01	23.25	36.90	3.56	131.21	2.64	N/A	N/A
5.06	24.20	38.43	3.48	133.53	2.62	N/A	N/A
5.12	25.07	39.82	3.46	137.68	2.62	N/A	N/A
5.19	26.19	41.61	3.39	141.02	2.61	N/A	N/A
5.28	27.49	43.69	3.30	144.05	2.60	N/A	N/A
5.33	28.44	45.21	3.23	146.02	2.58	N/A	N/A
5.39	28.69	45.61	3.25	148.05	2.59	N/A	N/A
5.46	28.95	46.02	3.10	142.78	2.56	N/A	N/A
5.54	28.61	45.47	2.81	127.88	2.51	N/A	N/A
5.59	28.35	45.04	2.80	126.15	2.51	N/A	N/A
5.66	27.57	43.78	2.97	129.89	2.54	N/A	N/A
5.73	27.31	43.36	3.07	132.93	2.56	N/A	N/A
5.78	27.23	43.23	3.12	134.91	2.57	N/A	N/A
5.85	26.71	42.38	3.23	137.02	2.58	N/A	N/A
5.92	27.31	43.34	3.19	138.20	2.58	N/A	N/A
5.98	26.79	42.50	3.29	139.69	2.59	N/A	N/A
6.04	27.40	43.47	3.22	140.14	2.58	0.72	0.72
6.12	27.31	43.32	3.28	142.13	2.59	0.72	0.72
6.17	27.23	43.19	3.33	143.76	2.60	5.50	5.50
6.24	26.71	42.34	3.42	144.73	2.61	5.34	5.34
6.30	25.41	40.25	3.60	145.02	2.64	5.02	5.02

::Strength loss calculation (Robertson (2009) ::(continued)

Depth (ft)	q_t (tsf)	Q_{tn}	K_c	$Q_{tn,cs}$	I_c	$S_{u(liq)}/\sigma'_v$	$S_{u(peak)}/\sigma'_v$
6.37	23.68	37.46	3.86	144.67	2.68	4.62	4.62
6.44	22.48	35.53	3.97	141.06	2.70	4.33	4.33
6.51	21.61	34.12	4.03	137.45	2.70	4.12	4.12
6.58	21.70	34.26	3.90	133.68	2.69	4.09	4.09
6.64	21.96	34.67	3.78	131.21	2.67	4.10	4.10
6.70	22.30	35.21	3.71	130.66	2.66	4.12	4.12
6.76	23.08	36.46	3.60	131.10	2.64	4.23	4.23
6.83	23.68	37.42	3.53	132.24	2.63	4.29	4.29
6.89	24.12	38.12	3.50	133.49	2.63	4.33	4.33
6.98	24.63	38.93	3.50	136.29	2.63	4.37	4.37
7.03	25.40	40.17	3.40	136.64	2.61	4.48	4.48
7.11	26.87	42.53	3.19	135.70	2.58	0.71	0.71
7.15	27.56	43.63	3.09	134.83	2.56	0.72	0.72
7.25	29.89	47.37	2.83	133.93	2.51	0.73	0.73
7.30	31.53	50.00	2.69	134.49	2.48	0.73	0.73
7.36	32.48	51.52	2.67	137.41	2.48	0.74	0.74
7.43	32.74	51.93	2.75	142.86	2.50	0.74	0.74
7.52	32.14	50.96	2.89	147.34	2.52	0.74	0.74
7.57	31.19	49.42	3.01	148.58	2.54	0.73	0.73
7.65	29.12	46.09	3.26	150.31	2.59	0.72	0.72
7.70	29.12	46.09	3.26	150.24	2.59	0.72	0.72
7.74	29.03	45.94	3.27	150.24	2.59	0.72	0.72
7.82	29.72	47.04	3.16	148.81	2.57	0.73	0.73
7.87	30.41	48.14	3.05	146.99	2.55	0.73	0.73
7.95	30.94	48.97	2.94	143.75	2.53	0.73	0.73
8.01	31.29	49.53	2.61	129.06	2.47	0.73	0.73
8.10	32.24	51.05	1.95	99.73	2.30	0.74	0.74
8.15	32.67	51.73	1.90	98.32	2.28	0.74	0.74
8.24	35.00	55.47	1.72	95.24	2.22	0.75	0.75
8.28	35.34	56.01	1.68	93.93	2.20	0.75	0.75
8.34	35.47	56.21	1.64	92.44	2.19	0.75	0.75
8.41	35.60	56.42	1.61	91.10	2.18	0.75	0.75
8.47	36.29	57.53	1.56	89.92	2.15	0.75	0.75
8.56	36.99	58.55	1.50	88.04	2.13	0.75	0.75
8.60	37.33	58.75	1.49	87.35	2.12	0.76	0.76
8.68	38.02	59.24	1.46	86.61	2.10	0.76	0.76
8.73	38.02	58.98	1.46	86.00	2.10	0.76	0.76
8.82	38.02	58.39	1.44	83.87	2.09	0.75	0.75
8.86	38.89	59.26	1.41	83.33	2.07	0.76	0.76
8.95	38.71	58.42	1.39	81.07	2.06	0.75	0.75
9.00	38.80	58.16	1.37	79.72	2.05	0.75	0.75
9.07	38.97	58.01	1.36	78.79	2.04	0.75	0.75
9.14	37.59	56.15	1.41	79.17	2.07	0.75	0.75
9.19	37.59	55.73	1.39	77.59	2.06	0.75	0.75
9.27	37.07	55.19	1.45	80.18	2.10	0.75	0.75
9.32	37.42	55.63	1.47	81.53	2.11	0.75	0.75
9.41	36.21	53.85	1.52	81.94	2.13	0.74	0.74
9.48	35.95	53.28	1.54	81.78	2.14	0.74	0.74

:: Strength loss calculation (Robertson (2009) :: (continued)

Depth (ft)	q_t (tsf)	Q_{tn}	K_c	$Q_{tn,cs}$	I_c	$S_{u(liq)}/\sigma'_v$	$S_{u(peak)}/\sigma'_v$
9.54	35.00	51.78	1.56	80.89	2.15	0.74	0.74
9.59	34.65	51.09	1.57	80.27	2.16	0.74	0.74
9.66	35.26	51.52	1.53	78.86	2.14	0.74	0.74
9.72	35.52	51.41	1.49	76.59	2.12	0.74	0.74
9.80	35.60	51.01	1.46	74.33	2.10	0.74	0.74
9.86	35.09	50.14	1.46	73.43	2.11	0.73	0.73
9.94	34.65	49.29	1.48	72.83	2.11	0.73	0.73
9.99	34.22	48.65	1.50	73.03	2.12	0.73	0.73
10.04	33.88	48.21	1.54	74.27	2.14	0.73	0.73
10.13	32.58	46.87	1.72	80.41	2.22	0.73	0.73
10.17	31.37	45.48	1.86	84.47	2.27	0.72	0.72
10.26	29.30	43.11	2.18	94.15	2.37	0.72	0.72
10.31	27.74	41.12	2.41	99.13	2.42	0.71	0.71
10.38	26.10	38.91	2.67	103.93	2.48	0.70	0.70
10.44	23.43	35.22	3.06	107.81	2.55	0.69	0.69
10.53	21.35	32.17	3.40	109.44	2.61	2.47	2.47
10.57	23.30	34.66	3.08	106.62	2.56	0.69	0.69
10.67	21.61	31.95	3.17	101.39	2.57	0.68	0.68
10.71	23.17	33.83	2.88	97.53	2.52	0.69	0.69
10.78	25.84	37.14	2.58	95.71	2.46	0.70	0.70
10.84	29.04	41.09	2.29	94.11	2.39	0.71	0.71
10.93	34.31	47.46	1.95	92.53	2.30	0.73	0.73
10.96	35.69	48.94	1.84	90.01	2.26	0.73	0.73
11.07	41.48	55.39	1.56	86.52	2.15	0.75	0.75
11.11	43.98	58.29	1.50	87.51	2.12	0.75	0.75
11.16	51.41	66.18	1.28	84.40	1.98	0.77	0.77
11.26	60.39	74.33	1.00	74.33	1.77	0.79	0.79
11.29	62.64	76.92	1.00	76.92	1.76	0.79	0.79
11.36	65.31	79.75	1.00	79.75	1.74	0.80	0.80
11.43	62.20	76.12	1.00	76.12	1.77	0.79	0.79
11.49	60.39	74.51	1.00	74.51	1.84	0.79	0.79
11.56	60.18	75.55	1.25	94.09	1.95	0.79	0.79
11.63	59.96	76.26	1.37	104.49	2.05	0.79	0.79
11.69	63.24	79.35	1.29	102.06	1.99	0.80	0.80
11.76	71.27	87.69	1.18	103.45	1.89	0.81	0.81
11.82	74.04	90.14	1.14	103.01	1.85	0.81	0.81
11.89	81.55	97.90	1.09	107.06	1.78	0.82	0.82
11.96	83.02	99.39	1.09	108.82	1.78	0.83	0.83
12.01	90.71	107.56	1.06	114.22	1.74	0.84	0.84
12.08	89.15	105.51	1.07	112.71	1.74	0.83	0.83
12.15	88.29	104.49	1.08	112.93	1.76	0.83	0.83
12.22	78.44	93.70	1.14	107.20	1.85	0.82	0.82
12.27	74.56	89.43	1.18	105.94	1.90	0.81	0.81
12.35	63.93	77.62	1.31	101.65	2.01	0.79	0.79
12.41	51.15	63.16	1.57	98.99	2.16	0.76	0.76
12.47	40.96	51.36	1.97	101.10	2.31	0.74	0.74
12.55	30.77	39.33	2.80	109.99	2.51	0.70	0.70
12.60	24.89	32.11	3.53	113.21	2.63	2.40	2.40

:: Strength loss calculation (Robertson (2009) :: (continued)

Depth (ft)	q_t (tsf)	Q_{tn}	K_c	$Q_{tn,cs}$	I_c	$S_{u(liq)}/\sigma'_v$	$S_{u(peak)}/\sigma'_v$
12.68	19.19	24.88	4.51	112.28	2.77	1.83	1.83
12.74	16.17	20.98	5.26	110.30	2.85	1.52	1.52
12.81	14.36	18.51	5.62	104.04	2.89	1.33	1.33
12.86	11.85	15.17	6.68	101.30	2.99	1.08	1.08
12.93	10.21	12.86	7.46	95.92	3.06	0.92	0.92
13.00	9.78	12.21	7.48	91.32	3.06	0.87	0.87
13.08	9.87	12.25	7.11	87.10	3.03	0.87	0.87
13.13	10.12	12.53	6.69	83.90	3.00	0.90	0.90
13.20	10.73	13.27	6.15	81.60	2.94	0.95	0.95
13.27	11.33	13.92	5.78	80.44	2.91	1.00	1.00
13.32	11.42	13.96	5.66	78.99	2.90	1.00	1.00
13.39	11.68	14.21	5.50	78.12	2.88	1.02	1.02
13.49	11.85	14.29	5.40	77.16	2.87	1.03	1.03
13.52	11.94	14.29	4.92	70.24	2.82	1.04	1.04
13.62	11.68	13.78	4.51	62.13	2.77	0.26	1.01
13.67	11.59	13.68	4.80	65.71	2.80	0.30	0.99
13.72	11.33	13.34	4.99	66.59	2.82	0.31	0.97
13.79	10.90	12.77	5.24	66.96	2.85	0.31	0.92
13.85	10.73	12.52	5.33	66.73	2.86	0.30	0.90
13.92	9.61	11.13	5.91	65.79	2.92	0.29	0.80
14.02	10.04	11.54	5.50	63.41	2.88	0.27	0.83
14.05	9.61	11.01	5.75	63.33	2.91	0.26	0.79
14.11	9.00	10.25	6.24	63.92	2.95	0.27	0.73
14.18	9.00	10.20	6.43	65.58	2.97	0.28	0.73
14.24	9.00	10.16	6.72	68.29	3.00	0.31	0.73
14.32	10.21	11.57	6.10	70.56	2.94	0.83	0.83
14.38	11.25	12.74	5.55	70.68	2.88	0.92	0.92
14.44	13.75	15.53	4.48	69.67	2.76	0.35	1.13
14.51	14.96	16.82	4.07	68.40	2.71	0.34	1.23
14.57	15.48	17.35	3.97	68.98	2.70	0.35	1.27
14.64	16.43	18.38	3.89	71.53	2.69	1.35	1.35
14.71	17.98	20.08	3.73	74.93	2.66	1.47	1.47
14.77	19.37	21.59	3.61	77.89	2.64	1.59	1.59
14.83	20.40	22.70	3.59	81.46	2.64	1.67	1.67
14.90	20.49	22.77	3.81	86.74	2.67	1.67	1.67
14.97	20.92	23.22	4.00	92.96	2.70	1.69	1.69
15.03	21.27	23.57	4.12	97.14	2.72	1.72	1.72
15.10	21.70	24.00	4.27	102.41	2.74	1.74	1.74
15.16	22.66	24.99	4.28	107.04	2.74	1.82	1.82
15.23	23.35	25.70	4.44	114.05	2.76	1.86	1.86
15.30	24.39	26.80	4.54	121.57	2.77	1.94	1.94
15.36	25.59	28.08	4.61	129.54	2.78	2.03	2.03
15.44	27.32	29.89	4.62	138.04	2.78	2.16	2.16
15.50	28.88	31.51	4.56	143.80	2.77	2.28	2.28
15.56	30.69	33.36	4.46	148.78	2.76	2.42	2.42
15.63	32.07	34.75	4.42	153.49	2.76	2.52	2.52
15.69	33.11	35.75	4.42	157.99	2.76	2.59	2.59
15.76	33.20	35.70	4.44	158.58	2.76	2.58	2.58

:: Strength loss calculation (Robertson (2009) :: (continued)

Depth (ft)	q_t (tsf)	Q_{tn}	K_c	$Q_{tn,cs}$	I_c	$S_{u(liq)}/\sigma'_v$	$S_{u(peak)}/\sigma'_v$
15.86	33.20	35.44	4.35	154.16	2.75	2.56	2.56
15.89	33.20	35.40	4.41	156.22	2.75	2.56	2.56
15.95	33.54	35.66	4.54	161.76	2.77	2.57	2.57
16.04	35.10	37.14	4.48	166.32	2.76	2.68	2.68
16.09	36.65	38.65	4.32	166.83	2.74	2.79	2.79
16.15	19.03	19.73	8.71	171.80	3.16	1.41	1.41
16.22	39.76	41.56	3.99	166.03	2.70	3.01	3.01
16.30	40.88	42.52	3.88	165.15	2.68	3.08	3.08
16.35	40.97	42.47	3.88	164.90	2.68	3.07	3.07
16.43	41.05	42.36	3.91	165.77	2.69	3.06	3.06
16.47	41.23	42.44	3.93	166.86	2.69	3.07	3.07
16.55	42.09	43.14	3.91	168.67	2.69	3.12	3.12
16.61	41.75	42.63	3.96	168.93	2.70	3.08	3.08
16.69	41.40	42.07	3.98	167.35	2.70	3.04	3.04
16.74	42.35	42.91	3.86	165.59	2.68	3.10	3.10
16.80	42.26	42.64	3.83	163.40	2.68	3.08	3.08
16.88	42.78	42.95	3.70	158.81	2.66	3.10	3.10
16.94	43.13	43.14	3.62	155.97	2.65	3.11	3.11
17.00	42.35	42.19	3.63	153.32	2.65	3.04	3.04
17.07	40.10	39.77	3.82	151.96	2.68	2.87	2.87
17.16	37.69	37.16	4.05	150.53	2.71	2.67	2.67
17.21	37.73	37.09	3.99	148.07	2.70	2.67	2.67
17.30	37.73	36.89	3.94	145.15	2.69	2.65	2.65
17.34	37.77	36.84	3.94	145.02	2.69	2.65	2.65
17.42	38.20	37.11	3.90	144.61	2.69	2.67	2.67
17.46	38.38	37.25	3.86	143.93	2.68	2.68	2.68
17.52	39.07	37.86	3.76	142.25	2.67	2.72	2.72
17.61	37.43	36.15	3.92	141.69	2.69	2.60	2.60
17.66	36.82	35.51	4.00	141.96	2.70	2.55	2.55
17.75	36.13	34.75	4.14	143.93	2.72	2.49	2.49
17.79	35.70	34.28	4.24	145.51	2.73	2.46	2.46
17.85	36.22	34.73	4.18	145.24	2.73	2.49	2.49
17.93	38.64	37.02	3.95	146.34	2.69	2.66	2.66
18.01	39.07	37.35	3.93	146.95	2.69	2.68	2.68
18.05	39.76	37.97	3.85	146.20	2.68	2.72	2.72
18.14	40.28	38.38	3.83	147.11	2.68	2.75	2.75
18.20	39.33	37.40	3.91	146.42	2.69	2.68	2.68
18.24	40.41	38.36	3.36	128.96	2.61	2.75	2.75
18.34	40.54	38.32	2.44	93.66	2.43	0.70	0.70
18.42	42.18	39.85	2.68	106.68	2.48	0.71	0.71
18.46	43.47	41.06	2.70	110.95	2.49	0.71	0.71
18.51	44.16	41.69	2.77	115.51	2.50	0.71	0.71
18.58	45.20	42.62	2.82	120.38	2.51	0.71	0.71
18.64	43.39	40.82	3.05	124.44	2.55	0.71	0.71
18.73	42.61	39.98	3.14	125.50	2.57	0.71	0.71
18.77	38.90	36.39	3.49	126.97	2.63	2.61	2.61
18.84	34.84	32.44	3.96	128.35	2.69	2.32	2.32
18.91	31.81	29.48	4.32	127.23	2.74	2.11	2.11

:: Strength loss calculation (Robertson (2009) :: (continued)

Depth (ft)	q_t (tsf)	Q_{tn}	K_c	$Q_{tn,cs}$	I_c	$S_{u(liq)}/\sigma'_v$	$S_{u(peak)}/\sigma'_v$
18.99	29.57	27.27	4.44	121.16	2.76	1.95	1.95
19.05	30.00	27.64	4.24	117.07	2.73	1.98	1.98
19.11	32.59	30.05	3.77	113.30	2.67	2.15	2.15
19.16	34.58	31.90	3.50	111.55	2.63	2.28	2.28
19.26	37.34	34.44	3.18	109.69	2.58	0.69	0.69
19.32	37.60	34.64	3.15	109.29	2.57	0.69	0.69
19.36	35.96	33.05	3.31	109.37	2.60	0.68	0.68
19.44	34.40	31.51	3.46	108.99	2.62	2.25	2.25
19.50	35.01	32.04	3.38	108.31	2.61	2.29	2.29
19.56	36.91	33.78	3.19	107.79	2.58	0.69	0.69
19.63	41.83	38.36	2.78	106.71	2.50	0.70	0.70
19.69	53.06	48.89	2.15	105.35	2.36	0.73	0.73
19.77	63.08	58.24	1.87	108.76	2.27	0.75	0.75
19.82	71.02	65.63	1.74	113.87	2.23	0.77	0.77
19.90	75.60	69.82	1.75	122.46	2.23	0.78	0.78
19.95	77.76	71.76	1.77	126.79	2.24	0.78	0.78
20.04	73.87	67.96	1.98	134.33	2.31	0.77	0.77
20.09	66.27	60.74	2.31	140.57	2.40	0.76	0.76
20.17	55.91	50.94	2.89	147.45	2.52	0.74	0.74
20.22	43.65	39.45	3.44	135.78	2.62	2.81	2.81
20.28	38.64	34.77	3.04	105.69	2.55	0.69	0.69
20.35	32.50	29.00	3.54	102.63	2.63	2.07	2.07
20.42	27.50	24.30	4.33	105.35	2.74	1.73	1.73
20.48	27.37	24.14	4.48	108.11	2.76	1.72	1.72
20.54	27.37	24.10	4.68	112.83	2.79	1.72	1.72
20.65	27.25	23.91	4.85	115.94	2.81	1.70	1.70
20.68	28.37	24.92	4.65	115.95	2.78	1.78	1.78
20.74	32.08	28.31	4.09	115.68	2.71	2.02	2.02
20.82	44.26	39.49	2.87	113.49	2.52	0.70	0.70
20.88	56.01	50.29	2.23	112.25	2.38	0.74	0.74
20.95	70.42	63.57	1.77	112.37	2.24	0.77	0.77
21.03	99.35	90.30	1.31	118.66	2.01	0.81	0.81
21.10	120.43	109.80	1.18	129.10	1.89	0.84	0.84
21.14	128.89	117.58	1.15	134.89	1.85	0.85	0.85
21.22	149.53	136.51	1.11	151.55	1.80	0.87	0.87
21.28	159.91	146.07	1.07	156.11	1.75	0.88	0.88
21.34	168.03	153.52	1.04	159.83	1.70	0.89	0.89
21.41	184.18	168.35	1.01	170.43	1.66	0.90	0.90
21.48	177.35	161.83	1.03	166.44	1.69	0.90	0.90
21.55	169.15	154.05	1.05	161.21	1.71	0.89	0.89
21.59	176.79	161.05	1.03	165.63	1.69	0.90	0.90
21.68	171.57	155.98	1.04	162.51	1.71	0.89	0.89
21.74	176.23	160.13	1.04	166.29	1.70	0.90	0.90
21.81	184.18	167.20	1.04	174.27	1.71	0.90	0.90
21.86	191.94	174.17	1.04	181.27	1.70	0.91	0.91
21.94	198.95	180.29	1.05	189.41	1.72	0.91	0.91
22.00	204.98	185.65	1.05	194.18	1.71	0.92	0.92
22.07	209.22	189.26	1.05	198.61	1.72	0.92	0.92

:: Strength loss calculation (Robertson (2009) :: (continued)

Depth (ft)	q_t (tsf)	Q_{tn}	K_c	$Q_{tn,cs}$	I_c	$S_{u(liq)}/\sigma'_v$	$S_{u(peak)}/\sigma'_v$
22.13	211.38	191.03	1.05	200.90	1.72	0.92	0.92
22.21	211.99	191.30	1.06	202.33	1.73	0.92	0.92
22.27	211.73	190.86	1.06	202.36	1.73	0.92	0.92
22.35	208.88	187.99	1.06	199.77	1.74	0.92	0.92
22.38	206.81	186.02	1.07	198.30	1.74	0.92	0.92
22.45	198.77	178.41	1.08	192.79	1.76	0.91	0.91
22.53	189.45	169.63	1.10	186.40	1.79	0.90	0.90
22.59	180.98	161.68	1.12	180.80	1.82	0.90	0.90
22.67	173.04	154.21	1.14	175.81	1.84	0.89	0.89
22.71	169.84	151.44	1.11	167.92	1.80	0.89	0.89
22.80	162.07	144.56	1.07	154.08	1.74	0.88	0.88
22.85	160.43	142.65	1.11	158.42	1.81	0.88	0.88
22.93	162.28	143.92	1.14	163.90	1.84	0.88	0.88
22.98	161.29	142.87	1.15	163.71	1.85	0.88	0.88
23.04	162.50	143.83	1.15	164.83	1.85	0.88	0.88
23.12	167.25	147.80	1.16	170.83	1.86	0.88	0.88
23.18	188.58	167.02	1.11	185.16	1.80	0.90	0.90
23.24	220.88	196.41	1.04	204.46	1.70	0.93	0.93
23.30	249.04	221.96	1.00	221.96	1.64	0.95	0.95
23.37	266.40	237.19	1.00	237.78	1.65	0.96	0.96
23.43	285.66	254.12	1.01	256.57	1.66	0.97	0.97
23.52	291.97	259.61	1.00	259.61	1.61	0.97	0.97
23.56	303.37	269.61	1.00	269.61	1.56	0.98	0.98
23.63	297.84	264.43	1.00	264.43	1.55	0.97	0.97
23.69	313.73	278.34	1.00	278.34	1.51	0.98	0.98
23.77	299.13	265.05	1.00	265.05	1.50	0.97	0.97
23.83	304.07	269.19	1.00	269.19	1.45	0.98	0.98
23.89	320.81	283.84	1.00	283.84	1.41	0.99	0.99
23.97	337.06	297.97	1.00	297.97	1.35	0.99	0.99
24.02	346.55	306.19	1.00	306.19	1.32	1.00	1.00
24.10	366.68	323.67	1.00	323.67	1.29	1.01	1.01
24.15	402.01	354.72	1.00	354.72	1.23	1.02	1.02
24.23	418.85	369.23	1.00	369.23	1.23	1.03	1.03
24.28	447.27	394.06	1.00	394.06	1.22	1.04	1.04
24.37	461.69	406.31	1.00	406.31	1.23	1.05	1.05
24.42	460.05	404.57	1.00	404.57	1.29	1.05	1.05
24.49	451.84	396.95	1.00	396.95	1.34	1.04	1.04
24.55	438.28	384.63	1.00	384.63	1.28	1.04	1.04
24.61	450.94	395.43	1.00	395.43	1.29	1.04	1.04
24.69	432.06	378.41	1.00	378.41	1.34	1.03	1.03
24.75	450.03	393.88	1.00	393.88	1.33	1.04	1.04
24.82	464.54	406.17	1.00	406.17	1.34	1.05	1.05
24.88	494.60	432.19	1.00	432.19	1.30	1.06	1.06
24.94	508.93	444.36	1.00	444.36	1.27	1.06	1.06
25.00	488.03	425.68	1.00	425.68	1.26	1.05	1.05
25.07	511.78	446.02	1.00	446.02	1.19	1.06	1.06
25.14	537.95	468.46	1.00	468.46	1.16	1.07	1.07
25.22	588.66	512.08	1.00	512.08	1.19	1.09	1.09

:: Strength loss calculation (Robertson (2009) :: (continued)

Depth (ft)	q_t (tsf)	Q_{tn}	K_c	$Q_{tn,cs}$	I_c	$S_{u(liq)}/\sigma'_v$	$S_{u(peak)}/\sigma'_v$
25.27	628.39	546.39	1.00	546.39	1.19	1.10	1.10
25.35	662.85	575.69	1.00	575.69	1.22	1.11	1.11
25.40	675.29	586.14	1.00	586.14	1.22	1.11	1.11
25.47	677.79	587.63	1.00	587.63	1.22	1.11	1.11
25.54	704.31	610.11	1.00	610.11	1.19	1.12	1.12
25.60	705.00	610.16	1.00	610.16	1.20	1.12	1.12
25.67	705.69	610.14	1.00	610.14	1.20	1.12	1.12
25.72	693.68	599.23	1.00	599.23	1.22	1.12	1.12
25.81	682.29	588.61	1.00	588.61	1.22	1.11	1.11
25.86	669.68	577.30	1.00	577.30	1.24	1.11	1.11
25.93	562.32	484.00	1.00	484.00	1.34	1.08	1.08
25.99	546.77	470.17	1.00	470.17	1.36	1.07	1.07
26.06	564.13	484.68	1.00	484.68	1.35	1.08	1.08
26.13	565.95	485.73	1.00	485.73	1.32	1.08	1.08
26.18	573.46	491.81	1.00	491.81	1.26	1.08	1.08
26.27	581.42	498.09	1.00	498.09	1.20	1.08	1.08
26.33	551.19	471.72	1.00	471.72	1.23	1.07	1.07
26.40	547.12	467.78	1.00	467.78	1.22	1.07	1.07
26.45	528.89	451.80	1.00	451.80	1.26	1.07	1.07
26.52	519.65	443.46	1.00	443.46	1.30	1.06	1.06
26.59	541.33	461.55	1.00	461.55	1.26	1.07	1.07
26.64	564.48	481.01	1.00	481.01	1.18	1.08	1.08
26.73	604.82	514.89	1.00	514.89	1.02	1.09	1.09
26.78	626.59	533.15	1.00	533.15	0.97	1.09	1.09
26.84	650.08	552.74	1.00	552.74	0.94	1.10	1.10
26.91	627.62	533.14	1.00	533.14	0.97	1.09	1.09
26.97	609.14	516.97	1.00	516.97	1.03	1.09	1.09
27.05	595.49	504.83	1.00	504.83	1.07	1.09	1.09
27.11	552.22	467.64	1.00	467.64	1.16	1.07	1.07
27.17	485.80	410.90	1.00	410.90	1.27	1.05	1.05
27.25	514.30	434.61	1.00	434.61	1.34	1.06	1.06
27.30	529.84	447.46	1.00	447.46	1.32	1.06	1.06
27.37	543.49	458.63	1.00	458.63	1.23	1.07	1.07
27.43	565.17	476.59	1.00	476.59	1.23	1.07	1.07
27.52	603.78	-1.00	1.00	-1.00	-1.00	N/A	N/A
27.56	634.78	-1.00	1.00	-1.00	-1.00	N/A	N/A
27.63	686.09	-1.00	1.00	-1.00	-1.00	N/A	N/A
27.70	766.85	-1.00	1.00	-1.00	-1.00	N/A	N/A
27.76	809.51	-1.00	1.00	-1.00	-1.00	N/A	N/A
27.82	811.50	-1.00	1.00	-1.00	-1.00	N/A	N/A

Abbreviations

q_t: Total cone resistance
K_c: Cone resistance correction factor due to fines
$Q_{tn,cs}$: Adjusted and corrected cone resistance due to fines
I_c: Soil behavior type index
$S_{u(liq)}/\sigma'_v$: Calculated liquefied undrained strength ratio
$S_{u(peak)}/\sigma'_v$: Calculated peak undrained strength ratio

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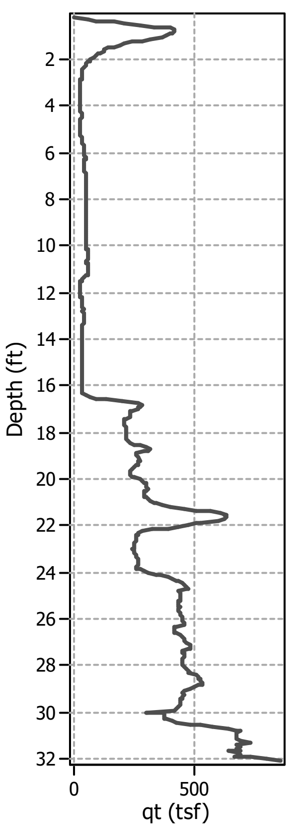
LIQUEFACTION ANALYSIS REPORT

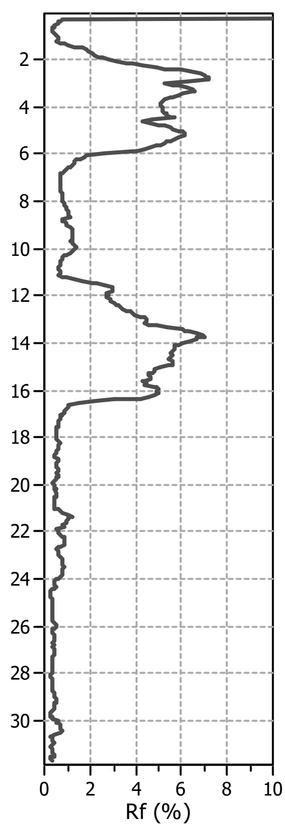
Project title : Twining Consulting **Location : 4112 Del Rey Ave, Marina Del Rey, CA**

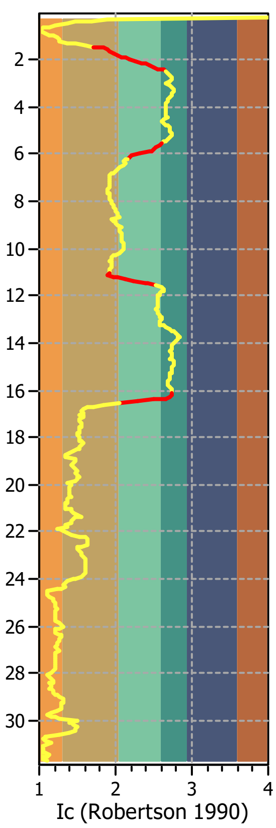
CPT file : CPT-2

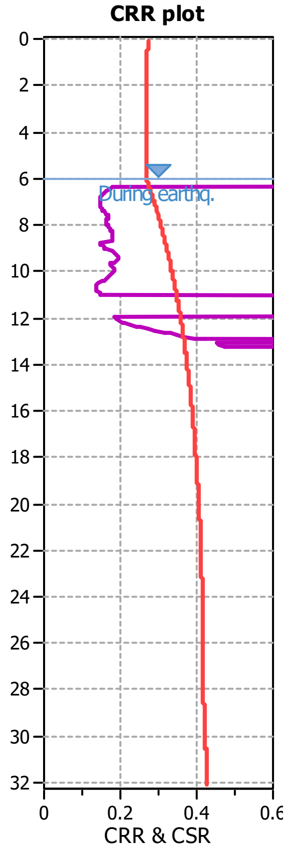
Input parameters and analysis data

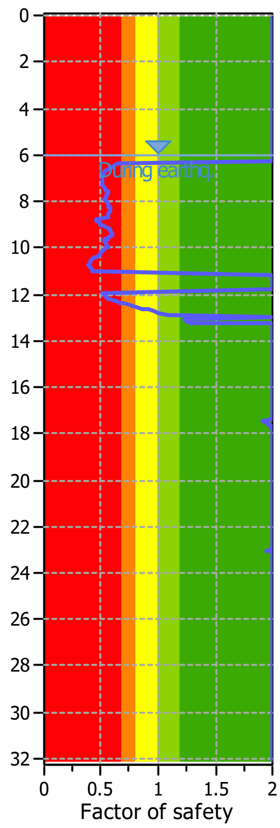
Analysis method:	NCEER (1998)	G.W.T. (in-situ):	22.00 ft	Use fill:	No	Clay like behavior applied:	Sands only
Fines correction method:	NCEER (1998)	G.W.T. (earthq.):	6.00 ft	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	1	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	6.35	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.58	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

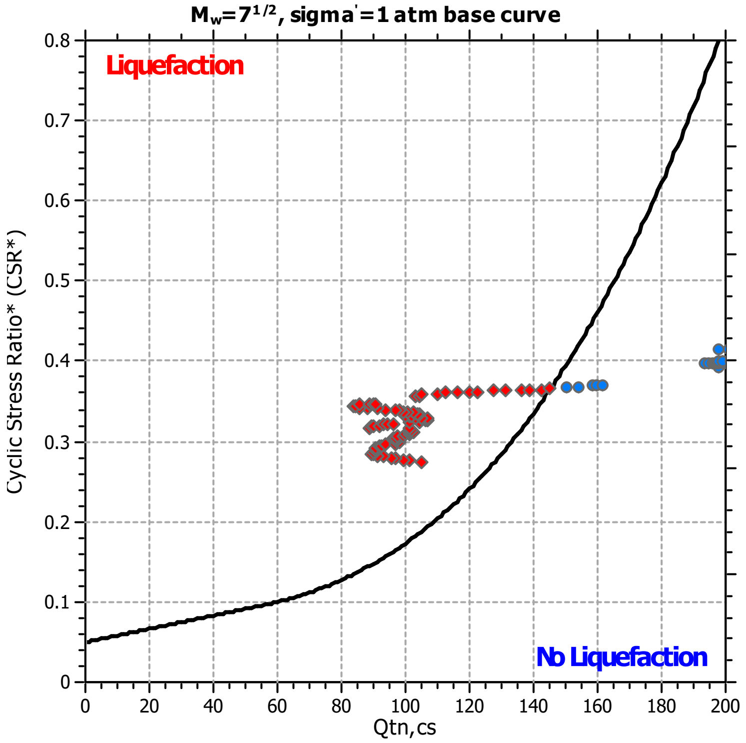


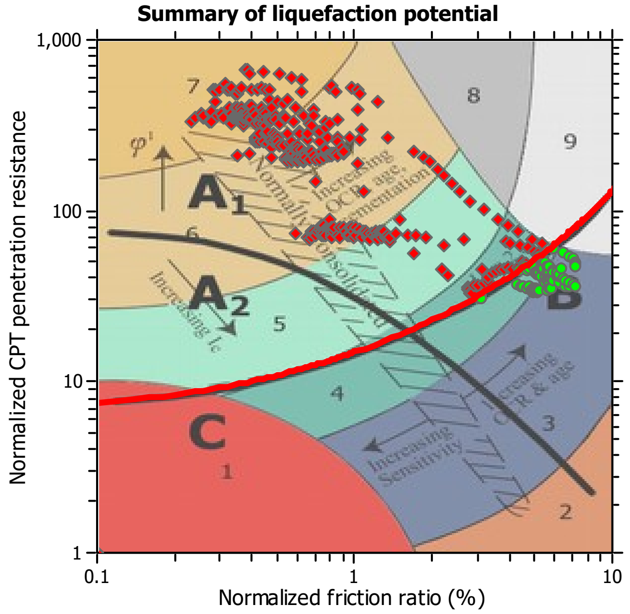






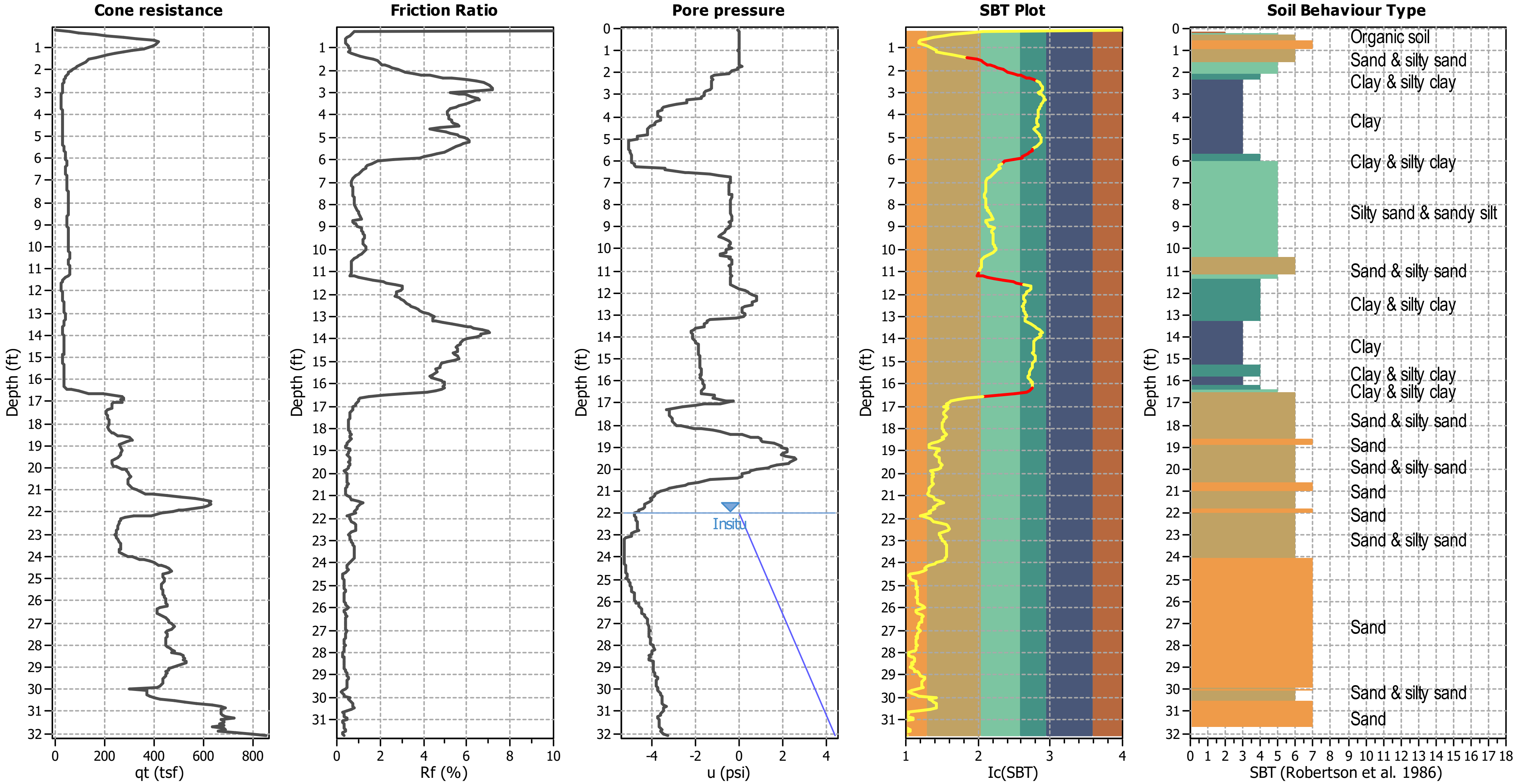






Zone A_1: Cyclic liquefaction likely depending on size and duration of cyclic loading
Zone A_2: Cyclic liquefaction and strength loss likely depending on loading and ground geometry
Zone B: Liquefaction and post-earthquake strength loss unlikely, check cyclic softening
Zone C: Cyclic liquefaction and strength loss possible depending on soil plasticity, brittleness/sensitivity, strain to peak undrained strength and ground geometry

CPT basic interpretation plots



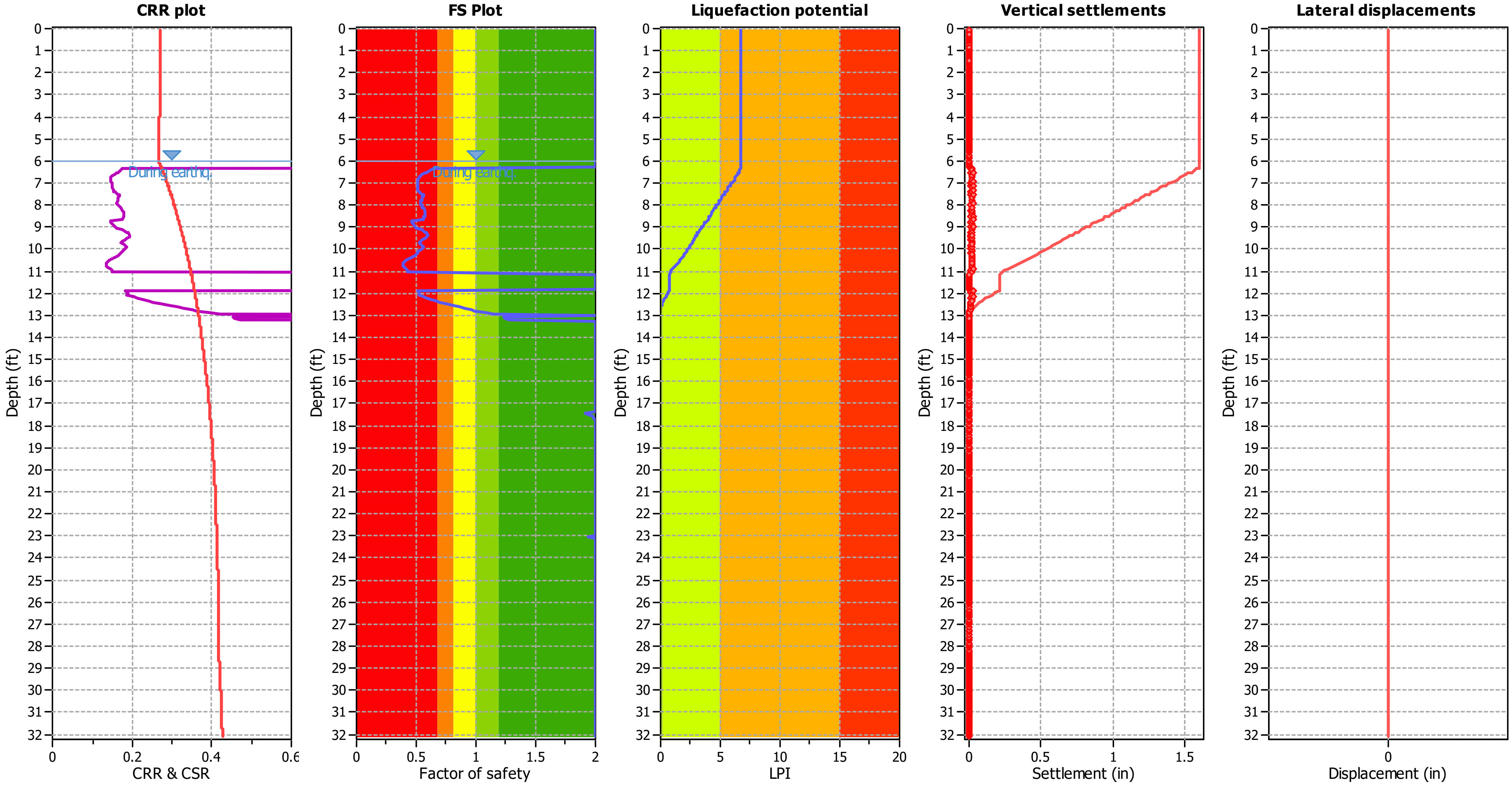
Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	6.00 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	1	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	6.35	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.58	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	22.00 ft	Fill height:	N/A	Limit depth:	N/A

SBT legend

1. Sensitive fine grained	4. Clayey silt to silty	7. Gravely sand to sand
2. Organic material	5. Silty sand to sandy silt	8. Very stiff sand to
3. Clay to silty clay	6. Clean sand to silty sand	9. Very stiff fine grained

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	6.00 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	1	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	6.35	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.58	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	22.00 ft	Fill height:	N/A	Limit depth:	N/A

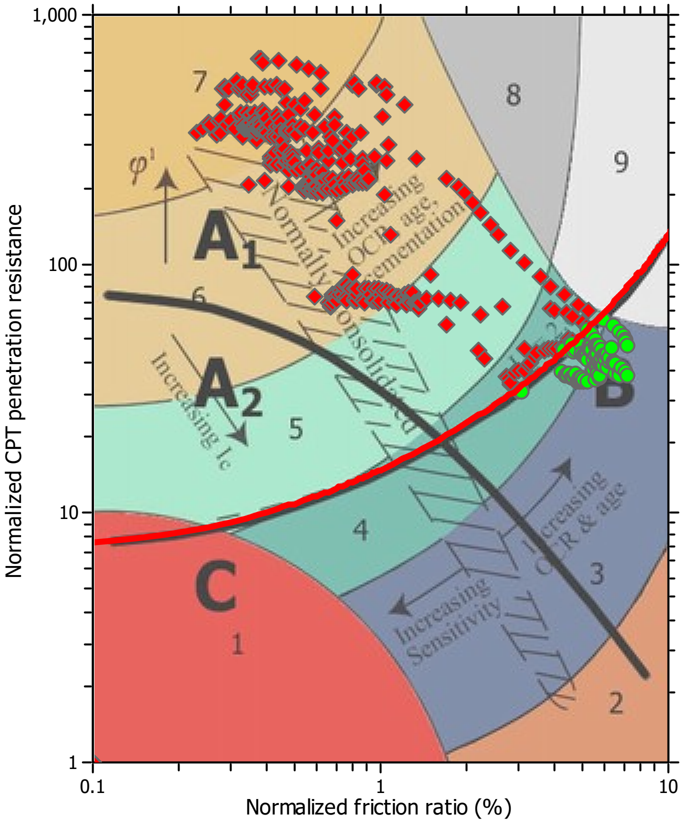
F.S. color scheme

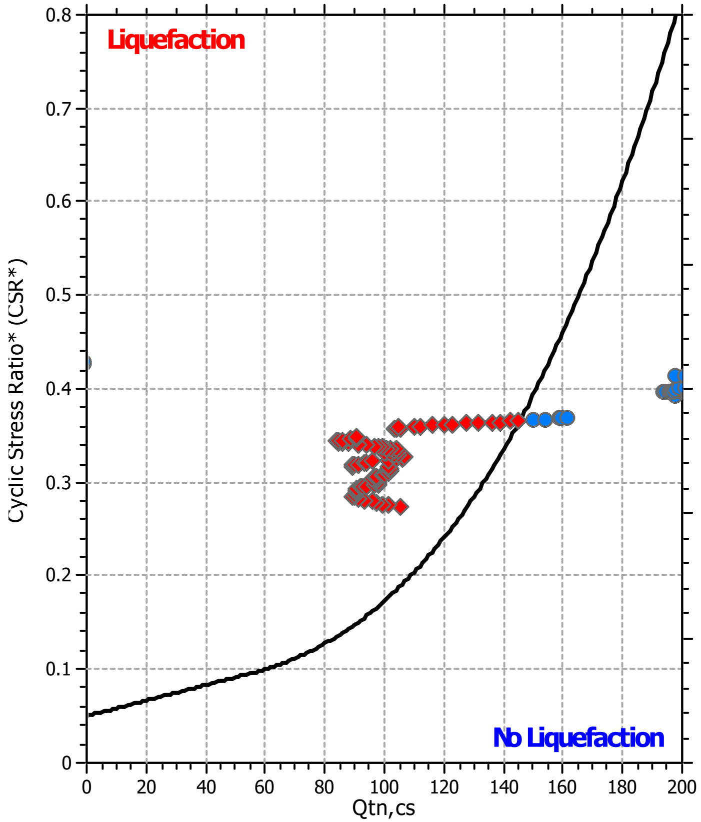
- Almost certain it will liquefy
- Very likely to liquefy
- Liquefaction and no liq. are equally likely
- Unlike to liquefy
- Almost certain it will not liquefy

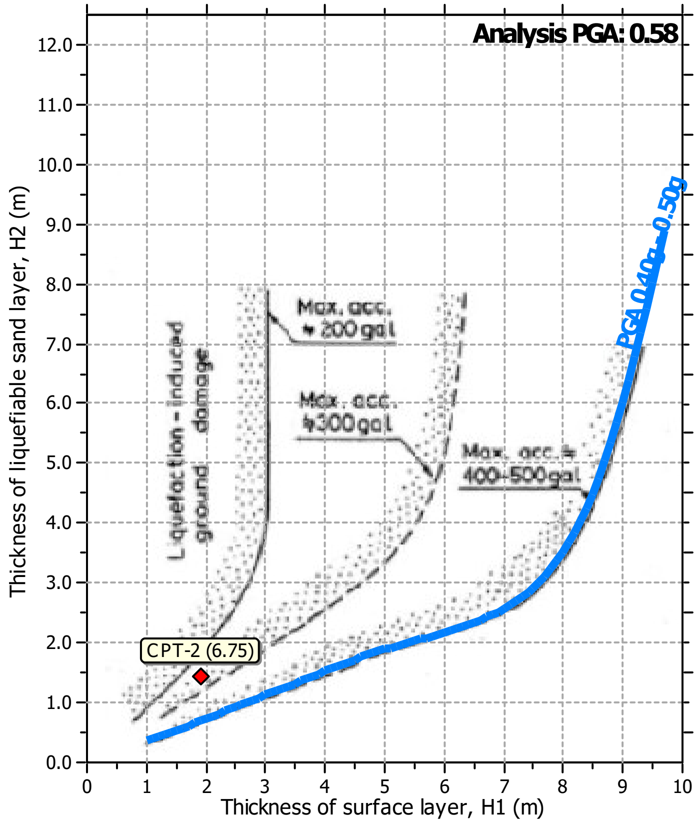
LPI color scheme

- Very high risk
- High risk
- Low risk

Liquefaction analysis summary plots







Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	6.00 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	1	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	6.35	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.58	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	22.00 ft	Fill height:	N/A	Limit depth:	N/A

:: Field input data ::

Point ID	Depth (ft)	q_c (tsf)	f_s (tsf)	u (tsf)	Fines content (%)	Unit weight (pcf)
1	0.07	0.00	0.06	-0.09	N/A	120.90
2	0.14	0.00	0.18	0.00	N/A	120.90
3	0.20	1.38	0.31	0.00	100.00	102.48
4	0.30	56.04	0.45	0.00	10.08	114.24
5	0.34	93.51	0.66	0.00	5.71	118.30
6	0.41	162.25	1.07	0.00	2.55	123.16
7	0.48	208.53	1.21	0.00	1.10	124.70
8	0.54	276.49	1.30	0.00	0.00	125.90
9	0.59	328.98	1.43	0.00	0.00	127.00
10	0.66	398.67	1.56	0.00	0.00	128.13
11	0.73	417.49	1.57	0.00	0.00	128.28
12	0.79	413.35	1.58	0.00	0.00	128.32
13	0.87	406.09	1.80	-0.03	0.00	129.23
14	0.92	394.95	2.02	0.00	0.00	130.01
15	0.99	377.60	2.13	-0.09	0.00	130.27
16	1.06	361.02	2.23	0.00	0.00	130.50
17	1.13	312.67	1.93	0.00	0.11	129.10
18	1.20	279.08	1.52	0.00	0.00	127.09
19	1.26	243.15	1.67	0.00	1.22	127.43
20	1.33	210.52	1.79	0.00	2.65	127.60
21	1.40	186.51	2.00	0.00	4.31	128.09
22	1.47	166.22	2.23	0.00	6.20	128.61
23	1.51	136.77	2.33	0.00	8.98	128.47
24	1.58	127.62	2.39	0.00	10.13	128.46
25	1.65	121.15	2.38	0.00	10.87	128.31
26	1.73	109.58	2.30	0.09	12.13	127.81
27	1.78	100.77	2.25	-0.09	13.33	127.47
28	1.85	90.23	2.17	-0.09	14.86	126.91
29	1.90	81.43	2.09	-0.35	16.39	126.39
30	1.99	70.03	1.97	-0.43	18.75	125.61
31	2.05	62.95	1.98	-0.52	21.02	125.37
32	2.12	55.18	1.97	-1.13	23.94	125.00
33	2.18	50.60	1.97	-1.30	26.09	124.82
34	2.24	47.06	2.03	-1.30	28.30	124.83
35	2.32	43.00	2.10	-1.21	31.27	124.88
36	2.37	40.58	2.14	-1.30	33.20	124.88
37	2.43	37.22	2.21	-1.30	36.27	124.90
38	2.50	34.97	2.25	-1.30	38.52	124.88
39	2.56	33.33	2.26	-1.30	40.17	124.80
40	2.64	32.12	2.26	-1.30	41.34	124.69
41	2.72	30.91	2.21	-1.30	42.22	124.43
42	2.77	30.31	2.17	-1.39	42.54	124.25
43	2.84	29.44	2.12	-1.56	43.13	124.01
44	2.90	28.58	1.80	-1.65	41.27	122.76
45	2.98	27.46	1.44	-1.65	38.74	121.00
46	3.04	26.68	1.50	-1.65	40.38	121.24
47	3.08	26.08	1.54	-1.73	41.57	121.37
48	3.16	25.30	1.57	-1.73	43.00	121.46

:: Field input data :: (continued)

Point ID	Depth (ft)	q_c (tsf)	f_s (tsf)	u (tsf)	Fines content (%)	Unit weight (pcf)
49	3.22	24.78	1.60	-2.44	44.08	121.55
50	3.30	24.61	1.62	-2.44	44.48	121.60
51	3.35	25.04	1.62	-2.44	43.90	121.64
52	3.44	25.65	1.56	-2.86	42.41	121.42
53	3.49	25.73	1.51	-3.21	41.81	121.22
54	3.56	25.65	1.45	-3.46	41.18	120.89
55	3.61	25.65	1.41	-3.55	40.68	120.67
56	3.71	25.99	1.36	-3.55	39.75	120.49
57	3.75	26.34	1.36	-3.73	39.22	120.47
58	3.81	26.68	1.35	-3.73	38.77	120.48
59	3.89	26.77	1.36	-3.73	38.72	120.52
60	3.94	26.94	1.37	-3.73	38.69	120.61
61	4.03	27.29	1.40	-3.64	38.64	120.80
62	4.08	27.37	1.41	-3.64	38.70	120.88
63	4.15	27.89	1.45	-3.64	38.49	121.09
64	4.23	28.49	1.50	-3.81	38.44	121.43
65	4.29	29.19	1.55	-3.90	38.17	121.71
66	4.33	29.44	1.58	-3.90	38.16	121.84
67	4.43	29.36	1.63	-4.07	38.77	122.06
68	4.47	29.10	1.64	-4.16	39.25	122.13
69	4.55	28.49	1.35	-4.24	36.74	120.64
70	4.61	28.06	1.21	-4.24	35.48	119.78
71	4.66	27.54	1.28	-4.24	36.95	120.16
72	4.75	27.37	1.37	-4.24	38.22	120.63
73	4.80	27.11	1.42	-4.24	39.08	120.86
74	4.88	26.68	1.48	-4.68	40.36	121.14
75	4.93	27.07	1.53	-4.68	40.39	121.40
76	5.01	27.03	1.60	-4.68	41.22	121.73
77	5.06	27.03	1.63	-5.11	41.61	121.89
78	5.15	27.03	1.64	-5.11	41.75	121.95
79	5.19	27.03	1.65	-5.11	41.76	121.95
80	5.27	28.24	1.65	-5.11	40.34	122.07
81	5.33	29.27	1.67	-5.11	39.36	122.24
82	5.42	31.09	1.71	-5.11	37.89	122.59
83	5.47	32.64	1.74	-5.11	36.66	122.84
84	5.51	33.93	1.77	-5.11	35.74	123.06
85	5.58	35.06	1.79	-5.02	34.91	123.21
86	5.64	36.53	1.80	-5.02	33.79	123.36
87	5.73	38.51	1.78	-4.94	32.07	123.39
88	5.79	39.81	1.74	-4.94	30.82	123.31
89	5.88	41.02	1.64	-4.94	29.16	122.95
90	5.91	41.53	1.59	-4.94	28.38	122.75
91	5.99	42.74	1.12	-4.94	23.29	120.28
92	6.05	43.95	0.82	-4.94	19.29	118.05
93	6.11	44.99	0.77	-4.85	18.25	117.68
94	6.18	45.59	0.72	-4.85	17.31	117.19
95	6.25	45.76	0.65	-4.76	16.38	116.49
96	6.32	45.16	0.60	-3.45	15.93	115.87

:: Field input data :: (continued)

Point ID	Depth (ft)	q_c (tsf)	f_s (tsf)	u (tsf)	Fines content (%)	Unit weight (pcf)
97	6.37	42.31	0.57	-3.45	16.68	115.29
98	6.44	43.35	0.53	-3.45	15.62	114.82
99	6.53	43.78	0.49	-2.51	14.73	114.20
100	6.57	43.78	0.46	-2.34	14.40	113.88
101	6.63	43.78	0.43	-1.39	13.76	113.26
102	6.71	44.04	0.38	-0.95	12.93	112.51
103	6.77	44.47	0.36	-0.43	12.35	112.08
104	6.84	45.25	0.33	-0.43	11.59	111.56
105	6.92	46.63	0.32	-0.43	10.92	111.38
106	6.97	47.15	0.32	-0.43	10.71	111.35
107	7.02	47.49	0.32	-0.52	10.60	111.36
108	7.11	47.40	0.32	-0.52	10.66	111.40
109	7.16	47.49	0.32	-0.52	10.64	111.41
110	7.22	46.97	0.33	-0.52	11.02	111.64
111	7.33	47.49	0.35	-0.52	11.11	111.95
112	7.38	48.27	0.35	-0.52	11.01	112.11
113	7.42	49.65	0.36	-0.52	10.75	112.30
114	7.52	52.07	0.38	-0.52	10.52	112.90
115	7.56	53.02	0.39	-0.35	10.45	113.14
116	7.61	53.10	0.40	-0.35	10.57	113.29
117	7.69	52.33	0.41	-0.35	10.88	113.34
118	7.76	51.98	0.41	-0.43	11.02	113.33
119	7.82	51.81	0.41	-0.43	11.09	113.32
120	7.91	51.90	0.41	-0.43	11.12	113.32
121	7.96	52.15	0.42	-0.43	11.25	113.54
122	8.01	52.41	0.43	-0.43	11.38	113.78
123	8.09	52.84	0.46	-0.43	11.67	114.23
124	8.15	53.02	0.48	-0.43	11.91	114.55
125	8.22	53.10	0.50	-0.43	12.21	114.87
126	8.27	52.84	0.51	-0.43	12.47	115.05
127	8.33	52.50	0.53	-0.43	12.79	115.24
128	8.41	52.07	0.54	-0.43	13.14	115.42
129	8.50	51.03	0.55	-0.35	13.62	115.49
130	8.54	50.77	0.56	-0.35	13.79	115.54
131	8.65	49.91	0.56	-0.35	14.19	115.56
132	8.72	49.56	0.37	-0.35	11.74	112.54
133	8.77	49.56	0.38	-0.52	11.83	112.63
134	8.81	49.48	0.39	-0.43	12.17	112.99
135	8.87	49.48	0.42	-0.43	12.61	113.47
136	8.96	49.48	0.46	-0.43	13.15	114.04
137	8.99	49.65	0.47	-0.52	13.33	114.29
138	9.06	46.80	0.53	-0.52	15.08	114.95
139	9.13	51.03	0.59	-0.61	14.47	115.94
140	9.21	52.76	0.63	-0.69	14.50	116.55
141	9.27	53.19	0.66	-0.69	14.74	116.91
142	9.36	53.54	0.68	-0.87	14.93	117.17
143	9.41	53.71	0.68	-0.87	14.93	117.19
144	9.46	53.62	0.68	-0.95	14.98	117.17

:: Field input data :: (continued)

Point ID	Depth (ft)	q_c (tsf)	f_s (tsf)	u (tsf)	Fines content (%)	Unit weight (pcf)
145	9.54	53.36	0.66	-0.78	14.86	116.91
146	9.58	52.59	0.64	-0.61	14.89	116.65
147	9.65	51.64	0.61	-0.52	14.90	116.27
148	9.72	50.86	0.60	-0.43	15.11	116.14
149	9.80	50.86	0.64	-0.43	15.64	116.61
150	9.85	50.86	0.67	-0.52	16.04	116.95
151	9.93	50.86	0.69	-0.52	16.34	117.18
152	9.98	50.86	0.69	-0.35	16.27	117.09
153	10.05	50.86	0.66	-0.61	16.05	116.84
154	10.12	51.64	0.63	-0.61	15.45	116.52
155	10.17	54.14	0.60	-0.61	14.35	116.29
156	10.25	56.56	0.56	-0.87	13.17	115.86
157	10.31	57.59	0.52	-0.87	12.50	115.43
158	10.38	57.68	0.47	-0.43	11.84	114.65
159	10.44	57.08	0.43	-0.52	11.48	113.95
160	10.51	55.95	0.39	-0.35	11.21	113.15
161	10.57	54.57	0.37	-0.35	11.33	112.74
162	10.64	53.62	0.36	-0.35	11.41	112.43
163	10.71	53.36	0.35	-0.35	11.48	112.37
164	10.78	54.31	0.36	-0.52	11.31	112.48
165	10.84	55.87	0.37	-0.43	11.06	112.72
166	10.93	58.72	0.39	-0.43	10.82	113.40
167	10.96	60.10	0.41	-0.43	10.72	113.73
168	11.03	60.79	0.41	-0.43	10.65	113.83
169	11.15	59.67	0.35	-0.43	10.07	112.56
170	11.19	58.63	0.47	-0.43	11.99	114.69
171	11.23	56.90	0.56	-0.35	13.66	115.95
172	11.30	52.15	0.70	-0.43	16.82	117.32
173	11.38	44.04	0.73	-0.42	20.53	117.21
174	11.43	34.37	0.74	-0.40	26.18	116.67
175	11.50	31.95	0.72	-0.40	27.82	116.35
176	11.56	26.85	0.71	-0.43	32.28	115.83
177	11.64	23.31	0.70	-0.43	36.18	115.34
178	11.68	23.14	0.70	-0.26	36.36	115.28
179	11.77	23.06	0.70	-0.17	36.57	115.28
180	11.81	23.40	0.70	0.00	36.23	115.34
181	11.91	25.13	0.69	0.26	34.08	115.42
182	11.94	25.65	0.71	0.35	33.92	115.68
183	12.01	27.03	0.74	0.43	32.97	116.08
184	12.08	27.46	0.74	0.61	32.59	116.11
185	12.17	28.75	0.82	0.78	32.79	117.02
186	12.21	29.27	0.86	0.78	32.88	117.38
187	12.28	29.79	0.92	0.78	33.38	117.94
188	12.35	31.09	0.99	0.78	33.23	118.59
189	12.41	32.21	1.04	0.61	32.97	119.05
190	12.48	34.19	1.15	0.61	32.65	119.90
191	12.54	35.58	1.22	0.61	32.43	120.45
192	12.62	36.53	1.32	0.26	32.82	121.08

:: Field input data :: (continued)

Point ID	Depth (ft)	q_c (tsf)	f_s (tsf)	u (tsf)	Fines content (%)	Unit weight (pcf)
193	12.67	36.70	1.37	0.09	33.24	121.36
194	12.75	37.48	1.45	0.09	33.47	121.80
195	12.80	37.22	1.48	0.09	34.10	121.98
196	12.88	37.82	1.59	0.09	34.75	122.55
197	12.93	38.17	1.68	0.26	35.25	122.93
198	13.02	38.94	1.76	0.26	35.47	123.33
199	13.07	40.41	1.80	0.17	34.76	123.59
200	13.16	41.79	1.84	-0.17	34.22	123.84
201	13.20	41.36	1.88	-1.39	34.87	123.96
202	13.26	39.29	1.93	-1.47	36.83	124.02
203	13.33	37.91	2.01	-1.47	38.72	124.26
204	13.42	36.27	2.19	-1.65	41.63	124.77
205	13.47	35.14	2.16	-1.65	42.50	124.59
206	13.52	33.50	2.11	-1.65	43.75	124.29
207	13.61	32.04	2.15	-1.99	45.70	124.31
208	13.65	31.34	2.18	-2.08	46.80	124.36
209	13.74	30.05	2.11	-2.25	47.90	124.05
210	13.79	31.26	2.08	-2.25	46.22	124.01
211	13.86	30.61	2.04	-2.14	46.70	123.81
212	13.92	31.17	2.01	-2.14	45.88	123.75
213	13.98	33.16	2.01	-2.14	43.82	123.91
214	14.05	34.28	2.00	-2.17	42.71	123.97
215	14.11	34.88	2.00	-2.08	42.19	124.01
216	14.19	35.40	2.01	-1.99	41.86	124.08
217	14.25	35.40	2.01	-1.99	41.91	124.07
218	14.31	35.32	1.97	-1.91	41.71	123.92
219	14.39	34.88	1.92	-1.91	41.79	123.70
220	14.45	34.63	1.92	-1.91	42.11	123.69
221	14.52	34.80	1.94	-1.91	42.19	123.77
222	14.57	34.80	1.94	-1.91	42.21	123.76
223	14.64	35.06	1.89	-1.91	41.64	123.60
224	14.70	34.45	1.87	-1.91	42.13	123.49
225	14.78	33.42	1.87	-1.91	43.24	123.41
226	14.86	32.55	1.84	-1.82	43.92	123.21
227	14.90	32.29	1.81	-1.82	44.04	123.10
228	14.97	31.69	1.72	-1.82	43.86	122.67
229	15.03	31.34	1.60	-1.82	43.08	122.10
230	15.10	31.52	1.51	-1.82	42.08	121.72
231	15.18	31.52	1.51	-1.82	42.11	121.70
232	15.24	31.86	1.51	-1.82	41.84	121.74
233	15.31	32.90	1.51	-1.82	40.83	121.81
234	15.36	33.24	1.52	-1.82	40.61	121.87
235	15.44	34.11	1.58	-1.73	40.45	122.21
236	15.49	34.54	1.61	-1.73	40.38	122.38
237	15.57	34.37	1.51	-1.73	39.64	121.91
238	15.63	34.63	1.49	-1.73	39.27	121.85
239	15.71	35.32	1.57	-1.82	39.48	122.25
240	15.75	35.23	1.53	-1.73	39.23	122.07

:: Field input data :: (continued)

Point ID	Depth (ft)	q_c (tsf)	f_s (tsf)	u (tsf)	Fines content (%)	Unit weight (pcf)
241	15.85	34.28	1.65	-1.82	41.39	122.54
242	15.89	34.37	1.68	-1.73	41.69	122.70
243	15.95	33.81	1.69	-1.72	42.35	122.68
244	16.02	33.33	1.64	-1.72	42.50	122.46
245	16.11	33.59	1.65	-1.72	42.42	122.52
246	16.16	33.42	1.66	-1.65	42.73	122.55
247	16.21	33.76	1.64	-1.65	42.20	122.47
248	16.28	35.23	1.60	-1.65	40.45	122.40
249	16.34	37.04	1.55	-1.65	38.40	122.30
250	16.41	46.54	1.43	-1.73	30.48	122.26
251	16.48	63.90	1.39	-1.73	22.19	122.82
252	16.54	92.31	1.37	-1.73	14.63	123.60
253	16.61	135.31	1.45	-1.73	9.08	124.98
254	16.67	194.54	2.00	-1.16	6.47	128.21
255	16.74	268.11	2.78	-1.17	4.82	131.39
256	16.81	278.56	2.66	-1.23	4.20	131.17
257	16.88	275.19	2.36	-0.61	3.71	130.26
258	16.93	262.32	2.26	-0.26	3.95	129.81
259	17.01	268.11	1.96	-0.87	3.09	128.84
260	17.06	236.42	1.82	-1.65	3.91	127.97
261	17.13	232.19	1.72	-1.99	3.84	127.52
262	17.20	231.58	1.53	-2.60	3.33	126.65
263	17.28	229.17	1.44	-3.38	3.19	126.19
264	17.33	227.87	1.41	-3.21	3.14	126.00
265	17.39	211.47	1.34	-3.21	3.63	125.45
266	17.45	205.33	1.29	-3.21	3.76	125.13
267	17.53	207.06	1.24	-3.21	3.52	124.85
268	17.60	208.88	1.19	-3.21	3.27	124.56
269	17.68	209.74	1.14	-3.12	3.09	124.29
270	17.72	210.60	1.14	-3.12	3.06	124.29
271	17.79	211.98	1.15	-3.12	3.05	124.38
272	17.85	214.75	1.15	-3.12	2.94	124.41
273	17.93	215.61	1.17	-2.94	2.98	124.54
274	18.00	214.92	1.19	-2.86	3.08	124.65
275	18.05	214.66	1.21	-2.69	3.15	124.74
276	18.13	213.88	1.23	-2.08	3.27	124.87
277	18.18	214.14	1.30	-1.73	3.51	125.29
278	18.26	216.47	1.44	-1.21	3.86	126.05
279	18.31	218.98	1.35	-0.87	3.48	125.62
280	18.40	227.27	1.35	-0.43	3.14	125.69
281	18.45	233.74	1.49	0.09	3.32	126.50
282	18.53	252.05	1.57	0.52	2.88	127.07
283	18.58	268.97	1.49	0.87	2.12	126.83
284	18.64	297.99	1.47	0.95	1.31	127.00
285	18.72	310.42	1.40	0.95	0.86	126.73
286	18.77	306.97	1.32	1.04	0.75	126.25
287	18.84	289.44	1.20	1.56	0.87	125.40
288	18.93	256.19	1.49	1.91	2.58	126.73

:: Field input data :: (continued)

Point ID	Depth (ft)	q_c (tsf)	f_s (tsf)	u (tsf)	Fines content (%)	Unit weight (pcf)
289	18.97	259.47	1.51	1.91	2.53	126.86
290	19.05	263.79	1.35	1.91	1.97	126.06
291	19.11	263.79	1.34	2.17	1.96	126.03
292	19.19	271.74	1.37	2.17	1.80	126.22
293	19.23	268.20	1.41	2.17	2.03	126.44
294	19.30	262.67	1.52	1.99	2.50	126.94
295	19.37	262.84	1.56	1.91	2.59	127.11
296	19.44	256.54	1.50	2.08	2.66	126.79
297	19.51	251.01	1.43	2.51	2.65	126.35
298	19.57	241.34	1.40	2.60	2.90	126.09
299	19.64	232.10	1.34	2.42	3.09	125.70
300	19.70	231.41	1.25	2.34	2.85	125.19
301	19.77	231.41	1.24	2.25	2.84	125.14
302	19.82	230.72	1.10	1.73	2.40	124.22
303	19.90	237.89	0.82	1.47	1.26	122.21
304	19.95	246.35	0.96	1.30	1.48	123.44
305	20.03	269.84	1.28	0.78	1.72	125.73
306	20.09	285.21	1.30	0.52	1.37	126.00
307	20.16	287.36	1.39	0.43	1.54	126.49
308	20.22	296.52	1.40	0.09	1.35	126.64
309	20.31	298.07	1.45	0.09	1.43	126.89
310	20.36	300.58	1.46	0.09	1.40	126.97
311	20.41	304.12	1.51	-0.09	1.42	127.21
312	20.49	293.84	1.48	-1.39	1.62	127.00
313	20.54	291.94	1.38	-1.65	1.44	126.47
314	20.61	291.60	1.27	-1.91	1.19	125.88
315	20.67	291.77	1.21	-2.34	1.04	125.51
316	20.74	293.24	1.24	-2.51	1.07	125.68
317	20.80	297.64	1.23	-2.86	0.96	125.68
318	20.89	308.69	1.29	-3.21	0.86	126.10
319	20.94	314.22	1.30	-3.38	0.77	126.20
320	21.01	328.47	1.49	-3.64	0.90	127.33
321	21.07	339.95	2.05	-3.73	1.77	129.75
322	21.15	367.15	2.49	-3.90	1.95	131.35
323	21.20	393.31	3.01	-3.90	2.20	132.90
324	21.26	452.98	4.60	-3.98	3.01	136.35
325	21.34	508.33	6.18	-4.07	3.56	137.28
326	21.39	563.85	5.89	-4.00	2.42	137.28
327	21.47	602.53	6.20	-4.12	2.14	137.28
328	21.53	626.62	6.05	-4.24	1.73	137.28
329	21.59	623.08	6.01	-4.33	1.75	137.28
330	21.67	630.86	5.14	-4.33	0.99	137.28
331	21.73	616.69	4.94	-4.33	0.99	137.28
332	21.79	598.30	5.02	-4.42	1.27	137.28
333	21.87	518.43	2.59	-4.59	0.00	132.48
334	21.92	502.11	2.64	-4.59	0.06	132.53
335	21.99	475.34	2.78	-4.85	0.58	132.79
336	22.05	426.47	2.71	-4.82	1.23	132.34

:: Field input data :: (continued)

Point ID	Depth (ft)	q_c (tsf)	f_s (tsf)	u (tsf)	Fines content (%)	Unit weight (pcf)
337	22.14	385.20	2.56	-4.82	1.78	131.68
338	22.19	318.80	2.49	-4.78	3.25	131.02
339	22.25	284.69	2.50	-4.77	4.36	130.77
340	22.32	266.30	2.41	-4.72	4.85	130.33
341	22.38	261.63	2.35	-4.72	4.92	130.12
342	22.45	256.97	2.30	-4.72	4.99	129.90
343	22.52	256.88	2.21	-4.72	4.78	129.60
344	22.60	253.17	1.75	-4.68	3.78	127.84
345	22.65	253.43	1.45	-4.68	2.96	126.47
346	22.73	250.84	1.42	-4.68	2.99	126.33
347	22.79	248.51	1.45	-4.59	3.15	126.43
348	22.84	247.39	1.48	-4.82	3.28	126.57
349	22.91	246.26	1.53	-4.97	3.47	126.80
350	22.98	245.36	1.59	-4.97	3.67	127.07
351	23.04	240.31	1.68	-4.97	4.13	127.43
352	23.10	244.45	1.77	-5.20	4.22	127.86
353	23.18	249.03	1.89	-5.28	4.35	128.38
354	23.25	253.69	2.00	-5.28	4.46	128.86
355	23.32	257.49	2.09	-5.28	4.53	129.21
356	23.36	259.99	2.15	-5.28	4.58	129.44
357	23.43	264.31	2.19	-5.28	4.51	129.62
358	23.50	265.26	2.21	-5.28	4.53	129.70
359	23.58	266.21	2.18	-5.28	4.40	129.58
360	23.66	263.88	2.13	-5.28	4.38	129.39
361	23.69	260.86	2.10	-5.28	4.43	129.25
362	23.77	258.01	2.01	-5.28	4.34	128.92
363	23.83	259.73	1.94	-5.28	4.10	128.68
364	23.90	271.82	1.84	-5.28	3.43	128.42
365	23.98	293.24	1.75	-5.28	2.55	128.23
366	24.03	309.04	1.74	-5.28	2.10	128.32
367	24.11	342.80	1.65	-5.28	1.13	128.17
368	24.16	358.26	1.64	-5.28	0.81	128.25
369	24.23	385.02	1.74	-5.28	0.51	128.84
370	24.30	402.21	2.04	-5.28	0.73	130.10
371	24.38	418.87	1.89	-5.20	0.23	129.65
372	24.41	429.06	1.69	-5.20	0.00	128.88
373	24.48	446.16	1.15	-5.20	0.00	126.18
374	24.56	455.92	1.15	-5.20	0.00	126.22
375	24.62	462.31	1.27	-5.20	0.00	126.99
376	24.68	472.15	1.30	-5.20	0.00	127.22
377	24.75	461.36	1.40	-5.17	0.00	127.67
378	24.81	433.98	1.47	-5.17	0.00	127.88
379	24.88	437.52	1.46	-5.17	0.00	127.88
380	24.95	437.09	1.49	-5.20	0.00	128.03
381	25.01	438.04	1.55	-5.10	0.00	128.31
382	25.08	440.03	1.59	-5.11	0.00	128.51
383	25.15	442.62	1.58	-5.02	0.00	128.50
384	25.22	435.54	1.62	-5.02	0.00	128.60

:: Field input data :: (continued)

Point ID	Depth (ft)	q_c (tsf)	f_s (tsf)	u (tsf)	Fines content (%)	Unit weight (pcf)
385	25.27	431.22	1.62	-5.02	0.00	128.59
386	25.34	427.85	1.55	-4.94	0.00	128.27
387	25.40	428.46	1.54	-4.94	0.00	128.22
388	25.48	432.08	1.53	-4.94	0.00	128.19
389	25.53	435.54	1.52	-4.94	0.00	128.14
390	25.60	433.21	1.58	-4.85	0.00	128.42
391	25.67	433.38	1.53	-4.85	0.00	128.19
392	25.73	436.75	1.57	-4.85	0.00	128.40
393	25.80	439.94	1.68	-4.85	0.00	128.90
394	25.86	442.36	1.92	-4.85	0.00	129.89
395	25.94	449.53	2.20	-4.85	0.32	130.94
396	26.00	449.27	2.36	-4.76	0.55	131.46
397	26.07	449.27	2.00	-4.76	0.04	130.23
398	26.12	449.01	1.61	-4.59	0.00	128.65
399	26.21	452.81	1.64	-4.59	0.00	128.82
400	26.25	455.05	1.69	-4.59	0.00	129.05
401	26.34	421.29	1.79	-4.50	0.11	129.26
402	26.39	411.36	1.82	-4.46	0.30	129.31
403	26.46	411.79	1.76	-4.46	0.21	129.09
404	26.52	411.79	1.69	-4.46	0.11	128.81
405	26.60	412.22	1.70	-4.33	0.11	128.85
406	26.65	425.26	1.70	-4.33	0.00	128.90
407	26.71	436.75	1.72	-4.33	0.00	129.06
408	26.78	444.26	1.77	-4.24	0.00	129.32
409	26.86	452.55	1.70	-4.24	0.00	129.07
410	26.91	457.73	1.74	-4.24	0.00	129.27
411	26.97	459.11	1.89	-4.24	0.00	129.89
412	27.04	467.57	2.08	-4.24	0.00	130.64
413	27.14	482.08	1.94	-4.16	0.00	130.20
414	27.17	482.51	1.93	-4.16	0.00	130.17
415	27.25	477.59	1.91	-4.16	0.00	130.07
416	27.31	472.41	1.80	-4.07	0.00	129.59
417	27.36	450.99	1.72	-4.16	0.00	129.16
418	27.44	449.61	1.61	-4.16	0.00	128.65
419	27.50	451.04	1.60	-4.16	0.00	128.64
420	27.59	451.77	1.60	-4.16	0.00	128.62
421	27.63	451.08	1.65	-4.16	0.00	128.82
422	27.69	447.89	1.68	-4.07	0.00	128.95
423	27.77	447.80	1.63	-4.07	0.00	128.71
424	27.85	445.64	1.53	-4.07	0.00	128.24
425	27.91	449.35	1.52	-4.07	0.00	128.23
426	27.95	449.44	1.38	-4.07	0.00	127.54
427	28.02	449.61	1.09	-3.98	0.00	125.77
428	28.10	452.98	1.16	-3.98	0.00	126.27
429	28.17	462.82	1.34	-3.90	0.00	127.38
430	28.22	468.87	1.54	-3.90	0.00	128.45
431	28.28	482.86	1.75	-4.03	0.00	129.42
432	28.36	470.94	1.67	-4.03	0.00	129.04

:: Field input data :: (continued)

Point ID	Depth (ft)	q_c (tsf)	f_s (tsf)	u (tsf)	Fines content (%)	Unit weight (pcf)
433	28.42	503.23	1.64	-4.03	0.00	129.05
434	28.50	517.22	1.78	-4.16	0.00	129.71
435	28.55	515.84	1.81	-4.07	0.00	129.83
436	28.61	521.45	1.70	-4.16	0.00	129.42
437	28.69	518.95	1.87	-4.16	0.00	130.12
438	28.76	528.79	2.04	-3.98	0.00	130.78
439	28.81	527.07	2.08	-3.98	0.00	130.93
440	28.87	512.56	2.21	-3.98	0.00	131.30
441	28.94	493.82	2.19	-3.96	0.00	131.13
442	29.01	476.73	2.14	-3.96	0.00	130.87
443	29.08	457.82	2.41	-3.94	0.60	131.65
444	29.14	456.43	2.46	-3.94	0.69	131.79
445	29.21	446.07	2.18	-3.94	0.46	130.86
446	29.27	451.25	2.11	-3.90	0.28	130.63
447	29.34	449.09	2.13	-3.90	0.35	130.71
448	29.41	446.42	2.10	-3.90	0.34	130.57
449	29.48	440.81	2.06	-3.73	0.37	130.42
450	29.53	435.71	2.04	-3.73	0.41	130.30
451	29.61	435.71	1.61	-3.81	0.00	128.59
452	29.66	436.49	1.21	-3.81	0.00	126.48
453	29.73	436.49	1.00	-3.81	0.00	125.13
454	29.81	430.70	1.16	-3.81	0.00	126.18
455	29.88	424.31	1.39	-3.81	0.00	127.46
456	29.93	410.06	1.51	-3.75	0.00	127.95
457	30.00	299.89	1.79	-3.75	2.76	128.45
458	30.07	372.94	2.04	-3.75	1.50	129.93
459	30.13	369.65	2.23	-3.70	1.90	130.56
460	30.20	372.50	2.45	-3.64	2.22	131.27
461	30.27	372.07	2.71	-3.64	2.66	131.99
462	30.32	384.33	2.82	-3.55	2.56	132.36
463	30.40	402.55	3.09	-3.55	2.57	133.14
464	30.45	425.95	3.41	-3.55	2.55	134.02
465	30.53	479.32	3.32	-3.55	1.50	134.11
466	30.58	521.80	2.48	-3.55	0.00	132.17
467	30.64	572.14	1.65	-3.55	0.00	129.40
468	30.71	634.66	2.23	-3.46	0.00	131.87
469	30.80	672.39	2.20	-3.38	0.00	131.91
470	30.84	688.10	2.48	-3.48	0.00	132.84
471	30.92	671.70	3.10	-3.48	0.00	134.43
472	30.98	668.42	2.98	-3.50	0.00	134.14
473	31.07	668.85	1.90	-3.56	0.00	130.82
474	31.11	669.28	1.98	-3.63	0.00	131.13
475	31.18	674.12	2.17	-3.63	0.00	131.81
476	31.24	690.26	2.30	-3.73	0.00	132.30
477	31.32	724.89	2.28	-3.72	0.00	132.37
478	31.37	671.78	2.39	-3.71	0.00	132.53
479	31.44	680.33	2.83	-3.71	0.00	133.80
480	31.50	684.56	2.72	-3.71	0.00	133.52

:: Field input data :: (continued)

Point ID	Depth (ft)	q_c (tsf)	f_s (tsf)	u (tsf)	Fines content (%)	Unit weight (pcf)
481	31.56	666.43	1.93	-3.66	0.00	130.93
482	31.65	682.92	1.95	-3.66	0.00	131.06
483	31.70	636.38	2.19	-3.66	0.00	131.75
484	31.79	681.28	0.00	-3.64	N/A	87.36
485	31.83	688.71	0.00	-3.55	N/A	87.36
486	31.89	658.06	0.00	-3.64	N/A	87.36
487	31.96	731.02	0.00	-3.55	N/A	87.36
488	32.03	796.30	0.00	-3.46	N/A	87.36
489	32.09	852.34	0.00	-3.29	N/A	87.36

Abbreviations

Depth: Depth from free surface, at which CPT was performed (ft)
q_c: Measured cone resistance (tsf)
f_s: Sleeve friction resistance (tsf)
u: Pore pressure (tsf)
Fines content: Percentage of fines in soil (%)
Unit weight: Bulk soil unit weight (pcf)

:: Post-earthquake settlement of dry sands ::

Depth (ft)	Ic	Q_{tn}	Kc	$Q_{tn,cs}$	$N_{1,60}$ (blows)	G_{max} (tsf)	CSR	Shear, γ (%)	$e_{vol(15)}$ (%)	N_c	e_v (%)	Settle. (in)
0.07	-1.00	-1.00	1.00	-1.00	0	0	0.27	0.000	0.00	0.00	0.00	0.000
0.14	-1.00	-1.00	1.00	-1.00	0	0	0.27	0.000	0.00	0.00	0.00	0.000
0.20	4.05	2.20	26.38	58.00	0	0	0.27	0.000	0.00	0.00	0.00	0.000
0.30	1.89	90.01	1.18	105.93	21	550	0.27	0.001	0.00	6.39	0.00	0.000
0.34	1.68	150.21	1.02	153.63	28	704	0.27	0.001	0.00	6.39	0.00	0.000
0.41	1.48	260.64	1.00	260.64	45	950	0.27	0.001	0.00	6.39	0.00	0.000
0.48	1.36	334.99	1.00	334.99	56	1056	0.27	0.001	0.00	6.39	0.00	0.000
0.54	1.21	444.17	1.00	444.17	71	1156	0.27	0.001	0.00	6.39	0.00	0.000
0.59	1.14	528.50	1.00	528.50	83	1249	0.27	0.001	0.00	6.39	0.00	0.000
0.66	1.05	640.46	1.00	640.46	98	1354	0.27	0.001	0.00	6.39	0.00	0.000
0.73	1.02	670.69	1.00	670.69	101	1371	0.27	0.001	0.00	6.39	0.00	0.000
0.79	1.03	664.03	1.00	664.03	101	1374	0.27	0.001	0.00	6.39	0.00	0.000
0.87	1.09	652.35	1.00	652.35	100	1448	0.27	0.002	0.00	6.39	0.00	0.000
0.92	1.14	634.45	1.00	634.45	99	1514	0.27	0.002	0.00	6.39	0.00	0.000
0.99	1.19	606.57	1.00	606.57	96	1533	0.27	0.002	0.00	6.39	0.00	0.000
1.06	1.23	579.92	1.00	579.92	93	1548	0.27	0.002	0.00	6.39	0.00	0.000
1.13	1.27	502.24	1.00	502.24	82	1405	0.27	0.002	0.00	6.39	0.00	0.000
1.20	1.26	448.26	1.00	448.26	73	1237	0.27	0.003	0.00	6.39	0.00	0.000
1.26	1.37	390.53	1.00	390.53	66	1247	0.27	0.003	0.00	6.39	0.00	0.000
1.33	1.49	338.10	1.00	338.10	59	1244	0.27	0.003	0.00	6.39	0.00	0.000
1.40	1.60	299.51	1.00	299.51	54	1268	0.27	0.003	0.00	6.39	0.00	0.000
1.47	1.70	266.91	1.04	277.83	52	1294	0.27	0.003	0.00	6.39	0.00	0.000
1.51	1.84	219.59	1.14	249.53	0	0	0.27	0.000	0.00	13.43	0.00	0.000
1.58	1.89	204.88	1.18	241.49	0	0	0.27	0.000	0.00	13.43	0.00	0.000
1.65	1.92	194.48	1.21	234.94	0	0	0.27	0.000	0.00	13.43	0.00	0.000
1.73	1.97	175.88	1.26	221.92	0	0	0.27	0.000	0.00	13.43	0.00	0.000
1.78	2.01	161.72	1.32	213.25	0	0	0.27	0.000	0.00	13.43	0.00	0.000
1.85	2.07	144.78	1.40	202.67	0	0	0.27	0.000	0.00	13.43	0.00	0.000
1.90	2.12	130.63	1.49	194.65	0	0	0.27	0.000	0.00	13.43	0.00	0.000
1.99	2.19	112.30	1.65	185.17	0	0	0.27	0.000	0.00	13.43	0.00	0.000
2.05	2.26	100.92	1.82	184.00	0	0	0.27	0.000	0.00	13.43	0.00	0.000
2.12	2.34	88.42	2.07	183.46	0	0	0.27	0.000	0.00	13.43	0.00	0.000
2.18	2.39	81.05	2.28	184.86	0	0	0.27	0.000	0.00	13.43	0.00	0.000
2.24	2.45	75.36	2.51	188.95	0	0	0.27	0.000	0.00	13.43	0.00	0.000
2.32	2.51	68.83	2.83	195.12	0	0	0.27	0.000	0.00	13.43	0.00	0.000
2.37	2.56	64.93	3.06	198.85	0	0	0.27	0.000	0.00	13.43	0.00	0.000
2.43	2.62	59.53	3.44	204.92	0	0	0.27	0.000	0.00	0.00	0.00	0.000
2.50	2.66	55.91	3.73	208.80	0	0	0.27	0.000	0.00	0.00	0.00	0.000
2.56	2.69	53.27	3.96	210.77	0	0	0.27	0.000	0.00	0.00	0.00	0.000
2.64	2.72	51.31	4.12	211.32	0	0	0.27	0.000	0.00	0.00	0.00	0.000
2.72	2.73	49.36	4.24	209.32	0	0	0.27	0.000	0.00	0.00	0.00	0.000
2.77	2.74	48.39	4.29	207.43	0	0	0.27	0.000	0.00	0.00	0.00	0.000
2.84	2.75	46.98	4.37	205.27	0	0	0.27	0.000	0.00	0.00	0.00	0.000
2.90	2.72	45.59	4.11	187.30	0	0	0.27	0.000	0.00	0.00	0.00	0.000
2.98	2.67	43.79	3.77	164.86	0	0	0.27	0.000	0.00	0.00	0.00	0.000
3.04	2.70	42.53	3.99	169.52	0	0	0.27	0.000	0.00	0.00	0.00	0.000
3.08	2.72	41.56	4.15	172.45	0	0	0.27	0.000	0.00	0.00	0.00	0.000
3.16	2.75	40.30	4.35	175.31	0	0	0.27	0.000	0.00	0.00	0.00	0.000

:: Post-earthquake settlement of dry sands :: (continued)

Depth (ft)	Ic	Q_{tn}	Kc	$Q_{tn,cs}$	$N_{1,60}$ (blows)	G_{max} (tsf)	CSR	Shear, γ (%)	$e_{vol(15)}$ (%)	N_c	e_v (%)	Settle. (in)
3.22	2.77	39.44	4.51	177.72	0	0	0.27	0.000	0.00	0.00	0.00	0.000
3.30	2.77	39.16	4.56	178.72	0	0	0.27	0.000	0.00	0.00	0.00	0.000
3.35	2.76	39.85	4.48	178.47	0	0	0.27	0.000	0.00	0.00	0.00	0.000
3.44	2.74	40.81	4.27	174.18	0	0	0.27	0.000	0.00	0.00	0.00	0.000
3.49	2.73	40.93	4.18	171.22	0	0	0.27	0.000	0.00	0.00	0.00	0.000
3.56	2.71	40.79	4.10	167.04	0	0	0.27	0.000	0.00	0.00	0.00	0.000
3.61	2.70	40.78	4.03	164.25	0	0	0.27	0.000	0.00	0.00	0.00	0.000
3.71	2.69	41.32	3.90	161.16	0	0	0.27	0.000	0.00	0.00	0.00	0.000
3.75	2.68	41.87	3.83	160.32	0	0	0.27	0.000	0.00	0.00	0.00	0.000
3.81	2.67	42.41	3.77	159.83	0	0	0.27	0.000	0.00	0.00	0.00	0.000
3.89	2.67	42.55	3.76	160.08	0	0	0.27	0.000	0.00	0.00	0.00	0.000
3.94	2.67	42.82	3.76	160.88	0	0	0.27	0.000	0.00	0.00	0.00	0.000
4.03	2.67	43.37	3.75	162.67	0	0	0.27	0.000	0.00	0.00	0.00	0.000
4.08	2.67	43.50	3.76	163.52	0	0	0.27	0.000	0.00	0.00	0.00	0.000
4.15	2.66	44.32	3.73	165.37	0	0	0.27	0.000	0.00	0.00	0.00	0.000
4.23	2.66	45.28	3.72	168.63	0	0	0.27	0.000	0.00	0.00	0.00	0.000
4.29	2.66	46.39	3.69	171.13	0	0	0.27	0.000	0.00	0.00	0.00	0.000
4.33	2.66	46.79	3.69	172.55	0	0	0.27	0.000	0.00	0.00	0.00	0.000
4.43	2.67	46.65	3.77	175.79	0	0	0.27	0.000	0.00	0.00	0.00	0.000
4.47	2.68	46.23	3.83	177.17	0	0	0.27	0.000	0.00	0.00	0.00	0.000
4.55	2.63	45.24	3.50	158.44	0	0	0.27	0.000	0.00	0.00	0.00	0.000
4.61	2.60	44.54	3.34	148.84	0	0	0.27	0.000	0.00	0.00	0.00	0.000
4.66	2.63	43.70	3.53	154.24	0	0	0.27	0.000	0.00	0.00	0.00	0.000
4.75	2.66	43.42	3.70	160.44	0	0	0.27	0.000	0.00	0.00	0.00	0.000
4.80	2.67	43.00	3.81	163.83	0	0	0.27	0.000	0.00	0.00	0.00	0.000
4.88	2.70	42.29	3.98	168.42	0	0	0.27	0.000	0.00	0.00	0.00	0.000
4.93	2.70	42.91	3.99	171.09	0	0	0.27	0.000	0.00	0.00	0.00	0.000
5.01	2.71	42.84	4.10	175.72	0	0	0.27	0.000	0.00	0.00	0.00	0.000
5.06	2.72	42.82	4.16	177.97	0	0	0.27	0.000	0.00	0.00	0.00	0.000
5.15	2.72	42.82	4.18	178.76	0	0	0.27	0.000	0.00	0.00	0.00	0.000
5.19	2.72	42.81	4.18	178.82	0	0	0.27	0.000	0.00	0.00	0.00	0.000
5.27	2.70	44.75	3.98	178.15	0	0	0.27	0.000	0.00	0.00	0.00	0.000
5.33	2.68	46.40	3.85	178.50	0	0	0.27	0.000	0.00	0.00	0.00	0.000
5.42	2.65	49.31	3.65	180.08	0	0	0.27	0.000	0.00	0.00	0.00	0.000
5.47	2.63	51.80	3.49	180.87	0	0	0.27	0.000	0.00	0.00	0.00	0.000
5.51	2.61	53.87	3.37	181.76	0	0	0.27	0.000	0.00	0.00	0.00	0.000
5.58	2.59	55.68	3.27	182.09	0	0	0.27	0.000	0.00	13.43	0.00	0.000
5.64	2.57	58.03	3.13	181.81	0	0	0.27	0.000	0.00	13.43	0.00	0.000
5.73	2.53	61.21	2.93	179.23	0	0	0.27	0.000	0.00	13.43	0.00	0.000
5.79	2.50	63.29	2.78	176.18	0	0	0.27	0.000	0.00	13.43	0.00	0.000
5.88	2.47	65.22	2.60	169.56	0	0	0.27	0.000	0.00	13.43	0.00	0.000
5.91	2.45	66.04	2.52	166.16	0	0	0.27	0.000	0.00	13.43	0.00	0.000
5.99	2.32	67.98	2.02	137.06	0	0	0.27	0.000	0.00	13.43	0.00	0.000

:: Post-earthquake settlement of dry sands :: (continued)

Depth (ft)	Ic	Q_{tn}	Kc	$Q_{tn,cs}$	$N_{1,60}$ (blows)	G_{max} (tsf)	CSR	Shear, γ (%)	$e_{vol(15)}$ (%)	N_c	e_v (%)	Settle. (in)

Total estimated settlement: 0.00

Abbreviations

Q_{tn}: Equivalent clean sand normalized cone resistance
K_c: Fines correction factor
$Q_{tn,cs}$: Post-liquefaction volumentric strain
G_{max}: Small strain shear modulus
CSR: Soil cyclic stress ratio
γ: Cyclic shear strain
$e_{vol(15)}$: Volumetric strain after 15 cycles
N_c: Equivalent number of cycles
e_v: Volumetric strain
Settle.: Calculated settlement

:: Post-earthquake settlement due to soil liquefaction ::

Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)	Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)
6.05	118.03	2.00	0.00	1.00	0.00	6.11	115.48	2.00	0.00	1.00	0.00
6.18	112.38	2.00	0.00	1.00	0.00	6.25	108.45	2.00	0.00	1.00	0.00
6.32	105.06	0.68	2.24	1.00	0.02	6.37	101.49	0.64	2.31	1.00	0.01
6.44	99.50	0.62	2.35	1.00	0.02	6.53	96.99	0.59	2.40	1.00	0.03
6.57	95.70	0.58	2.42	1.00	0.01	6.63	93.39	0.55	2.47	1.00	0.02
6.71	91.03	0.53	2.52	1.00	0.02	6.77	90.02	0.52	2.55	1.00	0.02
6.84	89.15	0.51	2.57	1.00	0.02	6.92	89.80	0.51	2.55	1.00	0.03
6.97	90.17	0.52	2.54	1.00	0.01	7.02	90.49	0.52	2.54	1.00	0.02
7.11	90.50	0.51	2.54	1.00	0.03	7.16	90.59	0.51	2.53	1.00	0.01
7.22	90.73	0.51	2.53	1.00	0.02	7.33	91.77	0.52	2.51	1.00	0.03
7.38	92.48	0.52	2.49	1.00	0.02	7.42	93.70	0.53	2.46	1.00	0.01
7.52	96.60	0.55	2.40	1.00	0.03	7.56	97.78	0.56	2.38	1.00	0.01
7.61	98.06	0.56	2.37	1.00	0.02	7.69	97.43	0.55	2.39	1.00	0.02
7.76	96.87	0.54	2.40	1.00	0.02	7.82	96.51	0.54	2.41	1.00	0.02
7.91	96.17	0.53	2.41	1.00	0.03	7.96	96.82	0.54	2.40	1.00	0.01
8.01	97.59	0.54	2.38	1.00	0.01	8.09	99.10	0.55	2.35	1.00	0.02
8.15	100.13	0.56	2.33	1.00	0.02	8.22	101.14	0.57	2.32	1.00	0.02
8.27	101.54	0.57	2.31	1.00	0.01	8.33	101.93	0.57	2.30	1.00	0.02
8.41	102.22	0.57	2.29	1.00	0.02	8.50	101.83	0.57	2.30	1.00	0.03
8.54	101.81	0.57	2.30	1.00	0.01	8.65	101.23	0.56	2.31	1.00	0.03
8.72	89.01	0.46	2.57	1.00	0.02	8.77	89.12	0.46	2.57	1.00	0.01
8.81	90.09	0.46	2.55	1.00	0.01	8.87	91.57	0.47	2.51	1.00	0.02
8.96	93.31	0.48	2.47	1.00	0.03	8.99	94.22	0.49	2.45	1.00	0.01
9.06	96.14	0.50	2.41	1.00	0.02	9.13	101.29	0.55	2.31	1.00	0.02
9.21	104.32	0.57	2.26	1.00	0.02	9.27	105.98	0.59	2.23	1.00	0.01
9.36	107.04	0.59	2.21	1.00	0.02	9.41	106.99	0.59	2.21	1.00	0.01
9.46	106.64	0.59	2.22	1.00	0.01	9.54	104.95	0.57	2.25	1.00	0.02
9.58	103.28	0.55	2.28	1.00	0.01	9.65	101.01	0.53	2.32	1.00	0.02
9.72	99.97	0.52	2.34	1.00	0.02	9.80	102.00	0.54	2.30	1.00	0.02
9.85	103.65	0.55	2.27	1.00	0.01	9.93	104.59	0.56	2.25	1.00	0.02
9.98	103.88	0.55	2.26	1.00	0.01	10.05	102.28	0.53	2.29	1.00	0.02
10.12	100.43	0.52	2.33	1.00	0.02	10.17	99.66	0.51	2.34	1.00	0.01
10.25	98.23	0.50	2.37	1.00	0.02	10.31	96.73	0.48	2.40	1.00	0.02
10.38	93.78	0.46	2.46	1.00	0.02	10.44	91.04	0.44	2.52	1.00	0.02
10.51	87.86	0.42	2.60	1.00	0.02	10.57	85.80	0.41	2.65	1.00	0.02

:: Post-earthquake settlement due to soil liquefaction :: (continued)

Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)	Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)
10.64	84.24	0.40	2.69	1.00	0.02	10.71	83.77	0.39	2.70	1.00	0.02
10.78	84.36	0.39	2.69	1.00	0.02	10.84	85.63	0.40	2.65	1.00	0.02
10.93	88.75	0.42	2.58	1.00	0.03	10.96	90.29	0.43	2.54	1.00	0.01
11.03	90.74	0.43	2.53	1.00	0.02	11.15	86.45	2.00	0.00	1.00	0.00
11.19	91.70	2.00	0.00	1.00	0.00	11.23	95.45	2.00	0.00	1.00	0.00
11.30	100.77	2.00	0.00	1.00	0.00	11.38	101.17	2.00	0.00	1.00	0.00
11.43	103.13	2.00	0.00	1.00	0.00	11.50	102.90	2.00	0.00	1.00	0.00
11.56	104.82	2.00	0.00	1.00	0.00	11.64	106.05	2.00	0.00	1.00	0.00
11.68	105.73	2.00	0.00	1.00	0.00	11.77	105.55	2.00	0.00	1.00	0.00
11.81	105.38	2.00	0.00	1.00	0.00	11.91	103.14	0.51	2.28	1.00	0.03
11.94	104.34	0.52	2.26	1.00	0.01	12.01	105.29	0.53	2.24	1.00	0.02
12.08	104.81	0.52	2.25	1.00	0.02	12.17	110.05	0.57	2.16	1.00	0.03
12.21	112.19	0.59	2.13	1.00	0.01	12.28	116.16	0.63	2.07	1.00	0.02
12.35	119.96	0.67	1.90	1.00	0.02	12.41	122.50	0.69	1.84	1.00	0.01
12.48	127.81	0.76	1.42	1.00	0.01	12.54	131.38	0.80	1.36	1.00	0.01
12.62	136.38	0.87	0.99	1.00	0.01	12.67	139.01	0.91	0.96	1.00	0.01
12.75	142.62	0.96	0.64	1.00	0.01	12.80	144.82	0.99	0.63	1.00	0.00
12.88	150.33	1.08	0.42	1.00	0.00	12.93	154.27	1.15	0.42	1.00	0.00
13.02	157.82	2.00	0.00	1.00	0.00	13.07	158.75	1.23	0.29	1.00	0.00
13.16	159.72	1.25	0.29	1.00	0.00	13.20	161.65	1.28	0.21	1.00	0.00
13.26	165.21	2.00	0.00	1.00	0.00	13.33	170.34	2.00	0.00	1.00	0.00
13.42	179.84	2.00	0.00	1.00	0.00	13.47	178.82	2.00	0.00	1.00	0.00
13.52	177.12	2.00	0.00	1.00	0.00	13.61	179.47	2.00	0.00	1.00	0.00
13.65	181.13	2.00	0.00	1.00	0.00	13.74	178.52	2.00	0.00	1.00	0.00
13.79	175.60	2.00	0.00	1.00	0.00	13.86	173.60	2.00	0.00	1.00	0.00
13.92	171.47	2.00	0.00	1.00	0.00	13.98	169.92	2.00	0.00	1.00	0.00
14.05	168.46	2.00	0.00	1.00	0.00	14.11	167.77	2.00	0.00	1.00	0.00
14.19	167.52	2.00	0.00	1.00	0.00	14.25	167.07	2.00	0.00	1.00	0.00
14.31	164.88	2.00	0.00	1.00	0.00	14.39	162.34	2.00	0.00	1.00	0.00
14.45	162.31	2.00	0.00	1.00	0.00	14.52	162.76	2.00	0.00	1.00	0.00
14.57	162.30	2.00	0.00	1.00	0.00	14.64	159.65	2.00	0.00	1.00	0.00
14.70	158.79	2.00	0.00	1.00	0.00	14.78	159.05	2.00	0.00	1.00	0.00
14.86	157.51	2.00	0.00	1.00	0.00	14.90	156.47	2.00	0.00	1.00	0.00
14.97	151.85	2.00	0.00	1.00	0.00	15.03	145.65	2.00	0.00	1.00	0.00
15.10	140.98	2.00	0.00	1.00	0.00	15.18	140.44	2.00	0.00	1.00	0.00
15.24	140.13	2.00	0.00	1.00	0.00	15.31	139.25	2.00	0.00	1.00	0.00
15.36	139.26	2.00	0.00	1.00	0.00	15.44	141.44	2.00	0.00	1.00	0.00
15.49	142.49	2.00	0.00	1.00	0.00	15.57	137.46	2.00	0.00	1.00	0.00
15.63	136.25	2.00	0.00	1.00	0.00	15.71	139.38	2.00	0.00	1.00	0.00
15.75	137.45	2.00	0.00	1.00	0.00	15.85	143.34	2.00	0.00	1.00	0.00
15.89	144.84	2.00	0.00	1.00	0.00	15.95	145.09	2.00	0.00	1.00	0.00
16.02	143.10	2.00	0.00	1.00	0.00	16.11	143.15	2.00	0.00	1.00	0.00
16.16	143.43	2.00	0.00	1.00	0.00	16.21	141.91	2.00	0.00	1.00	0.00
16.28	139.12	2.00	0.00	1.00	0.00	16.34	135.64	2.00	0.00	1.00	0.00
16.41	125.43	2.00	0.00	1.00	0.00	16.48	120.15	2.00	0.00	1.00	0.00
16.54	124.88	2.00	0.00	1.00	0.00	16.61	149.83	2.00	0.00	1.00	0.00
16.67	197.89	2.00	0.00	1.00	0.00	16.74	259.03	2.00	0.00	1.00	0.00
16.81	268.59	2.00	0.00	1.00	0.00	16.88	264.73	2.00	0.00	1.00	0.00

:: Post-earthquake settlement due to soil liquefaction :: (continued)

Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)	Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)
16.93	251.89	2.00	0.00	1.00	0.00	17.01	256.82	2.00	0.00	1.00	0.00
17.06	225.96	2.00	0.00	1.00	0.00	17.13	221.43	2.00	0.00	1.00	0.00
17.20	220.38	2.00	0.00	1.00	0.00	17.28	217.50	2.00	0.00	1.00	0.00
17.33	215.96	2.00	0.00	1.00	0.00	17.39	199.93	2.00	0.00	1.00	0.00
17.45	193.74	1.91	0.00	1.00	0.00	17.53	194.94	1.94	0.00	1.00	0.00
17.60	196.26	1.98	0.00	1.00	0.00	17.68	196.59	1.98	0.00	1.00	0.00
17.72	197.19	2.00	0.00	1.00	0.00	17.79	198.10	2.00	0.00	1.00	0.00
17.85	200.31	2.00	0.00	1.00	0.00	17.93	200.65	2.00	0.00	1.00	0.00
18.00	199.59	2.00	0.00	1.00	0.00	18.05	199.08	2.00	0.00	1.00	0.00
18.13	197.88	2.00	0.00	1.00	0.00	18.18	197.84	2.00	0.00	1.00	0.00
18.26	199.57	2.00	0.00	1.00	0.00	18.31	201.60	2.00	0.00	1.00	0.00
18.40	208.74	2.00	0.00	1.00	0.00	18.45	214.43	2.00	0.00	1.00	0.00
18.53	230.79	2.00	0.00	1.00	0.00	18.58	245.97	2.00	0.00	1.00	0.00
18.64	272.12	2.00	0.00	1.00	0.00	18.72	282.95	2.00	0.00	1.00	0.00
18.77	279.34	2.00	0.00	1.00	0.00	18.84	262.88	2.00	0.00	1.00	0.00
18.93	231.97	2.00	0.00	1.00	0.00	18.97	234.69	2.00	0.00	1.00	0.00
19.05	238.10	2.00	0.00	1.00	0.00	19.11	237.71	2.00	0.00	1.00	0.00
19.19	244.31	2.00	0.00	1.00	0.00	19.23	240.84	2.00	0.00	1.00	0.00
19.30	235.40	2.00	0.00	1.00	0.00	19.37	235.11	2.00	0.00	1.00	0.00
19.44	229.05	2.00	0.00	1.00	0.00	19.51	223.67	2.00	0.00	1.00	0.00
19.57	214.64	2.00	0.00	1.00	0.00	19.64	206.03	2.00	0.00	1.00	0.00
19.70	205.05	2.00	0.00	1.00	0.00	19.77	204.69	2.00	0.00	1.00	0.00
19.82	203.79	2.00	0.00	1.00	0.00	19.90	209.73	2.00	0.00	1.00	0.00
19.95	216.94	2.00	0.00	1.00	0.00	20.03	237.20	2.00	0.00	1.00	0.00
20.09	250.40	2.00	0.00	1.00	0.00	20.16	251.87	2.00	0.00	1.00	0.00
20.22	259.48	2.00	0.00	1.00	0.00	20.31	260.21	2.00	0.00	1.00	0.00
20.36	262.12	2.00	0.00	1.00	0.00	20.41	264.85	2.00	0.00	1.00	0.00
20.49	255.30	2.00	0.00	1.00	0.00	20.54	253.34	2.00	0.00	1.00	0.00
20.61	252.55	2.00	0.00	1.00	0.00	20.67	252.32	2.00	0.00	1.00	0.00
20.74	253.19	2.00	0.00	1.00	0.00	20.80	256.56	2.00	0.00	1.00	0.00
20.89	265.53	2.00	0.00	1.00	0.00	20.94	270.02	2.00	0.00	1.00	0.00
21.01	281.79	2.00	0.00	1.00	0.00	21.07	291.21	2.00	0.00	1.00	0.00
21.15	313.95	2.00	0.00	1.00	0.00	21.20	335.98	2.00	0.00	1.00	0.00
21.26	386.50	2.00	0.00	1.00	0.00	21.34	432.99	2.00	0.00	1.00	0.00
21.39	479.67	2.00	0.00	1.00	0.00	21.47	511.65	2.00	0.00	1.00	0.00
21.53	531.31	2.00	0.00	1.00	0.00	21.59	527.46	2.00	0.00	1.00	0.00
21.67	532.92	2.00	0.00	1.00	0.00	21.73	520.13	2.00	0.00	1.00	0.00
21.79	503.82	2.00	0.00	1.00	0.00	21.87	435.50	2.00	0.00	1.00	0.00
21.92	421.26	2.00	0.00	1.00	0.00	21.99	398.04	2.00	0.00	1.00	0.00
22.05	356.63	2.00	0.00	1.00	0.00	22.14	321.65	2.00	0.00	1.00	0.00
22.19	265.83	2.00	0.00	1.00	0.00	22.25	237.06	2.00	0.00	1.00	0.00
22.32	221.47	2.00	0.00	1.00	0.00	22.38	217.41	2.00	0.00	1.00	0.00
22.45	213.33	2.00	0.00	1.00	0.00	22.52	213.07	2.00	0.00	1.00	0.00
22.60	209.77	2.00	0.00	1.00	0.00	22.65	209.84	2.00	0.00	1.00	0.00
22.73	207.48	2.00	0.00	1.00	0.00	22.79	205.41	2.00	0.00	1.00	0.00
22.84	204.35	2.00	0.00	1.00	0.00	22.91	203.25	2.00	0.00	1.00	0.00
22.98	202.33	2.00	0.00	1.00	0.00	23.04	197.99	1.94	0.00	1.00	0.00
23.10	201.28	2.00	0.00	1.00	0.00	23.18	204.88	2.00	0.00	1.00	0.00

:: Post-earthquake settlement due to soil liquefaction :: (continued)

Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)	Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)
23.25	208.55	2.00	0.00	1.00	0.00	23.32	211.52	2.00	0.00	1.00	0.00
23.36	213.46	2.00	0.00	1.00	0.00	23.43	216.85	2.00	0.00	1.00	0.00
23.50	217.45	2.00	0.00	1.00	0.00	23.58	218.00	2.00	0.00	1.00	0.00
23.66	215.88	2.00	0.00	1.00	0.00	23.69	213.31	2.00	0.00	1.00	0.00
23.77	210.78	2.00	0.00	1.00	0.00	23.83	212.02	2.00	0.00	1.00	0.00
23.90	221.77	2.00	0.00	1.00	0.00	23.98	239.11	2.00	0.00	1.00	0.00
24.03	251.92	2.00	0.00	1.00	0.00	24.11	279.31	2.00	0.00	1.00	0.00
24.16	291.79	2.00	0.00	1.00	0.00	24.23	313.43	2.00	0.00	1.00	0.00
24.30	327.18	2.00	0.00	1.00	0.00	24.38	340.45	2.00	0.00	1.00	0.00
24.41	348.65	2.00	0.00	1.00	0.00	24.48	362.31	2.00	0.00	1.00	0.00
24.56	369.93	2.00	0.00	1.00	0.00	24.62	374.89	2.00	0.00	1.00	0.00
24.68	382.60	2.00	0.00	1.00	0.00	24.75	373.53	2.00	0.00	1.00	0.00
24.81	351.04	2.00	0.00	1.00	0.00	24.88	353.63	2.00	0.00	1.00	0.00
24.95	353.02	2.00	0.00	1.00	0.00	25.01	353.52	2.00	0.00	1.00	0.00
25.08	354.85	2.00	0.00	1.00	0.00	25.15	356.67	2.00	0.00	1.00	0.00
25.22	350.66	2.00	0.00	1.00	0.00	25.27	346.98	2.00	0.00	1.00	0.00
25.34	343.95	2.00	0.00	1.00	0.00	25.40	344.21	2.00	0.00	1.00	0.00
25.48	346.82	2.00	0.00	1.00	0.00	25.53	349.39	2.00	0.00	1.00	0.00
25.60	347.26	2.00	0.00	1.00	0.00	25.67	347.12	2.00	0.00	1.00	0.00
25.73	349.59	2.00	0.00	1.00	0.00	25.80	351.88	2.00	0.00	1.00	0.00
25.86	353.55	2.00	0.00	1.00	0.00	25.94	358.97	2.00	0.00	1.00	0.00
26.00	358.50	2.00	0.00	1.00	0.00	26.07	358.21	2.00	0.00	1.00	0.00
26.12	357.82	2.00	0.00	1.00	0.00	26.21	360.49	2.00	0.00	1.00	0.00
26.25	362.11	2.00	0.00	1.00	0.00	26.34	334.79	2.00	0.00	1.00	0.00
26.39	326.70	2.00	0.00	1.00	0.00	26.46	326.76	2.00	0.00	1.00	0.00
26.52	326.56	2.00	0.00	1.00	0.00	26.60	326.58	2.00	0.00	1.00	0.00
26.65	336.78	2.00	0.00	1.00	0.00	26.71	345.69	2.00	0.00	1.00	0.00
26.78	351.36	2.00	0.00	1.00	0.00	26.86	357.61	2.00	0.00	1.00	0.00
26.91	361.51	2.00	0.00	1.00	0.00	26.97	362.39	2.00	0.00	1.00	0.00
27.04	368.80	2.00	0.00	1.00	0.00	27.14	379.86	2.00	0.00	1.00	0.00
27.17	380.07	2.00	0.00	1.00	0.00	27.25	375.82	2.00	0.00	1.00	0.00
27.31	371.48	2.00	0.00	1.00	0.00	27.36	354.36	2.00	0.00	1.00	0.00
27.44	352.96	2.00	0.00	1.00	0.00	27.50	353.87	2.00	0.00	1.00	0.00
27.59	354.11	2.00	0.00	1.00	0.00	27.63	353.38	2.00	0.00	1.00	0.00
27.69	350.66	2.00	0.00	1.00	0.00	27.77	350.30	2.00	0.00	1.00	0.00
27.85	348.28	2.00	0.00	1.00	0.00	27.91	350.98	2.00	0.00	1.00	0.00
27.95	350.87	2.00	0.00	1.00	0.00	28.02	350.77	2.00	0.00	1.00	0.00
28.10	353.11	2.00	0.00	1.00	0.00	28.17	360.53	2.00	0.00	1.00	0.00
28.22	365.09	2.00	0.00	1.00	0.00	28.28	375.74	2.00	0.00	1.00	0.00
28.36	366.12	2.00	0.00	1.00	0.00	28.42	391.06	2.00	0.00	1.00	0.00
28.50	401.65	2.00	0.00	1.00	0.00	28.55	400.35	2.00	0.00	1.00	0.00
28.61	404.42	2.00	0.00	1.00	0.00	28.69	402.13	2.00	0.00	1.00	0.00
28.76	409.48	2.00	0.00	1.00	0.00	28.81	407.92	2.00	0.00	1.00	0.00
28.87	396.37	2.00	0.00	1.00	0.00	28.94	381.55	2.00	0.00	1.00	0.00
29.01	368.02	2.00	0.00	1.00	0.00	29.08	353.09	2.00	0.00	1.00	0.00
29.14	351.78	2.00	0.00	1.00	0.00	29.21	343.47	2.00	0.00	1.00	0.00
29.27	347.26	2.00	0.00	1.00	0.00	29.34	345.32	2.00	0.00	1.00	0.00
29.41	343.02	2.00	0.00	1.00	0.00	29.48	338.43	2.00	0.00	1.00	0.00

:: Post-earthquake settlement due to soil liquefaction :: (continued)

Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)	Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)
29.53	334.29	2.00	0.00	1.00	0.00	29.61	334.03	2.00	0.00	1.00	0.00
29.66	334.45	2.00	0.00	1.00	0.00	29.73	334.24	2.00	0.00	1.00	0.00
29.81	329.51	2.00	0.00	1.00	0.00	29.88	324.37	2.00	0.00	1.00	0.00
29.93	313.26	2.00	0.00	1.00	0.00	30.00	228.54	2.00	0.00	1.00	0.00
30.07	284.33	2.00	0.00	1.00	0.00	30.13	281.64	2.00	0.00	1.00	0.00
30.20	283.62	2.00	0.00	1.00	0.00	30.27	283.07	2.00	0.00	1.00	0.00
30.32	292.28	2.00	0.00	1.00	0.00	30.40	305.94	2.00	0.00	1.00	0.00
30.45	323.63	2.00	0.00	1.00	0.00	30.53	364.03	2.00	0.00	1.00	0.00
30.58	396.20	2.00	0.00	1.00	0.00	30.64	434.28	2.00	0.00	1.00	0.00
30.71	481.53	2.00	0.00	1.00	0.00	30.80	509.77	2.00	0.00	1.00	0.00
30.84	521.47	2.00	0.00	1.00	0.00	30.92	508.59	2.00	0.00	1.00	0.00
30.98	505.77	2.00	0.00	1.00	0.00	31.07	505.62	2.00	0.00	1.00	0.00
31.11	505.70	2.00	0.00	1.00	0.00	31.18	509.00	2.00	0.00	1.00	0.00
31.24	520.87	2.00	0.00	1.00	0.00	31.32	546.64	2.00	0.00	1.00	0.00
31.37	506.21	2.00	0.00	1.00	0.00	31.44	512.26	2.00	0.00	1.00	0.00
31.50	515.13	2.00	0.00	1.00	0.00	31.56	501.13	2.00	0.00	1.00	0.00
31.65	513.07	2.00	0.00	1.00	0.00	31.70	477.78	2.00	0.00	1.00	0.00
31.79	-1.00	2.00	0.00	1.00	0.00	31.83	-1.00	2.00	0.00	1.00	0.00
31.89	-1.00	2.00	0.00	1.00	0.00	31.96	-1.00	2.00	0.00	1.00	0.00
32.03	-1.00	2.00	0.00	1.00	0.00	32.09	-1.00	2.00	0.00	1.00	0.00

Total estimated settlement: 1.60

Abbreviations

$Q_{tn,cs}$: Equivalent clean sand normalized cone resistance
FS: Factor of safety against liquefaction
e_v (%): Post-liquefaction volumentric strain
DF: e_v depth weighting factor
Settlement: Calculated settlement

:: Strength loss calculation (Robertson (2009) ::

Depth (ft)	q_t (tsf)	Q_{tn}	K_c	$Q_{tn,cs}$	I_c	$S_{u(liq)}/\sigma'_v$	$S_{u(peak)}/\sigma'_v$
0.07	0.00	-1.00	1.00	-1.00	-1.00	N/A	N/A
0.14	0.00	-1.00	1.00	-1.00	-1.00	N/A	N/A
0.20	1.38	2.20	26.38	58.00	4.05	N/A	N/A
0.30	56.04	90.01	1.18	105.93	1.89	N/A	N/A
0.34	93.51	150.21	1.02	153.63	1.68	N/A	N/A
0.41	162.25	260.64	1.00	260.64	1.48	N/A	N/A
0.48	208.53	334.99	1.00	334.99	1.36	N/A	N/A
0.54	276.49	444.17	1.00	444.17	1.21	N/A	N/A
0.59	328.98	528.50	1.00	528.50	1.14	N/A	N/A
0.66	398.67	640.46	1.00	640.46	1.05	N/A	N/A
0.73	417.49	670.69	1.00	670.69	1.02	N/A	N/A
0.79	413.35	664.03	1.00	664.03	1.03	N/A	N/A
0.87	406.09	652.35	1.00	652.35	1.09	N/A	N/A
0.92	394.95	634.45	1.00	634.45	1.14	N/A	N/A
0.99	377.60	606.57	1.00	606.57	1.19	N/A	N/A
1.06	361.02	579.92	1.00	579.92	1.23	N/A	N/A
1.13	312.67	502.24	1.00	502.24	1.27	N/A	N/A
1.20	279.08	448.26	1.00	448.26	1.26	N/A	N/A
1.26	243.15	390.53	1.00	390.53	1.37	N/A	N/A
1.33	210.52	338.10	1.00	338.10	1.49	N/A	N/A
1.40	186.51	299.51	1.00	299.51	1.60	N/A	N/A
1.47	166.22	266.91	1.04	277.83	1.70	N/A	N/A
1.51	136.77	219.59	1.14	249.53	1.84	N/A	N/A
1.58	127.62	204.88	1.18	241.49	1.89	N/A	N/A
1.65	121.15	194.48	1.21	234.94	1.92	N/A	N/A
1.73	109.58	175.88	1.26	221.92	1.97	N/A	N/A
1.78	100.77	161.72	1.32	213.25	2.01	N/A	N/A
1.85	90.23	144.78	1.40	202.67	2.07	N/A	N/A
1.90	81.43	130.63	1.49	194.65	2.12	N/A	N/A
1.99	70.02	112.30	1.65	185.17	2.19	N/A	N/A
2.05	62.94	100.92	1.82	184.00	2.26	N/A	N/A
2.12	55.17	88.42	2.07	183.46	2.34	N/A	N/A
2.18	50.58	81.05	2.28	184.86	2.39	N/A	N/A
2.24	47.04	75.36	2.51	188.95	2.45	N/A	N/A
2.32	42.99	68.83	2.83	195.12	2.51	N/A	N/A
2.37	40.56	64.93	3.06	198.85	2.56	N/A	N/A
2.43	37.20	59.53	3.44	204.92	2.62	N/A	N/A
2.50	34.95	55.91	3.73	208.80	2.66	N/A	N/A
2.56	33.31	53.27	3.96	210.77	2.69	N/A	N/A
2.64	32.10	51.31	4.12	211.32	2.72	N/A	N/A
2.72	30.89	49.36	4.24	209.32	2.73	N/A	N/A
2.77	30.29	48.39	4.29	207.43	2.74	N/A	N/A
2.84	29.42	46.98	4.37	205.27	2.75	N/A	N/A
2.90	28.56	45.59	4.11	187.30	2.72	N/A	N/A
2.98	27.44	43.79	3.77	164.86	2.67	N/A	N/A
3.04	26.66	42.53	3.99	169.52	2.70	N/A	N/A
3.08	26.06	41.56	4.15	172.45	2.72	N/A	N/A
3.16	25.28	40.30	4.35	175.31	2.75	N/A	N/A

:: Strength loss calculation (Robertson (2009) :: (continued)

Depth (ft)	q_t (tsf)	Q_{tn}	K_c	$Q_{tn,cs}$	I_c	$S_{u(liq)}/\sigma'_v$	$S_{u(peak)}/\sigma'_v$
3.22	24.75	39.44	4.51	177.72	2.77	N/A	N/A
3.30	24.58	39.16	4.56	178.72	2.77	N/A	N/A
3.35	25.01	39.85	4.48	178.47	2.76	N/A	N/A
3.44	25.62	40.81	4.27	174.18	2.74	N/A	N/A
3.49	25.69	40.93	4.18	171.22	2.73	N/A	N/A
3.56	25.61	40.79	4.10	167.04	2.71	N/A	N/A
3.61	25.61	40.78	4.03	164.25	2.70	N/A	N/A
3.71	25.95	41.32	3.90	161.16	2.69	N/A	N/A
3.75	26.29	41.87	3.83	160.32	2.68	N/A	N/A
3.81	26.63	42.41	3.77	159.83	2.67	N/A	N/A
3.89	26.72	42.55	3.76	160.08	2.67	N/A	N/A
3.94	26.89	42.82	3.76	160.88	2.67	N/A	N/A
4.03	27.25	43.37	3.75	162.67	2.67	N/A	N/A
4.08	27.33	43.50	3.76	163.52	2.67	N/A	N/A
4.15	27.85	44.32	3.73	165.37	2.66	N/A	N/A
4.23	28.44	45.28	3.72	168.63	2.66	N/A	N/A
4.29	29.14	46.39	3.69	171.13	2.66	N/A	N/A
4.33	29.39	46.79	3.69	172.55	2.66	N/A	N/A
4.43	29.31	46.65	3.77	175.79	2.67	N/A	N/A
4.47	29.05	46.23	3.83	177.17	2.68	N/A	N/A
4.55	28.44	45.24	3.50	158.44	2.63	N/A	N/A
4.61	28.01	44.54	3.34	148.84	2.60	N/A	N/A
4.66	27.49	43.70	3.53	154.24	2.63	N/A	N/A
4.75	27.32	43.42	3.70	160.44	2.66	N/A	N/A
4.80	27.06	43.00	3.81	163.83	2.67	N/A	N/A
4.88	26.62	42.29	3.98	168.42	2.70	N/A	N/A
4.93	27.01	42.91	3.99	171.09	2.70	N/A	N/A
5.01	26.97	42.84	4.10	175.72	2.71	N/A	N/A
5.06	26.97	42.82	4.16	177.97	2.72	N/A	N/A
5.15	26.97	42.82	4.18	178.76	2.72	N/A	N/A
5.19	26.97	42.81	4.18	178.82	2.72	N/A	N/A
5.27	28.18	44.75	3.98	178.15	2.70	N/A	N/A
5.33	29.21	46.40	3.85	178.50	2.68	N/A	N/A
5.42	31.03	49.31	3.65	180.08	2.65	N/A	N/A
5.47	32.58	51.80	3.49	180.87	2.63	N/A	N/A
5.51	33.87	53.87	3.37	181.76	2.61	N/A	N/A
5.58	35.00	55.68	3.27	182.09	2.59	N/A	N/A
5.64	36.47	58.03	3.13	181.81	2.57	N/A	N/A
5.73	38.45	61.21	2.93	179.23	2.53	N/A	N/A
5.79	39.75	63.29	2.78	176.18	2.50	N/A	N/A
5.88	40.96	65.22	2.60	169.56	2.47	N/A	N/A
5.91	41.47	66.04	2.52	166.16	2.45	N/A	N/A
5.99	42.68	67.98	2.02	137.06	2.32	N/A	N/A
6.05	43.89	69.92	1.69	118.03	2.21	0.78	0.78
6.11	44.93	71.58	1.61	115.48	2.18	0.78	0.78
6.18	45.53	72.54	1.55	112.38	2.15	0.78	0.78
6.25	45.70	72.81	1.49	108.45	2.12	0.78	0.78
6.32	45.12	71.86	1.46	105.06	2.10	0.78	0.78

:: Strength loss calculation (Robertson (2009) :: (continued)

Depth (ft)	q_t (tsf)	Q_{tn}	K_c	$Q_{tn,cs}$	I_c	$S_{u(liq)}/\sigma'_v$	$S_{u(peak)}/\sigma'_v$
6.37	42.27	67.28	1.51	101.49	2.13	0.77	0.77
6.44	43.31	68.94	1.44	99.50	2.09	0.78	0.78
6.53	43.75	69.65	1.39	96.99	2.06	0.78	0.78
6.57	43.75	69.65	1.37	95.70	2.05	0.78	0.78
6.63	43.76	69.66	1.34	93.39	2.03	0.78	0.78
6.71	44.03	70.08	1.30	91.03	2.00	0.78	0.78
6.77	44.46	70.77	1.27	90.02	1.98	0.78	0.78
6.84	45.24	72.02	1.24	89.15	1.95	0.78	0.78
6.92	46.62	74.23	1.21	89.80	1.92	0.79	0.79
6.97	47.14	75.06	1.20	90.17	1.91	0.79	0.79
7.02	47.48	75.60	1.20	90.49	1.91	0.79	0.79
7.11	47.39	75.45	1.20	90.50	1.91	0.79	0.79
7.16	47.48	75.59	1.20	90.59	1.91	0.79	0.79
7.22	46.96	74.75	1.21	90.73	1.93	0.79	0.79
7.33	47.48	75.36	1.22	91.77	1.93	0.79	0.79
7.38	48.26	76.21	1.21	92.48	1.93	0.79	0.79
7.42	49.64	77.90	1.20	93.70	1.91	0.79	0.79
7.52	52.06	80.92	1.19	96.60	1.91	0.80	0.80
7.56	53.02	82.08	1.19	97.78	1.90	0.80	0.80
7.61	53.10	82.00	1.20	98.06	1.91	0.80	0.80
7.69	52.33	80.63	1.21	97.43	1.92	0.80	0.80
7.76	51.97	79.81	1.21	96.87	1.93	0.80	0.80
7.82	51.80	79.31	1.22	96.51	1.93	0.80	0.80
7.91	51.89	78.94	1.22	96.17	1.93	0.79	0.79
7.96	52.14	79.14	1.22	96.82	1.93	0.79	0.79
8.01	52.40	79.40	1.23	97.59	1.94	0.80	0.80
8.09	52.83	79.82	1.24	99.10	1.95	0.80	0.80
8.15	53.01	79.98	1.25	100.13	1.96	0.80	0.80
8.22	53.09	79.93	1.27	101.14	1.97	0.80	0.80
8.27	52.83	79.48	1.28	101.54	1.98	0.80	0.80
8.33	52.49	78.87	1.29	101.93	1.99	0.79	0.79
8.41	52.06	78.08	1.31	102.22	2.01	0.79	0.79
8.50	51.03	76.36	1.33	101.83	2.02	0.79	0.79
8.54	50.77	75.85	1.34	101.81	2.03	0.79	0.79
8.65	49.91	74.27	1.36	101.23	2.04	0.79	0.79
8.72	49.56	71.53	1.24	89.01	1.95	0.78	0.78
8.77	49.55	71.39	1.25	89.12	1.96	0.78	0.78
8.81	49.47	71.29	1.26	90.09	1.97	0.78	0.78
8.87	49.47	71.33	1.28	91.57	1.99	0.78	0.78
8.96	49.47	71.24	1.31	93.31	2.01	0.78	0.78
8.99	49.64	71.45	1.32	94.22	2.01	0.78	0.78
9.06	46.79	68.07	1.41	96.14	2.08	0.77	0.77
9.13	51.02	73.50	1.38	101.29	2.05	0.78	0.78
9.21	52.75	75.60	1.38	104.32	2.06	0.79	0.79
9.27	53.18	76.09	1.39	105.98	2.06	0.79	0.79
9.36	53.53	76.25	1.40	107.04	2.07	0.79	0.79
9.41	53.70	76.22	1.40	106.99	2.07	0.79	0.79
9.46	53.61	75.83	1.41	106.64	2.07	0.79	0.79

:: Strength loss calculation (Robertson (2009) :: (continued)

Depth (ft)	q_t (tsf)	Q_{tn}	K_c	$Q_{tn,cs}$	I_c	$S_{u(liq)}/\sigma'_v$	$S_{u(peak)}/\sigma'_v$
9.54	53.35	74.99	1.40	104.95	2.07	0.79	0.79
9.58	52.58	73.69	1.40	103.28	2.07	0.79	0.79
9.65	51.63	72.04	1.40	101.01	2.07	0.78	0.78
9.72	50.85	70.71	1.41	99.97	2.08	0.78	0.78
9.80	50.85	70.59	1.44	102.00	2.09	0.78	0.78
9.85	50.85	70.58	1.47	103.65	2.11	0.78	0.78
9.93	50.85	70.33	1.49	104.59	2.12	0.78	0.78
9.98	50.86	70.05	1.48	103.88	2.12	0.78	0.78
10.05	50.85	69.60	1.47	102.28	2.11	0.78	0.78
10.12	51.63	70.06	1.43	100.43	2.09	0.78	0.78
10.17	54.13	72.67	1.37	99.66	2.05	0.78	0.78
10.25	56.55	74.94	1.31	98.23	2.01	0.79	0.79
10.31	57.58	75.66	1.28	96.73	1.98	0.79	0.79
10.38	57.67	75.09	1.25	93.78	1.96	0.79	0.79
10.44	57.07	73.83	1.23	91.04	1.94	0.79	0.79
10.51	55.95	71.91	1.22	87.86	1.93	0.78	0.78
10.57	54.57	69.93	1.23	85.80	1.94	0.78	0.78
10.64	53.62	68.47	1.23	84.24	1.94	0.78	0.78
10.71	53.36	67.94	1.23	83.77	1.94	0.77	0.77
10.78	54.30	68.80	1.23	84.36	1.94	0.78	0.78
10.84	55.86	70.43	1.22	85.63	1.93	0.78	0.78
10.93	58.71	73.59	1.21	88.75	1.92	0.79	0.79
10.96	60.09	75.12	1.20	90.29	1.91	0.79	0.79
11.03	60.78	75.69	1.20	90.74	1.91	0.79	0.79
11.15	59.66	73.50	1.18	86.45	1.89	0.78	0.78
11.19	58.62	73.03	1.26	91.70	1.96	0.78	0.78
11.23	56.90	71.48	1.34	95.45	2.03	0.78	0.78
11.30	52.14	66.39	1.52	100.77	2.13	0.77	0.77
11.38	44.03	56.72	1.78	101.17	2.24	0.75	0.75
11.43	34.37	45.04	2.29	103.13	2.39	0.72	0.72
11.50	31.95	41.89	2.46	102.90	2.43	0.71	0.71
11.56	26.84	35.49	2.95	104.82	2.54	0.69	0.69
11.64	23.30	30.91	3.43	106.05	2.62	2.33	2.33
11.68	23.14	30.61	3.45	105.73	2.62	2.31	2.31
11.77	23.06	30.32	3.48	105.55	2.62	2.28	2.28
11.81	23.40	30.66	3.44	105.38	2.62	2.31	2.31
11.91	25.13	32.54	3.17	103.14	2.57	0.68	0.68
11.94	25.65	33.13	3.15	104.34	2.57	0.68	0.68
12.01	27.04	34.70	3.03	105.29	2.55	0.69	0.69
12.08	27.47	35.06	2.99	104.81	2.54	0.69	0.69
12.17	28.76	36.52	3.01	110.05	2.55	0.69	0.69
12.21	29.28	37.10	3.02	112.19	2.55	0.70	0.70
12.28	29.80	37.66	3.08	116.16	2.56	0.70	0.70
12.35	31.10	39.13	3.07	119.96	2.56	0.70	0.70
12.41	32.22	40.37	3.03	122.50	2.55	0.71	0.71
12.48	34.20	42.65	3.00	127.81	2.54	0.71	0.71
12.54	35.59	44.23	2.97	131.38	2.54	0.72	0.72
12.62	36.53	45.22	3.02	136.38	2.55	0.72	0.72

:: Strength loss calculation (Robertson (2009) :: (continued)

Depth (ft)	q_t (tsf)	Q_{tn}	K_c	$Q_{tn,cs}$	I_c	$S_{u(liq)}/\sigma'_v$	$S_{u(peak)}/\sigma'_v$
12.67	36.70	45.33	3.07	139.01	2.56	0.72	0.72
12.75	37.48	46.08	3.09	142.62	2.56	0.72	0.72
12.80	37.22	45.68	3.17	144.82	2.57	0.72	0.72
12.88	37.82	46.25	3.25	150.33	2.59	0.72	0.72
12.93	38.17	46.56	3.31	154.27	2.60	0.73	0.73
13.02	38.94	47.24	3.34	157.82	2.60	3.52	3.52
13.07	40.41	48.82	3.25	158.75	2.59	0.73	0.73
13.16	41.79	50.13	3.19	159.72	2.58	0.73	0.73
13.20	41.34	49.50	3.27	161.65	2.59	0.73	0.73
13.26	39.27	47.01	3.51	165.21	2.63	3.48	3.48
13.33	37.89	45.28	3.76	170.34	2.67	3.34	3.34
13.42	36.25	43.24	4.16	179.84	2.72	3.17	3.17
13.47	35.12	41.78	4.28	178.82	2.74	3.05	3.05
13.52	33.48	39.73	4.46	177.12	2.76	2.89	2.89
13.61	32.02	37.85	4.74	179.47	2.79	2.75	2.75
13.65	31.31	36.94	4.90	181.13	2.81	2.68	2.68
13.74	30.02	35.22	5.07	178.52	2.83	2.55	2.55
13.79	31.23	36.45	4.82	175.60	2.80	2.64	2.64
13.86	30.58	35.51	4.89	173.60	2.81	2.57	2.57
13.92	31.14	35.97	4.77	171.47	2.80	2.61	2.61
13.98	33.13	38.03	4.47	169.92	2.76	2.76	2.76
14.05	34.25	39.08	4.31	168.46	2.74	2.84	2.84
14.11	34.85	39.59	4.24	167.77	2.73	2.88	2.88
14.19	35.38	39.97	4.19	167.52	2.73	2.91	2.91
14.25	35.38	39.80	4.20	167.07	2.73	2.90	2.90
14.31	35.30	39.55	4.17	164.88	2.72	2.88	2.88
14.39	34.86	38.84	4.18	162.34	2.72	2.82	2.82
14.45	34.61	38.42	4.23	162.31	2.73	2.79	2.79
14.52	34.78	38.42	4.24	162.76	2.73	2.79	2.79
14.57	34.78	38.28	4.24	162.30	2.73	2.78	2.78
14.64	35.04	38.38	4.16	159.65	2.72	2.79	2.79
14.70	34.43	37.56	4.23	158.79	2.73	2.72	2.72
14.78	33.40	36.27	4.38	159.05	2.75	2.63	2.63
14.86	32.53	35.14	4.48	157.51	2.76	2.54	2.54
14.90	32.27	34.77	4.50	156.47	2.77	2.51	2.51
14.97	31.67	33.94	4.47	151.85	2.76	2.45	2.45
15.03	31.32	33.39	4.36	145.65	2.75	2.41	2.41
15.10	31.50	33.40	4.22	140.98	2.73	2.42	2.42
15.18	31.50	33.24	4.22	140.44	2.73	2.41	2.41
15.24	31.84	33.46	4.19	140.13	2.73	2.42	2.42
15.31	32.88	34.41	4.05	139.25	2.71	2.49	2.49
15.36	33.22	34.66	4.02	139.26	2.70	2.51	2.51
15.44	34.09	35.40	4.00	141.44	2.70	2.56	2.56
15.49	34.52	35.75	3.99	142.49	2.70	2.59	2.59
15.57	34.35	35.38	3.89	137.46	2.68	2.56	2.56
15.63	34.61	35.52	3.84	136.25	2.68	2.57	2.57
15.71	35.30	36.07	3.86	139.38	2.68	2.61	2.61
15.75	35.21	35.89	3.83	137.45	2.68	2.59	2.59

:: Strength loss calculation (Robertson (2009) :: (continued)

Depth (ft)	q_t (tsf)	Q_{tn}	K_c	$Q_{tn,cs}$	I_c	$S_{u(liq)}/\sigma'_v$	$S_{u(peak)}/\sigma'_v$
15.85	34.26	34.75	4.13	143.34	2.72	2.51	2.51
15.89	34.35	34.76	4.17	144.84	2.72	2.51	2.51
15.95	33.79	34.07	4.26	145.09	2.74	2.45	2.45
16.02	33.31	33.43	4.28	143.10	2.74	2.41	2.41
16.11	33.57	33.53	4.27	143.15	2.74	2.41	2.41
16.16	33.40	33.26	4.31	143.43	2.74	2.39	2.39
16.21	33.74	33.48	4.24	141.91	2.73	2.41	2.41
16.28	35.21	34.82	4.00	139.12	2.70	2.51	2.51
16.34	37.02	36.47	3.72	135.64	2.66	2.63	2.63
16.41	46.52	45.69	2.75	125.43	2.50	0.72	0.72
16.48	63.88	62.57	1.92	120.15	2.29	0.76	0.76
16.54	92.29	90.04	1.39	124.88	2.06	0.81	0.81
16.61	135.29	131.42	1.14	149.83	1.84	0.87	0.87
16.67	194.53	188.43	1.05	197.89	1.72	0.92	0.92
16.74	268.10	259.03	1.00	259.03	1.63	0.97	0.97
16.81	278.54	268.59	1.00	268.59	1.59	0.98	0.98
16.88	275.18	264.73	1.00	264.73	1.56	0.97	0.97
16.93	262.32	251.89	1.00	251.89	1.57	0.97	0.97
17.01	268.10	256.82	1.00	256.82	1.52	0.97	0.97
17.06	236.40	225.96	1.00	225.96	1.57	0.95	0.95
17.13	232.17	221.43	1.00	221.43	1.57	0.95	0.95
17.20	231.55	220.38	1.00	220.38	1.53	0.94	0.94
17.28	229.13	217.50	1.00	217.50	1.52	0.94	0.94
17.33	227.83	215.96	1.00	215.96	1.52	0.94	0.94
17.39	211.43	199.93	1.00	199.93	1.55	0.93	0.93
17.45	205.29	193.74	1.00	193.74	1.56	0.92	0.92
17.53	207.02	194.94	1.00	194.94	1.55	0.93	0.93
17.60	208.84	196.26	1.00	196.26	1.53	0.93	0.93
17.68	209.70	196.59	1.00	196.59	1.52	0.93	0.93
17.72	210.56	197.19	1.00	197.19	1.52	0.93	0.93
17.79	211.94	198.10	1.00	198.10	1.51	0.93	0.93
17.85	214.71	200.31	1.00	200.31	1.51	0.93	0.93
17.93	215.57	200.65	1.00	200.65	1.51	0.93	0.93
18.00	214.89	199.59	1.00	199.59	1.52	0.93	0.93
18.05	214.63	199.08	1.00	199.08	1.52	0.93	0.93
18.13	213.85	197.88	1.00	197.88	1.53	0.93	0.93
18.18	214.12	197.84	1.00	197.84	1.55	0.93	0.93
18.26	216.46	199.57	1.00	199.57	1.57	0.93	0.93
18.31	218.97	201.60	1.00	201.60	1.54	0.93	0.93
18.40	227.26	208.74	1.00	208.74	1.52	0.94	0.94
18.45	233.74	214.43	1.00	214.43	1.53	0.94	0.94
18.53	252.06	230.79	1.00	230.79	1.50	0.95	0.95
18.58	268.98	245.97	1.00	245.97	1.45	0.96	0.96
18.64	298.00	272.12	1.00	272.12	1.38	0.98	0.98
18.72	310.43	282.95	1.00	282.95	1.34	0.99	0.99
18.77	306.98	279.34	1.00	279.34	1.33	0.98	0.98
18.84	289.46	262.88	1.00	262.88	1.34	0.97	0.97
18.93	256.21	231.97	1.00	231.97	1.48	0.95	0.95

:: Strength loss calculation (Robertson (2009) :: (continued)

Depth (ft)	q_t (tsf)	Q_{tn}	K_c	$Q_{tn,cs}$	I_c	$S_{u(liq)}/\sigma'_v$	$S_{u(peak)}/\sigma'_v$
18.97	259.49	234.69	1.00	234.69	1.48	0.95	0.95
19.05	263.81	238.10	1.00	238.10	1.44	0.96	0.96
19.11	263.82	237.71	1.00	237.71	1.44	0.96	0.96
19.19	271.77	244.31	1.00	244.31	1.42	0.96	0.96
19.23	268.23	240.84	1.00	240.84	1.44	0.96	0.96
19.30	262.69	235.40	1.00	235.40	1.48	0.96	0.96
19.37	262.86	235.11	1.00	235.11	1.48	0.96	0.96
19.44	256.57	229.05	1.00	229.05	1.49	0.95	0.95
19.51	251.04	223.67	1.00	223.67	1.49	0.95	0.95
19.57	241.37	214.64	1.00	214.64	1.50	0.94	0.94
19.64	232.13	206.03	1.00	206.03	1.52	0.93	0.93
19.70	231.44	205.05	1.00	205.05	1.50	0.93	0.93
19.77	231.44	204.69	1.00	204.69	1.50	0.93	0.93
19.82	230.74	203.79	1.00	203.79	1.47	0.93	0.93
19.90	237.91	209.73	1.00	209.73	1.38	0.94	0.94
19.95	246.37	216.94	1.00	216.94	1.40	0.94	0.94
20.03	269.85	237.20	1.00	237.20	1.42	0.96	0.96
20.09	285.22	250.40	1.00	250.40	1.39	0.97	0.97
20.16	287.37	251.87	1.00	251.87	1.40	0.97	0.97
20.22	296.52	259.48	1.00	259.48	1.39	0.97	0.97
20.31	298.07	260.21	1.00	260.21	1.39	0.97	0.97
20.36	300.58	262.12	1.00	262.12	1.39	0.97	0.97
20.41	304.12	264.85	1.00	264.85	1.39	0.97	0.97
20.49	293.82	255.30	1.00	255.30	1.41	0.97	0.97
20.54	291.92	253.34	1.00	253.34	1.39	0.97	0.97
20.61	291.58	252.55	1.00	252.55	1.37	0.97	0.97
20.67	291.74	252.32	1.00	252.32	1.36	0.97	0.97
20.74	293.21	253.19	1.00	253.19	1.36	0.97	0.97
20.80	297.61	256.56	1.00	256.56	1.35	0.97	0.97
20.89	308.65	265.53	1.00	265.53	1.34	0.97	0.97
20.94	314.18	270.02	1.00	270.02	1.33	0.98	0.98
21.01	328.43	281.79	1.00	281.79	1.35	0.98	0.98
21.07	339.90	291.21	1.00	291.21	1.42	0.99	0.99
21.15	367.10	313.95	1.00	313.95	1.43	1.00	1.00
21.20	393.26	335.98	1.00	335.98	1.45	1.01	1.01
21.26	452.93	386.50	1.00	386.50	1.51	1.04	1.04
21.34	508.28	432.99	1.00	432.99	1.55	1.06	1.06
21.39	563.80	479.67	1.00	479.67	1.47	1.08	1.08
21.47	602.48	511.65	1.00	511.65	1.45	1.09	1.09
21.53	626.57	531.31	1.00	531.31	1.42	1.09	1.09
21.59	623.03	527.46	1.00	527.46	1.42	1.09	1.09
21.67	630.81	532.92	1.00	532.92	1.35	1.09	1.09
21.73	616.64	520.13	1.00	520.13	1.35	1.09	1.09
21.79	598.25	503.82	1.00	503.82	1.38	1.08	1.08
21.87	518.37	435.50	1.00	435.50	1.24	1.06	1.06
21.92	502.05	421.26	1.00	421.26	1.27	1.05	1.05
21.99	475.28	398.04	1.00	398.04	1.32	1.04	1.04
22.05	426.41	356.63	1.00	356.63	1.38	1.02	1.02

:: Strength loss calculation (Robertson (2009) :: (continued)

Depth (ft)	q_t (tsf)	Q_{tn}	K_c	$Q_{tn,cs}$	I_c	$S_{u(liq)}/\sigma'_v$	$S_{u(peak)}/\sigma'_v$
22.14	385.14	321.65	1.00	321.65	1.42	1.01	1.01
22.19	318.74	265.83	1.00	265.83	1.53	0.97	0.97
22.25	284.63	237.06	1.00	237.06	1.60	0.96	0.96
22.32	266.24	221.47	1.00	221.47	1.63	0.95	0.95
22.38	261.57	217.41	1.00	217.41	1.63	0.94	0.94
22.45	256.91	213.33	1.00	213.33	1.64	0.94	0.94
22.52	256.82	213.07	1.00	213.07	1.62	0.94	0.94
22.60	253.11	209.77	1.00	209.77	1.56	0.94	0.94
22.65	253.37	209.84	1.00	209.84	1.51	0.94	0.94
22.73	250.78	207.48	1.00	207.48	1.51	0.94	0.94
22.79	248.45	205.41	1.00	205.41	1.52	0.93	0.93
22.84	247.33	204.35	1.00	204.35	1.53	0.93	0.93
22.91	246.20	203.25	1.00	203.25	1.54	0.93	0.93
22.98	245.30	202.33	1.00	202.33	1.56	0.93	0.93
23.04	240.25	197.99	1.00	197.99	1.59	0.93	0.93
23.10	244.39	201.28	1.00	201.28	1.59	0.93	0.93
23.18	248.97	204.88	1.00	204.88	1.60	0.93	0.93
23.25	253.63	208.55	1.00	208.55	1.61	0.94	0.94
23.32	257.43	211.52	1.00	211.52	1.61	0.94	0.94
23.36	259.93	213.46	1.00	213.46	1.61	0.94	0.94
23.43	264.25	216.85	1.00	216.85	1.61	0.94	0.94
23.50	265.20	217.45	1.00	217.45	1.61	0.94	0.94
23.58	266.15	218.00	1.00	218.00	1.60	0.94	0.94
23.66	263.82	215.88	1.00	215.88	1.60	0.94	0.94
23.69	260.80	213.31	1.00	213.31	1.60	0.94	0.94
23.77	257.95	210.78	1.00	210.78	1.60	0.94	0.94
23.83	259.67	212.02	1.00	212.02	1.58	0.94	0.94
23.90	271.76	221.77	1.00	221.77	1.54	0.95	0.95
23.98	293.18	239.11	1.00	239.11	1.48	0.96	0.96
24.03	308.98	251.92	1.00	251.92	1.45	0.97	0.97
24.11	342.74	279.31	1.00	279.31	1.37	0.98	0.98
24.16	358.20	291.79	1.00	291.79	1.34	0.99	0.99
24.23	384.96	313.43	1.00	313.43	1.31	1.00	1.00
24.30	402.15	327.18	1.00	327.18	1.33	1.01	1.01
24.38	418.81	340.45	1.00	340.45	1.28	1.02	1.02
24.41	429.00	348.65	1.00	348.65	1.24	1.02	1.02
24.48	446.10	362.31	1.00	362.31	1.11	1.03	1.03
24.56	455.86	369.93	1.00	369.93	1.10	1.03	1.03
24.62	462.25	374.89	1.00	374.89	1.11	1.03	1.03
24.68	472.09	382.60	1.00	382.60	1.11	1.04	1.04
24.75	461.30	373.53	1.00	373.53	1.14	1.03	1.03
24.81	433.92	351.04	1.00	351.04	1.19	1.02	1.02
24.88	437.46	353.63	1.00	353.63	1.19	1.02	1.02
24.95	437.03	353.02	1.00	353.02	1.19	1.02	1.02
25.01	437.98	353.52	1.00	353.52	1.20	1.02	1.02
25.08	439.97	354.85	1.00	354.85	1.21	1.02	1.02
25.15	442.56	356.67	1.00	356.67	1.20	1.02	1.02
25.22	435.48	350.66	1.00	350.66	1.22	1.02	1.02

:: Strength loss calculation (Robertson (2009) :: (continued)

Depth (ft)	q_t (tsf)	Q_{tn}	K_c	$Q_{tn,cs}$	I_c	$S_{u(liq)}/\sigma'_v$	$S_{u(peak)}/\sigma'_v$
25.27	431.16	346.98	1.00	346.98	1.22	1.02	1.02
25.34	427.79	343.95	1.00	343.95	1.22	1.02	1.02
25.40	428.40	344.21	1.00	344.21	1.21	1.02	1.02
25.48	432.02	346.82	1.00	346.82	1.21	1.02	1.02
25.53	435.48	349.39	1.00	349.39	1.20	1.02	1.02
25.60	433.15	347.26	1.00	347.26	1.22	1.02	1.02
25.67	433.32	347.12	1.00	347.12	1.21	1.02	1.02
25.73	436.69	349.59	1.00	349.59	1.21	1.02	1.02
25.80	439.88	351.88	1.00	351.88	1.22	1.02	1.02
25.86	442.30	353.55	1.00	353.55	1.26	1.02	1.02
25.94	449.47	358.97	1.00	358.97	1.29	1.02	1.02
26.00	449.21	358.50	1.00	358.50	1.31	1.02	1.02
26.07	449.21	358.21	1.00	358.21	1.26	1.02	1.02
26.12	448.95	357.82	1.00	357.82	1.20	1.02	1.02
26.21	452.75	360.49	1.00	360.49	1.20	1.03	1.03
26.25	454.99	362.11	1.00	362.11	1.21	1.03	1.03
26.34	421.23	334.79	1.00	334.79	1.27	1.01	1.01
26.39	411.31	326.70	1.00	326.70	1.29	1.01	1.01
26.46	411.74	326.76	1.00	326.76	1.28	1.01	1.01
26.52	411.74	326.56	1.00	326.56	1.27	1.01	1.01
26.60	412.17	326.58	1.00	326.58	1.27	1.01	1.01
26.65	425.21	336.78	1.00	336.78	1.25	1.01	1.01
26.71	436.70	345.69	1.00	345.69	1.24	1.02	1.02
26.78	444.21	351.36	1.00	351.36	1.24	1.02	1.02
26.86	452.50	357.61	1.00	357.61	1.21	1.02	1.02
26.91	457.68	361.51	1.00	361.51	1.21	1.03	1.03
26.97	459.06	362.39	1.00	362.39	1.24	1.03	1.03
27.04	467.52	368.80	1.00	368.80	1.25	1.03	1.03
27.14	482.03	379.86	1.00	379.86	1.22	1.03	1.03
27.17	482.46	380.07	1.00	380.07	1.21	1.03	1.03
27.25	477.54	375.82	1.00	375.82	1.22	1.03	1.03
27.31	472.36	371.48	1.00	371.48	1.21	1.03	1.03
27.36	450.94	354.36	1.00	354.36	1.22	1.02	1.02
27.44	449.56	352.96	1.00	352.96	1.20	1.02	1.02
27.50	450.99	353.87	1.00	353.87	1.20	1.02	1.02
27.59	451.72	354.11	1.00	354.11	1.20	1.02	1.02
27.63	451.03	353.38	1.00	353.38	1.21	1.02	1.02
27.69	447.84	350.66	1.00	350.66	1.22	1.02	1.02
27.77	447.75	350.30	1.00	350.30	1.21	1.02	1.02
27.85	445.59	348.28	1.00	348.28	1.20	1.02	1.02
27.91	449.30	350.98	1.00	350.98	1.19	1.02	1.02
27.95	449.39	350.87	1.00	350.87	1.17	1.02	1.02
28.02	449.56	350.77	1.00	350.77	1.11	1.02	1.02
28.10	452.93	353.11	1.00	353.11	1.12	1.02	1.02
28.17	462.77	360.53	1.00	360.53	1.14	1.03	1.03
28.22	468.82	365.09	1.00	365.09	1.17	1.03	1.03
28.28	482.81	375.74	1.00	375.74	1.19	1.03	1.03
28.36	470.89	366.12	1.00	366.12	1.19	1.03	1.03

:: Strength loss calculation (Robertson (2009) :: (continued)

Depth (ft)	q_t (tsf)	Q_{tn}	K_c	$Q_{tn,cs}$	I_c	$S_{u(liq)}/\sigma'_v$	$S_{u(peak)}/\sigma'_v$
28.42	503.18	391.06	1.00	391.06	1.14	1.04	1.04
28.50	517.17	401.65	1.00	401.65	1.15	1.04	1.04
28.55	515.79	400.35	1.00	400.35	1.16	1.04	1.04
28.61	521.40	404.42	1.00	404.42	1.13	1.05	1.05
28.69	518.90	402.13	1.00	402.13	1.16	1.04	1.04
28.76	528.74	409.48	1.00	409.48	1.18	1.05	1.05
28.81	527.02	407.92	1.00	407.92	1.19	1.05	1.05
28.87	512.51	396.37	1.00	396.37	1.22	1.04	1.04
28.94	493.77	381.55	1.00	381.55	1.24	1.04	1.04
29.01	476.68	368.02	1.00	368.02	1.26	1.03	1.03
29.08	457.77	353.09	1.00	353.09	1.32	1.02	1.02
29.14	456.38	351.78	1.00	351.78	1.33	1.02	1.02
29.21	446.02	343.47	1.00	343.47	1.31	1.02	1.02
29.27	451.20	347.26	1.00	347.26	1.29	1.02	1.02
29.34	449.04	345.32	1.00	345.32	1.29	1.02	1.02
29.41	446.37	343.02	1.00	343.02	1.29	1.02	1.02
29.48	440.76	338.43	1.00	338.43	1.30	1.01	1.01
29.53	435.66	334.29	1.00	334.29	1.30	1.01	1.01
29.61	435.66	334.03	1.00	334.03	1.23	1.01	1.01
29.66	436.44	334.45	1.00	334.45	1.16	1.01	1.01
29.73	436.44	334.24	1.00	334.24	1.11	1.01	1.01
29.81	430.65	329.51	1.00	329.51	1.15	1.01	1.01
29.88	424.26	324.37	1.00	324.37	1.21	1.01	1.01
29.93	410.01	313.26	1.00	313.26	1.25	1.00	1.00
30.00	299.84	228.54	1.00	228.54	1.49	0.95	0.95
30.07	372.89	284.33	1.00	284.33	1.40	0.99	0.99
30.13	369.60	281.64	1.00	281.64	1.43	0.98	0.98
30.20	372.46	283.62	1.00	283.62	1.46	0.99	0.99
30.27	372.03	283.07	1.00	283.07	1.49	0.99	0.99
30.32	384.29	292.28	1.00	292.28	1.48	0.99	0.99
30.40	402.51	305.94	1.00	305.94	1.48	1.00	1.00
30.45	425.91	323.63	1.00	323.63	1.48	1.01	1.01
30.53	479.28	364.03	1.00	364.03	1.40	1.03	1.03
30.58	521.76	396.20	1.00	396.20	1.25	1.04	1.04
30.64	572.10	434.28	1.00	434.28	1.07	1.06	1.06
30.71	634.62	481.53	1.00	481.53	1.10	1.08	1.08
30.80	672.35	509.77	1.00	509.77	1.06	1.09	1.09
30.84	688.06	521.47	1.00	521.47	1.08	1.09	1.09
30.92	671.66	508.59	1.00	508.59	1.17	1.09	1.09
30.98	668.38	505.77	1.00	505.77	1.16	1.09	1.09
31.07	668.81	505.62	1.00	505.62	1.02	1.09	1.09
31.11	669.24	505.70	1.00	505.70	1.03	1.09	1.09
31.18	674.08	509.00	1.00	509.00	1.05	1.09	1.09
31.24	690.21	520.87	1.00	520.87	1.06	1.09	1.09
31.32	724.84	546.64	1.00	546.64	1.03	1.10	1.10
31.37	671.73	506.21	1.00	506.21	1.09	1.09	1.09
31.44	680.28	512.26	1.00	512.26	1.13	1.09	1.09
31.50	684.51	515.13	1.00	515.13	1.12	1.09	1.09

:: Strength loss calculation (Robertson (2009) :: (continued)

Depth (ft)	q_t (tsf)	Q_{tn}	K_c	$Q_{tn,cs}$	I_c	$S_{u(liq)}/\sigma'_v$	$S_{u(peak)}/\sigma'_v$
31.56	666.39	501.13	1.00	501.13	1.03	1.08	1.08
31.65	682.88	513.07	1.00	513.07	1.02	1.09	1.09
31.70	636.34	477.78	1.00	477.78	1.10	1.08	1.08
31.79	681.24	-1.00	1.00	-1.00	-1.00	N/A	N/A
31.83	688.67	-1.00	1.00	-1.00	-1.00	N/A	N/A
31.89	658.02	-1.00	1.00	-1.00	-1.00	N/A	N/A
31.96	730.98	-1.00	1.00	-1.00	-1.00	N/A	N/A
32.03	796.26	-1.00	1.00	-1.00	-1.00	N/A	N/A
32.09	852.30	-1.00	1.00	-1.00	-1.00	N/A	N/A

Abbreviations

q_t: Total cone resistance
K_c: Cone resistance correction factor due to fines
$Q_{tn,cs}$: Adjusted and corrected cone resistance due to fines
I_c: Soil behavior type index
$S_{u(liq)}/\sigma'_v$: Calculated liquefied undrained strength ratio
$S_{u(peak)}/\sigma'_v$: Calculated peak undrained strength ratio

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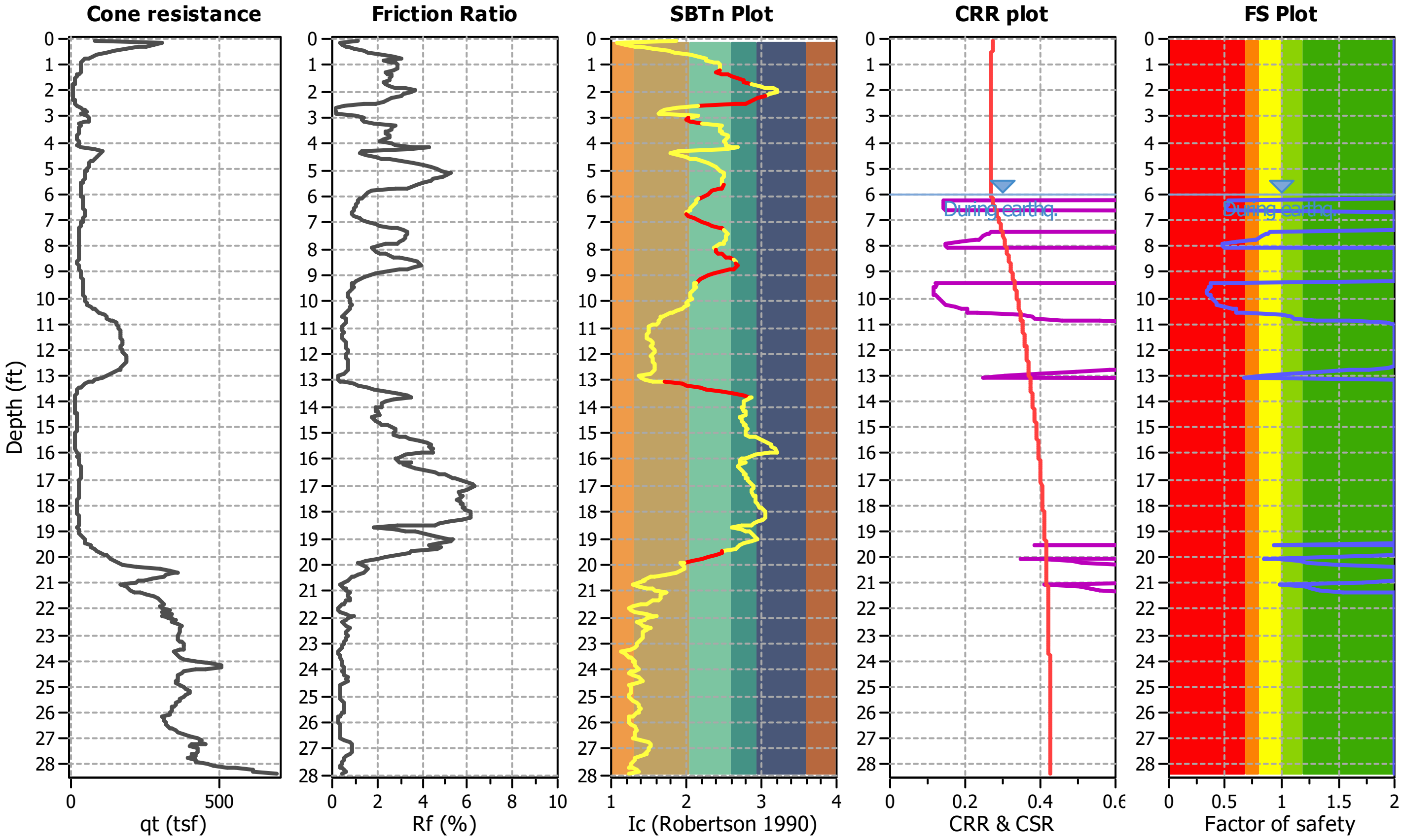
LIQUEFACTION ANALYSIS REPORT

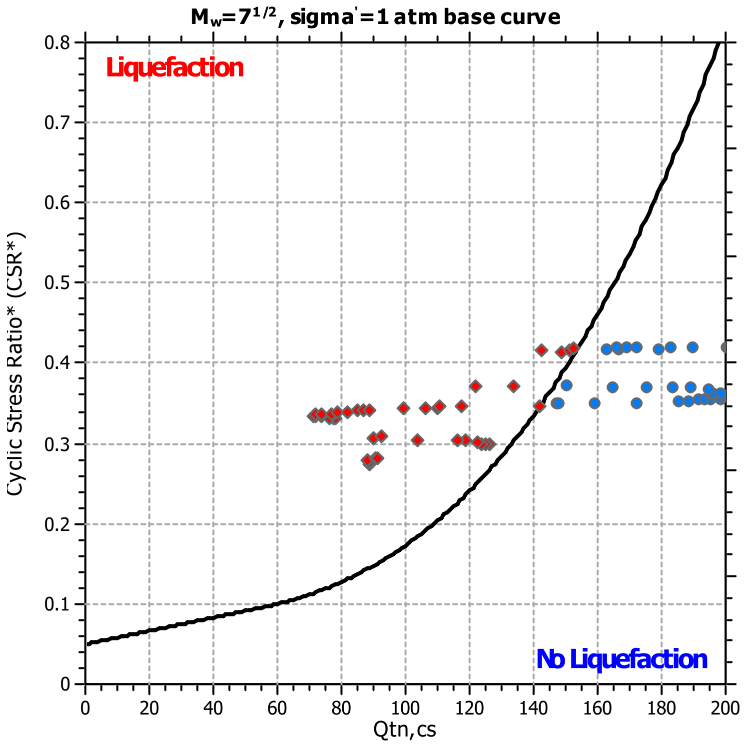
Project title : Twining Consulting **Location : 4112 Del Rey Ave, Marina Del Rey, CA**

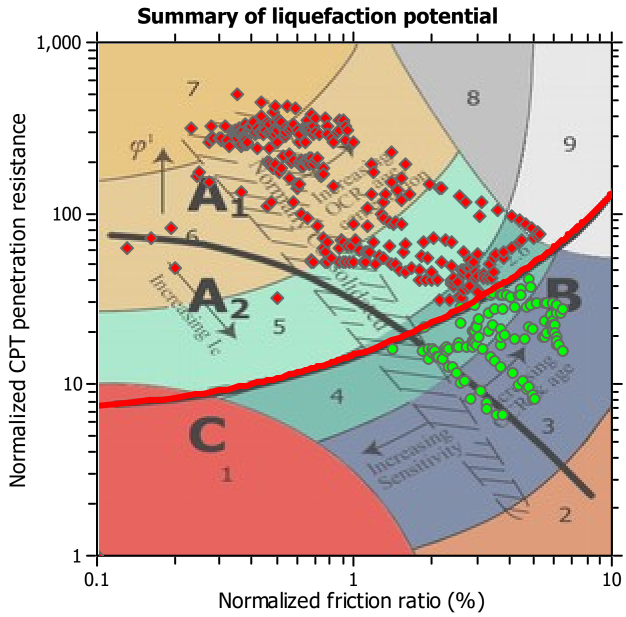
CPT file : CPT-3

Input parameters and analysis data

Analysis method:	NCEER (1998)	G.W.T. (in-situ):	22.00 ft	Use fill:	No	Clay like behavior applied:	Sands only
Fines correction method:	NCEER (1998)	G.W.T. (earthq.):	6.00 ft	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	1	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	6.35	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.58	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

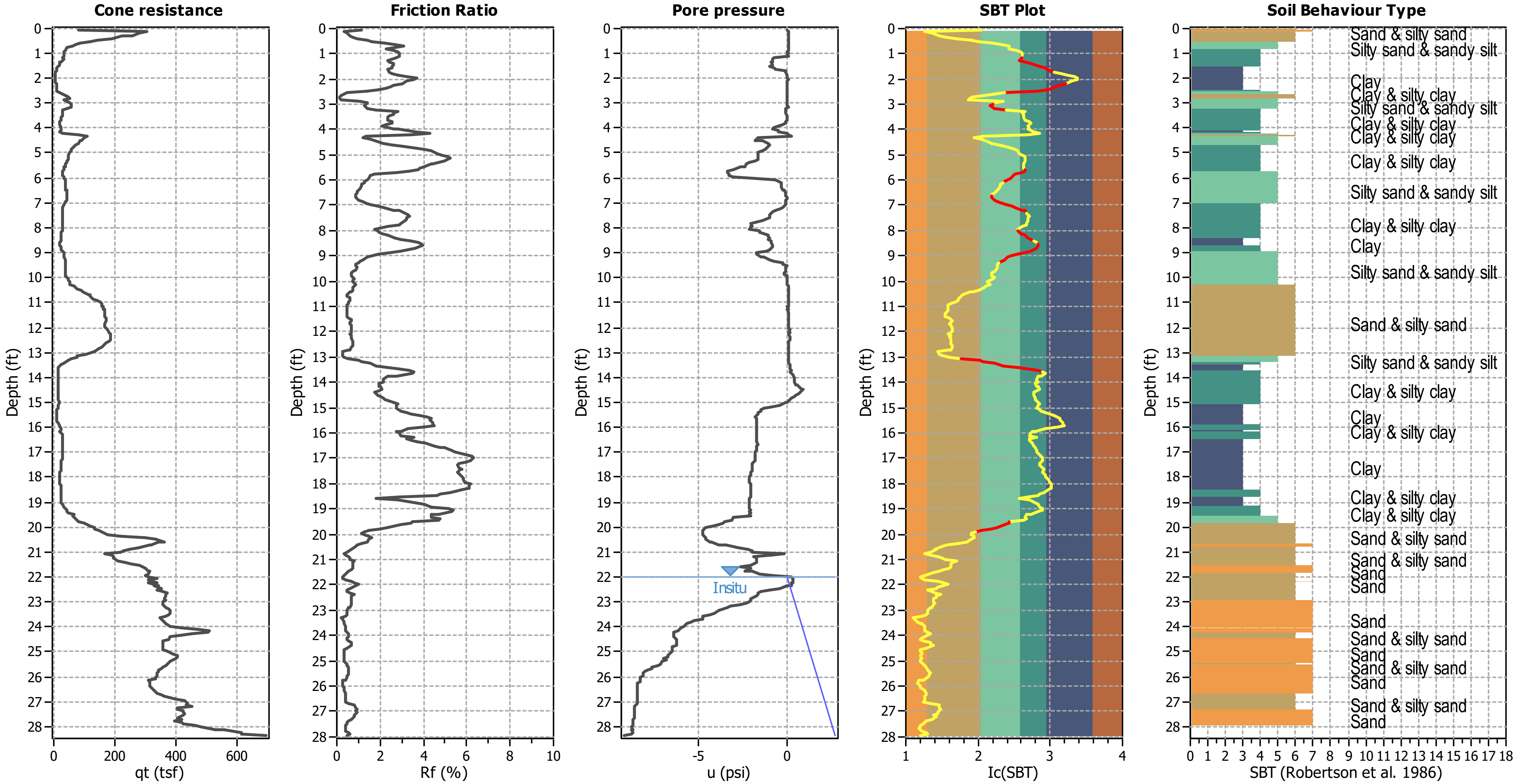






Zone A_1: Cyclic liquefaction likely depending on size and duration of cyclic loading
Zone A_2: Cyclic liquefaction and strength loss likely depending on loading and ground geometry
Zone B: Liquefaction and post-earthquake strength loss unlikely, check cyclic softening
Zone C: Cyclic liquefaction and strength loss possible depending on soil plasticity, brittleness/sensitivity, strain to peak undrained strength and ground geometry

CPT basic interpretation plots



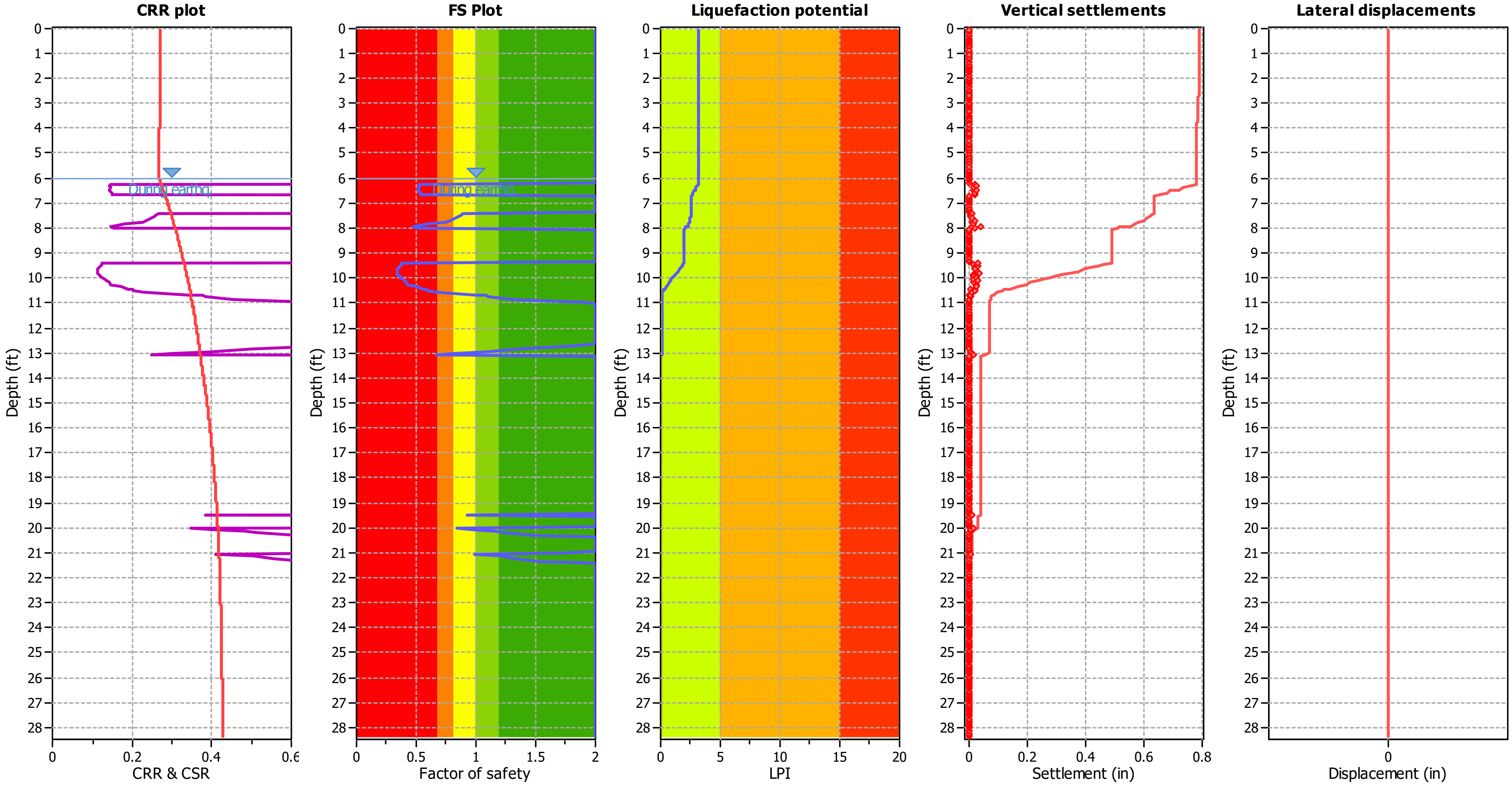
Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	6.00 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	1	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	6.35	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.58	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	22.00 ft	Fill height:	N/A	Limit depth:	N/A

SBT legend

1. Sensitive fine grained
2. Organic material
3. Clay to silty clay
4. Clayey silt to silty
5. Silty sand to sandy silt
6. Clean sand to silty sand
7. Gravely sand to sand
8. Very stiff sand to
9. Very stiff fine grained

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	6.00 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	1	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	6.35	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.58	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	22.00 ft	Fill height:	N/A	Limit depth:	N/A

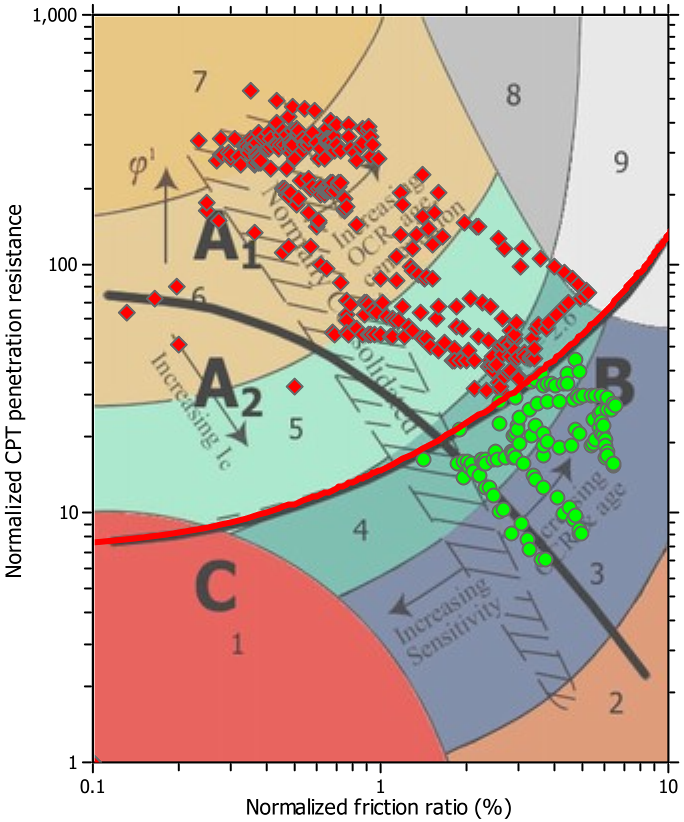
F.S. color scheme

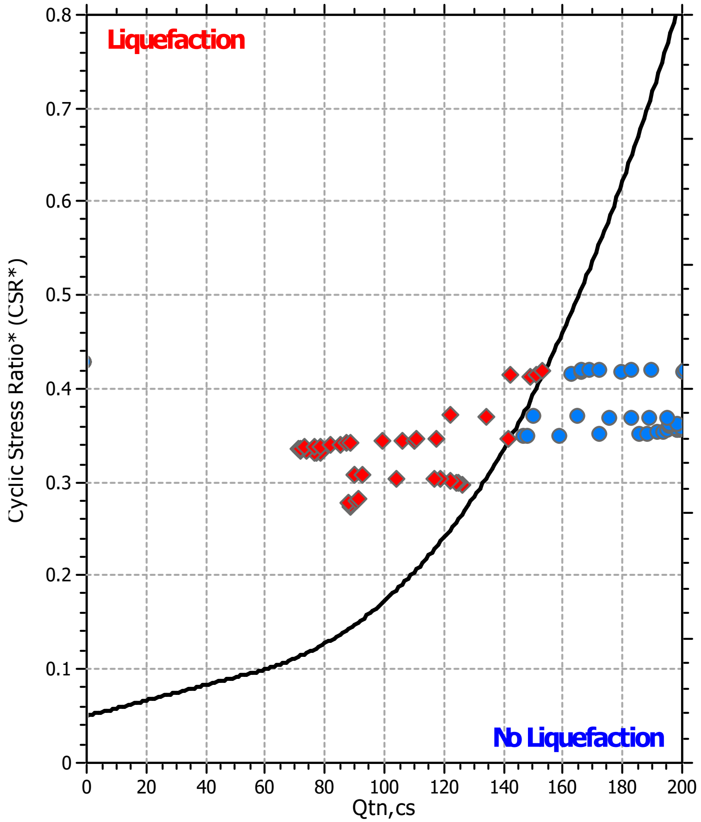
- Almost certain it will liquefy
- Very likely to liquefy
- Liquefaction and no liq. are equally likely
- Unlike to liquefy
- Almost certain it will not liquefy

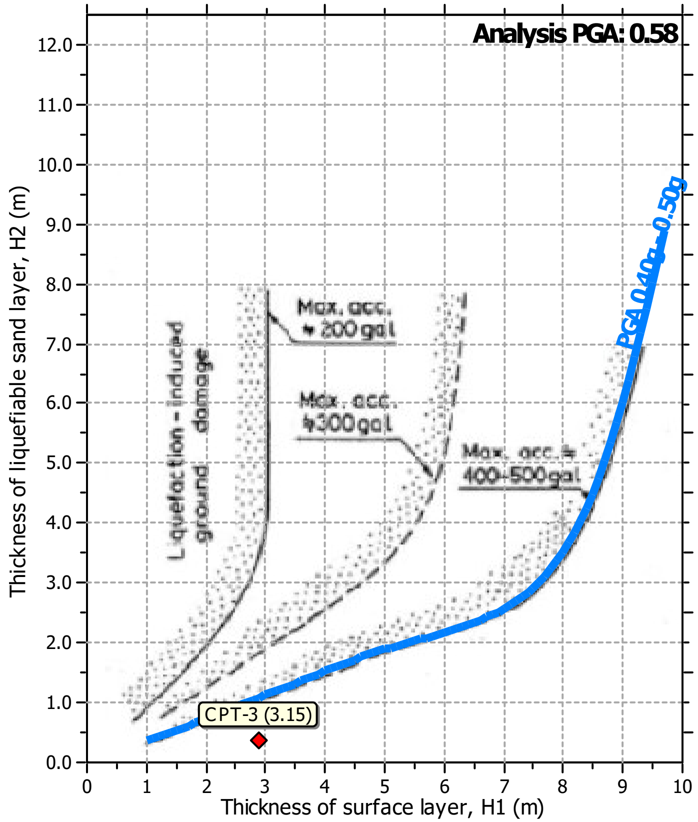
LPI color scheme

- Very high risk
- High risk
- Low risk

Liquefaction analysis summary plots







Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	6.00 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	1	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	6.35	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.58	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	22.00 ft	Fill height:	N/A	Limit depth:	N/A

:: Field input data ::

Point ID	Depth (ft)	q_c (tsf)	f_s (tsf)	u (tsf)	Fines content (%)	Unit weight (pcf)
1	0.07	80.93	0.95	0.00	9.68	120.58
2	0.15	306.43	1.08	0.09	0.00	124.77
3	0.20	281.13	1.23	0.09	0.00	125.53
4	0.28	255.30	1.50	0.09	0.51	126.78
5	0.34	225.77	1.59	0.09	1.57	126.90
6	0.40	188.37	1.78	0.09	3.59	127.26
7	0.47	143.20	2.00	0.09	7.26	127.46
8	0.53	121.00	1.92	0.09	9.18	126.75
9	0.59	87.40	1.92	0.09	14.24	125.94
10	0.66	72.29	1.95	0.09	17.93	125.59
11	0.72	60.37	1.86	0.09	21.18	124.81
12	0.79	43.44	0.98	0.09	21.20	119.33
13	0.87	37.40	0.98	0.09	24.69	118.99
14	0.93	33.42	0.94	0.00	26.95	118.40
15	0.98	31.09	0.90	0.09	28.29	117.92
16	1.07	32.22	0.94	0.04	27.84	118.28
17	1.12	31.01	0.90	0.09	28.31	117.88
18	1.19	30.32	0.83	-0.69	27.94	117.26
19	1.25	30.66	0.73	-0.78	26.02	116.30
20	1.33	24.70	0.60	-0.78	29.28	114.36
21	1.38	20.30	0.53	-0.87	33.18	112.98
22	1.45	17.36	0.45	-0.78	35.69	111.44
23	1.51	14.25	0.37	-0.95	38.95	109.41
24	1.59	10.97	0.28	-0.69	43.59	106.69
25	1.64	9.93	0.23	-0.61	44.44	105.12
26	1.73	7.86	0.19	-0.09	49.90	103.08
27	1.78	6.39	0.17	-0.09	55.90	101.61
28	1.86	5.18	0.14	0.00	62.56	100.15
29	1.90	4.49	0.14	0.00	68.98	99.81
30	1.98	4.15	0.15	0.00	73.64	99.96
31	2.05	4.15	0.15	0.09	72.94	99.68
32	2.11	4.92	0.16	0.00	66.35	100.62
33	2.19	5.70	0.17	0.00	61.57	101.69
34	2.23	6.56	0.17	0.00	55.70	102.01
35	2.32	7.34	0.18	0.00	52.02	102.61
36	2.37	7.95	0.18	0.00	49.13	102.86
37	2.44	8.72	0.17	0.00	44.69	102.48
38	2.50	10.19	0.14	0.00	37.68	101.72
39	2.57	20.21	0.10	0.00	5.00	100.77
40	2.63	29.62	0.06	0.00	5.00	97.80
41	2.70	39.73	0.05	0.00	5.00	97.59
42	2.76	45.17	0.07	0.00	5.00	100.45
43	2.83	50.61	0.10	0.00	5.00	102.88
44	2.89	32.13	0.34	0.00	17.66	110.93
45	2.97	54.15	0.77	0.00	14.58	118.11
46	3.02	56.14	0.76	0.00	13.87	118.12
47	3.09	59.08	0.76	0.00	13.01	118.25
48	3.15	55.45	0.79	0.09	14.40	118.37

:: Field input data :: (continued)

Point ID	Depth (ft)	q_c (tsf)	f_s (tsf)	u (tsf)	Fines content (%)	Unit weight (pcf)
49	3.22	42.41	0.78	-0.03	19.40	117.59
50	3.28	26.86	0.75	-0.03	29.94	116.20
51	3.36	29.02	0.75	-0.09	27.88	116.39
52	3.42	27.38	0.72	-0.09	28.82	115.90
53	3.49	26.43	0.64	0.00	28.42	115.02
54	3.55	24.70	0.59	0.00	29.11	114.19
55	3.62	24.18	0.57	0.00	29.32	113.92
56	3.70	20.90	0.53	0.00	32.58	113.10
57	3.75	19.69	0.51	-0.09	33.61	112.56
58	3.81	19.69	0.45	-0.09	32.22	111.77
59	3.87	19.86	0.42	-0.26	30.99	111.20
60	3.96	22.37	0.59	-0.69	32.00	114.02
61	4.01	23.58	0.66	-0.78	31.89	114.92
62	4.10	22.80	0.82	-0.52	36.00	116.48
63	4.14	20.73	0.89	-0.52	40.21	116.82
64	4.22	28.59	0.98	0.00	31.77	118.28
65	4.27	81.45	1.08	0.09	10.57	121.55
66	4.34	108.13	1.28	0.26	7.85	123.52
67	4.40	99.76	1.52	-1.65	10.19	124.57
68	4.49	92.16	1.78	-1.82	12.73	125.54
69	4.53	87.66	1.89	-1.39	14.08	125.83
70	4.60	79.46	2.05	-1.04	16.67	126.18
71	4.67	72.46	2.24	-0.95	19.51	126.62
72	4.73	65.64	2.36	-1.04	22.25	126.74
73	4.80	60.98	2.46	-1.13	24.49	126.87
74	4.87	57.78	2.52	-1.21	26.17	126.94
75	4.94	54.84	2.53	-1.39	27.54	126.83
76	4.99	51.99	2.52	-1.65	28.87	126.67
77	5.07	48.97	2.51	-1.65	30.42	126.49
78	5.12	47.68	2.50	-1.65	31.09	126.39
79	5.20	46.73	2.38	-1.65	30.94	126.00
80	5.25	45.26	2.24	-1.65	30.90	125.47
81	5.34	44.22	1.96	-1.82	29.61	124.45
82	5.38	42.49	1.85	-2.17	29.84	123.91
83	5.46	39.64	1.60	-2.34	29.67	122.69
84	5.53	36.88	1.40	-2.43	29.77	121.53
85	5.58	34.37	1.29	-2.60	30.53	120.74
86	5.66	31.78	1.06	-3.03	30.06	119.14
87	5.72	29.88	0.83	-3.38	28.53	117.20
88	5.78	29.11	0.52	-3.38	23.68	113.64
89	5.84	28.42	0.44	-3.29	22.69	112.47
90	5.93	29.54	0.44	-3.29	21.66	112.45
91	5.97	31.70	0.44	-3.03	20.18	112.67
92	6.05	34.29	0.44	-1.85	18.53	112.86
93	6.11	35.32	0.44	-0.61	17.93	112.94
94	6.18	37.57	0.43	-0.35	16.54	112.93
95	6.24	37.40	0.42	-0.35	16.38	112.68
96	6.32	37.66	0.41	-0.35	16.18	112.64

:: Field input data :: (continued)

Point ID	Depth (ft)	q_c (tsf)	f_s (tsf)	u (tsf)	Fines content (%)	Unit weight (pcf)
97	6.38	38.87	0.40	-0.35	15.41	112.54
98	6.46	39.99	0.38	-0.26	14.54	112.26
99	6.50	40.68	0.38	-0.17	14.17	112.22
100	6.58	43.18	0.39	-0.09	13.27	112.50
101	6.64	43.96	0.39	-0.09	12.97	112.54
102	6.70	44.05	0.39	-0.09	13.03	112.64
103	6.77	43.88	0.44	0.00	13.96	113.52
104	6.85	42.32	0.50	0.00	15.59	114.36
105	6.91	40.16	0.55	-0.09	17.29	114.85
106	6.96	37.66	0.58	-0.09	19.13	115.13
107	7.05	34.63	0.66	-0.09	22.26	115.88
108	7.09	32.47	0.70	-0.09	24.37	116.12
109	7.18	29.80	0.78	-0.26	27.92	116.77
110	7.23	28.50	0.82	-0.43	29.74	117.02
111	7.30	27.64	0.86	-0.61	31.24	117.30
112	7.36	26.95	0.89	-0.78	32.43	117.49
113	7.45	26.26	0.88	-0.87	33.04	117.34
114	7.50	26.86	0.87	-0.95	32.20	117.30
115	7.55	26.43	0.86	-0.95	32.43	117.14
116	7.61	26.77	0.84	-0.95	31.75	117.00
117	7.72	26.95	0.79	-1.39	30.86	116.62
118	7.76	26.43	0.77	-1.73	30.91	116.30
119	7.81	26.00	0.61	-2.08	28.52	114.60
120	7.94	25.95	0.46	-1.99	25.23	112.45
121	7.97	25.95	0.46	-2.08	25.30	112.50
122	8.03	25.91	0.48	-2.08	25.91	112.88
123	8.07	25.91	0.50	-2.17	26.36	113.17
124	8.14	25.82	0.54	-1.56	27.21	113.66
125	8.20	24.57	0.58	-1.56	29.51	114.14
126	8.28	23.23	0.63	-1.04	32.06	114.56
127	8.34	22.28	0.66	-1.04	33.92	114.81
128	8.40	21.51	0.73	-0.95	36.38	115.44
129	8.47	20.99	0.78	-1.04	38.24	115.91
130	8.53	20.99	0.81	-0.87	38.73	116.15
131	8.60	20.56	0.82	-0.87	39.61	116.19
132	8.68	20.73	0.75	-0.78	38.01	115.57
133	8.74	21.16	0.70	-0.78	36.30	115.09
134	8.80	22.54	0.67	-0.87	33.75	114.92
135	8.88	25.05	0.62	-0.95	29.71	114.59
136	8.94	28.50	0.56	-1.13	25.23	114.21
137	9.01	30.66	0.51	-1.73	22.40	113.63
138	9.07	32.30	0.46	-1.73	20.50	113.05
139	9.14	33.34	0.40	-1.47	18.80	112.10
140	9.19	34.12	0.37	-1.30	17.79	111.57
141	9.27	35.24	0.35	-0.95	16.83	111.21
142	9.33	35.67	0.32	-0.69	16.07	110.61
143	9.41	35.76	0.32	-0.26	16.18	110.72
144	9.46	35.84	0.33	-0.26	16.43	110.99

:: Field input data :: (continued)

Point ID	Depth (ft)	q_c (tsf)	f_s (tsf)	u (tsf)	Fines content (%)	Unit weight (pcf)
145	9.54	36.19	0.31	0.00	15.82	110.47
146	9.60	36.71	0.28	-0.09	14.89	109.68
147	9.65	37.31	0.25	-0.09	14.06	108.99
148	9.72	37.31	0.25	-0.09	14.09	108.96
149	9.82	37.40	0.25	-0.17	14.21	109.09
150	9.86	36.79	0.28	-0.17	15.14	109.82
151	9.91	38.87	0.31	0.00	14.94	110.72
152	9.99	42.58	0.32	0.00	13.68	111.12
153	10.04	46.03	0.35	0.00	12.93	111.83
154	10.13	45.69	0.40	0.00	13.94	112.80
155	10.18	50.27	0.39	0.00	12.42	112.94
156	10.26	52.94	0.40	0.00	11.82	113.23
157	10.35	64.52	0.46	0.09	9.93	114.78
158	10.43	73.50	0.48	0.09	8.46	115.32
159	10.45	77.99	0.48	0.09	7.79	115.53
160	10.53	88.53	0.40	0.09	5.00	114.56
161	10.57	94.49	0.45	0.09	5.00	115.49
162	10.67	113.75	0.68	0.09	5.30	118.96
163	10.71	119.71	0.72	0.09	5.07	119.55
164	10.77	120.92	0.73	0.09	5.06	119.70
165	10.84	129.90	0.73	0.09	4.31	119.81
166	10.89	141.21	0.72	0.09	3.48	119.95
167	10.96	152.35	0.73	0.09	2.87	120.23
168	11.04	155.20	0.73	0.09	2.73	120.29
169	11.13	158.83	0.76	0.09	2.68	120.59
170	11.17	160.39	0.78	0.00	2.74	120.87
171	11.26	162.55	0.77	0.09	2.57	120.75
172	11.29	165.57	0.76	0.00	2.40	120.76
173	11.38	166.86	0.76	0.09	2.36	120.78
174	11.44	166.69	0.94	0.09	3.18	122.31
175	11.52	167.81	1.07	0.09	3.69	123.29
176	11.57	167.04	1.09	0.09	3.79	123.36
177	11.63	169.37	1.07	0.09	3.61	123.28
178	11.69	173.08	1.07	0.09	3.41	123.31
179	11.75	172.39	1.11	0.09	3.62	123.58
180	11.84	167.55	1.12	0.09	3.99	123.62
181	11.89	167.90	1.12	0.09	3.98	123.63
182	11.95	168.50	1.11	0.09	3.91	123.55
183	12.01	170.84	1.09	0.09	3.71	123.46
184	12.07	174.81	1.00	0.17	3.15	122.89
185	12.17	179.56	1.18	0.09	3.61	124.14
186	12.23	183.27	1.22	0.17	3.57	124.41
187	12.29	185.00	1.25	0.09	3.62	124.64
188	12.38	184.40	1.33	0.17	3.94	125.06
189	12.43	186.56	1.32	0.17	3.83	125.07
190	12.47	183.71	1.31	0.17	3.94	124.96
191	12.55	180.68	1.28	0.09	4.00	124.74
192	12.62	172.48	1.18	0.09	4.11	124.05

:: Field input data :: (continued)

Point ID	Depth (ft)	q_c (tsf)	f_s (tsf)	u (tsf)	Fines content (%)	Unit weight (pcf)
193	12.69	168.16	1.04	0.09	3.78	123.03
194	12.74	163.15	0.84	0.09	3.21	121.43
195	12.80	156.76	0.39	0.09	1.20	115.73
196	12.87	147.34	0.36	0.09	1.46	115.01
197	12.94	134.91	0.37	0.09	2.16	114.91
198	13.00	120.57	0.44	0.09	3.63	115.90
199	13.08	104.33	0.59	0.09	6.33	117.80
200	13.14	76.35	0.75	0.09	11.74	118.76
201	13.19	74.45	0.83	0.09	12.85	119.44
202	13.26	57.52	0.90	0.09	18.04	119.35
203	13.33	47.50	0.86	0.09	21.60	118.56
204	13.42	31.78	0.75	0.09	29.96	116.64
205	13.47	24.36	0.70	0.17	36.68	115.48
206	13.54	18.66	0.62	0.17	43.64	113.93
207	13.61	15.63	0.55	0.17	48.22	112.63
208	13.65	14.34	0.50	0.17	50.01	111.72
209	13.74	14.16	0.39	0.26	46.68	109.81
210	13.78	14.16	0.33	0.17	44.58	108.70
211	13.87	13.91	0.30	0.35	43.84	107.86
212	13.92	13.82	0.30	0.35	44.09	107.83
213	13.98	13.73	0.30	0.43	44.35	107.78
214	14.05	13.73	0.27	0.43	43.08	107.03
215	14.14	13.39	0.26	0.43	43.49	106.64
216	14.19	12.87	0.26	0.43	44.91	106.54
217	14.28	12.52	0.26	0.52	46.14	106.54
218	14.32	13.04	0.26	0.61	44.72	106.63
219	14.41	14.16	0.25	0.78	41.58	106.58
220	14.47	14.42	0.26	0.87	41.76	107.05
221	14.50	14.51	0.28	0.95	42.19	107.41
222	14.60	14.68	0.31	0.78	43.46	108.30
223	14.65	14.86	0.33	0.69	43.67	108.64
224	14.72	14.94	0.36	0.52	45.11	109.46
225	14.77	15.11	0.39	0.43	45.87	110.05
226	14.84	15.29	0.43	0.26	46.91	110.76
227	14.90	15.81	0.44	0.17	46.02	110.97
228	14.99	16.24	0.44	0.00	45.33	111.11
229	15.03	16.15	0.44	-0.09	45.57	111.09
230	15.13	14.77	0.44	-0.43	48.90	110.82
231	15.18	13.30	0.43	-0.78	52.58	110.34
232	15.22	11.92	0.41	-1.30	56.62	109.81
233	15.30	10.97	0.42	-1.47	60.79	109.74
234	15.36	10.10	0.42	-1.47	64.82	109.56
235	15.43	9.50	0.41	-1.65	67.63	109.28
236	15.49	9.24	0.40	-1.65	68.28	108.90
237	15.58	8.55	0.38	-1.82	71.68	108.42
238	15.63	8.29	0.36	-1.73	72.57	108.05
239	15.71	8.29	0.37	-1.73	73.04	108.16
240	15.76	9.85	0.39	-1.73	65.30	108.93

:: Field input data :: (continued)

Point ID	Depth (ft)	q_c (tsf)	f_s (tsf)	u (tsf)	Fines content (%)	Unit weight (pcf)
241	15.84	13.21	0.43	-1.73	54.02	110.39
242	15.94	18.48	0.54	-1.73	44.82	112.87
243	15.95	19.78	0.55	-1.73	42.71	113.17
244	16.03	21.59	0.62	-1.73	41.53	114.26
245	16.12	23.49	0.69	-1.73	40.41	115.29
246	16.15	20.38	0.72	-1.73	46.01	115.24
247	16.21	25.13	0.80	-1.73	40.39	116.53
248	16.29	26.77	0.91	-1.73	40.30	117.63
249	16.35	27.21	1.00	-1.73	41.17	118.33
250	16.42	27.55	1.13	-1.73	42.65	119.22
251	16.51	28.07	1.27	-1.73	44.03	120.14
252	16.55	28.67	1.36	-1.73	44.52	120.72
253	16.60	29.28	1.46	-1.73	44.94	121.26
254	16.69	29.54	1.57	-1.65	45.98	121.81
255	16.74	29.71	1.61	-1.73	46.34	122.05
256	16.80	29.45	1.68	-1.73	47.43	122.31
257	16.86	28.93	1.73	-1.73	48.72	122.49
258	16.94	27.90	1.75	-1.73	50.35	122.46
259	17.00	27.47	1.74	-1.82	50.92	122.38
260	17.09	26.69	1.65	-1.82	51.19	121.94
261	17.14	26.69	1.59	-1.82	50.57	121.67
262	17.23	26.34	1.48	-1.82	49.93	121.14
263	17.26	26.00	1.45	-1.82	50.02	120.92
264	17.36	24.27	1.37	-1.82	51.86	120.36
265	17.41	23.41	1.35	-1.91	53.07	120.16
266	17.46	23.32	1.33	-1.99	52.98	120.03
267	17.53	23.32	1.29	-1.99	52.56	119.83
268	17.63	22.28	1.26	-1.99	54.08	119.53
269	17.65	21.94	1.25	-1.99	54.61	119.45
270	17.72	21.25	1.22	-1.99	55.59	119.20
271	17.81	20.21	1.17	-2.08	57.05	118.77
272	17.86	19.26	1.13	-2.08	58.44	118.37
273	17.94	18.48	1.09	-2.08	59.59	117.98
274	18.00	17.27	1.06	-2.17	62.25	117.64
275	18.08	17.32	1.06	-2.17	62.23	117.65
276	18.14	17.32	1.06	-2.17	62.32	117.65
277	18.21	17.36	1.06	-2.17	62.34	117.66
278	18.27	18.66	1.08	-2.08	59.43	117.94
279	18.34	20.99	1.09	-2.08	54.78	118.34
280	18.41	23.23	1.10	-2.08	50.91	118.66
281	18.48	24.01	1.10	-2.08	49.69	118.74
282	18.54	24.27	0.70	-2.08	42.02	115.44
283	18.57	24.10	0.44	-2.08	35.90	111.96
284	18.66	23.23	0.66	-2.08	42.74	114.86
285	18.71	23.06	0.74	-2.08	44.82	115.70
286	18.77	22.11	0.81	-2.08	47.89	116.25
287	18.84	20.99	0.84	-2.14	50.76	116.45
288	18.92	21.25	0.93	-2.14	52.01	117.18

:: Field input data :: (continued)

Point ID	Depth (ft)	q_c (tsf)	f_s (tsf)	u (tsf)	Fines content (%)	Unit weight (pcf)
289	19.00	21.51	1.10	-2.15	54.78	118.48
290	19.04	22.80	1.23	-2.15	54.34	119.38
291	19.10	26.95	1.43	-2.17	50.47	120.91
292	19.19	33.68	1.58	-2.17	43.95	122.19
293	19.23	37.22	1.61	-2.17	40.86	122.59
294	19.31	41.20	1.79	-2.08	39.17	123.60
295	19.37	42.32	2.02	-2.17	40.31	124.56
296	19.43	47.24	2.21	-2.08	38.15	125.47
297	19.50	65.29	2.29	-2.17	29.06	126.51
298	19.56	62.79	2.13	-2.08	29.20	125.90
299	19.64	66.59	1.95	-3.03	26.55	125.40
300	19.72	76.69	1.81	-3.12	22.22	125.19
301	19.77	82.31	1.65	-3.55	19.71	124.71
302	19.85	99.15	1.49	-3.64	15.01	124.38
303	19.90	110.98	1.39	-3.90	12.51	124.17
304	19.95	120.66	1.35	-4.25	10.95	124.15
305	20.04	131.63	1.68	-4.59	11.26	125.99
306	20.08	135.17	2.03	-4.68	12.31	127.41
307	20.16	145.96	2.36	-4.76	12.31	128.70
308	20.22	156.85	2.27	-4.76	10.88	128.61
309	20.28	175.33	2.43	-4.76	9.74	129.38
310	20.36	218.34	2.54	-4.68	7.08	130.22
311	20.45	302.20	2.79	-4.59	4.02	131.70
312	20.49	333.55	2.84	-4.59	3.20	132.09
313	20.58	363.87	2.50	-4.42	1.90	131.36
314	20.63	344.87	2.35	-4.33	2.07	130.77
315	20.69	319.39	1.55	-3.90	1.12	127.54
316	20.75	314.90	1.10	-3.47	0.21	124.99
317	20.81	274.22	1.14	-2.69	1.23	124.92
318	20.89	247.45	1.31	-2.25	2.50	125.67
319	20.94	229.22	1.38	-1.99	3.41	125.90
320	21.00	217.91	1.37	-1.94	3.87	125.73
321	21.07	165.91	1.37	-0.17	6.86	125.03
322	21.14	188.80	1.40	-0.87	5.47	125.52
323	21.20	193.72	1.44	-1.90	5.34	125.78
324	21.26	197.70	1.50	-1.73	5.33	126.12
325	21.34	211.34	1.58	-1.73	4.88	126.66
326	21.39	232.50	1.49	-1.73	3.66	126.49
327	21.47	254.10	1.41	-1.91	2.64	126.30
328	21.54	279.49	1.31	-2.08	1.61	125.97
329	21.61	290.80	0.94	-2.60	0.38	123.66
330	21.66	301.08	0.81	-2.04	0.00	122.66
331	21.74	309.11	0.93	-2.43	0.00	123.70
332	21.79	316.89	1.17	-1.99	0.44	125.49
333	21.87	307.64	1.97	-1.56	2.41	129.20
334	21.92	301.25	2.49	-0.84	3.66	130.88
335	21.99	307.90	3.03	0.26	4.46	132.35
336	22.07	336.58	2.45	0.35	2.59	131.01

:: Field input data :: (continued)

Point ID	Depth (ft)	q_c (tsf)	f_s (tsf)	u (tsf)	Fines content (%)	Unit weight (pcf)
337	22.13	308.16	1.88	0.35	2.23	128.86
338	22.21	338.87	1.49	0.35	0.72	127.39
339	22.25	309.98	1.55	0.26	1.46	127.45
340	22.33	341.16	2.09	0.26	1.85	129.90
341	22.38	327.42	2.63	0.00	3.18	131.48
342	22.45	352.21	2.45	-0.43	2.25	131.14
343	22.51	338.22	2.32	-0.95	2.36	130.65
344	22.58	360.16	2.32	-1.47	1.84	130.77
345	22.65	373.97	2.44	-1.65	1.76	131.24
346	22.73	369.40	2.44	-1.65	1.86	131.23
347	22.79	368.27	2.37	-1.73	1.77	131.00
348	22.88	364.91	2.19	-2.08	1.54	130.40
349	22.91	367.32	2.04	-2.08	1.23	129.88
350	23.00	359.90	1.79	-2.17	0.93	128.87
351	23.03	357.48	1.74	-2.34	0.89	128.67
352	23.10	358.60	1.66	-2.60	0.73	128.34
353	23.18	361.11	1.61	-3.21	0.58	128.12
354	23.23	366.55	1.35	-3.38	0.00	126.89
355	23.30	375.62	0.88	-3.64	0.00	123.75
356	23.37	381.06	1.06	-3.90	0.00	125.16
357	23.45	381.92	1.19	-4.16	0.00	126.06
358	23.54	378.29	1.34	-4.42	0.00	126.90
359	23.56	368.36	1.35	-4.82	0.00	126.89
360	23.65	350.05	1.42	-4.82	0.44	127.14
361	23.69	355.41	1.46	-4.82	0.43	127.39
362	23.76	357.82	1.53	-5.29	0.51	127.70
363	23.82	360.33	1.55	-5.46	0.51	127.85
364	23.89	365.51	1.77	-5.72	0.84	128.86
365	23.96	381.14	2.15	-5.89	1.20	130.36
366	24.02	421.05	2.13	-6.07	0.50	130.55
367	24.09	472.69	2.27	-6.15	0.00	131.30
368	24.16	511.13	2.51	-6.24	0.00	132.22
369	24.22	507.93	2.78	-6.41	0.19	132.94
370	24.29	454.47	3.06	-6.41	1.26	133.37
371	24.36	420.61	2.74	-6.41	1.41	132.38
372	24.42	382.35	2.52	-6.41	1.81	131.55
373	24.50	376.65	1.83	-6.33	0.77	129.17
374	24.59	358.26	1.20	-6.33	0.00	125.92
375	24.62	357.82	1.23	-6.33	0.00	126.10
376	24.68	357.82	1.28	-6.33	0.06	126.42
377	24.77	357.39	1.29	-6.33	0.09	126.48
378	24.81	359.72	1.26	-6.50	0.00	126.31
379	24.89	355.49	1.26	-6.50	0.06	126.27
380	24.95	370.35	1.27	-6.50	0.00	126.44
381	25.02	382.87	1.36	-6.58	0.00	127.03
382	25.08	389.87	1.51	-6.67	0.01	127.85
383	25.16	404.03	1.80	-6.76	0.29	129.21
384	25.20	404.03	1.89	-6.76	0.43	129.55

:: Field input data :: (continued)

Point ID	Depth (ft)	q_c (tsf)	f_s (tsf)	u (tsf)	Fines content (%)	Unit weight (pcf)
385	25.26	400.58	2.03	-7.02	0.72	130.07
386	25.35	389.87	2.09	-6.84	1.01	130.22
387	25.40	381.32	2.13	-7.11	1.22	130.28
388	25.48	370.43	2.06	-7.19	1.33	130.00
389	25.53	366.12	1.97	-7.37	1.26	129.63
390	25.62	356.62	1.76	-7.71	1.06	128.74
391	25.66	353.16	1.68	-7.71	0.98	128.38
392	25.75	344.78	1.27	-7.97	0.32	126.30
393	25.80	341.41	1.01	-8.14	0.00	124.54
394	25.86	338.74	0.94	-8.23	0.00	124.02
395	25.94	338.48	0.95	-8.23	0.00	124.11
396	26.00	336.32	1.01	-8.32	0.00	124.55
397	26.06	332.86	1.06	-8.38	0.07	124.84
398	26.15	309.20	1.12	-8.38	0.67	125.06
399	26.19	315.68	1.14	-8.38	0.60	125.29
400	26.28	314.99	1.19	-8.49	0.74	125.60
401	26.33	314.99	1.19	-8.49	0.73	125.57
402	26.38	317.23	1.19	-8.49	0.68	125.58
403	26.45	320.60	1.22	-8.49	0.68	125.77
404	26.52	328.63	1.24	-8.49	0.58	125.99
405	26.59	333.64	1.24	-8.49	0.50	126.04
406	26.64	340.81	1.27	-8.49	0.41	126.22
407	26.72	351.86	1.88	-8.49	1.43	129.20
408	26.77	362.23	2.86	-8.49	2.90	132.32
409	26.84	382.70	3.31	-8.49	3.11	133.53
410	26.90	402.22	3.69	-8.49	3.19	134.45
411	26.98	430.11	3.87	-8.49	2.84	134.96
412	27.05	440.74	4.00	-8.49	2.79	135.26
413	27.11	433.40	3.76	-8.58	2.65	134.78
414	27.18	455.08	3.53	-8.66	1.96	134.42
415	27.24	407.75	3.17	-8.66	2.37	133.36
416	27.30	404.20	2.58	-8.66	1.60	131.85
417	27.38	425.11	2.21	-8.66	0.68	130.82
418	27.44	426.75	2.10	-8.68	0.50	130.47
419	27.50	428.82	1.96	-8.68	0.26	129.97
420	27.56	422.69	1.72	-8.70	0.00	128.97
421	27.63	407.31	1.60	-8.72	0.00	128.36
422	27.70	420.53	1.59	-8.73	0.00	128.39
423	27.76	397.47	1.65	-8.75	0.23	128.52
424	27.84	418.37	2.16	-8.75	0.74	130.64
425	27.89	423.55	2.46	-8.75	1.10	131.60
426	27.96	461.73	2.01	-8.75	0.00	130.36
427	28.03	481.24	0.00	-8.85	N/A	87.36
428	28.11	529.70	0.00	-8.80	N/A	87.36
429	28.15	556.82	0.00	-8.85	N/A	87.36
430	28.22	617.71	0.00	-8.75	N/A	87.36
431	28.31	616.58	0.00	-8.84	N/A	87.36
432	28.36	697.17	0.00	-9.27	N/A	87.36

:: Field input data :: (continued)

Point ID	Depth (ft)	q_c (tsf)	f_s (tsf)	u (tsf)	Fines content (%)	Unit weight (pcf)

Abbreviations

Depth: Depth from free surface, at which CPT was performed (ft)
q_c: Measured cone resistance (tsf)
f_s: Sleeve friction resistance (tsf)
u: Pore pressure (tsf)
Fines content: Percentage of fines in soil (%)
Unit weight: Bulk soil unit weight (pcf)

:: Post-earthquake settlement of dry sands ::

Depth (ft)	Ic	Q_{tn}	Kc	$Q_{tn,cs}$	$N_{1,60}$ (blows)	G_{max} (tsf)	CSR	Shear, γ (%)	$e_{vol(15)}$ (%)	N_c	e_v (%)	Settle. (in)
0.07	1.87	130.02	1.16	151.07	30	778	0.27	0.000	0.00	6.39	0.00	0.000
0.15	1.09	492.31	1.00	492.31	76	1098	0.27	0.000	0.00	6.39	0.00	0.000
0.20	1.19	451.66	1.00	451.66	72	1135	0.27	0.000	0.00	6.39	0.00	0.000
0.28	1.31	410.15	1.00	410.15	67	1206	0.27	0.001	0.00	6.39	0.00	0.000
0.34	1.40	362.70	1.00	362.70	61	1202	0.27	0.001	0.00	6.39	0.00	0.000
0.40	1.55	302.60	1.00	302.60	54	1208	0.27	0.001	0.00	6.39	0.00	0.000
0.47	1.76	230.03	1.08	247.87	47	1195	0.27	0.001	0.00	6.39	0.00	0.000
0.53	1.85	194.35	1.14	222.22	44	1130	0.27	0.001	0.00	6.39	0.00	0.000
0.59	2.05	140.36	1.37	191.65	41	1049	0.27	0.001	0.00	6.39	0.00	0.000
0.66	2.17	116.08	1.59	184.72	41	1012	0.27	0.002	0.00	6.39	0.00	0.000
0.72	2.26	96.92	1.84	177.94	41	954	0.27	0.002	0.00	6.39	0.00	0.000
0.79	2.26	69.71	1.84	128.08	30	686	0.27	0.003	0.00	6.39	0.00	0.000
0.87	2.36	60.00	2.14	128.69	31	665	0.27	0.004	0.00	6.39	0.00	0.000
0.93	2.41	53.60	2.37	126.86	31	638	0.27	0.004	0.00	6.39	0.00	0.000
0.98	2.45	49.85	2.51	124.94	31	618	0.27	0.005	0.00	6.39	0.00	0.000
1.07	2.43	51.66	2.46	127.02	32	632	0.27	0.005	0.00	6.39	0.00	0.000
1.12	2.45	49.71	2.51	124.68	31	616	0.27	0.006	0.00	6.39	0.00	0.000
1.19	2.44	48.58	2.47	119.96	30	596	0.27	0.006	0.00	6.39	0.00	0.000
1.25	2.39	49.12	2.27	111.66	0	0	0.27	0.000	0.00	13.43	0.00	0.000
1.33	2.47	39.54	2.61	103.30	0	0	0.27	0.000	0.00	13.43	0.00	0.000
1.38	2.55	32.46	3.06	99.30	0	0	0.27	0.000	0.00	13.43	0.00	0.000
1.45	2.61	27.74	3.37	93.43	0	0	0.27	0.000	0.00	0.00	0.00	0.000
1.51	2.67	22.73	3.79	86.19	0	0	0.27	0.000	0.00	0.00	0.00	0.000
1.59	2.76	17.46	4.43	77.42	0	0	0.27	0.000	0.00	0.00	0.00	0.000
1.64	2.77	15.78	4.56	71.94	0	0	0.27	0.000	0.00	0.00	0.00	0.000
1.73	2.87	12.46	5.37	66.95	0	0	0.27	0.000	0.00	0.00	0.00	0.000
1.78	2.96	10.10	6.32	63.81	0	0	0.27	0.000	0.00	0.00	0.00	0.000
1.86	3.06	8.15	7.43	60.50	0	0	0.27	0.000	0.00	0.00	0.00	0.000
1.90	3.15	7.03	8.54	60.05	0	0	0.27	0.000	0.00	0.00	0.00	0.000
1.98	3.21	6.48	9.37	60.71	0	0	0.27	0.000	0.00	0.00	0.00	0.000
2.05	3.20	6.48	9.24	59.85	0	0	0.27	0.000	0.00	0.00	0.00	0.000
2.11	3.11	7.71	8.08	62.27	0	0	0.27	0.000	0.00	0.00	0.00	0.000
2.19	3.04	8.96	7.26	65.01	0	0	0.27	0.000	0.00	0.00	0.00	0.000
2.23	2.96	10.33	6.29	64.98	0	0	0.27	0.000	0.00	0.00	0.00	0.000
2.32	2.90	11.58	5.70	66.02	0	0	0.27	0.000	0.00	0.00	0.00	0.000
2.37	2.85	12.56	5.25	65.97	0	0	0.27	0.000	0.00	0.00	0.00	0.000
2.44	2.78	13.79	4.59	63.33	0	0	0.27	0.000	0.00	0.00	0.00	0.000
2.50	2.65	16.14	3.62	58.52	0	0	0.27	0.000	0.00	0.00	0.00	0.000
2.57	2.17	32.24	1.00	32.24	0	0	0.27	0.000	0.00	13.43	0.00	0.000
2.63	1.87	47.35	1.00	47.35	0	0	0.27	0.000	0.00	13.43	0.00	0.000
2.70	1.70	63.59	1.00	63.59	12	307	0.27	0.113	0.21	6.39	0.14	0.002
2.76	1.67	72.32	1.00	72.32	13	335	0.27	0.083	0.13	6.39	0.09	0.001
2.83	1.64	81.06	1.00	81.06	15	363	0.27	0.064	0.09	6.39	0.06	0.001
2.89	2.16	51.36	1.57	80.78	18	443	0.27	0.036	0.04	6.39	0.03	0.000
2.97	2.06	86.73	1.38	120.04	26	658	0.27	0.015	0.01	6.39	0.01	0.000
3.02	2.03	89.93	1.35	121.05	26	661	0.27	0.015	0.01	6.39	0.01	0.000
3.09	2.00	94.64	1.30	123.29	0	0	0.27	0.000	0.00	13.43	0.00	0.000
3.15	2.05	88.81	1.37	122.05	0	0	0.27	0.000	0.00	13.43	0.00	0.000

:: Post-earthquake settlement of dry sands :: (continued)

Depth (ft)	Ic	Q_{tn}	Kc	$Q_{tn,cs}$	$N_{1,60}$ (blows)	G_{max} (tsf)	CSR	Shear, γ (%)	$e_{vol(15)}$ (%)	N_c	e_v (%)	Settle. (in)
3.22	2.21	67.85	1.70	115.14	0	0	0.27	0.000	0.00	13.43	0.00	0.000
3.28	2.48	42.86	2.68	115.06	0	0	0.27	0.000	0.00	13.43	0.00	0.000
3.36	2.44	46.32	2.46	114.08	29	567	0.27	0.025	0.02	6.39	0.01	0.000
3.42	2.46	43.68	2.56	111.94	28	550	0.27	0.027	0.02	6.39	0.01	0.000
3.49	2.45	42.15	2.52	106.23	27	524	0.27	0.032	0.02	6.39	0.02	0.000
3.55	2.46	39.36	2.59	102.10	26	500	0.27	0.037	0.03	6.39	0.02	0.000
3.62	2.47	38.52	2.62	100.80	26	492	0.27	0.040	0.03	6.39	0.02	0.000
3.70	2.54	33.24	2.99	99.34	26	465	0.27	0.048	0.04	6.39	0.02	0.000
3.75	2.56	31.29	3.11	97.35	26	450	0.27	0.055	0.04	6.39	0.03	0.000
3.81	2.53	31.29	2.95	92.16	24	434	0.27	0.064	0.05	6.39	0.03	0.000
3.87	2.51	31.55	2.80	88.47	23	423	0.27	0.072	0.06	6.39	0.04	0.001
3.96	2.53	35.57	2.92	103.86	27	490	0.27	0.047	0.03	6.39	0.02	0.000
4.01	2.53	37.51	2.91	109.02	28	515	0.27	0.042	0.03	6.39	0.02	0.000
4.10	2.61	36.25	3.41	123.55	0	0	0.27	0.000	0.00	0.00	0.00	0.000
4.14	2.70	32.92	3.96	130.46	0	0	0.27	0.000	0.00	0.00	0.00	0.000
4.22	2.52	45.55	2.89	131.78	34	624	0.27	0.028	0.01	6.39	0.01	0.000
4.27	1.91	130.48	1.20	156.00	31	818	0.27	0.017	0.01	6.39	0.01	0.000
4.34	1.79	173.34	1.10	190.21	37	933	0.27	0.014	0.01	6.39	0.00	0.000
4.40	1.89	159.85	1.18	188.75	38	982	0.27	0.013	0.01	6.39	0.00	0.000
4.49	1.99	147.62	1.29	190.35	39	1030	0.27	0.013	0.01	6.39	0.00	0.000
4.53	2.04	140.40	1.36	190.54	40	1042	0.27	0.012	0.01	6.39	0.00	0.000
4.60	2.13	127.22	1.51	191.81	42	1055	0.27	0.013	0.01	6.39	0.00	0.000
4.67	2.22	115.97	1.70	197.69	45	1074	0.27	0.012	0.00	6.39	0.00	0.000
4.73	2.29	105.01	1.93	202.15	47	1072	0.27	0.013	0.00	6.39	0.00	0.000
4.80	2.35	97.51	2.13	207.36	50	1074	0.27	0.013	0.00	6.39	0.00	0.000
4.87	2.39	92.36	2.29	211.37	52	1073	0.27	0.013	0.00	6.39	0.00	0.000
4.94	2.43	87.63	2.43	212.69	53	1061	0.27	0.014	0.00	6.39	0.00	0.000
4.99	2.46	83.04	2.57	213.21	54	1046	0.27	0.014	0.00	6.39	0.00	0.000
5.07	2.49	78.18	2.74	214.13	55	1031	0.27	0.015	0.00	6.39	0.00	0.000
5.12	2.51	76.10	2.81	214.20	55	1022	0.27	0.015	0.00	6.39	0.00	0.000
5.20	2.51	74.56	2.80	208.63	54	998	0.27	0.016	0.00	6.39	0.00	0.000
5.25	2.50	72.20	2.79	201.62	52	965	0.27	0.017	0.01	6.39	0.00	0.000
5.34	2.48	70.51	2.65	186.78	48	908	0.27	0.019	0.01	6.39	0.00	0.000
5.38	2.48	67.72	2.67	181.08	46	878	0.27	0.021	0.01	6.39	0.01	0.000
5.46	2.48	63.13	2.66	167.66	43	815	0.27	0.024	0.01	6.39	0.01	0.000
5.53	2.48	58.69	2.67	156.51	40	759	0.27	0.029	0.01	6.39	0.01	0.000
5.58	2.50	54.65	2.75	150.36	39	723	0.27	0.032	0.01	6.39	0.01	0.000
5.66	2.49	50.47	2.70	136.21	0	0	0.27	0.000	0.00	13.43	0.00	0.000
5.72	2.45	47.41	2.53	120.01	0	0	0.27	0.000	0.00	13.43	0.00	0.000
5.78	2.33	46.16	2.05	94.69	0	0	0.27	0.000	0.00	13.43	0.00	0.000
5.84	2.30	45.05	1.96	88.47	0	0	0.27	0.000	0.00	13.43	0.00	0.000
5.93	2.28	46.84	1.88	87.87	0	0	0.27	0.000	0.00	13.43	0.00	0.000
5.97	2.23	50.31	1.76	88.37	0	0	0.27	0.000	0.00	13.43	0.00	0.000

:: Post-earthquake settlement of dry sands :: (continued)

Depth (ft)	Ic	Q_{tn}	Kc	$Q_{tn,cs}$	$N_{1,60}$ (blows)	G_{max} (tsf)	CSR	Shear, γ (%)	$e_{vol(15)}$ (%)	N_c	e_v (%)	Settle. (in)

Total estimated settlement: 0.01

Abbreviations

Q_{tn}: Equivalent clean sand normalized cone resistance
K_c: Fines correction factor
$Q_{tn,cs}$: Post-liquefaction volumentric strain
G_{max}: Small strain shear modulus
CSR: Soil cyclic stress ratio
γ: Cyclic shear strain
$e_{vol(15)}$: Volumetric strain after 15 cycles
N_c: Equivalent number of cycles
e_v: Volumetric strain
Settle.: Calculated settlement

:: Post-earthquake settlement due to soil liquefaction ::

Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)	Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)
6.05	89.02	2.00	0.00	1.00	0.00	6.11	89.38	2.00	0.00	1.00	0.00
6.18	89.66	2.00	0.00	1.00	0.00	6.24	88.62	0.53	2.58	1.00	0.02
6.32	88.51	0.53	2.58	1.00	0.03	6.38	88.53	0.52	2.58	1.00	0.02
6.46	87.96	0.52	2.60	1.00	0.03	6.50	88.17	0.52	2.59	1.00	0.01
6.58	90.47	0.53	2.54	1.00	0.02	6.64	91.10	0.53	2.52	1.00	0.02
6.70	91.47	2.00	0.00	1.00	0.00	6.77	94.39	2.00	0.00	1.00	0.00
6.85	97.10	2.00	0.00	1.00	0.00	6.91	98.91	2.00	0.00	1.00	0.00
6.96	100.39	2.00	0.00	1.00	0.00	7.05	105.92	2.00	0.00	1.00	0.00
7.09	108.93	2.00	0.00	1.00	0.00	7.18	116.47	2.00	0.00	1.00	0.00
7.23	120.11	2.00	0.00	1.00	0.00	7.30	123.80	2.00	0.00	1.00	0.00
7.36	126.56	2.00	0.00	1.00	0.00	7.45	126.20	0.90	1.11	1.00	0.01
7.50	124.92	0.87	1.13	1.00	0.01	7.55	123.99	0.86	1.14	1.00	0.01
7.61	122.24	0.83	1.52	1.00	0.01	7.72	118.65	0.78	1.58	1.00	0.02
7.76	116.55	0.75	1.98	1.00	0.01	7.81	103.75	0.60	2.27	1.00	0.01
7.94	89.88	0.48	2.55	1.00	0.04	7.97	90.12	0.48	2.54	1.00	0.01
8.03	92.41	0.50	2.49	1.00	0.02	8.07	94.24	2.00	0.00	1.00	0.00
8.14	97.41	2.00	0.00	1.00	0.00	8.20	102.04	2.00	0.00	1.00	0.00
8.28	106.91	2.00	0.00	1.00	0.00	8.34	110.24	2.00	0.00	1.00	0.00
8.40	116.68	2.00	0.00	1.00	0.00	8.47	121.74	2.00	0.00	1.00	0.00
8.53	123.87	2.00	0.00	1.00	0.00	8.60	125.03	2.00	0.00	1.00	0.00
8.68	119.15	2.00	0.00	1.00	0.00	8.74	114.31	2.00	0.00	1.00	0.00
8.80	110.69	2.00	0.00	1.00	0.00	8.88	104.79	2.00	0.00	1.00	0.00
8.94	98.72	2.00	0.00	1.00	0.00	9.01	93.80	2.00	0.00	1.00	0.00
9.07	89.41	2.00	0.00	1.00	0.00	9.14	84.04	2.00	0.00	1.00	0.00
9.19	81.44	2.00	0.00	1.00	0.00	9.27	79.68	2.00	0.00	1.00	0.00
9.33	77.26	2.00	0.00	1.00	0.00	9.41	77.43	0.37	2.88	1.00	0.03
9.46	78.31	0.38	2.86	1.00	0.02	9.54	76.28	0.36	2.92	1.00	0.03
9.60	73.69	0.35	3.00	1.00	0.02	9.65	71.73	0.34	3.07	1.00	0.02
9.72	71.46	0.34	3.08	1.00	0.03	9.82	71.61	0.34	3.07	1.00	0.03
9.86	73.45	0.35	3.01	1.00	0.02	9.91	76.65	0.36	2.91	1.00	0.02
9.99	78.78	0.37	2.84	1.00	0.03	10.04	82.10	0.39	2.75	1.00	0.02
10.13	84.91	0.40	2.67	1.00	0.03	10.18	86.96	0.41	2.62	1.00	0.01
10.26	88.81	0.42	2.58	1.00	0.02	10.35	99.49	0.50	2.35	1.00	0.03
10.43	106.33	0.56	2.22	1.00	0.02	10.45	109.73	0.59	2.17	1.00	0.00
10.53	110.72	0.60	2.15	1.00	0.02	10.57	117.73	0.67	1.95	1.00	0.01

:: Post-earthquake settlement due to soil liquefaction :: (continued)

Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)	Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)
10.67	141.90	1.00	0.64	1.00	0.01	10.71	147.25	1.08	0.43	1.00	0.00
10.77	148.29	1.10	0.43	1.00	0.00	10.84	159.21	1.30	0.21	1.00	0.00
10.89	172.66	1.60	0.00	1.00	0.00	10.96	185.71	1.93	0.00	1.00	0.00
11.04	188.56	2.00	0.00	1.00	0.00	11.13	192.16	2.00	0.00	1.00	0.00
11.17	193.66	2.00	0.00	1.00	0.00	11.26	195.47	2.00	0.00	1.00	0.00
11.29	198.79	2.00	0.00	1.00	0.00	11.38	199.53	2.00	0.00	1.00	0.00
11.44	198.74	2.00	0.00	1.00	0.00	11.52	199.32	2.00	0.00	1.00	0.00
11.57	197.97	2.00	0.00	1.00	0.00	11.63	200.20	2.00	0.00	1.00	0.00
11.69	204.04	2.00	0.00	1.00	0.00	11.75	202.63	2.00	0.00	1.00	0.00
11.84	196.10	2.00	0.00	1.00	0.00	11.89	196.09	2.00	0.00	1.00	0.00
11.95	196.26	2.00	0.00	1.00	0.00	12.01	198.45	2.00	0.00	1.00	0.00
12.07	202.49	2.00	0.00	1.00	0.00	12.17	207.10	2.00	0.00	1.00	0.00
12.23	210.89	2.00	0.00	1.00	0.00	12.29	212.31	2.00	0.00	1.00	0.00
12.38	210.80	2.00	0.00	1.00	0.00	12.43	212.84	2.00	0.00	1.00	0.00
12.47	209.17	2.00	0.00	1.00	0.00	12.55	205.02	2.00	0.00	1.00	0.00
12.62	195.05	2.00	0.00	1.00	0.00	12.69	189.56	1.94	0.00	1.00	0.00
12.74	183.54	1.78	0.00	1.00	0.00	12.80	175.93	1.59	0.00	1.00	0.00
12.87	164.82	1.34	0.20	1.00	0.00	12.94	150.46	1.07	0.42	1.00	0.00
13.00	134.03	0.82	1.32	1.00	0.01	13.08	121.86	0.67	1.86	1.00	0.02
13.14	108.83	2.00	0.00	1.00	0.00	13.19	110.74	2.00	0.00	1.00	0.00
13.26	107.18	2.00	0.00	1.00	0.00	13.33	104.12	2.00	0.00	1.00	0.00
13.42	101.13	2.00	0.00	1.00	0.00	13.47	101.38	2.00	0.00	1.00	0.00
13.54	98.71	2.00	0.00	1.00	0.00	13.61	94.86	2.00	0.00	1.00	0.00
13.65	91.22	2.00	0.00	1.00	0.00	13.74	80.61	2.00	0.00	1.00	0.00
13.78	75.04	2.00	0.00	1.00	0.00	13.87	71.40	2.00	0.00	1.00	0.00
13.92	71.28	2.00	0.00	1.00	0.00	13.98	71.10	2.00	0.00	1.00	0.00
14.05	67.79	2.00	0.00	1.00	0.00	14.14	66.55	2.00	0.00	1.00	0.00
14.19	66.74	2.00	0.00	1.00	0.00	14.28	67.07	2.00	0.00	1.00	0.00
14.32	66.68	2.00	0.00	1.00	0.00	14.41	65.00	2.00	0.00	1.00	0.00
14.47	66.47	2.00	0.00	1.00	0.00	14.50	67.79	2.00	0.00	1.00	0.00
14.60	71.25	2.00	0.00	1.00	0.00	14.65	72.43	2.00	0.00	1.00	0.00
14.72	76.06	2.00	0.00	1.00	0.00	14.77	78.66	2.00	0.00	1.00	0.00
14.84	81.94	2.00	0.00	1.00	0.00	14.90	82.21	2.00	0.00	1.00	0.00
14.99	82.20	2.00	0.00	1.00	0.00	15.03	82.17	2.00	0.00	1.00	0.00
15.13	82.42	2.00	0.00	1.00	0.00	15.18	81.83	2.00	0.00	1.00	0.00
15.22	80.80	2.00	0.00	1.00	0.00	15.30	81.31	2.00	0.00	1.00	0.00
15.36	81.13	2.00	0.00	1.00	0.00	15.43	80.16	2.00	0.00	1.00	0.00
15.49	78.46	2.00	0.00	1.00	0.00	15.58	76.62	2.00	0.00	1.00	0.00
15.63	75.07	2.00	0.00	1.00	0.00	15.71	75.34	2.00	0.00	1.00	0.00
15.76	77.61	2.00	0.00	1.00	0.00	15.84	80.92	2.00	0.00	1.00	0.00
15.94	87.36	2.00	0.00	1.00	0.00	15.95	87.45	2.00	0.00	1.00	0.00
16.03	91.64	2.00	0.00	1.00	0.00	16.12	95.70	2.00	0.00	1.00	0.00
16.15	99.27	2.00	0.00	1.00	0.00	16.21	102.07	2.00	0.00	1.00	0.00
16.29	108.11	2.00	0.00	1.00	0.00	16.35	112.97	2.00	0.00	1.00	0.00
16.42	119.84	2.00	0.00	1.00	0.00	16.51	127.21	2.00	0.00	1.00	0.00
16.55	131.76	2.00	0.00	1.00	0.00	16.60	136.10	2.00	0.00	1.00	0.00
16.69	141.18	2.00	0.00	1.00	0.00	16.74	143.22	2.00	0.00	1.00	0.00
16.80	146.17	2.00	0.00	1.00	0.00	16.86	148.61	2.00	0.00	1.00	0.00

:: Post-earthquake settlement due to soil liquefaction :: (continued)

Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)	Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)
16.94	149.41	2.00	0.00	1.00	0.00	17.00	148.89	2.00	0.00	1.00	0.00
17.09	144.84	2.00	0.00	1.00	0.00	17.14	141.88	2.00	0.00	1.00	0.00
17.23	136.58	2.00	0.00	1.00	0.00	17.26	134.85	2.00	0.00	1.00	0.00
17.36	131.44	2.00	0.00	1.00	0.00	17.41	130.48	2.00	0.00	1.00	0.00
17.46	129.24	2.00	0.00	1.00	0.00	17.53	127.18	2.00	0.00	1.00	0.00
17.63	125.59	2.00	0.00	1.00	0.00	17.65	125.17	2.00	0.00	1.00	0.00
17.72	123.66	2.00	0.00	1.00	0.00	17.81	121.07	2.00	0.00	1.00	0.00
17.86	118.74	2.00	0.00	1.00	0.00	17.94	116.34	2.00	0.00	1.00	0.00
18.00	114.81	2.00	0.00	1.00	0.00	18.08	114.56	2.00	0.00	1.00	0.00
18.14	114.36	2.00	0.00	1.00	0.00	18.21	114.24	2.00	0.00	1.00	0.00
18.27	114.80	2.00	0.00	1.00	0.00	18.34	115.17	2.00	0.00	1.00	0.00
18.41	114.97	2.00	0.00	1.00	0.00	18.48	114.48	2.00	0.00	1.00	0.00
18.54	91.15	2.00	0.00	1.00	0.00	18.57	72.82	2.00	0.00	1.00	0.00
18.66	88.55	2.00	0.00	1.00	0.00	18.71	93.69	2.00	0.00	1.00	0.00
18.77	98.11	2.00	0.00	1.00	0.00	18.84	100.45	2.00	0.00	1.00	0.00
18.92	104.90	2.00	0.00	1.00	0.00	19.00	113.83	2.00	0.00	1.00	0.00
19.04	119.43	2.00	0.00	1.00	0.00	19.10	127.70	2.00	0.00	1.00	0.00
19.19	131.89	2.00	0.00	1.00	0.00	19.23	131.89	2.00	0.00	1.00	0.00
19.31	137.69	2.00	0.00	1.00	0.00	19.37	146.75	2.00	0.00	1.00	0.00
19.43	151.95	2.00	0.00	1.00	0.00	19.50	148.68	0.93	0.87	1.00	0.01
19.56	143.33	2.00	0.00	1.00	0.00	19.64	135.70	2.00	0.00	1.00	0.00
19.72	129.47	2.00	0.00	1.00	0.00	19.77	124.38	2.00	0.00	1.00	0.00
19.85	123.18	2.00	0.00	1.00	0.00	19.90	125.54	2.00	0.00	1.00	0.00
19.95	129.39	2.00	0.00	1.00	0.00	20.04	142.26	0.84	1.21	1.00	0.01
20.08	151.19	0.97	0.60	1.00	0.00	20.16	162.94	1.16	0.29	1.00	0.00
20.22	166.69	1.23	0.28	1.00	0.00	20.28	179.65	1.49	0.00	1.00	0.00
20.36	206.79	2.00	0.00	1.00	0.00	20.45	268.18	2.00	0.00	1.00	0.00
20.49	295.76	2.00	0.00	1.00	0.00	20.58	321.92	2.00	0.00	1.00	0.00
20.63	304.68	2.00	0.00	1.00	0.00	20.69	281.60	2.00	0.00	1.00	0.00
20.75	277.23	2.00	0.00	1.00	0.00	20.81	240.86	2.00	0.00	1.00	0.00
20.89	216.81	2.00	0.00	1.00	0.00	20.94	200.50	2.00	0.00	1.00	0.00
21.00	190.23	1.72	0.00	1.00	0.00	21.07	152.70	0.98	0.60	1.00	0.00
21.14	166.13	1.21	0.28	1.00	0.00	21.20	169.38	1.27	0.20	1.00	0.00
21.26	172.54	1.33	0.20	1.00	0.00	21.34	182.89	1.55	0.00	1.00	0.00
21.39	201.02	2.00	0.00	1.00	0.00	21.47	219.35	2.00	0.00	1.00	0.00
21.54	241.01	2.00	0.00	1.00	0.00	21.61	250.35	2.00	0.00	1.00	0.00
21.66	258.88	2.00	0.00	1.00	0.00	21.74	265.32	2.00	0.00	1.00	0.00
21.79	271.70	2.00	0.00	1.00	0.00	21.87	263.21	2.00	0.00	1.00	0.00
21.92	257.36	2.00	0.00	1.00	0.00	21.99	262.60	2.00	0.00	1.00	0.00
22.07	286.85	2.00	0.00	1.00	0.00	22.13	262.34	2.00	0.00	1.00	0.00
22.21	288.30	2.00	0.00	1.00	0.00	22.25	263.48	2.00	0.00	1.00	0.00
22.33	289.78	2.00	0.00	1.00	0.00	22.38	277.89	2.00	0.00	1.00	0.00
22.45	298.70	2.00	0.00	1.00	0.00	22.51	286.59	2.00	0.00	1.00	0.00
22.58	304.96	2.00	0.00	1.00	0.00	22.65	316.39	2.00	0.00	1.00	0.00
22.73	312.19	2.00	0.00	1.00	0.00	22.79	310.99	2.00	0.00	1.00	0.00
22.88	307.77	2.00	0.00	1.00	0.00	22.91	309.66	2.00	0.00	1.00	0.00
23.00	303.04	2.00	0.00	1.00	0.00	23.03	300.87	2.00	0.00	1.00	0.00
23.10	301.57	2.00	0.00	1.00	0.00	23.18	303.39	2.00	0.00	1.00	0.00

:: Post-earthquake settlement due to soil liquefaction :: (continued)

Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)	Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)
23.23	307.78	2.00	0.00	1.00	0.00	23.30	315.16	2.00	0.00	1.00	0.00
23.37	319.48	2.00	0.00	1.00	0.00	23.45	319.89	2.00	0.00	1.00	0.00
23.54	316.48	2.00	0.00	1.00	0.00	23.56	308.07	2.00	0.00	1.00	0.00
23.65	292.37	2.00	0.00	1.00	0.00	23.69	296.71	2.00	0.00	1.00	0.00
23.76	298.47	2.00	0.00	1.00	0.00	23.82	300.34	2.00	0.00	1.00	0.00
23.89	304.41	2.00	0.00	1.00	0.00	23.96	317.20	2.00	0.00	1.00	0.00
24.02	350.26	2.00	0.00	1.00	0.00	24.09	393.03	2.00	0.00	1.00	0.00
24.16	424.72	2.00	0.00	1.00	0.00	24.22	421.73	2.00	0.00	1.00	0.00
24.29	376.85	2.00	0.00	1.00	0.00	24.36	348.35	2.00	0.00	1.00	0.00
24.42	316.32	2.00	0.00	1.00	0.00	24.50	311.29	2.00	0.00	1.00	0.00
24.59	295.71	2.00	0.00	1.00	0.00	24.62	295.22	2.00	0.00	1.00	0.00
24.68	295.03	2.00	0.00	1.00	0.00	24.77	294.38	2.00	0.00	1.00	0.00
24.81	296.13	2.00	0.00	1.00	0.00	24.89	292.38	2.00	0.00	1.00	0.00
24.95	304.44	2.00	0.00	1.00	0.00	25.02	314.49	2.00	0.00	1.00	0.00
25.08	320.06	2.00	0.00	1.00	0.00	25.16	331.38	2.00	0.00	1.00	0.00
25.20	331.24	2.00	0.00	1.00	0.00	25.26	328.14	2.00	0.00	1.00	0.00
25.35	318.99	2.00	0.00	1.00	0.00	25.40	311.78	2.00	0.00	1.00	0.00
25.48	302.53	2.00	0.00	1.00	0.00	25.53	298.81	2.00	0.00	1.00	0.00
25.62	290.72	2.00	0.00	1.00	0.00	25.66	287.74	2.00	0.00	1.00	0.00
25.75	280.59	2.00	0.00	1.00	0.00	25.80	277.69	2.00	0.00	1.00	0.00
25.86	275.30	2.00	0.00	1.00	0.00	25.94	274.86	2.00	0.00	1.00	0.00
26.00	272.90	2.00	0.00	1.00	0.00	26.06	269.92	2.00	0.00	1.00	0.00
26.15	250.38	2.00	0.00	1.00	0.00	26.19	255.53	2.00	0.00	1.00	0.00
26.28	254.72	2.00	0.00	1.00	0.00	26.33	254.58	2.00	0.00	1.00	0.00
26.38	256.25	2.00	0.00	1.00	0.00	26.45	258.77	2.00	0.00	1.00	0.00
26.52	265.08	2.00	0.00	1.00	0.00	26.59	268.95	2.00	0.00	1.00	0.00
26.64	274.58	2.00	0.00	1.00	0.00	26.72	283.28	2.00	0.00	1.00	0.00
26.77	291.47	2.00	0.00	1.00	0.00	26.84	307.77	2.00	0.00	1.00	0.00
26.90	323.27	2.00	0.00	1.00	0.00	26.98	345.43	2.00	0.00	1.00	0.00
27.05	353.72	2.00	0.00	1.00	0.00	27.11	347.53	2.00	0.00	1.00	0.00
27.18	364.67	2.00	0.00	1.00	0.00	27.24	326.37	2.00	0.00	1.00	0.00
27.30	323.25	2.00	0.00	1.00	0.00	27.38	339.76	2.00	0.00	1.00	0.00
27.44	340.82	2.00	0.00	1.00	0.00	27.50	342.24	2.00	0.00	1.00	0.00
27.56	337.08	2.00	0.00	1.00	0.00	27.63	324.52	2.00	0.00	1.00	0.00
27.70	334.85	2.00	0.00	1.00	0.00	27.76	316.18	2.00	0.00	1.00	0.00
27.84	332.59	2.00	0.00	1.00	0.00	27.89	336.49	2.00	0.00	1.00	0.00
27.96	366.68	2.00	0.00	1.00	0.00	28.03	-1.00	2.00	0.00	1.00	0.00
28.11	-1.00	2.00	0.00	1.00	0.00	28.15	-1.00	2.00	0.00	1.00	0.00
28.22	-1.00	2.00	0.00	1.00	0.00	28.31	-1.00	2.00	0.00	1.00	0.00
28.36	-1.00	2.00	0.00	1.00	0.00						

Total estimated settlement: 0.78

Abbreviations

$Q_{tn,cs}$: Equivalent clean sand normalized cone resistance
FS: Factor of safety against liquefaction
e_v (%): Post-liquefaction volumentric strain
DF: e_v depth weighting factor
Settlement: Calculated settlement

:: Strength loss calculation (Robertson (2009) ::

Depth (ft)	q_t (tsf)	Q_{tn}	K_c	$Q_{tn,cs}$	I_c	$S_{u(liq)}/\sigma'_v$	$S_{u(peak)}/\sigma'_v$
0.07	80.93	130.02	1.16	151.07	1.87	N/A	N/A
0.15	306.43	492.31	1.00	492.31	1.09	N/A	N/A
0.20	281.13	451.66	1.00	451.66	1.19	N/A	N/A
0.28	255.30	410.15	1.00	410.15	1.31	N/A	N/A
0.34	225.77	362.70	1.00	362.70	1.40	N/A	N/A
0.40	188.37	302.60	1.00	302.60	1.55	N/A	N/A
0.47	143.20	230.03	1.08	247.87	1.76	N/A	N/A
0.53	121.00	194.35	1.14	222.22	1.85	N/A	N/A
0.59	87.40	140.36	1.37	191.65	2.05	N/A	N/A
0.66	72.29	116.08	1.59	184.72	2.17	N/A	N/A
0.72	60.37	96.92	1.84	177.94	2.26	N/A	N/A
0.79	43.44	69.71	1.84	128.08	2.26	N/A	N/A
0.87	37.40	60.00	2.14	128.69	2.36	N/A	N/A
0.93	33.42	53.60	2.37	126.86	2.41	N/A	N/A
0.98	31.09	49.85	2.51	124.94	2.45	N/A	N/A
1.07	32.22	51.66	2.46	127.02	2.43	N/A	N/A
1.12	31.01	49.71	2.51	124.68	2.45	N/A	N/A
1.19	30.31	48.58	2.47	119.96	2.44	N/A	N/A
1.25	30.65	49.12	2.27	111.66	2.39	N/A	N/A
1.33	24.69	39.54	2.61	103.30	2.47	N/A	N/A
1.38	20.29	32.46	3.06	99.30	2.55	N/A	N/A
1.45	17.35	27.74	3.37	93.43	2.61	N/A	N/A
1.51	14.24	22.73	3.79	86.19	2.67	N/A	N/A
1.59	10.96	17.46	4.43	77.42	2.76	N/A	N/A
1.64	9.92	15.78	4.56	71.94	2.77	N/A	N/A
1.73	7.86	12.46	5.37	66.95	2.87	N/A	N/A
1.78	6.39	10.10	6.32	63.81	2.96	N/A	N/A
1.86	5.18	8.15	7.43	60.50	3.06	N/A	N/A
1.90	4.49	7.03	8.54	60.05	3.15	N/A	N/A
1.98	4.15	6.48	9.37	60.71	3.21	N/A	N/A
2.05	4.15	6.48	9.24	59.85	3.20	N/A	N/A
2.11	4.92	7.71	8.08	62.27	3.11	N/A	N/A
2.19	5.70	8.96	7.26	65.01	3.04	N/A	N/A
2.23	6.56	10.33	6.29	64.98	2.96	N/A	N/A
2.32	7.34	11.58	5.70	66.02	2.90	N/A	N/A
2.37	7.95	12.56	5.25	65.97	2.85	N/A	N/A
2.44	8.72	13.79	4.59	63.33	2.78	N/A	N/A
2.50	10.19	16.14	3.62	58.52	2.65	N/A	N/A
2.57	20.21	32.24	1.00	32.24	2.17	N/A	N/A
2.63	29.62	47.35	1.00	47.35	1.87	N/A	N/A
2.70	39.73	63.59	1.00	63.59	1.70	N/A	N/A
2.76	45.17	72.32	1.00	72.32	1.67	N/A	N/A
2.83	50.61	81.06	1.00	81.06	1.64	N/A	N/A
2.89	32.13	51.36	1.57	80.78	2.16	N/A	N/A
2.97	54.15	86.73	1.38	120.04	2.06	N/A	N/A
3.02	56.14	89.93	1.35	121.05	2.03	N/A	N/A
3.09	59.08	94.64	1.30	123.29	2.00	N/A	N/A
3.15	55.45	88.81	1.37	122.05	2.05	N/A	N/A

::Strength loss calculation (Robertson (2009) :: (continued)

Depth (ft)	q_t (tsf)	Q_{tn}	K_c	$Q_{tn,cs}$	I_c	$S_{u(liq)}/\sigma'_v$	$S_{u(peak)}/\sigma'_v$
3.22	42.41	67.85	1.70	115.14	2.21	N/A	N/A
3.28	26.86	42.86	2.68	115.06	2.48	N/A	N/A
3.36	29.02	46.32	2.46	114.08	2.44	N/A	N/A
3.42	27.38	43.68	2.56	111.94	2.46	N/A	N/A
3.49	26.43	42.15	2.52	106.23	2.45	N/A	N/A
3.55	24.70	39.36	2.59	102.10	2.46	N/A	N/A
3.62	24.18	38.52	2.62	100.80	2.47	N/A	N/A
3.70	20.90	33.24	2.99	99.34	2.54	N/A	N/A
3.75	19.69	31.29	3.11	97.35	2.56	N/A	N/A
3.81	19.69	31.29	2.95	92.16	2.53	N/A	N/A
3.87	19.86	31.55	2.80	88.47	2.51	N/A	N/A
3.96	22.36	35.57	2.92	103.86	2.53	N/A	N/A
4.01	23.57	37.51	2.91	109.02	2.53	N/A	N/A
4.10	22.79	36.25	3.41	123.55	2.61	N/A	N/A
4.14	20.72	32.92	3.96	130.46	2.70	N/A	N/A
4.22	28.59	45.55	2.89	131.78	2.52	N/A	N/A
4.27	81.45	130.48	1.20	156.00	1.91	N/A	N/A
4.34	108.13	173.34	1.10	190.21	1.79	N/A	N/A
4.40	99.74	159.85	1.18	188.75	1.89	N/A	N/A
4.49	92.14	147.62	1.29	190.35	1.99	N/A	N/A
4.53	87.64	140.40	1.36	190.54	2.04	N/A	N/A
4.60	79.45	127.22	1.51	191.81	2.13	N/A	N/A
4.67	72.45	115.97	1.70	197.69	2.22	N/A	N/A
4.73	65.63	105.01	1.93	202.15	2.29	N/A	N/A
4.80	60.97	97.51	2.13	207.36	2.35	N/A	N/A
4.87	57.77	92.36	2.29	211.37	2.39	N/A	N/A
4.94	54.82	87.63	2.43	212.69	2.43	N/A	N/A
4.99	51.97	83.04	2.57	213.21	2.46	N/A	N/A
5.07	48.95	78.18	2.74	214.13	2.49	N/A	N/A
5.12	47.66	76.10	2.81	214.20	2.51	N/A	N/A
5.20	46.71	74.56	2.80	208.63	2.51	N/A	N/A
5.25	45.24	72.20	2.79	201.62	2.50	N/A	N/A
5.34	44.20	70.51	2.65	186.78	2.48	N/A	N/A
5.38	42.46	67.72	2.67	181.08	2.48	N/A	N/A
5.46	39.61	63.13	2.66	167.66	2.48	N/A	N/A
5.53	36.85	58.69	2.67	156.51	2.48	N/A	N/A
5.58	34.34	54.65	2.75	150.36	2.50	N/A	N/A
5.66	31.74	50.47	2.70	136.21	2.49	N/A	N/A
5.72	29.84	47.41	2.53	120.01	2.45	N/A	N/A
5.78	29.07	46.16	2.05	94.69	2.33	N/A	N/A
5.84	28.38	45.05	1.96	88.47	2.30	N/A	N/A
5.93	29.50	46.84	1.88	87.87	2.28	N/A	N/A
5.97	31.66	50.31	1.76	88.37	2.23	N/A	N/A
6.05	34.27	54.49	1.63	89.02	2.19	0.75	0.75
6.11	35.31	56.17	1.59	89.38	2.17	0.75	0.75
6.18	37.57	59.78	1.50	89.66	2.12	0.76	0.76
6.24	37.40	59.50	1.49	88.62	2.12	0.76	0.76
6.32	37.66	59.91	1.48	88.51	2.11	0.76	0.76

:: Strength loss calculation (Robertson (2009) :: (continued)

Depth (ft)	q_t (tsf)	Q_{tn}	K_c	$Q_{tn,cs}$	I_c	$S_{u(liq)}/\sigma'_v$	$S_{u(peak)}/\sigma'_v$
6.38	38.87	61.85	1.43	88.53	2.09	0.76	0.76
6.46	39.99	63.64	1.38	87.96	2.06	0.77	0.77
6.50	40.68	64.75	1.36	88.17	2.04	0.77	0.77
6.58	43.18	68.76	1.32	90.47	2.01	0.78	0.78
6.64	43.96	70.01	1.30	91.10	2.00	0.78	0.78
6.70	44.05	70.15	1.30	91.47	2.00	0.78	0.78
6.77	43.88	69.87	1.35	94.39	2.04	0.78	0.78
6.85	42.32	67.36	1.44	97.10	2.09	0.77	0.77
6.91	40.16	63.88	1.55	98.91	2.15	0.77	0.77
6.96	37.66	59.86	1.68	100.39	2.20	0.76	0.76
7.05	34.63	54.98	1.93	105.92	2.29	0.75	0.75
7.09	32.47	51.51	2.11	108.93	2.35	0.74	0.74
7.18	29.80	47.21	2.47	116.47	2.44	0.73	0.73
7.23	28.49	45.11	2.66	120.11	2.48	0.72	0.72
7.30	27.63	43.72	2.83	123.80	2.51	0.72	0.72
7.36	26.94	42.60	2.97	126.56	2.54	0.71	0.71
7.45	26.25	41.48	3.04	126.20	2.55	0.71	0.71
7.50	26.85	42.44	2.94	124.92	2.53	0.71	0.71
7.55	26.42	41.74	2.97	123.99	2.54	0.71	0.71
7.61	26.76	42.28	2.89	122.24	2.52	0.71	0.71
7.72	26.93	42.56	2.79	118.65	2.50	0.71	0.71
7.76	26.41	41.71	2.79	116.55	2.51	0.71	0.71
7.81	25.97	41.01	2.53	103.75	2.45	0.71	0.71
7.94	25.93	40.92	2.20	89.88	2.37	0.71	0.71
7.97	25.92	40.91	2.20	90.12	2.37	0.71	0.71
8.03	25.88	40.84	2.26	92.41	2.39	0.71	0.71
8.07	25.88	40.84	2.31	94.24	2.40	0.71	0.71
8.14	25.80	40.70	2.39	97.41	2.42	0.71	0.71
8.20	24.55	38.68	2.64	102.04	2.47	0.70	0.70
8.28	23.22	36.53	2.93	106.91	2.53	0.69	0.69
8.34	22.27	35.00	3.15	110.24	2.57	0.69	0.69
8.40	21.50	33.76	3.46	116.68	2.62	3.09	3.09
8.47	20.98	32.92	3.70	121.74	2.66	2.99	2.99
8.53	20.98	32.91	3.76	123.87	2.67	2.97	2.97
8.60	20.55	32.22	3.88	125.03	2.68	2.89	2.89
8.68	20.72	32.48	3.67	119.15	2.65	2.88	2.88
8.74	21.15	33.17	3.45	114.31	2.62	2.92	2.92
8.80	22.53	35.38	3.13	110.69	2.57	0.69	0.69
8.88	25.04	39.40	2.66	104.79	2.48	0.70	0.70
8.94	28.49	44.94	2.20	98.72	2.37	0.72	0.72
9.01	30.64	48.39	1.94	93.80	2.30	0.73	0.73
9.07	32.28	50.19	1.78	89.41	2.24	0.73	0.73
9.14	33.32	50.86	1.65	84.04	2.19	0.74	0.74
9.19	34.10	51.49	1.58	81.44	2.16	0.74	0.74
9.27	35.23	52.49	1.52	79.68	2.13	0.74	0.74
9.33	35.66	52.55	1.47	77.26	2.11	0.74	0.74
9.41	35.76	52.41	1.48	77.43	2.11	0.74	0.74
9.46	35.84	52.46	1.49	78.31	2.12	0.74	0.74

:: Strength loss calculation (Robertson (2009) :: (continued)

Depth (ft)	q_t (tsf)	Q_{tn}	K_c	$Q_{tn,cs}$	I_c	$S_{u(liq)}/\sigma'_v$	$S_{u(peak)}/\sigma'_v$
9.54	36.19	52.41	1.46	76.28	2.10	0.74	0.74
9.60	36.71	52.58	1.40	73.69	2.07	0.74	0.74
9.65	37.31	52.89	1.36	71.73	2.04	0.74	0.74
9.72	37.31	52.64	1.36	71.46	2.04	0.74	0.74
9.82	37.40	52.50	1.36	71.61	2.05	0.74	0.74
9.86	36.79	51.88	1.42	73.45	2.08	0.74	0.74
9.91	38.87	54.59	1.40	76.65	2.07	0.75	0.75
9.99	42.58	58.96	1.34	78.78	2.03	0.76	0.76
10.04	46.03	63.19	1.30	82.10	2.00	0.76	0.76
10.13	45.69	62.89	1.35	84.91	2.04	0.76	0.76
10.18	50.27	68.21	1.27	86.96	1.98	0.77	0.77
10.26	52.94	71.16	1.25	88.81	1.96	0.78	0.78
10.35	64.52	84.94	1.17	99.49	1.88	0.80	0.80
10.43	73.50	95.09	1.12	106.33	1.82	0.82	0.82
10.45	77.99	100.18	1.10	109.73	1.78	0.83	0.83
10.53	88.53	110.72	1.00	110.72	1.68	0.84	0.84
10.57	94.49	117.73	1.00	117.73	1.66	0.85	0.85
10.67	113.75	140.94	1.01	141.90	1.65	0.88	0.88
10.71	119.71	147.60	1.00	147.25	1.64	0.88	0.88
10.77	120.92	148.71	1.00	148.29	1.64	0.88	0.88
10.84	129.90	159.21	1.00	159.21	1.60	0.89	0.89
10.89	141.21	172.66	1.00	172.66	1.54	0.91	0.91
10.96	152.35	185.71	1.00	185.71	1.50	0.92	0.92
11.04	155.20	188.56	1.00	188.56	1.49	0.92	0.92
11.13	158.83	192.16	1.00	192.16	1.49	0.92	0.92
11.17	160.39	193.66	1.00	193.66	1.49	0.92	0.92
11.26	162.55	195.47	1.00	195.47	1.48	0.93	0.93
11.29	165.57	198.79	1.00	198.79	1.47	0.93	0.93
11.38	166.86	199.53	1.00	199.53	1.47	0.93	0.93
11.44	166.69	198.74	1.00	198.74	1.52	0.93	0.93
11.52	167.81	199.32	1.00	199.32	1.56	0.93	0.93
11.57	167.04	197.97	1.00	197.97	1.56	0.93	0.93
11.63	169.37	200.20	1.00	200.20	1.55	0.93	0.93
11.69	173.08	204.04	1.00	204.04	1.54	0.93	0.93
11.75	172.39	202.63	1.00	202.63	1.55	0.93	0.93
11.84	167.55	196.10	1.00	196.10	1.58	0.93	0.93
11.89	167.90	196.09	1.00	196.09	1.58	0.93	0.93
11.95	168.50	196.26	1.00	196.26	1.57	0.93	0.93
12.01	170.84	198.45	1.00	198.45	1.56	0.93	0.93
12.07	174.81	202.49	1.00	202.49	1.52	0.93	0.93
12.17	179.56	207.10	1.00	207.10	1.55	0.94	0.94
12.23	183.27	210.89	1.00	210.89	1.55	0.94	0.94
12.29	185.00	212.31	1.00	212.31	1.55	0.94	0.94
12.38	184.40	210.80	1.00	210.80	1.57	0.94	0.94
12.43	186.56	212.84	1.00	212.84	1.57	0.94	0.94
12.47	183.71	209.17	1.00	209.17	1.57	0.94	0.94
12.55	180.68	205.02	1.00	205.02	1.58	0.93	0.93
12.62	172.48	195.05	1.00	195.05	1.58	0.93	0.93

:: Strength loss calculation (Robertson (2009) :: (continued)

Depth (ft)	q_t (tsf)	Q_{tn}	K_c	$Q_{tn,cs}$	I_c	$S_{u(liq)}/\sigma'_v$	$S_{u(peak)}/\sigma'_v$
12.69	168.16	189.56	1.00	189.56	1.56	0.92	0.92
12.74	163.15	183.54	1.00	183.54	1.53	0.92	0.92
12.80	156.76	175.93	1.00	175.93	1.37	0.91	0.91
12.87	147.34	164.82	1.00	164.82	1.39	0.90	0.90
12.94	134.91	150.46	1.00	150.46	1.45	0.89	0.89
13.00	120.57	134.03	1.00	134.03	1.55	0.87	0.87
13.08	104.33	116.57	1.05	121.86	1.71	0.85	0.85
13.14	76.35	87.45	1.24	108.83	1.95	0.81	0.81
13.19	74.45	85.49	1.30	110.74	2.00	0.81	0.81
13.26	57.52	67.04	1.60	107.18	2.17	0.77	0.77
13.33	47.50	55.67	1.87	104.12	2.27	0.75	0.75
13.42	31.78	37.64	2.69	101.13	2.48	0.70	0.70
13.47	24.36	29.01	3.49	101.38	2.63	2.15	2.15
13.54	18.66	22.22	4.44	98.71	2.76	1.62	1.62
13.61	15.63	18.54	5.12	94.86	2.84	1.34	1.34
13.65	14.34	16.93	5.39	91.22	2.87	1.22	1.22
13.74	14.16	16.50	4.89	80.61	2.81	1.20	1.20
13.78	14.16	16.39	4.58	75.04	2.78	1.19	1.19
13.87	13.91	15.97	4.47	71.40	2.76	1.16	1.16
13.92	13.82	15.82	4.51	71.28	2.77	1.15	1.15
13.98	13.74	15.65	4.54	71.10	2.77	1.14	1.14
14.05	13.74	15.54	4.36	67.79	2.75	0.33	1.13
14.14	13.40	15.05	4.42	66.55	2.76	0.31	1.10
14.19	12.88	14.43	4.63	66.74	2.78	0.31	1.05
14.28	12.53	13.95	4.81	67.07	2.80	0.31	1.01
14.32	13.05	14.50	4.60	66.68	2.78	0.31	1.05
14.41	14.17	15.66	4.15	65.00	2.72	0.30	1.14
14.47	14.43	15.92	4.18	66.47	2.72	0.32	1.16
14.50	14.52	16.00	4.24	67.79	2.73	0.33	1.17
14.60	14.69	16.13	4.42	71.25	2.76	1.17	1.17
14.65	14.87	16.29	4.45	72.43	2.76	1.18	1.18
14.72	14.95	16.34	4.66	76.06	2.78	1.18	1.18
14.77	15.12	16.51	4.77	78.66	2.80	1.19	1.19
14.84	15.29	16.65	4.92	81.94	2.82	1.20	1.20
14.90	15.81	17.17	4.79	82.21	2.80	1.24	1.24
14.99	16.24	17.54	4.69	82.20	2.79	1.27	1.27
15.03	16.15	17.40	4.72	82.17	2.79	1.26	1.26
15.13	14.76	15.79	5.22	82.42	2.85	1.14	1.14
15.18	13.29	14.13	5.79	81.83	2.91	1.01	1.01
15.22	11.90	12.55	6.44	80.80	2.97	0.90	0.90
15.30	10.95	11.41	7.13	81.31	3.03	0.81	0.81
15.36	10.08	10.38	7.81	81.13	3.09	0.74	0.74
15.43	9.48	9.66	8.30	80.16	3.13	0.69	0.69
15.49	9.22	9.32	8.41	78.46	3.14	0.67	0.67
15.58	8.53	8.50	9.01	76.62	3.18	0.61	0.61
15.63	8.27	8.18	9.17	75.07	3.19	0.58	0.58
15.71	8.27	8.14	9.26	75.34	3.20	0.58	0.58
15.76	9.83	9.83	7.90	77.61	3.10	0.70	0.70

:: Strength loss calculation (Robertson (2009) :: (continued)

Depth (ft)	q_t (tsf)	Q_{tn}	K_c	$Q_{tn,cs}$	I_c	$S_{u(liq)}/\sigma'_v$	$S_{u(peak)}/\sigma'_v$
15.84	13.19	13.44	6.02	80.92	2.93	0.96	0.96
15.94	18.46	18.94	4.61	87.36	2.78	1.37	1.37
15.95	19.76	20.29	4.31	87.45	2.74	1.47	1.47
16.03	21.57	22.11	4.15	91.64	2.72	1.60	1.60
16.12	23.47	23.99	3.99	95.70	2.70	1.74	1.74
16.15	20.36	20.74	4.79	99.27	2.80	1.49	1.49
16.21	25.11	25.59	3.99	102.07	2.70	1.85	1.85
16.29	26.75	27.20	3.97	108.11	2.70	1.97	1.97
16.35	27.19	27.59	4.10	112.97	2.71	1.99	1.99
16.42	27.53	27.86	4.30	119.84	2.74	2.01	2.01
16.51	28.05	28.28	4.50	127.21	2.77	2.04	2.04
16.55	28.65	28.84	4.57	131.76	2.77	2.07	2.07
16.60	29.26	29.39	4.63	136.10	2.78	2.11	2.11
16.69	29.52	29.52	4.78	141.18	2.80	2.12	2.12
16.74	29.69	29.62	4.84	143.22	2.81	2.13	2.13
16.80	29.43	29.25	5.00	146.17	2.82	2.10	2.10
16.86	28.91	28.62	5.19	148.61	2.85	2.05	2.05
16.94	27.88	27.45	5.44	149.41	2.87	1.97	1.97
17.00	27.45	26.93	5.53	148.89	2.88	1.93	1.93
17.09	26.67	25.99	5.57	144.84	2.89	1.86	1.86
17.14	26.67	25.91	5.48	141.88	2.88	1.85	1.85
17.23	26.32	25.40	5.38	136.58	2.87	1.82	1.82
17.26	25.98	25.01	5.39	134.85	2.87	1.79	1.79
17.36	24.25	23.16	5.68	131.44	2.90	1.66	1.66
17.41	23.39	22.24	5.87	130.48	2.92	1.59	1.59
17.46	23.30	22.08	5.85	129.24	2.92	1.58	1.58
17.53	23.30	21.98	5.79	127.18	2.91	1.57	1.57
17.63	22.26	20.84	6.03	125.59	2.93	1.49	1.49
17.65	21.92	20.48	6.11	125.17	2.94	1.46	1.46
17.72	21.23	19.72	6.27	123.66	2.96	1.41	1.41
17.81	20.18	18.60	6.51	121.07	2.98	1.33	1.33
17.86	19.23	17.62	6.74	118.74	3.00	1.26	1.26
17.94	18.45	16.79	6.93	116.34	3.02	1.20	1.20
18.00	17.24	15.57	7.37	114.81	3.05	1.11	1.11
18.08	17.29	15.54	7.37	114.56	3.05	1.11	1.11
18.14	17.29	15.48	7.39	114.36	3.06	1.11	1.11
18.21	17.33	15.46	7.39	114.24	3.06	1.10	1.10
18.27	18.63	16.63	6.90	114.80	3.01	1.19	1.19
18.34	20.96	18.76	6.14	115.17	2.94	1.34	1.34
18.41	23.20	20.79	5.53	114.97	2.88	1.48	1.48
18.48	23.98	21.44	5.34	114.48	2.86	1.53	1.53
18.54	24.24	21.63	4.21	91.15	2.73	1.54	1.54
18.57	24.07	21.45	3.40	72.82	2.61	1.53	1.53
18.66	23.20	20.53	4.31	88.55	2.74	1.46	1.46
18.71	23.03	20.31	4.61	93.69	2.78	1.45	1.45
18.77	22.08	19.36	5.07	98.11	2.83	1.38	1.38
18.84	20.96	18.24	5.51	100.45	2.88	1.30	1.30
18.92	21.22	18.40	5.70	104.90	2.90	1.31	1.31

:: Strength loss calculation (Robertson (2009) :: (continued)

Depth (ft)	q_t (tsf)	Q_{tn}	K_c	$Q_{tn,cs}$	I_c	$S_{u(liq)}/\sigma'_v$	$S_{u(peak)}/\sigma'_v$
19.00	21.48	18.54	6.14	113.83	2.94	1.32	1.32
19.04	22.77	19.68	6.07	119.43	2.94	1.41	1.41
19.10	26.92	23.39	5.46	127.70	2.88	1.67	1.67
19.19	33.65	29.40	4.49	131.89	2.76	2.09	2.09
19.23	37.19	32.56	4.05	131.89	2.71	2.31	2.31
19.31	41.17	36.02	3.82	137.69	2.68	2.56	2.56
19.37	42.29	36.91	3.98	146.75	2.70	2.62	2.62
19.43	47.21	41.23	3.69	151.95	2.66	2.92	2.92
19.50	65.26	57.44	2.59	148.68	2.46	0.75	0.75
19.56	62.76	55.06	2.60	143.33	2.47	0.75	0.75
19.64	66.55	58.33	2.33	135.70	2.40	0.75	0.75
19.72	76.65	67.32	1.92	129.47	2.29	0.77	0.77
19.77	82.27	72.32	1.72	124.38	2.22	0.78	0.78
19.85	99.11	87.49	1.41	123.18	2.07	0.81	0.81
19.90	110.93	98.14	1.28	125.54	1.98	0.82	0.82
19.95	120.61	106.85	1.21	129.39	1.92	0.84	0.84
20.04	131.57	116.25	1.22	142.26	1.94	0.85	0.85
20.08	135.11	119.07	1.27	151.19	1.98	0.85	0.85
20.16	145.90	128.31	1.27	162.94	1.98	0.86	0.86
20.22	156.79	137.97	1.21	166.69	1.92	0.87	0.87
20.28	175.27	154.33	1.16	179.65	1.87	0.89	0.89
20.36	218.28	193.00	1.07	206.79	1.75	0.92	0.92
20.45	302.14	268.18	1.00	268.18	1.58	0.98	0.98
20.49	333.49	295.76	1.00	295.76	1.53	0.99	0.99
20.58	363.82	321.92	1.00	321.92	1.43	1.01	1.01
20.63	344.82	304.68	1.00	304.68	1.44	1.00	1.00
20.69	319.34	281.60	1.00	281.60	1.37	0.98	0.98
20.75	314.86	277.23	1.00	277.23	1.28	0.98	0.98
20.81	274.19	240.86	1.00	240.86	1.38	0.96	0.96
20.89	247.42	216.81	1.00	216.81	1.48	0.94	0.94
20.94	229.20	200.50	1.00	200.50	1.54	0.93	0.93
21.00	217.89	190.23	1.00	190.23	1.57	0.92	0.92
21.07	165.91	143.53	1.06	152.70	1.74	0.88	0.88
21.14	188.79	163.86	1.01	166.13	1.66	0.90	0.90
21.20	193.70	167.96	1.01	169.38	1.66	0.90	0.90
21.26	197.68	171.17	1.01	172.54	1.66	0.91	0.91
21.34	211.32	182.89	1.00	182.89	1.63	0.92	0.92
21.39	232.48	201.02	1.00	201.02	1.56	0.93	0.93
21.47	254.08	219.35	1.00	219.35	1.49	0.94	0.94
21.54	279.46	241.01	1.00	241.01	1.41	0.96	0.96
21.61	290.77	250.35	1.00	250.35	1.30	0.97	0.97
21.66	301.06	258.88	1.00	258.88	1.24	0.97	0.97
21.74	309.08	265.32	1.00	265.32	1.26	0.97	0.97
21.79	316.87	271.70	1.00	271.70	1.30	0.98	0.98
21.87	307.62	263.21	1.00	263.21	1.47	0.97	0.97
21.92	301.24	257.36	1.00	257.36	1.56	0.97	0.97
21.99	307.90	262.60	1.00	262.60	1.61	0.97	0.97
22.07	336.58	286.85	1.00	286.85	1.48	0.99	0.99

:: Strength loss calculation (Robertson (2009) :: (continued)

Depth (ft)	q_t (tsf)	Q_{tn}	K_c	$Q_{tn,cs}$	I_c	$S_{u(liq)}/\sigma'_v$	$S_{u(peak)}/\sigma'_v$
22.13	308.16	262.34	1.00	262.34	1.46	0.97	0.97
22.21	338.87	288.30	1.00	288.30	1.33	0.99	0.99
22.25	309.98	263.48	1.00	263.48	1.40	0.97	0.97
22.33	341.16	289.78	1.00	289.78	1.43	0.99	0.99
22.38	327.42	277.89	1.00	277.89	1.52	0.98	0.98
22.45	352.20	298.70	1.00	298.70	1.46	0.99	0.99
22.51	338.21	286.59	1.00	286.59	1.47	0.99	0.99
22.58	360.14	304.96	1.00	304.96	1.43	1.00	1.00
22.65	373.95	316.39	1.00	316.39	1.42	1.00	1.00
22.73	369.38	312.19	1.00	312.19	1.43	1.00	1.00
22.79	368.25	310.99	1.00	310.99	1.42	1.00	1.00
22.88	364.88	307.77	1.00	307.77	1.40	1.00	1.00
22.91	367.29	309.66	1.00	309.66	1.38	1.00	1.00
23.00	359.87	303.04	1.00	303.04	1.35	1.00	1.00
23.03	357.45	300.87	1.00	300.87	1.35	1.00	1.00
23.10	358.57	301.57	1.00	301.57	1.33	1.00	1.00
23.18	361.07	303.39	1.00	303.39	1.32	1.00	1.00
23.23	366.51	307.78	1.00	307.78	1.26	1.00	1.00
23.30	375.58	315.16	1.00	315.16	1.14	1.00	1.00
23.37	381.01	319.48	1.00	319.48	1.17	1.01	1.01
23.45	381.87	319.89	1.00	319.89	1.20	1.01	1.01
23.54	378.24	316.48	1.00	316.48	1.24	1.00	1.00
23.56	368.30	308.07	1.00	308.07	1.26	1.00	1.00
23.65	349.99	292.37	1.00	292.37	1.30	0.99	0.99
23.69	355.35	296.71	1.00	296.71	1.30	0.99	0.99
23.76	357.76	298.47	1.00	298.47	1.31	0.99	0.99
23.82	360.26	300.34	1.00	300.34	1.31	0.99	0.99
23.89	365.44	304.41	1.00	304.41	1.34	1.00	1.00
23.96	381.07	317.20	1.00	317.20	1.37	1.00	1.00
24.02	420.98	350.26	1.00	350.26	1.31	1.02	1.02
24.09	472.61	393.03	1.00	393.03	1.26	1.04	1.04
24.16	511.05	424.72	1.00	424.72	1.24	1.05	1.05
24.22	507.85	421.73	1.00	421.73	1.28	1.05	1.05
24.29	454.39	376.85	1.00	376.85	1.38	1.03	1.03
24.36	420.53	348.35	1.00	348.35	1.39	1.02	1.02
24.42	382.27	316.32	1.00	316.32	1.42	1.00	1.00
24.50	376.57	311.29	1.00	311.29	1.33	1.00	1.00
24.59	358.18	295.71	1.00	295.71	1.25	0.99	0.99
24.62	357.74	295.22	1.00	295.22	1.25	0.99	0.99
24.68	357.74	295.03	1.00	295.03	1.27	0.99	0.99
24.77	357.31	294.38	1.00	294.38	1.27	0.99	0.99
24.81	359.64	296.13	1.00	296.13	1.26	0.99	0.99
24.89	355.41	292.38	1.00	292.38	1.27	0.99	0.99
24.95	370.27	304.44	1.00	304.44	1.24	1.00	1.00
25.02	382.79	314.49	1.00	314.49	1.24	1.00	1.00
25.08	389.79	320.06	1.00	320.06	1.26	1.01	1.01
25.16	403.95	331.38	1.00	331.38	1.29	1.01	1.01
25.20	403.95	331.24	1.00	331.24	1.30	1.01	1.01

:: Strength loss calculation (Robertson (2009) :: (continued)

Depth (ft)	q_t (tsf)	Q_{tn}	K_c	$Q_{tn,cs}$	I_c	$S_{u(liq)}/\sigma'_v$	$S_{u(peak)}/\sigma'_v$
25.26	400.49	328.14	1.00	328.14	1.33	1.01	1.01
25.35	389.79	318.99	1.00	318.99	1.36	1.00	1.00
25.40	381.23	311.78	1.00	311.78	1.37	1.00	1.00
25.48	370.34	302.53	1.00	302.53	1.38	1.00	1.00
25.53	366.03	298.81	1.00	298.81	1.38	0.99	0.99
25.62	356.53	290.72	1.00	290.72	1.36	0.99	0.99
25.66	353.07	287.74	1.00	287.74	1.35	0.99	0.99
25.75	344.68	280.59	1.00	280.59	1.29	0.98	0.98
25.80	341.31	277.69	1.00	277.69	1.24	0.98	0.98
25.86	338.64	275.30	1.00	275.30	1.23	0.98	0.98
25.94	338.38	274.86	1.00	274.86	1.23	0.98	0.98
26.00	336.22	272.90	1.00	272.90	1.25	0.98	0.98
26.06	332.76	269.92	1.00	269.92	1.27	0.98	0.98
26.15	309.10	250.38	1.00	250.38	1.33	0.97	0.97
26.19	315.58	255.53	1.00	255.53	1.32	0.97	0.97
26.28	314.89	254.72	1.00	254.72	1.33	0.97	0.97
26.33	314.89	254.58	1.00	254.58	1.33	0.97	0.97
26.38	317.13	256.25	1.00	256.25	1.33	0.97	0.97
26.45	320.50	258.77	1.00	258.77	1.33	0.97	0.97
26.52	328.53	265.08	1.00	265.08	1.32	0.97	0.97
26.59	333.54	268.95	1.00	268.95	1.31	0.98	0.98
26.64	340.71	274.58	1.00	274.58	1.30	0.98	0.98
26.72	351.76	283.28	1.00	283.28	1.39	0.99	0.99
26.77	362.13	291.47	1.00	291.47	1.50	0.99	0.99
26.84	382.60	307.77	1.00	307.77	1.52	1.00	1.00
26.90	402.12	323.27	1.00	323.27	1.52	1.01	1.01
26.98	430.01	345.43	1.00	345.43	1.50	1.02	1.02
27.05	440.64	353.72	1.00	353.72	1.50	1.02	1.02
27.11	433.30	347.53	1.00	347.53	1.49	1.02	1.02
27.18	454.97	364.67	1.00	364.67	1.43	1.03	1.03
27.24	407.64	326.37	1.00	326.37	1.47	1.01	1.01
27.30	404.09	323.25	1.00	323.25	1.41	1.01	1.01
27.38	425.00	339.76	1.00	339.76	1.33	1.02	1.02
27.44	426.64	340.82	1.00	340.82	1.31	1.02	1.02
27.50	428.71	342.24	1.00	342.24	1.29	1.02	1.02
27.56	422.58	337.08	1.00	337.08	1.26	1.01	1.01
27.63	407.20	324.52	1.00	324.52	1.26	1.01	1.01
27.70	420.42	334.85	1.00	334.85	1.24	1.01	1.01
27.76	397.36	316.18	1.00	316.18	1.28	1.00	1.00
27.84	418.26	332.59	1.00	332.59	1.33	1.01	1.01
27.89	423.44	336.49	1.00	336.49	1.36	1.01	1.01
27.96	461.62	366.68	1.00	366.68	1.25	1.03	1.03
28.03	481.13	-1.00	1.00	-1.00	-1.00	N/A	N/A
28.11	529.59	-1.00	1.00	-1.00	-1.00	N/A	N/A
28.15	556.71	-1.00	1.00	-1.00	-1.00	N/A	N/A
28.22	617.60	-1.00	1.00	-1.00	-1.00	N/A	N/A
28.31	616.47	-1.00	1.00	-1.00	-1.00	N/A	N/A
28.36	697.06	-1.00	1.00	-1.00	-1.00	N/A	N/A

:: Strength loss calculation (Robertson (2009) :: (continued)

Depth (ft)	q_t (tsf)	Q_{tn}	K_c	$Q_{tn,cs}$	I_c	$S_{u(liq)}/\sigma'_v$	$S_{u(peak)}/\sigma'_v$

Abbreviations

q_t:	Total cone resistance
K_c:	Cone resistance correction factor due to fines
$Q_{tn,cs}$:	Adjusted and corrected cone resistance due to fines
I_c:	Soil behavior type index
$S_{u(liq)}/\sigma'_v$:	Calculated liquefied undrained strength ratio
$S_{u(peak)}/\sigma'_v$:	Calculated peak undrained strength ratio

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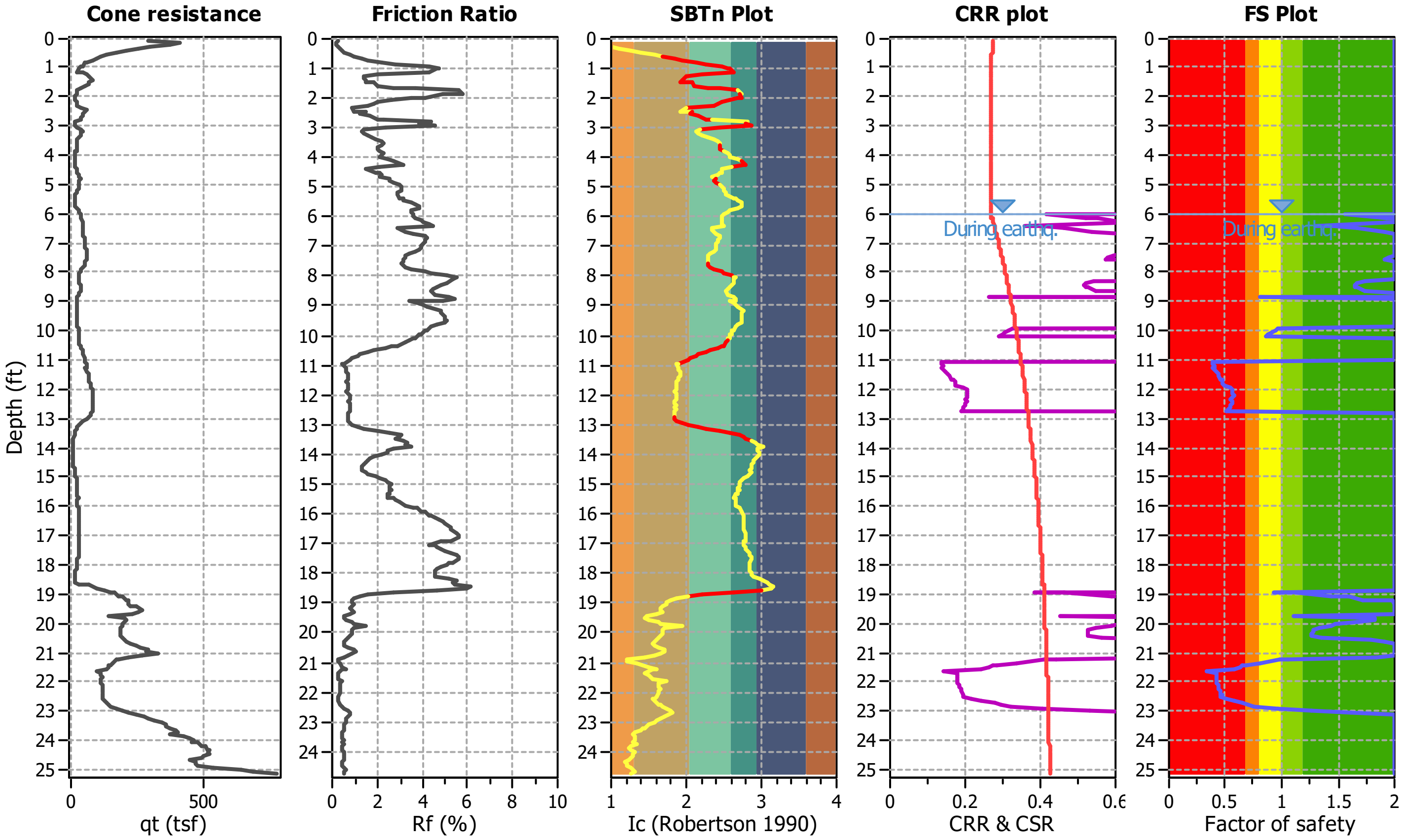
LIQUEFACTION ANALYSIS REPORT

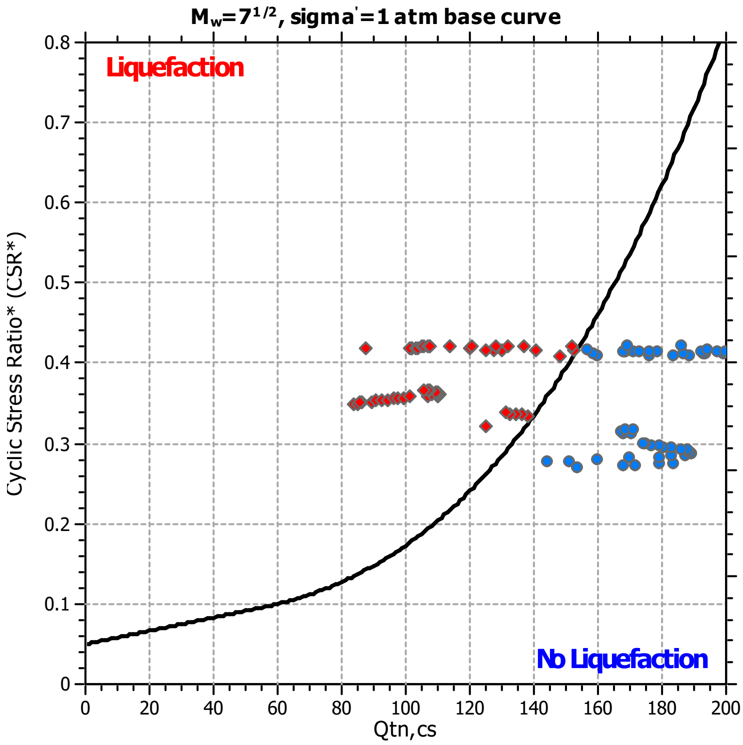
Project title : Twining Consulting **Location : 4112 Del Rey Ave, Marina Del Rey, CA**

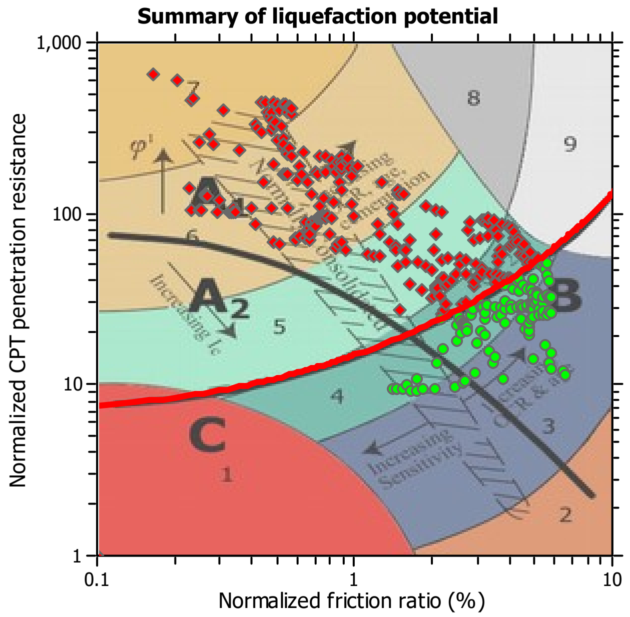
CPT file : CPT-4

Input parameters and analysis data

Analysis method:	NCEER (1998)	G.W.T. (in-situ):	18.80 ft	Use fill:	No	Clay like behavior applied:	Sands only
Fines correction method:	NCEER (1998)	G.W.T. (earthq.):	6.00 ft	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	1	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	6.35	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.58	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

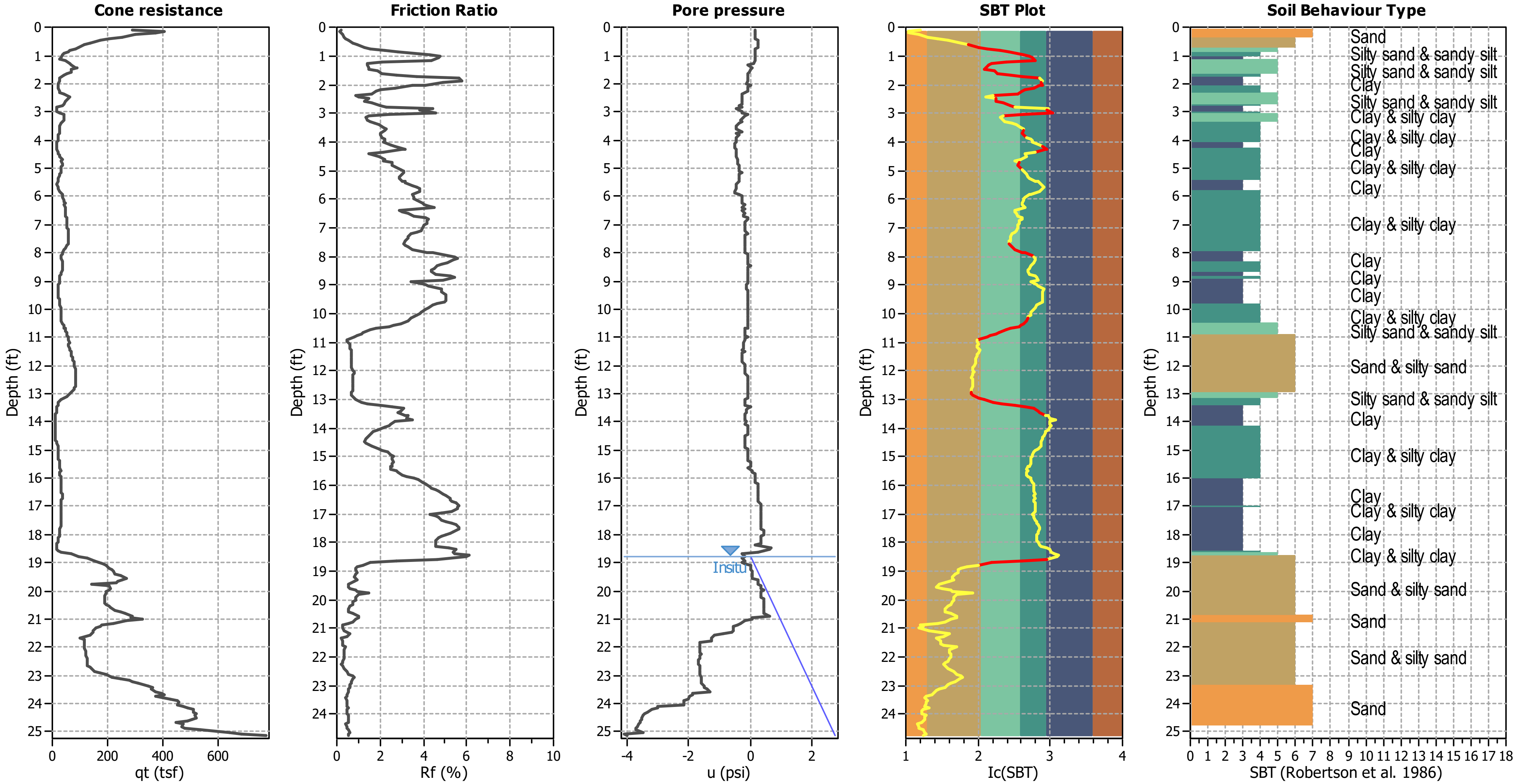






Zone A_1: Cyclic liquefaction likely depending on size and duration of cyclic loading
Zone A_2: Cyclic liquefaction and strength loss likely depending on loading and ground geometry
Zone B: Liquefaction and post-earthquake strength loss unlikely, check cyclic softening
Zone C: Cyclic liquefaction and strength loss possible depending on soil plasticity, brittleness/sensitivity, strain to peak undrained strength and ground geometry

CPT basic interpretation plots



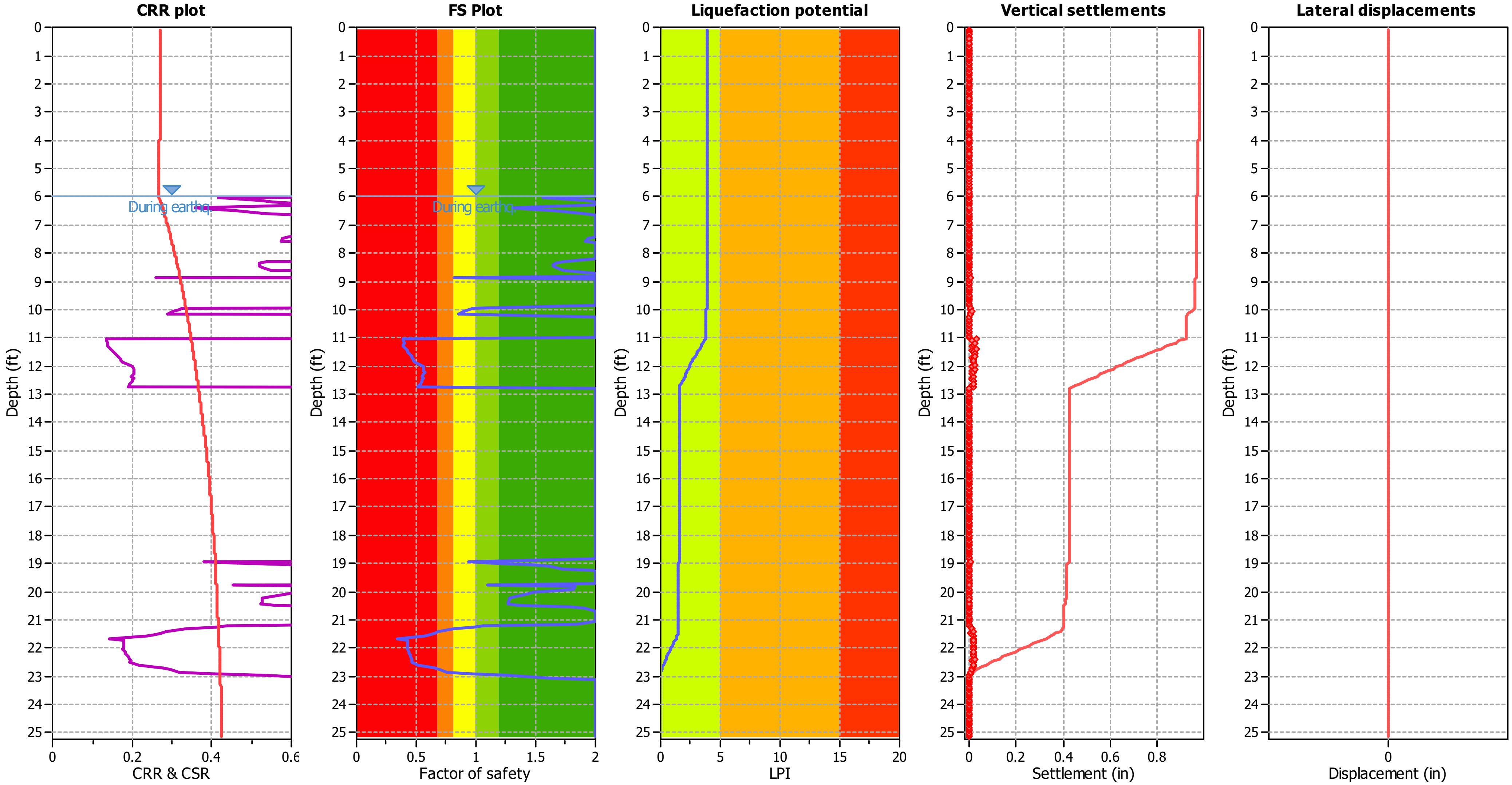
Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	6.00 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	1	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	6.35	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.58	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	18.80 ft	Fill height:	N/A	Limit depth:	N/A

SBT legend

1. Sensitive fine grained
2. Organic material
3. Clay to silty clay
4. Clayey silt to silty
5. Silty sand to sandy silt
6. Clean sand to silty sand
7. Gravely sand to sand
8. Very stiff sand to
9. Very stiff fine grained

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	6.00 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	1	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	6.35	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.58	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	18.80 ft	Fill height:	N/A	Limit depth:	N/A

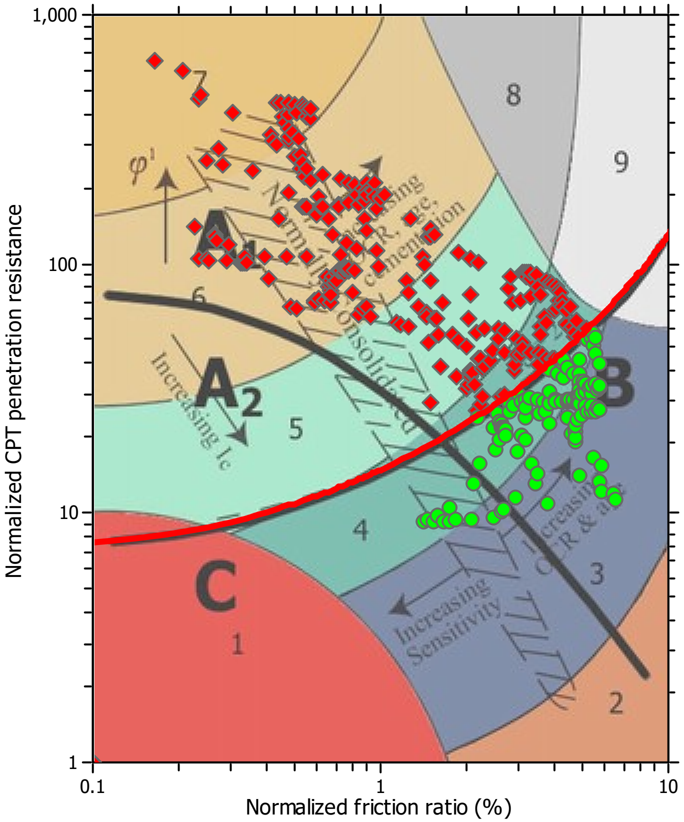
F.S. color scheme

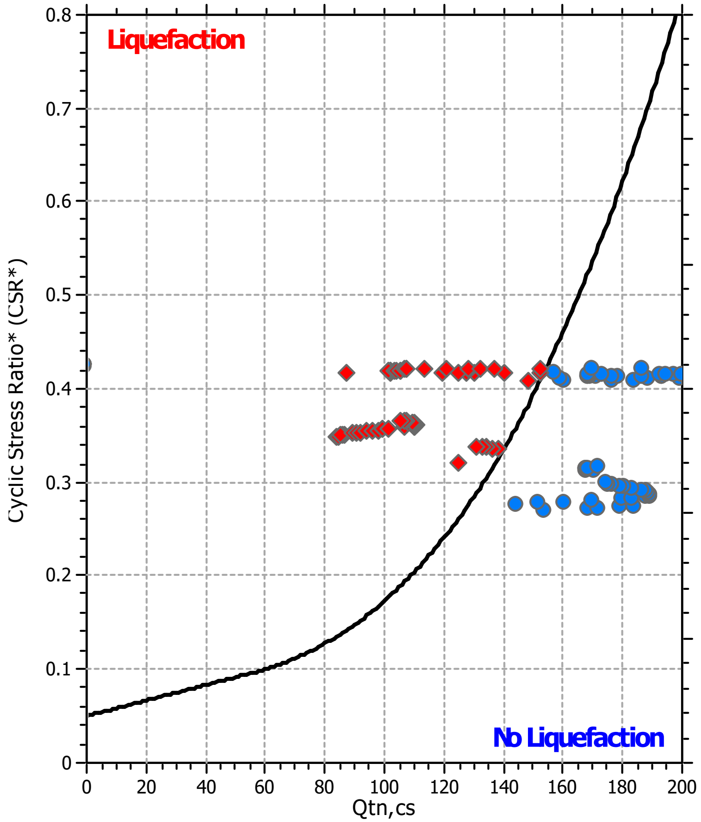
- Almost certain it will liquefy
- Very likely to liquefy
- Liquefaction and no liq. are equally likely
- Unlike to liquefy
- Almost certain it will not liquefy

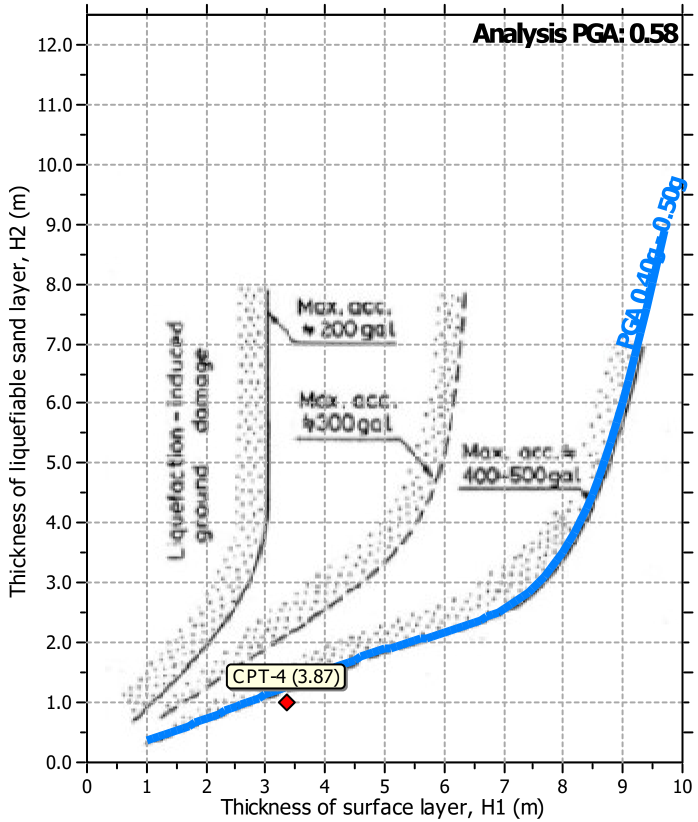
LPI color scheme

- Very high risk
- High risk
- Low risk

Liquefaction analysis summary plots







Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	6.00 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	1	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_{σ} applied:	Yes
Earthquake magnitude M_w:	6.35	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.58	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	18.80 ft	Fill height:	N/A	Limit depth:	N/A

:: Field input data ::

Point ID	Depth (ft)	q_c (tsf)	f_s (tsf)	u (tsf)	Fines content (%)	Unit weight (pcf)
1	0.09	287.18	0.67	0.17	0.00	121.15
2	0.14	405.59	0.67	0.17	0.00	121.99
3	0.20	370.95	0.76	0.17	0.00	122.69
4	0.27	296.85	0.70	0.17	0.00	121.58
5	0.34	251.25	0.77	0.17	0.00	121.88
6	0.41	205.64	0.85	0.17	0.06	122.04
7	0.47	169.37	0.89	0.26	1.53	121.97
8	0.55	133.09	1.02	0.26	4.18	122.38
9	0.60	115.39	1.09	0.26	6.05	122.51
10	0.69	94.49	1.21	0.26	9.21	122.74
11	0.74	81.01	1.25	0.17	11.76	122.62
12	0.82	63.39	1.39	0.17	17.00	122.78
13	0.86	54.93	1.55	0.17	21.15	123.25
14	0.93	41.89	1.80	0.17	29.67	123.69
15	0.99	37.14	1.77	0.17	32.76	123.27
16	1.05	31.70	1.48	0.17	34.66	121.58
17	1.14	25.74	1.12	0.17	36.62	119.00
18	1.19	46.81	0.96	0.17	19.39	119.36
19	1.27	62.27	0.88	0.13	13.23	119.42
20	1.32	67.28	0.94	-0.09	12.47	120.08
21	1.41	80.32	1.18	0.09	11.48	122.21
22	1.46	86.11	1.27	0.09	10.97	122.91
23	1.51	68.75	1.29	0.00	14.81	122.45
24	1.59	65.47	1.34	-0.04	16.07	122.62
25	1.65	49.83	1.37	-0.07	21.94	122.13
26	1.71	38.43	1.41	-0.07	28.64	121.71
27	1.78	26.86	1.51	-0.09	40.12	121.29
28	1.85	24.53	1.41	-0.10	42.04	120.60
29	1.91	22.46	1.10	-0.10	40.76	118.54
30	2.00	17.88	0.73	-0.11	41.76	115.00
31	2.04	17.62	0.61	0.00	39.60	113.71
32	2.11	18.83	0.50	-0.09	34.66	112.38
33	2.17	20.56	0.41	-0.09	29.72	111.16
34	2.25	22.28	0.41	-0.09	27.44	111.23
35	2.30	24.10	0.39	-0.17	25.07	111.14
36	2.37	41.54	0.36	-0.26	13.27	111.81
37	2.45	60.89	0.60	-0.26	10.77	116.57
38	2.50	53.55	0.79	-0.26	14.99	118.27
39	2.56	47.93	0.60	-0.26	14.65	115.94
40	2.63	43.70	0.72	-0.26	17.96	117.04
41	2.71	37.74	0.76	-0.26	21.64	117.11
42	2.76	34.72	0.80	-0.35	24.10	117.26
43	2.84	15.11	0.67	-0.26	46.29	113.95
44	2.90	14.25	0.55	-0.43	45.11	112.35
45	2.97	13.13	0.60	-0.26	49.70	112.85
46	3.04	25.48	0.61	-0.26	28.70	114.53
47	3.09	38.43	0.56	-0.09	18.23	114.87
48	3.16	42.06	0.57	-0.17	16.68	115.28

:: Field input data :: (continued)

Point ID	Depth (ft)	q_c (tsf)	f_s (tsf)	u (tsf)	Fines content (%)	Unit weight (pcf)
49	3.22	40.08	0.58	-0.27	17.74	115.26
50	3.29	37.83	0.58	-0.31	18.95	115.16
51	3.36	32.82	0.58	-0.26	21.95	114.76
52	3.42	29.02	0.57	-0.35	24.73	114.40
53	3.48	26.17	0.57	-0.43	27.22	114.09
54	3.54	24.53	0.56	-0.43	28.68	113.79
55	3.62	23.92	0.53	-0.43	28.82	113.40
56	3.70	23.58	0.48	-0.26	27.95	112.59
57	3.75	22.20	0.45	-0.43	28.84	112.00
58	3.83	20.56	0.43	-0.35	30.41	111.50
59	3.89	18.40	0.41	-0.43	33.00	110.91
60	3.96	17.27	0.38	-0.43	33.74	110.11
61	4.01	16.41	0.35	-0.43	34.27	109.41
62	4.09	13.82	0.34	-0.43	39.19	108.77
63	4.14	12.96	0.35	-0.52	41.76	108.85
64	4.24	12.35	0.39	-0.52	45.07	109.53
65	4.27	12.87	0.39	-0.52	43.66	109.65
66	4.34	15.11	0.32	-0.43	35.81	108.65
67	4.41	17.45	0.26	-0.43	29.06	107.33
68	4.50	20.04	0.39	-0.43	30.07	110.76
69	4.54	23.06	0.48	-0.43	28.51	112.49
70	4.59	26.17	0.57	-0.43	27.41	114.17
71	4.67	33.08	0.71	-0.42	24.04	116.30
72	4.74	31.61	0.80	-0.42	26.55	117.07
73	4.82	34.72	0.88	-0.42	25.32	117.98
74	4.87	33.86	0.91	-0.35	26.38	118.19
75	4.96	31.78	0.94	-0.35	28.35	118.22
76	5.01	30.49	0.94	-0.35	29.58	118.19
77	5.09	28.93	0.90	-0.35	30.32	117.67
78	5.14	27.47	0.83	-0.26	30.78	117.01
79	5.22	24.79	0.71	-0.35	31.61	115.63
80	5.25	23.49	0.67	-0.35	32.42	115.09
81	5.37	18.74	0.56	-0.35	36.75	113.24
82	5.38	17.79	0.56	-0.35	38.20	113.01
83	5.45	16.58	0.52	-0.35	39.61	112.40
84	5.54	15.72	0.55	-0.43	42.14	112.63
85	5.59	15.98	0.59	-0.43	42.58	113.14
86	5.64	17.27	0.66	-0.43	41.73	114.17
87	5.72	19.35	0.74	-0.43	39.74	115.29
88	5.82	25.13	0.88	-0.52	34.20	117.23
89	5.85	27.55	0.95	-0.52	32.61	118.02
90	5.95	32.82	1.18	-0.35	30.56	119.97
91	6.00	35.50	1.27	-0.26	29.50	120.74
92	6.04	36.53	1.36	-0.26	29.58	121.27
93	6.14	40.77	1.62	-0.26	29.10	122.84
94	6.18	41.72	1.69	-0.26	29.05	123.20
95	6.26	42.67	1.82	-0.26	29.50	123.80
96	6.31	41.98	1.89	-0.17	30.49	124.04

:: Field input data :: (continued)

Point ID	Depth (ft)	q_c (tsf)	f_s (tsf)	u (tsf)	Fines content (%)	Unit weight (pcf)
97	6.40	43.53	1.24	-0.26	24.03	121.07
98	6.44	44.83	1.36	-0.17	24.44	121.81
99	6.50	46.29	1.52	-0.26	24.98	122.67
100	6.59	46.90	1.68	-0.17	26.00	123.46
101	6.67	44.74	1.84	-0.20	28.43	124.01
102	6.70	44.65	1.90	-0.22	28.91	124.23
103	6.77	48.45	2.01	-0.09	27.58	124.85
104	6.83	49.40	2.05	-0.09	27.33	125.03
105	6.90	51.13	2.06	-0.17	26.54	125.16
106	6.98	51.82	2.04	-0.17	26.09	125.13
107	7.03	51.82	2.05	-0.17	26.12	125.14
108	7.10	52.51	2.04	-0.17	25.76	125.16
109	7.15	54.24	2.02	-0.17	24.81	125.15
110	7.23	57.00	1.96	-0.17	23.28	125.07
111	7.31	58.21	1.91	-0.09	22.46	124.92
112	7.35	58.13	1.89	-0.17	22.38	124.85
113	7.44	57.87	1.84	-0.17	22.13	124.62
114	7.49	57.69	1.81	-0.17	21.99	124.49
115	7.55	57.78	1.79	-0.17	21.86	124.43
116	7.63	56.31	1.79	-0.17	22.47	124.38
117	7.68	54.76	1.79	-0.17	23.11	124.31
118	7.76	50.87	1.79	-0.17	24.85	124.12
119	7.85	43.10	1.79	-0.17	29.05	123.70
120	7.89	40.59	1.79	-0.17	30.69	123.55
121	7.99	34.98	1.79	-0.17	34.99	123.19
122	8.02	32.82	1.78	-0.09	36.89	123.01
123	8.07	31.87	1.77	-0.09	37.71	122.89
124	8.14	31.78	1.71	-0.09	37.27	122.64
125	8.22	31.96	1.63	-0.09	36.34	122.31
126	8.30	32.56	1.57	-0.09	35.19	122.09
127	8.34	33.25	1.55	-0.09	34.28	122.00
128	8.43	34.72	1.55	-0.09	33.09	122.15
129	8.48	35.93	1.57	0.00	32.24	122.30
130	8.53	36.45	1.59	-0.09	32.02	122.43
131	8.61	35.58	1.62	-0.09	33.06	122.53
132	8.70	31.35	1.64	-0.09	36.99	122.27
133	8.74	29.62	1.62	-0.09	38.64	122.06
134	8.83	25.91	1.26	-0.09	38.91	119.92
135	8.87	24.87	0.86	-0.09	34.29	116.97
136	8.92	23.75	0.90	-0.09	36.44	117.23
137	8.99	22.89	0.93	-0.09	38.13	117.39
138	9.06	22.28	0.94	-0.09	39.23	117.43
139	9.15	20.04	0.97	-0.13	43.21	117.34
140	9.22	20.90	1.00	-0.13	42.38	117.71
141	9.26	21.33	1.03	-0.13	42.12	117.96
142	9.35	21.16	1.07	-0.09	42.96	118.18
143	9.40	21.25	1.06	-0.09	42.77	118.17
144	9.48	21.07	1.06	-0.09	43.06	118.14

:: Field input data :: (continued)

Point ID	Depth (ft)	q_c (tsf)	f_s (tsf)	u (tsf)	Fines content (%)	Unit weight (pcf)
145	9.53	21.07	1.06	-0.09	43.10	118.16
146	9.58	21.42	1.07	-0.09	42.55	118.21
147	9.66	23.06	1.07	-0.09	40.06	118.39
148	9.72	24.18	1.07	-0.09	38.50	118.50
149	9.80	25.48	1.08	-0.09	37.12	118.73
150	9.85	26.52	1.09	-0.09	36.09	118.87
151	9.94	27.38	1.07	-0.09	35.09	118.85
152	9.98	27.38	1.05	-0.09	34.90	118.71
153	10.08	27.81	1.03	-0.09	34.34	118.63
154	10.12	28.76	1.03	-0.09	33.37	118.66
155	10.18	29.45	1.02	-0.09	32.63	118.63
156	10.25	29.71	0.97	-0.09	31.87	118.31
157	10.34	29.88	0.87	-0.09	30.53	117.57
158	10.39	30.57	0.81	-0.09	29.00	117.03
159	10.44	31.35	0.75	-0.09	27.65	116.60
160	10.52	35.58	0.66	-0.09	23.32	115.90
161	10.57	38.09	0.60	-0.09	20.98	115.36
162	10.66	41.98	0.52	-0.09	17.95	114.59
163	10.70	44.05	0.49	-0.17	16.64	114.29
164	10.77	47.42	0.43	-0.17	14.52	113.55
165	10.83	48.80	0.41	-0.17	13.68	113.17
166	10.93	52.86	0.27	-0.17	10.19	110.23
167	10.97	54.15	0.26	-0.09	5.00	110.13
168	11.06	56.57	0.33	-0.17	10.41	112.00
169	11.10	57.69	0.34	-0.17	10.25	112.18
170	11.19	58.99	0.36	-0.20	10.28	112.65
171	11.25	57.69	0.37	-0.22	10.78	112.83
172	11.29	56.57	0.37	-0.21	11.18	112.91
173	11.38	60.72	0.40	-0.20	10.59	113.58
174	11.43	61.93	0.41	-0.26	10.48	113.82
175	11.49	64.17	0.42	-0.17	10.17	114.12
176	11.56	66.50	0.44	-0.26	9.88	114.43
177	11.64	68.66	0.45	-0.26	9.71	114.82
178	11.70	69.53	0.48	-0.26	9.82	115.20
179	11.75	70.99	0.50	-0.26	9.78	115.54
180	11.81	72.38	0.48	-0.26	9.41	115.40
181	11.88	75.14	0.48	-0.26	8.93	115.47
182	11.97	78.42	0.58	-0.17	9.38	116.91
183	12.01	79.46	0.64	-0.17	9.76	117.64
184	12.10	80.93	0.63	-0.17	9.44	117.55
185	12.16	81.53	0.62	-0.17	9.34	117.55
186	12.24	83.43	0.62	-0.17	9.01	117.53
187	12.28	82.65	0.62	-0.17	9.15	117.51
188	12.36	80.41	0.62	-0.09	9.56	117.45
189	12.41	82.65	0.62	-0.09	9.24	117.56
190	12.47	81.79	0.63	-0.09	9.46	117.61
191	12.55	82.65	0.62	-0.09	9.27	117.53
192	12.64	82.05	0.59	-0.09	9.14	117.18

:: Field input data :: (continued)

Point ID	Depth (ft)	q_c (tsf)	f_s (tsf)	u (tsf)	Fines content (%)	Unit weight (pcf)
193	12.67	81.79	0.58	-0.09	9.09	117.03
194	12.73	81.19	0.56	-0.09	9.05	116.79
195	12.81	78.34	0.53	-0.09	9.19	116.22
196	12.86	74.45	0.51	-0.09	9.70	115.84
197	12.93	67.11	0.53	-0.09	11.47	115.92
198	13.00	59.08	0.52	-0.09	13.36	115.47
199	13.08	48.97	0.57	-0.09	17.28	115.61
200	13.13	41.72	0.60	-0.09	20.96	115.60
201	13.22	30.92	0.62	-0.17	28.46	115.18
202	13.27	24.87	0.63	-0.17	34.58	114.71
203	13.33	20.21	0.62	-0.17	41.01	114.16
204	13.40	17.10	0.51	-0.17	43.69	112.21
205	13.46	14.86	0.42	0.00	46.02	110.53
206	13.54	13.30	0.42	-0.09	50.18	110.23
207	13.59	12.18	0.40	-0.12	52.97	109.69
208	13.67	11.31	0.36	-0.12	54.47	108.78
209	13.72	9.50	0.33	-0.16	60.57	107.67
210	13.79	10.10	0.27	-0.16	54.82	106.44
211	13.88	9.24	0.23	-0.16	55.85	104.88
212	13.92	8.98	0.22	-0.17	56.35	104.44
213	13.99	8.64	0.19	-0.12	56.34	103.50
214	14.06	8.55	0.16	-0.17	54.17	102.12
215	14.13	8.55	0.14	-0.09	52.62	101.23
216	14.19	8.46	0.13	-0.09	52.35	100.78
217	14.25	8.46	0.13	-0.09	51.74	100.39
218	14.32	8.64	0.12	-0.09	50.36	100.05
219	14.37	8.72	0.12	-0.09	49.63	99.82
220	14.46	8.72	0.11	-0.09	49.35	99.57
221	14.51	8.90	0.12	-0.17	49.22	99.97
222	14.57	9.24	0.13	-0.17	49.48	100.99
223	14.64	9.93	0.16	-0.17	49.00	102.40
224	14.73	12.26	0.24	-0.17	46.75	105.94
225	14.78	14.68	0.31	-0.17	43.64	108.16
226	14.85	16.58	0.39	-0.17	42.96	110.31
227	14.91	18.31	0.45	-0.17	41.57	111.57
228	14.98	19.17	0.50	-0.09	41.46	112.41
229	15.05	20.12	0.52	-0.09	40.37	112.75
230	15.10	20.47	0.52	-0.09	40.01	112.88
231	15.18	20.12	0.53	-0.09	40.81	112.91
232	15.23	20.56	0.53	-0.09	40.16	112.97
233	15.32	21.33	0.54	-0.09	39.36	113.22
234	15.36	21.94	0.55	-0.09	38.68	113.39
235	15.45	23.58	0.58	0.00	37.31	114.01
236	15.49	24.01	0.65	0.00	38.36	114.92
237	15.56	25.74	0.72	0.00	37.63	115.84
238	15.62	26.60	0.79	-0.09	37.94	116.59
239	15.71	27.72	0.89	0.09	38.33	117.52
240	15.77	26.64	0.95	0.09	40.71	117.94

:: Field input data :: (continued)

Point ID	Depth (ft)	q_c (tsf)	f_s (tsf)	u (tsf)	Fines content (%)	Unit weight (pcf)
241	15.82	26.69	1.00	0.17	41.45	118.30
242	15.90	26.77	1.06	0.17	42.35	118.74
243	15.96	26.95	1.11	0.17	42.88	119.08
244	16.05	27.21	1.18	0.17	43.53	119.51
245	16.09	27.47	1.20	0.17	43.62	119.70
246	16.16	27.90	1.28	0.17	44.15	120.18
247	16.22	28.76	1.35	0.26	44.10	120.68
248	16.29	29.45	1.44	0.26	44.34	121.17
249	16.36	30.40	1.53	0.26	44.30	121.69
250	16.45	31.27	1.64	0.26	44.61	122.28
251	16.50	31.96	1.68	0.26	44.34	122.52
252	16.54	32.47	1.72	0.26	44.22	122.73
253	16.63	32.73	1.80	0.26	44.78	123.07
254	16.72	32.30	1.82	0.26	45.53	123.11
255	16.75	32.13	1.80	0.26	45.61	123.04
256	16.81	31.70	1.77	0.26	45.86	122.88
257	16.94	30.57	1.61	0.35	45.68	122.10
258	16.95	30.14	1.45	0.35	44.40	121.29
259	17.02	29.37	1.27	0.35	43.20	120.26
260	17.07	28.93	1.32	0.35	44.47	120.53
261	17.14	28.59	1.34	0.35	45.11	120.57
262	17.21	28.42	1.36	0.35	45.76	120.71
263	17.28	28.24	1.42	0.35	46.76	120.99
264	17.34	28.07	1.48	0.35	47.81	121.29
265	17.40	27.90	1.53	0.35	48.67	121.50
266	17.47	27.47	1.55	0.35	49.52	121.54
267	17.52	27.29	1.53	0.35	49.71	121.47
268	17.62	27.29	1.47	0.35	49.01	121.14
269	17.66	27.38	1.43	0.35	48.43	120.95
270	17.72	27.21	1.37	0.35	48.07	120.65
271	17.80	26.52	1.28	0.35	47.82	120.05
272	17.85	25.74	1.20	0.43	48.01	119.55
273	17.93	24.61	1.13	0.43	48.67	118.97
274	18.00	23.41	1.06	0.43	49.69	118.42
275	18.06	22.28	1.01	0.35	50.85	117.95
276	18.11	21.42	0.97	0.35	51.74	117.55
277	18.20	18.74	0.97	0.35	57.40	117.21
278	18.25	17.36	0.96	0.35	60.59	116.93
279	18.33	15.37	0.83	0.35	63.36	115.55
280	18.38	14.16	0.77	0.17	65.84	114.81
281	18.46	13.21	0.81	0.69	70.39	115.00
282	18.51	13.82	0.83	0.61	68.71	115.29
283	18.59	16.41	0.76	0.43	59.16	115.12
284	18.64	30.57	0.83	0.26	37.07	117.29
285	18.70	66.42	1.03	-0.26	19.15	120.70
286	18.78	94.31	1.14	-0.17	13.40	122.31
287	18.85	123.51	1.19	-0.26	9.50	123.30
288	18.92	147.95	1.32	-0.17	7.68	124.48

:: Field input data :: (continued)

Point ID	Depth (ft)	q_c (tsf)	f_s (tsf)	u (tsf)	Fines content (%)	Unit weight (pcf)
289	18.97	164.45	1.43	-0.26	6.82	125.31
290	19.06	181.03	1.75	-0.17	6.84	127.03
291	19.11	194.76	1.71	0.00	5.88	127.07
292	19.19	205.56	1.68	0.00	5.18	127.06
293	19.24	215.32	1.92	0.00	5.38	128.15
294	19.32	216.44	2.04	0.09	5.66	128.59
295	19.38	225.42	1.83	0.09	4.65	127.90
296	19.44	243.30	1.32	0.09	2.49	125.71
297	19.54	264.55	1.39	0.09	2.01	126.29
298	19.59	250.99	1.58	0.26	2.95	127.09
299	19.65	234.06	2.07	0.26	4.92	128.89
300	19.71	231.47	2.18	0.26	5.34	129.26
301	19.76	142.25	2.12	0.26	11.66	127.85
302	19.83	203.83	2.03	0.35	6.39	128.43
303	19.91	209.18	1.87	0.35	5.61	127.87
304	19.96	201.50	1.76	0.43	5.71	127.35
305	20.03	192.77	1.62	0.35	5.76	126.63
306	20.09	194.24	1.49	0.35	5.25	126.06
307	20.16	189.58	1.34	0.35	4.99	125.23
308	20.22	187.16	1.15	0.35	4.39	124.05
309	20.30	187.16	1.01	0.43	3.84	123.11
310	20.36	187.16	0.99	0.43	3.77	122.97
311	20.45	187.16	1.03	0.43	3.91	123.21
312	20.48	192.26	1.36	0.43	4.91	125.34
313	20.55	204.61	2.04	0.43	6.43	128.46
314	20.61	210.05	2.14	0.43	6.41	128.88
315	20.68	223.09	1.92	0.43	5.12	128.24
316	20.76	243.99	1.78	0.43	3.82	127.88
317	20.81	259.28	1.40	0.43	2.28	126.31
318	20.88	289.42	0.71	0.61	0.00	121.62
319	20.94	280.87	0.79	0.09	0.02	122.27
320	21.00	323.28	0.88	0.09	0.00	123.45
321	21.06	265.58	0.95	-0.17	0.84	123.50
322	21.14	218.08	1.05	-0.30	2.66	123.74
323	21.20	176.36	1.04	-0.41	4.64	123.20
324	21.26	171.27	0.75	-0.55	3.58	120.71
325	21.33	158.31	0.36	-0.55	2.04	115.05
326	21.43	147.00	0.39	-0.55	2.84	115.49
327	21.46	144.24	0.38	-0.61	2.95	115.30
328	21.52	141.13	0.37	-0.87	3.10	115.15
329	21.59	135.43	0.40	-1.15	3.64	115.49
330	21.65	99.84	0.40	-1.27	5.00	114.86
331	21.73	115.73	0.38	-1.27	4.99	114.72
332	21.79	115.82	0.37	-1.27	4.95	114.65
333	21.85	115.99	0.38	-1.65	5.00	114.78
334	21.92	115.73	0.39	-1.65	5.00	115.02
335	21.98	115.69	0.39	-1.65	5.00	114.94
336	22.05	115.65	0.38	-1.65	5.00	114.86

:: Field input data :: (continued)

Point ID	Depth (ft)	q_c (tsf)	f_s (tsf)	u (tsf)	Fines content (%)	Unit weight (pcf)
337	22.13	117.46	0.34	-1.65	4.54	114.01
338	22.19	118.41	0.29	-1.65	4.05	112.98
339	22.25	119.88	0.28	-1.56	3.78	112.54
340	22.31	120.57	0.30	-1.65	3.93	113.11
341	22.41	122.13	0.41	-1.65	4.75	115.41
342	22.45	123.25	0.48	-1.66	5.00	116.72
343	22.52	123.25	0.57	-1.66	5.00	117.96
344	22.59	123.25	0.67	-1.66	6.73	119.12
345	22.65	126.53	0.92	-1.65	8.02	121.44
346	22.71	133.27	1.09	-1.65	8.31	122.80
347	22.78	140.61	1.06	-1.65	7.48	122.77
348	22.84	150.71	1.01	-1.65	6.36	122.59
349	22.92	173.08	1.13	-1.65	5.34	123.74
350	22.98	194.42	1.21	-1.65	4.43	124.52
351	23.04	213.76	1.30	-1.56	3.82	125.28
352	23.11	245.29	1.39	-1.56	2.85	126.11
353	23.19	278.71	1.54	-1.56	2.16	127.15
354	23.23	289.85	1.54	-1.56	1.86	127.25
355	23.30	309.63	1.54	-1.56	1.36	127.41
356	23.37	343.57	1.50	-1.47	0.57	127.47
357	23.44	359.98	1.51	-1.47	0.30	127.64
358	23.51	356.96	1.70	-1.39	0.70	128.47
359	23.57	373.11	1.79	-1.30	0.59	128.98
360	23.62	390.39	1.92	-1.86	0.51	129.59
361	23.71	402.82	1.92	-1.89	0.32	129.68
362	23.77	369.66	1.92	-1.94	0.89	129.48
363	23.82	424.50	1.97	-2.02	0.09	130.00
364	23.89	449.20	2.04	-2.16	0.00	130.40
365	23.97	457.41	2.18	-2.16	0.00	130.91
366	24.03	450.15	2.47	-2.16	0.44	131.79
367	24.08	473.90	2.64	-2.97	0.33	132.39
368	24.16	488.07	2.71	-2.97	0.25	132.67
369	24.21	506.38	2.69	-3.20	0.00	132.69
370	24.29	509.23	2.57	-3.34	0.00	132.37
371	24.35	519.07	2.26	-3.39	0.00	131.49
372	24.43	513.29	2.30	-3.45	0.00	131.58
373	24.49	520.89	2.50	-3.52	0.00	132.24
374	24.56	500.51	2.71	-3.52	0.11	132.73
375	24.63	486.69	2.78	-3.55	0.36	132.85
376	24.68	447.04	2.54	-3.58	0.61	131.99
377	24.74	469.33	2.39	-3.60	0.11	131.66
378	24.80	466.56	0.00	-3.64	N/A	87.36
379	24.88	478.65	0.00	-3.70	N/A	87.36
380	24.95	535.40	0.00	-3.70	N/A	87.36
381	25.01	638.78	0.00	-3.47	N/A	87.36
382	25.08	679.89	0.00	-4.07	N/A	87.36
383	25.13	771.44	0.00	-3.99	N/A	87.36

:: Field input data :: (continued)

Point ID	Depth (ft)	q_c (tsf)	f_s (tsf)	u (tsf)	Fines content (%)	Unit weight (pcf)

Abbreviations

Depth: Depth from free surface, at which CPT was performed (ft)
q_c: Measured cone resistance (tsf)
f_s: Sleeve friction resistance (tsf)
u: Pore pressure (tsf)
Fines content: Percentage of fines in soil (%)
Unit weight: Bulk soil unit weight (pcf)

:: Post-earthquake settlement of dry sands ::

Depth (ft)	Ic	Q_{tn}	Kc	$Q_{tn,cs}$	$N_{1,60}$ (blows)	G_{max} (tsf)	CSR	Shear, γ (%)	$e_{vol(15)}$ (%)	N_c	e_v (%)	Settle. (in)
0.09	1.00	461.39	1.00	461.39	69	914	0.27	0.000	0.00	6.39	0.00	0.000
0.14	0.79	651.63	1.00	651.63	93	991	0.27	0.000	0.00	6.39	0.00	0.000
0.20	0.87	595.97	1.00	595.97	87	1010	0.27	0.000	0.00	6.39	0.00	0.000
0.27	0.99	476.91	1.00	476.91	71	936	0.27	0.001	0.00	6.39	0.00	0.000
0.34	1.12	403.64	1.00	403.64	63	931	0.27	0.001	0.00	6.39	0.00	0.000
0.41	1.27	330.35	1.00	330.35	54	919	0.27	0.001	0.00	6.39	0.00	0.000
0.47	1.40	272.08	1.00	272.08	46	898	0.27	0.001	0.00	6.39	0.00	0.000
0.55	1.59	213.78	1.00	213.78	38	895	0.27	0.002	0.00	6.39	0.00	0.000
0.60	1.70	185.34	1.04	191.91	36	890	0.27	0.002	0.00	6.39	0.00	0.000
0.69	1.85	151.75	1.14	173.70	0	0	0.27	0.000	0.00	13.43	0.00	0.000
0.74	1.95	130.09	1.25	161.99	0	0	0.27	0.000	0.00	13.43	0.00	0.000
0.82	2.14	101.77	1.53	155.60	0	0	0.27	0.000	0.00	13.43	0.00	0.000
0.86	2.26	88.17	1.83	161.63	0	0	0.27	0.000	0.00	13.43	0.00	0.000
0.93	2.48	67.21	2.65	178.45	0	0	0.27	0.000	0.00	13.43	0.00	0.000
0.99	2.55	59.58	3.01	179.32	0	0	0.27	0.000	0.00	13.43	0.00	0.000
1.05	2.59	50.83	3.24	164.66	0	0	0.27	0.000	0.00	13.43	0.00	0.000
1.14	2.63	41.25	3.49	143.80	0	0	0.27	0.000	0.00	0.00	0.00	0.000
1.19	2.21	75.09	1.70	127.35	0	0	0.27	0.000	0.00	13.43	0.00	0.000
1.27	2.01	99.92	1.31	131.30	0	0	0.27	0.000	0.00	13.43	0.00	0.000
1.32	1.98	107.96	1.28	137.93	0	0	0.27	0.000	0.00	13.43	0.00	0.000
1.41	1.94	128.91	1.23	158.98	0	0	0.27	0.000	0.00	13.43	0.00	0.000
1.46	1.92	138.21	1.21	167.52	0	0	0.27	0.000	0.00	13.43	0.00	0.000
1.51	2.07	110.31	1.40	154.06	0	0	0.27	0.000	0.00	13.43	0.00	0.000
1.59	2.11	105.03	1.47	154.47	0	0	0.27	0.000	0.00	13.43	0.00	0.000
1.65	2.28	79.90	1.90	151.75	0	0	0.27	0.000	0.00	13.43	0.00	0.000
1.71	2.45	61.57	2.54	156.60	0	0	0.27	0.000	0.00	13.43	0.00	0.000
1.78	2.69	42.98	3.95	169.79	0	0	0.27	0.000	0.00	0.00	0.00	0.000
1.85	2.73	39.23	4.22	165.38	0	0	0.27	0.000	0.00	0.00	0.00	0.000
1.91	2.71	35.90	4.04	144.94	0	0	0.27	0.000	0.00	0.00	0.00	0.000
2.00	2.72	28.53	4.18	119.15	0	0	0.27	0.000	0.00	0.00	0.00	0.000
2.04	2.68	28.11	3.88	109.07	0	0	0.27	0.000	0.00	0.00	0.00	0.000
2.11	2.59	30.05	3.24	97.34	0	0	0.27	0.000	0.00	13.43	0.00	0.000
2.17	2.48	32.82	2.66	87.35	0	0	0.27	0.000	0.00	13.43	0.00	0.000
2.25	2.42	35.58	2.42	85.97	0	0	0.27	0.000	0.00	13.43	0.00	0.000
2.30	2.37	38.49	2.18	83.95	0	0	0.27	0.000	0.00	13.43	0.00	0.000
2.37	2.01	66.51	1.32	87.50	0	0	0.27	0.000	0.00	13.43	0.00	0.000
2.45	1.92	97.59	1.20	117.49	0	0	0.27	0.000	0.00	13.43	0.00	0.000
2.50	2.07	85.79	1.41	120.72	26	663	0.27	0.013	0.01	6.39	0.01	0.000
2.56	2.06	76.76	1.39	106.54	0	0	0.27	0.000	0.00	13.43	0.00	0.000
2.63	2.17	69.95	1.59	111.46	0	0	0.27	0.000	0.00	13.43	0.00	0.000
2.71	2.28	60.37	1.87	113.11	0	0	0.27	0.000	0.00	13.43	0.00	0.000
2.76	2.34	55.51	2.09	116.02	0	0	0.27	0.000	0.00	13.43	0.00	0.000
2.84	2.81	24.00	4.83	115.86	0	0	0.27	0.000	0.00	0.00	0.00	0.000
2.90	2.78	22.61	4.65	105.24	0	0	0.27	0.000	0.00	0.00	0.00	0.000
2.97	2.86	20.81	5.34	111.13	0	0	0.27	0.000	0.00	0.00	0.00	0.000
3.04	2.45	40.64	2.55	103.65	0	0	0.27	0.000	0.00	13.43	0.00	0.000
3.09	2.18	61.45	1.61	99.04	0	0	0.27	0.000	0.00	13.43	0.00	0.000
3.16	2.13	67.27	1.51	101.47	0	0	0.27	0.000	0.00	13.43	0.00	0.000

:: Post-earthquake settlement of dry sands :: (continued)

Depth (ft)	Ic	Q_{tn}	Kc	$Q_{tn,cs}$	$N_{1,60}$ (blows)	G_{max} (tsf)	CSR	Shear, γ (%)	$e_{vol(15)}$ (%)	N_c	e_v (%)	Settle. (in)
3.22	2.16	64.08	1.58	101.14	22	555	0.27	0.026	0.02	6.39	0.02	0.000
3.29	2.20	60.46	1.66	100.60	23	548	0.27	0.028	0.02	6.39	0.02	0.000
3.36	2.28	52.40	1.90	99.58	23	530	0.27	0.032	0.03	6.39	0.02	0.000
3.42	2.36	46.29	2.15	99.47	24	514	0.27	0.035	0.03	6.39	0.02	0.000
3.48	2.42	41.71	2.39	99.85	25	500	0.27	0.039	0.03	6.39	0.02	0.000
3.54	2.45	39.07	2.55	99.52	25	490	0.27	0.042	0.03	6.39	0.02	0.000
3.62	2.46	38.08	2.56	97.59	25	479	0.27	0.047	0.04	6.39	0.02	0.000
3.70	2.44	37.53	2.47	92.72	0	0	0.27	0.000	0.00	13.43	0.00	0.000
3.75	2.46	35.30	2.56	90.55	0	0	0.27	0.000	0.00	13.43	0.00	0.000
3.83	2.49	32.66	2.74	89.42	0	0	0.27	0.000	0.00	13.43	0.00	0.000
3.89	2.55	29.19	3.04	88.66	0	0	0.27	0.000	0.00	13.43	0.00	0.000
3.96	2.57	27.36	3.13	85.58	23	395	0.27	0.105	0.09	6.39	0.06	0.001
4.01	2.58	25.98	3.19	82.90	22	381	0.27	0.125	0.11	6.39	0.08	0.001
4.09	2.68	21.81	3.82	83.42	0	0	0.27	0.000	0.00	0.00	0.00	0.000
4.14	2.72	20.42	4.18	85.30	0	0	0.27	0.000	0.00	0.00	0.00	0.000
4.24	2.78	19.43	4.65	90.36	0	0	0.27	0.000	0.00	0.00	0.00	0.000
4.27	2.76	20.27	4.45	90.09	0	0	0.27	0.000	0.00	0.00	0.00	0.000
4.34	2.61	23.86	3.38	80.75	0	0	0.27	0.000	0.00	0.00	0.00	0.000
4.41	2.46	27.61	2.59	71.48	0	0	0.27	0.000	0.00	13.43	0.00	0.000
4.50	2.49	31.77	2.70	85.75	22	415	0.27	0.113	0.10	6.39	0.07	0.001
4.54	2.45	36.62	2.53	92.62	23	457	0.27	0.081	0.07	6.39	0.05	0.000
4.59	2.42	41.61	2.41	100.46	25	502	0.27	0.061	0.05	6.39	0.03	0.000
4.67	2.34	52.70	2.08	109.84	26	572	0.27	0.043	0.03	6.39	0.02	0.000
4.74	2.40	50.33	2.33	117.09	29	592	0.27	0.040	0.03	6.39	0.02	0.000
4.82	2.37	55.32	2.21	122.00	0	0	0.27	0.000	0.00	13.43	0.00	0.000
4.87	2.40	53.94	2.31	124.57	0	0	0.27	0.000	0.00	13.43	0.00	0.000
4.96	2.45	50.59	2.51	127.09	0	0	0.27	0.000	0.00	13.43	0.00	0.000
5.01	2.48	48.51	2.65	128.33	0	0	0.27	0.000	0.00	13.43	0.00	0.000
5.09	2.49	46.00	2.73	125.45	32	605	0.27	0.043	0.02	6.39	0.02	0.000
5.14	2.50	43.65	2.78	121.31	31	581	0.27	0.049	0.03	6.39	0.02	0.000
5.22	2.52	39.33	2.87	113.06	29	536	0.27	0.063	0.04	6.39	0.03	0.001
5.25	2.54	37.24	2.97	110.56	29	519	0.27	0.070	0.04	6.39	0.03	0.000
5.37	2.63	29.60	3.50	103.72	0	0	0.27	0.000	0.00	0.00	0.00	0.000
5.38	2.66	28.07	3.69	103.66	0	0	0.27	0.000	0.00	0.00	0.00	0.000
5.45	2.68	26.12	3.88	101.40	0	0	0.27	0.000	0.00	0.00	0.00	0.000
5.54	2.73	24.73	4.23	104.60	0	0	0.27	0.000	0.00	0.00	0.00	0.000
5.59	2.74	25.14	4.29	107.92	0	0	0.27	0.000	0.00	0.00	0.00	0.000
5.64	2.72	27.21	4.17	113.52	0	0	0.27	0.000	0.00	0.00	0.00	0.000
5.72	2.69	30.55	3.90	119.09	0	0	0.27	0.000	0.00	0.00	0.00	0.000
5.82	2.58	39.82	3.18	126.77	34	582	0.27	0.060	0.03	6.39	0.02	0.000
5.85	2.54	43.71	2.99	130.75	34	612	0.27	0.052	0.03	6.39	0.02	0.000
5.95	2.50	52.17	2.75	143.69	37	690	0.27	0.040	0.02	6.39	0.01	0.000
6.00	2.47	56.47	2.64	148.87	38	725	0.27	0.036	0.02	6.39	0.01	0.000

:: Post-earthquake settlement of dry sands :: (continued)

Depth (ft)	Ic	Q_{tn}	Kc	$Q_{tn,cs}$	$N_{1,60}$ (blows)	G_{max} (tsf)	CSR	Shear, γ (%)	$e_{vol(15)}$ (%)	N_c	e_v (%)	Settle. (in)

Total estimated settlement: 0.01

Abbreviations

Q_{tn}: Equivalent clean sand normalized cone resistance
K_c: Fines correction factor
$Q_{tn,cs}$: Post-liquefaction volumentric strain
G_{max}: Small strain shear modulus
CSR: Soil cyclic stress ratio
γ: Cyclic shear strain
$e_{vol(15)}$: Volumetric strain after 15 cycles
N_c: Equivalent number of cycles
e_v: Volumetric strain
Settle.: Calculated settlement

:: Post-earthquake settlement due to soil liquefaction ::

Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)
6.04	153.77	1.56	0.00	1.00	0.00
6.18	171.92	2.00	0.00	1.00	0.00
6.31	183.61	2.00	0.00	1.00	0.00
6.44	151.50	1.45	0.00	1.00	0.00
6.59	169.77	1.91	0.00	1.00	0.00
6.70	182.91	2.00	0.00	1.00	0.00
6.83	189.42	2.00	0.00	1.00	0.00
6.98	188.38	2.00	0.00	1.00	0.00
7.10	188.10	2.00	0.00	1.00	0.00
7.23	183.20	2.00	0.00	1.00	0.00
7.35	179.49	2.00	0.00	1.00	0.00
7.49	175.07	1.94	0.00	1.00	0.00
7.63	174.46	2.00	0.00	1.00	0.00
7.76	174.93	2.00	0.00	1.00	0.00
7.89	178.48	2.00	0.00	1.00	0.00
8.02	182.99	2.00	0.00	1.00	0.00
8.14	179.56	2.00	0.00	1.00	0.00
8.30	170.33	1.73	0.00	1.00	0.00
8.43	167.59	1.65	0.00	1.00	0.00
8.53	168.78	1.67	0.00	1.00	0.00
8.70	175.09	2.00	0.00	1.00	0.00
8.83	154.48	2.00	0.00	1.00	0.00
8.92	129.23	2.00	0.00	1.00	0.00
9.06	133.80	2.00	0.00	1.00	0.00
9.22	139.39	2.00	0.00	1.00	0.00
9.35	143.86	2.00	0.00	1.00	0.00
9.48	143.62	2.00	0.00	1.00	0.00
9.58	143.63	2.00	0.00	1.00	0.00
9.72	141.56	2.00	0.00	1.00	0.00
9.85	140.61	2.00	0.00	1.00	0.00
9.98	136.50	0.94	0.99	1.00	0.01
10.12	132.79	0.88	1.03	1.00	0.01
10.25	127.05	2.00	0.00	1.00	0.00
10.39	113.40	2.00	0.00	1.00	0.00
10.52	99.60	2.00	0.00	1.00	0.00
6.14	168.31	1.93	0.00	1.00	0.00
6.26	179.17	2.00	0.00	1.00	0.00
6.40	144.45	1.30	0.22	1.00	0.00
6.50	160.23	1.66	0.00	1.00	0.00
6.67	179.64	2.00	0.00	1.00	0.00
6.77	187.70	2.00	0.00	1.00	0.00
6.90	189.52	2.00	0.00	1.00	0.00
7.03	188.57	2.00	0.00	1.00	0.00
7.15	186.43	2.00	0.00	1.00	0.00
7.31	180.43	2.00	0.00	1.00	0.00
7.44	176.67	1.99	0.00	1.00	0.00
7.55	174.32	1.91	0.00	1.00	0.00
7.68	174.56	2.00	0.00	1.00	0.00
7.85	177.26	2.00	0.00	1.00	0.00
7.99	181.91	2.00	0.00	1.00	0.00
8.07	183.01	2.00	0.00	1.00	0.00
8.22	174.50	2.00	0.00	1.00	0.00
8.34	168.04	1.67	0.00	1.00	0.00
8.48	167.78	1.65	0.00	1.00	0.00
8.61	171.54	1.74	0.00	1.00	0.00
8.74	175.38	2.00	0.00	1.00	0.00
8.87	124.91	0.82	1.47	1.00	0.01
8.99	132.31	2.00	0.00	1.00	0.00
9.15	137.23	2.00	0.00	1.00	0.00
9.26	141.11	2.00	0.00	1.00	0.00
9.40	143.57	2.00	0.00	1.00	0.00
9.53	143.81	2.00	0.00	1.00	0.00
9.66	142.40	2.00	0.00	1.00	0.00
9.80	141.43	2.00	0.00	1.00	0.00
9.94	138.16	0.97	0.65	1.00	0.01
10.08	134.31	0.91	1.01	1.00	0.01
10.18	131.03	0.86	1.05	1.00	0.01
10.34	119.36	2.00	0.00	1.00	0.00
10.44	108.83	2.00	0.00	1.00	0.00
10.57	94.67	2.00	0.00	1.00	0.00

:: Post-earthquake settlement due to soil liquefaction :: (continued)

Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)	Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)
10.66	89.35	2.00	0.00	1.00	0.00	10.70	87.78	2.00	0.00	1.00	0.00
10.77	85.18	2.00	0.00	1.00	0.00	10.83	84.10	2.00	0.00	1.00	0.00
10.93	78.11	2.00	0.00	1.00	0.00	10.97	67.42	2.00	0.00	1.00	0.00
11.06	83.83	0.39	2.70	1.00	0.03	11.10	84.79	0.39	2.68	1.00	0.01
11.19	86.44	0.40	2.63	1.00	0.03	11.25	85.97	0.40	2.65	1.00	0.02
11.29	85.45	0.39	2.66	1.00	0.01	11.38	89.21	0.41	2.57	1.00	0.03
11.43	90.39	0.42	2.54	1.00	0.01	11.49	92.27	0.43	2.50	1.00	0.02
11.56	94.21	0.45	2.45	1.00	0.02	11.64	96.28	0.46	2.41	1.00	0.02
11.70	97.66	0.47	2.38	1.00	0.01	11.75	99.31	0.48	2.35	1.00	0.02
11.81	99.49	0.48	2.35	1.00	0.02	11.88	101.13	0.49	2.32	1.00	0.02
11.97	106.96	0.54	2.21	1.00	0.02	12.01	109.76	0.57	2.16	1.00	0.01
12.10	109.94	0.57	2.16	1.00	0.02	12.16	110.08	0.57	2.16	1.00	0.01
12.24	110.83	0.57	2.15	1.00	0.02	12.28	110.14	0.56	2.16	1.00	0.01
12.36	108.38	0.55	2.19	1.00	0.02	12.41	109.81	0.56	2.16	1.00	0.01
12.47	109.26	0.55	2.17	1.00	0.02	12.55	109.23	0.55	2.17	1.00	0.02
12.64	107.49	0.54	2.20	1.00	0.02	12.67	106.76	0.53	2.21	1.00	0.01
12.73	105.51	0.52	2.24	1.00	0.02	12.81	101.94	2.00	0.00	1.00	0.00
12.86	98.45	2.00	0.00	1.00	0.00	12.93	94.57	2.00	0.00	1.00	0.00
13.00	89.49	2.00	0.00	1.00	0.00	13.08	87.75	2.00	0.00	1.00	0.00
13.13	88.48	2.00	0.00	1.00	0.00	13.22	92.07	2.00	0.00	1.00	0.00
13.27	95.36	2.00	0.00	1.00	0.00	13.33	97.97	2.00	0.00	1.00	0.00
13.40	89.91	2.00	0.00	1.00	0.00	13.46	83.54	2.00	0.00	1.00	0.00
13.54	84.19	2.00	0.00	1.00	0.00	13.59	82.93	2.00	0.00	1.00	0.00
13.67	79.42	2.00	0.00	1.00	0.00	13.72	76.35	2.00	0.00	1.00	0.00
13.79	70.38	2.00	0.00	1.00	0.00	13.88	65.19	2.00	0.00	1.00	0.00
13.92	63.83	2.00	0.00	1.00	0.00	13.99	60.87	2.00	0.00	1.00	0.00
14.06	56.49	2.00	0.00	1.00	0.00	14.13	53.80	2.00	0.00	1.00	0.00
14.19	52.56	2.00	0.00	1.00	0.00	14.25	51.46	2.00	0.00	1.00	0.00
14.32	50.31	2.00	0.00	1.00	0.00	14.37	49.58	2.00	0.00	1.00	0.00
14.46	48.89	2.00	0.00	1.00	0.00	14.51	49.66	2.00	0.00	1.00	0.00
14.57	51.94	2.00	0.00	1.00	0.00	14.64	55.15	2.00	0.00	1.00	0.00
14.73	64.29	2.00	0.00	1.00	0.00	14.78	70.19	2.00	0.00	1.00	0.00
14.85	77.69	2.00	0.00	1.00	0.00	14.91	81.89	2.00	0.00	1.00	0.00
14.98	85.26	2.00	0.00	1.00	0.00	15.05	85.92	2.00	0.00	1.00	0.00
15.10	86.09	2.00	0.00	1.00	0.00	15.18	86.59	2.00	0.00	1.00	0.00
15.23	86.27	2.00	0.00	1.00	0.00	15.32	86.64	2.00	0.00	1.00	0.00
15.36	86.80	2.00	0.00	1.00	0.00	15.45	88.47	2.00	0.00	1.00	0.00
15.49	93.55	2.00	0.00	1.00	0.00	15.56	97.46	2.00	0.00	1.00	0.00
15.62	101.60	2.00	0.00	1.00	0.00	15.71	106.99	2.00	0.00	1.00	0.00
15.77	111.48	2.00	0.00	1.00	0.00	15.82	114.25	2.00	0.00	1.00	0.00
15.90	117.67	2.00	0.00	1.00	0.00	15.96	120.17	2.00	0.00	1.00	0.00
16.05	123.39	2.00	0.00	1.00	0.00	16.09	124.64	2.00	0.00	1.00	0.00
16.16	128.32	2.00	0.00	1.00	0.00	16.22	131.69	2.00	0.00	1.00	0.00
16.29	135.44	2.00	0.00	1.00	0.00	16.36	139.18	2.00	0.00	1.00	0.00
16.45	143.94	2.00	0.00	1.00	0.00	16.50	145.51	2.00	0.00	1.00	0.00
16.54	146.95	2.00	0.00	1.00	0.00	16.63	150.06	2.00	0.00	1.00	0.00
16.72	150.76	2.00	0.00	1.00	0.00	16.75	149.99	2.00	0.00	1.00	0.00
16.81	148.57	2.00	0.00	1.00	0.00	16.94	141.22	2.00	0.00	1.00	0.00

:: Post-earthquake settlement due to soil liquefaction :: (continued)

Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)	Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)
16.95	133.47	2.00	0.00	1.00	0.00	17.02	124.46	2.00	0.00	1.00	0.00
17.07	127.33	2.00	0.00	1.00	0.00	17.14	127.90	2.00	0.00	1.00	0.00
17.21	129.20	2.00	0.00	1.00	0.00	17.28	131.83	2.00	0.00	1.00	0.00
17.34	134.83	2.00	0.00	1.00	0.00	17.40	136.93	2.00	0.00	1.00	0.00
17.47	137.58	2.00	0.00	1.00	0.00	17.52	136.93	2.00	0.00	1.00	0.00
17.62	133.42	2.00	0.00	1.00	0.00	17.66	131.28	2.00	0.00	1.00	0.00
17.72	128.57	2.00	0.00	1.00	0.00	17.80	123.71	2.00	0.00	1.00	0.00
17.85	120.25	2.00	0.00	1.00	0.00	17.93	116.51	2.00	0.00	1.00	0.00
18.00	113.40	2.00	0.00	1.00	0.00	18.06	110.91	2.00	0.00	1.00	0.00
18.11	108.80	2.00	0.00	1.00	0.00	18.20	109.03	2.00	0.00	1.00	0.00
18.25	108.32	2.00	0.00	1.00	0.00	18.33	100.92	2.00	0.00	1.00	0.00
18.38	97.29	2.00	0.00	1.00	0.00	18.46	98.80	2.00	0.00	1.00	0.00
18.51	99.99	2.00	0.00	1.00	0.00	18.59	96.71	2.00	0.00	1.00	0.00
18.64	96.27	2.00	0.00	1.00	0.00	18.70	101.21	2.00	0.00	1.00	0.00
18.78	113.71	2.00	0.00	1.00	0.00	18.85	130.56	2.00	0.00	1.00	0.00
18.92	148.06	0.93	0.88	1.00	0.01	18.97	160.27	1.13	0.41	1.00	0.00
19.06	176.39	1.44	0.00	1.00	0.00	19.11	183.77	1.60	0.00	1.00	0.00
19.19	188.82	1.72	0.00	1.00	0.00	19.24	199.30	1.99	0.00	1.00	0.00
19.32	202.11	2.00	0.00	1.00	0.00	19.38	206.20	2.00	0.00	1.00	0.00
19.44	222.44	2.00	0.00	1.00	0.00	19.54	241.62	2.00	0.00	1.00	0.00
19.59	229.00	2.00	0.00	1.00	0.00	19.65	213.28	2.00	0.00	1.00	0.00
19.71	212.41	2.00	0.00	1.00	0.00	19.76	158.87	1.10	0.41	1.00	0.00
19.83	193.55	1.83	0.00	1.00	0.00	19.91	193.20	1.82	0.00	1.00	0.00
19.96	186.62	1.66	0.00	1.00	0.00	20.03	178.61	1.48	0.00	1.00	0.00
20.09	176.52	1.43	0.00	1.00	0.00	20.16	171.29	1.33	0.20	1.00	0.00
20.22	168.95	1.28	0.20	1.00	0.00	20.30	168.75	1.27	0.20	1.00	0.00
20.36	168.62	1.27	0.20	1.00	0.00	20.45	168.43	1.27	0.20	1.00	0.00
20.48	172.96	1.36	0.00	1.00	0.00	20.55	192.46	1.79	0.00	1.00	0.00
20.61	197.31	1.92	0.00	1.00	0.00	20.68	200.19	2.00	0.00	1.00	0.00
20.76	218.89	2.00	0.00	1.00	0.00	20.81	232.53	2.00	0.00	1.00	0.00
20.88	259.44	2.00	0.00	1.00	0.00	20.94	251.55	2.00	0.00	1.00	0.00
21.00	289.47	2.00	0.00	1.00	0.00	21.06	237.40	2.00	0.00	1.00	0.00
21.14	194.54	1.84	0.00	1.00	0.00	21.20	156.98	1.06	0.41	1.00	0.00
21.26	152.30	0.98	0.60	1.00	0.00	21.33	140.58	0.81	1.24	1.00	0.01
21.43	130.30	0.69	1.69	1.00	0.02	21.46	127.79	0.66	1.74	1.00	0.01
21.52	124.91	0.63	1.95	1.00	0.01	21.59	119.72	0.57	2.02	1.00	0.02
21.65	87.51	0.34	2.61	1.00	0.02	21.73	101.98	0.43	2.30	1.00	0.02
21.79	101.99	0.43	2.30	1.00	0.02	21.85	102.06	0.43	2.30	1.00	0.02
21.92	101.72	0.42	2.30	1.00	0.02	21.98	101.62	0.42	2.31	1.00	0.02
22.05	101.51	0.42	2.31	1.00	0.02	22.13	103.04	0.43	2.28	1.00	0.02
22.19	103.82	0.44	2.27	1.00	0.02	22.25	105.05	0.45	2.24	1.00	0.02
22.31	105.59	0.45	2.23	1.00	0.02	22.41	106.85	0.46	2.21	1.00	0.03
22.45	107.71	0.47	2.20	1.00	0.01	22.52	107.41	0.46	2.20	1.00	0.02
22.59	113.47	0.51	2.11	1.00	0.02	22.65	120.81	0.58	2.00	1.00	0.02
22.71	128.29	0.66	1.73	1.00	0.01	22.78	132.13	0.70	1.66	1.00	0.01
22.84	137.02	0.76	1.28	1.00	0.01	22.92	152.09	0.97	0.60	1.00	0.01
22.98	169.59	1.26	0.20	1.00	0.00	23.04	186.43	1.62	0.00	1.00	0.00
23.11	213.93	2.00	0.00	1.00	0.00	23.19	242.97	2.00	0.00	1.00	0.00

:: Post-earthquake settlement due to soil liquefaction :: (continued)

Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)	Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)
23.23	252.60	2.00	0.00	1.00	0.00	23.30	269.68	2.00	0.00	1.00	0.00
23.37	299.06	2.00	0.00	1.00	0.00	23.44	313.14	2.00	0.00	1.00	0.00
23.51	310.21	2.00	0.00	1.00	0.00	23.57	324.04	2.00	0.00	1.00	0.00
23.62	338.84	2.00	0.00	1.00	0.00	23.71	349.23	2.00	0.00	1.00	0.00
23.77	320.16	2.00	0.00	1.00	0.00	23.82	367.54	2.00	0.00	1.00	0.00
23.89	388.62	2.00	0.00	1.00	0.00	23.97	395.36	2.00	0.00	1.00	0.00
24.03	388.72	2.00	0.00	1.00	0.00	24.08	408.97	2.00	0.00	1.00	0.00
24.16	420.79	2.00	0.00	1.00	0.00	24.21	436.29	2.00	0.00	1.00	0.00
24.29	438.26	2.00	0.00	1.00	0.00	24.35	446.42	2.00	0.00	1.00	0.00
24.43	440.95	2.00	0.00	1.00	0.00	24.49	447.12	2.00	0.00	1.00	0.00
24.56	429.17	2.00	0.00	1.00	0.00	24.63	416.89	2.00	0.00	1.00	0.00
24.68	382.52	2.00	0.00	1.00	0.00	24.74	401.33	2.00	0.00	1.00	0.00
24.80	-1.00	2.00	0.00	1.00	0.00	24.88	-1.00	2.00	0.00	1.00	0.00
24.95	-1.00	2.00	0.00	1.00	0.00	25.01	-1.00	2.00	0.00	1.00	0.00
25.08	-1.00	2.00	0.00	1.00	0.00	25.13	-1.00	2.00	0.00	1.00	0.00

Total estimated settlement: 0.97

Abbreviations

$Q_{tn,cs}$:	Equivalent clean sand normalized cone resistance
FS:	Factor of safety against liquefaction
e_v (%):	Post-liquefaction volumentric strain
DF:	e_v depth weighting factor
Settlement:	Calculated settlement

:: Strength loss calculation (Robertson (2009) ::

Depth (ft)	q_t (tsf)	Q_{tn}	K_c	$Q_{tn,cs}$	I_c	$S_{u(liq)}/\sigma'_v$	$S_{u(peak)}/\sigma'_v$
0.09	287.18	461.39	1.00	461.39	1.00	N/A	N/A
0.14	405.59	651.63	1.00	651.63	0.79	N/A	N/A
0.20	370.95	595.97	1.00	595.97	0.87	N/A	N/A
0.27	296.85	476.91	1.00	476.91	0.99	N/A	N/A
0.34	251.25	403.64	1.00	403.64	1.12	N/A	N/A
0.41	205.64	330.35	1.00	330.35	1.27	N/A	N/A
0.47	169.37	272.08	1.00	272.08	1.40	N/A	N/A
0.55	133.09	213.78	1.00	213.78	1.59	N/A	N/A
0.60	115.39	185.34	1.04	191.91	1.70	N/A	N/A
0.69	94.49	151.75	1.14	173.70	1.85	N/A	N/A
0.74	81.01	130.09	1.25	161.99	1.95	N/A	N/A
0.82	63.39	101.77	1.53	155.60	2.14	N/A	N/A
0.86	54.93	88.17	1.83	161.63	2.26	N/A	N/A
0.93	41.89	67.21	2.65	178.45	2.48	N/A	N/A
0.99	37.14	59.58	3.01	179.32	2.55	N/A	N/A
1.05	31.70	50.83	3.24	164.66	2.59	N/A	N/A
1.14	25.74	41.25	3.49	143.80	2.63	N/A	N/A
1.19	46.81	75.09	1.70	127.35	2.21	N/A	N/A
1.27	62.27	99.92	1.31	131.30	2.01	N/A	N/A
1.32	67.28	107.96	1.28	137.93	1.98	N/A	N/A
1.41	80.32	128.91	1.23	158.98	1.94	N/A	N/A
1.46	86.11	138.21	1.21	167.52	1.92	N/A	N/A
1.51	68.75	110.31	1.40	154.06	2.07	N/A	N/A
1.59	65.47	105.03	1.47	154.47	2.11	N/A	N/A
1.65	49.83	79.90	1.90	151.75	2.28	N/A	N/A
1.71	38.43	61.57	2.54	156.60	2.45	N/A	N/A
1.78	26.86	42.98	3.95	169.79	2.69	N/A	N/A
1.85	24.53	39.23	4.22	165.38	2.73	N/A	N/A
1.91	22.46	35.90	4.04	144.94	2.71	N/A	N/A
2.00	17.88	28.53	4.18	119.15	2.72	N/A	N/A
2.04	17.62	28.11	3.88	109.07	2.68	N/A	N/A
2.11	18.83	30.05	3.24	97.34	2.59	N/A	N/A
2.17	20.56	32.82	2.66	87.35	2.48	N/A	N/A
2.25	22.28	35.58	2.42	85.97	2.42	N/A	N/A
2.30	24.10	38.49	2.18	83.95	2.37	N/A	N/A
2.37	41.54	66.51	1.32	87.50	2.01	N/A	N/A
2.45	60.89	97.59	1.20	117.49	1.92	N/A	N/A
2.50	53.55	85.79	1.41	120.72	2.07	N/A	N/A
2.56	47.93	76.76	1.39	106.54	2.06	N/A	N/A
2.63	43.70	69.95	1.59	111.46	2.17	N/A	N/A
2.71	37.74	60.37	1.87	113.11	2.28	N/A	N/A
2.76	34.72	55.51	2.09	116.02	2.34	N/A	N/A
2.84	15.11	24.00	4.83	115.86	2.81	N/A	N/A
2.90	14.24	22.61	4.65	105.24	2.78	N/A	N/A
2.97	13.13	20.81	5.34	111.13	2.86	N/A	N/A
3.04	25.48	40.64	2.55	103.65	2.45	N/A	N/A
3.09	38.43	61.45	1.61	99.04	2.18	N/A	N/A
3.16	42.06	67.27	1.51	101.47	2.13	N/A	N/A

:: Strength loss calculation (Robertson (2009) :: (continued)

Depth (ft)	q_t (tsf)	Q_{tn}	K_c	$Q_{tn,cs}$	I_c	$S_{u(liq)}/\sigma'_v$	$S_{u(peak)}/\sigma'_v$
3.22	40.08	64.08	1.58	101.14	2.16	N/A	N/A
3.29	37.83	60.46	1.66	100.60	2.20	N/A	N/A
3.36	32.82	52.40	1.90	99.58	2.28	N/A	N/A
3.42	29.02	46.29	2.15	99.47	2.36	N/A	N/A
3.48	26.16	41.71	2.39	99.85	2.42	N/A	N/A
3.54	24.52	39.07	2.55	99.52	2.45	N/A	N/A
3.62	23.91	38.08	2.56	97.59	2.46	N/A	N/A
3.70	23.58	37.53	2.47	92.72	2.44	N/A	N/A
3.75	22.19	35.30	2.56	90.55	2.46	N/A	N/A
3.83	20.56	32.66	2.74	89.42	2.49	N/A	N/A
3.89	18.39	29.19	3.04	88.66	2.55	N/A	N/A
3.96	17.26	27.36	3.13	85.58	2.57	N/A	N/A
4.01	16.40	25.98	3.19	82.90	2.58	N/A	N/A
4.09	13.81	21.81	3.82	83.42	2.68	N/A	N/A
4.14	12.95	20.42	4.18	85.30	2.72	N/A	N/A
4.24	12.34	19.43	4.65	90.36	2.78	N/A	N/A
4.27	12.86	20.27	4.45	90.09	2.76	N/A	N/A
4.34	15.10	23.86	3.38	80.75	2.61	N/A	N/A
4.41	17.44	27.61	2.59	71.48	2.46	N/A	N/A
4.50	20.03	31.77	2.70	85.75	2.49	N/A	N/A
4.54	23.05	36.62	2.53	92.62	2.45	N/A	N/A
4.59	26.16	41.61	2.41	100.46	2.42	N/A	N/A
4.67	33.07	52.70	2.08	109.84	2.34	N/A	N/A
4.74	31.60	50.33	2.33	117.09	2.40	N/A	N/A
4.82	34.71	55.32	2.21	122.00	2.37	N/A	N/A
4.87	33.86	53.94	2.31	124.57	2.40	N/A	N/A
4.96	31.78	50.59	2.51	127.09	2.45	N/A	N/A
5.01	30.49	48.51	2.65	128.33	2.48	N/A	N/A
5.09	28.93	46.00	2.73	125.45	2.49	N/A	N/A
5.14	27.47	43.65	2.78	121.31	2.50	N/A	N/A
5.22	24.79	39.33	2.87	113.06	2.52	N/A	N/A
5.25	23.49	37.24	2.97	110.56	2.54	N/A	N/A
5.37	18.74	29.60	3.50	103.72	2.63	N/A	N/A
5.38	17.79	28.07	3.69	103.66	2.66	N/A	N/A
5.45	16.58	26.12	3.88	101.40	2.68	N/A	N/A
5.54	15.71	24.73	4.23	104.60	2.73	N/A	N/A
5.59	15.97	25.14	4.29	107.92	2.74	N/A	N/A
5.64	17.26	27.21	4.17	113.52	2.72	N/A	N/A
5.72	19.34	30.55	3.90	119.09	2.69	N/A	N/A
5.82	25.12	39.82	3.18	126.77	2.58	N/A	N/A
5.85	27.54	43.71	2.99	130.75	2.54	N/A	N/A
5.95	32.82	52.17	2.75	143.69	2.50	N/A	N/A
6.00	35.50	56.47	2.64	148.87	2.47	N/A	N/A
6.04	36.53	58.12	2.65	153.77	2.48	0.75	0.75
6.14	40.77	64.92	2.59	168.31	2.46	0.77	0.77
6.18	41.72	66.45	2.59	171.92	2.46	0.77	0.77
6.26	42.67	67.96	2.64	179.17	2.47	0.77	0.77
6.31	41.98	66.85	2.75	183.61	2.50	0.77	0.77

:: Strength loss calculation (Robertson (2009) :: (continued)

Depth (ft)	q_t (tsf)	Q_{tn}	K_c	$Q_{tn,cs}$	I_c	$S_{u(liq)}/\sigma'_v$	$S_{u(peak)}/\sigma'_v$
6.40	43.53	69.33	2.08	144.45	2.34	0.78	0.78
6.44	44.83	71.42	2.12	151.50	2.35	0.78	0.78
6.50	46.29	73.76	2.17	160.23	2.36	0.79	0.79
6.59	46.90	74.73	2.27	169.77	2.39	0.79	0.79
6.67	44.74	71.25	2.52	179.64	2.45	0.78	0.78
6.70	44.65	71.10	2.57	182.91	2.46	0.78	0.78
6.77	48.45	77.20	2.43	187.70	2.43	0.79	0.79
6.83	49.40	78.72	2.41	189.42	2.42	0.79	0.79
6.90	51.13	81.49	2.33	189.52	2.40	0.80	0.80
6.98	51.82	82.59	2.28	188.38	2.39	0.80	0.80
7.03	51.82	82.59	2.28	188.57	2.39	0.80	0.80
7.10	52.51	83.69	2.25	188.10	2.38	0.80	0.80
7.15	54.24	86.46	2.16	186.43	2.36	0.81	0.81
7.23	57.00	90.89	2.02	183.20	2.32	0.81	0.81
7.31	58.21	92.83	1.94	180.43	2.30	0.82	0.82
7.35	58.13	92.69	1.94	179.49	2.30	0.82	0.82
7.44	57.87	92.27	1.91	176.67	2.29	0.82	0.82
7.49	57.69	91.97	1.90	175.07	2.29	0.82	0.82
7.55	57.78	92.11	1.89	174.32	2.28	0.82	0.82
7.63	56.31	89.74	1.94	174.46	2.30	0.81	0.81
7.68	54.76	87.25	2.00	174.56	2.32	0.81	0.81
7.76	50.87	80.99	2.16	174.93	2.36	0.80	0.80
7.85	43.10	68.50	2.59	177.26	2.46	0.78	0.78
7.89	40.59	64.46	2.77	178.48	2.50	0.77	0.77
7.99	34.98	55.44	3.28	181.91	2.59	0.75	0.75
8.02	32.82	51.97	3.52	182.99	2.63	4.87	4.87
8.07	31.87	50.43	3.63	183.01	2.65	4.69	4.69
8.14	31.78	50.28	3.57	179.56	2.64	4.64	4.64
8.22	31.96	50.56	3.45	174.50	2.62	4.62	4.62
8.30	32.56	51.52	3.31	170.33	2.60	0.74	0.74
8.34	33.25	52.62	3.19	168.04	2.58	0.74	0.74
8.43	34.72	54.98	3.05	167.59	2.55	0.75	0.75
8.48	35.93	56.92	2.95	167.78	2.53	0.75	0.75
8.53	36.45	57.75	2.92	168.78	2.53	0.75	0.75
8.61	35.58	56.34	3.04	171.54	2.55	0.75	0.75
8.70	31.35	49.54	3.53	175.09	2.63	4.26	4.26
8.74	29.62	46.75	3.75	175.38	2.67	4.01	4.01
8.83	25.91	40.78	3.79	154.48	2.67	3.46	3.46
8.87	24.87	39.11	3.19	124.91	2.58	0.70	0.70
8.92	23.75	37.31	3.46	129.23	2.62	3.13	3.13
8.99	22.89	35.92	3.68	132.31	2.66	2.99	2.99
9.06	22.28	34.93	3.83	133.80	2.68	2.89	2.89
9.15	20.04	31.32	4.38	137.23	2.75	2.56	2.56
9.22	20.90	32.70	4.26	139.39	2.74	2.66	2.66
9.26	21.33	33.38	4.23	141.11	2.73	2.70	2.70
9.35	21.16	33.10	4.35	143.86	2.75	2.65	2.65
9.40	21.25	33.24	4.32	143.57	2.74	2.65	2.65
9.48	21.07	32.95	4.36	143.62	2.75	2.60	2.60

:: Strength loss calculation (Robertson (2009) :: (continued)

Depth (ft)	q_t (tsf)	Q_{tn}	K_c	$Q_{tn,cs}$	I_c	$S_{u(liq)}/\sigma'_v$	$S_{u(peak)}/\sigma'_v$
9.53	21.07	32.94	4.37	143.81	2.75	2.59	2.59
9.58	21.42	33.50	4.29	143.63	2.74	2.62	2.62
9.66	23.06	36.13	3.94	142.40	2.69	2.80	2.80
9.72	24.18	37.92	3.73	141.56	2.66	2.92	2.92
9.80	25.48	39.83	3.55	141.43	2.64	3.06	3.06
9.85	26.52	41.12	3.42	140.61	2.61	3.17	3.17
9.94	27.38	41.96	3.29	138.16	2.59	0.71	0.71
9.98	27.38	41.75	3.27	136.50	2.59	0.71	0.71
10.08	27.81	41.97	3.20	134.31	2.58	0.71	0.71
10.12	28.76	43.08	3.08	132.79	2.56	0.72	0.72
10.18	29.45	43.77	2.99	131.03	2.54	0.72	0.72
10.25	29.71	43.74	2.90	127.05	2.53	0.72	0.72
10.34	29.88	43.39	2.75	119.36	2.50	0.72	0.72
10.39	30.57	43.92	2.58	113.40	2.46	0.72	0.72
10.44	31.35	44.62	2.44	108.83	2.43	0.72	0.72
10.52	35.58	49.33	2.02	99.60	2.32	0.73	0.73
10.57	38.09	52.03	1.82	94.67	2.26	0.74	0.74
10.66	41.98	56.10	1.59	89.35	2.17	0.75	0.75
10.70	44.05	58.29	1.51	87.78	2.13	0.75	0.75
10.77	47.42	61.68	1.38	85.18	2.06	0.76	0.76
10.83	48.80	62.93	1.34	84.10	2.03	0.76	0.76
10.93	52.86	66.15	1.18	78.11	1.89	0.77	0.77
10.97	54.15	67.42	1.00	67.42	1.87	0.16	0.77
11.06	56.57	70.47	1.19	83.83	1.90	0.78	0.78
11.10	57.69	71.66	1.18	84.79	1.89	0.78	0.78
11.19	58.99	72.97	1.18	86.44	1.90	0.78	0.78
11.25	57.69	71.39	1.20	85.97	1.92	0.78	0.78
11.29	56.57	70.02	1.22	85.45	1.93	0.78	0.78
11.38	60.72	74.55	1.20	89.21	1.91	0.79	0.79
11.43	61.93	75.81	1.19	90.39	1.90	0.79	0.79
11.49	64.17	78.17	1.18	92.27	1.89	0.79	0.79
11.56	66.50	80.57	1.17	94.21	1.88	0.80	0.80
11.64	68.66	82.79	1.16	96.28	1.87	0.80	0.80
11.70	69.53	83.69	1.17	97.66	1.88	0.80	0.80
11.75	70.99	85.20	1.17	99.31	1.87	0.81	0.81
11.81	72.38	86.39	1.15	99.49	1.86	0.81	0.81
11.88	75.14	89.14	1.13	101.13	1.84	0.81	0.81
11.97	78.42	92.95	1.15	106.96	1.86	0.82	0.82
12.01	79.46	94.23	1.16	109.76	1.87	0.82	0.82
12.10	80.93	95.36	1.15	109.94	1.86	0.82	0.82
12.16	81.53	95.77	1.15	110.08	1.86	0.82	0.82
12.24	83.43	97.42	1.14	110.83	1.84	0.82	0.82
12.28	82.65	96.39	1.14	110.14	1.85	0.82	0.82
12.36	80.41	93.64	1.16	108.38	1.86	0.82	0.82
12.41	82.65	95.84	1.15	109.81	1.85	0.82	0.82
12.47	81.79	94.70	1.15	109.26	1.86	0.82	0.82
12.55	82.65	95.23	1.15	109.23	1.85	0.82	0.82
12.64	82.05	94.10	1.14	107.49	1.85	0.82	0.82

::Strength loss calculation (Robertson (2009) ::(continued)

Depth (ft)	q_t (tsf)	Q_{tn}	K_c	$Q_{tn,cs}$	I_c	$S_{u(liq)}/\sigma'_v$	$S_{u(peak)}/\sigma'_v$
12.67	81.79	93.61	1.14	106.76	1.84	0.82	0.82
12.73	81.19	92.64	1.14	105.51	1.84	0.82	0.82
12.81	78.34	89.12	1.14	101.94	1.85	0.81	0.81
12.86	74.45	84.69	1.16	98.45	1.87	0.80	0.80
12.93	67.11	76.71	1.23	94.57	1.94	0.79	0.79
13.00	59.08	67.79	1.32	89.49	2.02	0.77	0.77
13.08	48.97	56.72	1.55	87.75	2.15	0.75	0.75
13.13	41.72	48.68	1.82	88.48	2.26	0.73	0.73
13.22	30.92	36.48	2.52	92.07	2.45	0.69	0.69
13.27	24.87	29.52	3.23	95.36	2.58	0.67	0.67
13.33	20.21	24.06	4.07	97.97	2.71	1.77	1.77
13.40	17.10	20.21	4.45	89.91	2.76	1.47	1.47
13.46	14.86	17.45	4.79	83.54	2.80	1.27	1.27
13.54	13.30	15.55	5.42	84.19	2.87	1.12	1.12
13.59	12.18	14.17	5.85	82.93	2.92	1.02	1.02
13.67	11.31	13.04	6.09	79.42	2.94	0.93	0.93
13.72	9.50	10.77	7.09	76.35	3.03	0.77	0.77
13.79	10.10	11.45	6.15	70.38	2.94	0.82	0.82
13.88	9.24	10.33	6.31	65.19	2.96	0.28	0.74
13.92	8.98	9.98	6.39	63.83	2.97	0.27	0.71
13.99	8.64	9.52	6.39	60.87	2.97	0.24	0.68
14.06	8.55	9.35	6.04	56.49	2.93	0.19	0.67
14.13	8.55	9.28	5.80	53.80	2.91	0.17	0.67
14.19	8.46	9.14	5.75	52.56	2.91	0.16	0.66
14.25	8.46	9.09	5.66	51.46	2.90	0.15	0.65
14.32	8.64	9.24	5.44	50.31	2.87	0.14	0.66
14.37	8.72	9.30	5.33	49.58	2.86	0.14	0.67
14.46	8.72	9.24	5.29	48.89	2.86	0.13	0.67
14.51	8.90	9.43	5.27	49.66	2.85	0.14	0.68
14.57	9.24	9.79	5.31	51.94	2.86	0.16	0.70
14.64	9.93	10.54	5.23	55.15	2.85	0.19	0.76
14.73	12.26	13.13	4.90	64.29	2.81	0.28	0.95
14.78	14.68	15.80	4.44	70.19	2.76	1.15	1.15
14.85	16.58	17.88	4.35	77.69	2.75	1.30	1.30
14.91	18.31	19.73	4.15	81.89	2.72	1.43	1.43
14.98	19.17	20.62	4.14	85.26	2.72	1.50	1.50
15.05	20.12	21.56	3.98	85.92	2.70	1.57	1.57
15.10	20.47	21.87	3.94	86.09	2.69	1.59	1.59
15.18	20.12	21.40	4.05	86.59	2.71	1.55	1.55
15.23	20.56	21.81	3.96	86.27	2.69	1.59	1.59
15.32	21.33	22.52	3.85	86.64	2.68	1.64	1.64
15.36	21.94	23.11	3.76	86.80	2.67	1.68	1.68
15.45	23.58	24.74	3.58	88.47	2.64	1.80	1.80
15.49	24.01	25.19	3.71	93.55	2.66	1.83	1.83
15.56	25.74	26.94	3.62	97.46	2.65	1.96	1.96
15.62	26.60	27.77	3.66	101.60	2.65	2.02	2.02
15.71	27.72	28.84	3.71	106.99	2.66	2.09	2.09
15.77	26.64	27.65	4.03	111.48	2.70	2.00	2.00

:: Strength loss calculation (Robertson (2009) :: (continued)

Depth (ft)	q_t (tsf)	Q_{tn}	K_c	$Q_{tn,cs}$	I_c	$S_{u(liq)}/\sigma'_v$	$S_{u(peak)}/\sigma'_v$
15.82	26.69	27.64	4.13	114.25	2.72	2.00	2.00
15.90	26.77	27.63	4.26	117.67	2.74	2.00	2.00
15.96	26.95	27.73	4.33	120.17	2.74	2.00	2.00
16.05	27.21	27.87	4.43	123.39	2.76	2.01	2.01
16.09	27.47	28.07	4.44	124.64	2.76	2.02	2.02
16.16	27.90	28.42	4.52	128.32	2.77	2.05	2.05
16.22	28.76	29.21	4.51	131.69	2.77	2.10	2.10
16.29	29.45	29.81	4.54	135.44	2.77	2.15	2.15
16.36	30.40	30.68	4.54	139.18	2.77	2.21	2.21
16.45	31.27	31.41	4.58	143.94	2.78	2.26	2.26
16.50	31.96	32.03	4.54	145.51	2.77	2.30	2.30
16.54	32.47	32.47	4.53	146.95	2.77	2.33	2.33
16.63	32.73	32.57	4.61	150.06	2.78	2.34	2.34
16.72	32.30	31.97	4.72	150.76	2.79	2.30	2.30
16.75	32.13	31.72	4.73	149.99	2.79	2.28	2.28
16.81	31.70	31.19	4.76	148.57	2.80	2.24	2.24
16.94	30.57	29.81	4.74	141.22	2.79	2.14	2.14
16.95	30.14	29.33	4.55	133.47	2.77	2.10	2.10
17.02	29.37	28.42	4.38	124.46	2.75	2.04	2.04
17.07	28.93	27.91	4.56	127.33	2.77	2.00	2.00
17.14	28.59	27.48	4.66	127.90	2.78	1.97	1.97
17.21	28.42	27.20	4.75	129.20	2.80	1.95	1.95
17.28	28.24	26.91	4.90	131.83	2.81	1.93	1.93
17.34	28.07	26.67	5.06	134.83	2.83	1.91	1.91
17.40	27.90	26.41	5.18	136.93	2.85	1.89	1.89
17.47	27.47	25.89	5.31	137.58	2.86	1.85	1.85
17.52	27.29	25.63	5.34	136.93	2.86	1.83	1.83
17.62	27.29	25.48	5.24	133.42	2.85	1.82	1.82
17.66	27.38	25.50	5.15	131.28	2.84	1.82	1.82
17.72	27.21	25.24	5.09	128.57	2.84	1.80	1.80
17.80	26.52	24.46	5.06	123.71	2.83	1.75	1.75
17.85	25.75	23.65	5.08	120.25	2.83	1.69	1.69
17.93	24.62	22.47	5.19	116.51	2.85	1.61	1.61
18.00	23.42	21.24	5.34	113.40	2.86	1.52	1.52
18.06	22.28	20.09	5.52	110.91	2.88	1.44	1.44
18.11	21.42	19.23	5.66	108.80	2.90	1.37	1.37
18.20	18.74	16.61	6.57	109.03	2.98	1.19	1.19
18.25	17.36	15.27	7.09	108.32	3.03	1.09	1.09
18.33	15.37	13.35	7.56	100.92	3.07	0.95	0.95
18.38	14.16	12.18	7.99	97.29	3.10	0.87	0.87
18.46	13.22	11.24	8.79	98.80	3.17	0.80	0.80
18.51	13.83	11.78	8.49	99.99	3.14	0.84	0.84
18.59	16.42	14.11	6.86	96.71	3.01	1.01	1.01
18.64	30.57	27.15	3.55	96.27	2.63	1.93	1.93
18.70	66.42	60.30	1.68	101.21	2.20	0.76	0.76
18.78	94.31	86.00	1.32	113.71	2.02	0.81	0.81
18.85	123.51	113.02	1.16	130.56	1.86	0.84	0.84
18.92	147.95	135.62	1.09	148.06	1.78	0.87	0.87

:: Strength loss calculation (Robertson (2009) :: (continued)

Depth (ft)	q_t (tsf)	Q_{tn}	K_c	$Q_{tn,cs}$	I_c	$S_{u(liq)}/\sigma'_v$	$S_{u(peak)}/\sigma'_v$
18.97	164.45	150.84	1.06	160.27	1.74	0.89	0.89
19.06	181.03	165.91	1.06	176.39	1.74	0.90	0.90
19.11	194.76	178.58	1.03	183.77	1.69	0.91	0.91
19.19	205.56	188.45	1.00	188.82	1.65	0.92	0.92
19.24	215.32	197.26	1.01	199.30	1.66	0.93	0.93
19.32	216.44	197.96	1.02	202.11	1.68	0.93	0.93
19.38	225.42	206.20	1.00	206.20	1.62	0.93	0.93
19.44	243.30	222.44	1.00	222.44	1.48	0.95	0.95
19.54	264.55	241.62	1.00	241.62	1.44	0.96	0.96
19.59	250.99	229.00	1.00	229.00	1.51	0.95	0.95
19.65	234.06	213.28	1.00	213.28	1.63	0.94	0.94
19.71	231.47	210.64	1.01	212.41	1.66	0.94	0.94
19.76	142.25	128.00	1.24	158.87	1.95	0.86	0.86
19.83	203.83	184.77	1.05	193.55	1.71	0.92	0.92
19.91	209.18	189.61	1.02	193.20	1.67	0.92	0.92
19.96	201.51	182.45	1.02	186.62	1.68	0.92	0.92
20.03	192.77	174.31	1.02	178.61	1.68	0.91	0.91
20.09	194.24	175.63	1.01	176.52	1.65	0.91	0.91
20.16	189.58	171.29	1.00	171.29	1.64	0.91	0.91
20.22	187.16	168.95	1.00	168.95	1.60	0.90	0.90
20.30	187.17	168.75	1.00	168.75	1.57	0.90	0.90
20.36	187.17	168.62	1.00	168.62	1.56	0.90	0.90
20.45	187.17	168.43	1.00	168.43	1.57	0.90	0.90
20.48	192.27	172.96	1.00	172.96	1.63	0.91	0.91
20.55	204.62	183.46	1.05	192.46	1.72	0.92	0.92
20.61	210.06	188.21	1.05	197.31	1.72	0.92	0.92
20.68	223.10	200.26	1.00	200.19	1.64	0.93	0.93
20.76	244.00	218.89	1.00	218.89	1.57	0.94	0.94
20.81	259.29	232.53	1.00	232.53	1.46	0.95	0.95
20.88	289.43	259.44	1.00	259.44	1.22	0.97	0.97
20.94	280.87	251.55	1.00	251.55	1.26	0.97	0.97
21.00	323.28	289.47	1.00	289.47	1.20	0.99	0.99
21.06	265.58	237.40	1.00	237.40	1.34	0.96	0.96
21.14	218.08	194.54	1.00	194.54	1.49	0.93	0.93
21.20	176.35	156.98	1.00	156.98	1.62	0.89	0.89
21.26	171.26	152.30	1.00	152.30	1.55	0.89	0.89
21.33	158.30	140.58	1.00	140.58	1.44	0.88	0.88
21.43	146.99	130.30	1.00	130.30	1.50	0.87	0.87
21.46	144.23	127.79	1.00	127.79	1.51	0.86	0.86
21.52	141.12	124.91	1.00	124.91	1.52	0.86	0.86
21.59	135.42	119.72	1.00	119.72	1.55	0.85	0.85
21.65	99.82	87.51	1.00	87.51	1.74	0.81	0.81
21.73	115.71	101.98	1.00	101.98	1.64	0.83	0.83
21.79	115.80	101.99	1.00	101.99	1.64	0.83	0.83
21.85	115.97	102.06	1.00	102.06	1.64	0.83	0.83
21.92	115.71	101.72	1.00	101.72	1.65	0.83	0.83
21.98	115.67	101.62	1.00	101.62	1.64	0.83	0.83
22.05	115.63	101.51	1.00	101.51	1.64	0.83	0.83

:: Strength loss calculation (Robertson (2009) :: (continued)

Depth (ft)	q_t (tsf)	Q_{tn}	K_c	$Q_{tn,cs}$	I_c	$S_{u(liq)}/\sigma'_v$	$S_{u(peak)}/\sigma'_v$
22.13	117.44	103.04	1.00	103.04	1.61	0.83	0.83
22.19	118.39	103.82	1.00	103.82	1.58	0.83	0.83
22.25	119.86	105.05	1.00	105.05	1.56	0.83	0.83
22.31	120.55	105.59	1.00	105.59	1.57	0.83	0.83
22.41	122.11	106.85	1.00	106.85	1.62	0.84	0.84
22.45	123.23	107.71	1.00	107.71	1.66	0.84	0.84
22.52	123.23	107.41	1.00	107.41	1.69	0.84	0.84
22.59	123.23	107.10	1.06	113.47	1.73	0.84	0.84
22.65	126.51	109.52	1.10	120.81	1.80	0.84	0.84
22.71	133.25	115.24	1.11	128.29	1.81	0.85	0.85
22.78	140.59	121.78	1.08	132.13	1.77	0.86	0.86
22.84	150.69	130.92	1.05	137.02	1.71	0.87	0.87
22.92	173.06	150.82	1.01	152.09	1.66	0.89	0.89
22.98	194.40	169.59	1.00	169.59	1.60	0.90	0.90
23.04	213.74	186.43	1.00	186.43	1.57	0.92	0.92
23.11	245.27	213.93	1.00	213.93	1.50	0.94	0.94
23.19	278.69	242.97	1.00	242.97	1.45	0.96	0.96
23.23	289.83	252.60	1.00	252.60	1.43	0.97	0.97
23.30	309.61	269.68	1.00	269.68	1.39	0.98	0.98
23.37	343.55	299.06	1.00	299.06	1.32	0.99	0.99
23.44	359.96	313.14	1.00	313.14	1.29	1.00	1.00
23.51	356.94	310.21	1.00	310.21	1.33	1.00	1.00
23.57	373.09	324.04	1.00	324.04	1.32	1.01	1.01
23.62	390.37	338.84	1.00	338.84	1.31	1.02	1.02
23.71	402.80	349.23	1.00	349.23	1.29	1.02	1.02
23.77	369.64	320.16	1.00	320.16	1.35	1.01	1.01
23.82	424.48	367.54	1.00	367.54	1.27	1.03	1.03
23.89	449.17	388.62	1.00	388.62	1.24	1.04	1.04
23.97	457.38	395.36	1.00	395.36	1.25	1.04	1.04
24.03	450.12	388.72	1.00	388.72	1.30	1.04	1.04
24.08	473.86	408.97	1.00	408.97	1.29	1.05	1.05
24.16	488.03	420.79	1.00	420.79	1.28	1.05	1.05
24.21	506.34	436.29	1.00	436.29	1.26	1.06	1.06
24.29	509.19	438.26	1.00	438.26	1.24	1.06	1.06
24.35	519.03	446.42	1.00	446.42	1.19	1.06	1.06
24.43	513.25	440.95	1.00	440.95	1.20	1.06	1.06
24.49	520.85	447.12	1.00	447.12	1.22	1.06	1.06
24.56	500.47	429.17	1.00	429.17	1.27	1.06	1.06
24.63	486.65	416.89	1.00	416.89	1.30	1.05	1.05
24.68	447.00	382.52	1.00	382.52	1.32	1.04	1.04
24.74	469.29	401.33	1.00	401.33	1.27	1.04	1.04
24.80	466.52	-1.00	1.00	-1.00	-1.00	N/A	N/A
24.88	478.60	-1.00	1.00	-1.00	-1.00	N/A	N/A
24.95	535.35	-1.00	1.00	-1.00	-1.00	N/A	N/A
25.01	638.74	-1.00	1.00	-1.00	-1.00	N/A	N/A
25.08	679.84	-1.00	1.00	-1.00	-1.00	N/A	N/A
25.13	771.39	-1.00	1.00	-1.00	-1.00	N/A	N/A

:: Strength loss calculation (Robertson (2009) :: (continued)

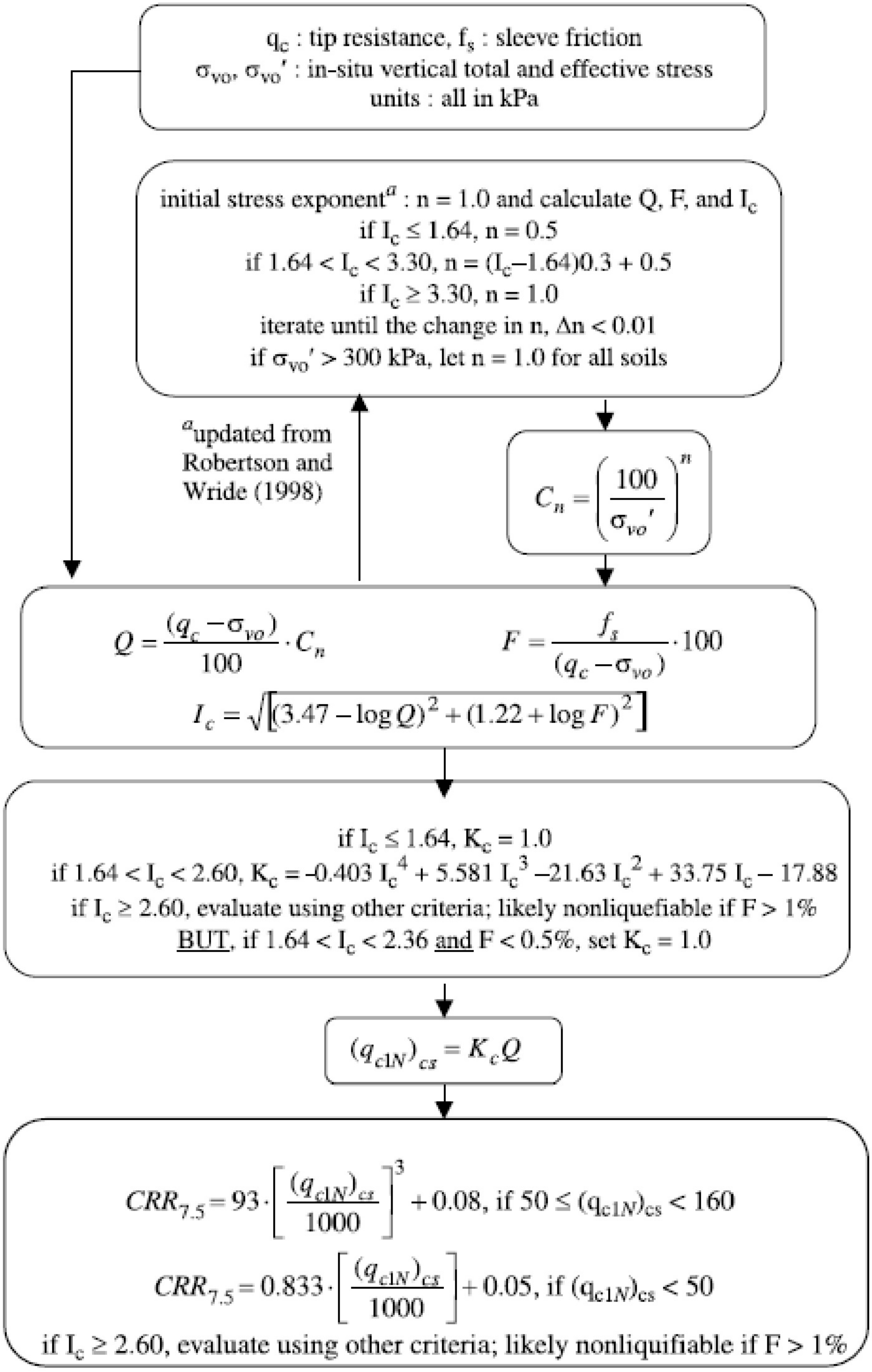
Depth (ft)	q_t (tsf)	Q_{tn}	K_c	$Q_{tn,cs}$	I_c	$S_{u(liq)}/\sigma'_v$	$S_{u(peak)}/\sigma'_v$

Abbreviations

q_t:	Total cone resistance
K_c:	Cone resistance correction factor due to fines
$Q_{tn,cs}$:	Adjusted and corrected cone resistance due to fines
I_c:	Soil behavior type index
$S_{u(liq)}/\sigma'_v$:	Calculated liquefied undrained strength ratio
$S_{u(peak)}/\sigma'_v$:	Calculated peak undrained strength ratio

Procedure for the evaluation of soil liquefaction resistance, NCEER (1998)

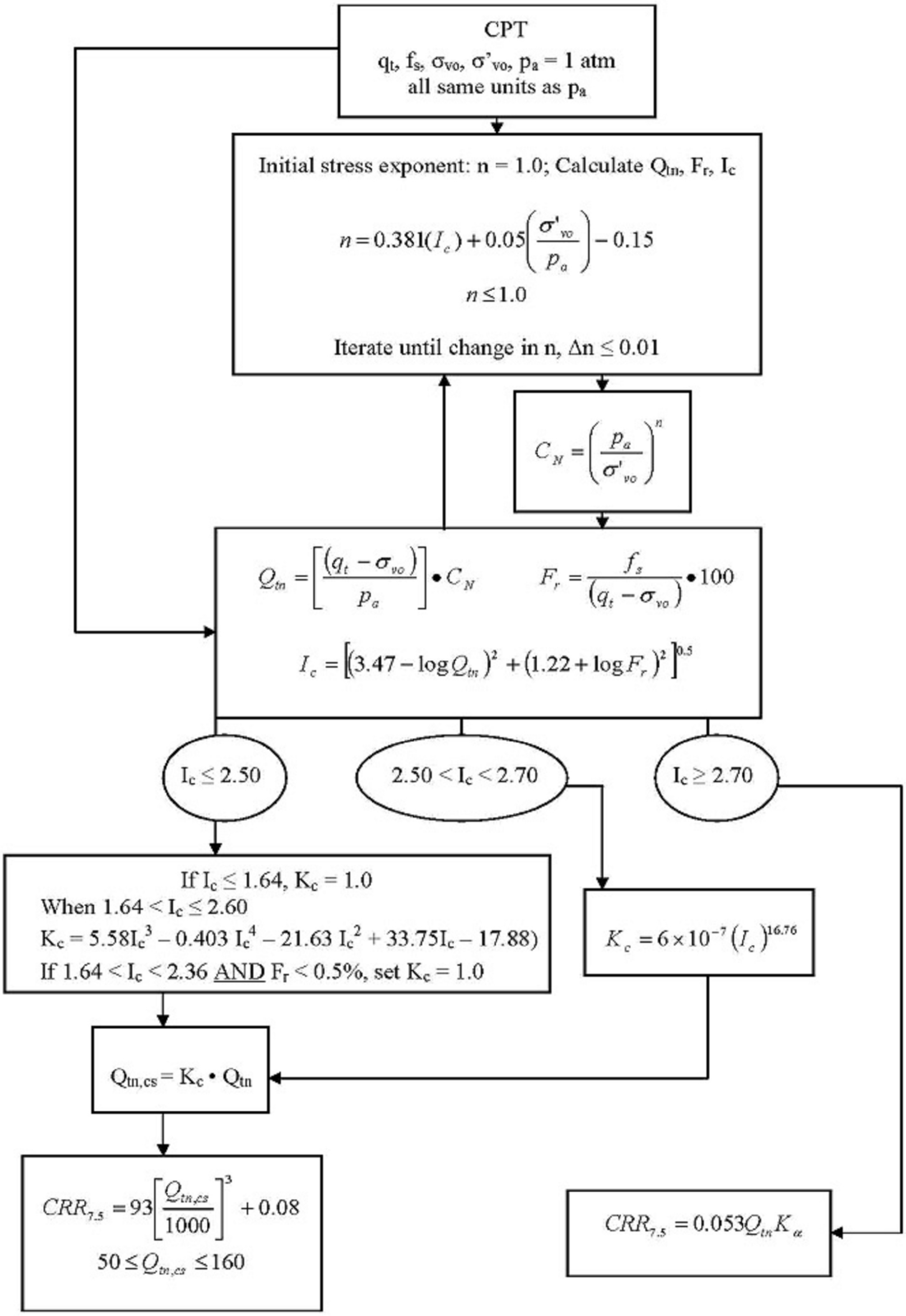
Calculation of soil resistance against liquefaction is performed according to the Robertson & Wride (1998) procedure. The procedure used in the software, slightly differs from the one originally published in NCEER-97-0022 (Proceedings of the NCEER Workshop on Evaluation of Liquefaction Resistance of Soils). The revised procedure is presented below in the form of a flowchart[1]:



[1] "Estimating liquefaction-induced ground settlements from CPT for level ground", G. Zhang, P.K. Robertson, and R.W.I. Brachman

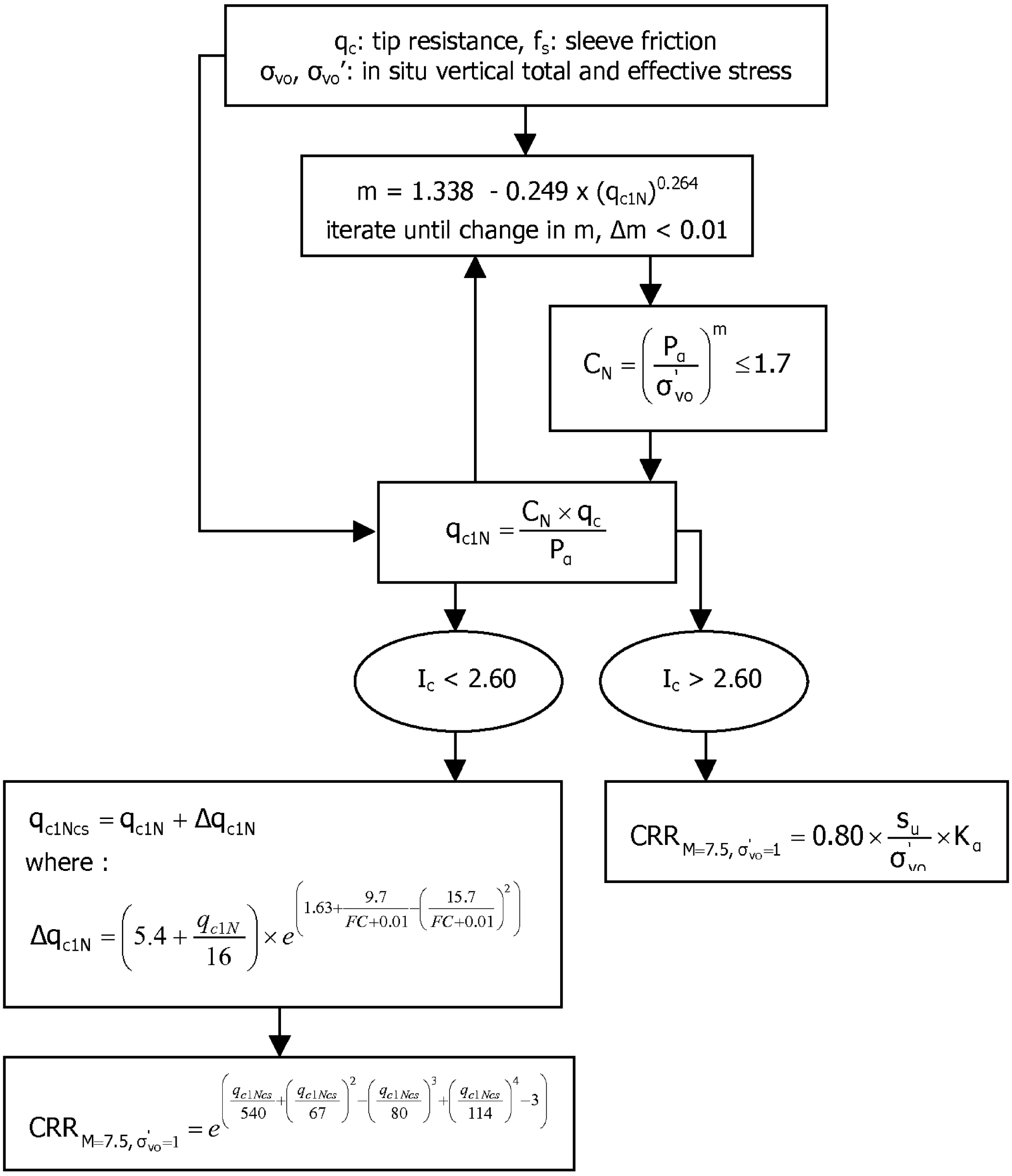
Procedure for the evaluation of soil liquefaction resistance (all soils), Robertson (2010)

Calculation of soil resistance against liquefaction is performed according to the Robertson & Wride (1998) procedure. This procedure used in the software, slightly differs from the one originally published in NCEER-97-0022 (Proceedings of the NCEER Workshop on Evaluation of Liquefaction Resistance of Soils). The revised procedure is presented below in the form of a flowchart[1]:

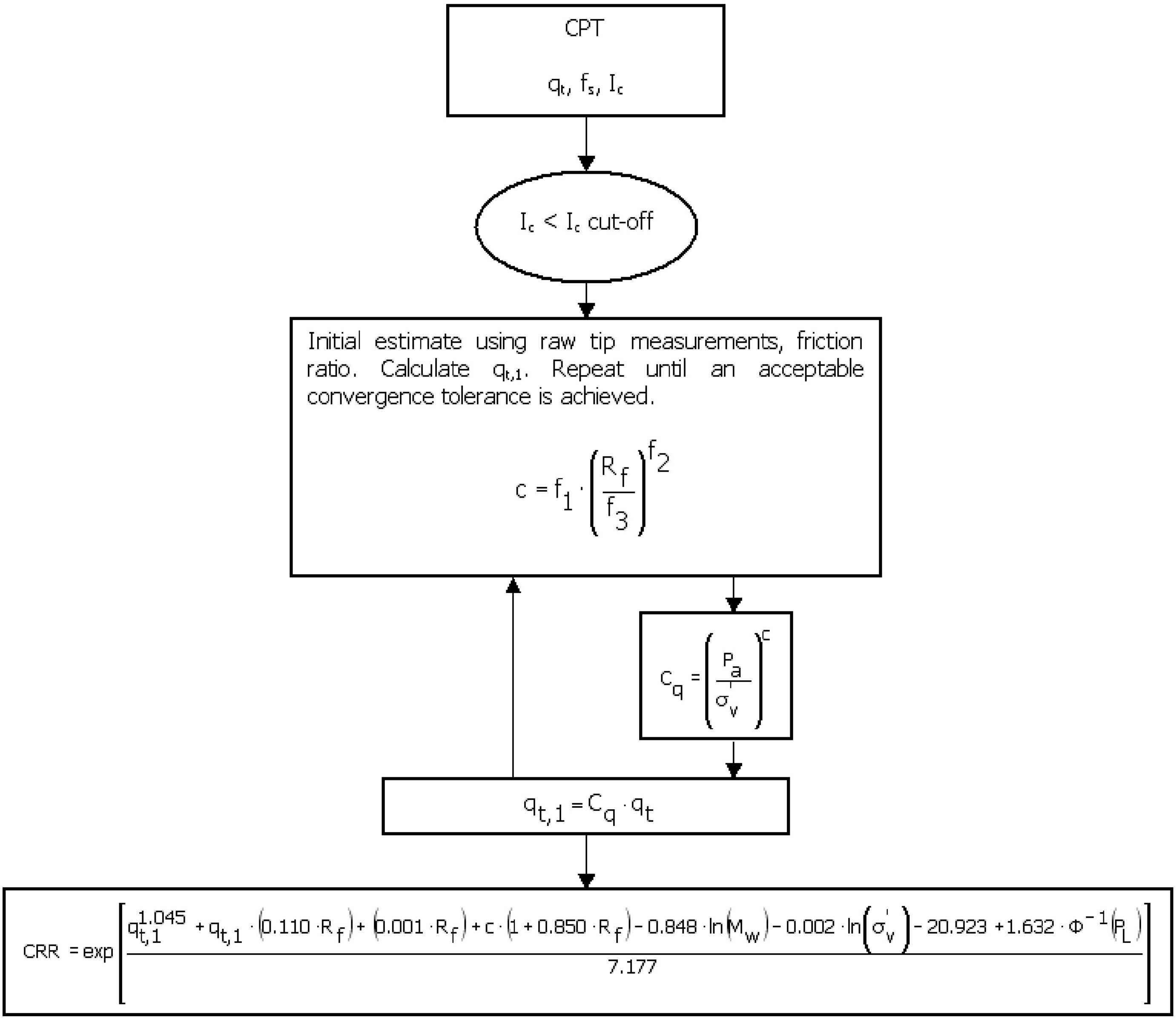


[1] P.K. Robertson, 2009. "Performance based earthquake design using the CPT", Keynote Lecture, International Conference on Performance-based Design in Earthquake Geotechnical Engineering – from case history to practice, IS-Tokyo, June 2009

Procedure for the evaluation of soil liquefaction resistance, Idriss & Boulanger (2008)



Procedure for the evaluation of soil liquefaction resistance (sandy soils), Moss et al. (2006)



Procedure for the evaluation of soil liquefaction resistance, Boulanger & Idriss(2014)

$$FS_{liq} = \frac{CRR_{M=7.5,\sigma'_v=1atm}}{CSR_{M=7.5,\sigma'_v=1atm}}$$

$$CSR_{M=7.5,\sigma'_v=1atm} = 0.65\frac{\sigma_v}{\sigma'_v}\frac{a_{\max}}{g}r_d\frac{1}{MSF}\frac{1}{K_\sigma}$$

$$r_d = \exp\left[\alpha(z)+\beta(z)\cdot M\right]$$

$$\alpha(z) = -1.012-1.126\sin\left(\frac{z}{11.73}+5.133\right)$$

$$\beta(z) = 0.106+0.118\sin\left(\frac{z}{11.28}+5.142\right)$$

$$K_\sigma = 1-C_\sigma\ln\left(\frac{\sigma'_v}{P_a}\right)\leq 1.1$$

$$C_\sigma = \frac{1}{37.3-8.27\left(q_{c1Ncs}\right)^{0.264}}\leq 0.3$$

$$MSF = 1+\left(MSF_{max}-1\right)\left(8.64\exp\left(\frac{-M}{4}\right)-1.325\right)$$

$$MSF_{max} = 1.09+\left(\frac{q_{c1Ncs}}{180}\right)^3\leq 2.2$$

σ'_v *and* σ_v *at start of earthquake shaking*

$$CRR_{M=7.5,\sigma'_v=1atm} = \exp\left(\frac{q_{c1Ncs}}{113}+\left(\frac{q_{c1Ncs}}{1000}\right)^2-\left(\frac{q_{c1Ncs}}{140}\right)^3+\left(\frac{q_{c1Ncs}}{137}\right)^4-2.80\right)$$

$$q_{c1Ncs} = q_{c1N}+\Delta q_{c1N}$$

$$\Delta q_{c1N} = \left(11.9+\frac{q_{c1N}}{14.6}\right)\exp\left(1.63-\frac{9.7}{FC+2}-\left(\frac{15.7}{FC+2}\right)^2\right)$$

$$q_{c1N} = C_{N}\frac{q_c}{P_a}$$

$$C_{N} = \left(\frac{P_a}{\sigma'_v}\right)^m\leq 1.7$$

$$m = 1.338-0.249\left(q_{c1Ncs}\right)^{0.264}\quad with\quad 0.264\leq m\leq 0.782$$

$$FC = 80\left(I_C+C_{FC}\right)-137\quad with\quad 0\%\leq FC\leq 100\%$$

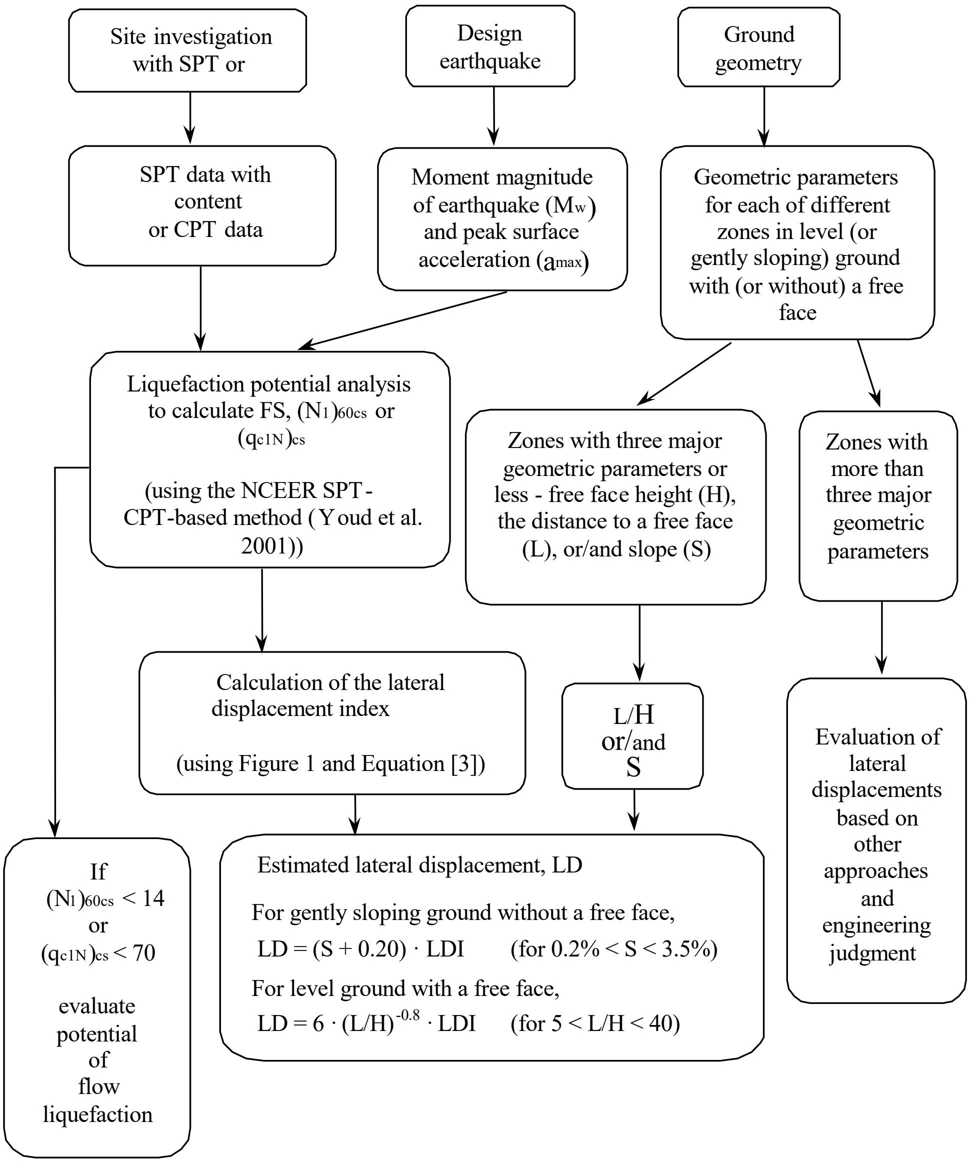
$$I_c = \left[\left(3.47-\log(Q)\right)^2+\left(1.22+\log(F)\right)^2\right]^{0.5}$$

$$Q = \left(\frac{q_c-\sigma_{vo}}{P_a}\right)\left(\frac{P_a}{\sigma'_{vo}}\right)^n\ with\ 0.5\leq n\leq 1.0\ per\ Robertson\ \&\ Wride\ (1998)$$

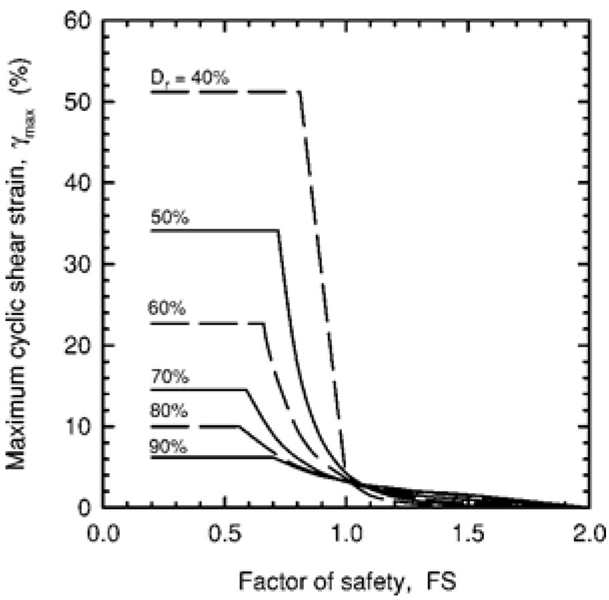
$$F = \left(\frac{f_s}{q_c-\sigma_{vo}}\right)\cdot 100\%$$

σ'_v *at time of CPT sounding*

Procedure for the evaluation of liquefaction-induced lateral spreading displacements



[1] Flow chart illustrating major steps in estimating liquefaction-induced lateral spreading displacements using the proposed approach



[1] **Figure 1**

$$LDI = \int_0^{Z_{max}} \gamma_{max}\, dz$$

[1] **Equation [3]**

[1] "Estimating liquefaction-induced ground settlements from CPT for level ground", G. Zhang, P.K. Robertson, and R.W.I. Brachman

Procedure for the estimation of seismic induced settlements in dry sands

Average shear stress, τ_{av}

$$\tau_{av} = CSR^{*} \cdot \sigma_{v0}' = 0.65 \cdot \frac{\alpha_{max}}{g} \cdot \sigma_{v0} \cdot \tau_a$$

Estimate small shear strain modulus, G_0

$$G_0 = 0.0188 \cdot \left[10^{(0.55 I_c - 1.68)}\right] \cdot (q_t - \sigma_v)$$

Estimate shear strain amplitude, γ (based on Pradel (1998))

$$\gamma = \left[\frac{1 + \alpha \cdot e^{bR}}{1 + \alpha}\right] \cdot R \cdot 100\ (\%)$$

$$R = \frac{\tau_{av}}{G_0} \text{ (Note } \tau_{av} \text{ and } G_0 \text{ same units)}$$

$$\alpha = 0.0389 \cdot \left(\frac{\sigma_v}{p_a}\right) + 0.124$$

$$b = 6400 \cdot \left(\frac{\sigma_v}{p_a}\right)$$

Estimate volumetric strain in 15 cycles

$$\varepsilon_{vol(15)} = \gamma \cdot \left[\frac{(N_1)_{60cs}}{20}\right]^{-1.20}$$

$$(N_1)_{60,cs} = \frac{Q_{tn,cs}}{8.5 \cdot \left[1 - \frac{I_c}{4.6}\right]}$$

Volumetric strain in design earthquake

$$\Sigma_{vol} = \varepsilon_{vol(15)} \cdot \left[\frac{N_c}{15}\right]^{0.45}$$

$$N_c = (M - 4)^{2.17}$$

Seismic settlement, s

$$s = 2 \cdot \int_0^{GWT} \Sigma_{vol} \cdot dz$$

Robertson, P.K. and Lisheng, S., 2010, "Estimation of seismic compression in dry soils using the CPT" FIFTH INTERNATIONAL CONFERENCE ON RECENT ADVANCES IN GEOTECHNICAL EARTHQUAKE ENGINEERING AND SOIL DYNAMICS, Symposium in honor of professor I. M. Idriss, San Diego, CA

Liquefaction Potential Index (LPI) calculation procedure

Calculation of the Liquefaction Potential Index (LPI) is used to interpret the liquefaction assessment calculations in terms of severity over depth. The calculation procedure is based on the methology developed by Iwasaki (1982) and is adopted by AFPS.

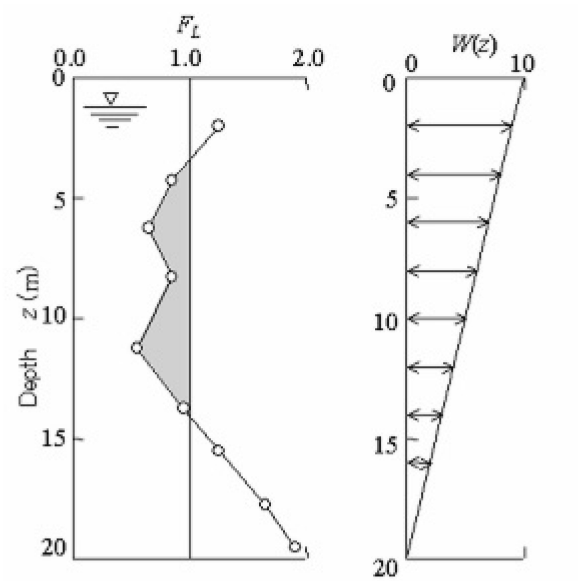
To estimate the severity of liquefaction extent at a given site, LPI is calculated based on the following equation:

$$\textbf{LPI} = \int_{0}^{20} (10 - 0{,}5_z) \times F_L \times d_z$$

where:
F_L = 1 - F.S. when F.S. less than 1
F_L = 0 when F.S. greater than 1
z depth of measurment in meters

Values of LPI range between zero (0) when no test point is characterized as liquefiable and 100 when all points are characterized as susceptible to liquefaction. Iwasaki proposed four (4) discrete categories based on the numeric value of LPI:

- LPI = 0 : Liquefaction risk is very low
- 0 < LPI <= 5 : Liquefaction risk is low
- 5 < LPI <= 15 : Liquefaction risk is high
- LPI > 15 : Liquefaction risk is very high



Graphical presentation of the LPI calculation procedure

Shear-Induced Building Settlement (Ds) calculation procedure

The shear-induced building settlement (Ds) due to liquefaction below the building can be estimated using the relationship developed by Bray and Macedo (2017):

$$Ln(Ds) = c1 + c2 * LBS + 0.58 * Ln\left(Tanh\left(\frac{HL}{6}\right)\right) +$$

$$4.59 * Ln(Q) - 0.42 * Ln(Q)^2 - 0.02 * B +$$
$$0.84 * Ln(CAVdp) + 0.41 * Ln(Sa1) + \varepsilon$$

where Ds is in the units of mm, c1= -8.35 and c2= 0.072 for LBS ≤ 16, and c1= -7.48 and c2= 0.014 otherwise. Q is the building contact pressure in units of kPa, HL is the cumulative thickness of the liquefiable layers in the units of m, B is the building width in the units of m, CAVdp is a standardized version of the cumulative absolute velocity in the units of g-s, Sa1 is 5%-damped pseudo-acceleration response spectral value at a period of 1 s in the units of g, and ε is a normal random variable with zero mean and 0.50 standard deviation in Ln units. The liquefaction-induced building settlement index (LBS) is:

$$LBS = \sum W * \frac{\varepsilon_{shear}}{z} dz$$

where z (m) is the depth measured from the ground surface > 0, W is a foundation-weighting factor wherein W = 0.0 for z less than Df, which is the embedment depth of the foundation, and W = 1.0 otherwise. The shear strain parameter (ε_shear) is the liquefaction-induced free-field shear strain (in %) estimated using Zhang et al. (2004). It is calculated based on the estimated Dr of the liquefied soil layer and the calculated safety factor against liquefaction triggering (FSL).

References

- Lunne, T., Robertson, P.K., and Powell, J.J.M 1997. Cone penetration testing in geotechnical practice, E & FN Spon Routledge, 352 p, ISBN 0-7514-0393-8.

- Boulanger, R.W. and Idriss, I. M., 2007. Evaluation of Cyclic Softening in Silts and Clays. ASCE Journal of Geotechnical and Geoenvironmental Engineering June, Vol. 133, No. 6 pp 641 -652

- Boulanger, R.W. and Idriss, I. M., 20 14. CPT AND SPT BASED LIQUEFACTION TRIGGERING PROCEDURES. DEPARTMENT OF CIVIL & ENVIRONMENTAL ENGINEERING COLLEGE OF ENGINEERING UNIVERSITY OF CALIFORNIA AT DAVIS

- Robertson, P.K. and Cabal, K.L., 2007 , Guide to Cone Penetration Testing for Geotechnical Engineering. Available at no cost at http://www.geologismiki.gr/

- Robertson, P.K. 1990. Soil classification using the cone penetration test. Canadian Geotechnical Journal, 27 (1), 151 -8.

- Robertson, P.K. and Wride, C.E., 1998. Cyclic Liquefaction and its Evaluation based on the CPT Canadian Geotechnical Journal, 1998, Vol. 35, August.

- Youd, T.L., Idriss, I.M., Andrus, R.D., Arango, I., Castro, G., Christian, J.T., Dobry, R., Finn, W.D.L., Harder, L.F., Hynes , M.E., Ishihara, K., Koester, J., Liao, S., Marcuson III, W.F., Martin, G.R., Mitchell, J.K., Moriwaki, Y., Power, M.S., Robertson, P.K., Seed, R., and Stokoe, K.H., Liquefaction Resistance of Soils: Summary Report from the 1996 NCEER and 1998 NCEER/NSF Workshop on Evaluation of Liquefaction Resistance of Soils, ASCE, Journal of Geotechnical & Geoenvironmental Engineering, Vol. 127, October, pp 817-833

- Zhang, G., Robertson. P.K., Brachman, R., 2002, Estimating Liquefaction Induced Ground Settlements from the CPT, Canadian Geotechnical Journal, 39: pp 1168-1180

- Zhang, G., Robertson. P.K., Brachman, R., 2004, Estimating Liquefaction Induced Lateral Displacements using the SPT and CPT, ASCE, Journal of Geotechnical & Geoenvironmental Engineering, Vol. 130, No. 8, 861 -871

- Pradel, D., 1998, Procedure to Evaluate Earthquake -Induced Settlements in Dry Sandy Soils, ASCE, Journal of Geotechnical & Geoenvironmental Engineering, Vol. 124, No. 4, 364-368

- Iwasaki, T., 1986, Soil liquefaction studies in Japan: state -of-the-art, Soil Dynamics and Earthquake Engineering, Vol. 5, No. 1, 2-70

- Papathanassiou G., 2008, LPI-based approach for calibrating the severity of liquefaction -induced failures and for assessing the probability of liquefaction surface evidence, Eng. Geol. 96:94 –104

- P.K. Robertson, 2009, Interpretation of Cone Penetration Tests - a unified approach., Canadian Geotechnical Journal, Vol. 46, No. 11, pp 1337-1355

- P.K. Robertson, 2009. “Performance based earthquake design using the CPT”, Keynote Lecture, International Conference on Performance-based Design in Earthquake Geotechnical Engineering - from case history to practice, IS-Tokyo, June 2009

- Robertson, P.K. and Lisheng, S., 2010, “Estimation of seismic compression in dry soils using the CPT” FIFTH INTERNATIONAL CONFERENCE ON RECENT ADVANCES IN GEOTECHNICAL EARTHQUAKE ENGINEERING AND SOIL DYNAMICS, *Symposium in honor of professor I. M. Idriss,* SAN diego, CA

- R. E. S. Moss, R. B. Seed, R. E. Kayen, J. P. Stewart, A. Der Kiureghian, K. O. Cetin, CPT -Based Probabilistic and Deterministic Assessment of In Situ Seismic Soil Liquefaction Potential, Journal of Geotechnical and Geoenvironmental Engineering, Vol. 132 , No. 8, August 1, 2006

- I. M. Idriss and R. W. Boulanger, 2008. Soil liquefaction during earthquakes, Earthquake Engineering Research Institute MNO-12

- Jonathan D. Bray & Jorge Macedo, Department of Civil & Environmental Engineering, Univ. of California, Berkeley, CA, USA, Simplified procedure for estimating liquefaction -induced building settlement, *Proceedings of the 19th International Conference on Soil Mechanics and Geotechnical Engineering, Seoul 201*

TABLE OF CONTENTS

Kehoe Testing and Engineering
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steve@kehoetesting.com
www.kehoetesting.com

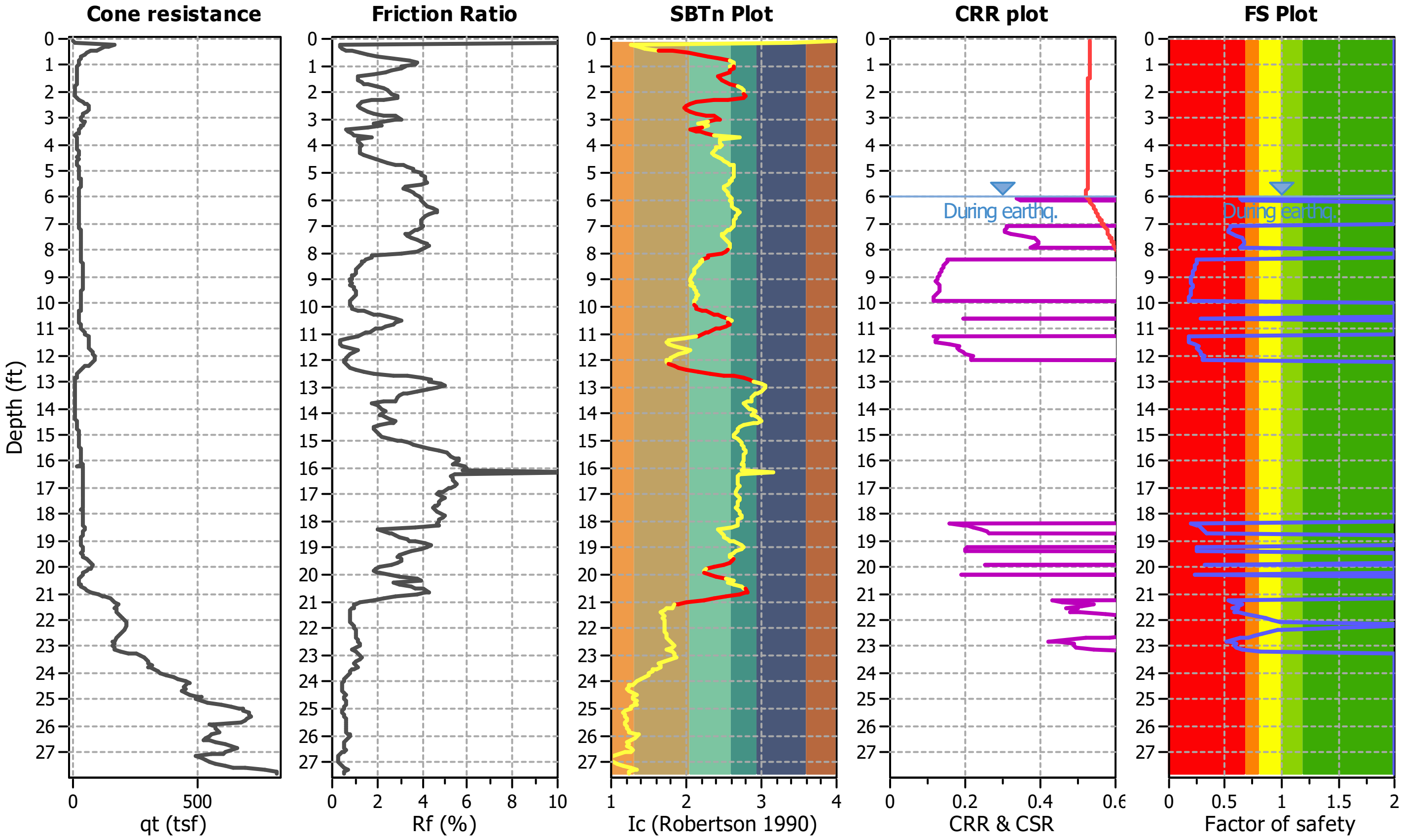
LIQUEFACTION ANALYSIS REPORT

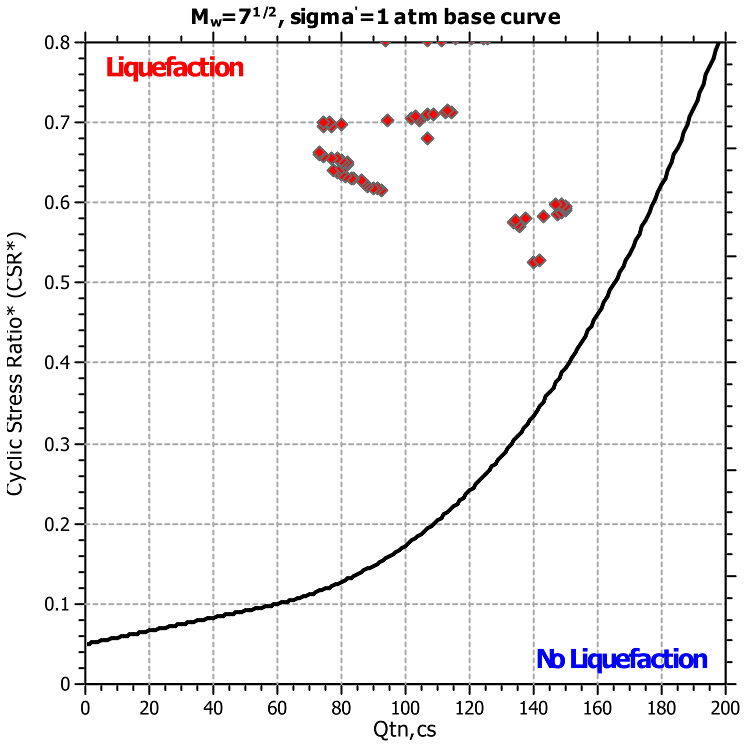
Project title : Twining Consulting **Location : 4112 Del Rey Ave, Marina Del Rey, CA**

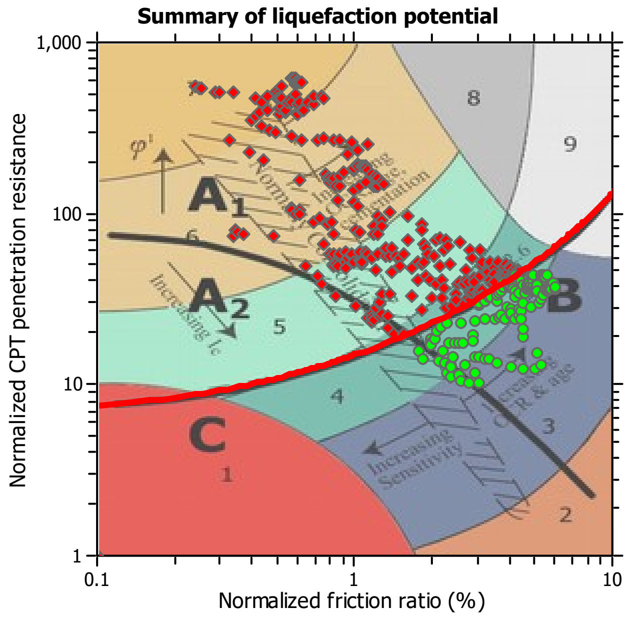
CPT file : CPT-1

Input parameters and analysis data

Analysis method:	NCEER (1998)	G.W.T. (in-situ):	17.40 ft	Use fill:	No	Clay like behavior applied:	Sands only
Fines correction method:	NCEER (1998)	G.W.T. (earthq.):	6.00 ft	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	1	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	7.31	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.87	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

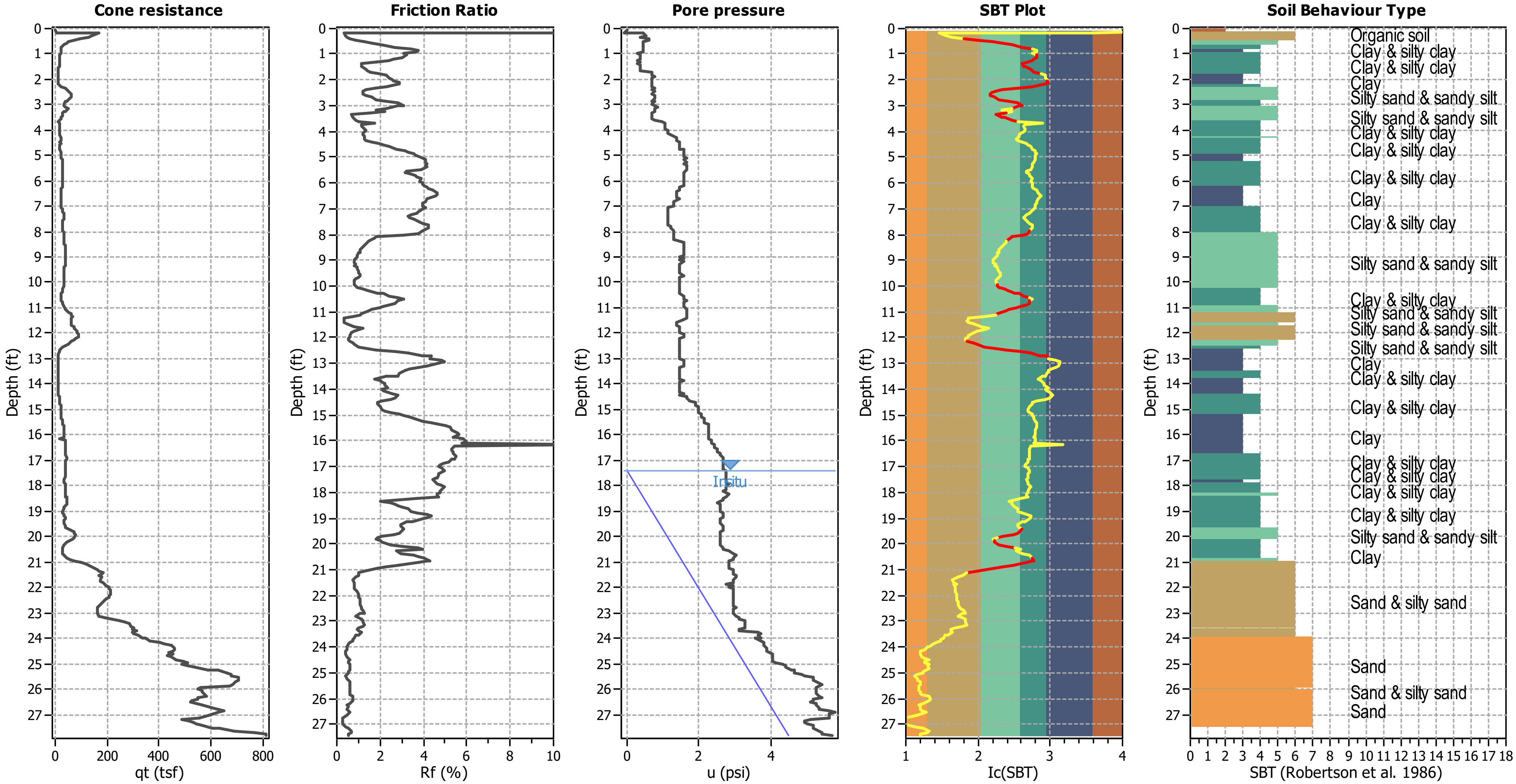






Zone A_1: Cyclic liquefaction likely depending on size and duration of cyclic loading
Zone A_2: Cyclic liquefaction and strength loss likely depending on loading and ground geometry
Zone B: Liquefaction and post-earthquake strength loss unlikely, check cyclic softening
Zone C: Cyclic liquefaction and strength loss possible depending on soil plasticity, brittleness/sensitivity, strain to peak undrained strength and ground geometry

CPT basic interpretation plots



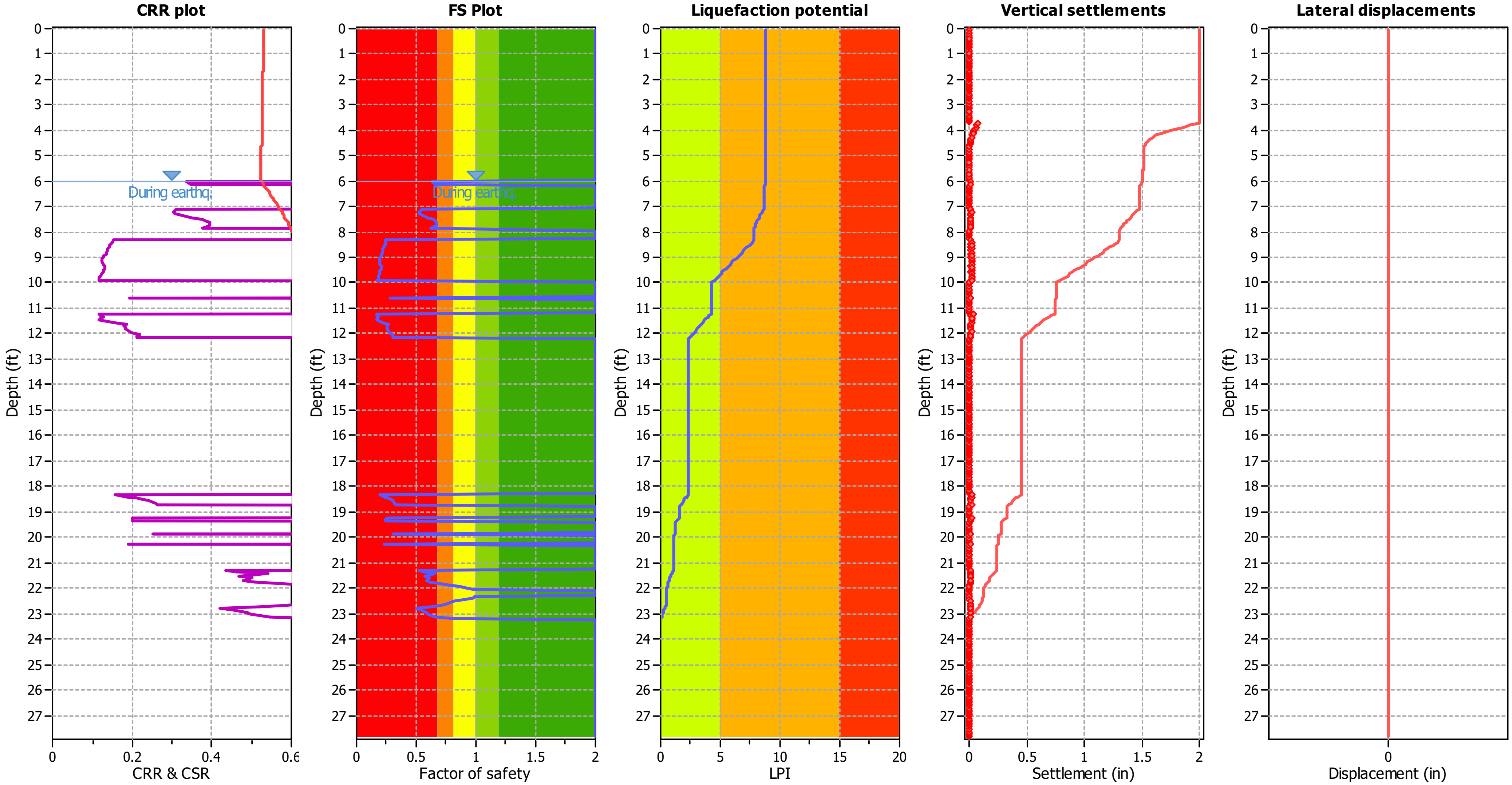
Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	6.00 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	1	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	7.31	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.87	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	17.40 ft	Fill height:	N/A	Limit depth:	N/A

SBT legend

1. Sensitive fine grained	4. Clayey silt to silty	7. Gravely sand to sand
2. Organic material	5. Silty sand to sandy silt	8. Very stiff sand to
3. Clay to silty clay	6. Clean sand to silty sand	9. Very stiff fine grained

Liquefaction analysis overall plots



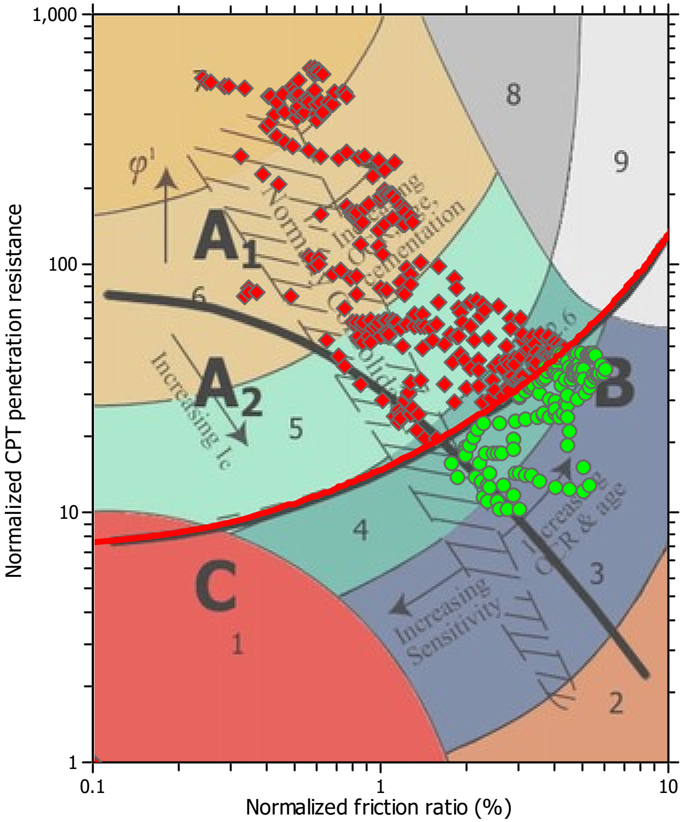
Input parameters and analysis data

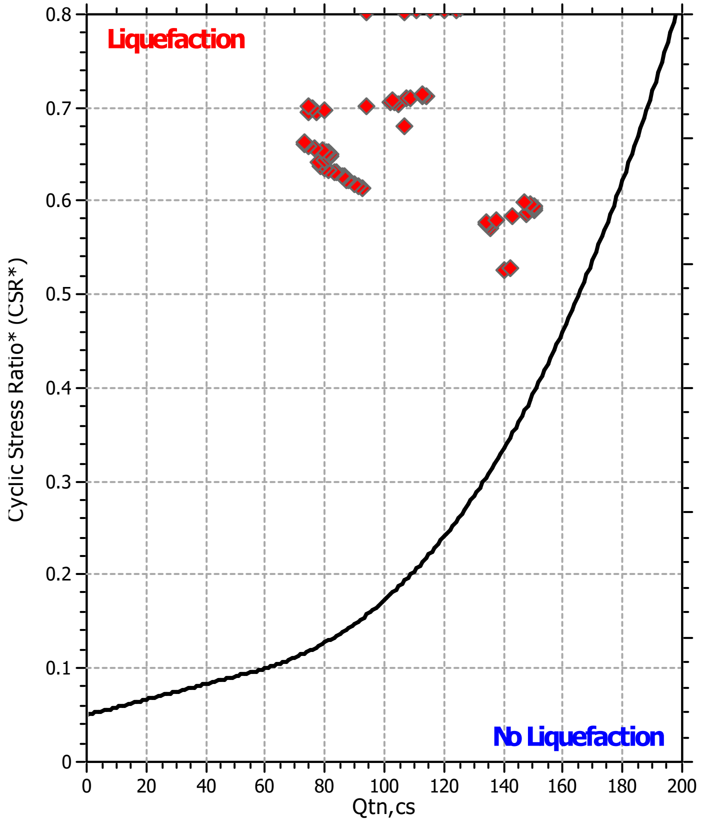
Analysis method:	NCEER (1998)	Depth to water table (erthq.):	6.00 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	1	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	7.31	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.87	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	17.40 ft	Fill height:	N/A	Limit depth:	N/A

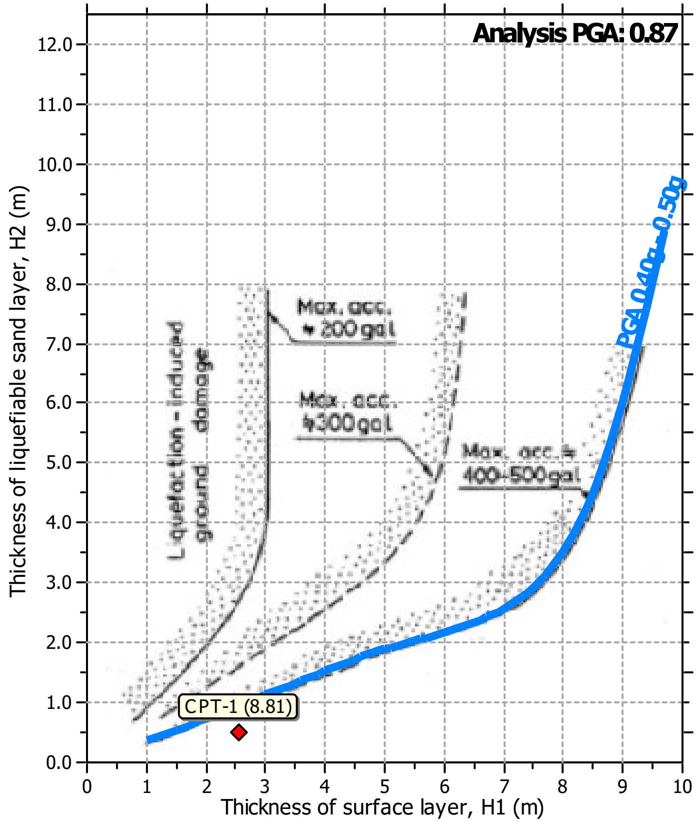
F.S. color scheme
- Almost certain it will liquefy
- Very likely to liquefy
- Liquefaction and no liq. are equally likely
- Unlike to liquefy
- Almost certain it will not liquefy

LPI color scheme
- Very high risk
- High risk
- Low risk

Liquefaction analysis summary plots







Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	6.00 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	1	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	7.31	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.87	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	17.40 ft	Fill height:	N/A	Limit depth:	N/A

:: Field input data ::

Point ID	Depth (ft)	q_c (tsf)	f_s (tsf)	u (tsf)	Fines content (%)	Unit weight (pcf)
1	0.08	0.43	0.51	0.00	100.00	103.24
2	0.16	5.18	0.56	-0.09	90.26	110.09
3	0.21	166.86	0.55	0.43	0.15	118.31
4	0.29	142.08	0.56	0.52	1.24	118.05
5	0.33	128.34	0.57	0.35	2.08	117.97
6	0.41	97.51	0.60	0.61	4.80	117.71
7	0.48	74.02	0.63	0.61	8.30	117.41
8	0.54	51.91	0.66	0.43	14.00	116.87
9	0.61	43.96	0.70	0.43	17.60	116.91
10	0.66	35.07	0.72	0.43	22.60	116.51
11	0.73	28.93	0.79	0.43	28.38	116.71
12	0.79	23.84	0.81	0.43	34.20	116.49
13	0.88	21.51	0.80	0.43	37.16	116.16
14	0.93	21.07	0.78	0.43	37.27	115.85
15	1.00	22.20	0.69	0.26	34.02	115.11
16	1.06	19.09	0.62	0.35	36.99	113.92
17	1.13	18.31	0.56	0.35	36.89	113.10
18	1.19	18.40	0.49	0.35	34.82	112.09
19	1.25	18.05	0.43	0.26	33.82	111.16
20	1.33	17.27	0.31	0.35	31.10	108.67
21	1.39	16.24	0.19	0.26	27.35	104.79
22	1.46	15.29	0.17	0.35	27.99	103.97
23	1.51	14.51	0.17	0.35	29.13	103.68
24	1.59	13.39	0.18	0.35	31.93	103.95
25	1.66	12.52	0.18	0.35	33.73	103.72
26	1.73	12.55	0.19	0.69	34.77	104.45
27	1.78	11.31	0.22	0.69	39.57	105.17
28	1.85	10.88	0.25	0.69	42.56	106.01
29	1.91	10.88	0.27	0.78	43.34	106.41
30	1.99	10.88	0.28	0.69	43.94	106.71
31	2.04	10.88	0.29	0.69	44.35	106.92
32	2.12	11.23	0.32	0.69	45.08	107.90
33	2.17	12.18	0.35	0.69	43.46	108.68
34	2.25	17.45	0.39	0.69	33.71	110.41
35	2.31	25.31	0.44	0.69	25.25	112.22
36	2.38	39.21	0.52	0.78	17.13	114.37
37	2.44	47.07	0.57	0.69	14.62	115.59
38	2.50	52.86	0.62	0.78	13.28	116.49
39	2.57	59.77	0.73	0.69	12.44	117.94
40	2.63	63.31	0.86	0.78	12.82	119.33
41	2.69	60.46	0.96	0.78	14.52	120.01
42	2.76	54.58	0.98	0.78	16.59	119.91
43	2.86	43.27	0.98	0.69	21.35	119.33
44	2.90	37.83	1.06	0.78	25.38	119.57
45	2.99	32.56	1.01	0.69	28.55	118.82
46	3.03	34.72	0.98	0.78	26.54	118.77
47	3.13	40.59	0.93	0.87	22.24	118.80
48	3.17	49.49	0.90	0.78	17.67	119.03

:: Field input data :: (continued)

Point ID	Depth (ft)	q_c (tsf)	f_s (tsf)	u (tsf)	Fines content (%)	Unit weight (pcf)
49	3.25	38.61	0.85	0.78	22.34	117.99
50	3.29	35.84	0.55	0.78	19.63	114.69
51	3.35	31.09	0.20	0.69	14.42	106.91
52	3.44	26.77	0.19	0.69	16.78	106.18
53	3.48	24.44	0.18	0.69	18.15	105.58
54	3.55	20.64	0.17	0.69	21.31	104.86
55	3.62	17.88	0.18	0.78	24.79	104.72
56	3.68	9.93	0.17	0.95	41.00	103.07
57	3.75	15.20	0.18	1.04	28.74	104.26
58	3.81	15.55	0.18	1.04	28.26	104.39
59	3.89	15.81	0.20	1.04	28.76	105.11
60	3.96	15.81	0.21	1.04	29.48	105.63
61	4.02	16.50	0.21	1.13	28.28	105.67
62	4.07	17.79	0.21	1.13	26.53	105.97
63	4.15	18.74	0.23	1.13	26.01	106.67
64	4.20	19.35	0.24	1.21	25.66	107.08
65	4.29	21.07	0.26	1.39	24.51	107.97
66	4.34	21.25	0.29	1.39	25.20	108.66
67	4.40	20.73	0.34	1.39	27.49	109.78
68	4.47	19.95	0.39	1.47	30.09	110.72
69	4.54	20.21	0.44	1.47	31.00	111.53
70	4.60	19.61	0.48	1.47	33.05	112.15
71	4.67	19.61	0.54	1.47	34.69	113.06
72	4.74	19.35	0.61	1.47	36.78	113.91
73	4.79	19.95	0.66	1.56	36.97	114.56
74	4.87	20.99	0.75	1.56	37.13	115.56
75	4.92	21.94	0.80	1.56	36.71	116.14
76	5.01	23.23	0.92	1.56	37.15	117.36
77	5.06	24.18	0.96	1.56	36.53	117.76
78	5.12	25.05	1.02	1.65	36.39	118.31
79	5.19	26.17	1.08	1.56	35.85	118.80
80	5.28	27.47	1.13	1.65	35.12	119.28
81	5.33	28.42	1.17	1.56	34.58	119.59
82	5.39	28.67	1.20	1.65	34.71	119.81
83	5.46	28.93	1.13	1.65	33.54	119.38
84	5.54	28.59	0.93	1.65	31.07	117.88
85	5.59	28.33	0.90	1.65	30.97	117.67
86	5.66	27.55	0.94	1.56	32.40	117.94
87	5.73	27.29	0.98	1.56	33.23	118.20
88	5.78	27.21	1.01	1.56	33.69	118.39
89	5.85	26.69	1.03	1.56	34.60	118.51
90	5.92	27.29	1.05	1.56	34.25	118.71
91	5.98	26.77	1.07	1.56	35.04	118.77
92	6.04	27.38	1.08	1.56	34.53	118.91
93	6.12	27.29	1.11	1.56	34.99	119.08
94	6.17	27.21	1.13	1.56	35.37	119.21
95	6.24	26.69	1.14	1.47	36.08	119.22
96	6.30	25.39	1.13	1.47	37.52	119.04

:: Field input data :: (continued)

Point ID	Depth (ft)	q_c (tsf)	f_s (tsf)	u (tsf)	Fines content (%)	Unit weight (pcf)
97	6.37	23.66	1.10	1.47	39.46	118.72
98	6.44	22.46	1.04	1.39	40.27	118.17
99	6.51	21.59	0.99	1.39	40.69	117.67
100	6.58	21.68	0.94	1.39	39.76	117.32
101	6.64	21.94	0.91	1.39	38.89	117.12
102	6.70	22.28	0.91	1.47	38.33	117.13
103	6.76	23.06	0.92	1.39	37.46	117.31
104	6.83	23.66	0.94	1.30	36.99	117.54
105	6.89	24.10	0.96	1.30	36.74	117.74
106	6.98	24.61	1.00	1.30	36.73	118.09
107	7.03	25.39	1.01	1.13	35.95	118.26
108	7.11	26.86	1.01	1.13	34.26	118.40
109	7.15	27.55	1.01	1.13	33.43	118.42
110	7.25	29.88	1.02	1.13	31.20	118.67
111	7.30	31.52	1.04	1.13	29.98	118.94
112	7.36	32.47	1.08	1.13	29.78	119.34
113	7.43	32.73	1.16	1.13	30.53	119.88
114	7.52	32.13	1.22	1.13	31.76	120.21
115	7.57	31.18	1.23	1.13	32.73	120.19
116	7.65	29.11	1.24	1.13	34.83	120.06
117	7.70	29.11	1.24	1.13	34.82	120.05
118	7.74	29.02	1.24	1.13	34.91	120.04
119	7.82	29.71	1.22	1.21	34.04	120.01
120	7.87	30.40	1.20	1.21	33.13	119.95
121	7.95	30.92	1.16	1.30	32.13	119.73
122	8.01	31.27	0.96	1.30	29.22	118.36
123	8.10	32.22	0.58	1.30	22.58	114.74
124	8.15	32.65	0.56	1.30	21.96	114.55
125	8.24	34.98	0.52	1.30	19.67	114.13
126	8.28	35.32	0.50	1.30	19.13	113.89
127	8.34	35.45	0.48	1.30	18.68	113.59
128	8.41	35.58	0.46	1.56	18.27	113.32
129	8.47	36.27	0.44	1.56	17.51	113.05
130	8.56	36.97	0.41	1.56	16.60	112.60
131	8.60	37.31	0.40	1.56	16.33	112.48
132	8.68	38.00	0.40	1.56	15.93	112.36
133	8.73	38.00	0.39	1.56	15.87	112.26
134	8.82	38.00	0.37	1.56	15.50	111.81
135	8.86	38.87	0.36	1.56	14.97	111.66
136	8.95	38.69	0.33	1.56	14.65	111.13
137	9.00	38.78	0.32	1.47	14.33	110.77
138	9.07	38.95	0.31	1.56	14.10	110.54
139	9.14	37.57	0.32	1.47	15.04	110.82
140	9.19	37.57	0.30	1.56	14.73	110.41
141	9.27	37.05	0.34	1.47	15.78	111.23
142	9.32	37.40	0.36	1.47	15.99	111.61
143	9.41	36.19	0.37	1.47	16.88	111.80
144	9.48	35.93	0.37	1.47	17.09	111.81

:: Field input data :: (continued)

Point ID	Depth (ft)	q_c (tsf)	f_s (tsf)	u (tsf)	Fines content (%)	Unit weight (pcf)
145	9.54	34.98	0.37	1.47	17.50	111.62
146	9.59	34.63	0.36	1.47	17.63	111.51
147	9.66	35.24	0.35	1.47	17.02	111.20
148	9.72	35.50	0.32	1.56	16.38	110.64
149	9.80	35.58	0.29	1.47	15.85	110.04
150	9.86	35.07	0.29	1.47	15.97	109.83
151	9.94	34.63	0.28	1.47	16.18	109.72
152	9.99	34.20	0.29	1.47	16.56	109.83
153	10.04	33.86	0.31	1.47	17.17	110.23
154	10.13	32.56	0.38	1.47	19.65	111.77
155	10.17	31.35	0.43	1.47	21.44	112.55
156	10.26	29.28	0.54	1.47	25.10	114.02
157	10.31	27.72	0.59	1.47	27.38	114.54
158	10.38	26.08	0.64	1.47	29.81	114.94
159	10.44	23.41	0.66	1.47	33.19	114.94
160	10.53	21.33	0.66	1.56	35.95	114.72
161	10.57	23.28	0.65	1.56	33.32	114.81
162	10.67	21.59	0.58	1.56	34.12	113.80
163	10.71	23.15	0.55	1.65	31.68	113.63
164	10.78	25.82	0.56	1.56	28.95	113.91
165	10.84	29.02	0.56	1.56	26.19	114.21
166	10.93	34.29	0.56	1.56	22.53	114.64
167	10.96	35.67	0.53	1.56	21.22	114.34
168	11.07	41.46	0.48	1.65	17.50	113.96
169	11.11	43.96	0.48	1.65	16.57	114.20
170	11.16	51.39	0.38	1.65	12.43	112.84
171	11.26	60.37	0.20	1.65	5.00	108.57
172	11.29	62.62	0.22	1.65	5.00	109.17
173	11.36	65.29	0.22	1.65	5.00	109.52
174	11.43	62.18	0.23	1.65	5.00	109.56
175	11.49	60.37	0.29	1.56	5.00	111.24
176	11.56	60.16	0.49	1.39	11.76	115.03
177	11.63	59.94	0.71	1.39	14.32	117.71
178	11.69	63.22	0.63	1.39	12.66	116.97
179	11.76	71.25	0.55	1.47	10.16	116.35
180	11.82	74.02	0.50	1.47	9.16	115.75
181	11.89	81.53	0.48	1.47	7.73	115.63
182	11.96	83.00	0.50	1.47	7.77	116.03
183	12.01	90.69	0.51	1.56	6.80	116.31
184	12.08	89.13	0.50	1.56	6.99	116.21
185	12.15	88.27	0.53	1.56	7.36	116.56
186	12.22	78.42	0.57	1.47	9.19	116.76
187	12.27	74.54	0.61	1.47	10.28	117.13
188	12.35	63.91	0.66	1.47	13.15	117.36
189	12.41	51.13	0.70	1.47	17.58	117.31
190	12.47	40.94	0.75	1.47	22.75	117.23
191	12.55	30.75	0.83	1.47	30.93	117.27
192	12.60	24.87	0.82	1.47	36.92	116.69

:: Field input data :: (continued)

Point ID	Depth (ft)	q_c (tsf)	f_s (tsf)	u (tsf)	Fines content (%)	Unit weight (pcf)
193	12.68	19.17	0.76	1.47	44.14	115.43
194	12.74	16.15	0.70	1.47	49.15	114.48
195	12.81	14.34	0.61	1.47	51.51	113.21
196	12.86	11.83	0.57	1.47	58.09	112.19
197	12.93	10.19	0.51	1.47	62.76	110.99
198	13.00	9.76	0.46	1.47	62.88	110.12
199	13.08	9.85	0.41	1.56	60.68	109.40
200	13.13	10.10	0.38	1.56	58.18	108.86
201	13.20	10.71	0.36	1.56	54.85	108.60
202	13.27	11.31	0.35	1.56	52.50	108.60
203	13.32	11.40	0.34	1.47	51.74	108.36
204	13.39	11.66	0.34	1.47	50.72	108.29
205	13.49	11.83	0.33	1.47	50.06	108.20
206	13.52	11.92	0.27	1.47	46.88	106.72
207	13.62	11.66	0.20	1.47	44.10	104.61
208	13.67	11.57	0.23	1.47	46.12	105.54
209	13.72	11.31	0.24	1.47	47.39	105.69
210	13.79	10.88	0.24	1.47	49.06	105.66
211	13.85	10.71	0.24	1.56	49.63	105.57
212	13.92	9.59	0.23	1.47	53.35	104.95
213	14.02	10.02	0.21	1.47	50.70	104.51
214	14.05	9.59	0.21	1.47	52.34	104.34
215	14.11	8.98	0.21	1.47	55.37	104.31
216	14.18	8.98	0.23	1.47	56.55	104.81
217	14.24	8.98	0.25	1.47	58.36	105.56
218	14.32	10.19	0.28	1.47	54.51	106.52
219	14.38	11.23	0.28	1.56	51.04	106.91
220	14.44	13.73	0.29	1.47	43.93	107.49
221	14.51	14.94	0.28	1.65	40.96	107.58
222	14.57	15.46	0.29	1.65	40.30	107.89
223	14.64	16.41	0.32	1.73	39.68	108.76
224	14.71	17.96	0.36	1.91	38.49	109.92
225	14.77	19.35	0.40	1.91	37.55	110.88
226	14.83	20.38	0.45	1.91	37.41	111.81
227	14.90	20.47	0.52	1.99	39.07	112.79
228	14.97	20.90	0.60	1.99	40.50	113.92
229	15.03	21.25	0.66	1.99	41.36	114.64
230	15.10	21.68	0.73	1.99	42.41	115.51
231	15.16	22.63	0.81	2.08	42.52	116.34
232	15.23	23.32	0.92	2.08	43.61	117.37
233	15.30	24.36	1.06	2.08	44.30	118.46
234	15.36	25.56	1.20	2.17	44.83	119.54
235	15.44	27.29	1.38	2.17	44.86	120.68
236	15.50	28.85	1.51	2.17	44.49	121.47
237	15.56	30.66	1.63	2.25	43.76	122.19
238	15.63	32.04	1.74	2.25	43.47	122.80
239	15.69	33.08	1.85	2.25	43.48	123.32
240	15.76	33.17	1.87	2.25	43.64	123.40

:: Field input data :: (continued)

Point ID	Depth (ft)	q_c (tsf)	f_s (tsf)	u (tsf)	Fines content (%)	Unit weight (pcf)
241	15.86	33.17	1.79	2.25	42.99	123.08
242	15.89	33.17	1.84	2.25	43.44	123.26
243	15.95	33.51	1.96	2.25	44.29	123.77
244	16.04	35.07	2.09	2.25	43.89	124.34
245	16.09	36.62	2.12	2.25	42.76	124.57
246	16.15	19.00	2.14	2.25	69.96	123.03
247	16.22	39.73	2.16	2.34	40.44	124.89
248	16.30	40.85	2.16	2.34	39.63	124.96
249	16.35	40.94	2.16	2.43	39.62	124.97
250	16.43	41.02	2.19	2.43	39.85	125.07
251	16.47	41.20	2.22	2.43	39.98	125.19
252	16.55	42.06	2.28	2.51	39.82	125.43
253	16.61	41.72	2.29	2.51	40.21	125.44
254	16.69	41.37	2.26	2.51	40.32	125.31
255	16.74	42.32	2.23	2.60	39.45	125.29
256	16.80	42.23	2.19	2.60	39.25	125.14
257	16.88	42.75	2.10	2.69	38.24	124.85
258	16.94	43.10	2.04	2.69	37.61	124.68
259	17.00	42.32	1.98	2.69	37.75	124.40
260	17.07	40.07	1.93	2.69	39.16	124.08
261	17.16	37.66	1.88	2.69	40.85	123.73
262	17.21	37.70	1.83	2.69	40.42	123.54
263	17.30	37.70	1.77	2.69	40.01	123.31
264	17.34	37.74	1.77	2.69	40.02	123.32
265	17.42	38.17	1.77	2.77	39.72	123.35
266	17.46	38.35	1.76	2.77	39.48	123.31
267	17.52	39.04	1.74	2.77	38.69	123.24
268	17.61	37.40	1.71	2.77	39.89	123.03
269	17.66	36.79	1.71	2.77	40.47	122.99
270	17.75	36.10	1.75	2.77	41.51	123.11
271	17.79	35.67	1.78	2.77	42.25	123.21
272	17.85	36.19	1.78	2.77	41.80	123.26
273	17.93	38.61	1.84	2.86	40.14	123.63
274	18.01	39.04	1.86	2.77	40.00	123.74
275	18.05	39.73	1.85	2.77	39.38	123.75
276	18.14	40.25	1.88	2.77	39.25	123.90
277	18.20	39.30	1.86	2.69	39.86	123.75
278	18.24	40.38	1.49	2.77	35.63	122.21
279	18.34	40.51	0.81	2.86	27.70	117.78
280	18.42	42.15	1.06	2.77	29.87	119.84
281	18.46	43.44	1.15	2.77	30.09	120.51
282	18.51	44.13	1.25	2.69	30.70	121.14
283	18.58	45.17	1.36	2.69	31.17	121.81
284	18.64	43.36	1.43	2.51	33.09	122.09
285	18.73	42.58	1.45	2.60	33.84	122.14
286	18.77	38.87	1.45	2.60	36.64	121.91
287	18.84	34.81	1.44	2.60	40.16	121.60
288	18.91	31.78	1.39	2.60	42.75	121.13

:: Field input data :: (continued)

Point ID	Depth (ft)	q_c (tsf)	f_s (tsf)	u (tsf)	Fines content (%)	Unit weight (pcf)
289	18.99	29.54	1.25	2.60	43.64	120.18
290	19.05	29.97	1.18	2.69	42.18	119.77
291	19.11	32.56	1.13	2.69	38.78	119.66
292	19.16	34.55	1.11	2.69	36.69	119.71
293	19.26	37.31	1.10	2.69	34.21	119.82
294	19.32	37.57	1.10	2.60	33.97	119.80
295	19.36	35.93	1.09	2.60	35.22	119.63
296	19.44	34.37	1.07	2.60	36.40	119.40
297	19.50	34.98	1.06	2.60	35.78	119.39
298	19.56	36.88	1.07	2.69	34.26	119.56
299	19.63	41.80	1.08	2.69	30.80	119.96
300	19.69	53.03	1.11	2.69	24.79	120.69
301	19.77	63.05	1.19	2.69	21.56	121.67
302	19.82	70.99	1.31	2.60	19.91	122.63
303	19.90	75.57	1.53	2.60	20.15	123.92
304	19.95	77.73	1.64	2.60	20.32	124.52
305	20.04	73.84	1.86	2.60	22.84	125.29
306	20.09	66.24	2.00	2.60	26.43	125.58
307	20.17	55.88	2.11	2.60	31.78	125.56
308	20.22	43.62	1.73	2.60	36.27	123.48
309	20.28	38.61	1.05	2.60	33.02	119.58
310	20.35	32.47	0.96	2.60	37.02	118.43
311	20.42	27.47	0.97	2.69	42.89	118.13
312	20.48	27.34	1.02	2.69	43.89	118.49
313	20.54	27.34	1.11	2.86	45.30	119.11
314	20.65	27.21	1.17	2.95	46.43	119.49
315	20.68	28.33	1.18	2.95	45.09	119.65
316	20.74	32.04	1.21	3.03	41.11	120.11
317	20.82	44.22	1.26	2.95	31.61	121.20
318	20.88	55.97	1.29	2.95	25.60	121.96
319	20.95	70.39	1.30	2.86	20.33	122.59
320	21.03	99.32	1.24	2.86	13.23	123.08
321	21.10	120.40	1.22	2.86	10.05	123.41
322	21.14	128.86	1.26	2.86	9.28	123.80
323	21.22	149.50	1.47	2.86	8.22	125.28
324	21.28	159.87	1.38	2.95	7.00	125.00
325	21.34	167.99	1.33	2.95	6.21	124.85
326	21.41	184.14	1.40	2.95	5.44	125.45
327	21.48	177.31	1.40	2.95	5.86	125.35
328	21.55	169.11	1.38	3.03	6.36	125.15
329	21.59	176.75	1.38	3.03	5.86	125.28
330	21.68	171.53	1.39	2.95	6.23	125.22
331	21.74	176.19	1.44	2.95	6.14	125.57
332	21.81	184.14	1.61	2.95	6.24	126.49
333	21.86	191.91	1.74	2.77	6.20	127.15
334	21.94	198.91	1.96	2.95	6.48	128.12
335	22.00	204.95	2.04	2.86	6.34	128.46
336	22.07	209.18	2.15	2.95	6.44	128.91

:: Field input data :: (continued)

Point ID	Depth (ft)	q_c (tsf)	f_s (tsf)	u (tsf)	Fines content (%)	Unit weight (pcf)
337	22.13	211.34	2.22	2.95	6.51	129.16
338	22.21	211.95	2.29	2.95	6.68	129.40
339	22.27	211.69	2.31	2.95	6.75	129.46
340	22.35	208.84	2.27	2.95	6.83	129.31
341	22.38	206.77	2.26	2.95	6.92	129.26
342	22.45	198.73	2.24	2.95	7.35	129.07
343	22.53	189.41	2.21	2.95	7.89	128.85
344	22.59	180.94	2.19	2.95	8.46	128.69
345	22.67	173.00	2.19	2.95	9.08	128.57
346	22.71	169.80	1.85	2.95	8.19	127.29
347	22.80	162.03	1.36	3.03	6.92	124.93
348	22.85	160.39	1.65	2.95	8.23	126.32
349	22.93	162.24	1.91	2.95	9.05	127.40
350	22.98	161.25	1.93	2.95	9.24	127.50
351	23.04	162.46	1.96	2.95	9.25	127.62
352	23.12	167.21	2.16	3.03	9.52	128.38
353	23.18	188.54	2.26	3.12	8.18	129.01
354	23.24	220.84	2.26	3.12	6.20	129.41
355	23.30	249.00	2.33	3.29	5.02	129.92
356	23.37	266.36	2.73	3.29	5.19	131.24
357	23.43	285.62	3.20	3.29	5.37	132.58
358	23.52	291.93	2.84	3.29	4.46	131.76
359	23.56	303.33	2.65	3.29	3.72	131.34
360	23.63	297.80	2.48	3.12	3.56	130.80
361	23.69	313.69	2.38	3.12	2.91	130.64
362	23.77	299.09	2.13	3.64	2.84	129.71
363	23.83	304.02	1.88	3.73	2.18	128.83
364	23.89	320.77	1.81	3.64	1.61	128.68
365	23.97	337.01	1.66	3.73	0.96	128.18
366	24.02	346.51	1.60	3.55	0.66	127.97
367	24.10	366.63	1.60	3.73	0.30	128.12
368	24.15	401.96	1.61	3.81	0.00	128.36
369	24.23	418.80	1.73	3.81	0.00	129.01
370	24.28	447.22	1.90	3.81	0.00	129.85
371	24.37	461.64	2.13	3.90	0.00	130.75
372	24.42	460.00	2.49	3.90	0.28	131.91
373	24.49	451.79	2.81	3.90	0.81	132.75
374	24.55	438.23	2.22	3.99	0.22	130.95
375	24.61	450.89	2.42	4.07	0.31	131.64
376	24.69	432.01	2.59	4.07	0.82	132.03
377	24.75	449.98	2.69	4.07	0.68	132.40
378	24.82	464.49	2.93	4.07	0.78	133.11
379	24.88	494.55	2.98	4.07	0.44	133.39
380	24.94	508.88	2.87	4.16	0.14	133.20
381	25.00	487.98	2.52	4.33	0.00	132.12
382	25.07	511.73	2.23	4.42	0.00	131.37
383	25.14	537.90	2.21	4.42	0.00	131.41
384	25.22	588.60	2.92	4.59	0.00	133.66

:: Field input data :: (continued)

Point ID	Depth (ft)	q_c (tsf)	f_s (tsf)	u (tsf)	Fines content (%)	Unit weight (pcf)
385	25.27	628.33	3.28	4.68	0.00	134.67
386	25.35	662.79	3.87	4.68	0.00	136.02
387	25.40	675.23	4.00	4.85	0.00	136.30
388	25.47	677.73	4.09	4.94	0.00	136.48
389	25.54	704.25	4.03	5.20	0.00	136.46
390	25.60	704.94	4.05	5.20	0.00	136.50
391	25.67	705.63	4.13	5.20	0.00	136.64
392	25.72	693.62	4.18	5.29	0.00	136.70
393	25.81	682.22	4.14	5.46	0.00	136.58
394	25.86	669.61	4.17	5.37	0.00	136.60
395	25.93	562.26	4.17	5.29	0.88	136.16
396	25.99	546.71	4.16	5.29	1.06	136.07
397	26.06	564.07	4.21	5.29	0.90	136.24
398	26.13	565.89	3.88	5.29	0.57	135.65
399	26.18	573.40	3.37	5.29	0.00	134.66
400	26.27	581.35	2.91	5.37	0.00	133.62
401	26.33	551.12	2.83	5.46	0.00	133.27
402	26.40	547.06	2.75	5.20	0.00	133.04
403	26.45	528.83	2.87	5.20	0.00	133.29
404	26.52	519.59	3.18	5.11	0.42	133.99
405	26.59	541.27	3.03	5.29	0.01	133.74
406	26.64	564.42	2.58	5.29	0.00	132.65
407	26.73	604.75	1.74	5.37	0.00	129.93
408	26.78	626.52	1.56	5.37	0.00	129.25
409	26.84	650.01	1.56	5.63	0.00	129.34
410	26.91	627.55	1.60	5.80	0.00	129.43
411	26.97	609.07	1.81	5.63	0.00	130.27
412	27.05	595.42	2.00	5.63	0.00	130.92
413	27.11	552.15	2.26	5.63	0.00	131.64
414	27.17	485.74	2.49	5.11	0.06	132.03
415	27.25	514.24	3.52	4.94	0.88	134.71
416	27.30	529.78	3.49	4.94	0.65	134.71
417	27.37	543.43	2.80	5.03	0.00	133.16
418	27.43	565.11	2.94	5.20	0.00	133.62
419	27.52	603.72	0.00	5.20	N/A	87.36
420	27.56	634.72	0.00	5.20	N/A	87.36
421	27.63	686.02	0.00	5.37	N/A	87.36
422	27.70	766.78	0.00	5.46	N/A	87.36
423	27.76	809.44	0.00	5.46	N/A	87.36
424	27.82	811.43	0.00	5.72	N/A	87.36

Abbreviations

Depth: Depth from free surface, at which CPT was performed (ft)
q_c: Measured cone resistance (tsf)
f_s: Sleeve friction resistance (tsf)
u: Pore pressure (tsf)
Fines content: Percentage of fines in soil (%)
Unit weight: Bulk soil unit weight (pcf)

:: Post-earthquake settlement of dry sands ::

Depth (ft)	Ic	Q_{tn}	Kc	$Q_{tn,cs}$	$N_{1,60}$ (blows)	G_{max} (tsf)	CSR	Shear, γ (%)	$e_{vol(15)}$ (%)	N_c	e_v (%)	Settle. (in)
0.08	4.06	0.68	26.61	18.21	0	0	0.53	0.000	0.00	0.00	0.00	0.000
0.16	3.41	8.31	12.43	103.29	0	0	0.53	0.000	0.00	0.00	0.00	0.000
0.21	1.27	268.07	1.00	268.07	44	754	0.53	0.001	0.00	13.43	0.00	0.000
0.29	1.38	228.26	1.00	228.26	38	731	0.53	0.001	0.00	13.43	0.00	0.000
0.33	1.44	206.17	1.00	206.17	35	719	0.53	0.002	0.00	13.43	0.00	0.000
0.41	1.63	156.64	1.00	156.64	29	688	0.53	0.002	0.00	13.43	0.00	0.000
0.48	1.81	118.89	1.11	132.31	0	0	0.53	0.000	0.00	13.43	0.00	0.000
0.54	2.04	83.36	1.35	112.80	0	0	0.53	0.000	0.00	13.43	0.00	0.000
0.61	2.16	70.58	1.57	110.73	0	0	0.53	0.000	0.00	13.43	0.00	0.000
0.66	2.30	56.29	1.96	110.08	0	0	0.53	0.000	0.00	13.43	0.00	0.000
0.73	2.45	46.42	2.52	116.77	0	0	0.53	0.000	0.00	13.43	0.00	0.000
0.79	2.58	38.24	3.18	121.73	0	0	0.53	0.000	0.00	13.43	0.00	0.000
0.88	2.64	34.49	3.56	122.68	0	0	0.53	0.000	0.00	0.00	0.00	0.000
0.93	2.64	33.77	3.57	120.63	0	0	0.53	0.000	0.00	0.00	0.00	0.000
1.00	2.57	35.58	3.16	112.46	30	518	0.53	0.013	0.01	13.43	0.01	0.000
1.06	2.63	30.58	3.53	108.08	0	0	0.53	0.000	0.00	0.00	0.00	0.000
1.13	2.63	29.32	3.52	103.24	0	0	0.53	0.000	0.00	0.00	0.00	0.000
1.19	2.59	29.46	3.26	96.01	0	0	0.53	0.000	0.00	13.43	0.00	0.000
1.25	2.57	28.89	3.14	90.61	0	0	0.53	0.000	0.00	13.43	0.00	0.000
1.33	2.51	27.63	2.82	77.81	0	0	0.53	0.000	0.00	13.43	0.00	0.000
1.39	2.42	25.97	2.41	62.54	0	0	0.53	0.000	0.00	13.43	0.00	0.000
1.46	2.44	24.44	2.47	60.48	0	0	0.53	0.000	0.00	13.43	0.00	0.000
1.51	2.46	23.18	2.60	60.19	0	0	0.53	0.000	0.00	13.43	0.00	0.000
1.59	2.53	21.38	2.91	62.25	0	0	0.53	0.000	0.00	13.43	0.00	0.000
1.66	2.57	19.97	3.13	62.43	0	0	0.53	0.000	0.00	13.43	0.00	0.000
1.73	2.59	20.02	3.25	65.14	0	0	0.53	0.000	0.00	13.43	0.00	0.000
1.78	2.68	18.02	3.88	69.87	0	0	0.53	0.000	0.00	0.00	0.00	0.000
1.85	2.74	17.33	4.29	74.33	0	0	0.53	0.000	0.00	0.00	0.00	0.000
1.91	2.75	17.32	4.40	76.21	0	0	0.53	0.000	0.00	0.00	0.00	0.000
1.99	2.76	17.32	4.48	77.66	0	0	0.53	0.000	0.00	0.00	0.00	0.000
2.04	2.77	17.31	4.54	78.66	0	0	0.53	0.000	0.00	0.00	0.00	0.000
2.12	2.78	17.87	4.65	83.08	0	0	0.53	0.000	0.00	0.00	0.00	0.000
2.17	2.76	19.39	4.42	85.63	0	0	0.53	0.000	0.00	0.00	0.00	0.000
2.25	2.57	27.85	3.12	86.98	0	0	0.53	0.000	0.00	13.43	0.00	0.000
2.31	2.37	40.47	2.20	88.96	0	0	0.53	0.000	0.00	13.43	0.00	0.000
2.38	2.14	62.80	1.54	96.57	0	0	0.53	0.000	0.00	13.43	0.00	0.000
2.44	2.06	75.42	1.39	104.55	0	0	0.53	0.000	0.00	13.43	0.00	0.000
2.50	2.01	84.72	1.32	111.51	0	0	0.53	0.000	0.00	13.43	0.00	0.000
2.57	1.98	95.81	1.28	122.27	0	0	0.53	0.000	0.00	13.43	0.00	0.000
2.63	2.00	101.50	1.29	131.34	0	0	0.53	0.000	0.00	13.43	0.00	0.000
2.69	2.06	96.91	1.38	133.82	0	0	0.53	0.000	0.00	13.43	0.00	0.000
2.76	2.13	87.46	1.50	131.43	0	0	0.53	0.000	0.00	13.43	0.00	0.000
2.86	2.27	69.27	1.85	128.18	0	0	0.53	0.000	0.00	13.43	0.00	0.000
2.90	2.37	60.53	2.21	133.82	0	0	0.53	0.000	0.00	13.43	0.00	0.000
2.99	2.45	52.06	2.53	131.91	0	0	0.53	0.000	0.00	13.43	0.00	0.000
3.03	2.40	55.52	2.33	129.09	0	0	0.53	0.000	0.00	13.43	0.00	0.000
3.13	2.29	64.95	1.92	124.97	0	0	0.53	0.000	0.00	13.43	0.00	0.000
3.17	2.16	79.24	1.57	124.68	0	0	0.53	0.000	0.00	13.43	0.00	0.000

:: Post-earthquake settlement of dry sands :: (continued)

Depth (ft)	Ic	Q_{tn}	Kc	$Q_{tn,cs}$	$N_{1,60}$ (blows)	G_{max} (tsf)	CSR	Shear, γ (%)	$e_{vol(15)}$ (%)	N_c	e_v (%)	Settle. (in)
3.25	2.30	61.75	1.93	119.39	28	633	0.53	0.052	0.03	13.43	0.03	0.001
3.29	2.22	57.30	1.71	98.22	22	533	0.53	0.098	0.09	13.43	0.08	0.001
3.35	2.05	49.66	1.38	68.31	0	0	0.53	0.000	0.00	13.43	0.00	0.000
3.44	2.13	42.71	1.51	64.70	0	0	0.53	0.000	0.00	13.43	0.00	0.000
3.48	2.17	38.96	1.61	62.61	0	0	0.53	0.000	0.00	13.43	0.00	0.000
3.55	2.27	32.85	1.85	60.66	0	0	0.53	0.000	0.00	13.43	0.00	0.000
3.62	2.36	28.42	2.15	61.22	0	0	0.53	0.000	0.00	13.43	0.00	0.000
3.68	2.71	15.64	4.07	63.68	0	0	0.53	0.000	0.00	0.00	0.00	0.000
3.75	2.46	24.10	2.55	61.57	16	303	0.53	3.318	4.49	13.43	4.27	0.076
3.81	2.44	24.66	2.50	61.74	16	305	0.53	3.287	4.46	13.43	4.25	0.064
3.89	2.46	25.07	2.56	64.09	16	315	0.53	2.782	3.59	13.43	3.41	0.061
3.96	2.47	25.07	2.63	66.04	17	322	0.53	2.550	3.14	13.43	2.99	0.055
4.02	2.44	26.17	2.50	65.56	16	324	0.53	2.514	3.18	13.43	3.02	0.037
4.07	2.40	28.24	2.32	65.64	16	332	0.53	2.234	2.88	13.43	2.74	0.038
4.15	2.39	29.76	2.27	67.64	17	344	0.53	1.840	2.31	13.43	2.19	0.040
4.20	2.38	30.74	2.24	68.80	17	351	0.53	1.657	2.05	13.43	1.95	0.025
4.29	2.35	33.50	2.13	71.28	17	369	0.53	1.273	1.53	13.43	1.45	0.030
4.34	2.37	33.78	2.19	74.09	18	380	0.53	1.085	1.23	13.43	1.17	0.015
4.40	2.43	32.94	2.42	79.78	20	398	0.53	0.850	0.86	13.43	0.82	0.012
4.47	2.49	31.68	2.70	85.59	22	414	0.53	0.707	0.63	13.43	0.60	0.009
4.54	2.51	32.09	2.80	90.02	23	430	0.53	0.592	0.49	13.43	0.47	0.009
4.60	2.55	31.12	3.04	94.76	25	441	0.53	0.529	0.40	13.43	0.38	0.005
4.67	2.59	31.12	3.24	100.94	27	461	0.52	0.437	0.30	13.43	0.29	0.005
4.74	2.63	30.69	3.51	107.67	0	0	0.52	0.000	0.00	0.00	0.00	0.000
4.79	2.63	31.65	3.53	111.82	0	0	0.52	0.000	0.00	0.00	0.00	0.000
4.87	2.64	33.32	3.55	118.37	0	0	0.52	0.000	0.00	0.00	0.00	0.000
4.92	2.63	34.84	3.50	121.89	0	0	0.52	0.000	0.00	0.00	0.00	0.000
5.01	2.64	36.90	3.56	131.21	0	0	0.52	0.000	0.00	0.00	0.00	0.000
5.06	2.62	38.43	3.48	133.53	0	0	0.52	0.000	0.00	0.00	0.00	0.000
5.12	2.62	39.82	3.46	137.68	0	0	0.52	0.000	0.00	0.00	0.00	0.000
5.19	2.61	41.61	3.39	141.02	0	0	0.52	0.000	0.00	0.00	0.00	0.000
5.28	2.60	43.69	3.30	144.05	39	655	0.52	0.119	0.05	13.43	0.05	0.001
5.33	2.58	45.21	3.23	146.02	39	668	0.52	0.113	0.05	13.43	0.05	0.001
5.39	2.59	45.61	3.25	148.05	40	676	0.52	0.111	0.05	13.43	0.05	0.001
5.46	2.56	46.02	3.10	142.78	38	661	0.52	0.124	0.06	13.43	0.05	0.001
5.54	2.51	45.47	2.81	127.88	33	610	0.52	0.178	0.10	13.43	0.09	0.002
5.59	2.51	45.04	2.80	126.15	33	603	0.52	0.192	0.11	13.43	0.10	0.001
5.66	2.54	43.78	2.97	129.89	34	610	0.52	0.187	0.10	13.43	0.09	0.001
5.73	2.56	43.36	3.07	132.93	35	618	0.52	0.183	0.09	13.43	0.09	0.002
5.78	2.57	43.23	3.12	134.91	36	624	0.52	0.179	0.09	13.43	0.08	0.001
5.85	2.58	42.38	3.23	137.02	37	626	0.52	0.182	0.09	13.43	0.08	0.002
5.92	2.58	43.34	3.19	138.20	37	635	0.52	0.177	0.08	13.43	0.08	0.001
5.98	2.59	42.50	3.29	139.69	38	635	0.52	0.180	0.08	13.43	0.08	0.001

:: Post-earthquake settlement of dry sands :: (continued)

Depth (ft)	Ic	Q_{tn}	Kc	$Q_{tn,cs}$	$N_{1,60}$ (blows)	G_{max} (tsf)	CSR	Shear, γ (%)	$e_{vol(15)}$ (%)	N_c	e_v (%)	Settle. (in)

Total estimated settlement: 0.50

Abbreviations

Q_{tn}: Equivalent clean sand normalized cone resistance
K_c: Fines correction factor
$Q_{tn,cs}$: Post-liquefaction volumentric strain
G_{max}: Small strain shear modulus
CSR: Soil cyclic stress ratio
γ: Cyclic shear strain
$e_{vol(15)}$: Volumetric strain after 15 cycles
N_c: Equivalent number of cycles
e_v: Volumetric strain
Settle.: Calculated settlement

:: Post-earthquake settlement due to soil liquefaction ::

Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)
6.04	140.14	0.64	1.77	1.00	0.01
6.17	143.76	2.00	0.00	1.00	0.00
6.30	145.02	2.00	0.00	1.00	0.00
6.44	141.06	2.00	0.00	1.00	0.00
6.58	133.68	2.00	0.00	1.00	0.00
6.70	130.66	2.00	0.00	1.00	0.00
6.83	132.24	2.00	0.00	1.00	0.00
6.98	136.29	2.00	0.00	1.00	0.00
7.11	135.70	0.55	1.82	1.00	0.02
7.25	133.93	0.53	1.84	1.00	0.02
7.36	137.41	0.55	1.80	1.00	0.01
7.52	147.34	0.64	1.73	1.00	0.02
7.65	150.31	0.67	1.38	1.00	0.01
7.74	150.24	0.67	1.38	1.00	0.01
7.87	146.99	0.63	1.70	1.00	0.01
8.01	129.06	2.00	0.00	1.00	0.00
8.15	98.32	2.00	0.00	1.00	0.00
8.28	93.93	2.00	0.00	1.00	0.00
8.41	91.10	0.24	2.52	1.00	0.02
8.56	88.04	0.23	2.59	1.00	0.03
8.68	86.61	0.22	2.63	1.00	0.03
8.82	83.87	0.21	2.70	1.00	0.03
8.95	81.07	0.20	2.78	1.00	0.03
9.07	78.79	0.20	2.84	1.00	0.02
9.19	77.59	0.19	2.88	1.00	0.02
9.32	81.53	0.20	2.76	1.00	0.01
9.48	81.78	0.20	2.76	1.00	0.02
9.59	80.27	0.20	2.80	1.00	0.02
9.72	76.59	0.19	2.91	1.00	0.02
9.86	73.43	0.18	3.01	1.00	0.02
9.99	73.03	2.00	0.00	1.00	0.00
10.13	80.41	2.00	0.00	1.00	0.00
10.26	94.15	2.00	0.00	1.00	0.00
10.38	103.93	2.00	0.00	1.00	0.00
10.53	109.44	2.00	0.00	1.00	0.00

Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)
6.12	142.13	0.66	1.49	1.00	0.01
6.24	144.73	2.00	0.00	1.00	0.00
6.37	144.67	2.00	0.00	1.00	0.00
6.51	137.45	2.00	0.00	1.00	0.00
6.64	131.21	2.00	0.00	1.00	0.00
6.76	131.10	2.00	0.00	1.00	0.00
6.89	133.49	2.00	0.00	1.00	0.00
7.03	136.64	2.00	0.00	1.00	0.00
7.15	134.83	0.54	1.83	1.00	0.01
7.30	134.49	0.53	1.83	1.00	0.01
7.43	142.86	0.60	1.74	1.00	0.02
7.57	148.58	0.65	1.40	1.00	0.01
7.70	150.24	0.67	1.38	1.00	0.01
7.82	148.81	0.65	1.71	1.00	0.02
7.95	143.75	2.00	0.00	1.00	0.00
8.10	99.73	2.00	0.00	1.00	0.00
8.24	95.24	2.00	0.00	1.00	0.00
8.34	92.44	0.25	2.49	1.00	0.02
8.47	89.92	0.24	2.55	1.00	0.02
8.60	87.35	0.23	2.61	1.00	0.01
8.73	86.00	0.22	2.64	1.00	0.02
8.86	83.33	0.21	2.71	1.00	0.01
9.00	79.72	0.20	2.81	1.00	0.02
9.14	79.17	0.20	2.83	1.00	0.02
9.27	80.18	0.20	2.80	1.00	0.03
9.41	81.94	0.20	2.75	1.00	0.03
9.54	80.89	0.20	2.78	1.00	0.02
9.66	78.86	0.19	2.84	1.00	0.02
9.80	74.33	0.18	2.98	1.00	0.03
9.94	72.83	0.17	3.03	1.00	0.03
10.04	74.27	2.00	0.00	1.00	0.00
10.17	84.47	2.00	0.00	1.00	0.00
10.31	99.13	2.00	0.00	1.00	0.00
10.44	107.81	2.00	0.00	1.00	0.00
10.57	106.62	0.28	2.22	1.00	0.01

:: Post-earthquake settlement due to soil liquefaction :: (continued)

Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)	Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)
10.67	101.39	2.00	0.00	1.00	0.00	10.71	97.53	2.00	0.00	1.00	0.00
10.78	95.71	2.00	0.00	1.00	0.00	10.84	94.11	2.00	0.00	1.00	0.00
10.93	92.53	2.00	0.00	1.00	0.00	10.96	90.01	2.00	0.00	1.00	0.00
11.07	86.52	2.00	0.00	1.00	0.00	11.11	87.51	2.00	0.00	1.00	0.00
11.16	84.40	2.00	0.00	1.00	0.00	11.26	74.33	0.17	2.98	1.00	0.04
11.29	76.92	0.18	2.90	1.00	0.01	11.36	79.75	0.18	2.81	1.00	0.02
11.43	76.12	0.17	2.92	1.00	0.02	11.49	74.51	0.17	2.97	1.00	0.02
11.56	94.09	0.22	2.46	1.00	0.02	11.63	104.49	0.26	2.25	1.00	0.02
11.69	102.06	0.25	2.30	1.00	0.02	11.76	103.45	0.26	2.27	1.00	0.02
11.82	103.01	0.26	2.28	1.00	0.02	11.89	107.06	0.27	2.21	1.00	0.02
11.96	108.82	0.28	2.18	1.00	0.02	12.01	114.22	0.31	2.10	1.00	0.01
12.08	112.71	0.30	2.12	1.00	0.02	12.15	112.93	0.30	2.11	1.00	0.02
12.22	107.20	2.00	0.00	1.00	0.00	12.27	105.94	2.00	0.00	1.00	0.00
12.35	101.65	2.00	0.00	1.00	0.00	12.41	98.99	2.00	0.00	1.00	0.00
12.47	101.10	2.00	0.00	1.00	0.00	12.55	109.99	2.00	0.00	1.00	0.00
12.60	113.21	2.00	0.00	1.00	0.00	12.68	112.28	2.00	0.00	1.00	0.00
12.74	110.30	2.00	0.00	1.00	0.00	12.81	104.04	2.00	0.00	1.00	0.00
12.86	101.30	2.00	0.00	1.00	0.00	12.93	95.92	2.00	0.00	1.00	0.00
13.00	91.32	2.00	0.00	1.00	0.00	13.08	87.10	2.00	0.00	1.00	0.00
13.13	83.90	2.00	0.00	1.00	0.00	13.20	81.60	2.00	0.00	1.00	0.00
13.27	80.44	2.00	0.00	1.00	0.00	13.32	78.99	2.00	0.00	1.00	0.00
13.39	78.12	2.00	0.00	1.00	0.00	13.49	77.16	2.00	0.00	1.00	0.00
13.52	70.24	2.00	0.00	1.00	0.00	13.62	62.13	2.00	0.00	1.00	0.00
13.67	65.71	2.00	0.00	1.00	0.00	13.72	66.59	2.00	0.00	1.00	0.00
13.79	66.96	2.00	0.00	1.00	0.00	13.85	66.73	2.00	0.00	1.00	0.00
13.92	65.79	2.00	0.00	1.00	0.00	14.02	63.41	2.00	0.00	1.00	0.00
14.05	63.33	2.00	0.00	1.00	0.00	14.11	63.92	2.00	0.00	1.00	0.00
14.18	65.58	2.00	0.00	1.00	0.00	14.24	68.29	2.00	0.00	1.00	0.00
14.32	70.56	2.00	0.00	1.00	0.00	14.38	70.68	2.00	0.00	1.00	0.00
14.44	69.67	2.00	0.00	1.00	0.00	14.51	68.40	2.00	0.00	1.00	0.00
14.57	68.98	2.00	0.00	1.00	0.00	14.64	71.53	2.00	0.00	1.00	0.00
14.71	74.93	2.00	0.00	1.00	0.00	14.77	77.89	2.00	0.00	1.00	0.00
14.83	81.46	2.00	0.00	1.00	0.00	14.90	86.74	2.00	0.00	1.00	0.00
14.97	92.96	2.00	0.00	1.00	0.00	15.03	97.14	2.00	0.00	1.00	0.00
15.10	102.41	2.00	0.00	1.00	0.00	15.16	107.04	2.00	0.00	1.00	0.00
15.23	114.05	2.00	0.00	1.00	0.00	15.30	121.57	2.00	0.00	1.00	0.00
15.36	129.54	2.00	0.00	1.00	0.00	15.44	138.04	2.00	0.00	1.00	0.00
15.50	143.80	2.00	0.00	1.00	0.00	15.56	148.78	2.00	0.00	1.00	0.00
15.63	153.49	2.00	0.00	1.00	0.00	15.69	157.99	2.00	0.00	1.00	0.00
15.76	158.58	2.00	0.00	1.00	0.00	15.86	154.16	2.00	0.00	1.00	0.00
15.89	156.22	2.00	0.00	1.00	0.00	15.95	161.76	2.00	0.00	1.00	0.00
16.04	166.32	2.00	0.00	1.00	0.00	16.09	166.83	2.00	0.00	1.00	0.00
16.15	171.80	2.00	0.00	1.00	0.00	16.22	166.03	2.00	0.00	1.00	0.00
16.30	165.15	2.00	0.00	1.00	0.00	16.35	164.90	2.00	0.00	1.00	0.00
16.43	165.77	2.00	0.00	1.00	0.00	16.47	166.86	2.00	0.00	1.00	0.00
16.55	168.67	2.00	0.00	1.00	0.00	16.61	168.93	2.00	0.00	1.00	0.00
16.69	167.35	2.00	0.00	1.00	0.00	16.74	165.59	2.00	0.00	1.00	0.00
16.80	163.40	2.00	0.00	1.00	0.00	16.88	158.81	2.00	0.00	1.00	0.00

:: Post-earthquake settlement due to soil liquefaction :: (continued)

Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)	Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)
16.94	155.97	2.00	0.00	1.00	0.00	17.00	153.32	2.00	0.00	1.00	0.00
17.07	151.96	2.00	0.00	1.00	0.00	17.16	150.53	2.00	0.00	1.00	0.00
17.21	148.07	2.00	0.00	1.00	0.00	17.30	145.15	2.00	0.00	1.00	0.00
17.34	145.02	2.00	0.00	1.00	0.00	17.42	144.61	2.00	0.00	1.00	0.00
17.46	143.93	2.00	0.00	1.00	0.00	17.52	142.25	2.00	0.00	1.00	0.00
17.61	141.69	2.00	0.00	1.00	0.00	17.66	141.96	2.00	0.00	1.00	0.00
17.75	143.93	2.00	0.00	1.00	0.00	17.79	145.51	2.00	0.00	1.00	0.00
17.85	145.24	2.00	0.00	1.00	0.00	17.93	146.34	2.00	0.00	1.00	0.00
18.01	146.95	2.00	0.00	1.00	0.00	18.05	146.20	2.00	0.00	1.00	0.00
18.14	147.11	2.00	0.00	1.00	0.00	18.20	146.42	2.00	0.00	1.00	0.00
18.24	128.96	2.00	0.00	1.00	0.00	18.34	93.66	0.19	2.47	1.00	0.03
18.42	106.68	0.24	2.22	1.00	0.02	18.46	110.95	0.26	2.15	1.00	0.01
18.51	115.51	0.28	2.08	1.00	0.01	18.58	120.38	0.30	2.01	1.00	0.02
18.64	124.44	0.32	1.95	1.00	0.02	18.73	125.50	0.33	1.94	1.00	0.02
18.77	126.97	2.00	0.00	1.00	0.00	18.84	128.35	2.00	0.00	1.00	0.00
18.91	127.23	2.00	0.00	1.00	0.00	18.99	121.16	2.00	0.00	1.00	0.00
19.05	117.07	2.00	0.00	1.00	0.00	19.11	113.30	2.00	0.00	1.00	0.00
19.16	111.55	2.00	0.00	1.00	0.00	19.26	109.69	0.25	2.17	1.00	0.03
19.32	109.29	0.25	2.17	1.00	0.01	19.36	109.37	0.25	2.17	1.00	0.01
19.44	108.99	2.00	0.00	1.00	0.00	19.50	108.31	2.00	0.00	1.00	0.00
19.56	107.79	2.00	0.00	1.00	0.00	19.63	106.71	2.00	0.00	1.00	0.00
19.69	105.35	2.00	0.00	1.00	0.00	19.77	108.76	2.00	0.00	1.00	0.00
19.82	113.87	2.00	0.00	1.00	0.00	19.90	122.46	0.31	1.98	1.00	0.02
19.95	126.79	2.00	0.00	1.00	0.00	20.04	134.33	2.00	0.00	1.00	0.00
20.09	140.57	2.00	0.00	1.00	0.00	20.17	147.45	2.00	0.00	1.00	0.00
20.22	135.78	2.00	0.00	1.00	0.00	20.28	105.69	0.23	2.23	1.00	0.02
20.35	102.63	2.00	0.00	1.00	0.00	20.42	105.35	2.00	0.00	1.00	0.00
20.48	108.11	2.00	0.00	1.00	0.00	20.54	112.83	2.00	0.00	1.00	0.00
20.65	115.94	2.00	0.00	1.00	0.00	20.68	115.95	2.00	0.00	1.00	0.00
20.74	115.68	2.00	0.00	1.00	0.00	20.82	113.49	2.00	0.00	1.00	0.00
20.88	112.25	2.00	0.00	1.00	0.00	20.95	112.37	2.00	0.00	1.00	0.00
21.03	118.66	2.00	0.00	1.00	0.00	21.10	129.10	2.00	0.00	1.00	0.00
21.14	134.89	2.00	0.00	1.00	0.00	21.22	151.55	2.00	0.00	1.00	0.00
21.28	156.11	0.53	1.62	1.00	0.01	21.34	159.83	0.56	1.54	1.00	0.01
21.41	170.43	0.66	1.15	1.00	0.01	21.48	166.44	0.62	1.45	1.00	0.01
21.55	161.21	0.57	1.52	1.00	0.01	21.59	165.63	0.61	1.46	1.00	0.01
21.68	162.51	0.58	1.50	1.00	0.02	21.74	166.29	0.61	1.45	1.00	0.01
21.81	174.27	0.69	1.12	1.00	0.01	21.86	181.27	0.77	0.85	1.00	0.01
21.94	189.41	0.86	0.61	1.00	0.01	22.00	194.18	0.92	0.59	1.00	0.00
22.07	198.61	0.98	0.47	1.00	0.00	22.13	200.90	2.00	0.00	1.00	0.00
22.21	202.33	2.00	0.00	1.00	0.00	22.27	202.36	2.00	0.00	1.00	0.00
22.35	199.77	0.99	0.46	1.00	0.00	22.38	198.30	0.97	0.47	1.00	0.00
22.45	192.79	0.90	0.59	1.00	0.01	22.53	186.40	0.82	0.82	1.00	0.01
22.59	180.80	0.76	0.86	1.00	0.01	22.67	175.81	0.71	1.10	1.00	0.01
22.71	167.92	0.63	1.43	1.00	0.01	22.80	154.08	0.51	1.64	1.00	0.02
22.85	158.42	0.54	1.60	1.00	0.01	22.93	163.90	0.59	1.48	1.00	0.02
22.98	163.71	0.59	1.49	1.00	0.01	23.04	164.83	0.60	1.47	1.00	0.01
23.12	170.83	0.65	1.15	1.00	0.01	23.18	185.16	0.81	0.83	1.00	0.01

:: Post-earthquake settlement due to soil liquefaction :: (continued)

Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)	Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)
23.24	204.46	2.00	0.00	1.00	0.00	23.30	221.96	2.00	0.00	1.00	0.00
23.37	237.78	2.00	0.00	1.00	0.00	23.43	256.57	2.00	0.00	1.00	0.00
23.52	259.61	2.00	0.00	1.00	0.00	23.56	269.61	2.00	0.00	1.00	0.00
23.63	264.43	2.00	0.00	1.00	0.00	23.69	278.34	2.00	0.00	1.00	0.00
23.77	265.05	2.00	0.00	1.00	0.00	23.83	269.19	2.00	0.00	1.00	0.00
23.89	283.84	2.00	0.00	1.00	0.00	23.97	297.97	2.00	0.00	1.00	0.00
24.02	306.19	2.00	0.00	1.00	0.00	24.10	323.67	2.00	0.00	1.00	0.00
24.15	354.72	2.00	0.00	1.00	0.00	24.23	369.23	2.00	0.00	1.00	0.00
24.28	394.06	2.00	0.00	1.00	0.00	24.37	406.31	2.00	0.00	1.00	0.00
24.42	404.57	2.00	0.00	1.00	0.00	24.49	396.95	2.00	0.00	1.00	0.00
24.55	384.63	2.00	0.00	1.00	0.00	24.61	395.43	2.00	0.00	1.00	0.00
24.69	378.41	2.00	0.00	1.00	0.00	24.75	393.88	2.00	0.00	1.00	0.00
24.82	406.17	2.00	0.00	1.00	0.00	24.88	432.19	2.00	0.00	1.00	0.00
24.94	444.36	2.00	0.00	1.00	0.00	25.00	425.68	2.00	0.00	1.00	0.00
25.07	446.02	2.00	0.00	1.00	0.00	25.14	468.46	2.00	0.00	1.00	0.00
25.22	512.08	2.00	0.00	1.00	0.00	25.27	546.39	2.00	0.00	1.00	0.00
25.35	575.69	2.00	0.00	1.00	0.00	25.40	586.14	2.00	0.00	1.00	0.00
25.47	587.63	2.00	0.00	1.00	0.00	25.54	610.11	2.00	0.00	1.00	0.00
25.60	610.16	2.00	0.00	1.00	0.00	25.67	610.14	2.00	0.00	1.00	0.00
25.72	599.23	2.00	0.00	1.00	0.00	25.81	588.61	2.00	0.00	1.00	0.00
25.86	577.30	2.00	0.00	1.00	0.00	25.93	484.00	2.00	0.00	1.00	0.00
25.99	470.17	2.00	0.00	1.00	0.00	26.06	484.68	2.00	0.00	1.00	0.00
26.13	485.73	2.00	0.00	1.00	0.00	26.18	491.81	2.00	0.00	1.00	0.00
26.27	498.09	2.00	0.00	1.00	0.00	26.33	471.72	2.00	0.00	1.00	0.00
26.40	467.78	2.00	0.00	1.00	0.00	26.45	451.80	2.00	0.00	1.00	0.00
26.52	443.46	2.00	0.00	1.00	0.00	26.59	461.55	2.00	0.00	1.00	0.00
26.64	481.01	2.00	0.00	1.00	0.00	26.73	514.89	2.00	0.00	1.00	0.00
26.78	533.15	2.00	0.00	1.00	0.00	26.84	552.74	2.00	0.00	1.00	0.00
26.91	533.14	2.00	0.00	1.00	0.00	26.97	516.97	2.00	0.00	1.00	0.00
27.05	504.83	2.00	0.00	1.00	0.00	27.11	467.64	2.00	0.00	1.00	0.00
27.17	410.90	2.00	0.00	1.00	0.00	27.25	434.61	2.00	0.00	1.00	0.00
27.30	447.46	2.00	0.00	1.00	0.00	27.37	458.63	2.00	0.00	1.00	0.00
27.43	476.59	2.00	0.00	1.00	0.00	27.52	-1.00	2.00	0.00	1.00	0.00
27.56	-1.00	2.00	0.00	1.00	0.00	27.63	-1.00	2.00	0.00	1.00	0.00
27.70	-1.00	2.00	0.00	1.00	0.00	27.76	-1.00	2.00	0.00	1.00	0.00
27.82	-1.00	2.00	0.00	1.00	0.00						

Total estimated settlement: 1.50

Abbreviations

$Q_{tn,cs}$: Equivalent dean sand normalized cone resistance
FS: Factor of safety against liquefaction
e_v (%): Post-liquefaction volumentric strain
DF: e_v depth weighting factor
Settlement: Calculated settlement

:: Strength loss calculation (Robertson (2009) ::

Depth (ft)	q_t (tsf)	Q_{tn}	K_c	$Q_{tn,cs}$	I_c	$S_{u(liq)}/\sigma'_v$	$S_{u(peak)}/\sigma'_v$
0.08	0.43	0.68	26.61	18.21	4.06	N/A	N/A
0.16	5.18	8.31	12.43	103.29	3.41	N/A	N/A
0.21	166.87	268.07	1.00	268.07	1.27	N/A	N/A
0.29	142.09	228.26	1.00	228.26	1.38	N/A	N/A
0.33	128.34	206.17	1.00	206.17	1.44	N/A	N/A
0.41	97.52	156.64	1.00	156.64	1.63	N/A	N/A
0.48	74.03	118.89	1.11	132.31	1.81	N/A	N/A
0.54	51.92	83.36	1.35	112.80	2.04	N/A	N/A
0.61	43.97	70.58	1.57	110.73	2.16	N/A	N/A
0.66	35.08	56.29	1.96	110.08	2.30	N/A	N/A
0.73	28.94	46.42	2.52	116.77	2.45	N/A	N/A
0.79	23.85	38.24	3.18	121.73	2.58	N/A	N/A
0.88	21.52	34.49	3.56	122.68	2.64	N/A	N/A
0.93	21.08	33.77	3.57	120.63	2.64	N/A	N/A
1.00	22.20	35.58	3.16	112.46	2.57	N/A	N/A
1.06	19.09	30.58	3.53	108.08	2.63	N/A	N/A
1.13	18.31	29.32	3.52	103.24	2.63	N/A	N/A
1.19	18.40	29.46	3.26	96.01	2.59	N/A	N/A
1.25	18.05	28.89	3.14	90.61	2.57	N/A	N/A
1.33	17.27	27.63	2.82	77.81	2.51	N/A	N/A
1.39	16.24	25.97	2.41	62.54	2.42	N/A	N/A
1.46	15.29	24.44	2.47	60.48	2.44	N/A	N/A
1.51	14.51	23.18	2.60	60.19	2.46	N/A	N/A
1.59	13.39	21.38	2.91	62.25	2.53	N/A	N/A
1.66	12.52	19.97	3.13	62.43	2.57	N/A	N/A
1.73	12.56	20.02	3.25	65.14	2.59	N/A	N/A
1.78	11.32	18.02	3.88	69.87	2.68	N/A	N/A
1.85	10.89	17.33	4.29	74.33	2.74	N/A	N/A
1.91	10.89	17.32	4.40	76.21	2.75	N/A	N/A
1.99	10.89	17.32	4.48	77.66	2.76	N/A	N/A
2.04	10.89	17.31	4.54	78.66	2.77	N/A	N/A
2.12	11.24	17.87	4.65	83.08	2.78	N/A	N/A
2.17	12.19	19.39	4.42	85.63	2.76	N/A	N/A
2.25	17.46	27.85	3.12	86.98	2.57	N/A	N/A
2.31	25.32	40.47	2.20	88.96	2.37	N/A	N/A
2.38	39.22	62.80	1.54	96.57	2.14	N/A	N/A
2.44	47.08	75.42	1.39	104.55	2.06	N/A	N/A
2.50	52.87	84.72	1.32	111.51	2.01	N/A	N/A
2.57	59.78	95.81	1.28	122.27	1.98	N/A	N/A
2.63	63.32	101.50	1.29	131.34	2.00	N/A	N/A
2.69	60.47	96.91	1.38	133.82	2.06	N/A	N/A
2.76	54.59	87.46	1.50	131.43	2.13	N/A	N/A
2.86	43.28	69.27	1.85	128.18	2.27	N/A	N/A
2.90	37.84	60.53	2.21	133.82	2.37	N/A	N/A
2.99	32.57	52.06	2.53	131.91	2.45	N/A	N/A
3.03	34.73	55.52	2.33	129.09	2.40	N/A	N/A
3.13	40.60	64.95	1.92	124.97	2.29	N/A	N/A
3.17	49.50	79.24	1.57	124.68	2.16	N/A	N/A

::Strength loss calculation (Robertson (2009) :: (continued)

Depth (ft)	q_t (tsf)	Q_{tn}	K_c	$Q_{tn,cs}$	I_c	$S_{u(liq)}/\sigma'_v$	$S_{u(peak)}/\sigma'_v$
3.25	38.62	61.75	1.93	119.39	2.30	N/A	N/A
3.29	35.85	57.30	1.71	98.22	2.22	N/A	N/A
3.35	31.10	49.66	1.38	68.31	2.05	N/A	N/A
3.44	26.78	42.71	1.51	64.70	2.13	N/A	N/A
3.48	24.45	38.96	1.61	62.61	2.17	N/A	N/A
3.55	20.65	32.85	1.85	60.66	2.27	N/A	N/A
3.62	17.89	28.42	2.15	61.22	2.36	N/A	N/A
3.68	9.94	15.64	4.07	63.68	2.71	N/A	N/A
3.75	15.21	24.10	2.55	61.57	2.46	N/A	N/A
3.81	15.56	24.66	2.50	61.74	2.44	N/A	N/A
3.89	15.82	25.07	2.56	64.09	2.46	N/A	N/A
3.96	15.82	25.07	2.63	66.04	2.47	N/A	N/A
4.02	16.51	26.17	2.50	65.56	2.44	N/A	N/A
4.07	17.80	28.24	2.32	65.64	2.40	N/A	N/A
4.15	18.75	29.76	2.27	67.64	2.39	N/A	N/A
4.20	19.36	30.74	2.24	68.80	2.38	N/A	N/A
4.29	21.09	33.50	2.13	71.28	2.35	N/A	N/A
4.34	21.27	33.78	2.19	74.09	2.37	N/A	N/A
4.40	20.75	32.94	2.42	79.78	2.43	N/A	N/A
4.47	19.97	31.68	2.70	85.59	2.49	N/A	N/A
4.54	20.23	32.09	2.80	90.02	2.51	N/A	N/A
4.60	19.63	31.12	3.04	94.76	2.55	N/A	N/A
4.67	19.63	31.12	3.24	100.94	2.59	N/A	N/A
4.74	19.37	30.69	3.51	107.67	2.63	N/A	N/A
4.79	19.97	31.65	3.53	111.82	2.63	N/A	N/A
4.87	21.01	33.32	3.55	118.37	2.64	N/A	N/A
4.92	21.96	34.84	3.50	121.89	2.63	N/A	N/A
5.01	23.25	36.90	3.56	131.21	2.64	N/A	N/A
5.06	24.20	38.43	3.48	133.53	2.62	N/A	N/A
5.12	25.07	39.82	3.46	137.68	2.62	N/A	N/A
5.19	26.19	41.61	3.39	141.02	2.61	N/A	N/A
5.28	27.49	43.69	3.30	144.05	2.60	N/A	N/A
5.33	28.44	45.21	3.23	146.02	2.58	N/A	N/A
5.39	28.69	45.61	3.25	148.05	2.59	N/A	N/A
5.46	28.95	46.02	3.10	142.78	2.56	N/A	N/A
5.54	28.61	45.47	2.81	127.88	2.51	N/A	N/A
5.59	28.35	45.04	2.80	126.15	2.51	N/A	N/A
5.66	27.57	43.78	2.97	129.89	2.54	N/A	N/A
5.73	27.31	43.36	3.07	132.93	2.56	N/A	N/A
5.78	27.23	43.23	3.12	134.91	2.57	N/A	N/A
5.85	26.71	42.38	3.23	137.02	2.58	N/A	N/A
5.92	27.31	43.34	3.19	138.20	2.58	N/A	N/A
5.98	26.79	42.50	3.29	139.69	2.59	N/A	N/A
6.04	27.40	43.47	3.22	140.14	2.58	0.72	0.72
6.12	27.31	43.32	3.28	142.13	2.59	0.72	0.72
6.17	27.23	43.19	3.33	143.76	2.60	5.50	5.50
6.24	26.71	42.34	3.42	144.73	2.61	5.34	5.34
6.30	25.41	40.25	3.60	145.02	2.64	5.02	5.02

:: Strength loss calculation (Robertson (2009) :: (continued)

Depth (ft)	q_t (tsf)	Q_{tn}	K_c	$Q_{tn,cs}$	I_c	$S_{u(liq)}/\sigma'_v$	$S_{u(peak)}/\sigma'_v$
6.37	23.68	37.46	3.86	144.67	2.68	4.62	4.62
6.44	22.48	35.53	3.97	141.06	2.70	4.33	4.33
6.51	21.61	34.12	4.03	137.45	2.70	4.12	4.12
6.58	21.70	34.26	3.90	133.68	2.69	4.09	4.09
6.64	21.96	34.67	3.78	131.21	2.67	4.10	4.10
6.70	22.30	35.21	3.71	130.66	2.66	4.12	4.12
6.76	23.08	36.46	3.60	131.10	2.64	4.23	4.23
6.83	23.68	37.42	3.53	132.24	2.63	4.29	4.29
6.89	24.12	38.12	3.50	133.49	2.63	4.33	4.33
6.98	24.63	38.93	3.50	136.29	2.63	4.37	4.37
7.03	25.40	40.17	3.40	136.64	2.61	4.48	4.48
7.11	26.87	42.53	3.19	135.70	2.58	0.71	0.71
7.15	27.56	43.63	3.09	134.83	2.56	0.72	0.72
7.25	29.89	47.37	2.83	133.93	2.51	0.73	0.73
7.30	31.53	50.00	2.69	134.49	2.48	0.73	0.73
7.36	32.48	51.52	2.67	137.41	2.48	0.74	0.74
7.43	32.74	51.93	2.75	142.86	2.50	0.74	0.74
7.52	32.14	50.96	2.89	147.34	2.52	0.74	0.74
7.57	31.19	49.42	3.01	148.58	2.54	0.73	0.73
7.65	29.12	46.09	3.26	150.31	2.59	0.72	0.72
7.70	29.12	46.09	3.26	150.24	2.59	0.72	0.72
7.74	29.03	45.94	3.27	150.24	2.59	0.72	0.72
7.82	29.72	47.04	3.16	148.81	2.57	0.73	0.73
7.87	30.41	48.14	3.05	146.99	2.55	0.73	0.73
7.95	30.94	48.97	2.94	143.75	2.53	0.73	0.73
8.01	31.29	49.53	2.61	129.06	2.47	0.73	0.73
8.10	32.24	51.05	1.95	99.73	2.30	0.74	0.74
8.15	32.67	51.73	1.90	98.32	2.28	0.74	0.74
8.24	35.00	55.47	1.72	95.24	2.22	0.75	0.75
8.28	35.34	56.01	1.68	93.93	2.20	0.75	0.75
8.34	35.47	56.21	1.64	92.44	2.19	0.75	0.75
8.41	35.60	56.42	1.61	91.10	2.18	0.75	0.75
8.47	36.29	57.53	1.56	89.92	2.15	0.75	0.75
8.56	36.99	58.55	1.50	88.04	2.13	0.75	0.75
8.60	37.33	58.75	1.49	87.35	2.12	0.76	0.76
8.68	38.02	59.24	1.46	86.61	2.10	0.76	0.76
8.73	38.02	58.98	1.46	86.00	2.10	0.76	0.76
8.82	38.02	58.39	1.44	83.87	2.09	0.75	0.75
8.86	38.89	59.26	1.41	83.33	2.07	0.76	0.76
8.95	38.71	58.42	1.39	81.07	2.06	0.75	0.75
9.00	38.80	58.16	1.37	79.72	2.05	0.75	0.75
9.07	38.97	58.01	1.36	78.79	2.04	0.75	0.75
9.14	37.59	56.15	1.41	79.17	2.07	0.75	0.75
9.19	37.59	55.73	1.39	77.59	2.06	0.75	0.75
9.27	37.07	55.19	1.45	80.18	2.10	0.75	0.75
9.32	37.42	55.63	1.47	81.53	2.11	0.75	0.75
9.41	36.21	53.85	1.52	81.94	2.13	0.74	0.74
9.48	35.95	53.28	1.54	81.78	2.14	0.74	0.74

:: Strength loss calculation (Robertson (2009) :: (continued)

Depth (ft)	q_t (tsf)	Q_{tn}	K_c	$Q_{tn,cs}$	I_c	$S_{u(liq)}/\sigma'_v$	$S_{u(peak)}/\sigma'_v$
9.54	35.00	51.78	1.56	80.89	2.15	0.74	0.74
9.59	34.65	51.09	1.57	80.27	2.16	0.74	0.74
9.66	35.26	51.52	1.53	78.86	2.14	0.74	0.74
9.72	35.52	51.41	1.49	76.59	2.12	0.74	0.74
9.80	35.60	51.01	1.46	74.33	2.10	0.74	0.74
9.86	35.09	50.14	1.46	73.43	2.11	0.73	0.73
9.94	34.65	49.29	1.48	72.83	2.11	0.73	0.73
9.99	34.22	48.65	1.50	73.03	2.12	0.73	0.73
10.04	33.88	48.21	1.54	74.27	2.14	0.73	0.73
10.13	32.58	46.87	1.72	80.41	2.22	0.73	0.73
10.17	31.37	45.48	1.86	84.47	2.27	0.72	0.72
10.26	29.30	43.11	2.18	94.15	2.37	0.72	0.72
10.31	27.74	41.12	2.41	99.13	2.42	0.71	0.71
10.38	26.10	38.91	2.67	103.93	2.48	0.70	0.70
10.44	23.43	35.22	3.06	107.81	2.55	0.69	0.69
10.53	21.35	32.17	3.40	109.44	2.61	2.47	2.47
10.57	23.30	34.66	3.08	106.62	2.56	0.69	0.69
10.67	21.61	31.95	3.17	101.39	2.57	0.68	0.68
10.71	23.17	33.83	2.88	97.53	2.52	0.69	0.69
10.78	25.84	37.14	2.58	95.71	2.46	0.70	0.70
10.84	29.04	41.09	2.29	94.11	2.39	0.71	0.71
10.93	34.31	47.46	1.95	92.53	2.30	0.73	0.73
10.96	35.69	48.94	1.84	90.01	2.26	0.73	0.73
11.07	41.48	55.39	1.56	86.52	2.15	0.75	0.75
11.11	43.98	58.29	1.50	87.51	2.12	0.75	0.75
11.16	51.41	66.18	1.28	84.40	1.98	0.77	0.77
11.26	60.39	74.33	1.00	74.33	1.77	0.79	0.79
11.29	62.64	76.92	1.00	76.92	1.76	0.79	0.79
11.36	65.31	79.75	1.00	79.75	1.74	0.80	0.80
11.43	62.20	76.12	1.00	76.12	1.77	0.79	0.79
11.49	60.39	74.51	1.00	74.51	1.84	0.79	0.79
11.56	60.18	75.55	1.25	94.09	1.95	0.79	0.79
11.63	59.96	76.26	1.37	104.49	2.05	0.79	0.79
11.69	63.24	79.35	1.29	102.06	1.99	0.80	0.80
11.76	71.27	87.69	1.18	103.45	1.89	0.81	0.81
11.82	74.04	90.14	1.14	103.01	1.85	0.81	0.81
11.89	81.55	97.90	1.09	107.06	1.78	0.82	0.82
11.96	83.02	99.39	1.09	108.82	1.78	0.83	0.83
12.01	90.71	107.56	1.06	114.22	1.74	0.84	0.84
12.08	89.15	105.51	1.07	112.71	1.74	0.83	0.83
12.15	88.29	104.49	1.08	112.93	1.76	0.83	0.83
12.22	78.44	93.70	1.14	107.20	1.85	0.82	0.82
12.27	74.56	89.43	1.18	105.94	1.90	0.81	0.81
12.35	63.93	77.62	1.31	101.65	2.01	0.79	0.79
12.41	51.15	63.16	1.57	98.99	2.16	0.76	0.76
12.47	40.96	51.36	1.97	101.10	2.31	0.74	0.74
12.55	30.77	39.33	2.80	109.99	2.51	0.70	0.70
12.60	24.89	32.11	3.53	113.21	2.63	2.40	2.40

:: Strength loss calculation (Robertson (2009) :: (continued)

Depth (ft)	q_t (tsf)	Q_{tn}	K_c	$Q_{tn,cs}$	I_c	$S_{u(liq)}/\sigma'_v$	$S_{u(peak)}/\sigma'_v$
12.68	19.19	24.88	4.51	112.28	2.77	1.83	1.83
12.74	16.17	20.98	5.26	110.30	2.85	1.52	1.52
12.81	14.36	18.51	5.62	104.04	2.89	1.33	1.33
12.86	11.85	15.17	6.68	101.30	2.99	1.08	1.08
12.93	10.21	12.86	7.46	95.92	3.06	0.92	0.92
13.00	9.78	12.21	7.48	91.32	3.06	0.87	0.87
13.08	9.87	12.25	7.11	87.10	3.03	0.87	0.87
13.13	10.12	12.53	6.69	83.90	3.00	0.90	0.90
13.20	10.73	13.27	6.15	81.60	2.94	0.95	0.95
13.27	11.33	13.92	5.78	80.44	2.91	1.00	1.00
13.32	11.42	13.96	5.66	78.99	2.90	1.00	1.00
13.39	11.68	14.21	5.50	78.12	2.88	1.02	1.02
13.49	11.85	14.29	5.40	77.16	2.87	1.03	1.03
13.52	11.94	14.29	4.92	70.24	2.82	1.04	1.04
13.62	11.68	13.78	4.51	62.13	2.77	0.26	1.01
13.67	11.59	13.68	4.80	65.71	2.80	0.30	0.99
13.72	11.33	13.34	4.99	66.59	2.82	0.31	0.97
13.79	10.90	12.77	5.24	66.96	2.85	0.31	0.92
13.85	10.73	12.52	5.33	66.73	2.86	0.30	0.90
13.92	9.61	11.13	5.91	65.79	2.92	0.29	0.80
14.02	10.04	11.54	5.50	63.41	2.88	0.27	0.83
14.05	9.61	11.01	5.75	63.33	2.91	0.26	0.79
14.11	9.00	10.25	6.24	63.92	2.95	0.27	0.73
14.18	9.00	10.20	6.43	65.58	2.97	0.28	0.73
14.24	9.00	10.16	6.72	68.29	3.00	0.31	0.73
14.32	10.21	11.57	6.10	70.56	2.94	0.83	0.83
14.38	11.25	12.74	5.55	70.68	2.88	0.92	0.92
14.44	13.75	15.53	4.48	69.67	2.76	0.35	1.13
14.51	14.96	16.82	4.07	68.40	2.71	0.34	1.23
14.57	15.48	17.35	3.97	68.98	2.70	0.35	1.27
14.64	16.43	18.38	3.89	71.53	2.69	1.35	1.35
14.71	17.98	20.08	3.73	74.93	2.66	1.47	1.47
14.77	19.37	21.59	3.61	77.89	2.64	1.59	1.59
14.83	20.40	22.70	3.59	81.46	2.64	1.67	1.67
14.90	20.49	22.77	3.81	86.74	2.67	1.67	1.67
14.97	20.92	23.22	4.00	92.96	2.70	1.69	1.69
15.03	21.27	23.57	4.12	97.14	2.72	1.72	1.72
15.10	21.70	24.00	4.27	102.41	2.74	1.74	1.74
15.16	22.66	24.99	4.28	107.04	2.74	1.82	1.82
15.23	23.35	25.70	4.44	114.05	2.76	1.86	1.86
15.30	24.39	26.80	4.54	121.57	2.77	1.94	1.94
15.36	25.59	28.08	4.61	129.54	2.78	2.03	2.03
15.44	27.32	29.89	4.62	138.04	2.78	2.16	2.16
15.50	28.88	31.51	4.56	143.80	2.77	2.28	2.28
15.56	30.69	33.36	4.46	148.78	2.76	2.42	2.42
15.63	32.07	34.75	4.42	153.49	2.76	2.52	2.52
15.69	33.11	35.75	4.42	157.99	2.76	2.59	2.59
15.76	33.20	35.70	4.44	158.58	2.76	2.58	2.58

:: Strength loss calculation (Robertson (2009) :: (continued)

Depth (ft)	q_t (tsf)	Q_{tn}	K_c	$Q_{tn,cs}$	I_c	$S_{u(liq)}/\sigma'_v$	$S_{u(peak)}/\sigma'_v$
15.86	33.20	35.44	4.35	154.16	2.75	2.56	2.56
15.89	33.20	35.40	4.41	156.22	2.75	2.56	2.56
15.95	33.54	35.66	4.54	161.76	2.77	2.57	2.57
16.04	35.10	37.14	4.48	166.32	2.76	2.68	2.68
16.09	36.65	38.65	4.32	166.83	2.74	2.79	2.79
16.15	19.03	19.73	8.71	171.80	3.16	1.41	1.41
16.22	39.76	41.56	3.99	166.03	2.70	3.01	3.01
16.30	40.88	42.52	3.88	165.15	2.68	3.08	3.08
16.35	40.97	42.47	3.88	164.90	2.68	3.07	3.07
16.43	41.05	42.36	3.91	165.77	2.69	3.06	3.06
16.47	41.23	42.44	3.93	166.86	2.69	3.07	3.07
16.55	42.09	43.14	3.91	168.67	2.69	3.12	3.12
16.61	41.75	42.63	3.96	168.93	2.70	3.08	3.08
16.69	41.40	42.07	3.98	167.35	2.70	3.04	3.04
16.74	42.35	42.91	3.86	165.59	2.68	3.10	3.10
16.80	42.26	42.64	3.83	163.40	2.68	3.08	3.08
16.88	42.78	42.95	3.70	158.81	2.66	3.10	3.10
16.94	43.13	43.14	3.62	155.97	2.65	3.11	3.11
17.00	42.35	42.19	3.63	153.32	2.65	3.04	3.04
17.07	40.10	39.77	3.82	151.96	2.68	2.87	2.87
17.16	37.69	37.16	4.05	150.53	2.71	2.67	2.67
17.21	37.73	37.09	3.99	148.07	2.70	2.67	2.67
17.30	37.73	36.89	3.94	145.15	2.69	2.65	2.65
17.34	37.77	36.84	3.94	145.02	2.69	2.65	2.65
17.42	38.20	37.11	3.90	144.61	2.69	2.67	2.67
17.46	38.38	37.25	3.86	143.93	2.68	2.68	2.68
17.52	39.07	37.86	3.76	142.25	2.67	2.72	2.72
17.61	37.43	36.15	3.92	141.69	2.69	2.60	2.60
17.66	36.82	35.51	4.00	141.96	2.70	2.55	2.55
17.75	36.13	34.75	4.14	143.93	2.72	2.49	2.49
17.79	35.70	34.28	4.24	145.51	2.73	2.46	2.46
17.85	36.22	34.73	4.18	145.24	2.73	2.49	2.49
17.93	38.64	37.02	3.95	146.34	2.69	2.66	2.66
18.01	39.07	37.35	3.93	146.95	2.69	2.68	2.68
18.05	39.76	37.97	3.85	146.20	2.68	2.72	2.72
18.14	40.28	38.38	3.83	147.11	2.68	2.75	2.75
18.20	39.33	37.40	3.91	146.42	2.69	2.68	2.68
18.24	40.41	38.36	3.36	128.96	2.61	2.75	2.75
18.34	40.54	38.32	2.44	93.66	2.43	0.70	0.70
18.42	42.18	39.85	2.68	106.68	2.48	0.71	0.71
18.46	43.47	41.06	2.70	110.95	2.49	0.71	0.71
18.51	44.16	41.69	2.77	115.51	2.50	0.71	0.71
18.58	45.20	42.62	2.82	120.38	2.51	0.71	0.71
18.64	43.39	40.82	3.05	124.44	2.55	0.71	0.71
18.73	42.61	39.98	3.14	125.50	2.57	0.71	0.71
18.77	38.90	36.39	3.49	126.97	2.63	2.61	2.61
18.84	34.84	32.44	3.96	128.35	2.69	2.32	2.32
18.91	31.81	29.48	4.32	127.23	2.74	2.11	2.11

:: Strength loss calculation (Robertson (2009) :: (continued)

Depth (ft)	q_t (tsf)	Q_{tn}	K_c	$Q_{tn,cs}$	I_c	$S_{u(liq)}/\sigma'_v$	$S_{u(peak)}/\sigma'_v$
18.99	29.57	27.27	4.44	121.16	2.76	1.95	1.95
19.05	30.00	27.64	4.24	117.07	2.73	1.98	1.98
19.11	32.59	30.05	3.77	113.30	2.67	2.15	2.15
19.16	34.58	31.90	3.50	111.55	2.63	2.28	2.28
19.26	37.34	34.44	3.18	109.69	2.58	0.69	0.69
19.32	37.60	34.64	3.15	109.29	2.57	0.69	0.69
19.36	35.96	33.05	3.31	109.37	2.60	0.68	0.68
19.44	34.40	31.51	3.46	108.99	2.62	2.25	2.25
19.50	35.01	32.04	3.38	108.31	2.61	2.29	2.29
19.56	36.91	33.78	3.19	107.79	2.58	0.69	0.69
19.63	41.83	38.36	2.78	106.71	2.50	0.70	0.70
19.69	53.06	48.89	2.15	105.35	2.36	0.73	0.73
19.77	63.08	58.24	1.87	108.76	2.27	0.75	0.75
19.82	71.02	65.63	1.74	113.87	2.23	0.77	0.77
19.90	75.60	69.82	1.75	122.46	2.23	0.78	0.78
19.95	77.76	71.76	1.77	126.79	2.24	0.78	0.78
20.04	73.87	67.96	1.98	134.33	2.31	0.77	0.77
20.09	66.27	60.74	2.31	140.57	2.40	0.76	0.76
20.17	55.91	50.94	2.89	147.45	2.52	0.74	0.74
20.22	43.65	39.45	3.44	135.78	2.62	2.81	2.81
20.28	38.64	34.77	3.04	105.69	2.55	0.69	0.69
20.35	32.50	29.00	3.54	102.63	2.63	2.07	2.07
20.42	27.50	24.30	4.33	105.35	2.74	1.73	1.73
20.48	27.37	24.14	4.48	108.11	2.76	1.72	1.72
20.54	27.37	24.10	4.68	112.83	2.79	1.72	1.72
20.65	27.25	23.91	4.85	115.94	2.81	1.70	1.70
20.68	28.37	24.92	4.65	115.95	2.78	1.78	1.78
20.74	32.08	28.31	4.09	115.68	2.71	2.02	2.02
20.82	44.26	39.49	2.87	113.49	2.52	0.70	0.70
20.88	56.01	50.29	2.23	112.25	2.38	0.74	0.74
20.95	70.42	63.57	1.77	112.37	2.24	0.77	0.77
21.03	99.35	90.30	1.31	118.66	2.01	0.81	0.81
21.10	120.43	109.80	1.18	129.10	1.89	0.84	0.84
21.14	128.89	117.58	1.15	134.89	1.85	0.85	0.85
21.22	149.53	136.51	1.11	151.55	1.80	0.87	0.87
21.28	159.91	146.07	1.07	156.11	1.75	0.88	0.88
21.34	168.03	153.52	1.04	159.83	1.70	0.89	0.89
21.41	184.18	168.35	1.01	170.43	1.66	0.90	0.90
21.48	177.35	161.83	1.03	166.44	1.69	0.90	0.90
21.55	169.15	154.05	1.05	161.21	1.71	0.89	0.89
21.59	176.79	161.05	1.03	165.63	1.69	0.90	0.90
21.68	171.57	155.98	1.04	162.51	1.71	0.89	0.89
21.74	176.23	160.13	1.04	166.29	1.70	0.90	0.90
21.81	184.18	167.20	1.04	174.27	1.71	0.90	0.90
21.86	191.94	174.17	1.04	181.27	1.70	0.91	0.91
21.94	198.95	180.29	1.05	189.41	1.72	0.91	0.91
22.00	204.98	185.65	1.05	194.18	1.71	0.92	0.92
22.07	209.22	189.26	1.05	198.61	1.72	0.92	0.92

:: Strength loss calculation (Robertson (2009) :: (continued)

Depth (ft)	q_t (tsf)	Q_{tn}	K_c	$Q_{tn,cs}$	I_c	$S_{u(liq)}/\sigma'_v$	$S_{u(peak)}/\sigma'_v$
22.13	211.38	191.03	1.05	200.90	1.72	0.92	0.92
22.21	211.99	191.30	1.06	202.33	1.73	0.92	0.92
22.27	211.73	190.86	1.06	202.36	1.73	0.92	0.92
22.35	208.88	187.99	1.06	199.77	1.74	0.92	0.92
22.38	206.81	186.02	1.07	198.30	1.74	0.92	0.92
22.45	198.77	178.41	1.08	192.79	1.76	0.91	0.91
22.53	189.45	169.63	1.10	186.40	1.79	0.90	0.90
22.59	180.98	161.68	1.12	180.80	1.82	0.90	0.90
22.67	173.04	154.21	1.14	175.81	1.84	0.89	0.89
22.71	169.84	151.44	1.11	167.92	1.80	0.89	0.89
22.80	162.07	144.56	1.07	154.08	1.74	0.88	0.88
22.85	160.43	142.65	1.11	158.42	1.81	0.88	0.88
22.93	162.28	143.92	1.14	163.90	1.84	0.88	0.88
22.98	161.29	142.87	1.15	163.71	1.85	0.88	0.88
23.04	162.50	143.83	1.15	164.83	1.85	0.88	0.88
23.12	167.25	147.80	1.16	170.83	1.86	0.88	0.88
23.18	188.58	167.02	1.11	185.16	1.80	0.90	0.90
23.24	220.88	196.41	1.04	204.46	1.70	0.93	0.93
23.30	249.04	221.96	1.00	221.96	1.64	0.95	0.95
23.37	266.40	237.19	1.00	237.78	1.65	0.96	0.96
23.43	285.66	254.12	1.01	256.57	1.66	0.97	0.97
23.52	291.97	259.61	1.00	259.61	1.61	0.97	0.97
23.56	303.37	269.61	1.00	269.61	1.56	0.98	0.98
23.63	297.84	264.43	1.00	264.43	1.55	0.97	0.97
23.69	313.73	278.34	1.00	278.34	1.51	0.98	0.98
23.77	299.13	265.05	1.00	265.05	1.50	0.97	0.97
23.83	304.07	269.19	1.00	269.19	1.45	0.98	0.98
23.89	320.81	283.84	1.00	283.84	1.41	0.99	0.99
23.97	337.06	297.97	1.00	297.97	1.35	0.99	0.99
24.02	346.55	306.19	1.00	306.19	1.32	1.00	1.00
24.10	366.68	323.67	1.00	323.67	1.29	1.01	1.01
24.15	402.01	354.72	1.00	354.72	1.23	1.02	1.02
24.23	418.85	369.23	1.00	369.23	1.23	1.03	1.03
24.28	447.27	394.06	1.00	394.06	1.22	1.04	1.04
24.37	461.69	406.31	1.00	406.31	1.23	1.05	1.05
24.42	460.05	404.57	1.00	404.57	1.29	1.05	1.05
24.49	451.84	396.95	1.00	396.95	1.34	1.04	1.04
24.55	438.28	384.63	1.00	384.63	1.28	1.04	1.04
24.61	450.94	395.43	1.00	395.43	1.29	1.04	1.04
24.69	432.06	378.41	1.00	378.41	1.34	1.03	1.03
24.75	450.03	393.88	1.00	393.88	1.33	1.04	1.04
24.82	464.54	406.17	1.00	406.17	1.34	1.05	1.05
24.88	494.60	432.19	1.00	432.19	1.30	1.06	1.06
24.94	508.93	444.36	1.00	444.36	1.27	1.06	1.06
25.00	488.03	425.68	1.00	425.68	1.26	1.05	1.05
25.07	511.78	446.02	1.00	446.02	1.19	1.06	1.06
25.14	537.95	468.46	1.00	468.46	1.16	1.07	1.07
25.22	588.66	512.08	1.00	512.08	1.19	1.09	1.09

:: Strength loss calculation (Robertson (2009) :: (continued)

Depth (ft)	q_t (tsf)	Q_{tn}	K_c	$Q_{tn,cs}$	I_c	$S_{u(liq)}/\sigma'_v$	$S_{u(peak)}/\sigma'_v$
25.27	628.39	546.39	1.00	546.39	1.19	1.10	1.10
25.35	662.85	575.69	1.00	575.69	1.22	1.11	1.11
25.40	675.29	586.14	1.00	586.14	1.22	1.11	1.11
25.47	677.79	587.63	1.00	587.63	1.22	1.11	1.11
25.54	704.31	610.11	1.00	610.11	1.19	1.12	1.12
25.60	705.00	610.16	1.00	610.16	1.20	1.12	1.12
25.67	705.69	610.14	1.00	610.14	1.20	1.12	1.12
25.72	693.68	599.23	1.00	599.23	1.22	1.12	1.12
25.81	682.29	588.61	1.00	588.61	1.22	1.11	1.11
25.86	669.68	577.30	1.00	577.30	1.24	1.11	1.11
25.93	562.32	484.00	1.00	484.00	1.34	1.08	1.08
25.99	546.77	470.17	1.00	470.17	1.36	1.07	1.07
26.06	564.13	484.68	1.00	484.68	1.35	1.08	1.08
26.13	565.95	485.73	1.00	485.73	1.32	1.08	1.08
26.18	573.46	491.81	1.00	491.81	1.26	1.08	1.08
26.27	581.42	498.09	1.00	498.09	1.20	1.08	1.08
26.33	551.19	471.72	1.00	471.72	1.23	1.07	1.07
26.40	547.12	467.78	1.00	467.78	1.22	1.07	1.07
26.45	528.89	451.80	1.00	451.80	1.26	1.07	1.07
26.52	519.65	443.46	1.00	443.46	1.30	1.06	1.06
26.59	541.33	461.55	1.00	461.55	1.26	1.07	1.07
26.64	564.48	481.01	1.00	481.01	1.18	1.08	1.08
26.73	604.82	514.89	1.00	514.89	1.02	1.09	1.09
26.78	626.59	533.15	1.00	533.15	0.97	1.09	1.09
26.84	650.08	552.74	1.00	552.74	0.94	1.10	1.10
26.91	627.62	533.14	1.00	533.14	0.97	1.09	1.09
26.97	609.14	516.97	1.00	516.97	1.03	1.09	1.09
27.05	595.49	504.83	1.00	504.83	1.07	1.09	1.09
27.11	552.22	467.64	1.00	467.64	1.16	1.07	1.07
27.17	485.80	410.90	1.00	410.90	1.27	1.05	1.05
27.25	514.30	434.61	1.00	434.61	1.34	1.06	1.06
27.30	529.84	447.46	1.00	447.46	1.32	1.06	1.06
27.37	543.49	458.63	1.00	458.63	1.23	1.07	1.07
27.43	565.17	476.59	1.00	476.59	1.23	1.07	1.07
27.52	603.78	-1.00	1.00	-1.00	-1.00	N/A	N/A
27.56	634.78	-1.00	1.00	-1.00	-1.00	N/A	N/A
27.63	686.09	-1.00	1.00	-1.00	-1.00	N/A	N/A
27.70	766.85	-1.00	1.00	-1.00	-1.00	N/A	N/A
27.76	809.51	-1.00	1.00	-1.00	-1.00	N/A	N/A
27.82	811.50	-1.00	1.00	-1.00	-1.00	N/A	N/A

Abbreviations

q_t: Total cone resistance
K_c: Cone resistance correction factor due to fines
$Q_{tn,cs}$: Adjusted and corrected cone resistance due to fines
I_c: Soil behavior type index
$S_{u(liq)}/\sigma'_v$: Calculated liquefied undrained strength ratio
$S_{u(peak)}/\sigma'_v$: Calculated peak undrained strength ratio

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LIQUEFACTION ANALYSIS REPORT

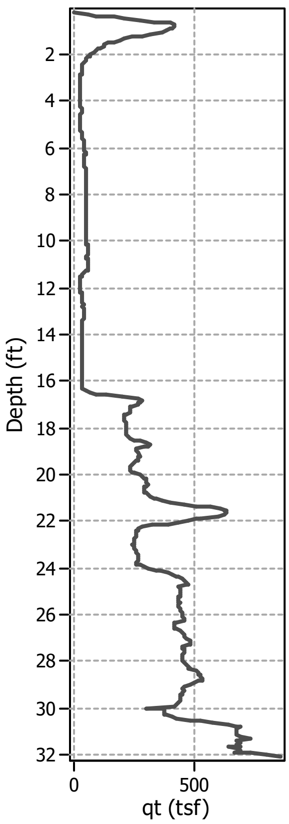
Project title : Twining Consulting **Location : 4112 Del Rey Ave, Marina Del Rey, CA**

CPT file : CPT-2

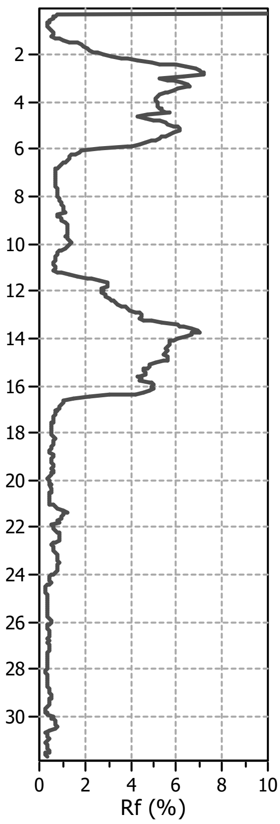
Input parameters and analysis data

Analysis method:	NCEER (1998)	G.W.T. (in-situ):	22.00 ft	Use fill:	No	Clay like behavior applied:	Sands only
Fines correction method:	NCEER (1998)	G.W.T. (earthq.):	6.00 ft	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	1	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	7.31	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.87	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

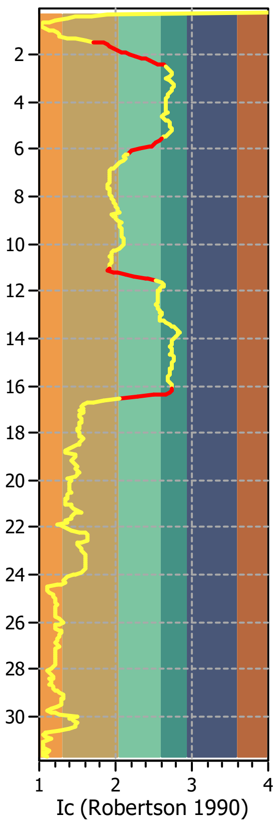
Cone resistance



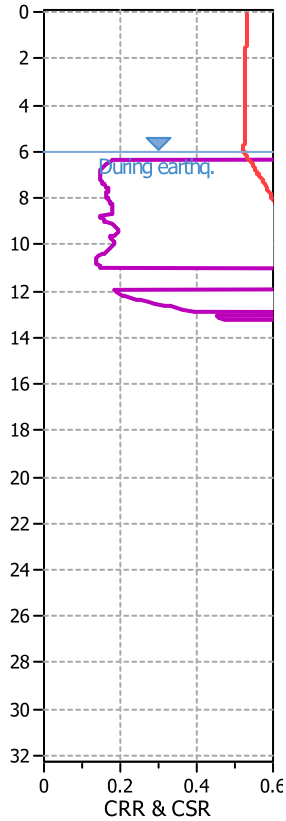
Friction Ratio



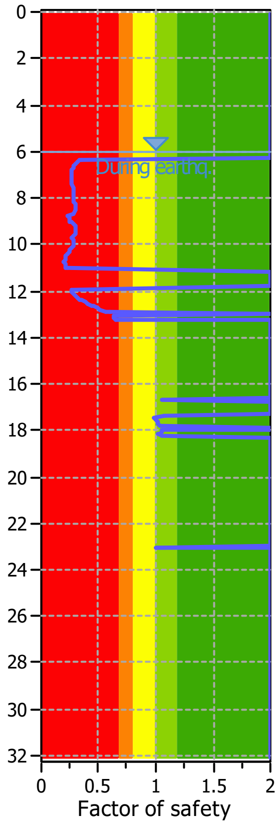
SBTn Plot



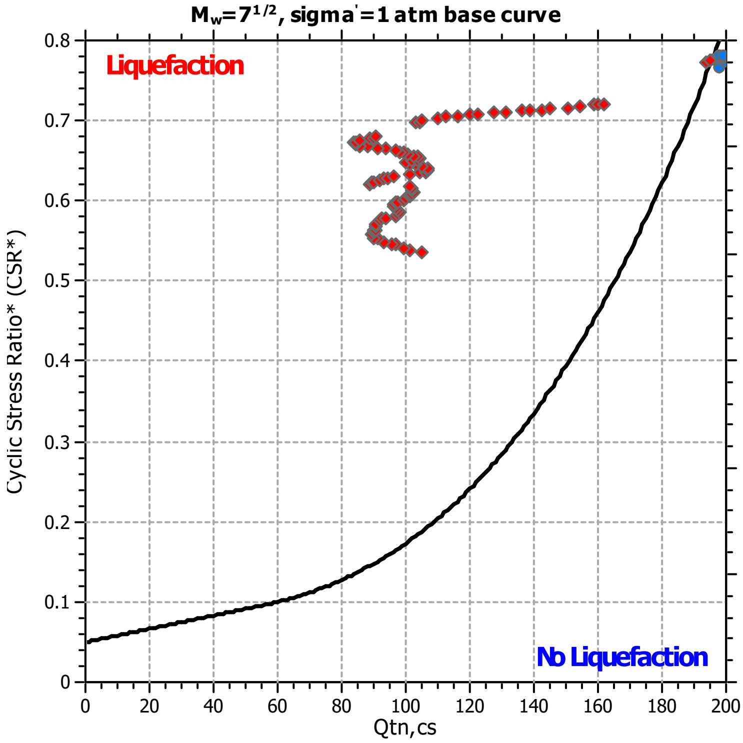
CRR plot



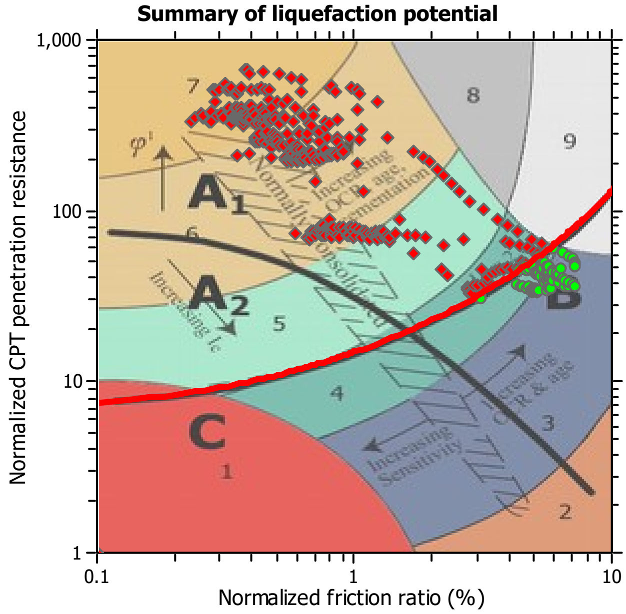
FS Plot



$M_w=7^{1/2}$, sigma'=1 atm base curve

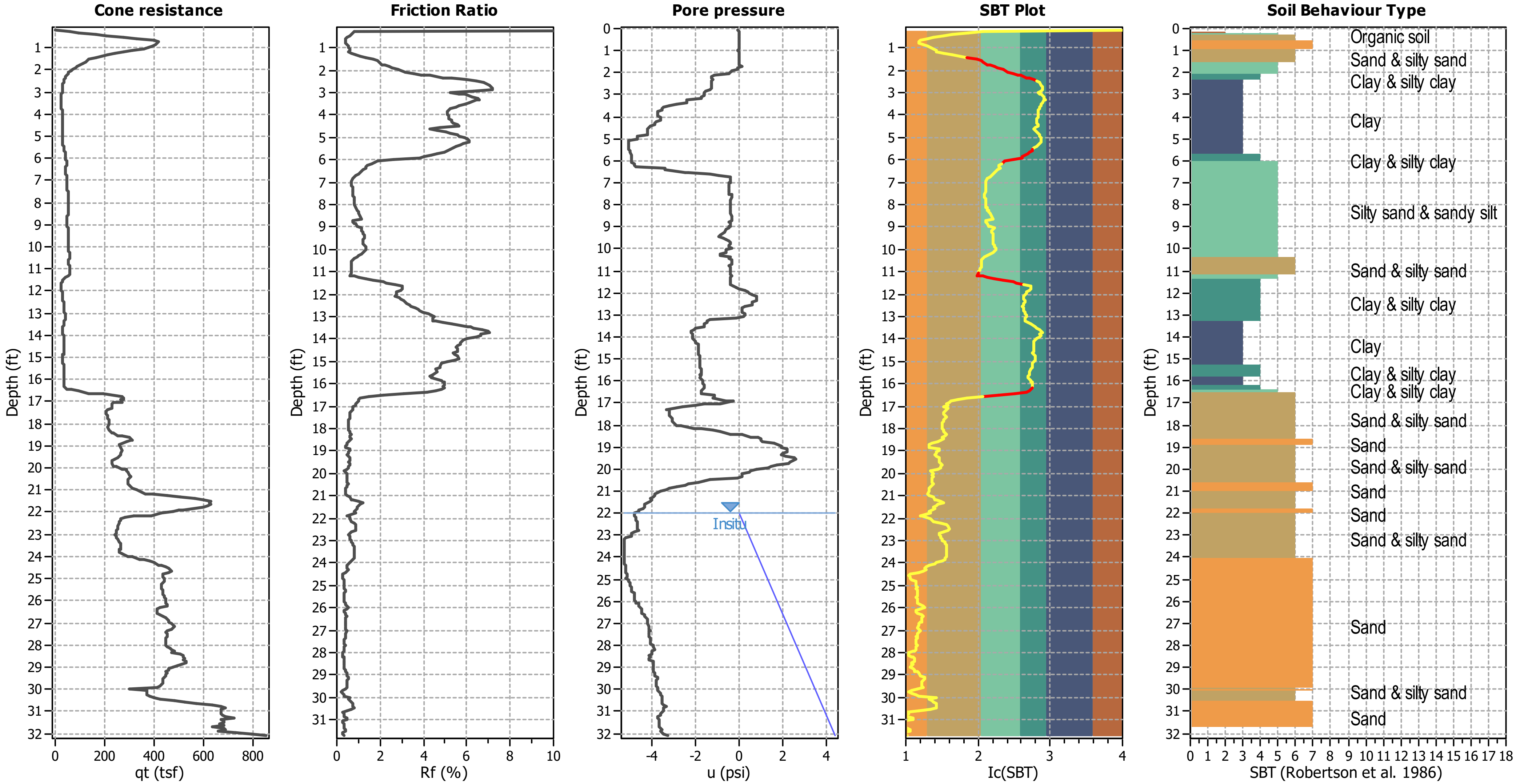


Summary of liquefaction potential



Zone A_1: Cyclic liquefaction likely depending on size and duration of cyclic loading
Zone A_2: Cyclic liquefaction and strength loss likely depending on loading and ground geometry
Zone B: Liquefaction and post-earthquake strength loss unlikely, check cyclic softening
Zone C: Cyclic liquefaction and strength loss possible depending on soil plasticity, brittleness/sensitivity, strain to peak undrained strength and ground geometry

CPT basic interpretation plots



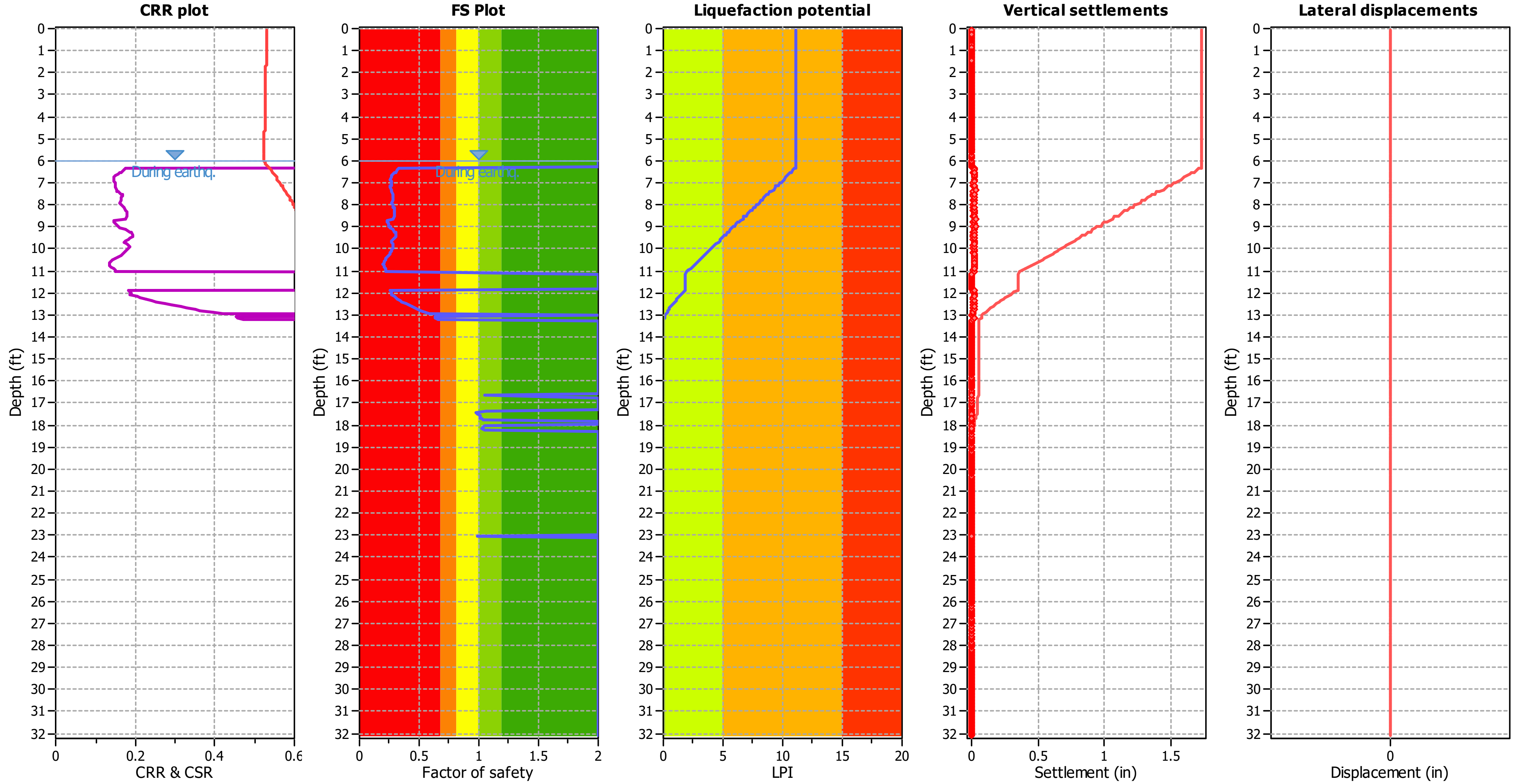
Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	6.00 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	1	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	7.31	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.87	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	22.00 ft	Fill height:	N/A	Limit depth:	N/A

SBT legend

1. Sensitive fine grained
2. Organic material
3. Clay to silty clay
4. Clayey silt to silty
5. Silty sand to sandy silt
6. Clean sand to silty sand
7. Gravely sand to sand
8. Very stiff sand to
9. Very stiff fine grained

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	6.00 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	1	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	7.31	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.87	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	22.00 ft	Fill height:	N/A	Limit depth:	N/A

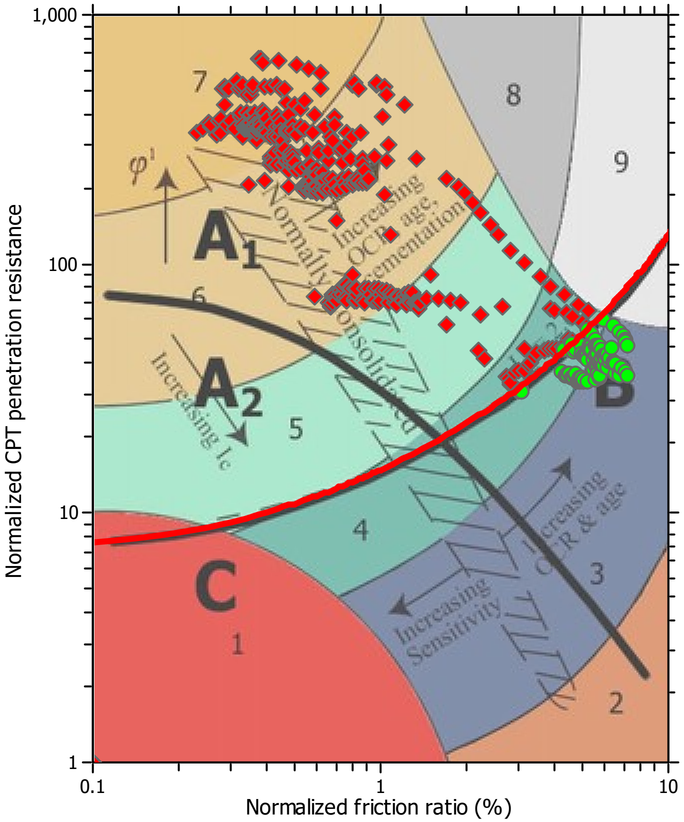
F.S. color scheme

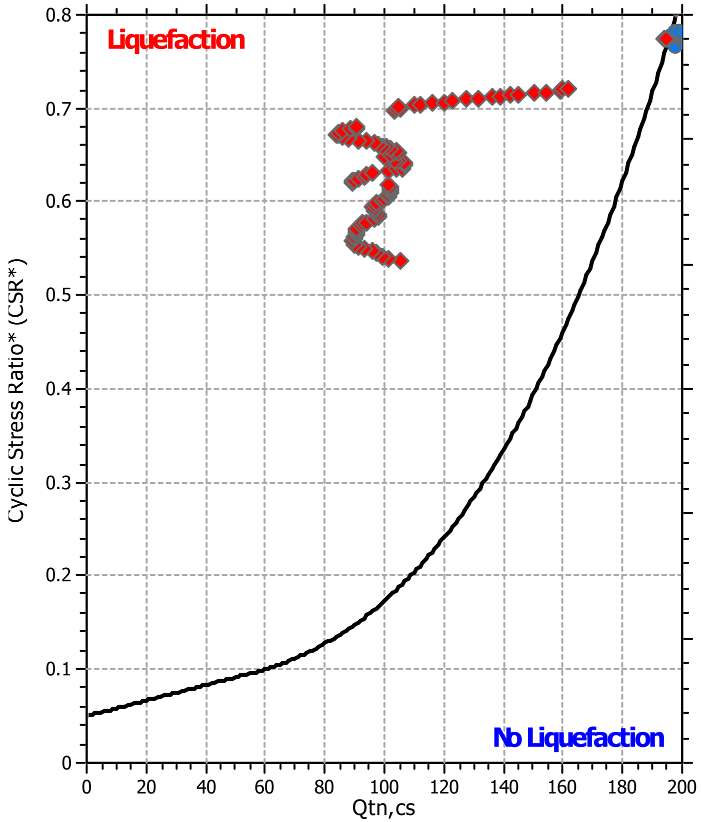
- Almost certain it will liquefy
- Very likely to liquefy
- Liquefaction and no liq. are equally likely
- Unlike to liquefy
- Almost certain it will not liquefy

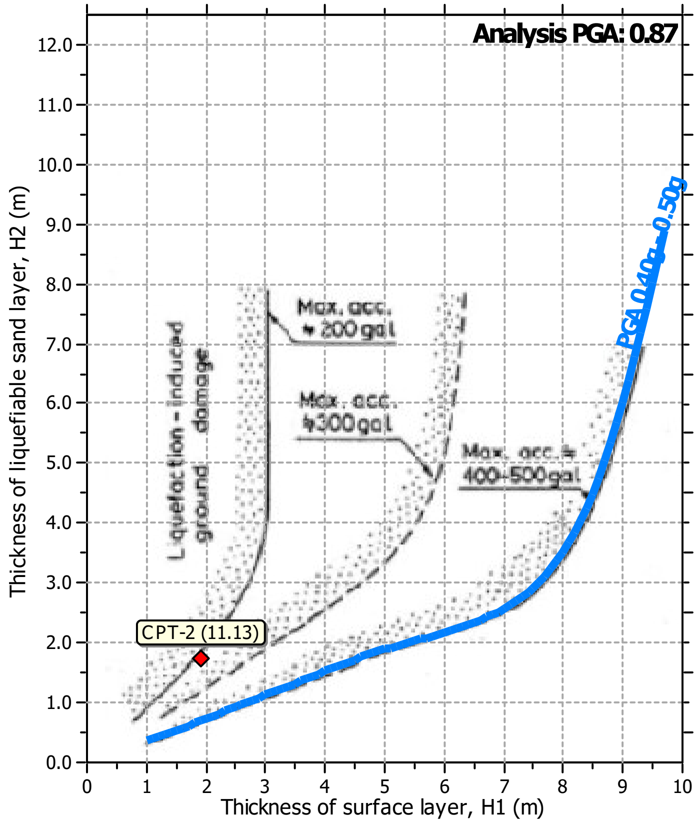
LPI color scheme

- Very high risk
- High risk
- Low risk

Liquefaction analysis summary plots







Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	6.00 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	1	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	7.31	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.87	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	22.00 ft	Fill height:	N/A	Limit depth:	N/A

:: Field input data ::

Point ID	Depth (ft)	q_c (tsf)	f_s (tsf)	u (tsf)	Fines content (%)	Unit weight (pcf)
1	0.07	0.00	0.06	-0.09	N/A	120.90
2	0.14	0.00	0.18	0.00	N/A	120.90
3	0.20	1.38	0.31	0.00	100.00	102.48
4	0.30	56.04	0.45	0.00	10.08	114.24
5	0.34	93.51	0.66	0.00	5.71	118.30
6	0.41	162.25	1.07	0.00	2.55	123.16
7	0.48	208.53	1.21	0.00	1.10	124.70
8	0.54	276.49	1.30	0.00	0.00	125.90
9	0.59	328.98	1.43	0.00	0.00	127.00
10	0.66	398.67	1.56	0.00	0.00	128.13
11	0.73	417.49	1.57	0.00	0.00	128.28
12	0.79	413.35	1.58	0.00	0.00	128.32
13	0.87	406.09	1.80	-0.03	0.00	129.23
14	0.92	394.95	2.02	0.00	0.00	130.01
15	0.99	377.60	2.13	-0.09	0.00	130.27
16	1.06	361.02	2.23	0.00	0.00	130.50
17	1.13	312.67	1.93	0.00	0.11	129.10
18	1.20	279.08	1.52	0.00	0.00	127.09
19	1.26	243.15	1.67	0.00	1.22	127.43
20	1.33	210.52	1.79	0.00	2.65	127.60
21	1.40	186.51	2.00	0.00	4.31	128.09
22	1.47	166.22	2.23	0.00	6.20	128.61
23	1.51	136.77	2.33	0.00	8.98	128.47
24	1.58	127.62	2.39	0.00	10.13	128.46
25	1.65	121.15	2.38	0.00	10.87	128.31
26	1.73	109.58	2.30	0.09	12.13	127.81
27	1.78	100.77	2.25	-0.09	13.33	127.47
28	1.85	90.23	2.17	-0.09	14.86	126.91
29	1.90	81.43	2.09	-0.35	16.39	126.39
30	1.99	70.03	1.97	-0.43	18.75	125.61
31	2.05	62.95	1.98	-0.52	21.02	125.37
32	2.12	55.18	1.97	-1.13	23.94	125.00
33	2.18	50.60	1.97	-1.30	26.09	124.82
34	2.24	47.06	2.03	-1.30	28.30	124.83
35	2.32	43.00	2.10	-1.21	31.27	124.88
36	2.37	40.58	2.14	-1.30	33.20	124.88
37	2.43	37.22	2.21	-1.30	36.27	124.90
38	2.50	34.97	2.25	-1.30	38.52	124.88
39	2.56	33.33	2.26	-1.30	40.17	124.80
40	2.64	32.12	2.26	-1.30	41.34	124.69
41	2.72	30.91	2.21	-1.30	42.22	124.43
42	2.77	30.31	2.17	-1.39	42.54	124.25
43	2.84	29.44	2.12	-1.56	43.13	124.01
44	2.90	28.58	1.80	-1.65	41.27	122.76
45	2.98	27.46	1.44	-1.65	38.74	121.00
46	3.04	26.68	1.50	-1.65	40.38	121.24
47	3.08	26.08	1.54	-1.73	41.57	121.37
48	3.16	25.30	1.57	-1.73	43.00	121.46

:: Field input data :: (continued)

Point ID	Depth (ft)	q_c (tsf)	f_s (tsf)	u (tsf)	Fines content (%)	Unit weight (pcf)
49	3.22	24.78	1.60	-2.44	44.08	121.55
50	3.30	24.61	1.62	-2.44	44.48	121.60
51	3.35	25.04	1.62	-2.44	43.90	121.64
52	3.44	25.65	1.56	-2.86	42.41	121.42
53	3.49	25.73	1.51	-3.21	41.81	121.22
54	3.56	25.65	1.45	-3.46	41.18	120.89
55	3.61	25.65	1.41	-3.55	40.68	120.67
56	3.71	25.99	1.36	-3.55	39.75	120.49
57	3.75	26.34	1.36	-3.73	39.22	120.47
58	3.81	26.68	1.35	-3.73	38.77	120.48
59	3.89	26.77	1.36	-3.73	38.72	120.52
60	3.94	26.94	1.37	-3.73	38.69	120.61
61	4.03	27.29	1.40	-3.64	38.64	120.80
62	4.08	27.37	1.41	-3.64	38.70	120.88
63	4.15	27.89	1.45	-3.64	38.49	121.09
64	4.23	28.49	1.50	-3.81	38.44	121.43
65	4.29	29.19	1.55	-3.90	38.17	121.71
66	4.33	29.44	1.58	-3.90	38.16	121.84
67	4.43	29.36	1.63	-4.07	38.77	122.06
68	4.47	29.10	1.64	-4.16	39.25	122.13
69	4.55	28.49	1.35	-4.24	36.74	120.64
70	4.61	28.06	1.21	-4.24	35.48	119.78
71	4.66	27.54	1.28	-4.24	36.95	120.16
72	4.75	27.37	1.37	-4.24	38.22	120.63
73	4.80	27.11	1.42	-4.24	39.08	120.86
74	4.88	26.68	1.48	-4.68	40.36	121.14
75	4.93	27.07	1.53	-4.68	40.39	121.40
76	5.01	27.03	1.60	-4.68	41.22	121.73
77	5.06	27.03	1.63	-5.11	41.61	121.89
78	5.15	27.03	1.64	-5.11	41.75	121.95
79	5.19	27.03	1.65	-5.11	41.76	121.95
80	5.27	28.24	1.65	-5.11	40.34	122.07
81	5.33	29.27	1.67	-5.11	39.36	122.24
82	5.42	31.09	1.71	-5.11	37.89	122.59
83	5.47	32.64	1.74	-5.11	36.66	122.84
84	5.51	33.93	1.77	-5.11	35.74	123.06
85	5.58	35.06	1.79	-5.02	34.91	123.21
86	5.64	36.53	1.80	-5.02	33.79	123.36
87	5.73	38.51	1.78	-4.94	32.07	123.39
88	5.79	39.81	1.74	-4.94	30.82	123.31
89	5.88	41.02	1.64	-4.94	29.16	122.95
90	5.91	41.53	1.59	-4.94	28.38	122.75
91	5.99	42.74	1.12	-4.94	23.29	120.28
92	6.05	43.95	0.82	-4.94	19.29	118.05
93	6.11	44.99	0.77	-4.85	18.25	117.68
94	6.18	45.59	0.72	-4.85	17.31	117.19
95	6.25	45.76	0.65	-4.76	16.38	116.49
96	6.32	45.16	0.60	-3.45	15.93	115.87

:: Field input data :: (continued)

Point ID	Depth (ft)	q_c (tsf)	f_s (tsf)	u (tsf)	Fines content (%)	Unit weight (pcf)
97	6.37	42.31	0.57	-3.45	16.68	115.29
98	6.44	43.35	0.53	-3.45	15.62	114.82
99	6.53	43.78	0.49	-2.51	14.73	114.20
100	6.57	43.78	0.46	-2.34	14.40	113.88
101	6.63	43.78	0.43	-1.39	13.76	113.26
102	6.71	44.04	0.38	-0.95	12.93	112.51
103	6.77	44.47	0.36	-0.43	12.35	112.08
104	6.84	45.25	0.33	-0.43	11.59	111.56
105	6.92	46.63	0.32	-0.43	10.92	111.38
106	6.97	47.15	0.32	-0.43	10.71	111.35
107	7.02	47.49	0.32	-0.52	10.60	111.36
108	7.11	47.40	0.32	-0.52	10.66	111.40
109	7.16	47.49	0.32	-0.52	10.64	111.41
110	7.22	46.97	0.33	-0.52	11.02	111.64
111	7.33	47.49	0.35	-0.52	11.11	111.95
112	7.38	48.27	0.35	-0.52	11.01	112.11
113	7.42	49.65	0.36	-0.52	10.75	112.30
114	7.52	52.07	0.38	-0.52	10.52	112.90
115	7.56	53.02	0.39	-0.35	10.45	113.14
116	7.61	53.10	0.40	-0.35	10.57	113.29
117	7.69	52.33	0.41	-0.35	10.88	113.34
118	7.76	51.98	0.41	-0.43	11.02	113.33
119	7.82	51.81	0.41	-0.43	11.09	113.32
120	7.91	51.90	0.41	-0.43	11.12	113.32
121	7.96	52.15	0.42	-0.43	11.25	113.54
122	8.01	52.41	0.43	-0.43	11.38	113.78
123	8.09	52.84	0.46	-0.43	11.67	114.23
124	8.15	53.02	0.48	-0.43	11.91	114.55
125	8.22	53.10	0.50	-0.43	12.21	114.87
126	8.27	52.84	0.51	-0.43	12.47	115.05
127	8.33	52.50	0.53	-0.43	12.79	115.24
128	8.41	52.07	0.54	-0.43	13.14	115.42
129	8.50	51.03	0.55	-0.35	13.62	115.49
130	8.54	50.77	0.56	-0.35	13.79	115.54
131	8.65	49.91	0.56	-0.35	14.19	115.56
132	8.72	49.56	0.37	-0.35	11.74	112.54
133	8.77	49.56	0.38	-0.52	11.83	112.63
134	8.81	49.48	0.39	-0.43	12.17	112.99
135	8.87	49.48	0.42	-0.43	12.61	113.47
136	8.96	49.48	0.46	-0.43	13.15	114.04
137	8.99	49.65	0.47	-0.52	13.33	114.29
138	9.06	46.80	0.53	-0.52	15.08	114.95
139	9.13	51.03	0.59	-0.61	14.47	115.94
140	9.21	52.76	0.63	-0.69	14.50	116.55
141	9.27	53.19	0.66	-0.69	14.74	116.91
142	9.36	53.54	0.68	-0.87	14.93	117.17
143	9.41	53.71	0.68	-0.87	14.93	117.19
144	9.46	53.62	0.68	-0.95	14.98	117.17

:: Field input data :: (continued)

Point ID	Depth (ft)	q_c (tsf)	f_s (tsf)	u (tsf)	Fines content (%)	Unit weight (pcf)
145	9.54	53.36	0.66	-0.78	14.86	116.91
146	9.58	52.59	0.64	-0.61	14.89	116.65
147	9.65	51.64	0.61	-0.52	14.90	116.27
148	9.72	50.86	0.60	-0.43	15.11	116.14
149	9.80	50.86	0.64	-0.43	15.64	116.61
150	9.85	50.86	0.67	-0.52	16.04	116.95
151	9.93	50.86	0.69	-0.52	16.34	117.18
152	9.98	50.86	0.69	-0.35	16.27	117.09
153	10.05	50.86	0.66	-0.61	16.05	116.84
154	10.12	51.64	0.63	-0.61	15.45	116.52
155	10.17	54.14	0.60	-0.61	14.35	116.29
156	10.25	56.56	0.56	-0.87	13.17	115.86
157	10.31	57.59	0.52	-0.87	12.50	115.43
158	10.38	57.68	0.47	-0.43	11.84	114.65
159	10.44	57.08	0.43	-0.52	11.48	113.95
160	10.51	55.95	0.39	-0.35	11.21	113.15
161	10.57	54.57	0.37	-0.35	11.33	112.74
162	10.64	53.62	0.36	-0.35	11.41	112.43
163	10.71	53.36	0.35	-0.35	11.48	112.37
164	10.78	54.31	0.36	-0.52	11.31	112.48
165	10.84	55.87	0.37	-0.43	11.06	112.72
166	10.93	58.72	0.39	-0.43	10.82	113.40
167	10.96	60.10	0.41	-0.43	10.72	113.73
168	11.03	60.79	0.41	-0.43	10.65	113.83
169	11.15	59.67	0.35	-0.43	10.07	112.56
170	11.19	58.63	0.47	-0.43	11.99	114.69
171	11.23	56.90	0.56	-0.35	13.66	115.95
172	11.30	52.15	0.70	-0.43	16.82	117.32
173	11.38	44.04	0.73	-0.42	20.53	117.21
174	11.43	34.37	0.74	-0.40	26.18	116.67
175	11.50	31.95	0.72	-0.40	27.82	116.35
176	11.56	26.85	0.71	-0.43	32.28	115.83
177	11.64	23.31	0.70	-0.43	36.18	115.34
178	11.68	23.14	0.70	-0.26	36.36	115.28
179	11.77	23.06	0.70	-0.17	36.57	115.28
180	11.81	23.40	0.70	0.00	36.23	115.34
181	11.91	25.13	0.69	0.26	34.08	115.42
182	11.94	25.65	0.71	0.35	33.92	115.68
183	12.01	27.03	0.74	0.43	32.97	116.08
184	12.08	27.46	0.74	0.61	32.59	116.11
185	12.17	28.75	0.82	0.78	32.79	117.02
186	12.21	29.27	0.86	0.78	32.88	117.38
187	12.28	29.79	0.92	0.78	33.38	117.94
188	12.35	31.09	0.99	0.78	33.23	118.59
189	12.41	32.21	1.04	0.61	32.97	119.05
190	12.48	34.19	1.15	0.61	32.65	119.90
191	12.54	35.58	1.22	0.61	32.43	120.45
192	12.62	36.53	1.32	0.26	32.82	121.08

:: Field input data :: (continued)

Point ID	Depth (ft)	q_c (tsf)	f_s (tsf)	u (tsf)	Fines content (%)	Unit weight (pcf)
193	12.67	36.70	1.37	0.09	33.24	121.36
194	12.75	37.48	1.45	0.09	33.47	121.80
195	12.80	37.22	1.48	0.09	34.10	121.98
196	12.88	37.82	1.59	0.09	34.75	122.55
197	12.93	38.17	1.68	0.26	35.25	122.93
198	13.02	38.94	1.76	0.26	35.47	123.33
199	13.07	40.41	1.80	0.17	34.76	123.59
200	13.16	41.79	1.84	-0.17	34.22	123.84
201	13.20	41.36	1.88	-1.39	34.87	123.96
202	13.26	39.29	1.93	-1.47	36.83	124.02
203	13.33	37.91	2.01	-1.47	38.72	124.26
204	13.42	36.27	2.19	-1.65	41.63	124.77
205	13.47	35.14	2.16	-1.65	42.50	124.59
206	13.52	33.50	2.11	-1.65	43.75	124.29
207	13.61	32.04	2.15	-1.99	45.70	124.31
208	13.65	31.34	2.18	-2.08	46.80	124.36
209	13.74	30.05	2.11	-2.25	47.90	124.05
210	13.79	31.26	2.08	-2.25	46.22	124.01
211	13.86	30.61	2.04	-2.14	46.70	123.81
212	13.92	31.17	2.01	-2.14	45.88	123.75
213	13.98	33.16	2.01	-2.14	43.82	123.91
214	14.05	34.28	2.00	-2.17	42.71	123.97
215	14.11	34.88	2.00	-2.08	42.19	124.01
216	14.19	35.40	2.01	-1.99	41.86	124.08
217	14.25	35.40	2.01	-1.99	41.91	124.07
218	14.31	35.32	1.97	-1.91	41.71	123.92
219	14.39	34.88	1.92	-1.91	41.79	123.70
220	14.45	34.63	1.92	-1.91	42.11	123.69
221	14.52	34.80	1.94	-1.91	42.19	123.77
222	14.57	34.80	1.94	-1.91	42.21	123.76
223	14.64	35.06	1.89	-1.91	41.64	123.60
224	14.70	34.45	1.87	-1.91	42.13	123.49
225	14.78	33.42	1.87	-1.91	43.24	123.41
226	14.86	32.55	1.84	-1.82	43.92	123.21
227	14.90	32.29	1.81	-1.82	44.04	123.10
228	14.97	31.69	1.72	-1.82	43.86	122.67
229	15.03	31.34	1.60	-1.82	43.08	122.10
230	15.10	31.52	1.51	-1.82	42.08	121.72
231	15.18	31.52	1.51	-1.82	42.11	121.70
232	15.24	31.86	1.51	-1.82	41.84	121.74
233	15.31	32.90	1.51	-1.82	40.83	121.81
234	15.36	33.24	1.52	-1.82	40.61	121.87
235	15.44	34.11	1.58	-1.73	40.45	122.21
236	15.49	34.54	1.61	-1.73	40.38	122.38
237	15.57	34.37	1.51	-1.73	39.64	121.91
238	15.63	34.63	1.49	-1.73	39.27	121.85
239	15.71	35.32	1.57	-1.82	39.48	122.25
240	15.75	35.23	1.53	-1.73	39.23	122.07

:: Field input data :: (continued)

Point ID	Depth (ft)	q_c (tsf)	f_s (tsf)	u (tsf)	Fines content (%)	Unit weight (pcf)
241	15.85	34.28	1.65	-1.82	41.39	122.54
242	15.89	34.37	1.68	-1.73	41.69	122.70
243	15.95	33.81	1.69	-1.72	42.35	122.68
244	16.02	33.33	1.64	-1.72	42.50	122.46
245	16.11	33.59	1.65	-1.72	42.42	122.52
246	16.16	33.42	1.66	-1.65	42.73	122.55
247	16.21	33.76	1.64	-1.65	42.20	122.47
248	16.28	35.23	1.60	-1.65	40.45	122.40
249	16.34	37.04	1.55	-1.65	38.40	122.30
250	16.41	46.54	1.43	-1.73	30.48	122.26
251	16.48	63.90	1.39	-1.73	22.19	122.82
252	16.54	92.31	1.37	-1.73	14.63	123.60
253	16.61	135.31	1.45	-1.73	9.08	124.98
254	16.67	194.54	2.00	-1.16	6.47	128.21
255	16.74	268.11	2.78	-1.17	4.82	131.39
256	16.81	278.56	2.66	-1.23	4.20	131.17
257	16.88	275.19	2.36	-0.61	3.71	130.26
258	16.93	262.32	2.26	-0.26	3.95	129.81
259	17.01	268.11	1.96	-0.87	3.09	128.84
260	17.06	236.42	1.82	-1.65	3.91	127.97
261	17.13	232.19	1.72	-1.99	3.84	127.52
262	17.20	231.58	1.53	-2.60	3.33	126.65
263	17.28	229.17	1.44	-3.38	3.19	126.19
264	17.33	227.87	1.41	-3.21	3.14	126.00
265	17.39	211.47	1.34	-3.21	3.63	125.45
266	17.45	205.33	1.29	-3.21	3.76	125.13
267	17.53	207.06	1.24	-3.21	3.52	124.85
268	17.60	208.88	1.19	-3.21	3.27	124.56
269	17.68	209.74	1.14	-3.12	3.09	124.29
270	17.72	210.60	1.14	-3.12	3.06	124.29
271	17.79	211.98	1.15	-3.12	3.05	124.38
272	17.85	214.75	1.15	-3.12	2.94	124.41
273	17.93	215.61	1.17	-2.94	2.98	124.54
274	18.00	214.92	1.19	-2.86	3.08	124.65
275	18.05	214.66	1.21	-2.69	3.15	124.74
276	18.13	213.88	1.23	-2.08	3.27	124.87
277	18.18	214.14	1.30	-1.73	3.51	125.29
278	18.26	216.47	1.44	-1.21	3.86	126.05
279	18.31	218.98	1.35	-0.87	3.48	125.62
280	18.40	227.27	1.35	-0.43	3.14	125.69
281	18.45	233.74	1.49	0.09	3.32	126.50
282	18.53	252.05	1.57	0.52	2.88	127.07
283	18.58	268.97	1.49	0.87	2.12	126.83
284	18.64	297.99	1.47	0.95	1.31	127.00
285	18.72	310.42	1.40	0.95	0.86	126.73
286	18.77	306.97	1.32	1.04	0.75	126.25
287	18.84	289.44	1.20	1.56	0.87	125.40
288	18.93	256.19	1.49	1.91	2.58	126.73

:: Field input data :: (continued)

Point ID	Depth (ft)	q_c (tsf)	f_s (tsf)	u (tsf)	Fines content (%)	Unit weight (pcf)
289	18.97	259.47	1.51	1.91	2.53	126.86
290	19.05	263.79	1.35	1.91	1.97	126.06
291	19.11	263.79	1.34	2.17	1.96	126.03
292	19.19	271.74	1.37	2.17	1.80	126.22
293	19.23	268.20	1.41	2.17	2.03	126.44
294	19.30	262.67	1.52	1.99	2.50	126.94
295	19.37	262.84	1.56	1.91	2.59	127.11
296	19.44	256.54	1.50	2.08	2.66	126.79
297	19.51	251.01	1.43	2.51	2.65	126.35
298	19.57	241.34	1.40	2.60	2.90	126.09
299	19.64	232.10	1.34	2.42	3.09	125.70
300	19.70	231.41	1.25	2.34	2.85	125.19
301	19.77	231.41	1.24	2.25	2.84	125.14
302	19.82	230.72	1.10	1.73	2.40	124.22
303	19.90	237.89	0.82	1.47	1.26	122.21
304	19.95	246.35	0.96	1.30	1.48	123.44
305	20.03	269.84	1.28	0.78	1.72	125.73
306	20.09	285.21	1.30	0.52	1.37	126.00
307	20.16	287.36	1.39	0.43	1.54	126.49
308	20.22	296.52	1.40	0.09	1.35	126.64
309	20.31	298.07	1.45	0.09	1.43	126.89
310	20.36	300.58	1.46	0.09	1.40	126.97
311	20.41	304.12	1.51	-0.09	1.42	127.21
312	20.49	293.84	1.48	-1.39	1.62	127.00
313	20.54	291.94	1.38	-1.65	1.44	126.47
314	20.61	291.60	1.27	-1.91	1.19	125.88
315	20.67	291.77	1.21	-2.34	1.04	125.51
316	20.74	293.24	1.24	-2.51	1.07	125.68
317	20.80	297.64	1.23	-2.86	0.96	125.68
318	20.89	308.69	1.29	-3.21	0.86	126.10
319	20.94	314.22	1.30	-3.38	0.77	126.20
320	21.01	328.47	1.49	-3.64	0.90	127.33
321	21.07	339.95	2.05	-3.73	1.77	129.75
322	21.15	367.15	2.49	-3.90	1.95	131.35
323	21.20	393.31	3.01	-3.90	2.20	132.90
324	21.26	452.98	4.60	-3.98	3.01	136.35
325	21.34	508.33	6.18	-4.07	3.56	137.28
326	21.39	563.85	5.89	-4.00	2.42	137.28
327	21.47	602.53	6.20	-4.12	2.14	137.28
328	21.53	626.62	6.05	-4.24	1.73	137.28
329	21.59	623.08	6.01	-4.33	1.75	137.28
330	21.67	630.86	5.14	-4.33	0.99	137.28
331	21.73	616.69	4.94	-4.33	0.99	137.28
332	21.79	598.30	5.02	-4.42	1.27	137.28
333	21.87	518.43	2.59	-4.59	0.00	132.48
334	21.92	502.11	2.64	-4.59	0.06	132.53
335	21.99	475.34	2.78	-4.85	0.58	132.79
336	22.05	426.47	2.71	-4.82	1.23	132.34

:: Field input data :: (continued)

Point ID	Depth (ft)	q_c (tsf)	f_s (tsf)	u (tsf)	Fines content (%)	Unit weight (pcf)
337	22.14	385.20	2.56	-4.82	1.78	131.68
338	22.19	318.80	2.49	-4.78	3.25	131.02
339	22.25	284.69	2.50	-4.77	4.36	130.77
340	22.32	266.30	2.41	-4.72	4.85	130.33
341	22.38	261.63	2.35	-4.72	4.92	130.12
342	22.45	256.97	2.30	-4.72	4.99	129.90
343	22.52	256.88	2.21	-4.72	4.78	129.60
344	22.60	253.17	1.75	-4.68	3.78	127.84
345	22.65	253.43	1.45	-4.68	2.96	126.47
346	22.73	250.84	1.42	-4.68	2.99	126.33
347	22.79	248.51	1.45	-4.59	3.15	126.43
348	22.84	247.39	1.48	-4.82	3.28	126.57
349	22.91	246.26	1.53	-4.97	3.47	126.80
350	22.98	245.36	1.59	-4.97	3.67	127.07
351	23.04	240.31	1.68	-4.97	4.13	127.43
352	23.10	244.45	1.77	-5.20	4.22	127.86
353	23.18	249.03	1.89	-5.28	4.35	128.38
354	23.25	253.69	2.00	-5.28	4.46	128.86
355	23.32	257.49	2.09	-5.28	4.53	129.21
356	23.36	259.99	2.15	-5.28	4.58	129.44
357	23.43	264.31	2.19	-5.28	4.51	129.62
358	23.50	265.26	2.21	-5.28	4.53	129.70
359	23.58	266.21	2.18	-5.28	4.40	129.58
360	23.66	263.88	2.13	-5.28	4.38	129.39
361	23.69	260.86	2.10	-5.28	4.43	129.25
362	23.77	258.01	2.01	-5.28	4.34	128.92
363	23.83	259.73	1.94	-5.28	4.10	128.68
364	23.90	271.82	1.84	-5.28	3.43	128.42
365	23.98	293.24	1.75	-5.28	2.55	128.23
366	24.03	309.04	1.74	-5.28	2.10	128.32
367	24.11	342.80	1.65	-5.28	1.13	128.17
368	24.16	358.26	1.64	-5.28	0.81	128.25
369	24.23	385.02	1.74	-5.28	0.51	128.84
370	24.30	402.21	2.04	-5.28	0.73	130.10
371	24.38	418.87	1.89	-5.20	0.23	129.65
372	24.41	429.06	1.69	-5.20	0.00	128.88
373	24.48	446.16	1.15	-5.20	0.00	126.18
374	24.56	455.92	1.15	-5.20	0.00	126.22
375	24.62	462.31	1.27	-5.20	0.00	126.99
376	24.68	472.15	1.30	-5.20	0.00	127.22
377	24.75	461.36	1.40	-5.17	0.00	127.67
378	24.81	433.98	1.47	-5.17	0.00	127.88
379	24.88	437.52	1.46	-5.17	0.00	127.88
380	24.95	437.09	1.49	-5.20	0.00	128.03
381	25.01	438.04	1.55	-5.10	0.00	128.31
382	25.08	440.03	1.59	-5.11	0.00	128.51
383	25.15	442.62	1.58	-5.02	0.00	128.50
384	25.22	435.54	1.62	-5.02	0.00	128.60

:: Field input data :: (continued)

Point ID	Depth (ft)	q_c (tsf)	f_s (tsf)	u (tsf)	Fines content (%)	Unit weight (pcf)
385	25.27	431.22	1.62	-5.02	0.00	128.59
386	25.34	427.85	1.55	-4.94	0.00	128.27
387	25.40	428.46	1.54	-4.94	0.00	128.22
388	25.48	432.08	1.53	-4.94	0.00	128.19
389	25.53	435.54	1.52	-4.94	0.00	128.14
390	25.60	433.21	1.58	-4.85	0.00	128.42
391	25.67	433.38	1.53	-4.85	0.00	128.19
392	25.73	436.75	1.57	-4.85	0.00	128.40
393	25.80	439.94	1.68	-4.85	0.00	128.90
394	25.86	442.36	1.92	-4.85	0.00	129.89
395	25.94	449.53	2.20	-4.85	0.32	130.94
396	26.00	449.27	2.36	-4.76	0.55	131.46
397	26.07	449.27	2.00	-4.76	0.04	130.23
398	26.12	449.01	1.61	-4.59	0.00	128.65
399	26.21	452.81	1.64	-4.59	0.00	128.82
400	26.25	455.05	1.69	-4.59	0.00	129.05
401	26.34	421.29	1.79	-4.50	0.11	129.26
402	26.39	411.36	1.82	-4.46	0.30	129.31
403	26.46	411.79	1.76	-4.46	0.21	129.09
404	26.52	411.79	1.69	-4.46	0.11	128.81
405	26.60	412.22	1.70	-4.33	0.11	128.85
406	26.65	425.26	1.70	-4.33	0.00	128.90
407	26.71	436.75	1.72	-4.33	0.00	129.06
408	26.78	444.26	1.77	-4.24	0.00	129.32
409	26.86	452.55	1.70	-4.24	0.00	129.07
410	26.91	457.73	1.74	-4.24	0.00	129.27
411	26.97	459.11	1.89	-4.24	0.00	129.89
412	27.04	467.57	2.08	-4.24	0.00	130.64
413	27.14	482.08	1.94	-4.16	0.00	130.20
414	27.17	482.51	1.93	-4.16	0.00	130.17
415	27.25	477.59	1.91	-4.16	0.00	130.07
416	27.31	472.41	1.80	-4.07	0.00	129.59
417	27.36	450.99	1.72	-4.16	0.00	129.16
418	27.44	449.61	1.61	-4.16	0.00	128.65
419	27.50	451.04	1.60	-4.16	0.00	128.64
420	27.59	451.77	1.60	-4.16	0.00	128.62
421	27.63	451.08	1.65	-4.16	0.00	128.82
422	27.69	447.89	1.68	-4.07	0.00	128.95
423	27.77	447.80	1.63	-4.07	0.00	128.71
424	27.85	445.64	1.53	-4.07	0.00	128.24
425	27.91	449.35	1.52	-4.07	0.00	128.23
426	27.95	449.44	1.38	-4.07	0.00	127.54
427	28.02	449.61	1.09	-3.98	0.00	125.77
428	28.10	452.98	1.16	-3.98	0.00	126.27
429	28.17	462.82	1.34	-3.90	0.00	127.38
430	28.22	468.87	1.54	-3.90	0.00	128.45
431	28.28	482.86	1.75	-4.03	0.00	129.42
432	28.36	470.94	1.67	-4.03	0.00	129.04

:: Field input data :: (continued)

Point ID	Depth (ft)	q_c (tsf)	f_s (tsf)	u (tsf)	Fines content (%)	Unit weight (pcf)
433	28.42	503.23	1.64	-4.03	0.00	129.05
434	28.50	517.22	1.78	-4.16	0.00	129.71
435	28.55	515.84	1.81	-4.07	0.00	129.83
436	28.61	521.45	1.70	-4.16	0.00	129.42
437	28.69	518.95	1.87	-4.16	0.00	130.12
438	28.76	528.79	2.04	-3.98	0.00	130.78
439	28.81	527.07	2.08	-3.98	0.00	130.93
440	28.87	512.56	2.21	-3.98	0.00	131.30
441	28.94	493.82	2.19	-3.96	0.00	131.13
442	29.01	476.73	2.14	-3.96	0.00	130.87
443	29.08	457.82	2.41	-3.94	0.60	131.65
444	29.14	456.43	2.46	-3.94	0.69	131.79
445	29.21	446.07	2.18	-3.94	0.46	130.86
446	29.27	451.25	2.11	-3.90	0.28	130.63
447	29.34	449.09	2.13	-3.90	0.35	130.71
448	29.41	446.42	2.10	-3.90	0.34	130.57
449	29.48	440.81	2.06	-3.73	0.37	130.42
450	29.53	435.71	2.04	-3.73	0.41	130.30
451	29.61	435.71	1.61	-3.81	0.00	128.59
452	29.66	436.49	1.21	-3.81	0.00	126.48
453	29.73	436.49	1.00	-3.81	0.00	125.13
454	29.81	430.70	1.16	-3.81	0.00	126.18
455	29.88	424.31	1.39	-3.81	0.00	127.46
456	29.93	410.06	1.51	-3.75	0.00	127.95
457	30.00	299.89	1.79	-3.75	2.76	128.45
458	30.07	372.94	2.04	-3.75	1.50	129.93
459	30.13	369.65	2.23	-3.70	1.90	130.56
460	30.20	372.50	2.45	-3.64	2.22	131.27
461	30.27	372.07	2.71	-3.64	2.66	131.99
462	30.32	384.33	2.82	-3.55	2.56	132.36
463	30.40	402.55	3.09	-3.55	2.57	133.14
464	30.45	425.95	3.41	-3.55	2.55	134.02
465	30.53	479.32	3.32	-3.55	1.50	134.11
466	30.58	521.80	2.48	-3.55	0.00	132.17
467	30.64	572.14	1.65	-3.55	0.00	129.40
468	30.71	634.66	2.23	-3.46	0.00	131.87
469	30.80	672.39	2.20	-3.38	0.00	131.91
470	30.84	688.10	2.48	-3.48	0.00	132.84
471	30.92	671.70	3.10	-3.48	0.00	134.43
472	30.98	668.42	2.98	-3.50	0.00	134.14
473	31.07	668.85	1.90	-3.56	0.00	130.82
474	31.11	669.28	1.98	-3.63	0.00	131.13
475	31.18	674.12	2.17	-3.63	0.00	131.81
476	31.24	690.26	2.30	-3.73	0.00	132.30
477	31.32	724.89	2.28	-3.72	0.00	132.37
478	31.37	671.78	2.39	-3.71	0.00	132.53
479	31.44	680.33	2.83	-3.71	0.00	133.80
480	31.50	684.56	2.72	-3.71	0.00	133.52

:: Field input data :: (continued)

Point ID	Depth (ft)	q_c (tsf)	f_s (tsf)	u (tsf)	Fines content (%)	Unit weight (pcf)
481	31.56	666.43	1.93	-3.66	0.00	130.93
482	31.65	682.92	1.95	-3.66	0.00	131.06
483	31.70	636.38	2.19	-3.66	0.00	131.75
484	31.79	681.28	0.00	-3.64	N/A	87.36
485	31.83	688.71	0.00	-3.55	N/A	87.36
486	31.89	658.06	0.00	-3.64	N/A	87.36
487	31.96	731.02	0.00	-3.55	N/A	87.36
488	32.03	796.30	0.00	-3.46	N/A	87.36
489	32.09	852.34	0.00	-3.29	N/A	87.36

Abbreviations

Depth: Depth from free surface, at which CPT was performed (ft)
q_c: Measured cone resistance (tsf)
f_s: Sleeve friction resistance (tsf)
u: Pore pressure (tsf)
Fines content: Percentage of fines in soil (%)
Unit weight: Bulk soil unit weight (pcf)

:: Post-earthquake settlement of dry sands ::

Depth (ft)	Ic	Q_{tn}	Kc	$Q_{tn,cs}$	$N_{1,60}$ (blows)	G_{max} (tsf)	CSR	Shear, γ (%)	$e_{vol(15)}$ (%)	N_c	e_v (%)	Settle. (in)
0.07	-1.00	-1.00	1.00	-1.00	0	0	0.53	0.000	0.00	0.00	0.00	0.000
0.14	-1.00	-1.00	1.00	-1.00	0	0	0.53	0.000	0.00	0.00	0.00	0.000
0.20	4.05	2.20	26.38	58.00	0	0	0.53	0.000	0.00	0.00	0.00	0.000
0.30	1.89	90.01	1.18	105.93	21	550	0.53	0.002	0.00	13.43	0.00	0.000
0.34	1.68	150.21	1.02	153.63	28	704	0.53	0.002	0.00	13.43	0.00	0.000
0.41	1.48	260.64	1.00	260.64	45	950	0.53	0.002	0.00	13.43	0.00	0.000
0.48	1.36	334.99	1.00	334.99	56	1056	0.53	0.002	0.00	13.43	0.00	0.000
0.54	1.21	444.17	1.00	444.17	71	1156	0.53	0.002	0.00	13.43	0.00	0.000
0.59	1.14	528.50	1.00	528.50	83	1249	0.53	0.002	0.00	13.43	0.00	0.000
0.66	1.05	640.46	1.00	640.46	98	1354	0.53	0.002	0.00	13.43	0.00	0.000
0.73	1.02	670.69	1.00	670.69	101	1371	0.53	0.002	0.00	13.43	0.00	0.000
0.79	1.03	664.03	1.00	664.03	101	1374	0.53	0.002	0.00	13.43	0.00	0.000
0.87	1.09	652.35	1.00	652.35	100	1448	0.53	0.002	0.00	13.43	0.00	0.000
0.92	1.14	634.45	1.00	634.45	99	1514	0.53	0.002	0.00	13.43	0.00	0.000
0.99	1.19	606.57	1.00	606.57	96	1533	0.53	0.003	0.00	13.43	0.00	0.000
1.06	1.23	579.92	1.00	579.92	93	1548	0.53	0.003	0.00	13.43	0.00	0.000
1.13	1.27	502.24	1.00	502.24	82	1405	0.53	0.003	0.00	13.43	0.00	0.000
1.20	1.26	448.26	1.00	448.26	73	1237	0.53	0.004	0.00	13.43	0.00	0.000
1.26	1.37	390.53	1.00	390.53	66	1247	0.53	0.004	0.00	13.43	0.00	0.000
1.33	1.49	338.10	1.00	338.10	59	1244	0.53	0.005	0.00	13.43	0.00	0.000
1.40	1.60	299.51	1.00	299.51	54	1268	0.53	0.005	0.00	13.43	0.00	0.000
1.47	1.70	266.91	1.04	277.83	52	1294	0.53	0.005	0.00	13.43	0.00	0.000
1.51	1.84	219.59	1.14	249.53	0	0	0.53	0.000	0.00	13.43	0.00	0.000
1.58	1.89	204.88	1.18	241.49	0	0	0.53	0.000	0.00	13.43	0.00	0.000
1.65	1.92	194.48	1.21	234.94	0	0	0.53	0.000	0.00	13.43	0.00	0.000
1.73	1.97	175.88	1.26	221.92	0	0	0.53	0.000	0.00	13.43	0.00	0.000
1.78	2.01	161.72	1.32	213.25	0	0	0.53	0.000	0.00	13.43	0.00	0.000
1.85	2.07	144.78	1.40	202.67	0	0	0.53	0.000	0.00	13.43	0.00	0.000
1.90	2.12	130.63	1.49	194.65	0	0	0.53	0.000	0.00	13.43	0.00	0.000
1.99	2.19	112.30	1.65	185.17	0	0	0.53	0.000	0.00	13.43	0.00	0.000
2.05	2.26	100.92	1.82	184.00	0	0	0.53	0.000	0.00	13.43	0.00	0.000
2.12	2.34	88.42	2.07	183.46	0	0	0.53	0.000	0.00	13.43	0.00	0.000
2.18	2.39	81.05	2.28	184.86	0	0	0.53	0.000	0.00	13.43	0.00	0.000
2.24	2.45	75.36	2.51	188.95	0	0	0.53	0.000	0.00	13.43	0.00	0.000
2.32	2.51	68.83	2.83	195.12	0	0	0.53	0.000	0.00	13.43	0.00	0.000
2.37	2.56	64.93	3.06	198.85	0	0	0.53	0.000	0.00	13.43	0.00	0.000
2.43	2.62	59.53	3.44	204.92	0	0	0.53	0.000	0.00	0.00	0.00	0.000
2.50	2.66	55.91	3.73	208.80	0	0	0.53	0.000	0.00	0.00	0.00	0.000
2.56	2.69	53.27	3.96	210.77	0	0	0.53	0.000	0.00	0.00	0.00	0.000
2.64	2.72	51.31	4.12	211.32	0	0	0.53	0.000	0.00	0.00	0.00	0.000
2.72	2.73	49.36	4.24	209.32	0	0	0.53	0.000	0.00	0.00	0.00	0.000
2.77	2.74	48.39	4.29	207.43	0	0	0.53	0.000	0.00	0.00	0.00	0.000
2.84	2.75	46.98	4.37	205.27	0	0	0.53	0.000	0.00	0.00	0.00	0.000
2.90	2.72	45.59	4.11	187.30	0	0	0.53	0.000	0.00	0.00	0.00	0.000
2.98	2.67	43.79	3.77	164.86	0	0	0.53	0.000	0.00	0.00	0.00	0.000
3.04	2.70	42.53	3.99	169.52	0	0	0.53	0.000	0.00	0.00	0.00	0.000
3.08	2.72	41.56	4.15	172.45	0	0	0.53	0.000	0.00	0.00	0.00	0.000
3.16	2.75	40.30	4.35	175.31	0	0	0.53	0.000	0.00	0.00	0.00	0.000

:: Post-earthquake settlement of dry sands :: (continued)

Depth (ft)	Ic	Q_{tn}	Kc	$Q_{tn,cs}$	$N_{1,60}$ (blows)	G_{max} (tsf)	CSR	Shear, γ (%)	$e_{vol(15)}$ (%)	N_c	e_v (%)	Settle. (in)
3.22	2.77	39.44	4.51	177.72	0	0	0.53	0.000	0.00	0.00	0.00	0.000
3.30	2.77	39.16	4.56	178.72	0	0	0.53	0.000	0.00	0.00	0.00	0.000
3.35	2.76	39.85	4.48	178.47	0	0	0.53	0.000	0.00	0.00	0.00	0.000
3.44	2.74	40.81	4.27	174.18	0	0	0.53	0.000	0.00	0.00	0.00	0.000
3.49	2.73	40.93	4.18	171.22	0	0	0.53	0.000	0.00	0.00	0.00	0.000
3.56	2.71	40.79	4.10	167.04	0	0	0.53	0.000	0.00	0.00	0.00	0.000
3.61	2.70	40.78	4.03	164.25	0	0	0.53	0.000	0.00	0.00	0.00	0.000
3.71	2.69	41.32	3.90	161.16	0	0	0.53	0.000	0.00	0.00	0.00	0.000
3.75	2.68	41.87	3.83	160.32	0	0	0.53	0.000	0.00	0.00	0.00	0.000
3.81	2.67	42.41	3.77	159.83	0	0	0.53	0.000	0.00	0.00	0.00	0.000
3.89	2.67	42.55	3.76	160.08	0	0	0.53	0.000	0.00	0.00	0.00	0.000
3.94	2.67	42.82	3.76	160.88	0	0	0.53	0.000	0.00	0.00	0.00	0.000
4.03	2.67	43.37	3.75	162.67	0	0	0.53	0.000	0.00	0.00	0.00	0.000
4.08	2.67	43.50	3.76	163.52	0	0	0.53	0.000	0.00	0.00	0.00	0.000
4.15	2.66	44.32	3.73	165.37	0	0	0.53	0.000	0.00	0.00	0.00	0.000
4.23	2.66	45.28	3.72	168.63	0	0	0.53	0.000	0.00	0.00	0.00	0.000
4.29	2.66	46.39	3.69	171.13	0	0	0.53	0.000	0.00	0.00	0.00	0.000
4.33	2.66	46.79	3.69	172.55	0	0	0.53	0.000	0.00	0.00	0.00	0.000
4.43	2.67	46.65	3.77	175.79	0	0	0.53	0.000	0.00	0.00	0.00	0.000
4.47	2.68	46.23	3.83	177.17	0	0	0.53	0.000	0.00	0.00	0.00	0.000
4.55	2.63	45.24	3.50	158.44	0	0	0.53	0.000	0.00	0.00	0.00	0.000
4.61	2.60	44.54	3.34	148.84	0	0	0.53	0.000	0.00	0.00	0.00	0.000
4.66	2.63	43.70	3.53	154.24	0	0	0.52	0.000	0.00	0.00	0.00	0.000
4.75	2.66	43.42	3.70	160.44	0	0	0.52	0.000	0.00	0.00	0.00	0.000
4.80	2.67	43.00	3.81	163.83	0	0	0.52	0.000	0.00	0.00	0.00	0.000
4.88	2.70	42.29	3.98	168.42	0	0	0.52	0.000	0.00	0.00	0.00	0.000
4.93	2.70	42.91	3.99	171.09	0	0	0.52	0.000	0.00	0.00	0.00	0.000
5.01	2.71	42.84	4.10	175.72	0	0	0.52	0.000	0.00	0.00	0.00	0.000
5.06	2.72	42.82	4.16	177.97	0	0	0.52	0.000	0.00	0.00	0.00	0.000
5.15	2.72	42.82	4.18	178.76	0	0	0.52	0.000	0.00	0.00	0.00	0.000
5.19	2.72	42.81	4.18	178.82	0	0	0.52	0.000	0.00	0.00	0.00	0.000
5.27	2.70	44.75	3.98	178.15	0	0	0.52	0.000	0.00	0.00	0.00	0.000
5.33	2.68	46.40	3.85	178.50	0	0	0.52	0.000	0.00	0.00	0.00	0.000
5.42	2.65	49.31	3.65	180.08	0	0	0.52	0.000	0.00	0.00	0.00	0.000
5.47	2.63	51.80	3.49	180.87	0	0	0.52	0.000	0.00	0.00	0.00	0.000
5.51	2.61	53.87	3.37	181.76	0	0	0.52	0.000	0.00	0.00	0.00	0.000
5.58	2.59	55.68	3.27	182.09	0	0	0.52	0.000	0.00	13.43	0.00	0.000
5.64	2.57	58.03	3.13	181.81	0	0	0.52	0.000	0.00	13.43	0.00	0.000
5.73	2.53	61.21	2.93	179.23	0	0	0.52	0.000	0.00	13.43	0.00	0.000
5.79	2.50	63.29	2.78	176.18	0	0	0.52	0.000	0.00	13.43	0.00	0.000
5.88	2.47	65.22	2.60	169.56	0	0	0.52	0.000	0.00	13.43	0.00	0.000
5.91	2.45	66.04	2.52	166.16	0	0	0.52	0.000	0.00	13.43	0.00	0.000
5.99	2.32	67.98	2.02	137.06	0	0	0.52	0.000	0.00	13.43	0.00	0.000

:: Post-earthquake settlement of dry sands :: (continued)

Depth (ft)	Ic	Q_{tn}	Kc	$Q_{tn,cs}$	$N_{1,60}$ (blows)	G_{max} (tsf)	CSR	Shear, γ (%)	$e_{vol(15)}$ (%)	N_c	e_v (%)	Settle. (in)

Total estimated settlement: 0.00

Abbreviations

- Q_{tn}: Equivalent clean sand normalized cone resistance
- K_c: Fines correction factor
- $Q_{tn,cs}$: Post-liquefaction volumentric strain
- G_{max}: Small strain shear modulus
- CSR: Soil cyclic stress ratio
- γ: Cyclic shear strain
- $e_{vol(15)}$: Volumetric strain after 15 cycles
- N_c: Equivalent number of cycles
- e_v: Volumetric strain
- Settle.: Calculated settlement

:: Post-earthquake settlement due to soil liquefaction ::

Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)	Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)
6.05	118.03	2.00	0.00	1.00	0.00	6.11	115.48	2.00	0.00	1.00	0.00
6.18	112.38	2.00	0.00	1.00	0.00	6.25	108.45	2.00	0.00	1.00	0.00
6.32	105.06	0.35	2.24	1.00	0.02	6.37	101.49	0.33	2.31	1.00	0.01
6.44	99.50	0.32	2.35	1.00	0.02	6.53	96.99	0.30	2.40	1.00	0.03
6.57	95.70	0.30	2.42	1.00	0.01	6.63	93.39	0.28	2.47	1.00	0.02
6.71	91.03	0.27	2.52	1.00	0.02	6.77	90.02	0.27	2.55	1.00	0.02
6.84	89.15	0.26	2.57	1.00	0.02	6.92	89.80	0.26	2.55	1.00	0.03
6.97	90.17	0.26	2.54	1.00	0.01	7.02	90.49	0.26	2.54	1.00	0.02
7.11	90.50	0.26	2.54	1.00	0.03	7.16	90.59	0.26	2.53	1.00	0.01
7.22	90.73	0.26	2.53	1.00	0.02	7.33	91.77	0.26	2.51	1.00	0.03
7.38	92.48	0.27	2.49	1.00	0.02	7.42	93.70	0.27	2.46	1.00	0.01
7.52	96.60	0.28	2.40	1.00	0.03	7.56	97.78	0.29	2.38	1.00	0.01
7.61	98.06	0.29	2.37	1.00	0.02	7.69	97.43	0.28	2.39	1.00	0.02
7.76	96.87	0.28	2.40	1.00	0.02	7.82	96.51	0.28	2.41	1.00	0.02
7.91	96.17	0.27	2.41	1.00	0.03	7.96	96.82	0.28	2.40	1.00	0.01
8.01	97.59	0.28	2.38	1.00	0.01	8.09	99.10	0.28	2.35	1.00	0.02
8.15	100.13	0.29	2.33	1.00	0.02	8.22	101.14	0.29	2.32	1.00	0.02
8.27	101.54	0.29	2.31	1.00	0.01	8.33	101.93	0.29	2.30	1.00	0.02
8.41	102.22	0.29	2.29	1.00	0.02	8.50	101.83	0.29	2.30	1.00	0.03
8.54	101.81	0.29	2.30	1.00	0.01	8.65	101.23	0.29	2.31	1.00	0.03
8.72	89.01	0.23	2.57	1.00	0.02	8.77	89.12	0.23	2.57	1.00	0.01
8.81	90.09	0.24	2.55	1.00	0.01	8.87	91.57	0.24	2.51	1.00	0.02
8.96	93.31	0.25	2.47	1.00	0.03	8.99	94.22	0.25	2.45	1.00	0.01
9.06	96.14	0.26	2.41	1.00	0.02	9.13	101.29	0.28	2.31	1.00	0.02
9.21	104.32	0.29	2.26	1.00	0.02	9.27	105.98	0.30	2.23	1.00	0.01
9.36	107.04	0.30	2.21	1.00	0.02	9.41	106.99	0.30	2.21	1.00	0.01
9.46	106.64	0.30	2.22	1.00	0.01	9.54	104.95	0.29	2.25	1.00	0.02
9.58	103.28	0.28	2.28	1.00	0.01	9.65	101.01	0.27	2.32	1.00	0.02
9.72	99.97	0.27	2.34	1.00	0.02	9.80	102.00	0.27	2.30	1.00	0.02
9.85	103.65	0.28	2.27	1.00	0.01	9.93	104.59	0.29	2.25	1.00	0.02
9.98	103.88	0.28	2.26	1.00	0.01	10.05	102.28	0.27	2.29	1.00	0.02
10.12	100.43	0.26	2.33	1.00	0.02	10.17	99.66	0.26	2.34	1.00	0.01
10.25	98.23	0.25	2.37	1.00	0.02	10.31	96.73	0.25	2.40	1.00	0.02
10.38	93.78	0.24	2.46	1.00	0.02	10.44	91.04	0.23	2.52	1.00	0.02
10.51	87.86	0.21	2.60	1.00	0.02	10.57	85.80	0.21	2.65	1.00	0.02

:: Post-earthquake settlement due to soil liquefaction :: (continued)

Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)	Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)
10.64	84.24	0.20	2.69	1.00	0.02	10.71	83.77	0.20	2.70	1.00	0.02
10.78	84.36	0.20	2.69	1.00	0.02	10.84	85.63	0.20	2.65	1.00	0.02
10.93	88.75	0.21	2.58	1.00	0.03	10.96	90.29	0.22	2.54	1.00	0.01
11.03	90.74	0.22	2.53	1.00	0.02	11.15	86.45	2.00	0.00	1.00	0.00
11.19	91.70	2.00	0.00	1.00	0.00	11.23	95.45	2.00	0.00	1.00	0.00
11.30	100.77	2.00	0.00	1.00	0.00	11.38	101.17	2.00	0.00	1.00	0.00
11.43	103.13	2.00	0.00	1.00	0.00	11.50	102.90	2.00	0.00	1.00	0.00
11.56	104.82	2.00	0.00	1.00	0.00	11.64	106.05	2.00	0.00	1.00	0.00
11.68	105.73	2.00	0.00	1.00	0.00	11.77	105.55	2.00	0.00	1.00	0.00
11.81	105.38	2.00	0.00	1.00	0.00	11.91	103.14	0.26	2.28	1.00	0.03
11.94	104.34	0.27	2.26	1.00	0.01	12.01	105.29	0.27	2.24	1.00	0.02
12.08	104.81	0.27	2.25	1.00	0.02	12.17	110.05	0.29	2.16	1.00	0.03
12.21	112.19	0.30	2.13	1.00	0.01	12.28	116.16	0.32	2.07	1.00	0.02
12.35	119.96	0.34	2.01	1.00	0.02	12.41	122.50	0.35	1.98	1.00	0.01
12.48	127.81	0.39	1.91	1.00	0.02	12.54	131.38	0.41	1.87	1.00	0.01
12.62	136.38	0.44	1.81	1.00	0.02	12.67	139.01	0.46	1.78	1.00	0.01
12.75	142.62	0.49	1.75	1.00	0.02	12.80	144.82	0.51	1.72	1.00	0.01
12.88	150.33	0.55	1.68	1.00	0.02	12.93	154.27	0.59	1.62	1.00	0.01
13.02	157.82	2.00	0.00	1.00	0.00	13.07	158.75	0.63	1.55	1.00	0.01
13.16	159.72	0.64	1.54	1.00	0.02	13.20	161.65	0.66	1.24	1.00	0.01
13.26	165.21	2.00	0.00	1.00	0.00	13.33	170.34	2.00	0.00	1.00	0.00
13.42	179.84	2.00	0.00	1.00	0.00	13.47	178.82	2.00	0.00	1.00	0.00
13.52	177.12	2.00	0.00	1.00	0.00	13.61	179.47	2.00	0.00	1.00	0.00
13.65	181.13	2.00	0.00	1.00	0.00	13.74	178.52	2.00	0.00	1.00	0.00
13.79	175.60	2.00	0.00	1.00	0.00	13.86	173.60	2.00	0.00	1.00	0.00
13.92	171.47	2.00	0.00	1.00	0.00	13.98	169.92	2.00	0.00	1.00	0.00
14.05	168.46	2.00	0.00	1.00	0.00	14.11	167.77	2.00	0.00	1.00	0.00
14.19	167.52	2.00	0.00	1.00	0.00	14.25	167.07	2.00	0.00	1.00	0.00
14.31	164.88	2.00	0.00	1.00	0.00	14.39	162.34	2.00	0.00	1.00	0.00
14.45	162.31	2.00	0.00	1.00	0.00	14.52	162.76	2.00	0.00	1.00	0.00
14.57	162.30	2.00	0.00	1.00	0.00	14.64	159.65	2.00	0.00	1.00	0.00
14.70	158.79	2.00	0.00	1.00	0.00	14.78	159.05	2.00	0.00	1.00	0.00
14.86	157.51	2.00	0.00	1.00	0.00	14.90	156.47	2.00	0.00	1.00	0.00
14.97	151.85	2.00	0.00	1.00	0.00	15.03	145.65	2.00	0.00	1.00	0.00
15.10	140.98	2.00	0.00	1.00	0.00	15.18	140.44	2.00	0.00	1.00	0.00
15.24	140.13	2.00	0.00	1.00	0.00	15.31	139.25	2.00	0.00	1.00	0.00
15.36	139.26	2.00	0.00	1.00	0.00	15.44	141.44	2.00	0.00	1.00	0.00
15.49	142.49	2.00	0.00	1.00	0.00	15.57	137.46	2.00	0.00	1.00	0.00
15.63	136.25	2.00	0.00	1.00	0.00	15.71	139.38	2.00	0.00	1.00	0.00
15.75	137.45	2.00	0.00	1.00	0.00	15.85	143.34	2.00	0.00	1.00	0.00
15.89	144.84	2.00	0.00	1.00	0.00	15.95	145.09	2.00	0.00	1.00	0.00
16.02	143.10	2.00	0.00	1.00	0.00	16.11	143.15	2.00	0.00	1.00	0.00
16.16	143.43	2.00	0.00	1.00	0.00	16.21	141.91	2.00	0.00	1.00	0.00
16.28	139.12	2.00	0.00	1.00	0.00	16.34	135.64	2.00	0.00	1.00	0.00
16.41	125.43	2.00	0.00	1.00	0.00	16.48	120.15	2.00	0.00	1.00	0.00
16.54	124.88	2.00	0.00	1.00	0.00	16.61	149.83	2.00	0.00	1.00	0.00
16.67	197.89	1.04	0.47	1.00	0.00	16.74	259.03	2.00	0.00	1.00	0.00
16.81	268.59	2.00	0.00	1.00	0.00	16.88	264.73	2.00	0.00	1.00	0.00

:: Post-earthquake settlement due to soil liquefaction :: (continued)

Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)	Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)
16.93	251.89	2.00	0.00	1.00	0.00	17.01	256.82	2.00	0.00	1.00	0.00
17.06	225.96	2.00	0.00	1.00	0.00	17.13	221.43	2.00	0.00	1.00	0.00
17.20	220.38	2.00	0.00	1.00	0.00	17.28	217.50	2.00	0.00	1.00	0.00
17.33	215.96	2.00	0.00	1.00	0.00	17.39	199.93	1.07	0.35	1.00	0.00
17.45	193.74	0.98	0.48	1.00	0.00	17.53	194.94	0.99	0.47	1.00	0.00
17.60	196.26	1.01	0.47	1.00	0.00	17.68	196.59	1.01	0.47	1.00	0.00
17.72	197.19	1.02	0.47	1.00	0.00	17.79	198.10	1.03	0.47	1.00	0.00
17.85	200.31	2.00	0.00	1.00	0.00	17.93	200.65	2.00	0.00	1.00	0.00
18.00	199.59	1.05	0.35	1.00	0.00	18.05	199.08	1.05	0.47	1.00	0.00
18.13	197.88	1.03	0.47	1.00	0.00	18.18	197.84	1.03	0.47	1.00	0.00
18.26	199.57	1.05	0.46	1.00	0.00	18.31	201.60	2.00	0.00	1.00	0.00
18.40	208.74	2.00	0.00	1.00	0.00	18.45	214.43	2.00	0.00	1.00	0.00
18.53	230.79	2.00	0.00	1.00	0.00	18.58	245.97	2.00	0.00	1.00	0.00
18.64	272.12	2.00	0.00	1.00	0.00	18.72	282.95	2.00	0.00	1.00	0.00
18.77	279.34	2.00	0.00	1.00	0.00	18.84	262.88	2.00	0.00	1.00	0.00
18.93	231.97	2.00	0.00	1.00	0.00	18.97	234.69	2.00	0.00	1.00	0.00
19.05	238.10	2.00	0.00	1.00	0.00	19.11	237.71	2.00	0.00	1.00	0.00
19.19	244.31	2.00	0.00	1.00	0.00	19.23	240.84	2.00	0.00	1.00	0.00
19.30	235.40	2.00	0.00	1.00	0.00	19.37	235.11	2.00	0.00	1.00	0.00
19.44	229.05	2.00	0.00	1.00	0.00	19.51	223.67	2.00	0.00	1.00	0.00
19.57	214.64	2.00	0.00	1.00	0.00	19.64	206.03	2.00	0.00	1.00	0.00
19.70	205.05	2.00	0.00	1.00	0.00	19.77	204.69	2.00	0.00	1.00	0.00
19.82	203.79	2.00	0.00	1.00	0.00	19.90	209.73	2.00	0.00	1.00	0.00
19.95	216.94	2.00	0.00	1.00	0.00	20.03	237.20	2.00	0.00	1.00	0.00
20.09	250.40	2.00	0.00	1.00	0.00	20.16	251.87	2.00	0.00	1.00	0.00
20.22	259.48	2.00	0.00	1.00	0.00	20.31	260.21	2.00	0.00	1.00	0.00
20.36	262.12	2.00	0.00	1.00	0.00	20.41	264.85	2.00	0.00	1.00	0.00
20.49	255.30	2.00	0.00	1.00	0.00	20.54	253.34	2.00	0.00	1.00	0.00
20.61	252.55	2.00	0.00	1.00	0.00	20.67	252.32	2.00	0.00	1.00	0.00
20.74	253.19	2.00	0.00	1.00	0.00	20.80	256.56	2.00	0.00	1.00	0.00
20.89	265.53	2.00	0.00	1.00	0.00	20.94	270.02	2.00	0.00	1.00	0.00
21.01	281.79	2.00	0.00	1.00	0.00	21.07	291.21	2.00	0.00	1.00	0.00
21.15	313.95	2.00	0.00	1.00	0.00	21.20	335.98	2.00	0.00	1.00	0.00
21.26	386.50	2.00	0.00	1.00	0.00	21.34	432.99	2.00	0.00	1.00	0.00
21.39	479.67	2.00	0.00	1.00	0.00	21.47	511.65	2.00	0.00	1.00	0.00
21.53	531.31	2.00	0.00	1.00	0.00	21.59	527.46	2.00	0.00	1.00	0.00
21.67	532.92	2.00	0.00	1.00	0.00	21.73	520.13	2.00	0.00	1.00	0.00
21.79	503.82	2.00	0.00	1.00	0.00	21.87	435.50	2.00	0.00	1.00	0.00
21.92	421.26	2.00	0.00	1.00	0.00	21.99	398.04	2.00	0.00	1.00	0.00
22.05	356.63	2.00	0.00	1.00	0.00	22.14	321.65	2.00	0.00	1.00	0.00
22.19	265.83	2.00	0.00	1.00	0.00	22.25	237.06	2.00	0.00	1.00	0.00
22.32	221.47	2.00	0.00	1.00	0.00	22.38	217.41	2.00	0.00	1.00	0.00
22.45	213.33	2.00	0.00	1.00	0.00	22.52	213.07	2.00	0.00	1.00	0.00
22.60	209.77	2.00	0.00	1.00	0.00	22.65	209.84	2.00	0.00	1.00	0.00
22.73	207.48	2.00	0.00	1.00	0.00	22.79	205.41	2.00	0.00	1.00	0.00
22.84	204.35	2.00	0.00	1.00	0.00	22.91	203.25	2.00	0.00	1.00	0.00
22.98	202.33	2.00	0.00	1.00	0.00	23.04	197.99	0.99	0.47	1.00	0.00
23.10	201.28	2.00	0.00	1.00	0.00	23.18	204.88	2.00	0.00	1.00	0.00

:: Post-earthquake settlement due to soil liquefaction :: (continued)

Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)	Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)
23.25	208.55	2.00	0.00	1.00	0.00	23.32	211.52	2.00	0.00	1.00	0.00
23.36	213.46	2.00	0.00	1.00	0.00	23.43	216.85	2.00	0.00	1.00	0.00
23.50	217.45	2.00	0.00	1.00	0.00	23.58	218.00	2.00	0.00	1.00	0.00
23.66	215.88	2.00	0.00	1.00	0.00	23.69	213.31	2.00	0.00	1.00	0.00
23.77	210.78	2.00	0.00	1.00	0.00	23.83	212.02	2.00	0.00	1.00	0.00
23.90	221.77	2.00	0.00	1.00	0.00	23.98	239.11	2.00	0.00	1.00	0.00
24.03	251.92	2.00	0.00	1.00	0.00	24.11	279.31	2.00	0.00	1.00	0.00
24.16	291.79	2.00	0.00	1.00	0.00	24.23	313.43	2.00	0.00	1.00	0.00
24.30	327.18	2.00	0.00	1.00	0.00	24.38	340.45	2.00	0.00	1.00	0.00
24.41	348.65	2.00	0.00	1.00	0.00	24.48	362.31	2.00	0.00	1.00	0.00
24.56	369.93	2.00	0.00	1.00	0.00	24.62	374.89	2.00	0.00	1.00	0.00
24.68	382.60	2.00	0.00	1.00	0.00	24.75	373.53	2.00	0.00	1.00	0.00
24.81	351.04	2.00	0.00	1.00	0.00	24.88	353.63	2.00	0.00	1.00	0.00
24.95	353.02	2.00	0.00	1.00	0.00	25.01	353.52	2.00	0.00	1.00	0.00
25.08	354.85	2.00	0.00	1.00	0.00	25.15	356.67	2.00	0.00	1.00	0.00
25.22	350.66	2.00	0.00	1.00	0.00	25.27	346.98	2.00	0.00	1.00	0.00
25.34	343.95	2.00	0.00	1.00	0.00	25.40	344.21	2.00	0.00	1.00	0.00
25.48	346.82	2.00	0.00	1.00	0.00	25.53	349.39	2.00	0.00	1.00	0.00
25.60	347.26	2.00	0.00	1.00	0.00	25.67	347.12	2.00	0.00	1.00	0.00
25.73	349.59	2.00	0.00	1.00	0.00	25.80	351.88	2.00	0.00	1.00	0.00
25.86	353.55	2.00	0.00	1.00	0.00	25.94	358.97	2.00	0.00	1.00	0.00
26.00	358.50	2.00	0.00	1.00	0.00	26.07	358.21	2.00	0.00	1.00	0.00
26.12	357.82	2.00	0.00	1.00	0.00	26.21	360.49	2.00	0.00	1.00	0.00
26.25	362.11	2.00	0.00	1.00	0.00	26.34	334.79	2.00	0.00	1.00	0.00
26.39	326.70	2.00	0.00	1.00	0.00	26.46	326.76	2.00	0.00	1.00	0.00
26.52	326.56	2.00	0.00	1.00	0.00	26.60	326.58	2.00	0.00	1.00	0.00
26.65	336.78	2.00	0.00	1.00	0.00	26.71	345.69	2.00	0.00	1.00	0.00
26.78	351.36	2.00	0.00	1.00	0.00	26.86	357.61	2.00	0.00	1.00	0.00
26.91	361.51	2.00	0.00	1.00	0.00	26.97	362.39	2.00	0.00	1.00	0.00
27.04	368.80	2.00	0.00	1.00	0.00	27.14	379.86	2.00	0.00	1.00	0.00
27.17	380.07	2.00	0.00	1.00	0.00	27.25	375.82	2.00	0.00	1.00	0.00
27.31	371.48	2.00	0.00	1.00	0.00	27.36	354.36	2.00	0.00	1.00	0.00
27.44	352.96	2.00	0.00	1.00	0.00	27.50	353.87	2.00	0.00	1.00	0.00
27.59	354.11	2.00	0.00	1.00	0.00	27.63	353.38	2.00	0.00	1.00	0.00
27.69	350.66	2.00	0.00	1.00	0.00	27.77	350.30	2.00	0.00	1.00	0.00
27.85	348.28	2.00	0.00	1.00	0.00	27.91	350.98	2.00	0.00	1.00	0.00
27.95	350.87	2.00	0.00	1.00	0.00	28.02	350.77	2.00	0.00	1.00	0.00
28.10	353.11	2.00	0.00	1.00	0.00	28.17	360.53	2.00	0.00	1.00	0.00
28.22	365.09	2.00	0.00	1.00	0.00	28.28	375.74	2.00	0.00	1.00	0.00
28.36	366.12	2.00	0.00	1.00	0.00	28.42	391.06	2.00	0.00	1.00	0.00
28.50	401.65	2.00	0.00	1.00	0.00	28.55	400.35	2.00	0.00	1.00	0.00
28.61	404.42	2.00	0.00	1.00	0.00	28.69	402.13	2.00	0.00	1.00	0.00
28.76	409.48	2.00	0.00	1.00	0.00	28.81	407.92	2.00	0.00	1.00	0.00
28.87	396.37	2.00	0.00	1.00	0.00	28.94	381.55	2.00	0.00	1.00	0.00
29.01	368.02	2.00	0.00	1.00	0.00	29.08	353.09	2.00	0.00	1.00	0.00
29.14	351.78	2.00	0.00	1.00	0.00	29.21	343.47	2.00	0.00	1.00	0.00
29.27	347.26	2.00	0.00	1.00	0.00	29.34	345.32	2.00	0.00	1.00	0.00
29.41	343.02	2.00	0.00	1.00	0.00	29.48	338.43	2.00	0.00	1.00	0.00

:: Post-earthquake settlement due to soil liquefaction :: (continued)

Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)	Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)
29.53	334.29	2.00	0.00	1.00	0.00	29.61	334.03	2.00	0.00	1.00	0.00
29.66	334.45	2.00	0.00	1.00	0.00	29.73	334.24	2.00	0.00	1.00	0.00
29.81	329.51	2.00	0.00	1.00	0.00	29.88	324.37	2.00	0.00	1.00	0.00
29.93	313.26	2.00	0.00	1.00	0.00	30.00	228.54	2.00	0.00	1.00	0.00
30.07	284.33	2.00	0.00	1.00	0.00	30.13	281.64	2.00	0.00	1.00	0.00
30.20	283.62	2.00	0.00	1.00	0.00	30.27	283.07	2.00	0.00	1.00	0.00
30.32	292.28	2.00	0.00	1.00	0.00	30.40	305.94	2.00	0.00	1.00	0.00
30.45	323.63	2.00	0.00	1.00	0.00	30.53	364.03	2.00	0.00	1.00	0.00
30.58	396.20	2.00	0.00	1.00	0.00	30.64	434.28	2.00	0.00	1.00	0.00
30.71	481.53	2.00	0.00	1.00	0.00	30.80	509.77	2.00	0.00	1.00	0.00
30.84	521.47	2.00	0.00	1.00	0.00	30.92	508.59	2.00	0.00	1.00	0.00
30.98	505.77	2.00	0.00	1.00	0.00	31.07	505.62	2.00	0.00	1.00	0.00
31.11	505.70	2.00	0.00	1.00	0.00	31.18	509.00	2.00	0.00	1.00	0.00
31.24	520.87	2.00	0.00	1.00	0.00	31.32	546.64	2.00	0.00	1.00	0.00
31.37	506.21	2.00	0.00	1.00	0.00	31.44	512.26	2.00	0.00	1.00	0.00
31.50	515.13	2.00	0.00	1.00	0.00	31.56	501.13	2.00	0.00	1.00	0.00
31.65	513.07	2.00	0.00	1.00	0.00	31.70	477.78	2.00	0.00	1.00	0.00
31.79	-1.00	2.00	0.00	1.00	0.00	31.83	-1.00	2.00	0.00	1.00	0.00
31.89	-1.00	2.00	0.00	1.00	0.00	31.96	-1.00	2.00	0.00	1.00	0.00
32.03	-1.00	2.00	0.00	1.00	0.00	32.09	-1.00	2.00	0.00	1.00	0.00

Total estimated settlement: 1.73

Abbreviations

$Q_{tn,cs}$:	Equivalent dean sand normalized cone resistance
FS:	Factor of safety against liquefaction
e_v (%):	Post-liquefaction volumentric strain
DF:	e_v depth weighting factor
Settlement:	Calculated settlement

:: Strength loss calculation (Robertson (2009) ::

Depth (ft)	q_t (tsf)	Q_{tn}	K_c	$Q_{tn,cs}$	I_c	$S_{u(liq)}/\sigma'_v$	$S_{u(peak)}/\sigma'_v$
0.07	0.00	-1.00	1.00	-1.00	-1.00	N/A	N/A
0.14	0.00	-1.00	1.00	-1.00	-1.00	N/A	N/A
0.20	1.38	2.20	26.38	58.00	4.05	N/A	N/A
0.30	56.04	90.01	1.18	105.93	1.89	N/A	N/A
0.34	93.51	150.21	1.02	153.63	1.68	N/A	N/A
0.41	162.25	260.64	1.00	260.64	1.48	N/A	N/A
0.48	208.53	334.99	1.00	334.99	1.36	N/A	N/A
0.54	276.49	444.17	1.00	444.17	1.21	N/A	N/A
0.59	328.98	528.50	1.00	528.50	1.14	N/A	N/A
0.66	398.67	640.46	1.00	640.46	1.05	N/A	N/A
0.73	417.49	670.69	1.00	670.69	1.02	N/A	N/A
0.79	413.35	664.03	1.00	664.03	1.03	N/A	N/A
0.87	406.09	652.35	1.00	652.35	1.09	N/A	N/A
0.92	394.95	634.45	1.00	634.45	1.14	N/A	N/A
0.99	377.60	606.57	1.00	606.57	1.19	N/A	N/A
1.06	361.02	579.92	1.00	579.92	1.23	N/A	N/A
1.13	312.67	502.24	1.00	502.24	1.27	N/A	N/A
1.20	279.08	448.26	1.00	448.26	1.26	N/A	N/A
1.26	243.15	390.53	1.00	390.53	1.37	N/A	N/A
1.33	210.52	338.10	1.00	338.10	1.49	N/A	N/A
1.40	186.51	299.51	1.00	299.51	1.60	N/A	N/A
1.47	166.22	266.91	1.04	277.83	1.70	N/A	N/A
1.51	136.77	219.59	1.14	249.53	1.84	N/A	N/A
1.58	127.62	204.88	1.18	241.49	1.89	N/A	N/A
1.65	121.15	194.48	1.21	234.94	1.92	N/A	N/A
1.73	109.58	175.88	1.26	221.92	1.97	N/A	N/A
1.78	100.77	161.72	1.32	213.25	2.01	N/A	N/A
1.85	90.23	144.78	1.40	202.67	2.07	N/A	N/A
1.90	81.43	130.63	1.49	194.65	2.12	N/A	N/A
1.99	70.02	112.30	1.65	185.17	2.19	N/A	N/A
2.05	62.94	100.92	1.82	184.00	2.26	N/A	N/A
2.12	55.17	88.42	2.07	183.46	2.34	N/A	N/A
2.18	50.58	81.05	2.28	184.86	2.39	N/A	N/A
2.24	47.04	75.36	2.51	188.95	2.45	N/A	N/A
2.32	42.99	68.83	2.83	195.12	2.51	N/A	N/A
2.37	40.56	64.93	3.06	198.85	2.56	N/A	N/A
2.43	37.20	59.53	3.44	204.92	2.62	N/A	N/A
2.50	34.95	55.91	3.73	208.80	2.66	N/A	N/A
2.56	33.31	53.27	3.96	210.77	2.69	N/A	N/A
2.64	32.10	51.31	4.12	211.32	2.72	N/A	N/A
2.72	30.89	49.36	4.24	209.32	2.73	N/A	N/A
2.77	30.29	48.39	4.29	207.43	2.74	N/A	N/A
2.84	29.42	46.98	4.37	205.27	2.75	N/A	N/A
2.90	28.56	45.59	4.11	187.30	2.72	N/A	N/A
2.98	27.44	43.79	3.77	164.86	2.67	N/A	N/A
3.04	26.66	42.53	3.99	169.52	2.70	N/A	N/A
3.08	26.06	41.56	4.15	172.45	2.72	N/A	N/A
3.16	25.28	40.30	4.35	175.31	2.75	N/A	N/A

:: Strength loss calculation (Robertson (2009) :: (continued)

Depth (ft)	q_t (tsf)	Q_{tn}	K_c	$Q_{tn,cs}$	I_c	$S_{u(liq)}/\sigma'_v$	$S_{u(peak)}/\sigma'_v$
3.22	24.75	39.44	4.51	177.72	2.77	N/A	N/A
3.30	24.58	39.16	4.56	178.72	2.77	N/A	N/A
3.35	25.01	39.85	4.48	178.47	2.76	N/A	N/A
3.44	25.62	40.81	4.27	174.18	2.74	N/A	N/A
3.49	25.69	40.93	4.18	171.22	2.73	N/A	N/A
3.56	25.61	40.79	4.10	167.04	2.71	N/A	N/A
3.61	25.61	40.78	4.03	164.25	2.70	N/A	N/A
3.71	25.95	41.32	3.90	161.16	2.69	N/A	N/A
3.75	26.29	41.87	3.83	160.32	2.68	N/A	N/A
3.81	26.63	42.41	3.77	159.83	2.67	N/A	N/A
3.89	26.72	42.55	3.76	160.08	2.67	N/A	N/A
3.94	26.89	42.82	3.76	160.88	2.67	N/A	N/A
4.03	27.25	43.37	3.75	162.67	2.67	N/A	N/A
4.08	27.33	43.50	3.76	163.52	2.67	N/A	N/A
4.15	27.85	44.32	3.73	165.37	2.66	N/A	N/A
4.23	28.44	45.28	3.72	168.63	2.66	N/A	N/A
4.29	29.14	46.39	3.69	171.13	2.66	N/A	N/A
4.33	29.39	46.79	3.69	172.55	2.66	N/A	N/A
4.43	29.31	46.65	3.77	175.79	2.67	N/A	N/A
4.47	29.05	46.23	3.83	177.17	2.68	N/A	N/A
4.55	28.44	45.24	3.50	158.44	2.63	N/A	N/A
4.61	28.01	44.54	3.34	148.84	2.60	N/A	N/A
4.66	27.49	43.70	3.53	154.24	2.63	N/A	N/A
4.75	27.32	43.42	3.70	160.44	2.66	N/A	N/A
4.80	27.06	43.00	3.81	163.83	2.67	N/A	N/A
4.88	26.62	42.29	3.98	168.42	2.70	N/A	N/A
4.93	27.01	42.91	3.99	171.09	2.70	N/A	N/A
5.01	26.97	42.84	4.10	175.72	2.71	N/A	N/A
5.06	26.97	42.82	4.16	177.97	2.72	N/A	N/A
5.15	26.97	42.82	4.18	178.76	2.72	N/A	N/A
5.19	26.97	42.81	4.18	178.82	2.72	N/A	N/A
5.27	28.18	44.75	3.98	178.15	2.70	N/A	N/A
5.33	29.21	46.40	3.85	178.50	2.68	N/A	N/A
5.42	31.03	49.31	3.65	180.08	2.65	N/A	N/A
5.47	32.58	51.80	3.49	180.87	2.63	N/A	N/A
5.51	33.87	53.87	3.37	181.76	2.61	N/A	N/A
5.58	35.00	55.68	3.27	182.09	2.59	N/A	N/A
5.64	36.47	58.03	3.13	181.81	2.57	N/A	N/A
5.73	38.45	61.21	2.93	179.23	2.53	N/A	N/A
5.79	39.75	63.29	2.78	176.18	2.50	N/A	N/A
5.88	40.96	65.22	2.60	169.56	2.47	N/A	N/A
5.91	41.47	66.04	2.52	166.16	2.45	N/A	N/A
5.99	42.68	67.98	2.02	137.06	2.32	N/A	N/A
6.05	43.89	69.92	1.69	118.03	2.21	0.78	0.78
6.11	44.93	71.58	1.61	115.48	2.18	0.78	0.78
6.18	45.53	72.54	1.55	112.38	2.15	0.78	0.78
6.25	45.70	72.81	1.49	108.45	2.12	0.78	0.78
6.32	45.12	71.86	1.46	105.06	2.10	0.78	0.78

:: Strength loss calculation (Robertson (2009) :: (continued)

Depth (ft)	q_t (tsf)	Q_{tn}	K_c	$Q_{tn,cs}$	I_c	$S_{u(liq)}/\sigma'_v$	$S_{u(peak)}/\sigma'_v$
6.37	42.27	67.28	1.51	101.49	2.13	0.77	0.77
6.44	43.31	68.94	1.44	99.50	2.09	0.78	0.78
6.53	43.75	69.65	1.39	96.99	2.06	0.78	0.78
6.57	43.75	69.65	1.37	95.70	2.05	0.78	0.78
6.63	43.76	69.66	1.34	93.39	2.03	0.78	0.78
6.71	44.03	70.08	1.30	91.03	2.00	0.78	0.78
6.77	44.46	70.77	1.27	90.02	1.98	0.78	0.78
6.84	45.24	72.02	1.24	89.15	1.95	0.78	0.78
6.92	46.62	74.23	1.21	89.80	1.92	0.79	0.79
6.97	47.14	75.06	1.20	90.17	1.91	0.79	0.79
7.02	47.48	75.60	1.20	90.49	1.91	0.79	0.79
7.11	47.39	75.45	1.20	90.50	1.91	0.79	0.79
7.16	47.48	75.59	1.20	90.59	1.91	0.79	0.79
7.22	46.96	74.75	1.21	90.73	1.93	0.79	0.79
7.33	47.48	75.36	1.22	91.77	1.93	0.79	0.79
7.38	48.26	76.21	1.21	92.48	1.93	0.79	0.79
7.42	49.64	77.90	1.20	93.70	1.91	0.79	0.79
7.52	52.06	80.92	1.19	96.60	1.91	0.80	0.80
7.56	53.02	82.08	1.19	97.78	1.90	0.80	0.80
7.61	53.10	82.00	1.20	98.06	1.91	0.80	0.80
7.69	52.33	80.63	1.21	97.43	1.92	0.80	0.80
7.76	51.97	79.81	1.21	96.87	1.93	0.80	0.80
7.82	51.80	79.31	1.22	96.51	1.93	0.80	0.80
7.91	51.89	78.94	1.22	96.17	1.93	0.79	0.79
7.96	52.14	79.14	1.22	96.82	1.93	0.79	0.79
8.01	52.40	79.40	1.23	97.59	1.94	0.80	0.80
8.09	52.83	79.82	1.24	99.10	1.95	0.80	0.80
8.15	53.01	79.98	1.25	100.13	1.96	0.80	0.80
8.22	53.09	79.93	1.27	101.14	1.97	0.80	0.80
8.27	52.83	79.48	1.28	101.54	1.98	0.80	0.80
8.33	52.49	78.87	1.29	101.93	1.99	0.79	0.79
8.41	52.06	78.08	1.31	102.22	2.01	0.79	0.79
8.50	51.03	76.36	1.33	101.83	2.02	0.79	0.79
8.54	50.77	75.85	1.34	101.81	2.03	0.79	0.79
8.65	49.91	74.27	1.36	101.23	2.04	0.79	0.79
8.72	49.56	71.53	1.24	89.01	1.95	0.78	0.78
8.77	49.55	71.39	1.25	89.12	1.96	0.78	0.78
8.81	49.47	71.29	1.26	90.09	1.97	0.78	0.78
8.87	49.47	71.33	1.28	91.57	1.99	0.78	0.78
8.96	49.47	71.24	1.31	93.31	2.01	0.78	0.78
8.99	49.64	71.45	1.32	94.22	2.01	0.78	0.78
9.06	46.79	68.07	1.41	96.14	2.08	0.77	0.77
9.13	51.02	73.50	1.38	101.29	2.05	0.78	0.78
9.21	52.75	75.60	1.38	104.32	2.06	0.79	0.79
9.27	53.18	76.09	1.39	105.98	2.06	0.79	0.79
9.36	53.53	76.25	1.40	107.04	2.07	0.79	0.79
9.41	53.70	76.22	1.40	106.99	2.07	0.79	0.79
9.46	53.61	75.83	1.41	106.64	2.07	0.79	0.79

:: Strength loss calculation (Robertson (2009) :: (continued)

Depth (ft)	q_t (tsf)	Q_{tn}	K_c	$Q_{tn,cs}$	I_c	$S_{u(liq)}/\sigma'_v$	$S_{u(peak)}/\sigma'_v$
9.54	53.35	74.99	1.40	104.95	2.07	0.79	0.79
9.58	52.58	73.69	1.40	103.28	2.07	0.79	0.79
9.65	51.63	72.04	1.40	101.01	2.07	0.78	0.78
9.72	50.85	70.71	1.41	99.97	2.08	0.78	0.78
9.80	50.85	70.59	1.44	102.00	2.09	0.78	0.78
9.85	50.85	70.58	1.47	103.65	2.11	0.78	0.78
9.93	50.85	70.33	1.49	104.59	2.12	0.78	0.78
9.98	50.86	70.05	1.48	103.88	2.12	0.78	0.78
10.05	50.85	69.60	1.47	102.28	2.11	0.78	0.78
10.12	51.63	70.06	1.43	100.43	2.09	0.78	0.78
10.17	54.13	72.67	1.37	99.66	2.05	0.78	0.78
10.25	56.55	74.94	1.31	98.23	2.01	0.79	0.79
10.31	57.58	75.66	1.28	96.73	1.98	0.79	0.79
10.38	57.67	75.09	1.25	93.78	1.96	0.79	0.79
10.44	57.07	73.83	1.23	91.04	1.94	0.79	0.79
10.51	55.95	71.91	1.22	87.86	1.93	0.78	0.78
10.57	54.57	69.93	1.23	85.80	1.94	0.78	0.78
10.64	53.62	68.47	1.23	84.24	1.94	0.78	0.78
10.71	53.36	67.94	1.23	83.77	1.94	0.77	0.77
10.78	54.30	68.80	1.23	84.36	1.94	0.78	0.78
10.84	55.86	70.43	1.22	85.63	1.93	0.78	0.78
10.93	58.71	73.59	1.21	88.75	1.92	0.79	0.79
10.96	60.09	75.12	1.20	90.29	1.91	0.79	0.79
11.03	60.78	75.69	1.20	90.74	1.91	0.79	0.79
11.15	59.66	73.50	1.18	86.45	1.89	0.78	0.78
11.19	58.62	73.03	1.26	91.70	1.96	0.78	0.78
11.23	56.90	71.48	1.34	95.45	2.03	0.78	0.78
11.30	52.14	66.39	1.52	100.77	2.13	0.77	0.77
11.38	44.03	56.72	1.78	101.17	2.24	0.75	0.75
11.43	34.37	45.04	2.29	103.13	2.39	0.72	0.72
11.50	31.95	41.89	2.46	102.90	2.43	0.71	0.71
11.56	26.84	35.49	2.95	104.82	2.54	0.69	0.69
11.64	23.30	30.91	3.43	106.05	2.62	2.33	2.33
11.68	23.14	30.61	3.45	105.73	2.62	2.31	2.31
11.77	23.06	30.32	3.48	105.55	2.62	2.28	2.28
11.81	23.40	30.66	3.44	105.38	2.62	2.31	2.31
11.91	25.13	32.54	3.17	103.14	2.57	0.68	0.68
11.94	25.65	33.13	3.15	104.34	2.57	0.68	0.68
12.01	27.04	34.70	3.03	105.29	2.55	0.69	0.69
12.08	27.47	35.06	2.99	104.81	2.54	0.69	0.69
12.17	28.76	36.52	3.01	110.05	2.55	0.69	0.69
12.21	29.28	37.10	3.02	112.19	2.55	0.70	0.70
12.28	29.80	37.66	3.08	116.16	2.56	0.70	0.70
12.35	31.10	39.13	3.07	119.96	2.56	0.70	0.70
12.41	32.22	40.37	3.03	122.50	2.55	0.71	0.71
12.48	34.20	42.65	3.00	127.81	2.54	0.71	0.71
12.54	35.59	44.23	2.97	131.38	2.54	0.72	0.72
12.62	36.53	45.22	3.02	136.38	2.55	0.72	0.72

:: Strength loss calculation (Robertson (2009) :: (continued)

Depth (ft)	q_t (tsf)	Q_{tn}	K_c	$Q_{tn,cs}$	I_c	$S_{u(liq)}/\sigma'_v$	$S_{u(peak)}/\sigma'_v$
12.67	36.70	45.33	3.07	139.01	2.56	0.72	0.72
12.75	37.48	46.08	3.09	142.62	2.56	0.72	0.72
12.80	37.22	45.68	3.17	144.82	2.57	0.72	0.72
12.88	37.82	46.25	3.25	150.33	2.59	0.72	0.72
12.93	38.17	46.56	3.31	154.27	2.60	0.73	0.73
13.02	38.94	47.24	3.34	157.82	2.60	3.52	3.52
13.07	40.41	48.82	3.25	158.75	2.59	0.73	0.73
13.16	41.79	50.13	3.19	159.72	2.58	0.73	0.73
13.20	41.34	49.50	3.27	161.65	2.59	0.73	0.73
13.26	39.27	47.01	3.51	165.21	2.63	3.48	3.48
13.33	37.89	45.28	3.76	170.34	2.67	3.34	3.34
13.42	36.25	43.24	4.16	179.84	2.72	3.17	3.17
13.47	35.12	41.78	4.28	178.82	2.74	3.05	3.05
13.52	33.48	39.73	4.46	177.12	2.76	2.89	2.89
13.61	32.02	37.85	4.74	179.47	2.79	2.75	2.75
13.65	31.31	36.94	4.90	181.13	2.81	2.68	2.68
13.74	30.02	35.22	5.07	178.52	2.83	2.55	2.55
13.79	31.23	36.45	4.82	175.60	2.80	2.64	2.64
13.86	30.58	35.51	4.89	173.60	2.81	2.57	2.57
13.92	31.14	35.97	4.77	171.47	2.80	2.61	2.61
13.98	33.13	38.03	4.47	169.92	2.76	2.76	2.76
14.05	34.25	39.08	4.31	168.46	2.74	2.84	2.84
14.11	34.85	39.59	4.24	167.77	2.73	2.88	2.88
14.19	35.38	39.97	4.19	167.52	2.73	2.91	2.91
14.25	35.38	39.80	4.20	167.07	2.73	2.90	2.90
14.31	35.30	39.55	4.17	164.88	2.72	2.88	2.88
14.39	34.86	38.84	4.18	162.34	2.72	2.82	2.82
14.45	34.61	38.42	4.23	162.31	2.73	2.79	2.79
14.52	34.78	38.42	4.24	162.76	2.73	2.79	2.79
14.57	34.78	38.28	4.24	162.30	2.73	2.78	2.78
14.64	35.04	38.38	4.16	159.65	2.72	2.79	2.79
14.70	34.43	37.56	4.23	158.79	2.73	2.72	2.72
14.78	33.40	36.27	4.38	159.05	2.75	2.63	2.63
14.86	32.53	35.14	4.48	157.51	2.76	2.54	2.54
14.90	32.27	34.77	4.50	156.47	2.77	2.51	2.51
14.97	31.67	33.94	4.47	151.85	2.76	2.45	2.45
15.03	31.32	33.39	4.36	145.65	2.75	2.41	2.41
15.10	31.50	33.40	4.22	140.98	2.73	2.42	2.42
15.18	31.50	33.24	4.22	140.44	2.73	2.41	2.41
15.24	31.84	33.46	4.19	140.13	2.73	2.42	2.42
15.31	32.88	34.41	4.05	139.25	2.71	2.49	2.49
15.36	33.22	34.66	4.02	139.26	2.70	2.51	2.51
15.44	34.09	35.40	4.00	141.44	2.70	2.56	2.56
15.49	34.52	35.75	3.99	142.49	2.70	2.59	2.59
15.57	34.35	35.38	3.89	137.46	2.68	2.56	2.56
15.63	34.61	35.52	3.84	136.25	2.68	2.57	2.57
15.71	35.30	36.07	3.86	139.38	2.68	2.61	2.61
15.75	35.21	35.89	3.83	137.45	2.68	2.59	2.59

:: Strength loss calculation (Robertson (2009) :: (continued)

Depth (ft)	q_t (tsf)	Q_{tn}	K_c	$Q_{tn,cs}$	I_c	$S_{u(liq)}/\sigma'_v$	$S_{u(peak)}/\sigma'_v$
15.85	34.26	34.75	4.13	143.34	2.72	2.51	2.51
15.89	34.35	34.76	4.17	144.84	2.72	2.51	2.51
15.95	33.79	34.07	4.26	145.09	2.74	2.45	2.45
16.02	33.31	33.43	4.28	143.10	2.74	2.41	2.41
16.11	33.57	33.53	4.27	143.15	2.74	2.41	2.41
16.16	33.40	33.26	4.31	143.43	2.74	2.39	2.39
16.21	33.74	33.48	4.24	141.91	2.73	2.41	2.41
16.28	35.21	34.82	4.00	139.12	2.70	2.51	2.51
16.34	37.02	36.47	3.72	135.64	2.66	2.63	2.63
16.41	46.52	45.69	2.75	125.43	2.50	0.72	0.72
16.48	63.88	62.57	1.92	120.15	2.29	0.76	0.76
16.54	92.29	90.04	1.39	124.88	2.06	0.81	0.81
16.61	135.29	131.42	1.14	149.83	1.84	0.87	0.87
16.67	194.53	188.43	1.05	197.89	1.72	0.92	0.92
16.74	268.10	259.03	1.00	259.03	1.63	0.97	0.97
16.81	278.54	268.59	1.00	268.59	1.59	0.98	0.98
16.88	275.18	264.73	1.00	264.73	1.56	0.97	0.97
16.93	262.32	251.89	1.00	251.89	1.57	0.97	0.97
17.01	268.10	256.82	1.00	256.82	1.52	0.97	0.97
17.06	236.40	225.96	1.00	225.96	1.57	0.95	0.95
17.13	232.17	221.43	1.00	221.43	1.57	0.95	0.95
17.20	231.55	220.38	1.00	220.38	1.53	0.94	0.94
17.28	229.13	217.50	1.00	217.50	1.52	0.94	0.94
17.33	227.83	215.96	1.00	215.96	1.52	0.94	0.94
17.39	211.43	199.93	1.00	199.93	1.55	0.93	0.93
17.45	205.29	193.74	1.00	193.74	1.56	0.92	0.92
17.53	207.02	194.94	1.00	194.94	1.55	0.93	0.93
17.60	208.84	196.26	1.00	196.26	1.53	0.93	0.93
17.68	209.70	196.59	1.00	196.59	1.52	0.93	0.93
17.72	210.56	197.19	1.00	197.19	1.52	0.93	0.93
17.79	211.94	198.10	1.00	198.10	1.51	0.93	0.93
17.85	214.71	200.31	1.00	200.31	1.51	0.93	0.93
17.93	215.57	200.65	1.00	200.65	1.51	0.93	0.93
18.00	214.89	199.59	1.00	199.59	1.52	0.93	0.93
18.05	214.63	199.08	1.00	199.08	1.52	0.93	0.93
18.13	213.85	197.88	1.00	197.88	1.53	0.93	0.93
18.18	214.12	197.84	1.00	197.84	1.55	0.93	0.93
18.26	216.46	199.57	1.00	199.57	1.57	0.93	0.93
18.31	218.97	201.60	1.00	201.60	1.54	0.93	0.93
18.40	227.26	208.74	1.00	208.74	1.52	0.94	0.94
18.45	233.74	214.43	1.00	214.43	1.53	0.94	0.94
18.53	252.06	230.79	1.00	230.79	1.50	0.95	0.95
18.58	268.98	245.97	1.00	245.97	1.45	0.96	0.96
18.64	298.00	272.12	1.00	272.12	1.38	0.98	0.98
18.72	310.43	282.95	1.00	282.95	1.34	0.99	0.99
18.77	306.98	279.34	1.00	279.34	1.33	0.98	0.98
18.84	289.46	262.88	1.00	262.88	1.34	0.97	0.97
18.93	256.21	231.97	1.00	231.97	1.48	0.95	0.95

:: Strength loss calculation (Robertson (2009) :: (continued)

Depth (ft)	q_t (tsf)	Q_{tn}	K_c	$Q_{tn,cs}$	I_c	$S_{u(liq)}/\sigma'_v$	$S_{u(peak)}/\sigma'_v$
18.97	259.49	234.69	1.00	234.69	1.48	0.95	0.95
19.05	263.81	238.10	1.00	238.10	1.44	0.96	0.96
19.11	263.82	237.71	1.00	237.71	1.44	0.96	0.96
19.19	271.77	244.31	1.00	244.31	1.42	0.96	0.96
19.23	268.23	240.84	1.00	240.84	1.44	0.96	0.96
19.30	262.69	235.40	1.00	235.40	1.48	0.96	0.96
19.37	262.86	235.11	1.00	235.11	1.48	0.96	0.96
19.44	256.57	229.05	1.00	229.05	1.49	0.95	0.95
19.51	251.04	223.67	1.00	223.67	1.49	0.95	0.95
19.57	241.37	214.64	1.00	214.64	1.50	0.94	0.94
19.64	232.13	206.03	1.00	206.03	1.52	0.93	0.93
19.70	231.44	205.05	1.00	205.05	1.50	0.93	0.93
19.77	231.44	204.69	1.00	204.69	1.50	0.93	0.93
19.82	230.74	203.79	1.00	203.79	1.47	0.93	0.93
19.90	237.91	209.73	1.00	209.73	1.38	0.94	0.94
19.95	246.37	216.94	1.00	216.94	1.40	0.94	0.94
20.03	269.85	237.20	1.00	237.20	1.42	0.96	0.96
20.09	285.22	250.40	1.00	250.40	1.39	0.97	0.97
20.16	287.37	251.87	1.00	251.87	1.40	0.97	0.97
20.22	296.52	259.48	1.00	259.48	1.39	0.97	0.97
20.31	298.07	260.21	1.00	260.21	1.39	0.97	0.97
20.36	300.58	262.12	1.00	262.12	1.39	0.97	0.97
20.41	304.12	264.85	1.00	264.85	1.39	0.97	0.97
20.49	293.82	255.30	1.00	255.30	1.41	0.97	0.97
20.54	291.92	253.34	1.00	253.34	1.39	0.97	0.97
20.61	291.58	252.55	1.00	252.55	1.37	0.97	0.97
20.67	291.74	252.32	1.00	252.32	1.36	0.97	0.97
20.74	293.21	253.19	1.00	253.19	1.36	0.97	0.97
20.80	297.61	256.56	1.00	256.56	1.35	0.97	0.97
20.89	308.65	265.53	1.00	265.53	1.34	0.97	0.97
20.94	314.18	270.02	1.00	270.02	1.33	0.98	0.98
21.01	328.43	281.79	1.00	281.79	1.35	0.98	0.98
21.07	339.90	291.21	1.00	291.21	1.42	0.99	0.99
21.15	367.10	313.95	1.00	313.95	1.43	1.00	1.00
21.20	393.26	335.98	1.00	335.98	1.45	1.01	1.01
21.26	452.93	386.50	1.00	386.50	1.51	1.04	1.04
21.34	508.28	432.99	1.00	432.99	1.55	1.06	1.06
21.39	563.80	479.67	1.00	479.67	1.47	1.08	1.08
21.47	602.48	511.65	1.00	511.65	1.45	1.09	1.09
21.53	626.57	531.31	1.00	531.31	1.42	1.09	1.09
21.59	623.03	527.46	1.00	527.46	1.42	1.09	1.09
21.67	630.81	532.92	1.00	532.92	1.35	1.09	1.09
21.73	616.64	520.13	1.00	520.13	1.35	1.09	1.09
21.79	598.25	503.82	1.00	503.82	1.38	1.08	1.08
21.87	518.37	435.50	1.00	435.50	1.24	1.06	1.06
21.92	502.05	421.26	1.00	421.26	1.27	1.05	1.05
21.99	475.28	398.04	1.00	398.04	1.32	1.04	1.04
22.05	426.41	356.63	1.00	356.63	1.38	1.02	1.02

:: Strength loss calculation (Robertson (2009) :: (continued)

Depth (ft)	q_t (tsf)	Q_{tn}	K_c	$Q_{tn,cs}$	I_c	$S_{u(liq)}/\sigma'_v$	$S_{u(peak)}/\sigma'_v$
22.14	385.14	321.65	1.00	321.65	1.42	1.01	1.01
22.19	318.74	265.83	1.00	265.83	1.53	0.97	0.97
22.25	284.63	237.06	1.00	237.06	1.60	0.96	0.96
22.32	266.24	221.47	1.00	221.47	1.63	0.95	0.95
22.38	261.57	217.41	1.00	217.41	1.63	0.94	0.94
22.45	256.91	213.33	1.00	213.33	1.64	0.94	0.94
22.52	256.82	213.07	1.00	213.07	1.62	0.94	0.94
22.60	253.11	209.77	1.00	209.77	1.56	0.94	0.94
22.65	253.37	209.84	1.00	209.84	1.51	0.94	0.94
22.73	250.78	207.48	1.00	207.48	1.51	0.94	0.94
22.79	248.45	205.41	1.00	205.41	1.52	0.93	0.93
22.84	247.33	204.35	1.00	204.35	1.53	0.93	0.93
22.91	246.20	203.25	1.00	203.25	1.54	0.93	0.93
22.98	245.30	202.33	1.00	202.33	1.56	0.93	0.93
23.04	240.25	197.99	1.00	197.99	1.59	0.93	0.93
23.10	244.39	201.28	1.00	201.28	1.59	0.93	0.93
23.18	248.97	204.88	1.00	204.88	1.60	0.93	0.93
23.25	253.63	208.55	1.00	208.55	1.61	0.94	0.94
23.32	257.43	211.52	1.00	211.52	1.61	0.94	0.94
23.36	259.93	213.46	1.00	213.46	1.61	0.94	0.94
23.43	264.25	216.85	1.00	216.85	1.61	0.94	0.94
23.50	265.20	217.45	1.00	217.45	1.61	0.94	0.94
23.58	266.15	218.00	1.00	218.00	1.60	0.94	0.94
23.66	263.82	215.88	1.00	215.88	1.60	0.94	0.94
23.69	260.80	213.31	1.00	213.31	1.60	0.94	0.94
23.77	257.95	210.78	1.00	210.78	1.60	0.94	0.94
23.83	259.67	212.02	1.00	212.02	1.58	0.94	0.94
23.90	271.76	221.77	1.00	221.77	1.54	0.95	0.95
23.98	293.18	239.11	1.00	239.11	1.48	0.96	0.96
24.03	308.98	251.92	1.00	251.92	1.45	0.97	0.97
24.11	342.74	279.31	1.00	279.31	1.37	0.98	0.98
24.16	358.20	291.79	1.00	291.79	1.34	0.99	0.99
24.23	384.96	313.43	1.00	313.43	1.31	1.00	1.00
24.30	402.15	327.18	1.00	327.18	1.33	1.01	1.01
24.38	418.81	340.45	1.00	340.45	1.28	1.02	1.02
24.41	429.00	348.65	1.00	348.65	1.24	1.02	1.02
24.48	446.10	362.31	1.00	362.31	1.11	1.03	1.03
24.56	455.86	369.93	1.00	369.93	1.10	1.03	1.03
24.62	462.25	374.89	1.00	374.89	1.11	1.03	1.03
24.68	472.09	382.60	1.00	382.60	1.11	1.04	1.04
24.75	461.30	373.53	1.00	373.53	1.14	1.03	1.03
24.81	433.92	351.04	1.00	351.04	1.19	1.02	1.02
24.88	437.46	353.63	1.00	353.63	1.19	1.02	1.02
24.95	437.03	353.02	1.00	353.02	1.19	1.02	1.02
25.01	437.98	353.52	1.00	353.52	1.20	1.02	1.02
25.08	439.97	354.85	1.00	354.85	1.21	1.02	1.02
25.15	442.56	356.67	1.00	356.67	1.20	1.02	1.02
25.22	435.48	350.66	1.00	350.66	1.22	1.02	1.02

:: Strength loss calculation (Robertson (2009) :: (continued)

Depth (ft)	q_t (tsf)	Q_{tn}	K_c	$Q_{tn,cs}$	I_c	$S_{u(liq)}/\sigma'_v$	$S_{u(peak)}/\sigma'_v$
25.27	431.16	346.98	1.00	346.98	1.22	1.02	1.02
25.34	427.79	343.95	1.00	343.95	1.22	1.02	1.02
25.40	428.40	344.21	1.00	344.21	1.21	1.02	1.02
25.48	432.02	346.82	1.00	346.82	1.21	1.02	1.02
25.53	435.48	349.39	1.00	349.39	1.20	1.02	1.02
25.60	433.15	347.26	1.00	347.26	1.22	1.02	1.02
25.67	433.32	347.12	1.00	347.12	1.21	1.02	1.02
25.73	436.69	349.59	1.00	349.59	1.21	1.02	1.02
25.80	439.88	351.88	1.00	351.88	1.22	1.02	1.02
25.86	442.30	353.55	1.00	353.55	1.26	1.02	1.02
25.94	449.47	358.97	1.00	358.97	1.29	1.02	1.02
26.00	449.21	358.50	1.00	358.50	1.31	1.02	1.02
26.07	449.21	358.21	1.00	358.21	1.26	1.02	1.02
26.12	448.95	357.82	1.00	357.82	1.20	1.02	1.02
26.21	452.75	360.49	1.00	360.49	1.20	1.03	1.03
26.25	454.99	362.11	1.00	362.11	1.21	1.03	1.03
26.34	421.23	334.79	1.00	334.79	1.27	1.01	1.01
26.39	411.31	326.70	1.00	326.70	1.29	1.01	1.01
26.46	411.74	326.76	1.00	326.76	1.28	1.01	1.01
26.52	411.74	326.56	1.00	326.56	1.27	1.01	1.01
26.60	412.17	326.58	1.00	326.58	1.27	1.01	1.01
26.65	425.21	336.78	1.00	336.78	1.25	1.01	1.01
26.71	436.70	345.69	1.00	345.69	1.24	1.02	1.02
26.78	444.21	351.36	1.00	351.36	1.24	1.02	1.02
26.86	452.50	357.61	1.00	357.61	1.21	1.02	1.02
26.91	457.68	361.51	1.00	361.51	1.21	1.03	1.03
26.97	459.06	362.39	1.00	362.39	1.24	1.03	1.03
27.04	467.52	368.80	1.00	368.80	1.25	1.03	1.03
27.14	482.03	379.86	1.00	379.86	1.22	1.03	1.03
27.17	482.46	380.07	1.00	380.07	1.21	1.03	1.03
27.25	477.54	375.82	1.00	375.82	1.22	1.03	1.03
27.31	472.36	371.48	1.00	371.48	1.21	1.03	1.03
27.36	450.94	354.36	1.00	354.36	1.22	1.02	1.02
27.44	449.56	352.96	1.00	352.96	1.20	1.02	1.02
27.50	450.99	353.87	1.00	353.87	1.20	1.02	1.02
27.59	451.72	354.11	1.00	354.11	1.20	1.02	1.02
27.63	451.03	353.38	1.00	353.38	1.21	1.02	1.02
27.69	447.84	350.66	1.00	350.66	1.22	1.02	1.02
27.77	447.75	350.30	1.00	350.30	1.21	1.02	1.02
27.85	445.59	348.28	1.00	348.28	1.20	1.02	1.02
27.91	449.30	350.98	1.00	350.98	1.19	1.02	1.02
27.95	449.39	350.87	1.00	350.87	1.17	1.02	1.02
28.02	449.56	350.77	1.00	350.77	1.11	1.02	1.02
28.10	452.93	353.11	1.00	353.11	1.12	1.02	1.02
28.17	462.77	360.53	1.00	360.53	1.14	1.03	1.03
28.22	468.82	365.09	1.00	365.09	1.17	1.03	1.03
28.28	482.81	375.74	1.00	375.74	1.19	1.03	1.03
28.36	470.89	366.12	1.00	366.12	1.19	1.03	1.03

:: Strength loss calculation (Robertson (2009) :: (continued)

Depth (ft)	q_t (tsf)	Q_{tn}	K_c	$Q_{tn,cs}$	I_c	$S_{u(liq)}/\sigma'_v$	$S_{u(peak)}/\sigma'_v$
28.42	503.18	391.06	1.00	391.06	1.14	1.04	1.04
28.50	517.17	401.65	1.00	401.65	1.15	1.04	1.04
28.55	515.79	400.35	1.00	400.35	1.16	1.04	1.04
28.61	521.40	404.42	1.00	404.42	1.13	1.05	1.05
28.69	518.90	402.13	1.00	402.13	1.16	1.04	1.04
28.76	528.74	409.48	1.00	409.48	1.18	1.05	1.05
28.81	527.02	407.92	1.00	407.92	1.19	1.05	1.05
28.87	512.51	396.37	1.00	396.37	1.22	1.04	1.04
28.94	493.77	381.55	1.00	381.55	1.24	1.04	1.04
29.01	476.68	368.02	1.00	368.02	1.26	1.03	1.03
29.08	457.77	353.09	1.00	353.09	1.32	1.02	1.02
29.14	456.38	351.78	1.00	351.78	1.33	1.02	1.02
29.21	446.02	343.47	1.00	343.47	1.31	1.02	1.02
29.27	451.20	347.26	1.00	347.26	1.29	1.02	1.02
29.34	449.04	345.32	1.00	345.32	1.29	1.02	1.02
29.41	446.37	343.02	1.00	343.02	1.29	1.02	1.02
29.48	440.76	338.43	1.00	338.43	1.30	1.01	1.01
29.53	435.66	334.29	1.00	334.29	1.30	1.01	1.01
29.61	435.66	334.03	1.00	334.03	1.23	1.01	1.01
29.66	436.44	334.45	1.00	334.45	1.16	1.01	1.01
29.73	436.44	334.24	1.00	334.24	1.11	1.01	1.01
29.81	430.65	329.51	1.00	329.51	1.15	1.01	1.01
29.88	424.26	324.37	1.00	324.37	1.21	1.01	1.01
29.93	410.01	313.26	1.00	313.26	1.25	1.00	1.00
30.00	299.84	228.54	1.00	228.54	1.49	0.95	0.95
30.07	372.89	284.33	1.00	284.33	1.40	0.99	0.99
30.13	369.60	281.64	1.00	281.64	1.43	0.98	0.98
30.20	372.46	283.62	1.00	283.62	1.46	0.99	0.99
30.27	372.03	283.07	1.00	283.07	1.49	0.99	0.99
30.32	384.29	292.28	1.00	292.28	1.48	0.99	0.99
30.40	402.51	305.94	1.00	305.94	1.48	1.00	1.00
30.45	425.91	323.63	1.00	323.63	1.48	1.01	1.01
30.53	479.28	364.03	1.00	364.03	1.40	1.03	1.03
30.58	521.76	396.20	1.00	396.20	1.25	1.04	1.04
30.64	572.10	434.28	1.00	434.28	1.07	1.06	1.06
30.71	634.62	481.53	1.00	481.53	1.10	1.08	1.08
30.80	672.35	509.77	1.00	509.77	1.06	1.09	1.09
30.84	688.06	521.47	1.00	521.47	1.08	1.09	1.09
30.92	671.66	508.59	1.00	508.59	1.17	1.09	1.09
30.98	668.38	505.77	1.00	505.77	1.16	1.09	1.09
31.07	668.81	505.62	1.00	505.62	1.02	1.09	1.09
31.11	669.24	505.70	1.00	505.70	1.03	1.09	1.09
31.18	674.08	509.00	1.00	509.00	1.05	1.09	1.09
31.24	690.21	520.87	1.00	520.87	1.06	1.09	1.09
31.32	724.84	546.64	1.00	546.64	1.03	1.10	1.10
31.37	671.73	506.21	1.00	506.21	1.09	1.09	1.09
31.44	680.28	512.26	1.00	512.26	1.13	1.09	1.09
31.50	684.51	515.13	1.00	515.13	1.12	1.09	1.09

:: Strength loss calculation (Robertson (2009) :: (continued)

Depth (ft)	q_t (tsf)	Q_{tn}	K_c	$Q_{tn,cs}$	I_c	$S_{u(liq)}/\sigma'_v$	$S_{u(peak)}/\sigma'_v$
31.56	666.39	501.13	1.00	501.13	1.03	1.08	1.08
31.65	682.88	513.07	1.00	513.07	1.02	1.09	1.09
31.70	636.34	477.78	1.00	477.78	1.10	1.08	1.08
31.79	681.24	-1.00	1.00	-1.00	-1.00	N/A	N/A
31.83	688.67	-1.00	1.00	-1.00	-1.00	N/A	N/A
31.89	658.02	-1.00	1.00	-1.00	-1.00	N/A	N/A
31.96	730.98	-1.00	1.00	-1.00	-1.00	N/A	N/A
32.03	796.26	-1.00	1.00	-1.00	-1.00	N/A	N/A
32.09	852.30	-1.00	1.00	-1.00	-1.00	N/A	N/A

Abbreviations

q_t: Total cone resistance
K_c: Cone resistance correction factor due to fines
$Q_{tn,cs}$: Adjusted and corrected cone resistance due to fines
I_c: Soil behavior type index
$S_{u(liq)}/\sigma'_v$: Calculated liquefied undrained strength ratio
$S_{u(peak)}/\sigma'_v$: Calculated peak undrained strength ratio

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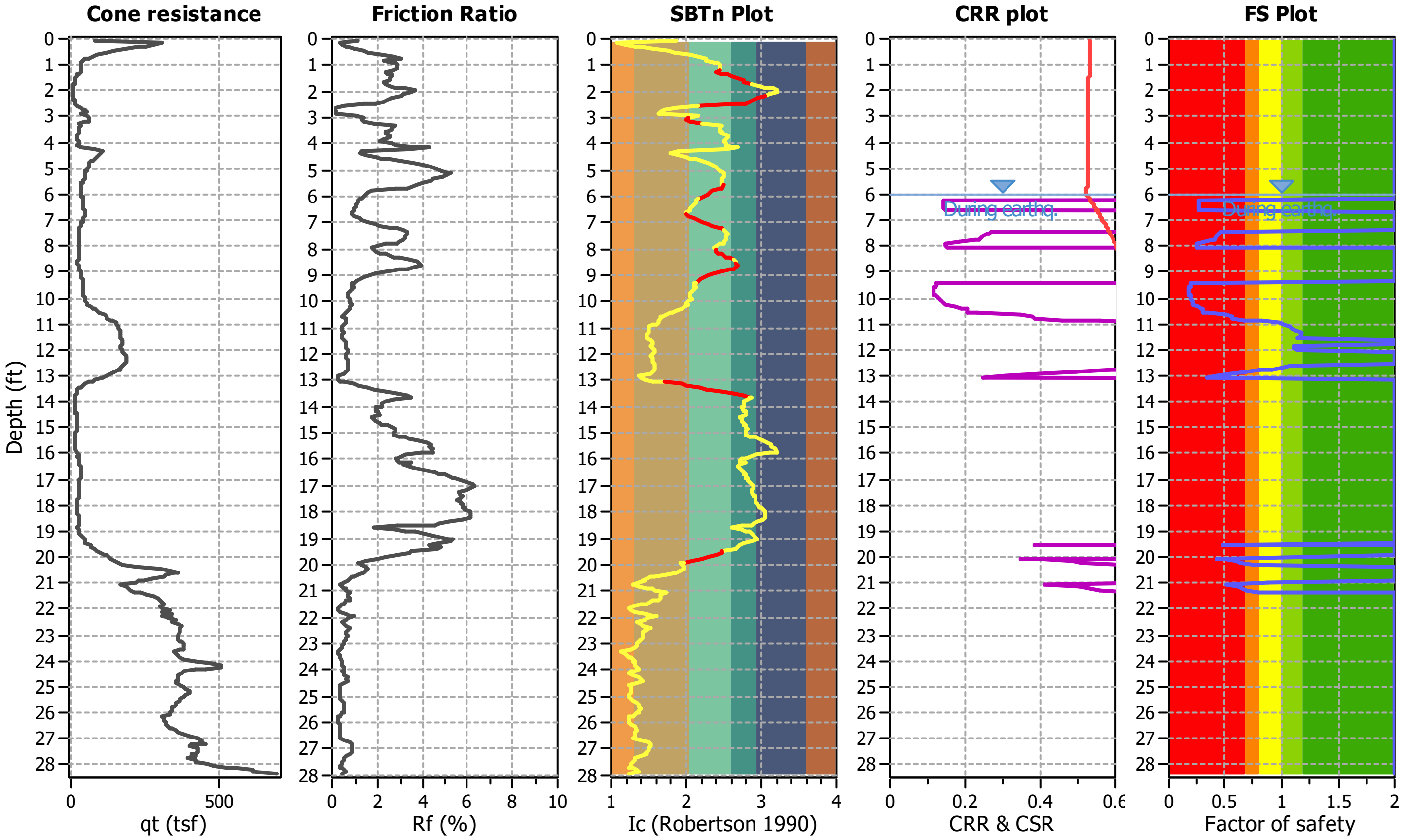
LIQUEFACTION ANALYSIS REPORT

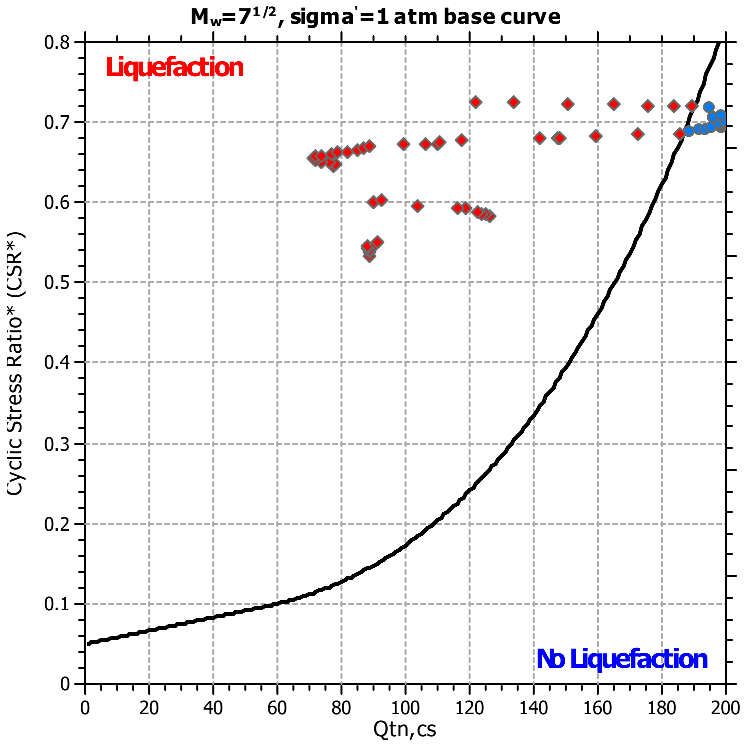
Project title : Twining Consulting **Location : 4112 Del Rey Ave, Marina Del Rey, CA**

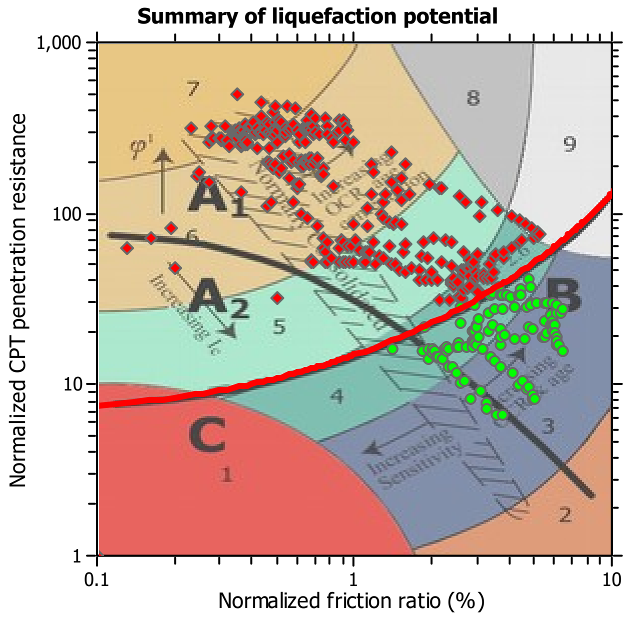
CPT file : CPT-3

Input parameters and analysis data

Analysis method:	NCEER (1998)	G.W.T. (in-situ):	22.00 ft	Use fill:	No	Clay like behavior applied:	Sands only
Fines correction method:	NCEER (1998)	G.W.T. (earthq.):	6.00 ft	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	1	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	7.31	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.87	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

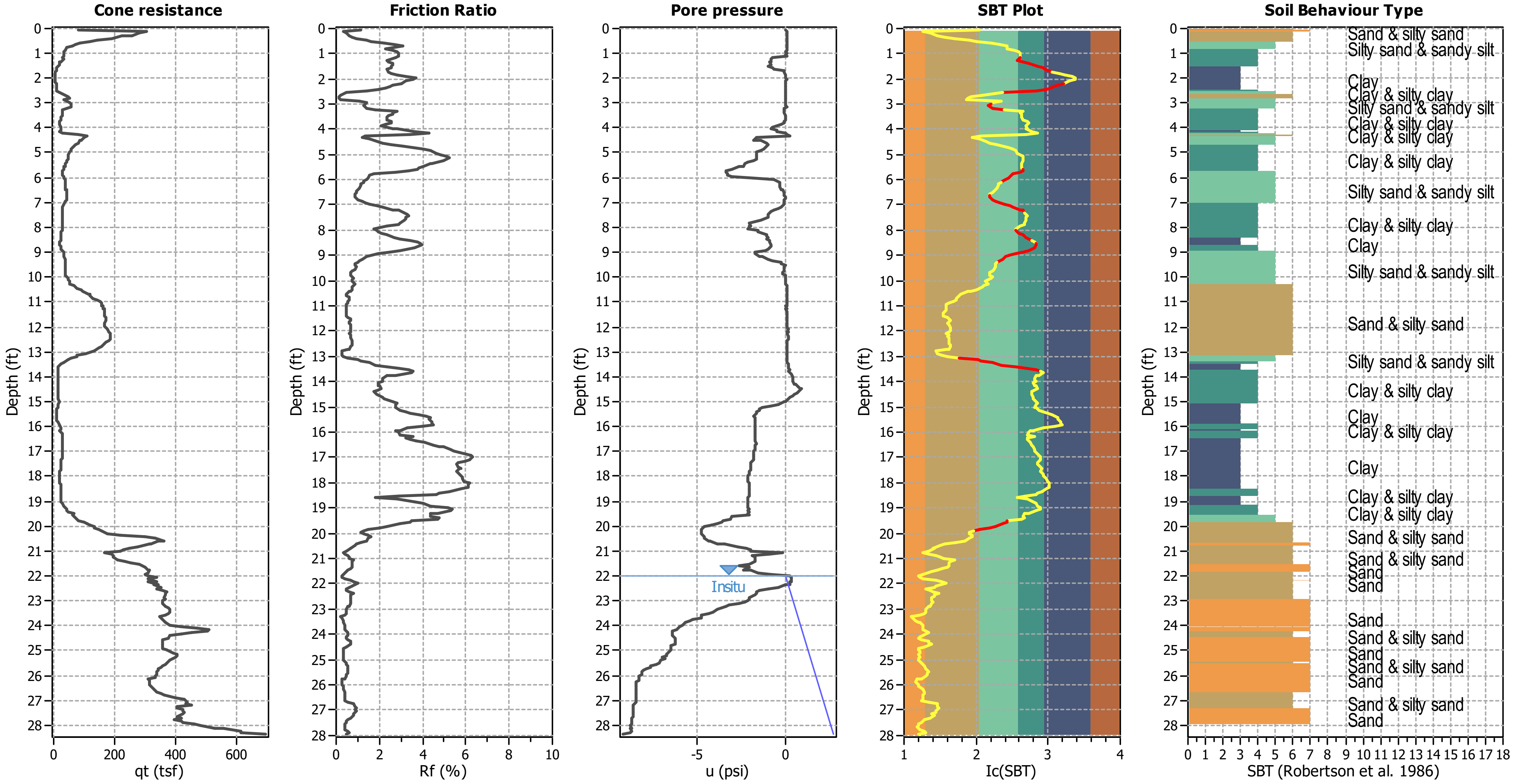






Zone A_1: Cyclic liquefaction likely depending on size and duration of cyclic loading
Zone A_2: Cyclic liquefaction and strength loss likely depending on loading and ground geometry
Zone B: Liquefaction and post-earthquake strength loss unlikely, check cyclic softening
Zone C: Cyclic liquefaction and strength loss possible depending on soil plasticity, brittleness/sensitivity, strain to peak undrained strength and ground geometry

CPT basic interpretation plots



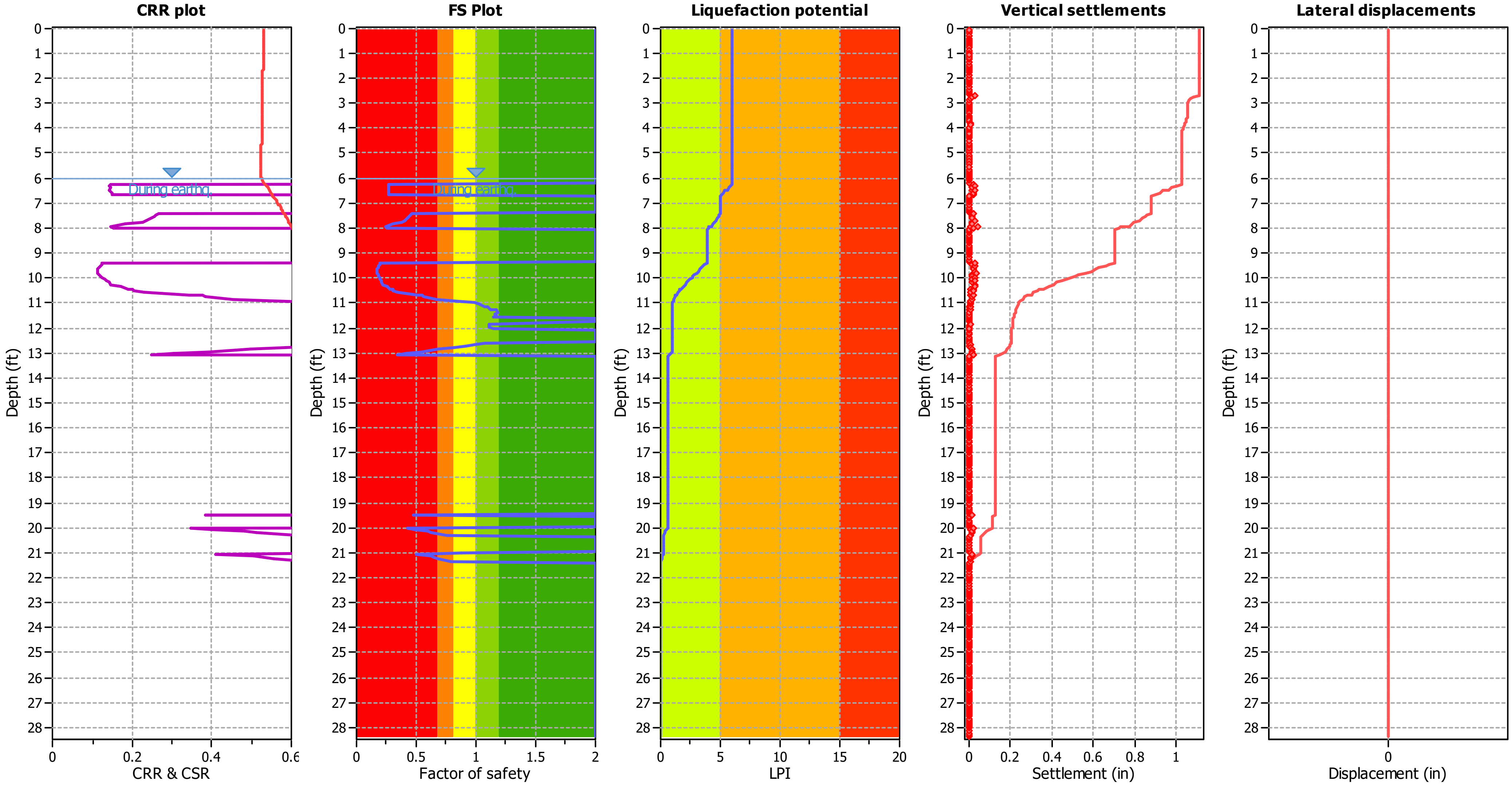
Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	6.00 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	1	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	7.31	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.87	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	22.00 ft	Fill height:	N/A	Limit depth:	N/A

SBT legend

1. Sensitive fine grained
2. Organic material
3. Clay to silty clay
4. Clayey silt to silty
5. Silty sand to sandy silt
6. Clean sand to silty sand
7. Gravely sand to sand
8. Very stiff sand to
9. Very stiff fine grained

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	6.00 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	1	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	7.31	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.87	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	22.00 ft	Fill height:	N/A	Limit depth:	N/A

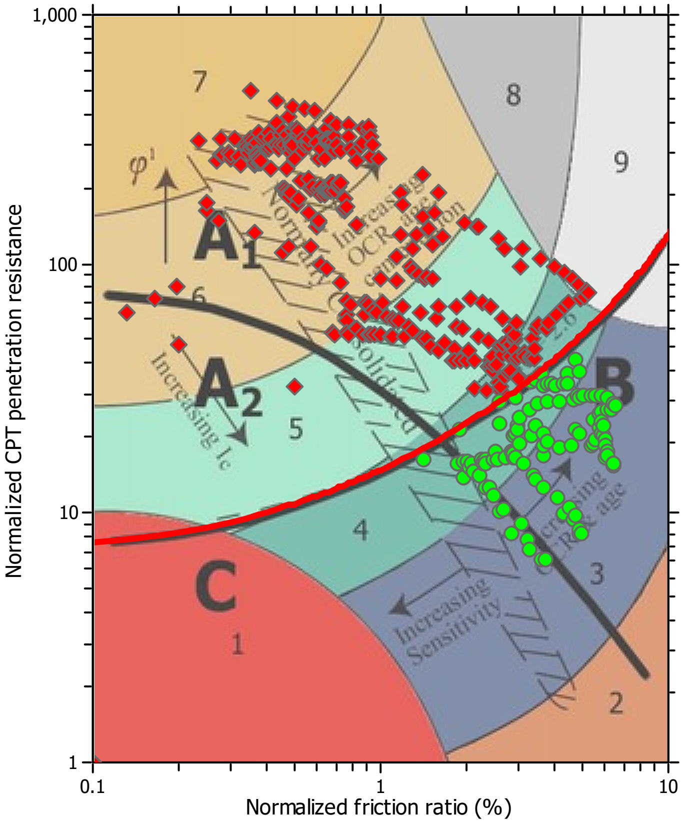
F.S. color scheme

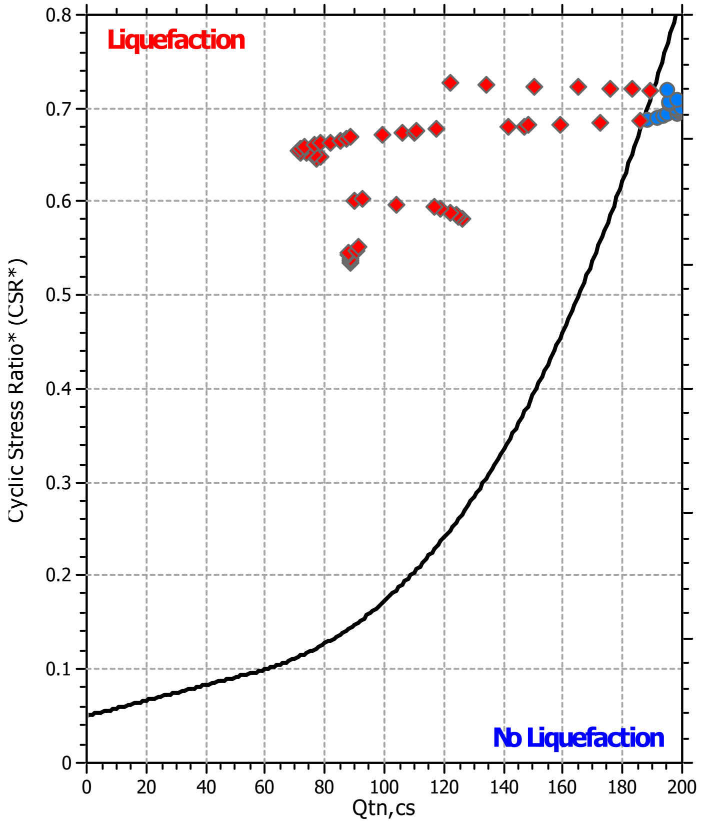
- Almost certain it will liquefy
- Very likely to liquefy
- Liquefaction and no liq. are equally likely
- Unlike to liquefy
- Almost certain it will not liquefy

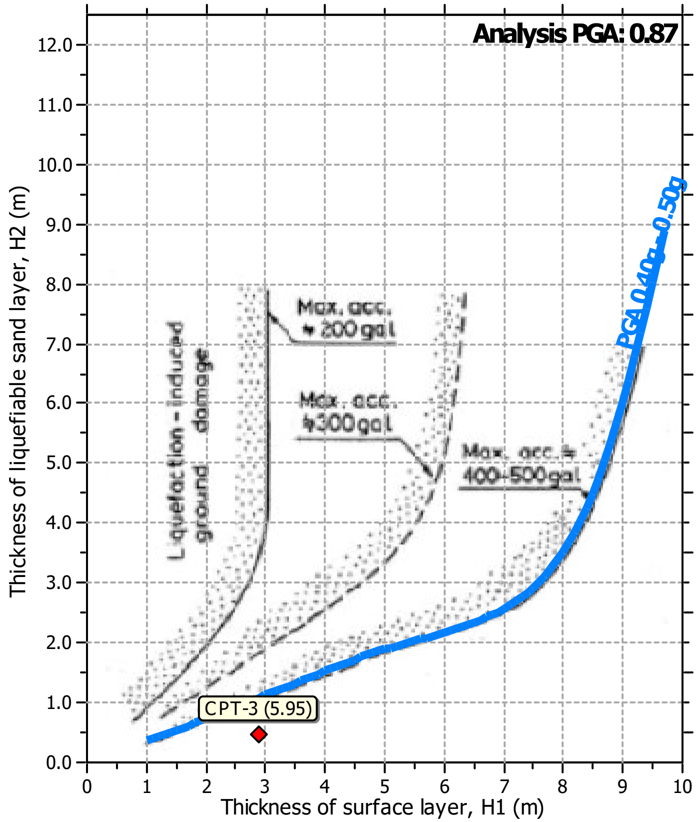
LPI color scheme

- Very high risk
- High risk
- Low risk

Liquefaction analysis summary plots







Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	6.00 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	1	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	7.31	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.87	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	22.00 ft	Fill height:	N/A	Limit depth:	N/A

:: Field input data ::

Point ID	Depth (ft)	q_c (tsf)	f_s (tsf)	u (tsf)	Fines content (%)	Unit weight (pcf)
1	0.07	80.93	0.95	0.00	9.68	120.58
2	0.15	306.43	1.08	0.09	0.00	124.77
3	0.20	281.13	1.23	0.09	0.00	125.53
4	0.28	255.30	1.50	0.09	0.51	126.78
5	0.34	225.77	1.59	0.09	1.57	126.90
6	0.40	188.37	1.78	0.09	3.59	127.26
7	0.47	143.20	2.00	0.09	7.26	127.46
8	0.53	121.00	1.92	0.09	9.18	126.75
9	0.59	87.40	1.92	0.09	14.24	125.94
10	0.66	72.29	1.95	0.09	17.93	125.59
11	0.72	60.37	1.86	0.09	21.18	124.81
12	0.79	43.44	0.98	0.09	21.20	119.33
13	0.87	37.40	0.98	0.09	24.69	118.99
14	0.93	33.42	0.94	0.00	26.95	118.40
15	0.98	31.09	0.90	0.09	28.29	117.92
16	1.07	32.22	0.94	0.04	27.84	118.28
17	1.12	31.01	0.90	0.09	28.31	117.88
18	1.19	30.32	0.83	-0.69	27.94	117.26
19	1.25	30.66	0.73	-0.78	26.02	116.30
20	1.33	24.70	0.60	-0.78	29.28	114.36
21	1.38	20.30	0.53	-0.87	33.18	112.98
22	1.45	17.36	0.45	-0.78	35.69	111.44
23	1.51	14.25	0.37	-0.95	38.95	109.41
24	1.59	10.97	0.28	-0.69	43.59	106.69
25	1.64	9.93	0.23	-0.61	44.44	105.12
26	1.73	7.86	0.19	-0.09	49.90	103.08
27	1.78	6.39	0.17	-0.09	55.90	101.61
28	1.86	5.18	0.14	0.00	62.56	100.15
29	1.90	4.49	0.14	0.00	68.98	99.81
30	1.98	4.15	0.15	0.00	73.64	99.96
31	2.05	4.15	0.15	0.09	72.94	99.68
32	2.11	4.92	0.16	0.00	66.35	100.62
33	2.19	5.70	0.17	0.00	61.57	101.69
34	2.23	6.56	0.17	0.00	55.70	102.01
35	2.32	7.34	0.18	0.00	52.02	102.61
36	2.37	7.95	0.18	0.00	49.13	102.86
37	2.44	8.72	0.17	0.00	44.69	102.48
38	2.50	10.19	0.14	0.00	37.68	101.72
39	2.57	20.21	0.10	0.00	5.00	100.77
40	2.63	29.62	0.06	0.00	5.00	97.80
41	2.70	39.73	0.05	0.00	5.00	97.59
42	2.76	45.17	0.07	0.00	5.00	100.45
43	2.83	50.61	0.10	0.00	5.00	102.88
44	2.89	32.13	0.34	0.00	17.66	110.93
45	2.97	54.15	0.77	0.00	14.58	118.11
46	3.02	56.14	0.76	0.00	13.87	118.12
47	3.09	59.08	0.76	0.00	13.01	118.25
48	3.15	55.45	0.79	0.09	14.40	118.37

:: Field input data :: (continued)

Point ID	Depth (ft)	q_c (tsf)	f_s (tsf)	u (tsf)	Fines content (%)	Unit weight (pcf)
49	3.22	42.41	0.78	-0.03	19.40	117.59
50	3.28	26.86	0.75	-0.03	29.94	116.20
51	3.36	29.02	0.75	-0.09	27.88	116.39
52	3.42	27.38	0.72	-0.09	28.82	115.90
53	3.49	26.43	0.64	0.00	28.42	115.02
54	3.55	24.70	0.59	0.00	29.11	114.19
55	3.62	24.18	0.57	0.00	29.32	113.92
56	3.70	20.90	0.53	0.00	32.58	113.10
57	3.75	19.69	0.51	-0.09	33.61	112.56
58	3.81	19.69	0.45	-0.09	32.22	111.77
59	3.87	19.86	0.42	-0.26	30.99	111.20
60	3.96	22.37	0.59	-0.69	32.00	114.02
61	4.01	23.58	0.66	-0.78	31.89	114.92
62	4.10	22.80	0.82	-0.52	36.00	116.48
63	4.14	20.73	0.89	-0.52	40.21	116.82
64	4.22	28.59	0.98	0.00	31.77	118.28
65	4.27	81.45	1.08	0.09	10.57	121.55
66	4.34	108.13	1.28	0.26	7.85	123.52
67	4.40	99.76	1.52	-1.65	10.19	124.57
68	4.49	92.16	1.78	-1.82	12.73	125.54
69	4.53	87.66	1.89	-1.39	14.08	125.83
70	4.60	79.46	2.05	-1.04	16.67	126.18
71	4.67	72.46	2.24	-0.95	19.51	126.62
72	4.73	65.64	2.36	-1.04	22.25	126.74
73	4.80	60.98	2.46	-1.13	24.49	126.87
74	4.87	57.78	2.52	-1.21	26.17	126.94
75	4.94	54.84	2.53	-1.39	27.54	126.83
76	4.99	51.99	2.52	-1.65	28.87	126.67
77	5.07	48.97	2.51	-1.65	30.42	126.49
78	5.12	47.68	2.50	-1.65	31.09	126.39
79	5.20	46.73	2.38	-1.65	30.94	126.00
80	5.25	45.26	2.24	-1.65	30.90	125.47
81	5.34	44.22	1.96	-1.82	29.61	124.45
82	5.38	42.49	1.85	-2.17	29.84	123.91
83	5.46	39.64	1.60	-2.34	29.67	122.69
84	5.53	36.88	1.40	-2.43	29.77	121.53
85	5.58	34.37	1.29	-2.60	30.53	120.74
86	5.66	31.78	1.06	-3.03	30.06	119.14
87	5.72	29.88	0.83	-3.38	28.53	117.20
88	5.78	29.11	0.52	-3.38	23.68	113.64
89	5.84	28.42	0.44	-3.29	22.69	112.47
90	5.93	29.54	0.44	-3.29	21.66	112.45
91	5.97	31.70	0.44	-3.03	20.18	112.67
92	6.05	34.29	0.44	-1.85	18.53	112.86
93	6.11	35.32	0.44	-0.61	17.93	112.94
94	6.18	37.57	0.43	-0.35	16.54	112.93
95	6.24	37.40	0.42	-0.35	16.38	112.68
96	6.32	37.66	0.41	-0.35	16.18	112.64

:: Field input data :: (continued)

Point ID	Depth (ft)	q_c (tsf)	f_s (tsf)	u (tsf)	Fines content (%)	Unit weight (pcf)
97	6.38	38.87	0.40	-0.35	15.41	112.54
98	6.46	39.99	0.38	-0.26	14.54	112.26
99	6.50	40.68	0.38	-0.17	14.17	112.22
100	6.58	43.18	0.39	-0.09	13.27	112.50
101	6.64	43.96	0.39	-0.09	12.97	112.54
102	6.70	44.05	0.39	-0.09	13.03	112.64
103	6.77	43.88	0.44	0.00	13.96	113.52
104	6.85	42.32	0.50	0.00	15.59	114.36
105	6.91	40.16	0.55	-0.09	17.29	114.85
106	6.96	37.66	0.58	-0.09	19.13	115.13
107	7.05	34.63	0.66	-0.09	22.26	115.88
108	7.09	32.47	0.70	-0.09	24.37	116.12
109	7.18	29.80	0.78	-0.26	27.92	116.77
110	7.23	28.50	0.82	-0.43	29.74	117.02
111	7.30	27.64	0.86	-0.61	31.24	117.30
112	7.36	26.95	0.89	-0.78	32.43	117.49
113	7.45	26.26	0.88	-0.87	33.04	117.34
114	7.50	26.86	0.87	-0.95	32.20	117.30
115	7.55	26.43	0.86	-0.95	32.43	117.14
116	7.61	26.77	0.84	-0.95	31.75	117.00
117	7.72	26.95	0.79	-1.39	30.86	116.62
118	7.76	26.43	0.77	-1.73	30.91	116.30
119	7.81	26.00	0.61	-2.08	28.52	114.60
120	7.94	25.95	0.46	-1.99	25.23	112.45
121	7.97	25.95	0.46	-2.08	25.30	112.50
122	8.03	25.91	0.48	-2.08	25.91	112.88
123	8.07	25.91	0.50	-2.17	26.36	113.17
124	8.14	25.82	0.54	-1.56	27.21	113.66
125	8.20	24.57	0.58	-1.56	29.51	114.14
126	8.28	23.23	0.63	-1.04	32.06	114.56
127	8.34	22.28	0.66	-1.04	33.92	114.81
128	8.40	21.51	0.73	-0.95	36.38	115.44
129	8.47	20.99	0.78	-1.04	38.24	115.91
130	8.53	20.99	0.81	-0.87	38.73	116.15
131	8.60	20.56	0.82	-0.87	39.61	116.19
132	8.68	20.73	0.75	-0.78	38.01	115.57
133	8.74	21.16	0.70	-0.78	36.30	115.09
134	8.80	22.54	0.67	-0.87	33.75	114.92
135	8.88	25.05	0.62	-0.95	29.71	114.59
136	8.94	28.50	0.56	-1.13	25.23	114.21
137	9.01	30.66	0.51	-1.73	22.40	113.63
138	9.07	32.30	0.46	-1.73	20.50	113.05
139	9.14	33.34	0.40	-1.47	18.80	112.10
140	9.19	34.12	0.37	-1.30	17.79	111.57
141	9.27	35.24	0.35	-0.95	16.83	111.21
142	9.33	35.67	0.32	-0.69	16.07	110.61
143	9.41	35.76	0.32	-0.26	16.18	110.72
144	9.46	35.84	0.33	-0.26	16.43	110.99

:: Field input data :: (continued)

Point ID	Depth (ft)	q_c (tsf)	f_s (tsf)	u (tsf)	Fines content (%)	Unit weight (pcf)
145	9.54	36.19	0.31	0.00	15.82	110.47
146	9.60	36.71	0.28	-0.09	14.89	109.68
147	9.65	37.31	0.25	-0.09	14.06	108.99
148	9.72	37.31	0.25	-0.09	14.09	108.96
149	9.82	37.40	0.25	-0.17	14.21	109.09
150	9.86	36.79	0.28	-0.17	15.14	109.82
151	9.91	38.87	0.31	0.00	14.94	110.72
152	9.99	42.58	0.32	0.00	13.68	111.12
153	10.04	46.03	0.35	0.00	12.93	111.83
154	10.13	45.69	0.40	0.00	13.94	112.80
155	10.18	50.27	0.39	0.00	12.42	112.94
156	10.26	52.94	0.40	0.00	11.82	113.23
157	10.35	64.52	0.46	0.09	9.93	114.78
158	10.43	73.50	0.48	0.09	8.46	115.32
159	10.45	77.99	0.48	0.09	7.79	115.53
160	10.53	88.53	0.40	0.09	5.00	114.56
161	10.57	94.49	0.45	0.09	5.00	115.49
162	10.67	113.75	0.68	0.09	5.30	118.96
163	10.71	119.71	0.72	0.09	5.07	119.55
164	10.77	120.92	0.73	0.09	5.06	119.70
165	10.84	129.90	0.73	0.09	4.31	119.81
166	10.89	141.21	0.72	0.09	3.48	119.95
167	10.96	152.35	0.73	0.09	2.87	120.23
168	11.04	155.20	0.73	0.09	2.73	120.29
169	11.13	158.83	0.76	0.09	2.68	120.59
170	11.17	160.39	0.78	0.00	2.74	120.87
171	11.26	162.55	0.77	0.09	2.57	120.75
172	11.29	165.57	0.76	0.00	2.40	120.76
173	11.38	166.86	0.76	0.09	2.36	120.78
174	11.44	166.69	0.94	0.09	3.18	122.31
175	11.52	167.81	1.07	0.09	3.69	123.29
176	11.57	167.04	1.09	0.09	3.79	123.36
177	11.63	169.37	1.07	0.09	3.61	123.28
178	11.69	173.08	1.07	0.09	3.41	123.31
179	11.75	172.39	1.11	0.09	3.62	123.58
180	11.84	167.55	1.12	0.09	3.99	123.62
181	11.89	167.90	1.12	0.09	3.98	123.63
182	11.95	168.50	1.11	0.09	3.91	123.55
183	12.01	170.84	1.09	0.09	3.71	123.46
184	12.07	174.81	1.00	0.17	3.15	122.89
185	12.17	179.56	1.18	0.09	3.61	124.14
186	12.23	183.27	1.22	0.17	3.57	124.41
187	12.29	185.00	1.25	0.09	3.62	124.64
188	12.38	184.40	1.33	0.17	3.94	125.06
189	12.43	186.56	1.32	0.17	3.83	125.07
190	12.47	183.71	1.31	0.17	3.94	124.96
191	12.55	180.68	1.28	0.09	4.00	124.74
192	12.62	172.48	1.18	0.09	4.11	124.05

:: Field input data :: (continued)

Point ID	Depth (ft)	q_c (tsf)	f_s (tsf)	u (tsf)	Fines content (%)	Unit weight (pcf)
193	12.69	168.16	1.04	0.09	3.78	123.03
194	12.74	163.15	0.84	0.09	3.21	121.43
195	12.80	156.76	0.39	0.09	1.20	115.73
196	12.87	147.34	0.36	0.09	1.46	115.01
197	12.94	134.91	0.37	0.09	2.16	114.91
198	13.00	120.57	0.44	0.09	3.63	115.90
199	13.08	104.33	0.59	0.09	6.33	117.80
200	13.14	76.35	0.75	0.09	11.74	118.76
201	13.19	74.45	0.83	0.09	12.85	119.44
202	13.26	57.52	0.90	0.09	18.04	119.35
203	13.33	47.50	0.86	0.09	21.60	118.56
204	13.42	31.78	0.75	0.09	29.96	116.64
205	13.47	24.36	0.70	0.17	36.68	115.48
206	13.54	18.66	0.62	0.17	43.64	113.93
207	13.61	15.63	0.55	0.17	48.22	112.63
208	13.65	14.34	0.50	0.17	50.01	111.72
209	13.74	14.16	0.39	0.26	46.68	109.81
210	13.78	14.16	0.33	0.17	44.58	108.70
211	13.87	13.91	0.30	0.35	43.84	107.86
212	13.92	13.82	0.30	0.35	44.09	107.83
213	13.98	13.73	0.30	0.43	44.35	107.78
214	14.05	13.73	0.27	0.43	43.08	107.03
215	14.14	13.39	0.26	0.43	43.49	106.64
216	14.19	12.87	0.26	0.43	44.91	106.54
217	14.28	12.52	0.26	0.52	46.14	106.54
218	14.32	13.04	0.26	0.61	44.72	106.63
219	14.41	14.16	0.25	0.78	41.58	106.58
220	14.47	14.42	0.26	0.87	41.76	107.05
221	14.50	14.51	0.28	0.95	42.19	107.41
222	14.60	14.68	0.31	0.78	43.46	108.30
223	14.65	14.86	0.33	0.69	43.67	108.64
224	14.72	14.94	0.36	0.52	45.11	109.46
225	14.77	15.11	0.39	0.43	45.87	110.05
226	14.84	15.29	0.43	0.26	46.91	110.76
227	14.90	15.81	0.44	0.17	46.02	110.97
228	14.99	16.24	0.44	0.00	45.33	111.11
229	15.03	16.15	0.44	-0.09	45.57	111.09
230	15.13	14.77	0.44	-0.43	48.90	110.82
231	15.18	13.30	0.43	-0.78	52.58	110.34
232	15.22	11.92	0.41	-1.30	56.62	109.81
233	15.30	10.97	0.42	-1.47	60.79	109.74
234	15.36	10.10	0.42	-1.47	64.82	109.56
235	15.43	9.50	0.41	-1.65	67.63	109.28
236	15.49	9.24	0.40	-1.65	68.28	108.90
237	15.58	8.55	0.38	-1.82	71.68	108.42
238	15.63	8.29	0.36	-1.73	72.57	108.05
239	15.71	8.29	0.37	-1.73	73.04	108.16
240	15.76	9.85	0.39	-1.73	65.30	108.93

:: Field input data :: (continued)

Point ID	Depth (ft)	q_c (tsf)	f_s (tsf)	u (tsf)	Fines content (%)	Unit weight (pcf)
241	15.84	13.21	0.43	-1.73	54.02	110.39
242	15.94	18.48	0.54	-1.73	44.82	112.87
243	15.95	19.78	0.55	-1.73	42.71	113.17
244	16.03	21.59	0.62	-1.73	41.53	114.26
245	16.12	23.49	0.69	-1.73	40.41	115.29
246	16.15	20.38	0.72	-1.73	46.01	115.24
247	16.21	25.13	0.80	-1.73	40.39	116.53
248	16.29	26.77	0.91	-1.73	40.30	117.63
249	16.35	27.21	1.00	-1.73	41.17	118.33
250	16.42	27.55	1.13	-1.73	42.65	119.22
251	16.51	28.07	1.27	-1.73	44.03	120.14
252	16.55	28.67	1.36	-1.73	44.52	120.72
253	16.60	29.28	1.46	-1.73	44.94	121.26
254	16.69	29.54	1.57	-1.65	45.98	121.81
255	16.74	29.71	1.61	-1.73	46.34	122.05
256	16.80	29.45	1.68	-1.73	47.43	122.31
257	16.86	28.93	1.73	-1.73	48.72	122.49
258	16.94	27.90	1.75	-1.73	50.35	122.46
259	17.00	27.47	1.74	-1.82	50.92	122.38
260	17.09	26.69	1.65	-1.82	51.19	121.94
261	17.14	26.69	1.59	-1.82	50.57	121.67
262	17.23	26.34	1.48	-1.82	49.93	121.14
263	17.26	26.00	1.45	-1.82	50.02	120.92
264	17.36	24.27	1.37	-1.82	51.86	120.36
265	17.41	23.41	1.35	-1.91	53.07	120.16
266	17.46	23.32	1.33	-1.99	52.98	120.03
267	17.53	23.32	1.29	-1.99	52.56	119.83
268	17.63	22.28	1.26	-1.99	54.08	119.53
269	17.65	21.94	1.25	-1.99	54.61	119.45
270	17.72	21.25	1.22	-1.99	55.59	119.20
271	17.81	20.21	1.17	-2.08	57.05	118.77
272	17.86	19.26	1.13	-2.08	58.44	118.37
273	17.94	18.48	1.09	-2.08	59.59	117.98
274	18.00	17.27	1.06	-2.17	62.25	117.64
275	18.08	17.32	1.06	-2.17	62.23	117.65
276	18.14	17.32	1.06	-2.17	62.32	117.65
277	18.21	17.36	1.06	-2.17	62.34	117.66
278	18.27	18.66	1.08	-2.08	59.43	117.94
279	18.34	20.99	1.09	-2.08	54.78	118.34
280	18.41	23.23	1.10	-2.08	50.91	118.66
281	18.48	24.01	1.10	-2.08	49.69	118.74
282	18.54	24.27	0.70	-2.08	42.02	115.44
283	18.57	24.10	0.44	-2.08	35.90	111.96
284	18.66	23.23	0.66	-2.08	42.74	114.86
285	18.71	23.06	0.74	-2.08	44.82	115.70
286	18.77	22.11	0.81	-2.08	47.89	116.25
287	18.84	20.99	0.84	-2.14	50.76	116.45
288	18.92	21.25	0.93	-2.14	52.01	117.18

:: Field input data :: (continued)

Point ID	Depth (ft)	q_c (tsf)	f_s (tsf)	u (tsf)	Fines content (%)	Unit weight (pcf)
289	19.00	21.51	1.10	-2.15	54.78	118.48
290	19.04	22.80	1.23	-2.15	54.34	119.38
291	19.10	26.95	1.43	-2.17	50.47	120.91
292	19.19	33.68	1.58	-2.17	43.95	122.19
293	19.23	37.22	1.61	-2.17	40.86	122.59
294	19.31	41.20	1.79	-2.08	39.17	123.60
295	19.37	42.32	2.02	-2.17	40.31	124.56
296	19.43	47.24	2.21	-2.08	38.15	125.47
297	19.50	65.29	2.29	-2.17	29.06	126.51
298	19.56	62.79	2.13	-2.08	29.20	125.90
299	19.64	66.59	1.95	-3.03	26.55	125.40
300	19.72	76.69	1.81	-3.12	22.22	125.19
301	19.77	82.31	1.65	-3.55	19.71	124.71
302	19.85	99.15	1.49	-3.64	15.01	124.38
303	19.90	110.98	1.39	-3.90	12.51	124.17
304	19.95	120.66	1.35	-4.25	10.95	124.15
305	20.04	131.63	1.68	-4.59	11.26	125.99
306	20.08	135.17	2.03	-4.68	12.31	127.41
307	20.16	145.96	2.36	-4.76	12.31	128.70
308	20.22	156.85	2.27	-4.76	10.88	128.61
309	20.28	175.33	2.43	-4.76	9.74	129.38
310	20.36	218.34	2.54	-4.68	7.08	130.22
311	20.45	302.20	2.79	-4.59	4.02	131.70
312	20.49	333.55	2.84	-4.59	3.20	132.09
313	20.58	363.87	2.50	-4.42	1.90	131.36
314	20.63	344.87	2.35	-4.33	2.07	130.77
315	20.69	319.39	1.55	-3.90	1.12	127.54
316	20.75	314.90	1.10	-3.47	0.21	124.99
317	20.81	274.22	1.14	-2.69	1.23	124.92
318	20.89	247.45	1.31	-2.25	2.50	125.67
319	20.94	229.22	1.38	-1.99	3.41	125.90
320	21.00	217.91	1.37	-1.94	3.87	125.73
321	21.07	165.91	1.37	-0.17	6.86	125.03
322	21.14	188.80	1.40	-0.87	5.47	125.52
323	21.20	193.72	1.44	-1.90	5.34	125.78
324	21.26	197.70	1.50	-1.73	5.33	126.12
325	21.34	211.34	1.58	-1.73	4.88	126.66
326	21.39	232.50	1.49	-1.73	3.66	126.49
327	21.47	254.10	1.41	-1.91	2.64	126.30
328	21.54	279.49	1.31	-2.08	1.61	125.97
329	21.61	290.80	0.94	-2.60	0.38	123.66
330	21.66	301.08	0.81	-2.04	0.00	122.66
331	21.74	309.11	0.93	-2.43	0.00	123.70
332	21.79	316.89	1.17	-1.99	0.44	125.49
333	21.87	307.64	1.97	-1.56	2.41	129.20
334	21.92	301.25	2.49	-0.84	3.66	130.88
335	21.99	307.90	3.03	0.26	4.46	132.35
336	22.07	336.58	2.45	0.35	2.59	131.01

:: Field input data :: (continued)

Point ID	Depth (ft)	q_c (tsf)	f_s (tsf)	u (tsf)	Fines content (%)	Unit weight (pcf)
337	22.13	308.16	1.88	0.35	2.23	128.86
338	22.21	338.87	1.49	0.35	0.72	127.39
339	22.25	309.98	1.55	0.26	1.46	127.45
340	22.33	341.16	2.09	0.26	1.85	129.90
341	22.38	327.42	2.63	0.00	3.18	131.48
342	22.45	352.21	2.45	-0.43	2.25	131.14
343	22.51	338.22	2.32	-0.95	2.36	130.65
344	22.58	360.16	2.32	-1.47	1.84	130.77
345	22.65	373.97	2.44	-1.65	1.76	131.24
346	22.73	369.40	2.44	-1.65	1.86	131.23
347	22.79	368.27	2.37	-1.73	1.77	131.00
348	22.88	364.91	2.19	-2.08	1.54	130.40
349	22.91	367.32	2.04	-2.08	1.23	129.88
350	23.00	359.90	1.79	-2.17	0.93	128.87
351	23.03	357.48	1.74	-2.34	0.89	128.67
352	23.10	358.60	1.66	-2.60	0.73	128.34
353	23.18	361.11	1.61	-3.21	0.58	128.12
354	23.23	366.55	1.35	-3.38	0.00	126.89
355	23.30	375.62	0.88	-3.64	0.00	123.75
356	23.37	381.06	1.06	-3.90	0.00	125.16
357	23.45	381.92	1.19	-4.16	0.00	126.06
358	23.54	378.29	1.34	-4.42	0.00	126.90
359	23.56	368.36	1.35	-4.82	0.00	126.89
360	23.65	350.05	1.42	-4.82	0.44	127.14
361	23.69	355.41	1.46	-4.82	0.43	127.39
362	23.76	357.82	1.53	-5.29	0.51	127.70
363	23.82	360.33	1.55	-5.46	0.51	127.85
364	23.89	365.51	1.77	-5.72	0.84	128.86
365	23.96	381.14	2.15	-5.89	1.20	130.36
366	24.02	421.05	2.13	-6.07	0.50	130.55
367	24.09	472.69	2.27	-6.15	0.00	131.30
368	24.16	511.13	2.51	-6.24	0.00	132.22
369	24.22	507.93	2.78	-6.41	0.19	132.94
370	24.29	454.47	3.06	-6.41	1.26	133.37
371	24.36	420.61	2.74	-6.41	1.41	132.38
372	24.42	382.35	2.52	-6.41	1.81	131.55
373	24.50	376.65	1.83	-6.33	0.77	129.17
374	24.59	358.26	1.20	-6.33	0.00	125.92
375	24.62	357.82	1.23	-6.33	0.00	126.10
376	24.68	357.82	1.28	-6.33	0.06	126.42
377	24.77	357.39	1.29	-6.33	0.09	126.48
378	24.81	359.72	1.26	-6.50	0.00	126.31
379	24.89	355.49	1.26	-6.50	0.06	126.27
380	24.95	370.35	1.27	-6.50	0.00	126.44
381	25.02	382.87	1.36	-6.58	0.00	127.03
382	25.08	389.87	1.51	-6.67	0.01	127.85
383	25.16	404.03	1.80	-6.76	0.29	129.21
384	25.20	404.03	1.89	-6.76	0.43	129.55

:: Field input data :: (continued)

Point ID	Depth (ft)	q_c (tsf)	f_s (tsf)	u (tsf)	Fines content (%)	Unit weight (pcf)
385	25.26	400.58	2.03	-7.02	0.72	130.07
386	25.35	389.87	2.09	-6.84	1.01	130.22
387	25.40	381.32	2.13	-7.11	1.22	130.28
388	25.48	370.43	2.06	-7.19	1.33	130.00
389	25.53	366.12	1.97	-7.37	1.26	129.63
390	25.62	356.62	1.76	-7.71	1.06	128.74
391	25.66	353.16	1.68	-7.71	0.98	128.38
392	25.75	344.78	1.27	-7.97	0.32	126.30
393	25.80	341.41	1.01	-8.14	0.00	124.54
394	25.86	338.74	0.94	-8.23	0.00	124.02
395	25.94	338.48	0.95	-8.23	0.00	124.11
396	26.00	336.32	1.01	-8.32	0.00	124.55
397	26.06	332.86	1.06	-8.38	0.07	124.84
398	26.15	309.20	1.12	-8.38	0.67	125.06
399	26.19	315.68	1.14	-8.38	0.60	125.29
400	26.28	314.99	1.19	-8.49	0.74	125.60
401	26.33	314.99	1.19	-8.49	0.73	125.57
402	26.38	317.23	1.19	-8.49	0.68	125.58
403	26.45	320.60	1.22	-8.49	0.68	125.77
404	26.52	328.63	1.24	-8.49	0.58	125.99
405	26.59	333.64	1.24	-8.49	0.50	126.04
406	26.64	340.81	1.27	-8.49	0.41	126.22
407	26.72	351.86	1.88	-8.49	1.43	129.20
408	26.77	362.23	2.86	-8.49	2.90	132.32
409	26.84	382.70	3.31	-8.49	3.11	133.53
410	26.90	402.22	3.69	-8.49	3.19	134.45
411	26.98	430.11	3.87	-8.49	2.84	134.96
412	27.05	440.74	4.00	-8.49	2.79	135.26
413	27.11	433.40	3.76	-8.58	2.65	134.78
414	27.18	455.08	3.53	-8.66	1.96	134.42
415	27.24	407.75	3.17	-8.66	2.37	133.36
416	27.30	404.20	2.58	-8.66	1.60	131.85
417	27.38	425.11	2.21	-8.66	0.68	130.82
418	27.44	426.75	2.10	-8.68	0.50	130.47
419	27.50	428.82	1.96	-8.68	0.26	129.97
420	27.56	422.69	1.72	-8.70	0.00	128.97
421	27.63	407.31	1.60	-8.72	0.00	128.36
422	27.70	420.53	1.59	-8.73	0.00	128.39
423	27.76	397.47	1.65	-8.75	0.23	128.52
424	27.84	418.37	2.16	-8.75	0.74	130.64
425	27.89	423.55	2.46	-8.75	1.10	131.60
426	27.96	461.73	2.01	-8.75	0.00	130.36
427	28.03	481.24	0.00	-8.85	N/A	87.36
428	28.11	529.70	0.00	-8.80	N/A	87.36
429	28.15	556.82	0.00	-8.85	N/A	87.36
430	28.22	617.71	0.00	-8.75	N/A	87.36
431	28.31	616.58	0.00	-8.84	N/A	87.36
432	28.36	697.17	0.00	-9.27	N/A	87.36

:: Field input data :: (continued)

Point ID	Depth (ft)	q_c (tsf)	f_s (tsf)	u (tsf)	Fines content (%)	Unit weight (pcf)

Abbreviations

Depth: Depth from free surface, at which CPT was performed (ft)
q_c: Measured cone resistance (tsf)
f_s: Sleeve friction resistance (tsf)
u: Pore pressure (tsf)
Fines content: Percentage of fines in soil (%)
Unit weight: Bulk soil unit weight (pcf)

:: Post-earthquake settlement of dry sands ::

Depth (ft)	Ic	Q_{tn}	Kc	$Q_{tn,cs}$	$N_{1,60}$ (blows)	G_{max} (tsf)	CSR	Shear, γ (%)	$e_{vol(15)}$ (%)	N_c	e_v (%)	Settle. (in)
0.07	1.87	130.02	1.16	151.07	30	778	0.53	0.000	0.00	13.43	0.00	0.000
0.15	1.09	492.31	1.00	492.31	76	1098	0.53	0.001	0.00	13.43	0.00	0.000
0.20	1.19	451.66	1.00	451.66	72	1135	0.53	0.001	0.00	13.43	0.00	0.000
0.28	1.31	410.15	1.00	410.15	67	1206	0.53	0.001	0.00	13.43	0.00	0.000
0.34	1.40	362.70	1.00	362.70	61	1202	0.53	0.001	0.00	13.43	0.00	0.000
0.40	1.55	302.60	1.00	302.60	54	1208	0.53	0.001	0.00	13.43	0.00	0.000
0.47	1.76	230.03	1.08	247.87	47	1195	0.53	0.002	0.00	13.43	0.00	0.000
0.53	1.85	194.35	1.14	222.22	44	1130	0.53	0.002	0.00	13.43	0.00	0.000
0.59	2.05	140.36	1.37	191.65	41	1049	0.53	0.002	0.00	13.43	0.00	0.000
0.66	2.17	116.08	1.59	184.72	41	1012	0.53	0.003	0.00	13.43	0.00	0.000
0.72	2.26	96.92	1.84	177.94	41	954	0.53	0.003	0.00	13.43	0.00	0.000
0.79	2.26	69.71	1.84	128.08	30	686	0.53	0.006	0.00	13.43	0.00	0.000
0.87	2.36	60.00	2.14	128.69	31	665	0.53	0.007	0.00	13.43	0.00	0.000
0.93	2.41	53.60	2.37	126.86	31	638	0.53	0.008	0.00	13.43	0.00	0.000
0.98	2.45	49.85	2.51	124.94	31	618	0.53	0.009	0.01	13.43	0.01	0.000
1.07	2.43	51.66	2.46	127.02	32	632	0.53	0.010	0.01	13.43	0.01	0.000
1.12	2.45	49.71	2.51	124.68	31	616	0.53	0.011	0.01	13.43	0.01	0.000
1.19	2.44	48.58	2.47	119.96	30	596	0.53	0.013	0.01	13.43	0.01	0.000
1.25	2.39	49.12	2.27	111.66	0	0	0.53	0.000	0.00	13.43	0.00	0.000
1.33	2.47	39.54	2.61	103.30	0	0	0.53	0.000	0.00	13.43	0.00	0.000
1.38	2.55	32.46	3.06	99.30	0	0	0.53	0.000	0.00	13.43	0.00	0.000
1.45	2.61	27.74	3.37	93.43	0	0	0.53	0.000	0.00	0.00	0.00	0.000
1.51	2.67	22.73	3.79	86.19	0	0	0.53	0.000	0.00	0.00	0.00	0.000
1.59	2.76	17.46	4.43	77.42	0	0	0.53	0.000	0.00	0.00	0.00	0.000
1.64	2.77	15.78	4.56	71.94	0	0	0.53	0.000	0.00	0.00	0.00	0.000
1.73	2.87	12.46	5.37	66.95	0	0	0.53	0.000	0.00	0.00	0.00	0.000
1.78	2.96	10.10	6.32	63.81	0	0	0.53	0.000	0.00	0.00	0.00	0.000
1.86	3.06	8.15	7.43	60.50	0	0	0.53	0.000	0.00	0.00	0.00	0.000
1.90	3.15	7.03	8.54	60.05	0	0	0.53	0.000	0.00	0.00	0.00	0.000
1.98	3.21	6.48	9.37	60.71	0	0	0.53	0.000	0.00	0.00	0.00	0.000
2.05	3.20	6.48	9.24	59.85	0	0	0.53	0.000	0.00	0.00	0.00	0.000
2.11	3.11	7.71	8.08	62.27	0	0	0.53	0.000	0.00	0.00	0.00	0.000
2.19	3.04	8.96	7.26	65.01	0	0	0.53	0.000	0.00	0.00	0.00	0.000
2.23	2.96	10.33	6.29	64.98	0	0	0.53	0.000	0.00	0.00	0.00	0.000
2.32	2.90	11.58	5.70	66.02	0	0	0.53	0.000	0.00	0.00	0.00	0.000
2.37	2.85	12.56	5.25	65.97	0	0	0.53	0.000	0.00	0.00	0.00	0.000
2.44	2.78	13.79	4.59	63.33	0	0	0.53	0.000	0.00	0.00	0.00	0.000
2.50	2.65	16.14	3.62	58.52	0	0	0.53	0.000	0.00	0.00	0.00	0.000
2.57	2.17	32.24	1.00	32.24	0	0	0.53	0.000	0.00	13.43	0.00	0.000
2.63	1.87	47.35	1.00	47.35	0	0	0.53	0.000	0.00	13.43	0.00	0.000
2.70	1.70	63.59	1.00	63.59	12	307	0.53	0.993	1.86	13.43	1.77	0.029
2.76	1.67	72.32	1.00	72.32	13	335	0.53	0.608	0.99	13.43	0.94	0.014
2.83	1.64	81.06	1.00	81.06	15	363	0.53	0.402	0.58	13.43	0.55	0.009
2.89	2.16	51.36	1.57	80.78	18	443	0.53	0.154	0.18	13.43	0.17	0.002
2.97	2.06	86.73	1.38	120.04	26	658	0.53	0.038	0.03	13.43	0.03	0.001
3.02	2.03	89.93	1.35	121.05	26	661	0.53	0.039	0.03	13.43	0.03	0.000
3.09	2.00	94.64	1.30	123.29	0	0	0.53	0.000	0.00	13.43	0.00	0.000
3.15	2.05	88.81	1.37	122.05	0	0	0.53	0.000	0.00	13.43	0.00	0.000

:: Post-earthquake settlement of dry sands :: (continued)

Depth (ft)	Ic	Q_{tn}	Kc	$Q_{tn,cs}$	$N_{1,60}$ (blows)	G_{max} (tsf)	CSR	Shear, γ (%)	$e_{vol(15)}$ (%)	N_c	e_v (%)	Settle. (in)
3.22	2.21	67.85	1.70	115.14	0	0	0.53	0.000	0.00	13.43	0.00	0.000
3.28	2.48	42.86	2.68	115.06	0	0	0.53	0.000	0.00	13.43	0.00	0.000
3.36	2.44	46.32	2.46	114.08	29	567	0.53	0.080	0.05	13.43	0.05	0.001
3.42	2.46	43.68	2.56	111.94	28	550	0.53	0.093	0.06	13.43	0.06	0.001
3.49	2.45	42.15	2.52	106.23	27	524	0.53	0.117	0.08	13.43	0.08	0.001
3.55	2.46	39.36	2.59	102.10	26	500	0.53	0.150	0.11	13.43	0.10	0.002
3.62	2.47	38.52	2.62	100.80	26	492	0.53	0.169	0.13	13.43	0.12	0.002
3.70	2.54	33.24	2.99	99.34	26	465	0.53	0.231	0.17	13.43	0.16	0.003
3.75	2.56	31.29	3.11	97.35	26	450	0.53	0.282	0.21	13.43	0.20	0.003
3.81	2.53	31.29	2.95	92.16	24	434	0.53	0.357	0.29	13.43	0.27	0.004
3.87	2.51	31.55	2.80	88.47	23	423	0.53	0.429	0.37	13.43	0.35	0.005
3.96	2.53	35.57	2.92	103.86	27	490	0.53	0.214	0.15	13.43	0.14	0.003
4.01	2.53	37.51	2.91	109.02	28	515	0.53	0.176	0.11	13.43	0.11	0.001
4.10	2.61	36.25	3.41	123.55	0	0	0.53	0.000	0.00	0.00	0.00	0.000
4.14	2.70	32.92	3.96	130.46	0	0	0.53	0.000	0.00	0.00	0.00	0.000
4.22	2.52	45.55	2.89	131.78	34	624	0.53	0.091	0.05	13.43	0.05	0.001
4.27	1.91	130.48	1.20	156.00	31	818	0.53	0.040	0.02	13.43	0.02	0.000
4.34	1.79	173.34	1.10	190.21	37	933	0.53	0.030	0.01	13.43	0.01	0.000
4.40	1.89	159.85	1.18	188.75	38	982	0.53	0.027	0.01	13.43	0.01	0.000
4.49	1.99	147.62	1.29	190.35	39	1030	0.53	0.025	0.01	13.43	0.01	0.000
4.53	2.04	140.40	1.36	190.54	40	1042	0.53	0.025	0.01	13.43	0.01	0.000
4.60	2.13	127.22	1.51	191.81	42	1055	0.53	0.025	0.01	13.43	0.01	0.000
4.67	2.22	115.97	1.70	197.69	45	1074	0.52	0.025	0.01	13.43	0.01	0.000
4.73	2.29	105.01	1.93	202.15	47	1072	0.52	0.025	0.01	13.43	0.01	0.000
4.80	2.35	97.51	2.13	207.36	50	1074	0.52	0.026	0.01	13.43	0.01	0.000
4.87	2.39	92.36	2.29	211.37	52	1073	0.52	0.027	0.01	13.43	0.01	0.000
4.94	2.43	87.63	2.43	212.69	53	1061	0.52	0.028	0.01	13.43	0.01	0.000
4.99	2.46	83.04	2.57	213.21	54	1046	0.52	0.029	0.01	13.43	0.01	0.000
5.07	2.49	78.18	2.74	214.13	55	1031	0.52	0.031	0.01	13.43	0.01	0.000
5.12	2.51	76.10	2.81	214.20	55	1022	0.52	0.032	0.01	13.43	0.01	0.000
5.20	2.51	74.56	2.80	208.63	54	998	0.52	0.035	0.01	13.43	0.01	0.000
5.25	2.50	72.20	2.79	201.62	52	965	0.52	0.038	0.01	13.43	0.01	0.000
5.34	2.48	70.51	2.65	186.78	48	908	0.52	0.046	0.02	13.43	0.02	0.000
5.38	2.48	67.72	2.67	181.08	46	878	0.52	0.051	0.02	13.43	0.02	0.000
5.46	2.48	63.13	2.66	167.66	43	815	0.52	0.065	0.03	13.43	0.02	0.000
5.53	2.48	58.69	2.67	156.51	40	759	0.52	0.083	0.04	13.43	0.03	0.001
5.58	2.50	54.65	2.75	150.36	39	723	0.52	0.100	0.05	13.43	0.04	0.001
5.66	2.49	50.47	2.70	136.21	0	0	0.52	0.000	0.00	13.43	0.00	0.000
5.72	2.45	47.41	2.53	120.01	0	0	0.52	0.000	0.00	13.43	0.00	0.000
5.78	2.33	46.16	2.05	94.69	0	0	0.52	0.000	0.00	13.43	0.00	0.000
5.84	2.30	45.05	1.96	88.47	0	0	0.52	0.000	0.00	13.43	0.00	0.000
5.93	2.28	46.84	1.88	87.87	0	0	0.52	0.000	0.00	13.43	0.00	0.000
5.97	2.23	50.31	1.76	88.37	0	0	0.52	0.000	0.00	13.43	0.00	0.000

:: Post-earthquake settlement of dry sands :: (continued)

Depth (ft)	Ic	Q_{tn}	Kc	$Q_{tn,cs}$	$N_{1,60}$ (blows)	G_{max} (tsf)	CSR	Shear, γ (%)	$e_{vol(15)}$ (%)	N_c	e_v (%)	Settle. (in)

Total estimated settlement: 0.09

Abbreviations

Q_{tn}: Equivalent clean sand normalized cone resistance
K_c: Fines correction factor
$Q_{tn,cs}$: Post-liquefaction volumentric strain
G_{max}: Small strain shear modulus
CSR: Soil cyclic stress ratio
γ: Cyclic shear strain
$e_{vol(15)}$: Volumetric strain after 15 cycles
N_c: Equivalent number of cycles
e_v: Volumetric strain
Settle.: Calculated settlement

:: Post-earthquake settlement due to soil liquefaction ::

Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)	Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)
6.05	89.02	2.00	0.00	1.00	0.00	6.11	89.38	2.00	0.00	1.00	0.00
6.18	89.66	2.00	0.00	1.00	0.00	6.24	88.62	0.27	2.58	1.00	0.02
6.32	88.51	0.27	2.58	1.00	0.03	6.38	88.53	0.27	2.58	1.00	0.02
6.46	87.96	0.26	2.60	1.00	0.03	6.50	88.17	0.26	2.59	1.00	0.01
6.58	90.47	0.27	2.54	1.00	0.02	6.64	91.10	0.27	2.52	1.00	0.02
6.70	91.47	2.00	0.00	1.00	0.00	6.77	94.39	2.00	0.00	1.00	0.00
6.85	97.10	2.00	0.00	1.00	0.00	6.91	98.91	2.00	0.00	1.00	0.00
6.96	100.39	2.00	0.00	1.00	0.00	7.05	105.92	2.00	0.00	1.00	0.00
7.09	108.93	2.00	0.00	1.00	0.00	7.18	116.47	2.00	0.00	1.00	0.00
7.23	120.11	2.00	0.00	1.00	0.00	7.30	123.80	2.00	0.00	1.00	0.00
7.36	126.56	2.00	0.00	1.00	0.00	7.45	126.20	0.46	1.93	1.00	0.02
7.50	124.92	0.45	1.95	1.00	0.01	7.55	123.99	0.44	1.96	1.00	0.01
7.61	122.24	0.42	1.98	1.00	0.02	7.72	118.65	0.40	2.03	1.00	0.03
7.76	116.55	0.38	2.06	1.00	0.01	7.81	103.75	0.31	2.27	1.00	0.01
7.94	89.88	0.25	2.55	1.00	0.04	7.97	90.12	0.25	2.54	1.00	0.01
8.03	92.41	0.25	2.49	1.00	0.02	8.07	94.24	2.00	0.00	1.00	0.00
8.14	97.41	2.00	0.00	1.00	0.00	8.20	102.04	2.00	0.00	1.00	0.00
8.28	106.91	2.00	0.00	1.00	0.00	8.34	110.24	2.00	0.00	1.00	0.00
8.40	116.68	2.00	0.00	1.00	0.00	8.47	121.74	2.00	0.00	1.00	0.00
8.53	123.87	2.00	0.00	1.00	0.00	8.60	125.03	2.00	0.00	1.00	0.00
8.68	119.15	2.00	0.00	1.00	0.00	8.74	114.31	2.00	0.00	1.00	0.00
8.80	110.69	2.00	0.00	1.00	0.00	8.88	104.79	2.00	0.00	1.00	0.00
8.94	98.72	2.00	0.00	1.00	0.00	9.01	93.80	2.00	0.00	1.00	0.00
9.07	89.41	2.00	0.00	1.00	0.00	9.14	84.04	2.00	0.00	1.00	0.00
9.19	81.44	2.00	0.00	1.00	0.00	9.27	79.68	2.00	0.00	1.00	0.00
9.33	77.26	2.00	0.00	1.00	0.00	9.41	77.43	0.19	2.88	1.00	0.03
9.46	78.31	0.19	2.86	1.00	0.02	9.54	76.28	0.19	2.92	1.00	0.03
9.60	73.69	0.18	3.00	1.00	0.02	9.65	71.73	0.18	3.07	1.00	0.02
9.72	71.46	0.17	3.08	1.00	0.03	9.82	71.61	0.17	3.07	1.00	0.03
9.86	73.45	0.18	3.01	1.00	0.02	9.91	76.65	0.18	2.91	1.00	0.02
9.99	78.78	0.19	2.84	1.00	0.03	10.04	82.10	0.20	2.75	1.00	0.02
10.13	84.91	0.21	2.67	1.00	0.03	10.18	86.96	0.21	2.62	1.00	0.01
10.26	88.81	0.22	2.58	1.00	0.02	10.35	99.49	0.26	2.35	1.00	0.03
10.43	106.33	0.28	2.22	1.00	0.02	10.45	109.73	0.30	2.17	1.00	0.00
10.53	110.72	0.31	2.15	1.00	0.02	10.57	117.73	0.34	2.04	1.00	0.01

:: Post-earthquake settlement due to soil liquefaction :: (continued)

Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)	Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)
10.67	141.90	0.51	1.75	1.00	0.02	10.71	147.25	0.55	1.73	1.00	0.01
10.77	148.29	0.56	1.71	1.00	0.01	10.84	159.21	0.67	1.27	1.00	0.01
10.89	172.66	0.82	0.92	1.00	0.01	10.96	185.71	0.98	0.50	1.00	0.00
11.04	188.56	1.02	0.49	1.00	0.00	11.13	192.16	1.07	0.36	1.00	0.00
11.17	193.66	1.09	0.36	1.00	0.00	11.26	195.47	1.12	0.36	1.00	0.00
11.29	198.79	1.17	0.25	1.00	0.00	11.38	199.53	1.18	0.25	1.00	0.00
11.44	198.74	1.16	0.25	1.00	0.00	11.52	199.32	1.17	0.25	1.00	0.00
11.57	197.97	1.15	0.35	1.00	0.00	11.63	200.20	2.00	0.00	1.00	0.00
11.69	204.04	2.00	0.00	1.00	0.00	11.75	202.63	2.00	0.00	1.00	0.00
11.84	196.10	1.11	0.36	1.00	0.00	11.89	196.09	1.11	0.36	1.00	0.00
11.95	196.26	1.11	0.36	1.00	0.00	12.01	198.45	1.14	0.35	1.00	0.00
12.07	202.49	2.00	0.00	1.00	0.00	12.17	207.10	2.00	0.00	1.00	0.00
12.23	210.89	2.00	0.00	1.00	0.00	12.29	212.31	2.00	0.00	1.00	0.00
12.38	210.80	2.00	0.00	1.00	0.00	12.43	212.84	2.00	0.00	1.00	0.00
12.47	209.17	2.00	0.00	1.00	0.00	12.55	205.02	2.00	0.00	1.00	0.00
12.62	195.05	1.07	0.36	1.00	0.00	12.69	189.56	0.99	0.49	1.00	0.00
12.74	183.54	0.91	0.64	1.00	0.00	12.80	175.93	0.81	0.89	1.00	0.01
12.87	164.82	0.69	1.21	1.00	0.01	12.94	150.46	0.55	1.67	1.00	0.01
13.00	134.03	0.42	1.84	1.00	0.01	13.08	121.86	0.34	1.99	1.00	0.02
13.14	108.83	2.00	0.00	1.00	0.00	13.19	110.74	2.00	0.00	1.00	0.00
13.26	107.18	2.00	0.00	1.00	0.00	13.33	104.12	2.00	0.00	1.00	0.00
13.42	101.13	2.00	0.00	1.00	0.00	13.47	101.38	2.00	0.00	1.00	0.00
13.54	98.71	2.00	0.00	1.00	0.00	13.61	94.86	2.00	0.00	1.00	0.00
13.65	91.22	2.00	0.00	1.00	0.00	13.74	80.61	2.00	0.00	1.00	0.00
13.78	75.04	2.00	0.00	1.00	0.00	13.87	71.40	2.00	0.00	1.00	0.00
13.92	71.28	2.00	0.00	1.00	0.00	13.98	71.10	2.00	0.00	1.00	0.00
14.05	67.79	2.00	0.00	1.00	0.00	14.14	66.55	2.00	0.00	1.00	0.00
14.19	66.74	2.00	0.00	1.00	0.00	14.28	67.07	2.00	0.00	1.00	0.00
14.32	66.68	2.00	0.00	1.00	0.00	14.41	65.00	2.00	0.00	1.00	0.00
14.47	66.47	2.00	0.00	1.00	0.00	14.50	67.79	2.00	0.00	1.00	0.00
14.60	71.25	2.00	0.00	1.00	0.00	14.65	72.43	2.00	0.00	1.00	0.00
14.72	76.06	2.00	0.00	1.00	0.00	14.77	78.66	2.00	0.00	1.00	0.00
14.84	81.94	2.00	0.00	1.00	0.00	14.90	82.21	2.00	0.00	1.00	0.00
14.99	82.20	2.00	0.00	1.00	0.00	15.03	82.17	2.00	0.00	1.00	0.00
15.13	82.42	2.00	0.00	1.00	0.00	15.18	81.83	2.00	0.00	1.00	0.00
15.22	80.80	2.00	0.00	1.00	0.00	15.30	81.31	2.00	0.00	1.00	0.00
15.36	81.13	2.00	0.00	1.00	0.00	15.43	80.16	2.00	0.00	1.00	0.00
15.49	78.46	2.00	0.00	1.00	0.00	15.58	76.62	2.00	0.00	1.00	0.00
15.63	75.07	2.00	0.00	1.00	0.00	15.71	75.34	2.00	0.00	1.00	0.00
15.76	77.61	2.00	0.00	1.00	0.00	15.84	80.92	2.00	0.00	1.00	0.00
15.94	87.36	2.00	0.00	1.00	0.00	15.95	87.45	2.00	0.00	1.00	0.00
16.03	91.64	2.00	0.00	1.00	0.00	16.12	95.70	2.00	0.00	1.00	0.00
16.15	99.27	2.00	0.00	1.00	0.00	16.21	102.07	2.00	0.00	1.00	0.00
16.29	108.11	2.00	0.00	1.00	0.00	16.35	112.97	2.00	0.00	1.00	0.00
16.42	119.84	2.00	0.00	1.00	0.00	16.51	127.21	2.00	0.00	1.00	0.00
16.55	131.76	2.00	0.00	1.00	0.00	16.60	136.10	2.00	0.00	1.00	0.00
16.69	141.18	2.00	0.00	1.00	0.00	16.74	143.22	2.00	0.00	1.00	0.00
16.80	146.17	2.00	0.00	1.00	0.00	16.86	148.61	2.00	0.00	1.00	0.00

:: Post-earthquake settlement due to soil liquefaction :: (continued)

Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)	Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)
16.94	149.41	2.00	0.00	1.00	0.00	17.00	148.89	2.00	0.00	1.00	0.00
17.09	144.84	2.00	0.00	1.00	0.00	17.14	141.88	2.00	0.00	1.00	0.00
17.23	136.58	2.00	0.00	1.00	0.00	17.26	134.85	2.00	0.00	1.00	0.00
17.36	131.44	2.00	0.00	1.00	0.00	17.41	130.48	2.00	0.00	1.00	0.00
17.46	129.24	2.00	0.00	1.00	0.00	17.53	127.18	2.00	0.00	1.00	0.00
17.63	125.59	2.00	0.00	1.00	0.00	17.65	125.17	2.00	0.00	1.00	0.00
17.72	123.66	2.00	0.00	1.00	0.00	17.81	121.07	2.00	0.00	1.00	0.00
17.86	118.74	2.00	0.00	1.00	0.00	17.94	116.34	2.00	0.00	1.00	0.00
18.00	114.81	2.00	0.00	1.00	0.00	18.08	114.56	2.00	0.00	1.00	0.00
18.14	114.36	2.00	0.00	1.00	0.00	18.21	114.24	2.00	0.00	1.00	0.00
18.27	114.80	2.00	0.00	1.00	0.00	18.34	115.17	2.00	0.00	1.00	0.00
18.41	114.97	2.00	0.00	1.00	0.00	18.48	114.48	2.00	0.00	1.00	0.00
18.54	91.15	2.00	0.00	1.00	0.00	18.57	72.82	2.00	0.00	1.00	0.00
18.66	88.55	2.00	0.00	1.00	0.00	18.71	93.69	2.00	0.00	1.00	0.00
18.77	98.11	2.00	0.00	1.00	0.00	18.84	100.45	2.00	0.00	1.00	0.00
18.92	104.90	2.00	0.00	1.00	0.00	19.00	113.83	2.00	0.00	1.00	0.00
19.04	119.43	2.00	0.00	1.00	0.00	19.10	127.70	2.00	0.00	1.00	0.00
19.19	131.89	2.00	0.00	1.00	0.00	19.23	131.89	2.00	0.00	1.00	0.00
19.31	137.69	2.00	0.00	1.00	0.00	19.37	146.75	2.00	0.00	1.00	0.00
19.43	151.95	2.00	0.00	1.00	0.00	19.50	148.68	0.48	1.69	1.00	0.01
19.56	143.33	2.00	0.00	1.00	0.00	19.64	135.70	2.00	0.00	1.00	0.00
19.72	129.47	2.00	0.00	1.00	0.00	19.77	124.38	2.00	0.00	1.00	0.00
19.85	123.18	2.00	0.00	1.00	0.00	19.90	125.54	2.00	0.00	1.00	0.00
19.95	129.39	2.00	0.00	1.00	0.00	20.04	142.26	0.43	1.75	1.00	0.02
20.08	151.19	0.49	1.66	1.00	0.01	20.16	162.94	0.59	1.50	1.00	0.01
20.22	166.69	0.63	1.45	1.00	0.01	20.28	179.65	0.76	0.86	1.00	0.01
20.36	206.79	2.00	0.00	1.00	0.00	20.45	268.18	2.00	0.00	1.00	0.00
20.49	295.76	2.00	0.00	1.00	0.00	20.58	321.92	2.00	0.00	1.00	0.00
20.63	304.68	2.00	0.00	1.00	0.00	20.69	281.60	2.00	0.00	1.00	0.00
20.75	277.23	2.00	0.00	1.00	0.00	20.81	240.86	2.00	0.00	1.00	0.00
20.89	216.81	2.00	0.00	1.00	0.00	20.94	200.50	2.00	0.00	1.00	0.00
21.00	190.23	0.88	0.61	1.00	0.00	21.07	152.70	0.50	1.65	1.00	0.01
21.14	166.13	0.62	1.45	1.00	0.01	21.20	169.38	0.65	1.41	1.00	0.01
21.26	172.54	0.68	1.13	1.00	0.01	21.34	182.89	0.79	0.84	1.00	0.01
21.39	201.02	2.00	0.00	1.00	0.00	21.47	219.35	2.00	0.00	1.00	0.00
21.54	241.01	2.00	0.00	1.00	0.00	21.61	250.35	2.00	0.00	1.00	0.00
21.66	258.88	2.00	0.00	1.00	0.00	21.74	265.32	2.00	0.00	1.00	0.00
21.79	271.70	2.00	0.00	1.00	0.00	21.87	263.21	2.00	0.00	1.00	0.00
21.92	257.36	2.00	0.00	1.00	0.00	21.99	262.60	2.00	0.00	1.00	0.00
22.07	286.85	2.00	0.00	1.00	0.00	22.13	262.34	2.00	0.00	1.00	0.00
22.21	288.30	2.00	0.00	1.00	0.00	22.25	263.48	2.00	0.00	1.00	0.00
22.33	289.78	2.00	0.00	1.00	0.00	22.38	277.89	2.00	0.00	1.00	0.00
22.45	298.70	2.00	0.00	1.00	0.00	22.51	286.59	2.00	0.00	1.00	0.00
22.58	304.96	2.00	0.00	1.00	0.00	22.65	316.39	2.00	0.00	1.00	0.00
22.73	312.19	2.00	0.00	1.00	0.00	22.79	310.99	2.00	0.00	1.00	0.00
22.88	307.77	2.00	0.00	1.00	0.00	22.91	309.66	2.00	0.00	1.00	0.00
23.00	303.04	2.00	0.00	1.00	0.00	23.03	300.87	2.00	0.00	1.00	0.00
23.10	301.57	2.00	0.00	1.00	0.00	23.18	303.39	2.00	0.00	1.00	0.00

:: Post-earthquake settlement due to soil liquefaction :: (continued)

Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)	Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)
23.23	307.78	2.00	0.00	1.00	0.00	23.30	315.16	2.00	0.00	1.00	0.00
23.37	319.48	2.00	0.00	1.00	0.00	23.45	319.89	2.00	0.00	1.00	0.00
23.54	316.48	2.00	0.00	1.00	0.00	23.56	308.07	2.00	0.00	1.00	0.00
23.65	292.37	2.00	0.00	1.00	0.00	23.69	296.71	2.00	0.00	1.00	0.00
23.76	298.47	2.00	0.00	1.00	0.00	23.82	300.34	2.00	0.00	1.00	0.00
23.89	304.41	2.00	0.00	1.00	0.00	23.96	317.20	2.00	0.00	1.00	0.00
24.02	350.26	2.00	0.00	1.00	0.00	24.09	393.03	2.00	0.00	1.00	0.00
24.16	424.72	2.00	0.00	1.00	0.00	24.22	421.73	2.00	0.00	1.00	0.00
24.29	376.85	2.00	0.00	1.00	0.00	24.36	348.35	2.00	0.00	1.00	0.00
24.42	316.32	2.00	0.00	1.00	0.00	24.50	311.29	2.00	0.00	1.00	0.00
24.59	295.71	2.00	0.00	1.00	0.00	24.62	295.22	2.00	0.00	1.00	0.00
24.68	295.03	2.00	0.00	1.00	0.00	24.77	294.38	2.00	0.00	1.00	0.00
24.81	296.13	2.00	0.00	1.00	0.00	24.89	292.38	2.00	0.00	1.00	0.00
24.95	304.44	2.00	0.00	1.00	0.00	25.02	314.49	2.00	0.00	1.00	0.00
25.08	320.06	2.00	0.00	1.00	0.00	25.16	331.38	2.00	0.00	1.00	0.00
25.20	331.24	2.00	0.00	1.00	0.00	25.26	328.14	2.00	0.00	1.00	0.00
25.35	318.99	2.00	0.00	1.00	0.00	25.40	311.78	2.00	0.00	1.00	0.00
25.48	302.53	2.00	0.00	1.00	0.00	25.53	298.81	2.00	0.00	1.00	0.00
25.62	290.72	2.00	0.00	1.00	0.00	25.66	287.74	2.00	0.00	1.00	0.00
25.75	280.59	2.00	0.00	1.00	0.00	25.80	277.69	2.00	0.00	1.00	0.00
25.86	275.30	2.00	0.00	1.00	0.00	25.94	274.86	2.00	0.00	1.00	0.00
26.00	272.90	2.00	0.00	1.00	0.00	26.06	269.92	2.00	0.00	1.00	0.00
26.15	250.38	2.00	0.00	1.00	0.00	26.19	255.53	2.00	0.00	1.00	0.00
26.28	254.72	2.00	0.00	1.00	0.00	26.33	254.58	2.00	0.00	1.00	0.00
26.38	256.25	2.00	0.00	1.00	0.00	26.45	258.77	2.00	0.00	1.00	0.00
26.52	265.08	2.00	0.00	1.00	0.00	26.59	268.95	2.00	0.00	1.00	0.00
26.64	274.58	2.00	0.00	1.00	0.00	26.72	283.28	2.00	0.00	1.00	0.00
26.77	291.47	2.00	0.00	1.00	0.00	26.84	307.77	2.00	0.00	1.00	0.00
26.90	323.27	2.00	0.00	1.00	0.00	26.98	345.43	2.00	0.00	1.00	0.00
27.05	353.72	2.00	0.00	1.00	0.00	27.11	347.53	2.00	0.00	1.00	0.00
27.18	364.67	2.00	0.00	1.00	0.00	27.24	326.37	2.00	0.00	1.00	0.00
27.30	323.25	2.00	0.00	1.00	0.00	27.38	339.76	2.00	0.00	1.00	0.00
27.44	340.82	2.00	0.00	1.00	0.00	27.50	342.24	2.00	0.00	1.00	0.00
27.56	337.08	2.00	0.00	1.00	0.00	27.63	324.52	2.00	0.00	1.00	0.00
27.70	334.85	2.00	0.00	1.00	0.00	27.76	316.18	2.00	0.00	1.00	0.00
27.84	332.59	2.00	0.00	1.00	0.00	27.89	336.49	2.00	0.00	1.00	0.00
27.96	366.68	2.00	0.00	1.00	0.00	28.03	-1.00	2.00	0.00	1.00	0.00
28.11	-1.00	2.00	0.00	1.00	0.00	28.15	-1.00	2.00	0.00	1.00	0.00
28.22	-1.00	2.00	0.00	1.00	0.00	28.31	-1.00	2.00	0.00	1.00	0.00
28.36	-1.00	2.00	0.00	1.00	0.00						

Total estimated settlement: 1.02

Abbreviations

$Q_{tn,cs}$: Equivalent clean sand normalized cone resistance
FS: Factor of safety against liquefaction
e_v (%): Post-liquefaction volumentric strain
DF: e_v depth weighting factor
Settlement: Calculated settlement

:: Strength loss calculation (Robertson (2009) ::

Depth (ft)	q_t (tsf)	Q_{tn}	K_c	$Q_{tn,cs}$	I_c	$S_{u(liq)}/\sigma'_v$	$S_{u(peak)}/\sigma'_v$
0.07	80.93	130.02	1.16	151.07	1.87	N/A	N/A
0.15	306.43	492.31	1.00	492.31	1.09	N/A	N/A
0.20	281.13	451.66	1.00	451.66	1.19	N/A	N/A
0.28	255.30	410.15	1.00	410.15	1.31	N/A	N/A
0.34	225.77	362.70	1.00	362.70	1.40	N/A	N/A
0.40	188.37	302.60	1.00	302.60	1.55	N/A	N/A
0.47	143.20	230.03	1.08	247.87	1.76	N/A	N/A
0.53	121.00	194.35	1.14	222.22	1.85	N/A	N/A
0.59	87.40	140.36	1.37	191.65	2.05	N/A	N/A
0.66	72.29	116.08	1.59	184.72	2.17	N/A	N/A
0.72	60.37	96.92	1.84	177.94	2.26	N/A	N/A
0.79	43.44	69.71	1.84	128.08	2.26	N/A	N/A
0.87	37.40	60.00	2.14	128.69	2.36	N/A	N/A
0.93	33.42	53.60	2.37	126.86	2.41	N/A	N/A
0.98	31.09	49.85	2.51	124.94	2.45	N/A	N/A
1.07	32.22	51.66	2.46	127.02	2.43	N/A	N/A
1.12	31.01	49.71	2.51	124.68	2.45	N/A	N/A
1.19	30.31	48.58	2.47	119.96	2.44	N/A	N/A
1.25	30.65	49.12	2.27	111.66	2.39	N/A	N/A
1.33	24.69	39.54	2.61	103.30	2.47	N/A	N/A
1.38	20.29	32.46	3.06	99.30	2.55	N/A	N/A
1.45	17.35	27.74	3.37	93.43	2.61	N/A	N/A
1.51	14.24	22.73	3.79	86.19	2.67	N/A	N/A
1.59	10.96	17.46	4.43	77.42	2.76	N/A	N/A
1.64	9.92	15.78	4.56	71.94	2.77	N/A	N/A
1.73	7.86	12.46	5.37	66.95	2.87	N/A	N/A
1.78	6.39	10.10	6.32	63.81	2.96	N/A	N/A
1.86	5.18	8.15	7.43	60.50	3.06	N/A	N/A
1.90	4.49	7.03	8.54	60.05	3.15	N/A	N/A
1.98	4.15	6.48	9.37	60.71	3.21	N/A	N/A
2.05	4.15	6.48	9.24	59.85	3.20	N/A	N/A
2.11	4.92	7.71	8.08	62.27	3.11	N/A	N/A
2.19	5.70	8.96	7.26	65.01	3.04	N/A	N/A
2.23	6.56	10.33	6.29	64.98	2.96	N/A	N/A
2.32	7.34	11.58	5.70	66.02	2.90	N/A	N/A
2.37	7.95	12.56	5.25	65.97	2.85	N/A	N/A
2.44	8.72	13.79	4.59	63.33	2.78	N/A	N/A
2.50	10.19	16.14	3.62	58.52	2.65	N/A	N/A
2.57	20.21	32.24	1.00	32.24	2.17	N/A	N/A
2.63	29.62	47.35	1.00	47.35	1.87	N/A	N/A
2.70	39.73	63.59	1.00	63.59	1.70	N/A	N/A
2.76	45.17	72.32	1.00	72.32	1.67	N/A	N/A
2.83	50.61	81.06	1.00	81.06	1.64	N/A	N/A
2.89	32.13	51.36	1.57	80.78	2.16	N/A	N/A
2.97	54.15	86.73	1.38	120.04	2.06	N/A	N/A
3.02	56.14	89.93	1.35	121.05	2.03	N/A	N/A
3.09	59.08	94.64	1.30	123.29	2.00	N/A	N/A
3.15	55.45	88.81	1.37	122.05	2.05	N/A	N/A

:: Strength loss calculation (Robertson (2009) :: (continued)

Depth (ft)	q_t (tsf)	Q_{tn}	K_c	$Q_{tn,cs}$	I_c	$S_{u(liq)}/\sigma'_v$	$S_{u(peak)}/\sigma'_v$
3.22	42.41	67.85	1.70	115.14	2.21	N/A	N/A
3.28	26.86	42.86	2.68	115.06	2.48	N/A	N/A
3.36	29.02	46.32	2.46	114.08	2.44	N/A	N/A
3.42	27.38	43.68	2.56	111.94	2.46	N/A	N/A
3.49	26.43	42.15	2.52	106.23	2.45	N/A	N/A
3.55	24.70	39.36	2.59	102.10	2.46	N/A	N/A
3.62	24.18	38.52	2.62	100.80	2.47	N/A	N/A
3.70	20.90	33.24	2.99	99.34	2.54	N/A	N/A
3.75	19.69	31.29	3.11	97.35	2.56	N/A	N/A
3.81	19.69	31.29	2.95	92.16	2.53	N/A	N/A
3.87	19.86	31.55	2.80	88.47	2.51	N/A	N/A
3.96	22.36	35.57	2.92	103.86	2.53	N/A	N/A
4.01	23.57	37.51	2.91	109.02	2.53	N/A	N/A
4.10	22.79	36.25	3.41	123.55	2.61	N/A	N/A
4.14	20.72	32.92	3.96	130.46	2.70	N/A	N/A
4.22	28.59	45.55	2.89	131.78	2.52	N/A	N/A
4.27	81.45	130.48	1.20	156.00	1.91	N/A	N/A
4.34	108.13	173.34	1.10	190.21	1.79	N/A	N/A
4.40	99.74	159.85	1.18	188.75	1.89	N/A	N/A
4.49	92.14	147.62	1.29	190.35	1.99	N/A	N/A
4.53	87.64	140.40	1.36	190.54	2.04	N/A	N/A
4.60	79.45	127.22	1.51	191.81	2.13	N/A	N/A
4.67	72.45	115.97	1.70	197.69	2.22	N/A	N/A
4.73	65.63	105.01	1.93	202.15	2.29	N/A	N/A
4.80	60.97	97.51	2.13	207.36	2.35	N/A	N/A
4.87	57.77	92.36	2.29	211.37	2.39	N/A	N/A
4.94	54.82	87.63	2.43	212.69	2.43	N/A	N/A
4.99	51.97	83.04	2.57	213.21	2.46	N/A	N/A
5.07	48.95	78.18	2.74	214.13	2.49	N/A	N/A
5.12	47.66	76.10	2.81	214.20	2.51	N/A	N/A
5.20	46.71	74.56	2.80	208.63	2.51	N/A	N/A
5.25	45.24	72.20	2.79	201.62	2.50	N/A	N/A
5.34	44.20	70.51	2.65	186.78	2.48	N/A	N/A
5.38	42.46	67.72	2.67	181.08	2.48	N/A	N/A
5.46	39.61	63.13	2.66	167.66	2.48	N/A	N/A
5.53	36.85	58.69	2.67	156.51	2.48	N/A	N/A
5.58	34.34	54.65	2.75	150.36	2.50	N/A	N/A
5.66	31.74	50.47	2.70	136.21	2.49	N/A	N/A
5.72	29.84	47.41	2.53	120.01	2.45	N/A	N/A
5.78	29.07	46.16	2.05	94.69	2.33	N/A	N/A
5.84	28.38	45.05	1.96	88.47	2.30	N/A	N/A
5.93	29.50	46.84	1.88	87.87	2.28	N/A	N/A
5.97	31.66	50.31	1.76	88.37	2.23	N/A	N/A
6.05	34.27	54.49	1.63	89.02	2.19	0.75	0.75
6.11	35.31	56.17	1.59	89.38	2.17	0.75	0.75
6.18	37.57	59.78	1.50	89.66	2.12	0.76	0.76
6.24	37.40	59.50	1.49	88.62	2.12	0.76	0.76
6.32	37.66	59.91	1.48	88.51	2.11	0.76	0.76

:: Strength loss calculation (Robertson (2009) :: (continued)

Depth (ft)	q_t (tsf)	Q_{tn}	K_c	$Q_{tn,cs}$	I_c	$S_{u(liq)}/\sigma'_v$	$S_{u(peak)}/\sigma'_v$
6.38	38.87	61.85	1.43	88.53	2.09	0.76	0.76
6.46	39.99	63.64	1.38	87.96	2.06	0.77	0.77
6.50	40.68	64.75	1.36	88.17	2.04	0.77	0.77
6.58	43.18	68.76	1.32	90.47	2.01	0.78	0.78
6.64	43.96	70.01	1.30	91.10	2.00	0.78	0.78
6.70	44.05	70.15	1.30	91.47	2.00	0.78	0.78
6.77	43.88	69.87	1.35	94.39	2.04	0.78	0.78
6.85	42.32	67.36	1.44	97.10	2.09	0.77	0.77
6.91	40.16	63.88	1.55	98.91	2.15	0.77	0.77
6.96	37.66	59.86	1.68	100.39	2.20	0.76	0.76
7.05	34.63	54.98	1.93	105.92	2.29	0.75	0.75
7.09	32.47	51.51	2.11	108.93	2.35	0.74	0.74
7.18	29.80	47.21	2.47	116.47	2.44	0.73	0.73
7.23	28.49	45.11	2.66	120.11	2.48	0.72	0.72
7.30	27.63	43.72	2.83	123.80	2.51	0.72	0.72
7.36	26.94	42.60	2.97	126.56	2.54	0.71	0.71
7.45	26.25	41.48	3.04	126.20	2.55	0.71	0.71
7.50	26.85	42.44	2.94	124.92	2.53	0.71	0.71
7.55	26.42	41.74	2.97	123.99	2.54	0.71	0.71
7.61	26.76	42.28	2.89	122.24	2.52	0.71	0.71
7.72	26.93	42.56	2.79	118.65	2.50	0.71	0.71
7.76	26.41	41.71	2.79	116.55	2.51	0.71	0.71
7.81	25.97	41.01	2.53	103.75	2.45	0.71	0.71
7.94	25.93	40.92	2.20	89.88	2.37	0.71	0.71
7.97	25.92	40.91	2.20	90.12	2.37	0.71	0.71
8.03	25.88	40.84	2.26	92.41	2.39	0.71	0.71
8.07	25.88	40.84	2.31	94.24	2.40	0.71	0.71
8.14	25.80	40.70	2.39	97.41	2.42	0.71	0.71
8.20	24.55	38.68	2.64	102.04	2.47	0.70	0.70
8.28	23.22	36.53	2.93	106.91	2.53	0.69	0.69
8.34	22.27	35.00	3.15	110.24	2.57	0.69	0.69
8.40	21.50	33.76	3.46	116.68	2.62	3.09	3.09
8.47	20.98	32.92	3.70	121.74	2.66	2.99	2.99
8.53	20.98	32.91	3.76	123.87	2.67	2.97	2.97
8.60	20.55	32.22	3.88	125.03	2.68	2.89	2.89
8.68	20.72	32.48	3.67	119.15	2.65	2.88	2.88
8.74	21.15	33.17	3.45	114.31	2.62	2.92	2.92
8.80	22.53	35.38	3.13	110.69	2.57	0.69	0.69
8.88	25.04	39.40	2.66	104.79	2.48	0.70	0.70
8.94	28.49	44.94	2.20	98.72	2.37	0.72	0.72
9.01	30.64	48.39	1.94	93.80	2.30	0.73	0.73
9.07	32.28	50.19	1.78	89.41	2.24	0.73	0.73
9.14	33.32	50.86	1.65	84.04	2.19	0.74	0.74
9.19	34.10	51.49	1.58	81.44	2.16	0.74	0.74
9.27	35.23	52.49	1.52	79.68	2.13	0.74	0.74
9.33	35.66	52.55	1.47	77.26	2.11	0.74	0.74
9.41	35.76	52.41	1.48	77.43	2.11	0.74	0.74
9.46	35.84	52.46	1.49	78.31	2.12	0.74	0.74

:: Strength loss calculation (Robertson (2009) :: (continued)

Depth (ft)	q_t (tsf)	Q_{tn}	K_c	$Q_{tn,cs}$	I_c	$S_{u(liq)}/\sigma'_v$	$S_{u(peak)}/\sigma'_v$
9.54	36.19	52.41	1.46	76.28	2.10	0.74	0.74
9.60	36.71	52.58	1.40	73.69	2.07	0.74	0.74
9.65	37.31	52.89	1.36	71.73	2.04	0.74	0.74
9.72	37.31	52.64	1.36	71.46	2.04	0.74	0.74
9.82	37.40	52.50	1.36	71.61	2.05	0.74	0.74
9.86	36.79	51.88	1.42	73.45	2.08	0.74	0.74
9.91	38.87	54.59	1.40	76.65	2.07	0.75	0.75
9.99	42.58	58.96	1.34	78.78	2.03	0.76	0.76
10.04	46.03	63.19	1.30	82.10	2.00	0.76	0.76
10.13	45.69	62.89	1.35	84.91	2.04	0.76	0.76
10.18	50.27	68.21	1.27	86.96	1.98	0.77	0.77
10.26	52.94	71.16	1.25	88.81	1.96	0.78	0.78
10.35	64.52	84.94	1.17	99.49	1.88	0.80	0.80
10.43	73.50	95.09	1.12	106.33	1.82	0.82	0.82
10.45	77.99	100.18	1.10	109.73	1.78	0.83	0.83
10.53	88.53	110.72	1.00	110.72	1.68	0.84	0.84
10.57	94.49	117.73	1.00	117.73	1.66	0.85	0.85
10.67	113.75	140.94	1.01	141.90	1.65	0.88	0.88
10.71	119.71	147.60	1.00	147.25	1.64	0.88	0.88
10.77	120.92	148.71	1.00	148.29	1.64	0.88	0.88
10.84	129.90	159.21	1.00	159.21	1.60	0.89	0.89
10.89	141.21	172.66	1.00	172.66	1.54	0.91	0.91
10.96	152.35	185.71	1.00	185.71	1.50	0.92	0.92
11.04	155.20	188.56	1.00	188.56	1.49	0.92	0.92
11.13	158.83	192.16	1.00	192.16	1.49	0.92	0.92
11.17	160.39	193.66	1.00	193.66	1.49	0.92	0.92
11.26	162.55	195.47	1.00	195.47	1.48	0.93	0.93
11.29	165.57	198.79	1.00	198.79	1.47	0.93	0.93
11.38	166.86	199.53	1.00	199.53	1.47	0.93	0.93
11.44	166.69	198.74	1.00	198.74	1.52	0.93	0.93
11.52	167.81	199.32	1.00	199.32	1.56	0.93	0.93
11.57	167.04	197.97	1.00	197.97	1.56	0.93	0.93
11.63	169.37	200.20	1.00	200.20	1.55	0.93	0.93
11.69	173.08	204.04	1.00	204.04	1.54	0.93	0.93
11.75	172.39	202.63	1.00	202.63	1.55	0.93	0.93
11.84	167.55	196.10	1.00	196.10	1.58	0.93	0.93
11.89	167.90	196.09	1.00	196.09	1.58	0.93	0.93
11.95	168.50	196.26	1.00	196.26	1.57	0.93	0.93
12.01	170.84	198.45	1.00	198.45	1.56	0.93	0.93
12.07	174.81	202.49	1.00	202.49	1.52	0.93	0.93
12.17	179.56	207.10	1.00	207.10	1.55	0.94	0.94
12.23	183.27	210.89	1.00	210.89	1.55	0.94	0.94
12.29	185.00	212.31	1.00	212.31	1.55	0.94	0.94
12.38	184.40	210.80	1.00	210.80	1.57	0.94	0.94
12.43	186.56	212.84	1.00	212.84	1.57	0.94	0.94
12.47	183.71	209.17	1.00	209.17	1.57	0.94	0.94
12.55	180.68	205.02	1.00	205.02	1.58	0.93	0.93
12.62	172.48	195.05	1.00	195.05	1.58	0.93	0.93

:: Strength loss calculation (Robertson (2009) :: (continued)

Depth (ft)	q_t (tsf)	Q_{tn}	K_c	$Q_{tn,cs}$	I_c	$S_{u(liq)}/\sigma'_v$	$S_{u(peak)}/\sigma'_v$
12.69	168.16	189.56	1.00	189.56	1.56	0.92	0.92
12.74	163.15	183.54	1.00	183.54	1.53	0.92	0.92
12.80	156.76	175.93	1.00	175.93	1.37	0.91	0.91
12.87	147.34	164.82	1.00	164.82	1.39	0.90	0.90
12.94	134.91	150.46	1.00	150.46	1.45	0.89	0.89
13.00	120.57	134.03	1.00	134.03	1.55	0.87	0.87
13.08	104.33	116.57	1.05	121.86	1.71	0.85	0.85
13.14	76.35	87.45	1.24	108.83	1.95	0.81	0.81
13.19	74.45	85.49	1.30	110.74	2.00	0.81	0.81
13.26	57.52	67.04	1.60	107.18	2.17	0.77	0.77
13.33	47.50	55.67	1.87	104.12	2.27	0.75	0.75
13.42	31.78	37.64	2.69	101.13	2.48	0.70	0.70
13.47	24.36	29.01	3.49	101.38	2.63	2.15	2.15
13.54	18.66	22.22	4.44	98.71	2.76	1.62	1.62
13.61	15.63	18.54	5.12	94.86	2.84	1.34	1.34
13.65	14.34	16.93	5.39	91.22	2.87	1.22	1.22
13.74	14.16	16.50	4.89	80.61	2.81	1.20	1.20
13.78	14.16	16.39	4.58	75.04	2.78	1.19	1.19
13.87	13.91	15.97	4.47	71.40	2.76	1.16	1.16
13.92	13.82	15.82	4.51	71.28	2.77	1.15	1.15
13.98	13.74	15.65	4.54	71.10	2.77	1.14	1.14
14.05	13.74	15.54	4.36	67.79	2.75	0.33	1.13
14.14	13.40	15.05	4.42	66.55	2.76	0.31	1.10
14.19	12.88	14.43	4.63	66.74	2.78	0.31	1.05
14.28	12.53	13.95	4.81	67.07	2.80	0.31	1.01
14.32	13.05	14.50	4.60	66.68	2.78	0.31	1.05
14.41	14.17	15.66	4.15	65.00	2.72	0.30	1.14
14.47	14.43	15.92	4.18	66.47	2.72	0.32	1.16
14.50	14.52	16.00	4.24	67.79	2.73	0.33	1.17
14.60	14.69	16.13	4.42	71.25	2.76	1.17	1.17
14.65	14.87	16.29	4.45	72.43	2.76	1.18	1.18
14.72	14.95	16.34	4.66	76.06	2.78	1.18	1.18
14.77	15.12	16.51	4.77	78.66	2.80	1.19	1.19
14.84	15.29	16.65	4.92	81.94	2.82	1.20	1.20
14.90	15.81	17.17	4.79	82.21	2.80	1.24	1.24
14.99	16.24	17.54	4.69	82.20	2.79	1.27	1.27
15.03	16.15	17.40	4.72	82.17	2.79	1.26	1.26
15.13	14.76	15.79	5.22	82.42	2.85	1.14	1.14
15.18	13.29	14.13	5.79	81.83	2.91	1.01	1.01
15.22	11.90	12.55	6.44	80.80	2.97	0.90	0.90
15.30	10.95	11.41	7.13	81.31	3.03	0.81	0.81
15.36	10.08	10.38	7.81	81.13	3.09	0.74	0.74
15.43	9.48	9.66	8.30	80.16	3.13	0.69	0.69
15.49	9.22	9.32	8.41	78.46	3.14	0.67	0.67
15.58	8.53	8.50	9.01	76.62	3.18	0.61	0.61
15.63	8.27	8.18	9.17	75.07	3.19	0.58	0.58
15.71	8.27	8.14	9.26	75.34	3.20	0.58	0.58
15.76	9.83	9.83	7.90	77.61	3.10	0.70	0.70

:: Strength loss calculation (Robertson (2009) :: (continued)

Depth (ft)	q_t (tsf)	Q_{tn}	K_c	$Q_{tn,cs}$	I_c	$S_{u(liq)}/\sigma'_v$	$S_{u(peak)}/\sigma'_v$
15.84	13.19	13.44	6.02	80.92	2.93	0.96	0.96
15.94	18.46	18.94	4.61	87.36	2.78	1.37	1.37
15.95	19.76	20.29	4.31	87.45	2.74	1.47	1.47
16.03	21.57	22.11	4.15	91.64	2.72	1.60	1.60
16.12	23.47	23.99	3.99	95.70	2.70	1.74	1.74
16.15	20.36	20.74	4.79	99.27	2.80	1.49	1.49
16.21	25.11	25.59	3.99	102.07	2.70	1.85	1.85
16.29	26.75	27.20	3.97	108.11	2.70	1.97	1.97
16.35	27.19	27.59	4.10	112.97	2.71	1.99	1.99
16.42	27.53	27.86	4.30	119.84	2.74	2.01	2.01
16.51	28.05	28.28	4.50	127.21	2.77	2.04	2.04
16.55	28.65	28.84	4.57	131.76	2.77	2.07	2.07
16.60	29.26	29.39	4.63	136.10	2.78	2.11	2.11
16.69	29.52	29.52	4.78	141.18	2.80	2.12	2.12
16.74	29.69	29.62	4.84	143.22	2.81	2.13	2.13
16.80	29.43	29.25	5.00	146.17	2.82	2.10	2.10
16.86	28.91	28.62	5.19	148.61	2.85	2.05	2.05
16.94	27.88	27.45	5.44	149.41	2.87	1.97	1.97
17.00	27.45	26.93	5.53	148.89	2.88	1.93	1.93
17.09	26.67	25.99	5.57	144.84	2.89	1.86	1.86
17.14	26.67	25.91	5.48	141.88	2.88	1.85	1.85
17.23	26.32	25.40	5.38	136.58	2.87	1.82	1.82
17.26	25.98	25.01	5.39	134.85	2.87	1.79	1.79
17.36	24.25	23.16	5.68	131.44	2.90	1.66	1.66
17.41	23.39	22.24	5.87	130.48	2.92	1.59	1.59
17.46	23.30	22.08	5.85	129.24	2.92	1.58	1.58
17.53	23.30	21.98	5.79	127.18	2.91	1.57	1.57
17.63	22.26	20.84	6.03	125.59	2.93	1.49	1.49
17.65	21.92	20.48	6.11	125.17	2.94	1.46	1.46
17.72	21.23	19.72	6.27	123.66	2.96	1.41	1.41
17.81	20.18	18.60	6.51	121.07	2.98	1.33	1.33
17.86	19.23	17.62	6.74	118.74	3.00	1.26	1.26
17.94	18.45	16.79	6.93	116.34	3.02	1.20	1.20
18.00	17.24	15.57	7.37	114.81	3.05	1.11	1.11
18.08	17.29	15.54	7.37	114.56	3.05	1.11	1.11
18.14	17.29	15.48	7.39	114.36	3.06	1.11	1.11
18.21	17.33	15.46	7.39	114.24	3.06	1.10	1.10
18.27	18.63	16.63	6.90	114.80	3.01	1.19	1.19
18.34	20.96	18.76	6.14	115.17	2.94	1.34	1.34
18.41	23.20	20.79	5.53	114.97	2.88	1.48	1.48
18.48	23.98	21.44	5.34	114.48	2.86	1.53	1.53
18.54	24.24	21.63	4.21	91.15	2.73	1.54	1.54
18.57	24.07	21.45	3.40	72.82	2.61	1.53	1.53
18.66	23.20	20.53	4.31	88.55	2.74	1.46	1.46
18.71	23.03	20.31	4.61	93.69	2.78	1.45	1.45
18.77	22.08	19.36	5.07	98.11	2.83	1.38	1.38
18.84	20.96	18.24	5.51	100.45	2.88	1.30	1.30
18.92	21.22	18.40	5.70	104.90	2.90	1.31	1.31

:: Strength loss calculation (Robertson (2009) :: (continued)

Depth (ft)	q_t (tsf)	Q_{tn}	K_c	$Q_{tn,cs}$	I_c	$S_{u(liq)}/\sigma'_v$	$S_{u(peak)}/\sigma'_v$
19.00	21.48	18.54	6.14	113.83	2.94	1.32	1.32
19.04	22.77	19.68	6.07	119.43	2.94	1.41	1.41
19.10	26.92	23.39	5.46	127.70	2.88	1.67	1.67
19.19	33.65	29.40	4.49	131.89	2.76	2.09	2.09
19.23	37.19	32.56	4.05	131.89	2.71	2.31	2.31
19.31	41.17	36.02	3.82	137.69	2.68	2.56	2.56
19.37	42.29	36.91	3.98	146.75	2.70	2.62	2.62
19.43	47.21	41.23	3.69	151.95	2.66	2.92	2.92
19.50	65.26	57.44	2.59	148.68	2.46	0.75	0.75
19.56	62.76	55.06	2.60	143.33	2.47	0.75	0.75
19.64	66.55	58.33	2.33	135.70	2.40	0.75	0.75
19.72	76.65	67.32	1.92	129.47	2.29	0.77	0.77
19.77	82.27	72.32	1.72	124.38	2.22	0.78	0.78
19.85	99.11	87.49	1.41	123.18	2.07	0.81	0.81
19.90	110.93	98.14	1.28	125.54	1.98	0.82	0.82
19.95	120.61	106.85	1.21	129.39	1.92	0.84	0.84
20.04	131.57	116.25	1.22	142.26	1.94	0.85	0.85
20.08	135.11	119.07	1.27	151.19	1.98	0.85	0.85
20.16	145.90	128.31	1.27	162.94	1.98	0.86	0.86
20.22	156.79	137.97	1.21	166.69	1.92	0.87	0.87
20.28	175.27	154.33	1.16	179.65	1.87	0.89	0.89
20.36	218.28	193.00	1.07	206.79	1.75	0.92	0.92
20.45	302.14	268.18	1.00	268.18	1.58	0.98	0.98
20.49	333.49	295.76	1.00	295.76	1.53	0.99	0.99
20.58	363.82	321.92	1.00	321.92	1.43	1.01	1.01
20.63	344.82	304.68	1.00	304.68	1.44	1.00	1.00
20.69	319.34	281.60	1.00	281.60	1.37	0.98	0.98
20.75	314.86	277.23	1.00	277.23	1.28	0.98	0.98
20.81	274.19	240.86	1.00	240.86	1.38	0.96	0.96
20.89	247.42	216.81	1.00	216.81	1.48	0.94	0.94
20.94	229.20	200.50	1.00	200.50	1.54	0.93	0.93
21.00	217.89	190.23	1.00	190.23	1.57	0.92	0.92
21.07	165.91	143.53	1.06	152.70	1.74	0.88	0.88
21.14	188.79	163.86	1.01	166.13	1.66	0.90	0.90
21.20	193.70	167.96	1.01	169.38	1.66	0.90	0.90
21.26	197.68	171.17	1.01	172.54	1.66	0.91	0.91
21.34	211.32	182.89	1.00	182.89	1.63	0.92	0.92
21.39	232.48	201.02	1.00	201.02	1.56	0.93	0.93
21.47	254.08	219.35	1.00	219.35	1.49	0.94	0.94
21.54	279.46	241.01	1.00	241.01	1.41	0.96	0.96
21.61	290.77	250.35	1.00	250.35	1.30	0.97	0.97
21.66	301.06	258.88	1.00	258.88	1.24	0.97	0.97
21.74	309.08	265.32	1.00	265.32	1.26	0.97	0.97
21.79	316.87	271.70	1.00	271.70	1.30	0.98	0.98
21.87	307.62	263.21	1.00	263.21	1.47	0.97	0.97
21.92	301.24	257.36	1.00	257.36	1.56	0.97	0.97
21.99	307.90	262.60	1.00	262.60	1.61	0.97	0.97
22.07	336.58	286.85	1.00	286.85	1.48	0.99	0.99

:: Strength loss calculation (Robertson (2009) :: (continued)

Depth (ft)	q_t (tsf)	Q_{tn}	K_c	$Q_{tn,cs}$	I_c	$S_{u(liq)}/\sigma'_v$	$S_{u(peak)}/\sigma'_v$
22.13	308.16	262.34	1.00	262.34	1.46	0.97	0.97
22.21	338.87	288.30	1.00	288.30	1.33	0.99	0.99
22.25	309.98	263.48	1.00	263.48	1.40	0.97	0.97
22.33	341.16	289.78	1.00	289.78	1.43	0.99	0.99
22.38	327.42	277.89	1.00	277.89	1.52	0.98	0.98
22.45	352.20	298.70	1.00	298.70	1.46	0.99	0.99
22.51	338.21	286.59	1.00	286.59	1.47	0.99	0.99
22.58	360.14	304.96	1.00	304.96	1.43	1.00	1.00
22.65	373.95	316.39	1.00	316.39	1.42	1.00	1.00
22.73	369.38	312.19	1.00	312.19	1.43	1.00	1.00
22.79	368.25	310.99	1.00	310.99	1.42	1.00	1.00
22.88	364.88	307.77	1.00	307.77	1.40	1.00	1.00
22.91	367.29	309.66	1.00	309.66	1.38	1.00	1.00
23.00	359.87	303.04	1.00	303.04	1.35	1.00	1.00
23.03	357.45	300.87	1.00	300.87	1.35	1.00	1.00
23.10	358.57	301.57	1.00	301.57	1.33	1.00	1.00
23.18	361.07	303.39	1.00	303.39	1.32	1.00	1.00
23.23	366.51	307.78	1.00	307.78	1.26	1.00	1.00
23.30	375.58	315.16	1.00	315.16	1.14	1.00	1.00
23.37	381.01	319.48	1.00	319.48	1.17	1.01	1.01
23.45	381.87	319.89	1.00	319.89	1.20	1.01	1.01
23.54	378.24	316.48	1.00	316.48	1.24	1.00	1.00
23.56	368.30	308.07	1.00	308.07	1.26	1.00	1.00
23.65	349.99	292.37	1.00	292.37	1.30	0.99	0.99
23.69	355.35	296.71	1.00	296.71	1.30	0.99	0.99
23.76	357.76	298.47	1.00	298.47	1.31	0.99	0.99
23.82	360.26	300.34	1.00	300.34	1.31	0.99	0.99
23.89	365.44	304.41	1.00	304.41	1.34	1.00	1.00
23.96	381.07	317.20	1.00	317.20	1.37	1.00	1.00
24.02	420.98	350.26	1.00	350.26	1.31	1.02	1.02
24.09	472.61	393.03	1.00	393.03	1.26	1.04	1.04
24.16	511.05	424.72	1.00	424.72	1.24	1.05	1.05
24.22	507.85	421.73	1.00	421.73	1.28	1.05	1.05
24.29	454.39	376.85	1.00	376.85	1.38	1.03	1.03
24.36	420.53	348.35	1.00	348.35	1.39	1.02	1.02
24.42	382.27	316.32	1.00	316.32	1.42	1.00	1.00
24.50	376.57	311.29	1.00	311.29	1.33	1.00	1.00
24.59	358.18	295.71	1.00	295.71	1.25	0.99	0.99
24.62	357.74	295.22	1.00	295.22	1.25	0.99	0.99
24.68	357.74	295.03	1.00	295.03	1.27	0.99	0.99
24.77	357.31	294.38	1.00	294.38	1.27	0.99	0.99
24.81	359.64	296.13	1.00	296.13	1.26	0.99	0.99
24.89	355.41	292.38	1.00	292.38	1.27	0.99	0.99
24.95	370.27	304.44	1.00	304.44	1.24	1.00	1.00
25.02	382.79	314.49	1.00	314.49	1.24	1.00	1.00
25.08	389.79	320.06	1.00	320.06	1.26	1.01	1.01
25.16	403.95	331.38	1.00	331.38	1.29	1.01	1.01
25.20	403.95	331.24	1.00	331.24	1.30	1.01	1.01

:: Strength loss calculation (Robertson (2009) :: (continued)

Depth (ft)	q_t (tsf)	Q_{tn}	K_c	$Q_{tn,cs}$	I_c	$S_{u(liq)}/\sigma'_v$	$S_{u(peak)}/\sigma'_v$
25.26	400.49	328.14	1.00	328.14	1.33	1.01	1.01
25.35	389.79	318.99	1.00	318.99	1.36	1.00	1.00
25.40	381.23	311.78	1.00	311.78	1.37	1.00	1.00
25.48	370.34	302.53	1.00	302.53	1.38	1.00	1.00
25.53	366.03	298.81	1.00	298.81	1.38	0.99	0.99
25.62	356.53	290.72	1.00	290.72	1.36	0.99	0.99
25.66	353.07	287.74	1.00	287.74	1.35	0.99	0.99
25.75	344.68	280.59	1.00	280.59	1.29	0.98	0.98
25.80	341.31	277.69	1.00	277.69	1.24	0.98	0.98
25.86	338.64	275.30	1.00	275.30	1.23	0.98	0.98
25.94	338.38	274.86	1.00	274.86	1.23	0.98	0.98
26.00	336.22	272.90	1.00	272.90	1.25	0.98	0.98
26.06	332.76	269.92	1.00	269.92	1.27	0.98	0.98
26.15	309.10	250.38	1.00	250.38	1.33	0.97	0.97
26.19	315.58	255.53	1.00	255.53	1.32	0.97	0.97
26.28	314.89	254.72	1.00	254.72	1.33	0.97	0.97
26.33	314.89	254.58	1.00	254.58	1.33	0.97	0.97
26.38	317.13	256.25	1.00	256.25	1.33	0.97	0.97
26.45	320.50	258.77	1.00	258.77	1.33	0.97	0.97
26.52	328.53	265.08	1.00	265.08	1.32	0.97	0.97
26.59	333.54	268.95	1.00	268.95	1.31	0.98	0.98
26.64	340.71	274.58	1.00	274.58	1.30	0.98	0.98
26.72	351.76	283.28	1.00	283.28	1.39	0.99	0.99
26.77	362.13	291.47	1.00	291.47	1.50	0.99	0.99
26.84	382.60	307.77	1.00	307.77	1.52	1.00	1.00
26.90	402.12	323.27	1.00	323.27	1.52	1.01	1.01
26.98	430.01	345.43	1.00	345.43	1.50	1.02	1.02
27.05	440.64	353.72	1.00	353.72	1.50	1.02	1.02
27.11	433.30	347.53	1.00	347.53	1.49	1.02	1.02
27.18	454.97	364.67	1.00	364.67	1.43	1.03	1.03
27.24	407.64	326.37	1.00	326.37	1.47	1.01	1.01
27.30	404.09	323.25	1.00	323.25	1.41	1.01	1.01
27.38	425.00	339.76	1.00	339.76	1.33	1.02	1.02
27.44	426.64	340.82	1.00	340.82	1.31	1.02	1.02
27.50	428.71	342.24	1.00	342.24	1.29	1.02	1.02
27.56	422.58	337.08	1.00	337.08	1.26	1.01	1.01
27.63	407.20	324.52	1.00	324.52	1.26	1.01	1.01
27.70	420.42	334.85	1.00	334.85	1.24	1.01	1.01
27.76	397.36	316.18	1.00	316.18	1.28	1.00	1.00
27.84	418.26	332.59	1.00	332.59	1.33	1.01	1.01
27.89	423.44	336.49	1.00	336.49	1.36	1.01	1.01
27.96	461.62	366.68	1.00	366.68	1.25	1.03	1.03
28.03	481.13	-1.00	1.00	-1.00	-1.00	N/A	N/A
28.11	529.59	-1.00	1.00	-1.00	-1.00	N/A	N/A
28.15	556.71	-1.00	1.00	-1.00	-1.00	N/A	N/A
28.22	617.60	-1.00	1.00	-1.00	-1.00	N/A	N/A
28.31	616.47	-1.00	1.00	-1.00	-1.00	N/A	N/A
28.36	697.06	-1.00	1.00	-1.00	-1.00	N/A	N/A

:: Strength loss calculation (Robertson (2009) :: (continued)

Depth (ft)	q_t (tsf)	Q_{tn}	K_c	$Q_{tn,cs}$	I_c	$S_{u(liq)}/\sigma'_v$	$S_{u(peak)}/\sigma'_v$

Abbreviations

q_t: Total cone resistance
K_c: Cone resistance correction factor due to fines
$Q_{tn,cs}$: Adjusted and corrected cone resistance due to fines
I_c: Soil behavior type index
$S_{u(liq)}/\sigma'_v$: Calculated liquefied undrained strength ratio
$S_{u(peak)}/\sigma'_v$: Calculated peak undrained strength ratio

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LIQUEFACTION ANALYSIS REPORT

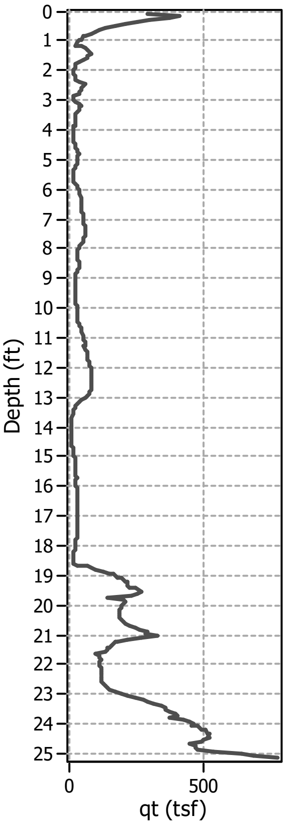
Project title : Twining Consulting **Location : 4112 Del Rey Ave, Marina Del Rey, CA**

CPT file : CPT-4

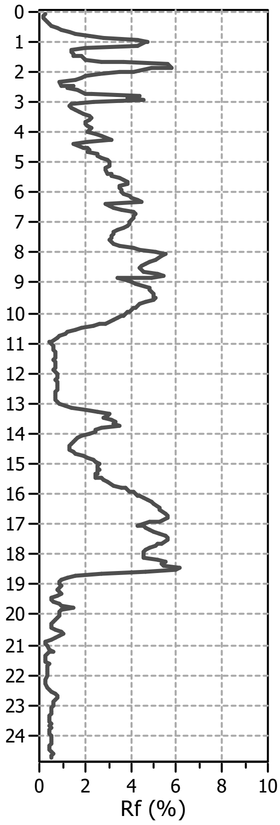
Input parameters and analysis data

Analysis method:	NCEER (1998)	G.W.T. (in-situ):	18.80 ft	Use fill:	No	Clay like behavior applied:	Sands only
Fines correction method:	NCEER (1998)	G.W.T. (earthq.):	6.00 ft	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	1	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	7.31	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.87	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

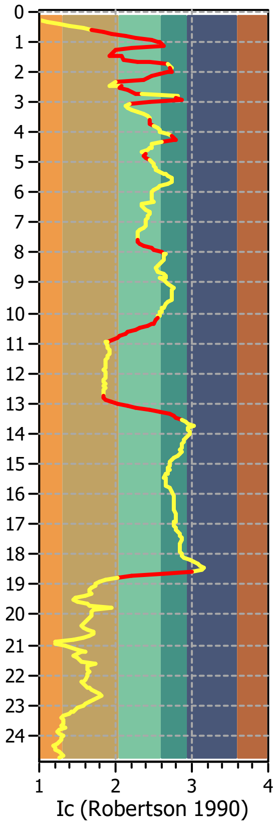
Cone resistance



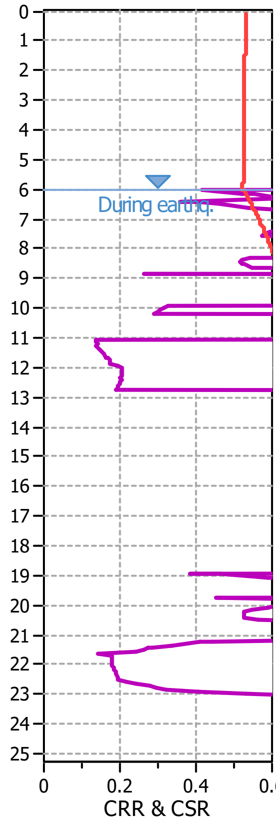
Friction Ratio



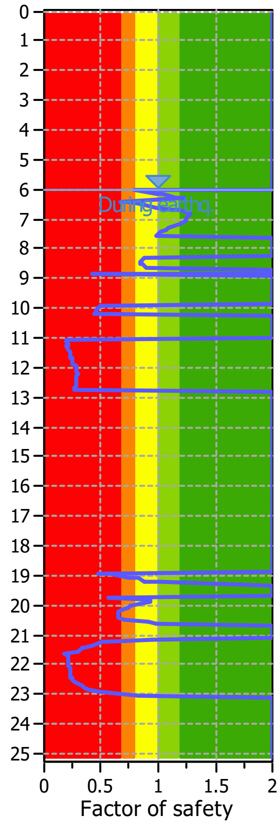
SBTn Plot



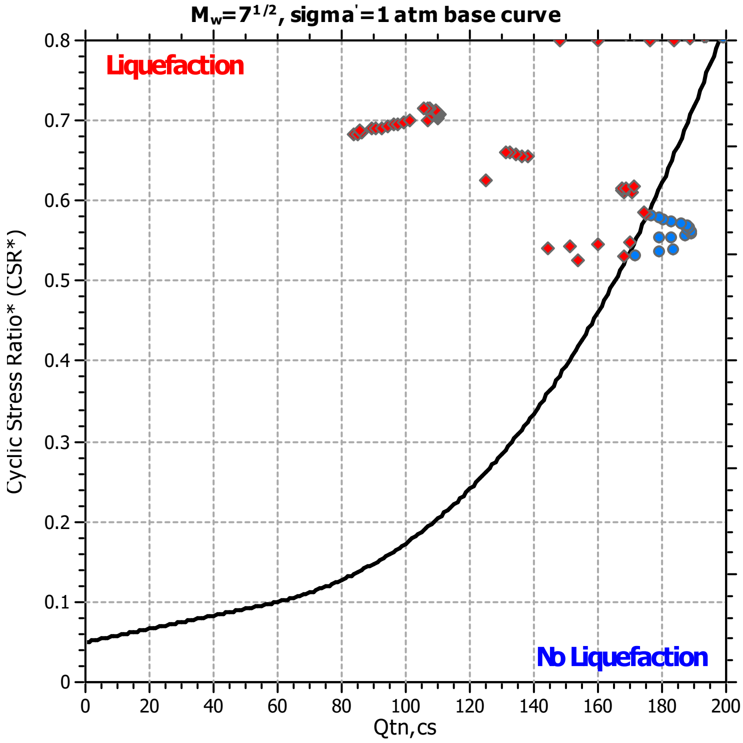
CRR plot



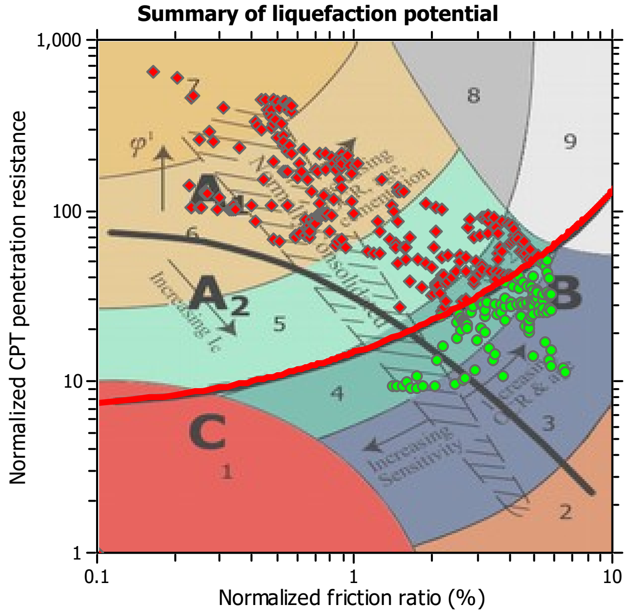
FS Plot



$M_w=7^{1/2}$, sigma'=1 atm base curve

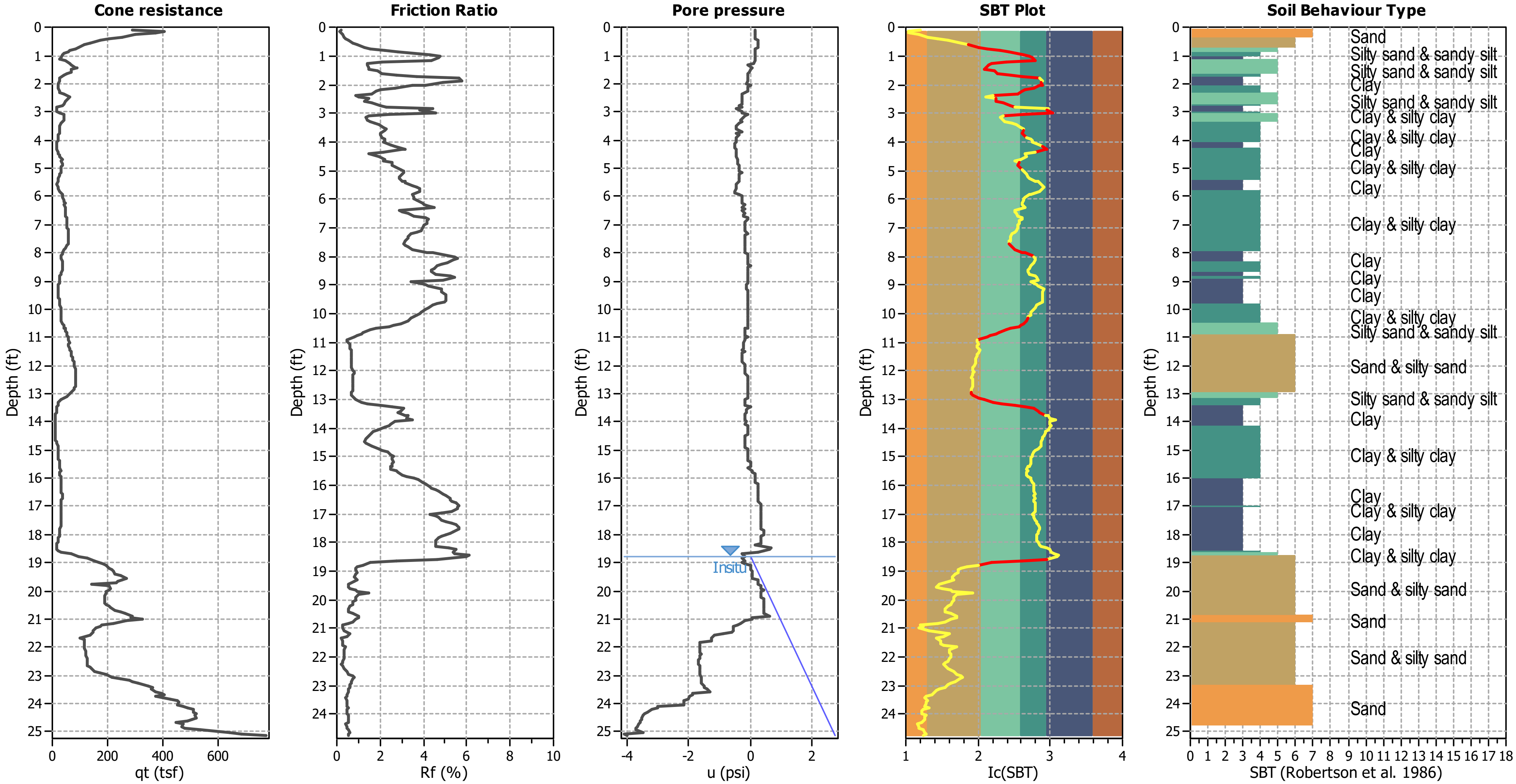


Summary of liquefaction potential



Zone A_1: Cyclic liquefaction likely depending on size and duration of cyclic loading
Zone A_2: Cyclic liquefaction and strength loss likely depending on loading and ground geometry
Zone B: Liquefaction and post-earthquake strength loss unlikely, check cyclic softening
Zone C: Cyclic liquefaction and strength loss possible depending on soil plasticity, brittleness/sensitivity, strain to peak undrained strength and ground geometry

CPT basic interpretation plots



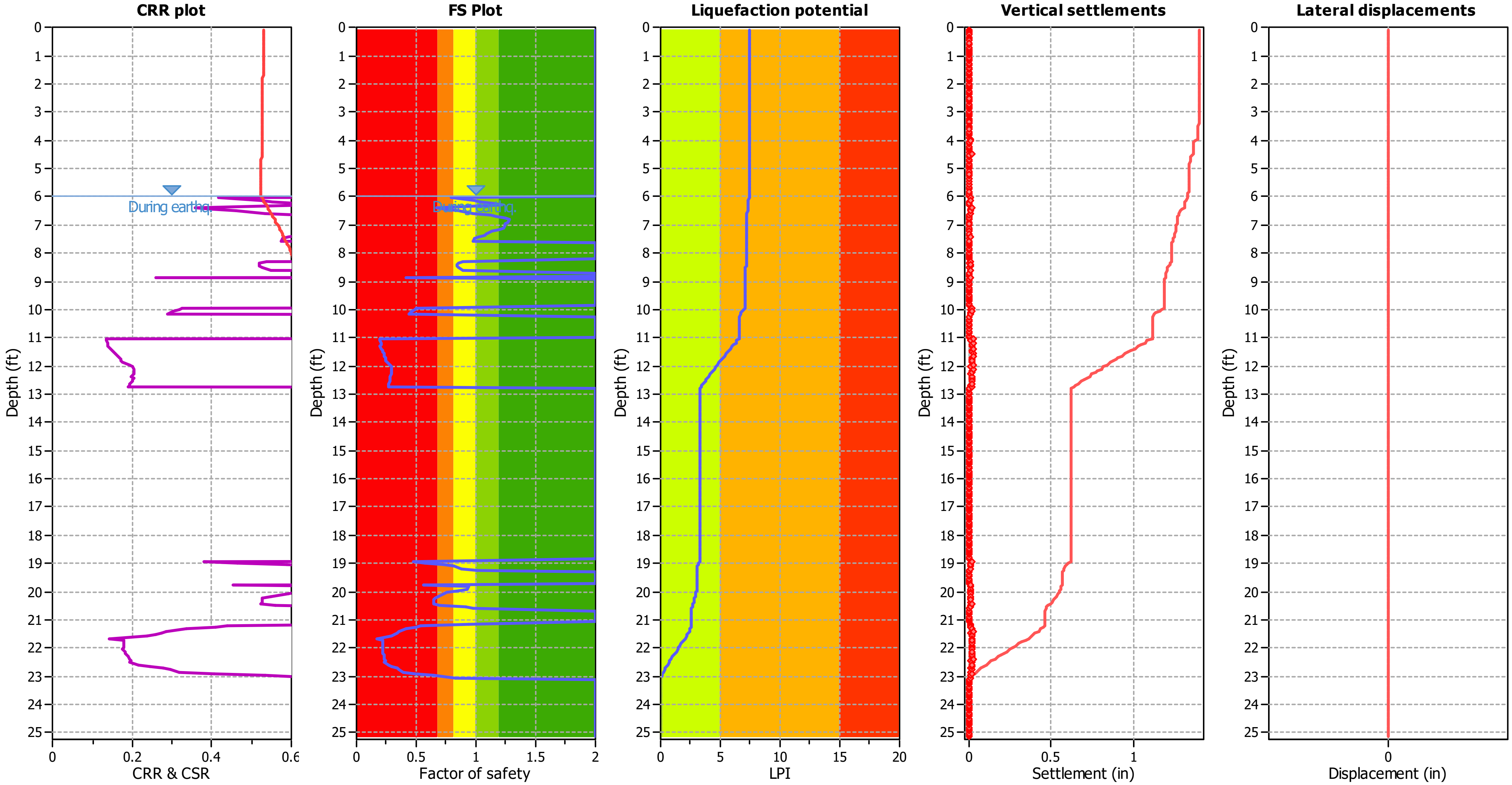
Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	6.00 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	1	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	7.31	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.87	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	18.80 ft	Fill height:	N/A	Limit depth:	N/A

SBT legend

- 1. Sensitive fine grained
- 2. Organic material
- 3. Clay to silty clay
- 4. Clayey silt to silty
- 5. Silty sand to sandy silt
- 6. Clean sand to silty sand
- 7. Gravely sand to sand
- 8. Very stiff sand to
- 9. Very stiff fine grained

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	6.00 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	1	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	7.31	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.87	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	18.80 ft	Fill height:	N/A	Limit depth:	N/A

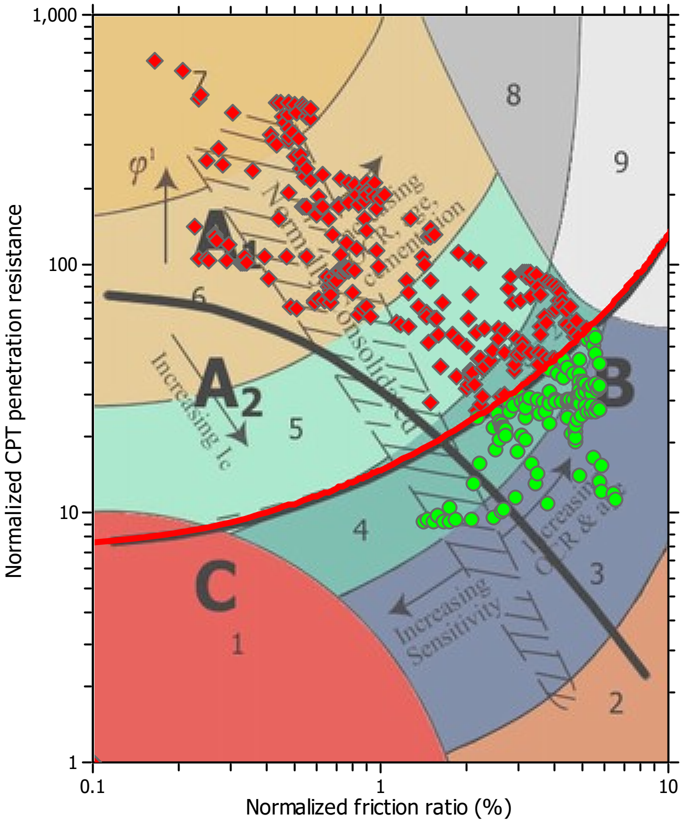
F.S. color scheme

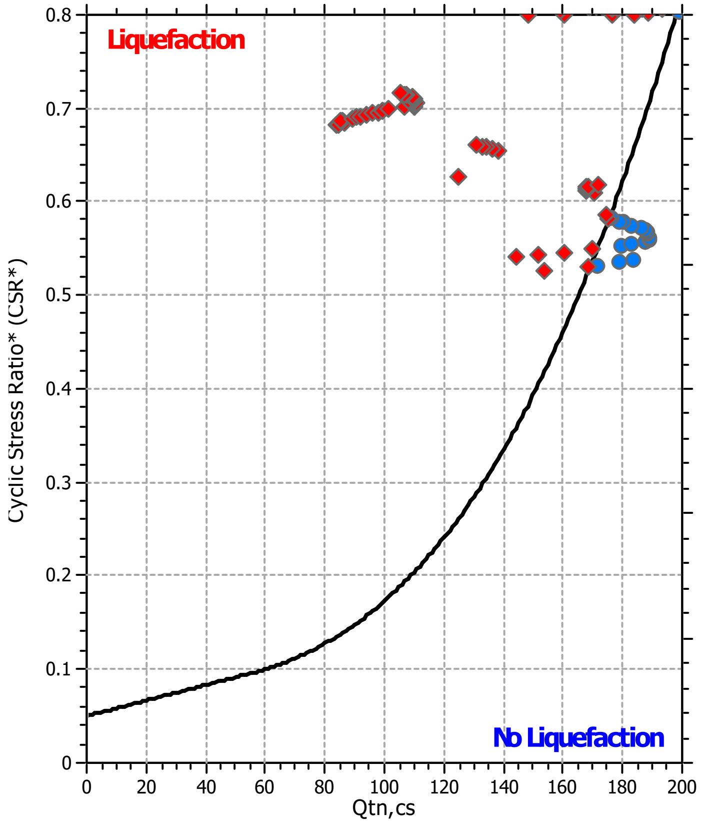
- Almost certain it will liquefy
- Very likely to liquefy
- Liquefaction and no liq. are equally likely
- Unlike to liquefy
- Almost certain it will not liquefy

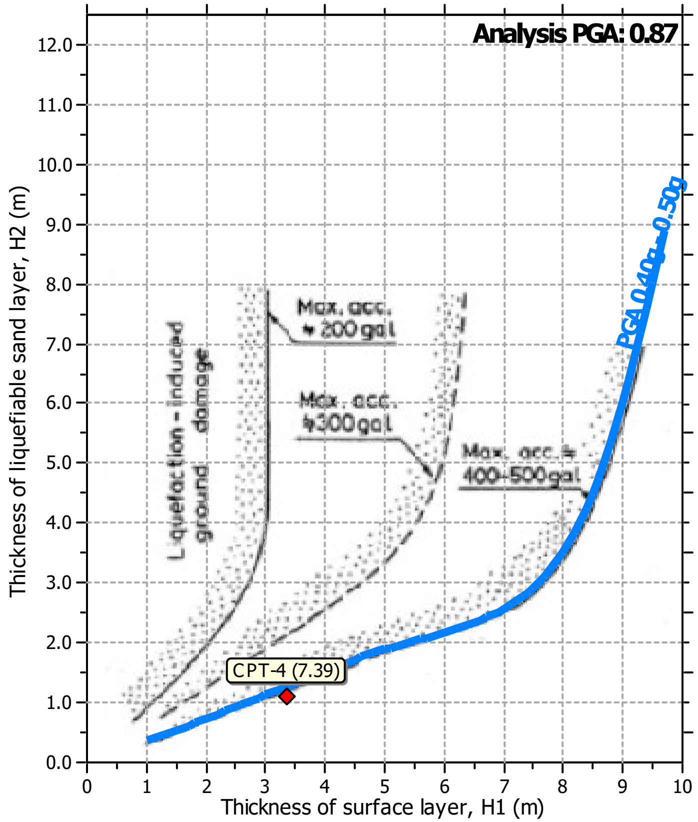
LPI color scheme

- Very high risk
- High risk
- Low risk

Liquefaction analysis summary plots







Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	6.00 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	1	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	7.31	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.87	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	18.80 ft	Fill height:	N/A	Limit depth:	N/A

:: Field input data ::

Point ID	Depth (ft)	q_c (tsf)	f_s (tsf)	u (tsf)	Fines content (%)	Unit weight (pcf)
1	0.09	287.18	0.67	0.17	0.00	121.15
2	0.14	405.59	0.67	0.17	0.00	121.99
3	0.20	370.95	0.76	0.17	0.00	122.69
4	0.27	296.85	0.70	0.17	0.00	121.58
5	0.34	251.25	0.77	0.17	0.00	121.88
6	0.41	205.64	0.85	0.17	0.06	122.04
7	0.47	169.37	0.89	0.26	1.53	121.97
8	0.55	133.09	1.02	0.26	4.18	122.38
9	0.60	115.39	1.09	0.26	6.05	122.51
10	0.69	94.49	1.21	0.26	9.21	122.74
11	0.74	81.01	1.25	0.17	11.76	122.62
12	0.82	63.39	1.39	0.17	17.00	122.78
13	0.86	54.93	1.55	0.17	21.15	123.25
14	0.93	41.89	1.80	0.17	29.67	123.69
15	0.99	37.14	1.77	0.17	32.76	123.27
16	1.05	31.70	1.48	0.17	34.66	121.58
17	1.14	25.74	1.12	0.17	36.62	119.00
18	1.19	46.81	0.96	0.17	19.39	119.36
19	1.27	62.27	0.88	0.13	13.23	119.42
20	1.32	67.28	0.94	-0.09	12.47	120.08
21	1.41	80.32	1.18	0.09	11.48	122.21
22	1.46	86.11	1.27	0.09	10.97	122.91
23	1.51	68.75	1.29	0.00	14.81	122.45
24	1.59	65.47	1.34	-0.04	16.07	122.62
25	1.65	49.83	1.37	-0.07	21.94	122.13
26	1.71	38.43	1.41	-0.07	28.64	121.71
27	1.78	26.86	1.51	-0.09	40.12	121.29
28	1.85	24.53	1.41	-0.10	42.04	120.60
29	1.91	22.46	1.10	-0.10	40.76	118.54
30	2.00	17.88	0.73	-0.11	41.76	115.00
31	2.04	17.62	0.61	0.00	39.60	113.71
32	2.11	18.83	0.50	-0.09	34.66	112.38
33	2.17	20.56	0.41	-0.09	29.72	111.16
34	2.25	22.28	0.41	-0.09	27.44	111.23
35	2.30	24.10	0.39	-0.17	25.07	111.14
36	2.37	41.54	0.36	-0.26	13.27	111.81
37	2.45	60.89	0.60	-0.26	10.77	116.57
38	2.50	53.55	0.79	-0.26	14.99	118.27
39	2.56	47.93	0.60	-0.26	14.65	115.94
40	2.63	43.70	0.72	-0.26	17.96	117.04
41	2.71	37.74	0.76	-0.26	21.64	117.11
42	2.76	34.72	0.80	-0.35	24.10	117.26
43	2.84	15.11	0.67	-0.26	46.29	113.95
44	2.90	14.25	0.55	-0.43	45.11	112.35
45	2.97	13.13	0.60	-0.26	49.70	112.85
46	3.04	25.48	0.61	-0.26	28.70	114.53
47	3.09	38.43	0.56	-0.09	18.23	114.87
48	3.16	42.06	0.57	-0.17	16.68	115.28

:: Field input data :: (continued)

Point ID	Depth (ft)	q_c (tsf)	f_s (tsf)	u (tsf)	Fines content (%)	Unit weight (pcf)
49	3.22	40.08	0.58	-0.27	17.74	115.26
50	3.29	37.83	0.58	-0.31	18.95	115.16
51	3.36	32.82	0.58	-0.26	21.95	114.76
52	3.42	29.02	0.57	-0.35	24.73	114.40
53	3.48	26.17	0.57	-0.43	27.22	114.09
54	3.54	24.53	0.56	-0.43	28.68	113.79
55	3.62	23.92	0.53	-0.43	28.82	113.40
56	3.70	23.58	0.48	-0.26	27.95	112.59
57	3.75	22.20	0.45	-0.43	28.84	112.00
58	3.83	20.56	0.43	-0.35	30.41	111.50
59	3.89	18.40	0.41	-0.43	33.00	110.91
60	3.96	17.27	0.38	-0.43	33.74	110.11
61	4.01	16.41	0.35	-0.43	34.27	109.41
62	4.09	13.82	0.34	-0.43	39.19	108.77
63	4.14	12.96	0.35	-0.52	41.76	108.85
64	4.24	12.35	0.39	-0.52	45.07	109.53
65	4.27	12.87	0.39	-0.52	43.66	109.65
66	4.34	15.11	0.32	-0.43	35.81	108.65
67	4.41	17.45	0.26	-0.43	29.06	107.33
68	4.50	20.04	0.39	-0.43	30.07	110.76
69	4.54	23.06	0.48	-0.43	28.51	112.49
70	4.59	26.17	0.57	-0.43	27.41	114.17
71	4.67	33.08	0.71	-0.42	24.04	116.30
72	4.74	31.61	0.80	-0.42	26.55	117.07
73	4.82	34.72	0.88	-0.42	25.32	117.98
74	4.87	33.86	0.91	-0.35	26.38	118.19
75	4.96	31.78	0.94	-0.35	28.35	118.22
76	5.01	30.49	0.94	-0.35	29.58	118.19
77	5.09	28.93	0.90	-0.35	30.32	117.67
78	5.14	27.47	0.83	-0.26	30.78	117.01
79	5.22	24.79	0.71	-0.35	31.61	115.63
80	5.25	23.49	0.67	-0.35	32.42	115.09
81	5.37	18.74	0.56	-0.35	36.75	113.24
82	5.38	17.79	0.56	-0.35	38.20	113.01
83	5.45	16.58	0.52	-0.35	39.61	112.40
84	5.54	15.72	0.55	-0.43	42.14	112.63
85	5.59	15.98	0.59	-0.43	42.58	113.14
86	5.64	17.27	0.66	-0.43	41.73	114.17
87	5.72	19.35	0.74	-0.43	39.74	115.29
88	5.82	25.13	0.88	-0.52	34.20	117.23
89	5.85	27.55	0.95	-0.52	32.61	118.02
90	5.95	32.82	1.18	-0.35	30.56	119.97
91	6.00	35.50	1.27	-0.26	29.50	120.74
92	6.04	36.53	1.36	-0.26	29.58	121.27
93	6.14	40.77	1.62	-0.26	29.10	122.84
94	6.18	41.72	1.69	-0.26	29.05	123.20
95	6.26	42.67	1.82	-0.26	29.50	123.80
96	6.31	41.98	1.89	-0.17	30.49	124.04

:: Field input data :: (continued)

Point ID	Depth (ft)	q_c (tsf)	f_s (tsf)	u (tsf)	Fines content (%)	Unit weight (pcf)
97	6.40	43.53	1.24	-0.26	24.03	121.07
98	6.44	44.83	1.36	-0.17	24.44	121.81
99	6.50	46.29	1.52	-0.26	24.98	122.67
100	6.59	46.90	1.68	-0.17	26.00	123.46
101	6.67	44.74	1.84	-0.20	28.43	124.01
102	6.70	44.65	1.90	-0.22	28.91	124.23
103	6.77	48.45	2.01	-0.09	27.58	124.85
104	6.83	49.40	2.05	-0.09	27.33	125.03
105	6.90	51.13	2.06	-0.17	26.54	125.16
106	6.98	51.82	2.04	-0.17	26.09	125.13
107	7.03	51.82	2.05	-0.17	26.12	125.14
108	7.10	52.51	2.04	-0.17	25.76	125.16
109	7.15	54.24	2.02	-0.17	24.81	125.15
110	7.23	57.00	1.96	-0.17	23.28	125.07
111	7.31	58.21	1.91	-0.09	22.46	124.92
112	7.35	58.13	1.89	-0.17	22.38	124.85
113	7.44	57.87	1.84	-0.17	22.13	124.62
114	7.49	57.69	1.81	-0.17	21.99	124.49
115	7.55	57.78	1.79	-0.17	21.86	124.43
116	7.63	56.31	1.79	-0.17	22.47	124.38
117	7.68	54.76	1.79	-0.17	23.11	124.31
118	7.76	50.87	1.79	-0.17	24.85	124.12
119	7.85	43.10	1.79	-0.17	29.05	123.70
120	7.89	40.59	1.79	-0.17	30.69	123.55
121	7.99	34.98	1.79	-0.17	34.99	123.19
122	8.02	32.82	1.78	-0.09	36.89	123.01
123	8.07	31.87	1.77	-0.09	37.71	122.89
124	8.14	31.78	1.71	-0.09	37.27	122.64
125	8.22	31.96	1.63	-0.09	36.34	122.31
126	8.30	32.56	1.57	-0.09	35.19	122.09
127	8.34	33.25	1.55	-0.09	34.28	122.00
128	8.43	34.72	1.55	-0.09	33.09	122.15
129	8.48	35.93	1.57	0.00	32.24	122.30
130	8.53	36.45	1.59	-0.09	32.02	122.43
131	8.61	35.58	1.62	-0.09	33.06	122.53
132	8.70	31.35	1.64	-0.09	36.99	122.27
133	8.74	29.62	1.62	-0.09	38.64	122.06
134	8.83	25.91	1.26	-0.09	38.91	119.92
135	8.87	24.87	0.86	-0.09	34.29	116.97
136	8.92	23.75	0.90	-0.09	36.44	117.23
137	8.99	22.89	0.93	-0.09	38.13	117.39
138	9.06	22.28	0.94	-0.09	39.23	117.43
139	9.15	20.04	0.97	-0.13	43.21	117.34
140	9.22	20.90	1.00	-0.13	42.38	117.71
141	9.26	21.33	1.03	-0.13	42.12	117.96
142	9.35	21.16	1.07	-0.09	42.96	118.18
143	9.40	21.25	1.06	-0.09	42.77	118.17
144	9.48	21.07	1.06	-0.09	43.06	118.14

:: Field input data :: (continued)

Point ID	Depth (ft)	q_c (tsf)	f_s (tsf)	u (tsf)	Fines content (%)	Unit weight (pcf)
145	9.53	21.07	1.06	-0.09	43.10	118.16
146	9.58	21.42	1.07	-0.09	42.55	118.21
147	9.66	23.06	1.07	-0.09	40.06	118.39
148	9.72	24.18	1.07	-0.09	38.50	118.50
149	9.80	25.48	1.08	-0.09	37.12	118.73
150	9.85	26.52	1.09	-0.09	36.09	118.87
151	9.94	27.38	1.07	-0.09	35.09	118.85
152	9.98	27.38	1.05	-0.09	34.90	118.71
153	10.08	27.81	1.03	-0.09	34.34	118.63
154	10.12	28.76	1.03	-0.09	33.37	118.66
155	10.18	29.45	1.02	-0.09	32.63	118.63
156	10.25	29.71	0.97	-0.09	31.87	118.31
157	10.34	29.88	0.87	-0.09	30.53	117.57
158	10.39	30.57	0.81	-0.09	29.00	117.03
159	10.44	31.35	0.75	-0.09	27.65	116.60
160	10.52	35.58	0.66	-0.09	23.32	115.90
161	10.57	38.09	0.60	-0.09	20.98	115.36
162	10.66	41.98	0.52	-0.09	17.95	114.59
163	10.70	44.05	0.49	-0.17	16.64	114.29
164	10.77	47.42	0.43	-0.17	14.52	113.55
165	10.83	48.80	0.41	-0.17	13.68	113.17
166	10.93	52.86	0.27	-0.17	10.19	110.23
167	10.97	54.15	0.26	-0.09	5.00	110.13
168	11.06	56.57	0.33	-0.17	10.41	112.00
169	11.10	57.69	0.34	-0.17	10.25	112.18
170	11.19	58.99	0.36	-0.20	10.28	112.65
171	11.25	57.69	0.37	-0.22	10.78	112.83
172	11.29	56.57	0.37	-0.21	11.18	112.91
173	11.38	60.72	0.40	-0.20	10.59	113.58
174	11.43	61.93	0.41	-0.26	10.48	113.82
175	11.49	64.17	0.42	-0.17	10.17	114.12
176	11.56	66.50	0.44	-0.26	9.88	114.43
177	11.64	68.66	0.45	-0.26	9.71	114.82
178	11.70	69.53	0.48	-0.26	9.82	115.20
179	11.75	70.99	0.50	-0.26	9.78	115.54
180	11.81	72.38	0.48	-0.26	9.41	115.40
181	11.88	75.14	0.48	-0.26	8.93	115.47
182	11.97	78.42	0.58	-0.17	9.38	116.91
183	12.01	79.46	0.64	-0.17	9.76	117.64
184	12.10	80.93	0.63	-0.17	9.44	117.55
185	12.16	81.53	0.62	-0.17	9.34	117.55
186	12.24	83.43	0.62	-0.17	9.01	117.53
187	12.28	82.65	0.62	-0.17	9.15	117.51
188	12.36	80.41	0.62	-0.09	9.56	117.45
189	12.41	82.65	0.62	-0.09	9.24	117.56
190	12.47	81.79	0.63	-0.09	9.46	117.61
191	12.55	82.65	0.62	-0.09	9.27	117.53
192	12.64	82.05	0.59	-0.09	9.14	117.18

:: Field input data :: (continued)

Point ID	Depth (ft)	q_c (tsf)	f_s (tsf)	u (tsf)	Fines content (%)	Unit weight (pcf)
193	12.67	81.79	0.58	-0.09	9.09	117.03
194	12.73	81.19	0.56	-0.09	9.05	116.79
195	12.81	78.34	0.53	-0.09	9.19	116.22
196	12.86	74.45	0.51	-0.09	9.70	115.84
197	12.93	67.11	0.53	-0.09	11.47	115.92
198	13.00	59.08	0.52	-0.09	13.36	115.47
199	13.08	48.97	0.57	-0.09	17.28	115.61
200	13.13	41.72	0.60	-0.09	20.96	115.60
201	13.22	30.92	0.62	-0.17	28.46	115.18
202	13.27	24.87	0.63	-0.17	34.58	114.71
203	13.33	20.21	0.62	-0.17	41.01	114.16
204	13.40	17.10	0.51	-0.17	43.69	112.21
205	13.46	14.86	0.42	0.00	46.02	110.53
206	13.54	13.30	0.42	-0.09	50.18	110.23
207	13.59	12.18	0.40	-0.12	52.97	109.69
208	13.67	11.31	0.36	-0.12	54.47	108.78
209	13.72	9.50	0.33	-0.16	60.57	107.67
210	13.79	10.10	0.27	-0.16	54.82	106.44
211	13.88	9.24	0.23	-0.16	55.85	104.88
212	13.92	8.98	0.22	-0.17	56.35	104.44
213	13.99	8.64	0.19	-0.12	56.34	103.50
214	14.06	8.55	0.16	-0.17	54.17	102.12
215	14.13	8.55	0.14	-0.09	52.62	101.23
216	14.19	8.46	0.13	-0.09	52.35	100.78
217	14.25	8.46	0.13	-0.09	51.74	100.39
218	14.32	8.64	0.12	-0.09	50.36	100.05
219	14.37	8.72	0.12	-0.09	49.63	99.82
220	14.46	8.72	0.11	-0.09	49.35	99.57
221	14.51	8.90	0.12	-0.17	49.22	99.97
222	14.57	9.24	0.13	-0.17	49.48	100.99
223	14.64	9.93	0.16	-0.17	49.00	102.40
224	14.73	12.26	0.24	-0.17	46.75	105.94
225	14.78	14.68	0.31	-0.17	43.64	108.16
226	14.85	16.58	0.39	-0.17	42.96	110.31
227	14.91	18.31	0.45	-0.17	41.57	111.57
228	14.98	19.17	0.50	-0.09	41.46	112.41
229	15.05	20.12	0.52	-0.09	40.37	112.75
230	15.10	20.47	0.52	-0.09	40.01	112.88
231	15.18	20.12	0.53	-0.09	40.81	112.91
232	15.23	20.56	0.53	-0.09	40.16	112.97
233	15.32	21.33	0.54	-0.09	39.36	113.22
234	15.36	21.94	0.55	-0.09	38.68	113.39
235	15.45	23.58	0.58	0.00	37.31	114.01
236	15.49	24.01	0.65	0.00	38.36	114.92
237	15.56	25.74	0.72	0.00	37.63	115.84
238	15.62	26.60	0.79	-0.09	37.94	116.59
239	15.71	27.72	0.89	0.09	38.33	117.52
240	15.77	26.64	0.95	0.09	40.71	117.94

:: Field input data :: (continued)

Point ID	Depth (ft)	q_c (tsf)	f_s (tsf)	u (tsf)	Fines content (%)	Unit weight (pcf)
241	15.82	26.69	1.00	0.17	41.45	118.30
242	15.90	26.77	1.06	0.17	42.35	118.74
243	15.96	26.95	1.11	0.17	42.88	119.08
244	16.05	27.21	1.18	0.17	43.53	119.51
245	16.09	27.47	1.20	0.17	43.62	119.70
246	16.16	27.90	1.28	0.17	44.15	120.18
247	16.22	28.76	1.35	0.26	44.10	120.68
248	16.29	29.45	1.44	0.26	44.34	121.17
249	16.36	30.40	1.53	0.26	44.30	121.69
250	16.45	31.27	1.64	0.26	44.61	122.28
251	16.50	31.96	1.68	0.26	44.34	122.52
252	16.54	32.47	1.72	0.26	44.22	122.73
253	16.63	32.73	1.80	0.26	44.78	123.07
254	16.72	32.30	1.82	0.26	45.53	123.11
255	16.75	32.13	1.80	0.26	45.61	123.04
256	16.81	31.70	1.77	0.26	45.86	122.88
257	16.94	30.57	1.61	0.35	45.68	122.10
258	16.95	30.14	1.45	0.35	44.40	121.29
259	17.02	29.37	1.27	0.35	43.20	120.26
260	17.07	28.93	1.32	0.35	44.47	120.53
261	17.14	28.59	1.34	0.35	45.11	120.57
262	17.21	28.42	1.36	0.35	45.76	120.71
263	17.28	28.24	1.42	0.35	46.76	120.99
264	17.34	28.07	1.48	0.35	47.81	121.29
265	17.40	27.90	1.53	0.35	48.67	121.50
266	17.47	27.47	1.55	0.35	49.52	121.54
267	17.52	27.29	1.53	0.35	49.71	121.47
268	17.62	27.29	1.47	0.35	49.01	121.14
269	17.66	27.38	1.43	0.35	48.43	120.95
270	17.72	27.21	1.37	0.35	48.07	120.65
271	17.80	26.52	1.28	0.35	47.82	120.05
272	17.85	25.74	1.20	0.43	48.01	119.55
273	17.93	24.61	1.13	0.43	48.67	118.97
274	18.00	23.41	1.06	0.43	49.69	118.42
275	18.06	22.28	1.01	0.35	50.85	117.95
276	18.11	21.42	0.97	0.35	51.74	117.55
277	18.20	18.74	0.97	0.35	57.40	117.21
278	18.25	17.36	0.96	0.35	60.59	116.93
279	18.33	15.37	0.83	0.35	63.36	115.55
280	18.38	14.16	0.77	0.17	65.84	114.81
281	18.46	13.21	0.81	0.69	70.39	115.00
282	18.51	13.82	0.83	0.61	68.71	115.29
283	18.59	16.41	0.76	0.43	59.16	115.12
284	18.64	30.57	0.83	0.26	37.07	117.29
285	18.70	66.42	1.03	-0.26	19.15	120.70
286	18.78	94.31	1.14	-0.17	13.40	122.31
287	18.85	123.51	1.19	-0.26	9.50	123.30
288	18.92	147.95	1.32	-0.17	7.68	124.48

:: Field input data :: (continued)

Point ID	Depth (ft)	q_c (tsf)	f_s (tsf)	u (tsf)	Fines content (%)	Unit weight (pcf)
289	18.97	164.45	1.43	-0.26	6.82	125.31
290	19.06	181.03	1.75	-0.17	6.84	127.03
291	19.11	194.76	1.71	0.00	5.88	127.07
292	19.19	205.56	1.68	0.00	5.18	127.06
293	19.24	215.32	1.92	0.00	5.38	128.15
294	19.32	216.44	2.04	0.09	5.66	128.59
295	19.38	225.42	1.83	0.09	4.65	127.90
296	19.44	243.30	1.32	0.09	2.49	125.71
297	19.54	264.55	1.39	0.09	2.01	126.29
298	19.59	250.99	1.58	0.26	2.95	127.09
299	19.65	234.06	2.07	0.26	4.92	128.89
300	19.71	231.47	2.18	0.26	5.34	129.26
301	19.76	142.25	2.12	0.26	11.66	127.85
302	19.83	203.83	2.03	0.35	6.39	128.43
303	19.91	209.18	1.87	0.35	5.61	127.87
304	19.96	201.50	1.76	0.43	5.71	127.35
305	20.03	192.77	1.62	0.35	5.76	126.63
306	20.09	194.24	1.49	0.35	5.25	126.06
307	20.16	189.58	1.34	0.35	4.99	125.23
308	20.22	187.16	1.15	0.35	4.39	124.05
309	20.30	187.16	1.01	0.43	3.84	123.11
310	20.36	187.16	0.99	0.43	3.77	122.97
311	20.45	187.16	1.03	0.43	3.91	123.21
312	20.48	192.26	1.36	0.43	4.91	125.34
313	20.55	204.61	2.04	0.43	6.43	128.46
314	20.61	210.05	2.14	0.43	6.41	128.88
315	20.68	223.09	1.92	0.43	5.12	128.24
316	20.76	243.99	1.78	0.43	3.82	127.88
317	20.81	259.28	1.40	0.43	2.28	126.31
318	20.88	289.42	0.71	0.61	0.00	121.62
319	20.94	280.87	0.79	0.09	0.02	122.27
320	21.00	323.28	0.88	0.09	0.00	123.45
321	21.06	265.58	0.95	-0.17	0.84	123.50
322	21.14	218.08	1.05	-0.30	2.66	123.74
323	21.20	176.36	1.04	-0.41	4.64	123.20
324	21.26	171.27	0.75	-0.55	3.58	120.71
325	21.33	158.31	0.36	-0.55	2.04	115.05
326	21.43	147.00	0.39	-0.55	2.84	115.49
327	21.46	144.24	0.38	-0.61	2.95	115.30
328	21.52	141.13	0.37	-0.87	3.10	115.15
329	21.59	135.43	0.40	-1.15	3.64	115.49
330	21.65	99.84	0.40	-1.27	5.00	114.86
331	21.73	115.73	0.38	-1.27	4.99	114.72
332	21.79	115.82	0.37	-1.27	4.95	114.65
333	21.85	115.99	0.38	-1.65	5.00	114.78
334	21.92	115.73	0.39	-1.65	5.00	115.02
335	21.98	115.69	0.39	-1.65	5.00	114.94
336	22.05	115.65	0.38	-1.65	5.00	114.86

:: Field input data :: (continued)

Point ID	Depth (ft)	q_c (tsf)	f_s (tsf)	u (tsf)	Fines content (%)	Unit weight (pcf)
337	22.13	117.46	0.34	-1.65	4.54	114.01
338	22.19	118.41	0.29	-1.65	4.05	112.98
339	22.25	119.88	0.28	-1.56	3.78	112.54
340	22.31	120.57	0.30	-1.65	3.93	113.11
341	22.41	122.13	0.41	-1.65	4.75	115.41
342	22.45	123.25	0.48	-1.66	5.00	116.72
343	22.52	123.25	0.57	-1.66	5.00	117.96
344	22.59	123.25	0.67	-1.66	6.73	119.12
345	22.65	126.53	0.92	-1.65	8.02	121.44
346	22.71	133.27	1.09	-1.65	8.31	122.80
347	22.78	140.61	1.06	-1.65	7.48	122.77
348	22.84	150.71	1.01	-1.65	6.36	122.59
349	22.92	173.08	1.13	-1.65	5.34	123.74
350	22.98	194.42	1.21	-1.65	4.43	124.52
351	23.04	213.76	1.30	-1.56	3.82	125.28
352	23.11	245.29	1.39	-1.56	2.85	126.11
353	23.19	278.71	1.54	-1.56	2.16	127.15
354	23.23	289.85	1.54	-1.56	1.86	127.25
355	23.30	309.63	1.54	-1.56	1.36	127.41
356	23.37	343.57	1.50	-1.47	0.57	127.47
357	23.44	359.98	1.51	-1.47	0.30	127.64
358	23.51	356.96	1.70	-1.39	0.70	128.47
359	23.57	373.11	1.79	-1.30	0.59	128.98
360	23.62	390.39	1.92	-1.86	0.51	129.59
361	23.71	402.82	1.92	-1.89	0.32	129.68
362	23.77	369.66	1.92	-1.94	0.89	129.48
363	23.82	424.50	1.97	-2.02	0.09	130.00
364	23.89	449.20	2.04	-2.16	0.00	130.40
365	23.97	457.41	2.18	-2.16	0.00	130.91
366	24.03	450.15	2.47	-2.16	0.44	131.79
367	24.08	473.90	2.64	-2.97	0.33	132.39
368	24.16	488.07	2.71	-2.97	0.25	132.67
369	24.21	506.38	2.69	-3.20	0.00	132.69
370	24.29	509.23	2.57	-3.34	0.00	132.37
371	24.35	519.07	2.26	-3.39	0.00	131.49
372	24.43	513.29	2.30	-3.45	0.00	131.58
373	24.49	520.89	2.50	-3.52	0.00	132.24
374	24.56	500.51	2.71	-3.52	0.11	132.73
375	24.63	486.69	2.78	-3.55	0.36	132.85
376	24.68	447.04	2.54	-3.58	0.61	131.99
377	24.74	469.33	2.39	-3.60	0.11	131.66
378	24.80	466.56	0.00	-3.64	N/A	87.36
379	24.88	478.65	0.00	-3.70	N/A	87.36
380	24.95	535.40	0.00	-3.70	N/A	87.36
381	25.01	638.78	0.00	-3.47	N/A	87.36
382	25.08	679.89	0.00	-4.07	N/A	87.36
383	25.13	771.44	0.00	-3.99	N/A	87.36

:: Field input data :: (continued)

Point ID	Depth (ft)	q_c (tsf)	f_s (tsf)	u (tsf)	Fines content (%)	Unit weight (pcf)

Abbreviations

Depth: Depth from free surface, at which CPT was performed (ft)
q_c: Measured cone resistance (tsf)
f_s: Sleeve friction resistance (tsf)
u: Pore pressure (tsf)
Fines content: Percentage of fines in soil (%)
Unit weight: Bulk soil unit weight (pcf)

:: Post-earthquake settlement of dry sands ::

Depth (ft)	Ic	Q_{tn}	Kc	$Q_{tn,cs}$	$N_{1,60}$ (blows)	G_{max} (tsf)	CSR	Shear, γ (%)	$e_{vol(15)}$ (%)	N_c	e_v (%)	Settle. (in)
0.09	1.00	461.39	1.00	461.39	69	914	0.53	0.000	0.00	13.43	0.00	0.000
0.14	0.79	651.63	1.00	651.63	93	991	0.53	0.001	0.00	13.43	0.00	0.000
0.20	0.87	595.97	1.00	595.97	87	1010	0.53	0.001	0.00	13.43	0.00	0.000
0.27	0.99	476.91	1.00	476.91	71	936	0.53	0.001	0.00	13.43	0.00	0.000
0.34	1.12	403.64	1.00	403.64	63	931	0.53	0.001	0.00	13.43	0.00	0.000
0.41	1.27	330.35	1.00	330.35	54	919	0.53	0.002	0.00	13.43	0.00	0.000
0.47	1.40	272.08	1.00	272.08	46	898	0.53	0.002	0.00	13.43	0.00	0.000
0.55	1.59	213.78	1.00	213.78	38	895	0.53	0.003	0.00	13.43	0.00	0.000
0.60	1.70	185.34	1.04	191.91	36	890	0.53	0.003	0.00	13.43	0.00	0.000
0.69	1.85	151.75	1.14	173.70	0	0	0.53	0.000	0.00	13.43	0.00	0.000
0.74	1.95	130.09	1.25	161.99	0	0	0.53	0.000	0.00	13.43	0.00	0.000
0.82	2.14	101.77	1.53	155.60	0	0	0.53	0.000	0.00	13.43	0.00	0.000
0.86	2.26	88.17	1.83	161.63	0	0	0.53	0.000	0.00	13.43	0.00	0.000
0.93	2.48	67.21	2.65	178.45	0	0	0.53	0.000	0.00	13.43	0.00	0.000
0.99	2.55	59.58	3.01	179.32	0	0	0.53	0.000	0.00	13.43	0.00	0.000
1.05	2.59	50.83	3.24	164.66	0	0	0.53	0.000	0.00	13.43	0.00	0.000
1.14	2.63	41.25	3.49	143.80	0	0	0.53	0.000	0.00	0.00	0.00	0.000
1.19	2.21	75.09	1.70	127.35	0	0	0.53	0.000	0.00	13.43	0.00	0.000
1.27	2.01	99.92	1.31	131.30	0	0	0.53	0.000	0.00	13.43	0.00	0.000
1.32	1.98	107.96	1.28	137.93	0	0	0.53	0.000	0.00	13.43	0.00	0.000
1.41	1.94	128.91	1.23	158.98	0	0	0.53	0.000	0.00	13.43	0.00	0.000
1.46	1.92	138.21	1.21	167.52	0	0	0.53	0.000	0.00	13.43	0.00	0.000
1.51	2.07	110.31	1.40	154.06	0	0	0.53	0.000	0.00	13.43	0.00	0.000
1.59	2.11	105.03	1.47	154.47	0	0	0.53	0.000	0.00	13.43	0.00	0.000
1.65	2.28	79.90	1.90	151.75	0	0	0.53	0.000	0.00	13.43	0.00	0.000
1.71	2.45	61.57	2.54	156.60	0	0	0.53	0.000	0.00	13.43	0.00	0.000
1.78	2.69	42.98	3.95	169.79	0	0	0.53	0.000	0.00	0.00	0.00	0.000
1.85	2.73	39.23	4.22	165.38	0	0	0.53	0.000	0.00	0.00	0.00	0.000
1.91	2.71	35.90	4.04	144.94	0	0	0.53	0.000	0.00	0.00	0.00	0.000
2.00	2.72	28.53	4.18	119.15	0	0	0.53	0.000	0.00	0.00	0.00	0.000
2.04	2.68	28.11	3.88	109.07	0	0	0.53	0.000	0.00	0.00	0.00	0.000
2.11	2.59	30.05	3.24	97.34	0	0	0.53	0.000	0.00	13.43	0.00	0.000
2.17	2.48	32.82	2.66	87.35	0	0	0.53	0.000	0.00	13.43	0.00	0.000
2.25	2.42	35.58	2.42	85.97	0	0	0.53	0.000	0.00	13.43	0.00	0.000
2.30	2.37	38.49	2.18	83.95	0	0	0.53	0.000	0.00	13.43	0.00	0.000
2.37	2.01	66.51	1.32	87.50	0	0	0.53	0.000	0.00	13.43	0.00	0.000
2.45	1.92	97.59	1.20	117.49	0	0	0.53	0.000	0.00	13.43	0.00	0.000
2.50	2.07	85.79	1.41	120.72	26	663	0.53	0.031	0.02	13.43	0.02	0.000
2.56	2.06	76.76	1.39	106.54	0	0	0.53	0.000	0.00	13.43	0.00	0.000
2.63	2.17	69.95	1.59	111.46	0	0	0.53	0.000	0.00	13.43	0.00	0.000
2.71	2.28	60.37	1.87	113.11	0	0	0.53	0.000	0.00	13.43	0.00	0.000
2.76	2.34	55.51	2.09	116.02	0	0	0.53	0.000	0.00	13.43	0.00	0.000
2.84	2.81	24.00	4.83	115.86	0	0	0.53	0.000	0.00	0.00	0.00	0.000
2.90	2.78	22.61	4.65	105.24	0	0	0.53	0.000	0.00	0.00	0.00	0.000
2.97	2.86	20.81	5.34	111.13	0	0	0.53	0.000	0.00	0.00	0.00	0.000
3.04	2.45	40.64	2.55	103.65	0	0	0.53	0.000	0.00	13.43	0.00	0.000
3.09	2.18	61.45	1.61	99.04	0	0	0.53	0.000	0.00	13.43	0.00	0.000
3.16	2.13	67.27	1.51	101.47	0	0	0.53	0.000	0.00	13.43	0.00	0.000

:: Post-earthquake settlement of dry sands :: (continued)

Depth (ft)	Ic	Q_{tn}	Kc	$Q_{tn,cs}$	$N_{1,60}$ (blows)	G_{max} (tsf)	CSR	Shear, γ (%)	$e_{vol(15)}$ (%)	N_c	e_v (%)	Settle. (in)
3.22	2.16	64.08	1.58	101.14	22	555	0.53	0.089	0.08	13.43	0.07	0.001
3.29	2.20	60.46	1.66	100.60	23	548	0.53	0.097	0.08	13.43	0.08	0.001
3.36	2.28	52.40	1.90	99.58	23	530	0.53	0.117	0.10	13.43	0.09	0.002
3.42	2.36	46.29	2.15	99.47	24	514	0.53	0.138	0.11	13.43	0.11	0.001
3.48	2.42	41.71	2.39	99.85	25	500	0.53	0.161	0.12	13.43	0.12	0.002
3.54	2.45	39.07	2.55	99.52	25	490	0.53	0.185	0.14	13.43	0.13	0.002
3.62	2.46	38.08	2.56	97.59	25	479	0.53	0.214	0.17	13.43	0.16	0.003
3.70	2.44	37.53	2.47	92.72	0	0	0.53	0.000	0.00	13.43	0.00	0.000
3.75	2.46	35.30	2.56	90.55	0	0	0.53	0.000	0.00	13.43	0.00	0.000
3.83	2.49	32.66	2.74	89.42	0	0	0.53	0.000	0.00	13.43	0.00	0.000
3.89	2.55	29.19	3.04	88.66	0	0	0.53	0.000	0.00	13.43	0.00	0.000
3.96	2.57	27.36	3.13	85.58	23	395	0.53	0.766	0.66	13.43	0.62	0.010
4.01	2.58	25.98	3.19	82.90	22	381	0.53	1.006	0.89	13.43	0.85	0.011
4.09	2.68	21.81	3.82	83.42	0	0	0.53	0.000	0.00	0.00	0.00	0.000
4.14	2.72	20.42	4.18	85.30	0	0	0.53	0.000	0.00	0.00	0.00	0.000
4.24	2.78	19.43	4.65	90.36	0	0	0.53	0.000	0.00	0.00	0.00	0.000
4.27	2.76	20.27	4.45	90.09	0	0	0.53	0.000	0.00	0.00	0.00	0.000
4.34	2.61	23.86	3.38	80.75	0	0	0.53	0.000	0.00	0.00	0.00	0.000
4.41	2.46	27.61	2.59	71.48	0	0	0.53	0.000	0.00	13.43	0.00	0.000
4.50	2.49	31.77	2.70	85.75	22	415	0.53	0.823	0.74	13.43	0.70	0.014
4.54	2.45	36.62	2.53	92.62	23	457	0.53	0.484	0.40	13.43	0.38	0.004
4.59	2.42	41.61	2.41	100.46	25	502	0.53	0.303	0.23	13.43	0.22	0.003
4.67	2.34	52.70	2.08	109.84	26	572	0.52	0.173	0.12	13.43	0.12	0.002
4.74	2.40	50.33	2.33	117.09	29	592	0.52	0.154	0.10	13.43	0.09	0.002
4.82	2.37	55.32	2.21	122.00	0	0	0.52	0.000	0.00	13.43	0.00	0.000
4.87	2.40	53.94	2.31	124.57	0	0	0.52	0.000	0.00	13.43	0.00	0.000
4.96	2.45	50.59	2.51	127.09	0	0	0.52	0.000	0.00	13.43	0.00	0.000
5.01	2.48	48.51	2.65	128.33	0	0	0.52	0.000	0.00	13.43	0.00	0.000
5.09	2.49	46.00	2.73	125.45	32	605	0.52	0.166	0.09	13.43	0.09	0.002
5.14	2.50	43.65	2.78	121.31	31	581	0.52	0.202	0.12	13.43	0.11	0.001
5.22	2.52	39.33	2.87	113.06	29	536	0.52	0.306	0.19	13.43	0.18	0.004
5.25	2.54	37.24	2.97	110.56	29	519	0.52	0.365	0.23	13.43	0.22	0.002
5.37	2.63	29.60	3.50	103.72	0	0	0.52	0.000	0.00	0.00	0.00	0.000
5.38	2.66	28.07	3.69	103.66	0	0	0.52	0.000	0.00	0.00	0.00	0.000
5.45	2.68	26.12	3.88	101.40	0	0	0.52	0.000	0.00	0.00	0.00	0.000
5.54	2.73	24.73	4.23	104.60	0	0	0.52	0.000	0.00	0.00	0.00	0.000
5.59	2.74	25.14	4.29	107.92	0	0	0.52	0.000	0.00	0.00	0.00	0.000
5.64	2.72	27.21	4.17	113.52	0	0	0.52	0.000	0.00	0.00	0.00	0.000
5.72	2.69	30.55	3.90	119.09	0	0	0.52	0.000	0.00	0.00	0.00	0.000
5.82	2.58	39.82	3.18	126.77	34	582	0.52	0.268	0.14	13.43	0.14	0.003
5.85	2.54	43.71	2.99	130.75	34	612	0.52	0.217	0.11	13.43	0.11	0.001
5.95	2.50	52.17	2.75	143.69	37	690	0.52	0.137	0.07	13.43	0.06	0.001
6.00	2.47	56.47	2.64	148.87	38	725	0.52	0.116	0.05	13.43	0.05	0.001

:: Post-earthquake settlement of dry sands :: (continued)

Depth (ft)	Ic	Q_{tn}	Kc	$Q_{tn,cs}$	$N_{1,60}$ (blows)	G_{max} (tsf)	CSR	Shear, γ (%)	$e_{vol(15)}$ (%)	N_c	e_v (%)	Settle. (in)

Total estimated settlement: 0.07

Abbreviations

Q_{tn}: Equivalent clean sand normalized cone resistance
K_c: Fines correction factor
$Q_{tn,cs}$: Post-liquefaction volumentric strain
G_{max}: Small strain shear modulus
CSR: Soil cyclic stress ratio
γ: Cyclic shear strain
$e_{vol(15)}$: Volumetric strain after 15 cycles
N_c: Equivalent number of cycles
e_v: Volumetric strain
Settle.: Calculated settlement

:: Post-earthquake settlement due to soil liquefaction ::

Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)	Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)
6.04	153.77	0.80	1.08	1.00	0.01	6.14	168.31	0.99	0.54	1.00	0.01
6.18	171.92	1.04	0.53	1.00	0.00	6.26	179.17	1.15	0.38	1.00	0.00
6.31	183.61	1.22	0.27	1.00	0.00	6.40	144.45	0.67	1.46	1.00	0.02
6.44	151.50	0.74	1.36	1.00	0.01	6.50	160.23	0.85	1.02	1.00	0.01
6.59	169.77	0.97	0.54	1.00	0.01	6.67	179.64	1.12	0.38	1.00	0.00
6.70	182.91	1.17	0.27	1.00	0.00	6.77	187.70	1.25	0.26	1.00	0.00
6.83	189.42	1.28	0.18	1.00	0.00	6.90	189.52	1.27	0.18	1.00	0.00
6.98	188.38	1.24	0.26	1.00	0.00	7.03	188.57	1.24	0.26	1.00	0.00
7.10	188.10	1.23	0.26	1.00	0.00	7.15	186.43	1.20	0.26	1.00	0.00
7.23	183.20	1.14	0.37	1.00	0.00	7.31	180.43	1.09	0.38	1.00	0.00
7.35	179.49	1.07	0.38	1.00	0.00	7.44	176.67	1.02	0.52	1.00	0.01
7.49	175.07	0.99	0.52	1.00	0.00	7.55	174.32	0.98	0.53	1.00	0.00
7.63	174.46	2.00	0.00	1.00	0.00	7.68	174.56	2.00	0.00	1.00	0.00
7.76	174.93	2.00	0.00	1.00	0.00	7.85	177.26	2.00	0.00	1.00	0.00
7.89	178.48	2.00	0.00	1.00	0.00	7.99	181.91	2.00	0.00	1.00	0.00
8.02	182.99	2.00	0.00	1.00	0.00	8.07	183.01	2.00	0.00	1.00	0.00
8.14	179.56	2.00	0.00	1.00	0.00	8.22	174.50	2.00	0.00	1.00	0.00
8.30	170.33	0.89	0.71	1.00	0.01	8.34	168.04	0.85	0.73	1.00	0.00
8.43	167.59	0.84	0.96	1.00	0.01	8.48	167.78	0.84	0.95	1.00	0.01
8.53	168.78	0.85	0.72	1.00	0.00	8.61	171.54	0.89	0.71	1.00	0.01
8.70	175.09	2.00	0.00	1.00	0.00	8.74	175.38	2.00	0.00	1.00	0.00
8.83	154.48	2.00	0.00	1.00	0.00	8.87	124.91	0.42	1.95	1.00	0.01
8.92	129.23	2.00	0.00	1.00	0.00	8.99	132.31	2.00	0.00	1.00	0.00
9.06	133.80	2.00	0.00	1.00	0.00	9.15	137.23	2.00	0.00	1.00	0.00
9.22	139.39	2.00	0.00	1.00	0.00	9.26	141.11	2.00	0.00	1.00	0.00
9.35	143.86	2.00	0.00	1.00	0.00	9.40	143.57	2.00	0.00	1.00	0.00
9.48	143.62	2.00	0.00	1.00	0.00	9.53	143.81	2.00	0.00	1.00	0.00
9.58	143.63	2.00	0.00	1.00	0.00	9.66	142.40	2.00	0.00	1.00	0.00
9.72	141.56	2.00	0.00	1.00	0.00	9.80	141.43	2.00	0.00	1.00	0.00
9.85	140.61	2.00	0.00	1.00	0.00	9.94	138.16	0.50	1.79	1.00	0.02
9.98	136.50	0.48	1.81	1.00	0.01	10.08	134.31	0.46	1.83	1.00	0.02
10.12	132.79	0.45	1.85	1.00	0.01	10.18	131.03	0.44	1.87	1.00	0.01
10.25	127.05	2.00	0.00	1.00	0.00	10.34	119.36	2.00	0.00	1.00	0.00
10.39	113.40	2.00	0.00	1.00	0.00	10.44	108.83	2.00	0.00	1.00	0.00
10.52	99.60	2.00	0.00	1.00	0.00	10.57	94.67	2.00	0.00	1.00	0.00

:: Post-earthquake settlement due to soil liquefaction :: (continued)

Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)	Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)
10.66	89.35	2.00	0.00	1.00	0.00	10.70	87.78	2.00	0.00	1.00	0.00
10.77	85.18	2.00	0.00	1.00	0.00	10.83	84.10	2.00	0.00	1.00	0.00
10.93	78.11	2.00	0.00	1.00	0.00	10.97	67.42	2.00	0.00	1.00	0.00
11.06	83.83	0.20	2.70	1.00	0.03	11.10	84.79	0.20	2.68	1.00	0.01
11.19	86.44	0.20	2.63	1.00	0.03	11.25	85.97	0.20	2.65	1.00	0.02
11.29	85.45	0.20	2.66	1.00	0.01	11.38	89.21	0.21	2.57	1.00	0.03
11.43	90.39	0.22	2.54	1.00	0.01	11.49	92.27	0.22	2.50	1.00	0.02
11.56	94.21	0.23	2.45	1.00	0.02	11.64	96.28	0.23	2.41	1.00	0.02
11.70	97.66	0.24	2.38	1.00	0.01	11.75	99.31	0.25	2.35	1.00	0.02
11.81	99.49	0.25	2.35	1.00	0.02	11.88	101.13	0.25	2.32	1.00	0.02
11.97	106.96	0.28	2.21	1.00	0.02	12.01	109.76	0.29	2.16	1.00	0.01
12.10	109.94	0.29	2.16	1.00	0.02	12.16	110.08	0.29	2.16	1.00	0.01
12.24	110.83	0.29	2.15	1.00	0.02	12.28	110.14	0.29	2.16	1.00	0.01
12.36	108.38	0.28	2.19	1.00	0.02	12.41	109.81	0.29	2.16	1.00	0.01
12.47	109.26	0.28	2.17	1.00	0.02	12.55	109.23	0.28	2.17	1.00	0.02
12.64	107.49	0.27	2.20	1.00	0.02	12.67	106.76	0.27	2.21	1.00	0.01
12.73	105.51	0.26	2.24	1.00	0.02	12.81	101.94	2.00	0.00	1.00	0.00
12.86	98.45	2.00	0.00	1.00	0.00	12.93	94.57	2.00	0.00	1.00	0.00
13.00	89.49	2.00	0.00	1.00	0.00	13.08	87.75	2.00	0.00	1.00	0.00
13.13	88.48	2.00	0.00	1.00	0.00	13.22	92.07	2.00	0.00	1.00	0.00
13.27	95.36	2.00	0.00	1.00	0.00	13.33	97.97	2.00	0.00	1.00	0.00
13.40	89.91	2.00	0.00	1.00	0.00	13.46	83.54	2.00	0.00	1.00	0.00
13.54	84.19	2.00	0.00	1.00	0.00	13.59	82.93	2.00	0.00	1.00	0.00
13.67	79.42	2.00	0.00	1.00	0.00	13.72	76.35	2.00	0.00	1.00	0.00
13.79	70.38	2.00	0.00	1.00	0.00	13.88	65.19	2.00	0.00	1.00	0.00
13.92	63.83	2.00	0.00	1.00	0.00	13.99	60.87	2.00	0.00	1.00	0.00
14.06	56.49	2.00	0.00	1.00	0.00	14.13	53.80	2.00	0.00	1.00	0.00
14.19	52.56	2.00	0.00	1.00	0.00	14.25	51.46	2.00	0.00	1.00	0.00
14.32	50.31	2.00	0.00	1.00	0.00	14.37	49.58	2.00	0.00	1.00	0.00
14.46	48.89	2.00	0.00	1.00	0.00	14.51	49.66	2.00	0.00	1.00	0.00
14.57	51.94	2.00	0.00	1.00	0.00	14.64	55.15	2.00	0.00	1.00	0.00
14.73	64.29	2.00	0.00	1.00	0.00	14.78	70.19	2.00	0.00	1.00	0.00
14.85	77.69	2.00	0.00	1.00	0.00	14.91	81.89	2.00	0.00	1.00	0.00
14.98	85.26	2.00	0.00	1.00	0.00	15.05	85.92	2.00	0.00	1.00	0.00
15.10	86.09	2.00	0.00	1.00	0.00	15.18	86.59	2.00	0.00	1.00	0.00
15.23	86.27	2.00	0.00	1.00	0.00	15.32	86.64	2.00	0.00	1.00	0.00
15.36	86.80	2.00	0.00	1.00	0.00	15.45	88.47	2.00	0.00	1.00	0.00
15.49	93.55	2.00	0.00	1.00	0.00	15.56	97.46	2.00	0.00	1.00	0.00
15.62	101.60	2.00	0.00	1.00	0.00	15.71	106.99	2.00	0.00	1.00	0.00
15.77	111.48	2.00	0.00	1.00	0.00	15.82	114.25	2.00	0.00	1.00	0.00
15.90	117.67	2.00	0.00	1.00	0.00	15.96	120.17	2.00	0.00	1.00	0.00
16.05	123.39	2.00	0.00	1.00	0.00	16.09	124.64	2.00	0.00	1.00	0.00
16.16	128.32	2.00	0.00	1.00	0.00	16.22	131.69	2.00	0.00	1.00	0.00
16.29	135.44	2.00	0.00	1.00	0.00	16.36	139.18	2.00	0.00	1.00	0.00
16.45	143.94	2.00	0.00	1.00	0.00	16.50	145.51	2.00	0.00	1.00	0.00
16.54	146.95	2.00	0.00	1.00	0.00	16.63	150.06	2.00	0.00	1.00	0.00
16.72	150.76	2.00	0.00	1.00	0.00	16.75	149.99	2.00	0.00	1.00	0.00
16.81	148.57	2.00	0.00	1.00	0.00	16.94	141.22	2.00	0.00	1.00	0.00

:: Post-earthquake settlement due to soil liquefaction :: (continued)

Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)	Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)
16.95	133.47	2.00	0.00	1.00	0.00	17.02	124.46	2.00	0.00	1.00	0.00
17.07	127.33	2.00	0.00	1.00	0.00	17.14	127.90	2.00	0.00	1.00	0.00
17.21	129.20	2.00	0.00	1.00	0.00	17.28	131.83	2.00	0.00	1.00	0.00
17.34	134.83	2.00	0.00	1.00	0.00	17.40	136.93	2.00	0.00	1.00	0.00
17.47	137.58	2.00	0.00	1.00	0.00	17.52	136.93	2.00	0.00	1.00	0.00
17.62	133.42	2.00	0.00	1.00	0.00	17.66	131.28	2.00	0.00	1.00	0.00
17.72	128.57	2.00	0.00	1.00	0.00	17.80	123.71	2.00	0.00	1.00	0.00
17.85	120.25	2.00	0.00	1.00	0.00	17.93	116.51	2.00	0.00	1.00	0.00
18.00	113.40	2.00	0.00	1.00	0.00	18.06	110.91	2.00	0.00	1.00	0.00
18.11	108.80	2.00	0.00	1.00	0.00	18.20	109.03	2.00	0.00	1.00	0.00
18.25	108.32	2.00	0.00	1.00	0.00	18.33	100.92	2.00	0.00	1.00	0.00
18.38	97.29	2.00	0.00	1.00	0.00	18.46	98.80	2.00	0.00	1.00	0.00
18.51	99.99	2.00	0.00	1.00	0.00	18.59	96.71	2.00	0.00	1.00	0.00
18.64	96.27	2.00	0.00	1.00	0.00	18.70	101.21	2.00	0.00	1.00	0.00
18.78	113.71	2.00	0.00	1.00	0.00	18.85	130.56	2.00	0.00	1.00	0.00
18.92	148.06	0.48	1.69	1.00	0.01	18.97	160.27	0.58	1.53	1.00	0.01
19.06	176.39	0.74	1.10	1.00	0.01	19.11	183.77	0.82	0.84	1.00	0.01
19.19	188.82	0.88	0.61	1.00	0.01	19.24	199.30	1.02	0.47	1.00	0.00
19.32	202.11	2.00	0.00	1.00	0.00	19.38	206.20	2.00	0.00	1.00	0.00
19.44	222.44	2.00	0.00	1.00	0.00	19.54	241.62	2.00	0.00	1.00	0.00
19.59	229.00	2.00	0.00	1.00	0.00	19.65	213.28	2.00	0.00	1.00	0.00
19.71	212.41	2.00	0.00	1.00	0.00	19.76	158.87	0.56	1.55	1.00	0.01
19.83	193.55	0.94	0.59	1.00	0.00	19.91	193.20	0.93	0.59	1.00	0.01
19.96	186.62	0.85	0.82	1.00	0.00	20.03	178.61	0.76	0.87	1.00	0.01
20.09	176.52	0.73	1.10	1.00	0.01	20.16	171.29	0.68	1.15	1.00	0.01
20.22	168.95	0.65	1.17	1.00	0.01	20.30	168.75	0.65	1.17	1.00	0.01
20.36	168.62	0.65	1.17	1.00	0.01	20.45	168.43	0.65	1.43	1.00	0.01
20.48	172.96	0.69	1.13	1.00	0.00	20.55	192.46	0.92	0.60	1.00	0.01
20.61	197.31	0.98	0.47	1.00	0.00	20.68	200.19	2.00	0.00	1.00	0.00
20.76	218.89	2.00	0.00	1.00	0.00	20.81	232.53	2.00	0.00	1.00	0.00
20.88	259.44	2.00	0.00	1.00	0.00	20.94	251.55	2.00	0.00	1.00	0.00
21.00	289.47	2.00	0.00	1.00	0.00	21.06	237.40	2.00	0.00	1.00	0.00
21.14	194.54	0.94	0.59	1.00	0.01	21.20	156.98	0.54	1.61	1.00	0.01
21.26	152.30	0.50	1.65	1.00	0.01	21.33	140.58	0.42	1.77	1.00	0.01
21.43	130.30	0.35	1.88	1.00	0.02	21.46	127.79	0.34	1.91	1.00	0.01
21.52	124.91	0.32	1.95	1.00	0.01	21.59	119.72	0.29	2.02	1.00	0.02
21.65	87.51	0.17	2.61	1.00	0.02	21.73	101.98	0.22	2.30	1.00	0.02
21.79	101.99	0.22	2.30	1.00	0.02	21.85	102.06	0.22	2.30	1.00	0.02
21.92	101.72	0.22	2.30	1.00	0.02	21.98	101.62	0.22	2.31	1.00	0.02
22.05	101.51	0.22	2.31	1.00	0.02	22.13	103.04	0.22	2.28	1.00	0.02
22.19	103.82	0.22	2.27	1.00	0.02	22.25	105.05	0.23	2.24	1.00	0.02
22.31	105.59	0.23	2.23	1.00	0.02	22.41	106.85	0.24	2.21	1.00	0.03
22.45	107.71	0.24	2.20	1.00	0.01	22.52	107.41	0.24	2.20	1.00	0.02
22.59	113.47	0.26	2.11	1.00	0.02	22.65	120.81	0.30	2.00	1.00	0.02
22.71	128.29	0.34	1.90	1.00	0.01	22.78	132.13	0.36	1.86	1.00	0.02
22.84	137.02	0.39	1.80	1.00	0.01	22.92	152.09	0.49	1.66	1.00	0.02
22.98	169.59	0.65	1.41	1.00	0.01	23.04	186.43	0.83	0.82	1.00	0.01
23.11	213.93	2.00	0.00	1.00	0.00	23.19	242.97	2.00	0.00	1.00	0.00

:: Post-earthquake settlement due to soil liquefaction :: (continued)

Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)	Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)
23.23	252.60	2.00	0.00	1.00	0.00	23.30	269.68	2.00	0.00	1.00	0.00
23.37	299.06	2.00	0.00	1.00	0.00	23.44	313.14	2.00	0.00	1.00	0.00
23.51	310.21	2.00	0.00	1.00	0.00	23.57	324.04	2.00	0.00	1.00	0.00
23.62	338.84	2.00	0.00	1.00	0.00	23.71	349.23	2.00	0.00	1.00	0.00
23.77	320.16	2.00	0.00	1.00	0.00	23.82	367.54	2.00	0.00	1.00	0.00
23.89	388.62	2.00	0.00	1.00	0.00	23.97	395.36	2.00	0.00	1.00	0.00
24.03	388.72	2.00	0.00	1.00	0.00	24.08	408.97	2.00	0.00	1.00	0.00
24.16	420.79	2.00	0.00	1.00	0.00	24.21	436.29	2.00	0.00	1.00	0.00
24.29	438.26	2.00	0.00	1.00	0.00	24.35	446.42	2.00	0.00	1.00	0.00
24.43	440.95	2.00	0.00	1.00	0.00	24.49	447.12	2.00	0.00	1.00	0.00
24.56	429.17	2.00	0.00	1.00	0.00	24.63	416.89	2.00	0.00	1.00	0.00
24.68	382.52	2.00	0.00	1.00	0.00	24.74	401.33	2.00	0.00	1.00	0.00
24.80	-1.00	2.00	0.00	1.00	0.00	24.88	-1.00	2.00	0.00	1.00	0.00
24.95	-1.00	2.00	0.00	1.00	0.00	25.01	-1.00	2.00	0.00	1.00	0.00
25.08	-1.00	2.00	0.00	1.00	0.00	25.13	-1.00	2.00	0.00	1.00	0.00

Total estimated settlement: 1.33

Abbreviations

$Q_{tn,cs}$: Equivalent clean sand normalized cone resistance
FS: Factor of safety against liquefaction
e_v (%): Post-liquefaction volumentric strain
DF: e_v depth weighting factor
Settlement: Calculated settlement

:: Strength loss calculation (Robertson (2009) ::

Depth (ft)	q_t (tsf)	Q_{tn}	K_c	$Q_{tn,cs}$	I_c	$S_{u(liq)}/\sigma'_v$	$S_{u(peak)}/\sigma'_v$
0.09	287.18	461.39	1.00	461.39	1.00	N/A	N/A
0.14	405.59	651.63	1.00	651.63	0.79	N/A	N/A
0.20	370.95	595.97	1.00	595.97	0.87	N/A	N/A
0.27	296.85	476.91	1.00	476.91	0.99	N/A	N/A
0.34	251.25	403.64	1.00	403.64	1.12	N/A	N/A
0.41	205.64	330.35	1.00	330.35	1.27	N/A	N/A
0.47	169.37	272.08	1.00	272.08	1.40	N/A	N/A
0.55	133.09	213.78	1.00	213.78	1.59	N/A	N/A
0.60	115.39	185.34	1.04	191.91	1.70	N/A	N/A
0.69	94.49	151.75	1.14	173.70	1.85	N/A	N/A
0.74	81.01	130.09	1.25	161.99	1.95	N/A	N/A
0.82	63.39	101.77	1.53	155.60	2.14	N/A	N/A
0.86	54.93	88.17	1.83	161.63	2.26	N/A	N/A
0.93	41.89	67.21	2.65	178.45	2.48	N/A	N/A
0.99	37.14	59.58	3.01	179.32	2.55	N/A	N/A
1.05	31.70	50.83	3.24	164.66	2.59	N/A	N/A
1.14	25.74	41.25	3.49	143.80	2.63	N/A	N/A
1.19	46.81	75.09	1.70	127.35	2.21	N/A	N/A
1.27	62.27	99.92	1.31	131.30	2.01	N/A	N/A
1.32	67.28	107.96	1.28	137.93	1.98	N/A	N/A
1.41	80.32	128.91	1.23	158.98	1.94	N/A	N/A
1.46	86.11	138.21	1.21	167.52	1.92	N/A	N/A
1.51	68.75	110.31	1.40	154.06	2.07	N/A	N/A
1.59	65.47	105.03	1.47	154.47	2.11	N/A	N/A
1.65	49.83	79.90	1.90	151.75	2.28	N/A	N/A
1.71	38.43	61.57	2.54	156.60	2.45	N/A	N/A
1.78	26.86	42.98	3.95	169.79	2.69	N/A	N/A
1.85	24.53	39.23	4.22	165.38	2.73	N/A	N/A
1.91	22.46	35.90	4.04	144.94	2.71	N/A	N/A
2.00	17.88	28.53	4.18	119.15	2.72	N/A	N/A
2.04	17.62	28.11	3.88	109.07	2.68	N/A	N/A
2.11	18.83	30.05	3.24	97.34	2.59	N/A	N/A
2.17	20.56	32.82	2.66	87.35	2.48	N/A	N/A
2.25	22.28	35.58	2.42	85.97	2.42	N/A	N/A
2.30	24.10	38.49	2.18	83.95	2.37	N/A	N/A
2.37	41.54	66.51	1.32	87.50	2.01	N/A	N/A
2.45	60.89	97.59	1.20	117.49	1.92	N/A	N/A
2.50	53.55	85.79	1.41	120.72	2.07	N/A	N/A
2.56	47.93	76.76	1.39	106.54	2.06	N/A	N/A
2.63	43.70	69.95	1.59	111.46	2.17	N/A	N/A
2.71	37.74	60.37	1.87	113.11	2.28	N/A	N/A
2.76	34.72	55.51	2.09	116.02	2.34	N/A	N/A
2.84	15.11	24.00	4.83	115.86	2.81	N/A	N/A
2.90	14.24	22.61	4.65	105.24	2.78	N/A	N/A
2.97	13.13	20.81	5.34	111.13	2.86	N/A	N/A
3.04	25.48	40.64	2.55	103.65	2.45	N/A	N/A
3.09	38.43	61.45	1.61	99.04	2.18	N/A	N/A
3.16	42.06	67.27	1.51	101.47	2.13	N/A	N/A

:: Strength loss calculation (Robertson (2009) :: (continued)

Depth (ft)	q_t (tsf)	Q_{tn}	K_c	$Q_{tn,cs}$	I_c	$S_{u(liq)}/\sigma'_v$	$S_{u(peak)}/\sigma'_v$
3.22	40.08	64.08	1.58	101.14	2.16	N/A	N/A
3.29	37.83	60.46	1.66	100.60	2.20	N/A	N/A
3.36	32.82	52.40	1.90	99.58	2.28	N/A	N/A
3.42	29.02	46.29	2.15	99.47	2.36	N/A	N/A
3.48	26.16	41.71	2.39	99.85	2.42	N/A	N/A
3.54	24.52	39.07	2.55	99.52	2.45	N/A	N/A
3.62	23.91	38.08	2.56	97.59	2.46	N/A	N/A
3.70	23.58	37.53	2.47	92.72	2.44	N/A	N/A
3.75	22.19	35.30	2.56	90.55	2.46	N/A	N/A
3.83	20.56	32.66	2.74	89.42	2.49	N/A	N/A
3.89	18.39	29.19	3.04	88.66	2.55	N/A	N/A
3.96	17.26	27.36	3.13	85.58	2.57	N/A	N/A
4.01	16.40	25.98	3.19	82.90	2.58	N/A	N/A
4.09	13.81	21.81	3.82	83.42	2.68	N/A	N/A
4.14	12.95	20.42	4.18	85.30	2.72	N/A	N/A
4.24	12.34	19.43	4.65	90.36	2.78	N/A	N/A
4.27	12.86	20.27	4.45	90.09	2.76	N/A	N/A
4.34	15.10	23.86	3.38	80.75	2.61	N/A	N/A
4.41	17.44	27.61	2.59	71.48	2.46	N/A	N/A
4.50	20.03	31.77	2.70	85.75	2.49	N/A	N/A
4.54	23.05	36.62	2.53	92.62	2.45	N/A	N/A
4.59	26.16	41.61	2.41	100.46	2.42	N/A	N/A
4.67	33.07	52.70	2.08	109.84	2.34	N/A	N/A
4.74	31.60	50.33	2.33	117.09	2.40	N/A	N/A
4.82	34.71	55.32	2.21	122.00	2.37	N/A	N/A
4.87	33.86	53.94	2.31	124.57	2.40	N/A	N/A
4.96	31.78	50.59	2.51	127.09	2.45	N/A	N/A
5.01	30.49	48.51	2.65	128.33	2.48	N/A	N/A
5.09	28.93	46.00	2.73	125.45	2.49	N/A	N/A
5.14	27.47	43.65	2.78	121.31	2.50	N/A	N/A
5.22	24.79	39.33	2.87	113.06	2.52	N/A	N/A
5.25	23.49	37.24	2.97	110.56	2.54	N/A	N/A
5.37	18.74	29.60	3.50	103.72	2.63	N/A	N/A
5.38	17.79	28.07	3.69	103.66	2.66	N/A	N/A
5.45	16.58	26.12	3.88	101.40	2.68	N/A	N/A
5.54	15.71	24.73	4.23	104.60	2.73	N/A	N/A
5.59	15.97	25.14	4.29	107.92	2.74	N/A	N/A
5.64	17.26	27.21	4.17	113.52	2.72	N/A	N/A
5.72	19.34	30.55	3.90	119.09	2.69	N/A	N/A
5.82	25.12	39.82	3.18	126.77	2.58	N/A	N/A
5.85	27.54	43.71	2.99	130.75	2.54	N/A	N/A
5.95	32.82	52.17	2.75	143.69	2.50	N/A	N/A
6.00	35.50	56.47	2.64	148.87	2.47	N/A	N/A
6.04	36.53	58.12	2.65	153.77	2.48	0.75	0.75
6.14	40.77	64.92	2.59	168.31	2.46	0.77	0.77
6.18	41.72	66.45	2.59	171.92	2.46	0.77	0.77
6.26	42.67	67.96	2.64	179.17	2.47	0.77	0.77
6.31	41.98	66.85	2.75	183.61	2.50	0.77	0.77

:: Strength loss calculation (Robertson (2009) :: (continued)

Depth (ft)	q_t (tsf)	Q_{tn}	K_c	$Q_{tn,cs}$	I_c	$S_{u(liq)}/\sigma'_v$	$S_{u(peak)}/\sigma'_v$
6.40	43.53	69.33	2.08	144.45	2.34	0.78	0.78
6.44	44.83	71.42	2.12	151.50	2.35	0.78	0.78
6.50	46.29	73.76	2.17	160.23	2.36	0.79	0.79
6.59	46.90	74.73	2.27	169.77	2.39	0.79	0.79
6.67	44.74	71.25	2.52	179.64	2.45	0.78	0.78
6.70	44.65	71.10	2.57	182.91	2.46	0.78	0.78
6.77	48.45	77.20	2.43	187.70	2.43	0.79	0.79
6.83	49.40	78.72	2.41	189.42	2.42	0.79	0.79
6.90	51.13	81.49	2.33	189.52	2.40	0.80	0.80
6.98	51.82	82.59	2.28	188.38	2.39	0.80	0.80
7.03	51.82	82.59	2.28	188.57	2.39	0.80	0.80
7.10	52.51	83.69	2.25	188.10	2.38	0.80	0.80
7.15	54.24	86.46	2.16	186.43	2.36	0.81	0.81
7.23	57.00	90.89	2.02	183.20	2.32	0.81	0.81
7.31	58.21	92.83	1.94	180.43	2.30	0.82	0.82
7.35	58.13	92.69	1.94	179.49	2.30	0.82	0.82
7.44	57.87	92.27	1.91	176.67	2.29	0.82	0.82
7.49	57.69	91.97	1.90	175.07	2.29	0.82	0.82
7.55	57.78	92.11	1.89	174.32	2.28	0.82	0.82
7.63	56.31	89.74	1.94	174.46	2.30	0.81	0.81
7.68	54.76	87.25	2.00	174.56	2.32	0.81	0.81
7.76	50.87	80.99	2.16	174.93	2.36	0.80	0.80
7.85	43.10	68.50	2.59	177.26	2.46	0.78	0.78
7.89	40.59	64.46	2.77	178.48	2.50	0.77	0.77
7.99	34.98	55.44	3.28	181.91	2.59	0.75	0.75
8.02	32.82	51.97	3.52	182.99	2.63	4.87	4.87
8.07	31.87	50.43	3.63	183.01	2.65	4.69	4.69
8.14	31.78	50.28	3.57	179.56	2.64	4.64	4.64
8.22	31.96	50.56	3.45	174.50	2.62	4.62	4.62
8.30	32.56	51.52	3.31	170.33	2.60	0.74	0.74
8.34	33.25	52.62	3.19	168.04	2.58	0.74	0.74
8.43	34.72	54.98	3.05	167.59	2.55	0.75	0.75
8.48	35.93	56.92	2.95	167.78	2.53	0.75	0.75
8.53	36.45	57.75	2.92	168.78	2.53	0.75	0.75
8.61	35.58	56.34	3.04	171.54	2.55	0.75	0.75
8.70	31.35	49.54	3.53	175.09	2.63	4.26	4.26
8.74	29.62	46.75	3.75	175.38	2.67	4.01	4.01
8.83	25.91	40.78	3.79	154.48	2.67	3.46	3.46
8.87	24.87	39.11	3.19	124.91	2.58	0.70	0.70
8.92	23.75	37.31	3.46	129.23	2.62	3.13	3.13
8.99	22.89	35.92	3.68	132.31	2.66	2.99	2.99
9.06	22.28	34.93	3.83	133.80	2.68	2.89	2.89
9.15	20.04	31.32	4.38	137.23	2.75	2.56	2.56
9.22	20.90	32.70	4.26	139.39	2.74	2.66	2.66
9.26	21.33	33.38	4.23	141.11	2.73	2.70	2.70
9.35	21.16	33.10	4.35	143.86	2.75	2.65	2.65
9.40	21.25	33.24	4.32	143.57	2.74	2.65	2.65
9.48	21.07	32.95	4.36	143.62	2.75	2.60	2.60

:: Strength loss calculation (Robertson (2009) :: (continued)

Depth (ft)	q_t (tsf)	Q_{tn}	K_c	$Q_{tn,cs}$	I_c	$S_{u(liq)}/\sigma'_v$	$S_{u(peak)}/\sigma'_v$
9.53	21.07	32.94	4.37	143.81	2.75	2.59	2.59
9.58	21.42	33.50	4.29	143.63	2.74	2.62	2.62
9.66	23.06	36.13	3.94	142.40	2.69	2.80	2.80
9.72	24.18	37.92	3.73	141.56	2.66	2.92	2.92
9.80	25.48	39.83	3.55	141.43	2.64	3.06	3.06
9.85	26.52	41.12	3.42	140.61	2.61	3.17	3.17
9.94	27.38	41.96	3.29	138.16	2.59	0.71	0.71
9.98	27.38	41.75	3.27	136.50	2.59	0.71	0.71
10.08	27.81	41.97	3.20	134.31	2.58	0.71	0.71
10.12	28.76	43.08	3.08	132.79	2.56	0.72	0.72
10.18	29.45	43.77	2.99	131.03	2.54	0.72	0.72
10.25	29.71	43.74	2.90	127.05	2.53	0.72	0.72
10.34	29.88	43.39	2.75	119.36	2.50	0.72	0.72
10.39	30.57	43.92	2.58	113.40	2.46	0.72	0.72
10.44	31.35	44.62	2.44	108.83	2.43	0.72	0.72
10.52	35.58	49.33	2.02	99.60	2.32	0.73	0.73
10.57	38.09	52.03	1.82	94.67	2.26	0.74	0.74
10.66	41.98	56.10	1.59	89.35	2.17	0.75	0.75
10.70	44.05	58.29	1.51	87.78	2.13	0.75	0.75
10.77	47.42	61.68	1.38	85.18	2.06	0.76	0.76
10.83	48.80	62.93	1.34	84.10	2.03	0.76	0.76
10.93	52.86	66.15	1.18	78.11	1.89	0.77	0.77
10.97	54.15	67.42	1.00	67.42	1.87	0.16	0.77
11.06	56.57	70.47	1.19	83.83	1.90	0.78	0.78
11.10	57.69	71.66	1.18	84.79	1.89	0.78	0.78
11.19	58.99	72.97	1.18	86.44	1.90	0.78	0.78
11.25	57.69	71.39	1.20	85.97	1.92	0.78	0.78
11.29	56.57	70.02	1.22	85.45	1.93	0.78	0.78
11.38	60.72	74.55	1.20	89.21	1.91	0.79	0.79
11.43	61.93	75.81	1.19	90.39	1.90	0.79	0.79
11.49	64.17	78.17	1.18	92.27	1.89	0.79	0.79
11.56	66.50	80.57	1.17	94.21	1.88	0.80	0.80
11.64	68.66	82.79	1.16	96.28	1.87	0.80	0.80
11.70	69.53	83.69	1.17	97.66	1.88	0.80	0.80
11.75	70.99	85.20	1.17	99.31	1.87	0.81	0.81
11.81	72.38	86.39	1.15	99.49	1.86	0.81	0.81
11.88	75.14	89.14	1.13	101.13	1.84	0.81	0.81
11.97	78.42	92.95	1.15	106.96	1.86	0.82	0.82
12.01	79.46	94.23	1.16	109.76	1.87	0.82	0.82
12.10	80.93	95.36	1.15	109.94	1.86	0.82	0.82
12.16	81.53	95.77	1.15	110.08	1.86	0.82	0.82
12.24	83.43	97.42	1.14	110.83	1.84	0.82	0.82
12.28	82.65	96.39	1.14	110.14	1.85	0.82	0.82
12.36	80.41	93.64	1.16	108.38	1.86	0.82	0.82
12.41	82.65	95.84	1.15	109.81	1.85	0.82	0.82
12.47	81.79	94.70	1.15	109.26	1.86	0.82	0.82
12.55	82.65	95.23	1.15	109.23	1.85	0.82	0.82
12.64	82.05	94.10	1.14	107.49	1.85	0.82	0.82

:: Strength loss calculation (Robertson (2009) :: (continued)

Depth (ft)	q_t (tsf)	Q_{tn}	K_c	$Q_{tn,cs}$	I_c	$S_{u(liq)}/\sigma'_v$	$S_{u(peak)}/\sigma'_v$
12.67	81.79	93.61	1.14	106.76	1.84	0.82	0.82
12.73	81.19	92.64	1.14	105.51	1.84	0.82	0.82
12.81	78.34	89.12	1.14	101.94	1.85	0.81	0.81
12.86	74.45	84.69	1.16	98.45	1.87	0.80	0.80
12.93	67.11	76.71	1.23	94.57	1.94	0.79	0.79
13.00	59.08	67.79	1.32	89.49	2.02	0.77	0.77
13.08	48.97	56.72	1.55	87.75	2.15	0.75	0.75
13.13	41.72	48.68	1.82	88.48	2.26	0.73	0.73
13.22	30.92	36.48	2.52	92.07	2.45	0.69	0.69
13.27	24.87	29.52	3.23	95.36	2.58	0.67	0.67
13.33	20.21	24.06	4.07	97.97	2.71	1.77	1.77
13.40	17.10	20.21	4.45	89.91	2.76	1.47	1.47
13.46	14.86	17.45	4.79	83.54	2.80	1.27	1.27
13.54	13.30	15.55	5.42	84.19	2.87	1.12	1.12
13.59	12.18	14.17	5.85	82.93	2.92	1.02	1.02
13.67	11.31	13.04	6.09	79.42	2.94	0.93	0.93
13.72	9.50	10.77	7.09	76.35	3.03	0.77	0.77
13.79	10.10	11.45	6.15	70.38	2.94	0.82	0.82
13.88	9.24	10.33	6.31	65.19	2.96	0.28	0.74
13.92	8.98	9.98	6.39	63.83	2.97	0.27	0.71
13.99	8.64	9.52	6.39	60.87	2.97	0.24	0.68
14.06	8.55	9.35	6.04	56.49	2.93	0.19	0.67
14.13	8.55	9.28	5.80	53.80	2.91	0.17	0.67
14.19	8.46	9.14	5.75	52.56	2.91	0.16	0.66
14.25	8.46	9.09	5.66	51.46	2.90	0.15	0.65
14.32	8.64	9.24	5.44	50.31	2.87	0.14	0.66
14.37	8.72	9.30	5.33	49.58	2.86	0.14	0.67
14.46	8.72	9.24	5.29	48.89	2.86	0.13	0.67
14.51	8.90	9.43	5.27	49.66	2.85	0.14	0.68
14.57	9.24	9.79	5.31	51.94	2.86	0.16	0.70
14.64	9.93	10.54	5.23	55.15	2.85	0.19	0.76
14.73	12.26	13.13	4.90	64.29	2.81	0.28	0.95
14.78	14.68	15.80	4.44	70.19	2.76	1.15	1.15
14.85	16.58	17.88	4.35	77.69	2.75	1.30	1.30
14.91	18.31	19.73	4.15	81.89	2.72	1.43	1.43
14.98	19.17	20.62	4.14	85.26	2.72	1.50	1.50
15.05	20.12	21.56	3.98	85.92	2.70	1.57	1.57
15.10	20.47	21.87	3.94	86.09	2.69	1.59	1.59
15.18	20.12	21.40	4.05	86.59	2.71	1.55	1.55
15.23	20.56	21.81	3.96	86.27	2.69	1.59	1.59
15.32	21.33	22.52	3.85	86.64	2.68	1.64	1.64
15.36	21.94	23.11	3.76	86.80	2.67	1.68	1.68
15.45	23.58	24.74	3.58	88.47	2.64	1.80	1.80
15.49	24.01	25.19	3.71	93.55	2.66	1.83	1.83
15.56	25.74	26.94	3.62	97.46	2.65	1.96	1.96
15.62	26.60	27.77	3.66	101.60	2.65	2.02	2.02
15.71	27.72	28.84	3.71	106.99	2.66	2.09	2.09
15.77	26.64	27.65	4.03	111.48	2.70	2.00	2.00

:: Strength loss calculation (Robertson (2009) :: (continued)

Depth (ft)	q_t (tsf)	Q_{tn}	K_c	$Q_{tn,cs}$	I_c	$S_{u(liq)}/\sigma'_v$	$S_{u(peak)}/\sigma'_v$
15.82	26.69	27.64	4.13	114.25	2.72	2.00	2.00
15.90	26.77	27.63	4.26	117.67	2.74	2.00	2.00
15.96	26.95	27.73	4.33	120.17	2.74	2.00	2.00
16.05	27.21	27.87	4.43	123.39	2.76	2.01	2.01
16.09	27.47	28.07	4.44	124.64	2.76	2.02	2.02
16.16	27.90	28.42	4.52	128.32	2.77	2.05	2.05
16.22	28.76	29.21	4.51	131.69	2.77	2.10	2.10
16.29	29.45	29.81	4.54	135.44	2.77	2.15	2.15
16.36	30.40	30.68	4.54	139.18	2.77	2.21	2.21
16.45	31.27	31.41	4.58	143.94	2.78	2.26	2.26
16.50	31.96	32.03	4.54	145.51	2.77	2.30	2.30
16.54	32.47	32.47	4.53	146.95	2.77	2.33	2.33
16.63	32.73	32.57	4.61	150.06	2.78	2.34	2.34
16.72	32.30	31.97	4.72	150.76	2.79	2.30	2.30
16.75	32.13	31.72	4.73	149.99	2.79	2.28	2.28
16.81	31.70	31.19	4.76	148.57	2.80	2.24	2.24
16.94	30.57	29.81	4.74	141.22	2.79	2.14	2.14
16.95	30.14	29.33	4.55	133.47	2.77	2.10	2.10
17.02	29.37	28.42	4.38	124.46	2.75	2.04	2.04
17.07	28.93	27.91	4.56	127.33	2.77	2.00	2.00
17.14	28.59	27.48	4.66	127.90	2.78	1.97	1.97
17.21	28.42	27.20	4.75	129.20	2.80	1.95	1.95
17.28	28.24	26.91	4.90	131.83	2.81	1.93	1.93
17.34	28.07	26.67	5.06	134.83	2.83	1.91	1.91
17.40	27.90	26.41	5.18	136.93	2.85	1.89	1.89
17.47	27.47	25.89	5.31	137.58	2.86	1.85	1.85
17.52	27.29	25.63	5.34	136.93	2.86	1.83	1.83
17.62	27.29	25.48	5.24	133.42	2.85	1.82	1.82
17.66	27.38	25.50	5.15	131.28	2.84	1.82	1.82
17.72	27.21	25.24	5.09	128.57	2.84	1.80	1.80
17.80	26.52	24.46	5.06	123.71	2.83	1.75	1.75
17.85	25.75	23.65	5.08	120.25	2.83	1.69	1.69
17.93	24.62	22.47	5.19	116.51	2.85	1.61	1.61
18.00	23.42	21.24	5.34	113.40	2.86	1.52	1.52
18.06	22.28	20.09	5.52	110.91	2.88	1.44	1.44
18.11	21.42	19.23	5.66	108.80	2.90	1.37	1.37
18.20	18.74	16.61	6.57	109.03	2.98	1.19	1.19
18.25	17.36	15.27	7.09	108.32	3.03	1.09	1.09
18.33	15.37	13.35	7.56	100.92	3.07	0.95	0.95
18.38	14.16	12.18	7.99	97.29	3.10	0.87	0.87
18.46	13.22	11.24	8.79	98.80	3.17	0.80	0.80
18.51	13.83	11.78	8.49	99.99	3.14	0.84	0.84
18.59	16.42	14.11	6.86	96.71	3.01	1.01	1.01
18.64	30.57	27.15	3.55	96.27	2.63	1.93	1.93
18.70	66.42	60.30	1.68	101.21	2.20	0.76	0.76
18.78	94.31	86.00	1.32	113.71	2.02	0.81	0.81
18.85	123.51	113.02	1.16	130.56	1.86	0.84	0.84
18.92	147.95	135.62	1.09	148.06	1.78	0.87	0.87

:: Strength loss calculation (Robertson (2009) :: (continued)

Depth (ft)	q_t (tsf)	Q_{tn}	K_c	$Q_{tn,cs}$	I_c	$S_{u(liq)}/\sigma'_v$	$S_{u(peak)}/\sigma'_v$
18.97	164.45	150.84	1.06	160.27	1.74	0.89	0.89
19.06	181.03	165.91	1.06	176.39	1.74	0.90	0.90
19.11	194.76	178.58	1.03	183.77	1.69	0.91	0.91
19.19	205.56	188.45	1.00	188.82	1.65	0.92	0.92
19.24	215.32	197.26	1.01	199.30	1.66	0.93	0.93
19.32	216.44	197.96	1.02	202.11	1.68	0.93	0.93
19.38	225.42	206.20	1.00	206.20	1.62	0.93	0.93
19.44	243.30	222.44	1.00	222.44	1.48	0.95	0.95
19.54	264.55	241.62	1.00	241.62	1.44	0.96	0.96
19.59	250.99	229.00	1.00	229.00	1.51	0.95	0.95
19.65	234.06	213.28	1.00	213.28	1.63	0.94	0.94
19.71	231.47	210.64	1.01	212.41	1.66	0.94	0.94
19.76	142.25	128.00	1.24	158.87	1.95	0.86	0.86
19.83	203.83	184.77	1.05	193.55	1.71	0.92	0.92
19.91	209.18	189.61	1.02	193.20	1.67	0.92	0.92
19.96	201.51	182.45	1.02	186.62	1.68	0.92	0.92
20.03	192.77	174.31	1.02	178.61	1.68	0.91	0.91
20.09	194.24	175.63	1.01	176.52	1.65	0.91	0.91
20.16	189.58	171.29	1.00	171.29	1.64	0.91	0.91
20.22	187.16	168.95	1.00	168.95	1.60	0.90	0.90
20.30	187.17	168.75	1.00	168.75	1.57	0.90	0.90
20.36	187.17	168.62	1.00	168.62	1.56	0.90	0.90
20.45	187.17	168.43	1.00	168.43	1.57	0.90	0.90
20.48	192.27	172.96	1.00	172.96	1.63	0.91	0.91
20.55	204.62	183.46	1.05	192.46	1.72	0.92	0.92
20.61	210.06	188.21	1.05	197.31	1.72	0.92	0.92
20.68	223.10	200.26	1.00	200.19	1.64	0.93	0.93
20.76	244.00	218.89	1.00	218.89	1.57	0.94	0.94
20.81	259.29	232.53	1.00	232.53	1.46	0.95	0.95
20.88	289.43	259.44	1.00	259.44	1.22	0.97	0.97
20.94	280.87	251.55	1.00	251.55	1.26	0.97	0.97
21.00	323.28	289.47	1.00	289.47	1.20	0.99	0.99
21.06	265.58	237.40	1.00	237.40	1.34	0.96	0.96
21.14	218.08	194.54	1.00	194.54	1.49	0.93	0.93
21.20	176.35	156.98	1.00	156.98	1.62	0.89	0.89
21.26	171.26	152.30	1.00	152.30	1.55	0.89	0.89
21.33	158.30	140.58	1.00	140.58	1.44	0.88	0.88
21.43	146.99	130.30	1.00	130.30	1.50	0.87	0.87
21.46	144.23	127.79	1.00	127.79	1.51	0.86	0.86
21.52	141.12	124.91	1.00	124.91	1.52	0.86	0.86
21.59	135.42	119.72	1.00	119.72	1.55	0.85	0.85
21.65	99.82	87.51	1.00	87.51	1.74	0.81	0.81
21.73	115.71	101.98	1.00	101.98	1.64	0.83	0.83
21.79	115.80	101.99	1.00	101.99	1.64	0.83	0.83
21.85	115.97	102.06	1.00	102.06	1.64	0.83	0.83
21.92	115.71	101.72	1.00	101.72	1.65	0.83	0.83
21.98	115.67	101.62	1.00	101.62	1.64	0.83	0.83
22.05	115.63	101.51	1.00	101.51	1.64	0.83	0.83

:: Strength loss calculation (Robertson (2009) :: (continued)

Depth (ft)	q_t (tsf)	Q_{tn}	K_c	$Q_{tn,cs}$	I_c	$S_{u(liq)}/\sigma'_v$	$S_{u(peak)}/\sigma'_v$
22.13	117.44	103.04	1.00	103.04	1.61	0.83	0.83
22.19	118.39	103.82	1.00	103.82	1.58	0.83	0.83
22.25	119.86	105.05	1.00	105.05	1.56	0.83	0.83
22.31	120.55	105.59	1.00	105.59	1.57	0.83	0.83
22.41	122.11	106.85	1.00	106.85	1.62	0.84	0.84
22.45	123.23	107.71	1.00	107.71	1.66	0.84	0.84
22.52	123.23	107.41	1.00	107.41	1.69	0.84	0.84
22.59	123.23	107.10	1.06	113.47	1.73	0.84	0.84
22.65	126.51	109.52	1.10	120.81	1.80	0.84	0.84
22.71	133.25	115.24	1.11	128.29	1.81	0.85	0.85
22.78	140.59	121.78	1.08	132.13	1.77	0.86	0.86
22.84	150.69	130.92	1.05	137.02	1.71	0.87	0.87
22.92	173.06	150.82	1.01	152.09	1.66	0.89	0.89
22.98	194.40	169.59	1.00	169.59	1.60	0.90	0.90
23.04	213.74	186.43	1.00	186.43	1.57	0.92	0.92
23.11	245.27	213.93	1.00	213.93	1.50	0.94	0.94
23.19	278.69	242.97	1.00	242.97	1.45	0.96	0.96
23.23	289.83	252.60	1.00	252.60	1.43	0.97	0.97
23.30	309.61	269.68	1.00	269.68	1.39	0.98	0.98
23.37	343.55	299.06	1.00	299.06	1.32	0.99	0.99
23.44	359.96	313.14	1.00	313.14	1.29	1.00	1.00
23.51	356.94	310.21	1.00	310.21	1.33	1.00	1.00
23.57	373.09	324.04	1.00	324.04	1.32	1.01	1.01
23.62	390.37	338.84	1.00	338.84	1.31	1.02	1.02
23.71	402.80	349.23	1.00	349.23	1.29	1.02	1.02
23.77	369.64	320.16	1.00	320.16	1.35	1.01	1.01
23.82	424.48	367.54	1.00	367.54	1.27	1.03	1.03
23.89	449.17	388.62	1.00	388.62	1.24	1.04	1.04
23.97	457.38	395.36	1.00	395.36	1.25	1.04	1.04
24.03	450.12	388.72	1.00	388.72	1.30	1.04	1.04
24.08	473.86	408.97	1.00	408.97	1.29	1.05	1.05
24.16	488.03	420.79	1.00	420.79	1.28	1.05	1.05
24.21	506.34	436.29	1.00	436.29	1.26	1.06	1.06
24.29	509.19	438.26	1.00	438.26	1.24	1.06	1.06
24.35	519.03	446.42	1.00	446.42	1.19	1.06	1.06
24.43	513.25	440.95	1.00	440.95	1.20	1.06	1.06
24.49	520.85	447.12	1.00	447.12	1.22	1.06	1.06
24.56	500.47	429.17	1.00	429.17	1.27	1.06	1.06
24.63	486.65	416.89	1.00	416.89	1.30	1.05	1.05
24.68	447.00	382.52	1.00	382.52	1.32	1.04	1.04
24.74	469.29	401.33	1.00	401.33	1.27	1.04	1.04
24.80	466.52	-1.00	1.00	-1.00	-1.00	N/A	N/A
24.88	478.60	-1.00	1.00	-1.00	-1.00	N/A	N/A
24.95	535.35	-1.00	1.00	-1.00	-1.00	N/A	N/A
25.01	638.74	-1.00	1.00	-1.00	-1.00	N/A	N/A
25.08	679.84	-1.00	1.00	-1.00	-1.00	N/A	N/A
25.13	771.39	-1.00	1.00	-1.00	-1.00	N/A	N/A

:: Strength loss calculation (Robertson (2009) :: (continued)

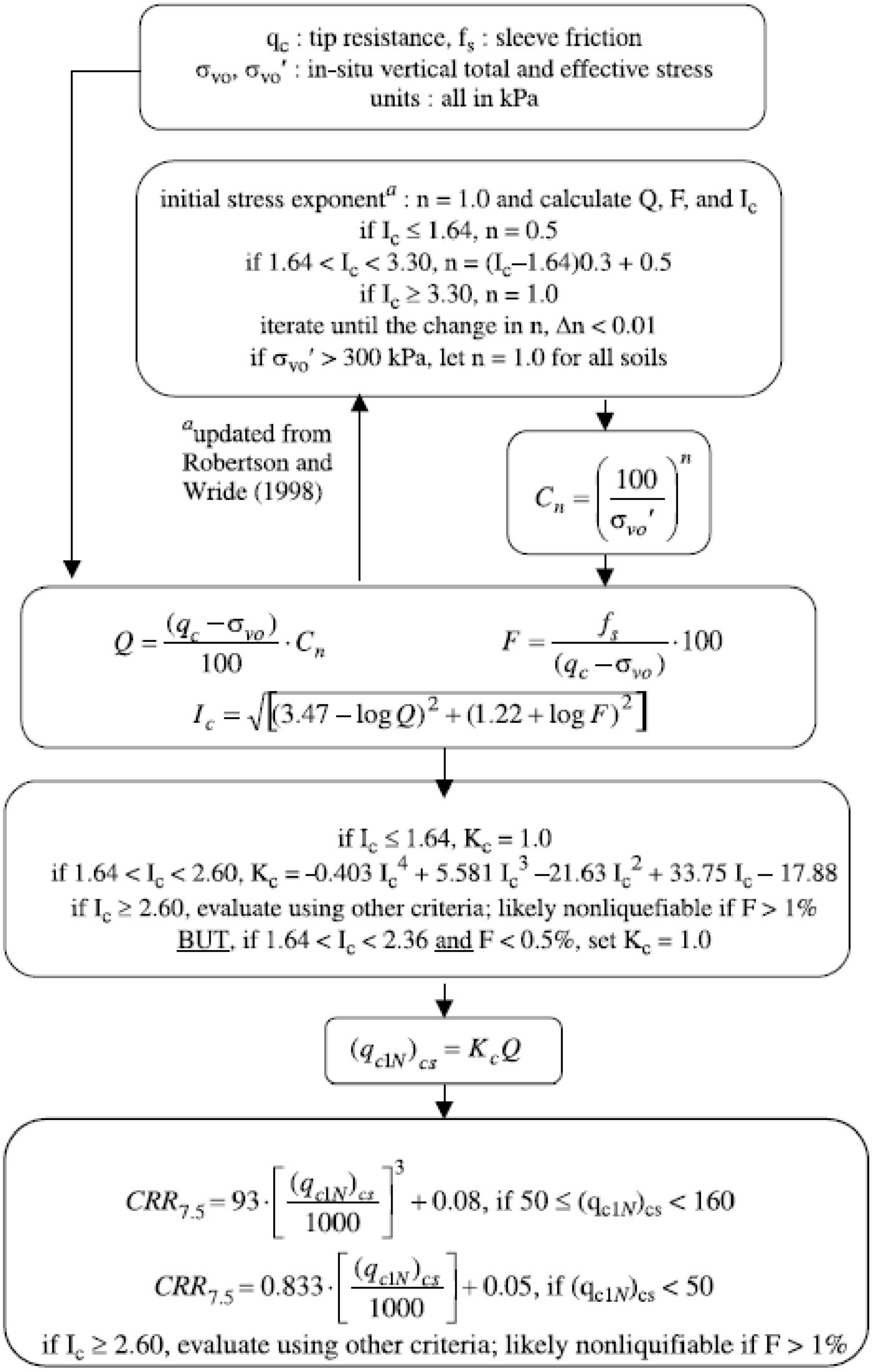
Depth (ft)	q_t (tsf)	Q_{tn}	K_c	$Q_{tn,cs}$	I_c	$S_{u(liq)}/\sigma'_v$	$S_{u(peak)}/\sigma'_v$

Abbreviations

q_t:	Total cone resistance
K_c:	Cone resistance correction factor due to fines
$Q_{tn,cs}$:	Adjusted and corrected cone resistance due to fines
I_c:	Soil behavior type index
$S_{u(liq)}/\sigma'_v$:	Calculated liquefied undrained strength ratio
$S_{u(peak)}/\sigma'_v$:	Calculated peak undrained strength ratio

Procedure for the evaluation of soil liquefaction resistance, NCEER (1998)

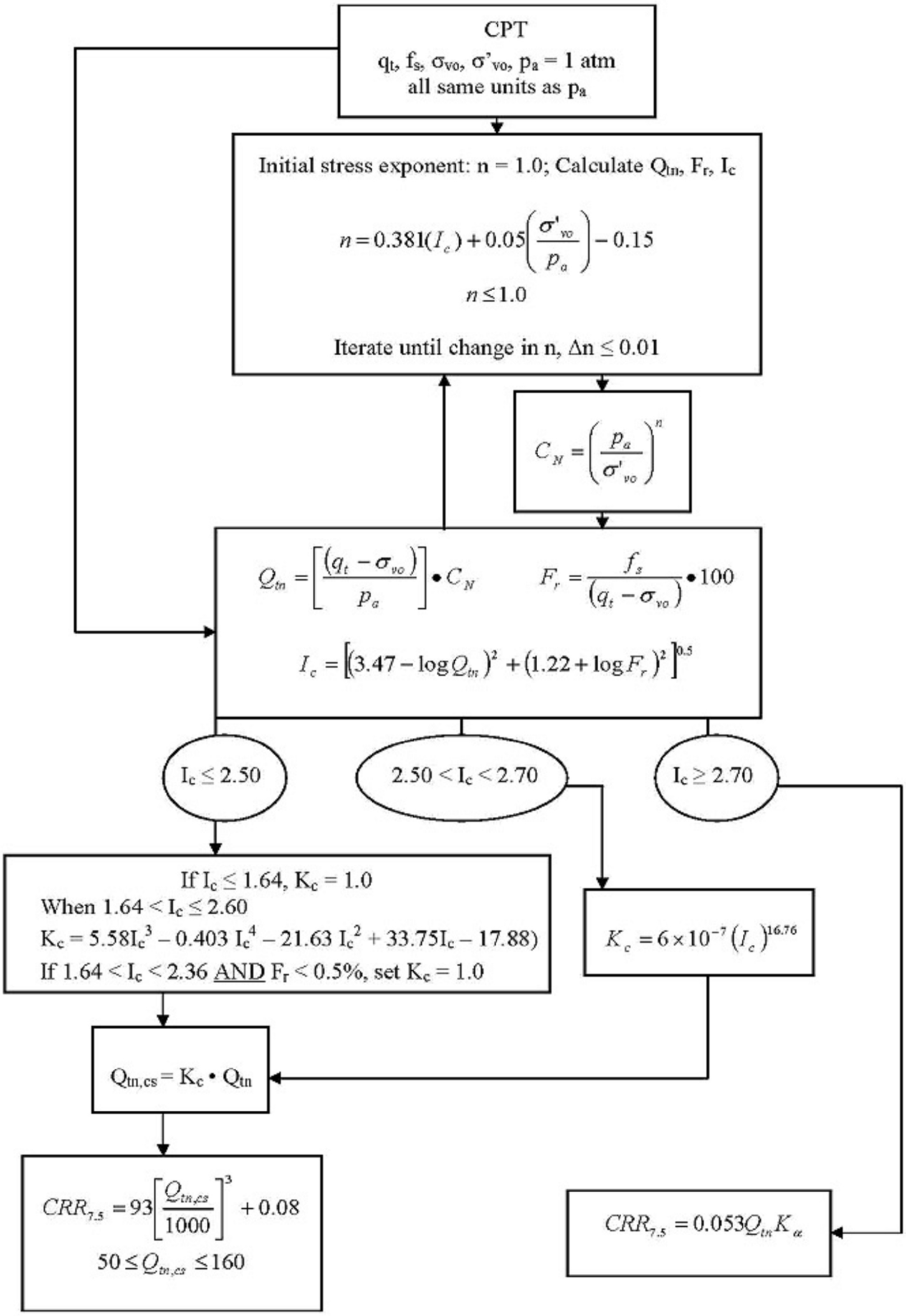
Calculation of soil resistance against liquefaction is performed according to the Robertson & Wride (1998) procedure. The procedure used in the software, slightly differs from the one originally published in NCEER-97-0022 (Proceedings of the NCEER Workshop on Evaluation of Liquefaction Resistance of Soils). The revised procedure is presented below in the form of a flowchart[1]:



[1] "Estimating liquefaction-induced ground settlements from CPT for level ground", G. Zhang, P.K. Robertson, and R.W.I. Brachman

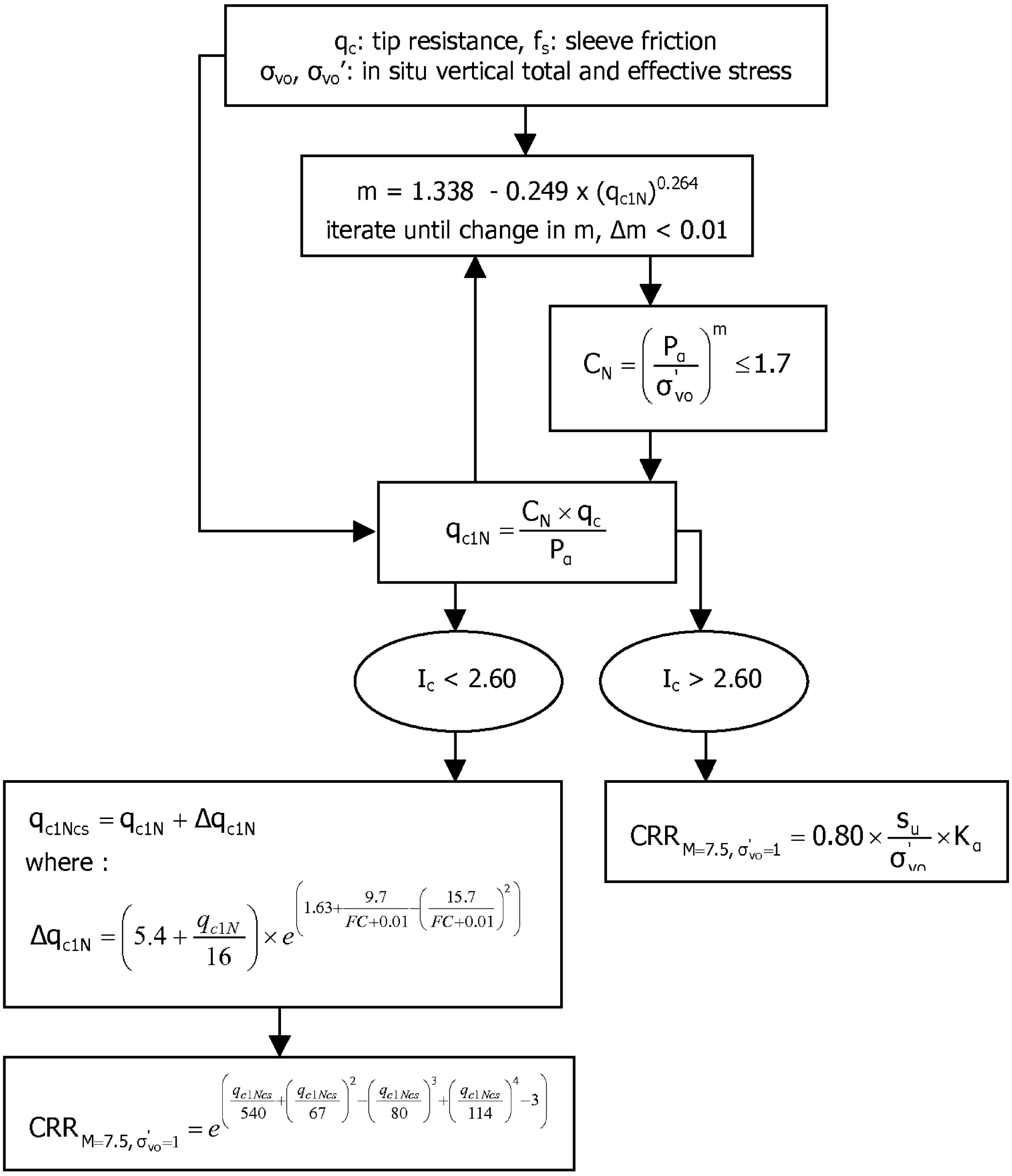
Procedure for the evaluation of soil liquefaction resistance (all soils), Robertson (2010)

Calculation of soil resistance against liquefaction is performed according to the Robertson & Wride (1998) procedure. This procedure used in the software, slightly differs from the one originally published in NCEER-97-0022 (Proceedings of the NCEER Workshop on Evaluation of Liquefaction Resistance of Soils). The revised procedure is presented below in the form of a flowchart[1]:

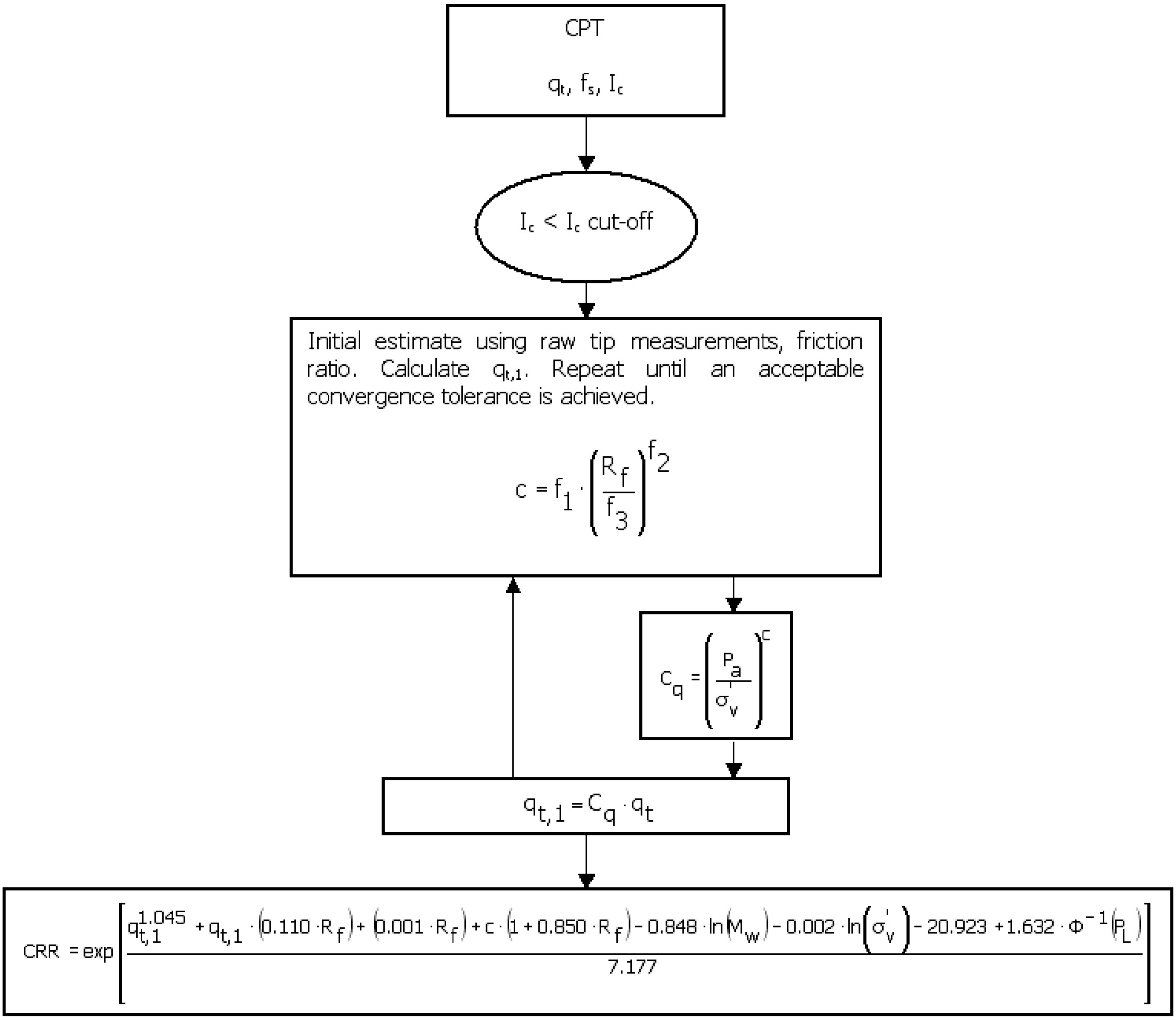


[1] P.K. Robertson, 2009. "Performance based earthquake design using the CPT", Keynote Lecture, International Conference on Performance-based Design in Earthquake Geotechnical Engineering – from case history to practice, IS-Tokyo, June 2009

Procedure for the evaluation of soil liquefaction resistance, Idriss & Boulanger (2008)



Procedure for the evaluation of soil liquefaction resistance (sandy soils), Moss et al. (2006)



Procedure for the evaluation of soil liquefaction resistance, Boulanger & Idriss(2014)

$$FS_{liq} = \frac{CRR_{M=7.5,\sigma_v'=1atm}}{CSR_{M=7.5,\sigma_v'=1atm}}$$

$$CSR_{M=7.5,\sigma_v'=1atm} = 0.65 \frac{\sigma_v}{\sigma_v'} \frac{a_{\max}}{g} r_d \frac{1}{MSF} \frac{1}{K_\sigma}$$

$$r_d = \exp\left[\alpha(z) + \beta(z) \cdot M\right]$$

$$\alpha(z) = -1.012 - 1.126 \sin\left(\frac{z}{11.73} + 5.133\right)$$

$$\beta(z) = 0.106 + 0.118 \sin\left(\frac{z}{11.28} + 5.142\right)$$

$$K_\sigma = 1 - C_\sigma \ln\left(\frac{\sigma_v'}{P_a}\right) \le 1.1$$

$$C_\sigma = \frac{1}{37.3 - 8.27\left(q_{c1Ncs}\right)^{0.264}} \le 0.3$$

$$MSF = 1 + \left(MSF_{max} - 1\right)\left(8.64 \exp\left(\frac{-M}{4}\right) - 1.325\right)$$

$$MSF_{max} = 1.09 + \left(\frac{q_{c1Ncs}}{180}\right)^3 \le 2.2$$

σ_v' *and* σ_v *at start of earthquake shaking*

$$CRR_{M=7.5,\sigma_v'=1atm} = \exp\left(\frac{q_{c1Ncs}}{113} + \left(\frac{q_{c1Ncs}}{1000}\right)^2 - \left(\frac{q_{c1Ncs}}{140}\right)^3 + \left(\frac{q_{c1Ncs}}{137}\right)^4 - 2.80\right)$$

$$q_{c1Ncs} = q_{c1N} + \Delta q_{c1N}$$

$$\Delta q_{c1N} = \left(11.9 + \frac{q_{c1N}}{14.6}\right) \exp\left(1.63 - \frac{9.7}{FC+2} - \left(\frac{15.7}{FC+2}\right)^2\right)$$

$$q_{c1N} = C_{N} \frac{q_c}{P_a}$$

$$C_{N} = \left(\frac{P_a}{\sigma_v'}\right)^m \le 1.7$$

$$m = 1.338 - 0.249\left(q_{c1Ncs}\right)^{0.264} \quad with \quad 0.264 \le m \le 0.782$$

$$FC = 80\left(I_C + C_{FC}\right) - 137 \quad with \quad 0\% \le FC \le 100\%$$

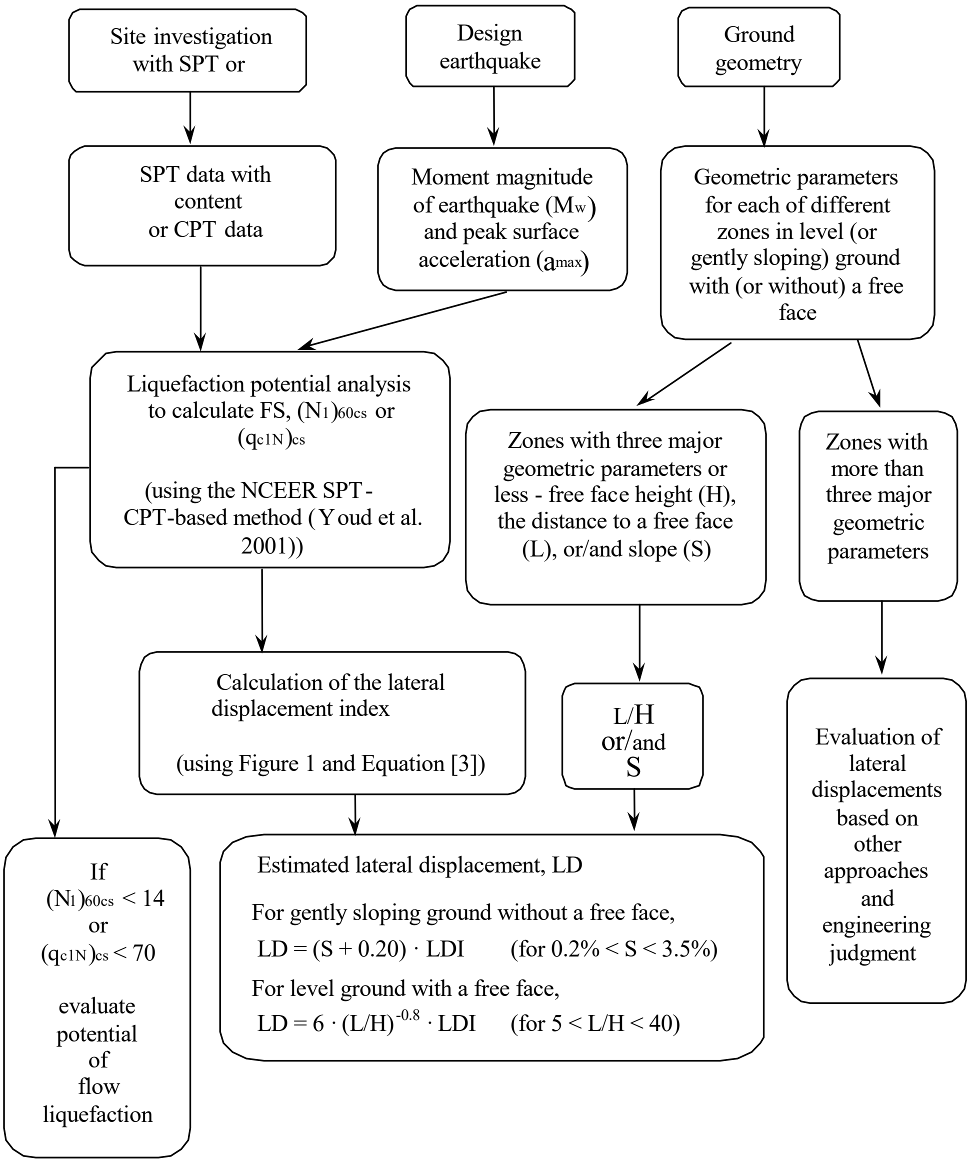
$$I_c = \left[\left(3.47 - \log(Q)\right)^2 + \left(1.22 + \log(F)\right)^2\right]^{0.5}$$

$$Q = \left(\frac{q_c - \sigma_{vc}}{P_a}\right)\left(\frac{P_a}{\sigma_{vc}'}\right)^n \; with\; 0.5 \le n \le 1.0 \; per\; Robertson\; \&\; Wride\; (1998)$$

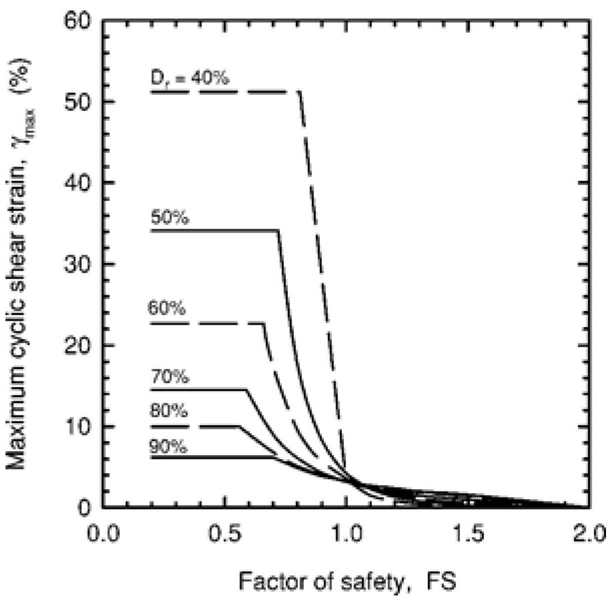
$$F = \left(\frac{f_s}{q_c - \sigma_{vc}}\right) \cdot 100\%$$

σ_v' *at time of CPT sounding*

Procedure for the evaluation of liquefaction-induced lateral spreading displacements



[1] Flow chart illustrating major steps in estimating liquefaction-induced lateral spreading displacements using the proposed approach



[1] **Figure 1**

$$\text{LDI} = \int_0^{Z_{\max}} \gamma_{\max} \, dz$$

[1] **Equation [3]**

[1] "Estimating liquefaction-induced ground settlements from CPT for level ground", G. Zhang, P.K. Robertson, and R.W.I. Brachman

Procedure for the estimation of seismic induced settlements in dry sands

Average shear stress, τ_{av}

$$\tau_{av} = CSR^{*} \cdot \sigma_{v0}' = 0.65 \cdot \frac{\alpha_{max}}{g} \cdot \sigma_{v0} \cdot \tau_{a}$$

Estimate small shear strain modulus, G_0

$$G_0 = 0.0188 \cdot \left[10^{(0.55 I_c - 1.68)}\right] \cdot (q_t - \sigma_v)$$

Estimate shear strain amplitude, γ

(based on Pradel (1998))

$$\gamma = \left[\frac{1 + \alpha \cdot e^{bR}}{1 + \alpha}\right] \cdot R \cdot 100\ (\%)$$

$$R = \frac{\tau_{av}}{G_0}\ \text{(Note } \tau_{av} \text{ and } G_0 \text{ same units)}$$

$$\alpha = 0.0389 \cdot \left(\frac{\sigma_v}{p_a}\right) + 0.124$$

$$b = 6400 \cdot \left(\frac{\sigma_v}{p_a}\right)$$

Estimate volumetric strain in 15 cycles

$$\varepsilon_{vol(15)} = \gamma \cdot \left[\frac{(N_1)_{60,cs}}{20}\right]^{-1.20}$$

$$(N_1)_{60,cs} = \frac{Q_{tn,cs}}{8.5 \cdot \left[1 - \frac{I_c}{4.6}\right]}$$

Volumetric strain in design earthquake

$$\Sigma_{vol} = \varepsilon_{vol(15)} \cdot \left[\frac{N_c}{15}\right]^{0.45}$$

$$N_c = (M - 4)^{2.17}$$

Seismic settlement, s

$$s = 2 \cdot \int_0^{GWT} \Sigma_{vol} \cdot dz$$

Robertson, P.K. and Lisheng, S., 2010, "Estimation of seismic compression in dry soils using the CPT" FIFTH INTERNATIONAL CONFERENCE ON RECENT ADVANCES IN GEOTECHNICAL EARTHQUAKE ENGINEERING AND SOIL DYNAMICS, Symposium in honor of professor I. M. Idriss, San Diego, CA

Liquefaction Potential Index (LPI) calculation procedure

Calculation of the Liquefaction Potential Index (LPI) is used to interpret the liquefaction assessment calculations in terms of severity over depth. The calculation procedure is based on the methology developed by Iwasaki (1982) and is adopted by AFPS.

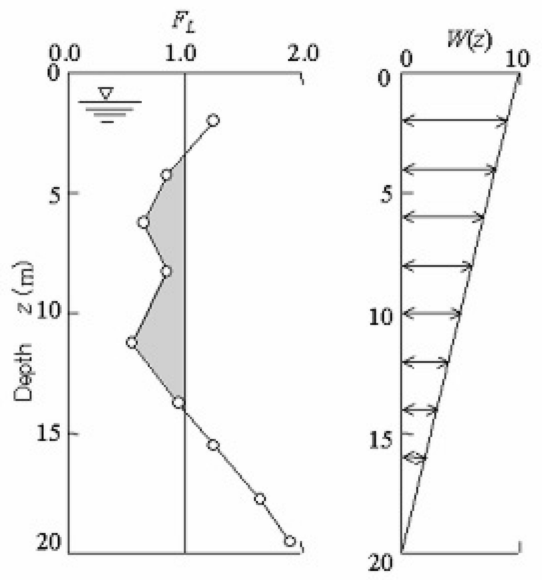
To estimate the severity of liquefaction extent at a given site, LPI is calculated based on the following equation:

$$\textbf{LPI} = \int_0^{20} (10 - 0{,}5_z) \times F_L \times d_z$$

where:
F_L = 1 - F.S. when F.S. less than 1
F_L = 0 when F.S. greater than 1
z depth of measurment in meters

Values of LPI range between zero (0) when no test point is characterized as liquefiable and 100 when all points are characterized as susceptible to liquefaction. Iwasaki proposed four (4) discrete categories based on the numeric value of LPI:

- LPI = 0 : Liquefaction risk is very low
- 0 < LPI <= 5 : Liquefaction risk is low
- 5 < LPI <= 15 : Liquefaction risk is high
- LPI > 15 : Liquefaction risk is very high



Graphical presentation of the LPI calculation procedure

Shear-Induced Building Settlement (Ds) calculation procedure

The shear-induced building settlement (Ds) due to liquefaction below the building can be estimated using the relationship developed by Bray and Macedo (2017):

$$Ln(Ds) = c1 + c2 * LBS + 0.58 * Ln\left(Tanh\left(\frac{HL}{6}\right)\right) +$$

$$4.59 * Ln(Q) - 0.42 * Ln(Q)^2 - 0.02 * B +$$
$$0.84 * Ln(CAVdp) + 0.41 * Ln(Sa1) + \varepsilon$$

where Ds is in the units of mm, c1= -8.35 and c2= 0.072 for LBS ≤ 16, and c1= -7.48 and c2= 0.014 otherwise. Q is the building contact pressure in units of kPa, HL is the cumulative thickness of the liquefiable layers in the units of m, B is the building width in the units of m, CAVdp is a standardized version of the cumulative absolute velocity in the units of g-s, Sa1 is 5%-damped pseudo-acceleration response spectral value at a period of 1 s in the units of g, and ε is a normal random variable with zero mean and 0.50 standard deviation in Ln units. The liquefaction-induced building settlement index (LBS) is:

$$LBS = \sum W * \frac{\varepsilon_{shear}}{z} dz$$

where z (m) is the depth measured from the ground surface > 0, W is a foundation-weighting factor wherein W = 0.0 for z less than Df, which is the embedment depth of the foundation, and W = 1.0 otherwise. The shear strain parameter (ε_shear) is the liquefaction-induced free-field shear strain (in %) estimated using Zhang et al. (2004). It is calculated based on the estimated Dr of the liquefied soil layer and the calculated safety factor against liquefaction triggering (FSL).

References

- Lunne, T., Robertson, P.K., and Powell, J.J.M 1997. Cone penetration testing in geotechnical practice, E & FN Spon Routledge, 352 p, ISBN 0-7514-0393-8.

- Boulanger, R.W. and Idriss, I. M., 2007. Evaluation of Cyclic Softening in Silts and Clays. ASCE Journal of Geotechnical and Geoenvironmental Engineering June, Vol. 133, No. 6 pp 641 -652

- Boulanger, R.W. and Idriss, I. M., 20 14. CPT AND SPT BASED LIQUEFACTION TRIGGERING PROCEDURES. DEPARTMENT OF CIVIL & ENVIRONMENTAL ENGINEERING COLLEGE OF ENGINEERING UNIVERSITY OF CALIFORNIA AT DAVIS

- Robertson, P.K. and Cabal, K.L., 2007 , Guide to Cone Penetration Testing for Geotechnical Engineering. Available at no cost at http://www.geologismiki.gr/

- Robertson, P.K. 1990. Soil classification using the cone penetration test. Canadian Geotechnical Journal, 27 (1), 151 -8.

- Robertson, P.K. and Wride, C.E., 1998. Cyclic Liquefaction and its Evaluation based on the CPT Canadian Geotechnical Journal, 1998, Vol. 35, August.

- Youd, T.L., Idriss, I.M., Andrus, R.D., Arango, I., Castro, G., Christian, J.T., Dobry, R., Finn, W.D.L., Harder, L.F., Hynes , M.E., Ishihara, K., Koester, J., Liao, S., Marcuson III, W.F., Martin, G.R., Mitchell, J.K., Moriwaki, Y., Power, M.S., Robertson, P.K., Seed, R., and Stokoe, K.H., Liquefaction Resistance of Soils: Summary Report from the 1996 NCEER and 1998 NCEER/NSF Workshop on Evaluation of Liquefaction Resistance of Soils, ASCE, Journal of Geotechnical & Geoenvironmental Engineering, Vol. 127, October, pp 817-833

- Zhang, G., Robertson. P.K., Brachman, R., 2002, Estimating Liquefaction Induced Ground Settlements from the CPT, Canadian Geotechnical Journal, 39: pp 1168-1180

- Zhang, G., Robertson. P.K., Brachman, R., 2004, Estimating Liquefaction Induced Lateral Displacements using the SPT and CPT, ASCE, Journal of Geotechnical & Geoenvironmental Engineering, Vol. 130, No. 8, 861 -871

- Pradel, D., 1998, Procedure to Evaluate Earthquake -Induced Settlements in Dry Sandy Soils, ASCE, Journal of Geotechnical & Geoenvironmental Engineering, Vol. 124, No. 4, 364-368

- Iwasaki, T., 1986, Soil liquefaction studies in Japan: state -of-the-art, Soil Dynamics and Earthquake Engineering, Vol. 5, No. 1, 2-70

- Papathanassiou G., 2008, LPI-based approach for calibrating the severity of liquefaction -induced failures and for assessing the probability of liquefaction surface evidence, Eng. Geol. 96:94 –104

- P.K. Robertson, 2009, Interpretation of Cone Penetration Tests - a unified approach., Canadian Geotechnical Journal, Vol. 46, No. 11, pp 1337-1355

- P.K. Robertson, 2009. "Performance based earthquake design using the CPT", Keynote Lecture, International Conference on Performance-based Design in Earthquake Geotechnical Engineering - from case history to practice, IS-Tokyo, June 2009

- Robertson, P.K. and Lisheng, S., 2010, "Estimation of seismic compression in dry soils using the CPT" FIFTH INTERNATIONAL CONFERENCE ON RECENT ADVANCES IN GEOTECHNICAL EARTHQUAKE ENGINEERING AND SOIL DYNAMICS, *Symposium in honor of professor I. M. Idriss,* SAN diego, CA

- R. E. S. Moss, R. B. Seed, R. E. Kayen, J. P. Stewart, A. Der Kiureghian, K. O. Cetin, CPT -Based Probabilistic and Deterministic Assessment of In Situ Seismic Soil Liquefaction Potential, Journal of Geotechnical and Geoenvironmental Engineering, Vol. 132 , No. 8, August 1, 2006

- I. M. Idriss and R. W. Boulanger, 2008. Soil liquefaction during earthquakes, Earthquake Engineering Research Institute MNO-12

- Jonathan D. Bray & Jorge Macedo, Department of Civil & Environmental Engineering, Univ. of California, Berkeley, CA, USA, Simplified procedure for estimating liquefaction -induced building settlement, *Proceedings of the 19th International Conference on Soil Mechanics and Geotechnical Engineering, Seoul 201*

Twining Consulting

TWINING

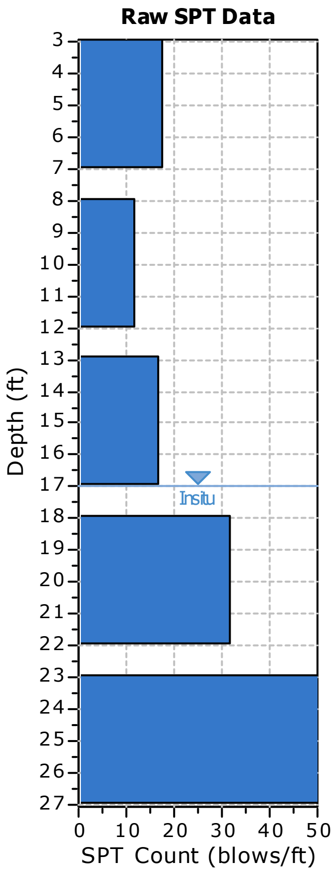
SPT BASED LIQUEFACTION ANALYSIS REPORT

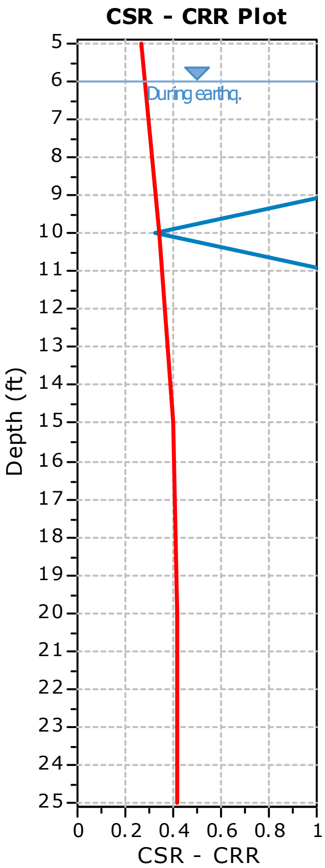
Project title : Proposed Del Rey Avenue Building **SPT Name: B-1**

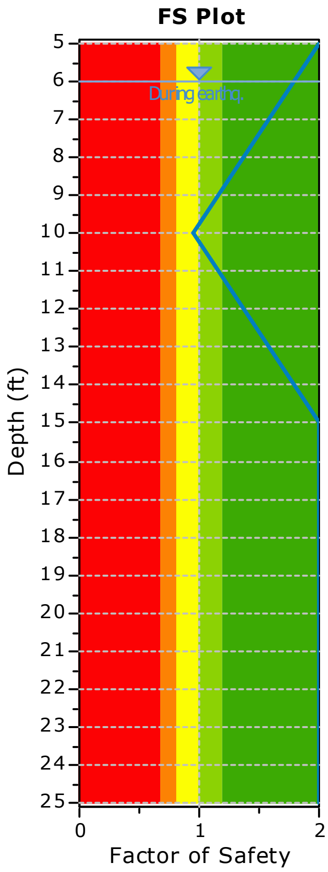
Location : 4112 Del Rey Ave, Marina Del Rey, CA

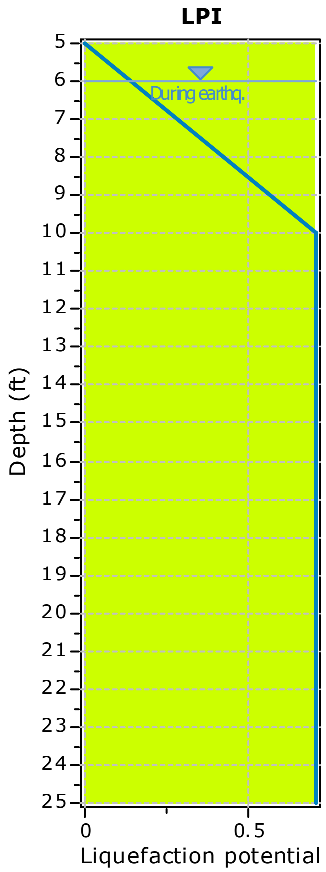
:: Input parameters and analysis properties ::

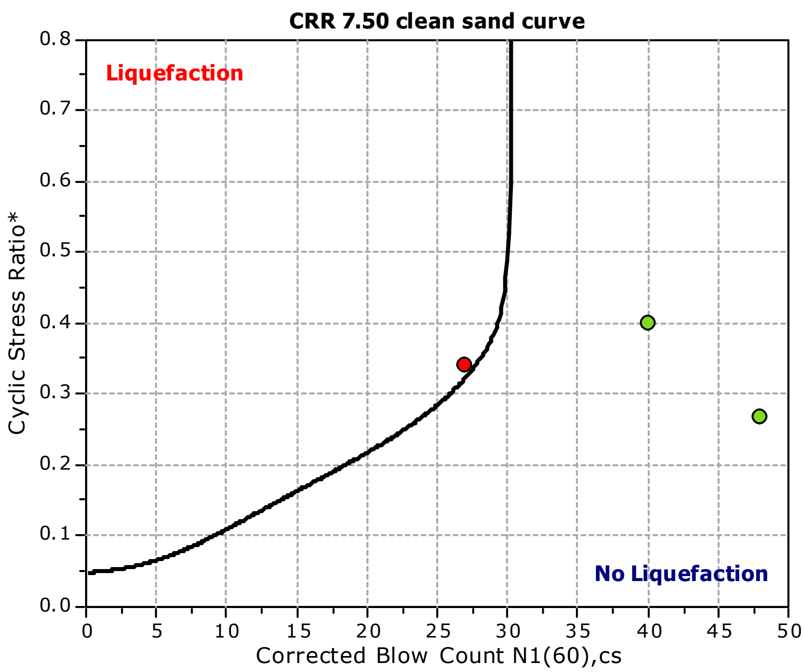
Analysis method:	NCEER 1998	G.W.T. (in-situ):	17.00 ft
Fines correction method:	NCEER 1998	G.W.T. (earthq.):	6.00 ft
Sampling method:	Sampler wo liners	Earthquake magnitude M_w:	6.35
Borehole diameter:	200mm	Peak ground acceleration:	0.58 g
Rod length:	3.30 ft	Eq. external load:	0.00 tsf
Hammer energy ratio:	1.30		











F.S. color scheme

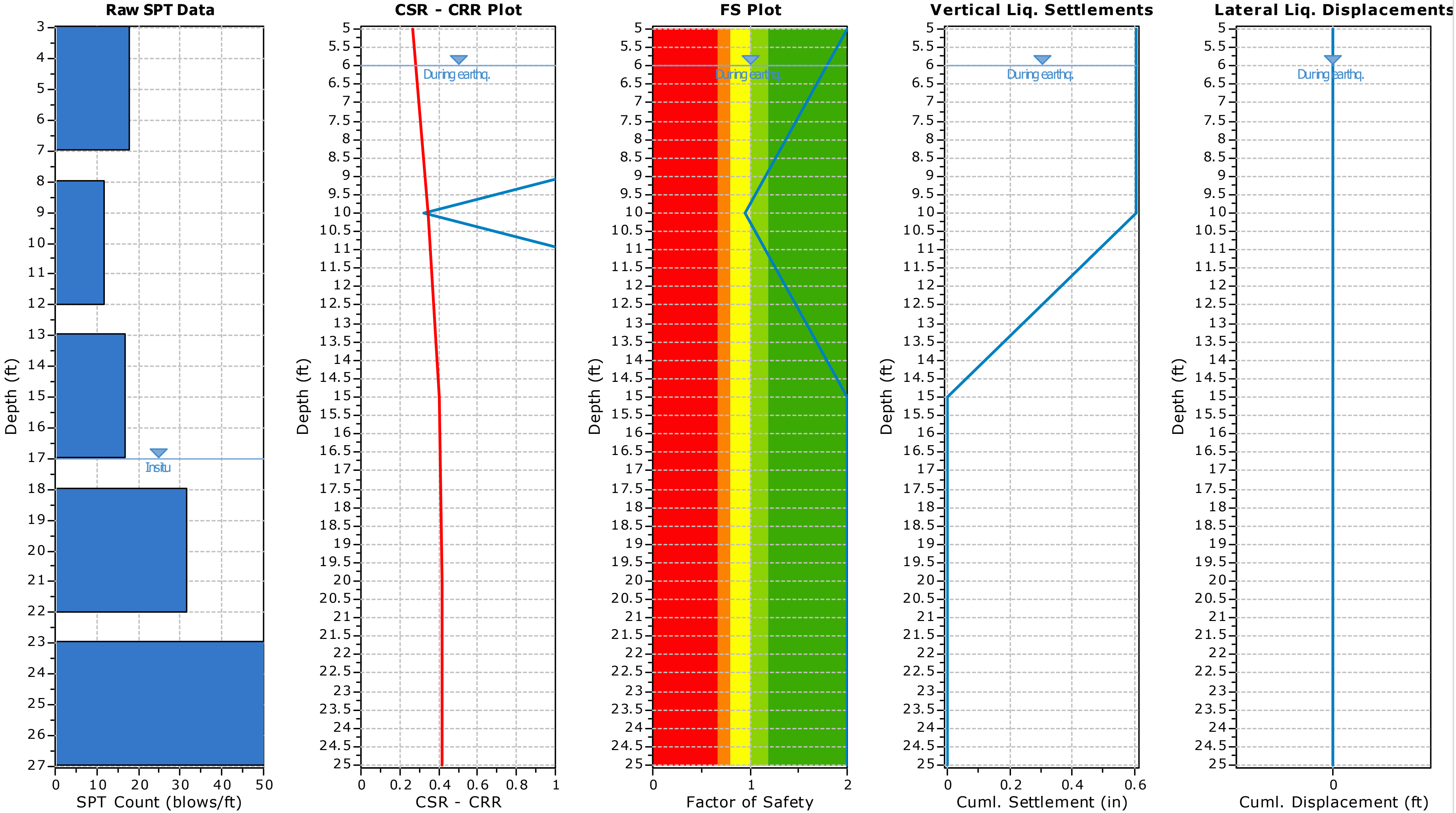
- Almost certain it will liquefy
- Very likely to liquefy
- Liquefaction and no liq. are equally likely
- Unlike to liquefy
- Almost certain it will not liquefy

LPI color scheme

- Very high risk
- High risk
- Low risk

Project File: \\TC-FS-01\Qai_Shares\COMPANY\PROJECTS\2022 TWINING CONSULTING PROJECTS\220205.1 - 4112 Del Rey Ave\Geotech Report\Appendix C - Liquefaction Ana

:: Overall Liquefaction Assessment Analysis Plots ::



:: Field input data ::

Test Depth (ft)	SPT Field Value (blows)	Fines Content (%)	Unit Weight (pcf)	Infl. Thickness (ft)	Can Liquefy
5.00	18	70.00	120.00	5.00	No
10.00	12	15.00	103.00	5.00	Yes
15.00	17	70.00	103.00	5.00	No
20.00	32	10.00	139.00	5.00	Yes
25.00	100	10.00	139.00	5.00	Yes

Abbreviations

Depth:	Depth at which test was performed (ft)
SPT Field Value:	Number of blows per foot
Fines Content:	Fines content at test depth (%)
Unit Weight:	Unit weight at test depth (pcf)
Infl. Thickness:	Thickness of the soil layer to be considered in settlements analysis (ft)
Can Liquefy:	User defined switch for excluding/including test depth from the analysis procedure

:: Cyclic Resistance Ratio (CRR) calculation data ::

Depth (ft)	SPT Field Value	Unit Weight (pcf)	σ_v (tsf)	u_o (tsf)	σ'_{vo} (tsf)	C_N	C_E	C_B	C_R	C_S	$(N_1)_{60}$	Fines Content (%)	α	β	$(N_1)_{60cs}$	$CRR_{7.5}$
5.00	18	120.00	0.30	0.00	0.30	1.48	1.30	1.15	0.75	1.20	36	70.00	5.00	1.20	48	4.000
10.00	12	103.00	0.56	0.00	0.56	1.27	1.30	1.15	0.85	1.20	23	15.00	2.50	1.05	27	0.323
15.00	17	103.00	0.81	0.00	0.81	1.12	1.30	1.15	0.85	1.20	29	70.00	5.00	1.20	40	4.000
20.00	32	139.00	1.16	0.09	1.07	1.00	1.30	1.15	0.95	1.20	54	10.00	0.87	1.02	56	4.000
25.00	100	139.00	1.51	0.25	1.26	0.92	1.30	1.15	0.95	1.20	157	10.00	0.87	1.02	161	4.000

Abbreviations

σ_v:	Total stress during SPT test (tsf)
u_o:	Water pore pressure during SPT test (tsf)
σ'_{vo}:	Effective overburden pressure during SPT test (tsf)
C_N:	Overburden corretion factor
C_E:	Energy correction factor
C_B:	Borehole diameter correction factor
C_R:	Rod length correction factor
C_S:	Liner correction factor
$N_{1(60)}$:	Corrected N_{SPT} to a 60% energy ratio
α, β:	Clean sand equivalent dean sand formula coeffidents
$N_{1(60)cs}$:	Corected $N_{1(60)}$ value for fines content
$CRR_{7.5}$:	Cydic resistance ratio for M=7.5

:: Cyclic Stress Ratio calculation (CSR fully adjusted and normalized) ::

Depth (ft)	Unit Weight (pcf)	$\sigma_{v,eq}$ (tsf)	$u_{o,eq}$ (tsf)	$\sigma'_{vo,eq}$ (tsf)	r_d	α	CSR	MSF	$CSR_{eq,M=7.5}$	K_{sigma}	CSR^*	FS
5.00	120.00	0.30	0.00	0.30	0.99	1.00	0.373	1.53	0.244	1.00	0.295	2.000
10.00	103.00	0.56	0.12	0.43	0.98	1.00	0.476	1.53	0.311	1.00	0.376	0.945
15.00	103.00	0.81	0.28	0.53	0.97	1.00	0.557	1.53	0.364	1.00	0.440	2.000
20.00	139.00	1.16	0.44	0.73	0.96	1.00	0.578	1.53	0.378	1.00	0.457	2.000
25.00	139.00	1.51	0.59	0.92	0.94	1.00	0.585	1.53	0.382	1.00	0.462	2.000

:: Cyclic Stress Ratio calculation (CSR fully adjusted and normalized) ::

Depth (ft)	Unit Weight (pcf)	$\sigma_{v,eq}$ (tsf)	$u_{o,eq}$ (tsf)	$\sigma'_{vo,eq}$ (tsf)	r_d	α	CSR	MSF	$CSR_{eq,M=7.5}$	K_{sigma}	CSR^*	FS

Abbreviations

$\sigma_{v,eq}$: Total overburden pressure at test point, during earthquake (tsf)
$u_{o,eq}$: Water pressure at test point, during earthquake (tsf)
$\sigma'_{vo,eq}$: Effective overburden pressure, during earthquake (tsf)
r_d : Nonlinear shear mass factor
α: Improvement factor due to stone columns
CSR : Cyclic Stress Ratio (adjusted for improvement)
MSF : Magnitude Scaling Factor
$CSR_{eq,M=7.5}$: CSR adjusted for M=7.5
K_{sigma}: Effective overburden stress factor
CSR^*: CSR fully adjusted (user FS applied)***
FS: Calculated factor of safety against soil liquefaction

*** User FS: 1.10

:: Liquefaction potential according to Iwasaki ::

Depth (ft)	FS	F	wz	Thickness (ft)	I_L
5.00	2.000	0.00	9.24	5.00	0.00
10.00	0.945	0.05	8.48	5.00	0.70
15.00	2.000	0.00	7.71	5.00	0.00
20.00	2.000	0.00	6.95	5.00	0.00
25.00	2.000	0.00	6.19	5.00	0.00

Overall potential I_L : 0.70

I_L = 0.00 - No liquefaction
I_L between 0.00 and 5 - Liquefaction not probable
I_L between 5 and 15 - Liquefaction probable
I_L > 15 - Liquefaction certain

:: Vertical settlements estimation for dry sands ::

Depth (ft)	$(N_1)_{60}$	τ_{av}	p	G_{max} (tsf)	α	b	γ	ε_{15}	N_c	ε_{Nc} (%)	Δh (ft)	ΔS (in)
5.00	36	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	5.00	0.000

Cumulative settlemetns: 0.000

Abbreviations

τ_{av}: Average cyclic shear stress
p: Average stress
G_{max}: Maximum shear modulus (tsf)
α, b: Shear strain formula variables
γ: Average shear strain
ε_{15}: Volumetric strain after 15 cycles
N_c: Number of cycles
ε_{Nc}: Volumetric strain for number of cycles N_c (%)
Δh: Thickness of soil layer (in)
ΔS: Settlement of soil layer (in)

:: Vertical settlements estimation for saturated sands ::

Depth (ft)	D_{50} (in)	q_c/N	e_v (%)	Δh (ft)	s (in)
10.00	0.00	5.00	1.01	5.00	0.603
15.00	0.00	5.00	0.00	5.00	0.000

:: Vertical settlements estimation for saturated sands ::

Depth (ft)	D_{50} (in)	q_c/N	e_v (%)	Δh (ft)	s (in)
20.00	0.00	5.00	0.00	5.00	0.000
25.00	0.00	5.00	0.00	5.00	0.000

Cumulative settlements: 0.603

Abbreviations

D_{50}: Median grain size (in)
q_c/N: Ratio of cone resistance to SPT
e_v: Post liquefaction volumetric strain (%)
Δh: Thickness of soil layer to be considered (ft)
s: Estimated settlement (in)

Twining Consulting

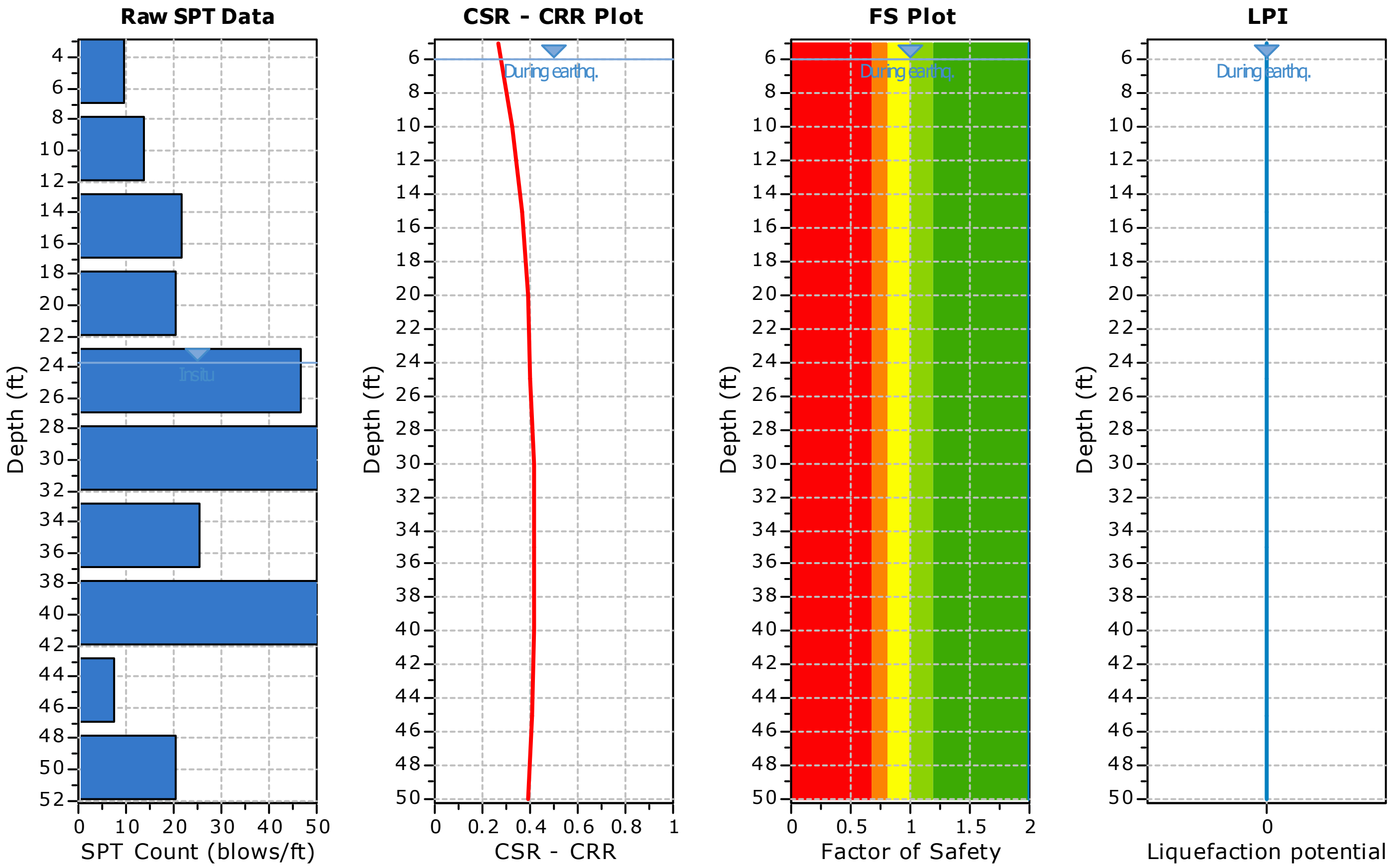
SPT BASED LIQUEFACTION ANALYSIS REPORT

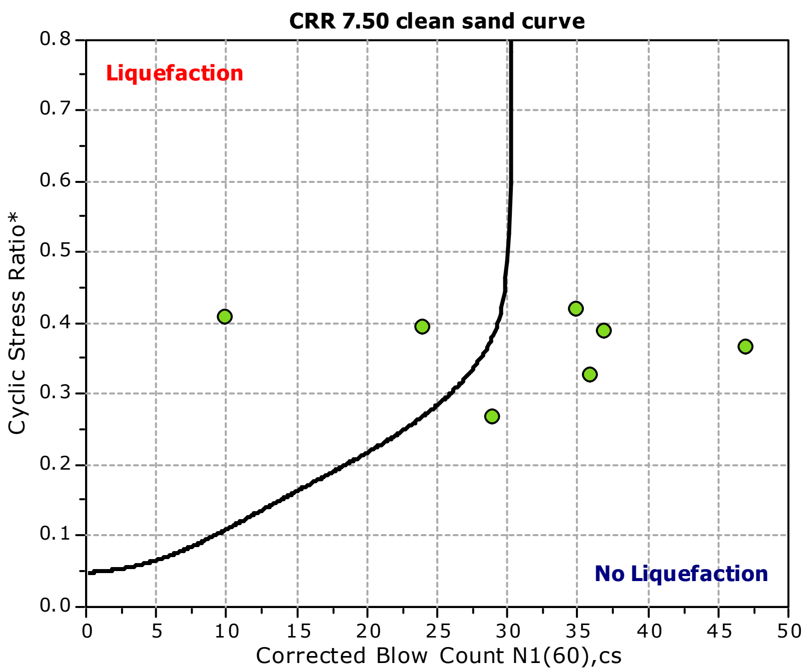
Project title : Proposed Del Rey Avenue Building **SPT Name: B-2**

Location : 4112 Del Rey Ave, Marina Del Rey, CA

:: Input parameters and analysis properties ::

Analysis method:	NCEER 1998	G.W.T. (in-situ):	23.70 ft
Fines correction method:	NCEER 1998	G.W.T. (earthq.):	6.00 ft
Sampling method:	Sampler wo liners	Earthquake magnitude M_w:	6.35
Borehole diameter:	200mm	Peak ground acceleration:	0.58 g
Rod length:	3.30 ft	Eq. external load:	0.00 tsf
Hammer energy ratio:	1.33		





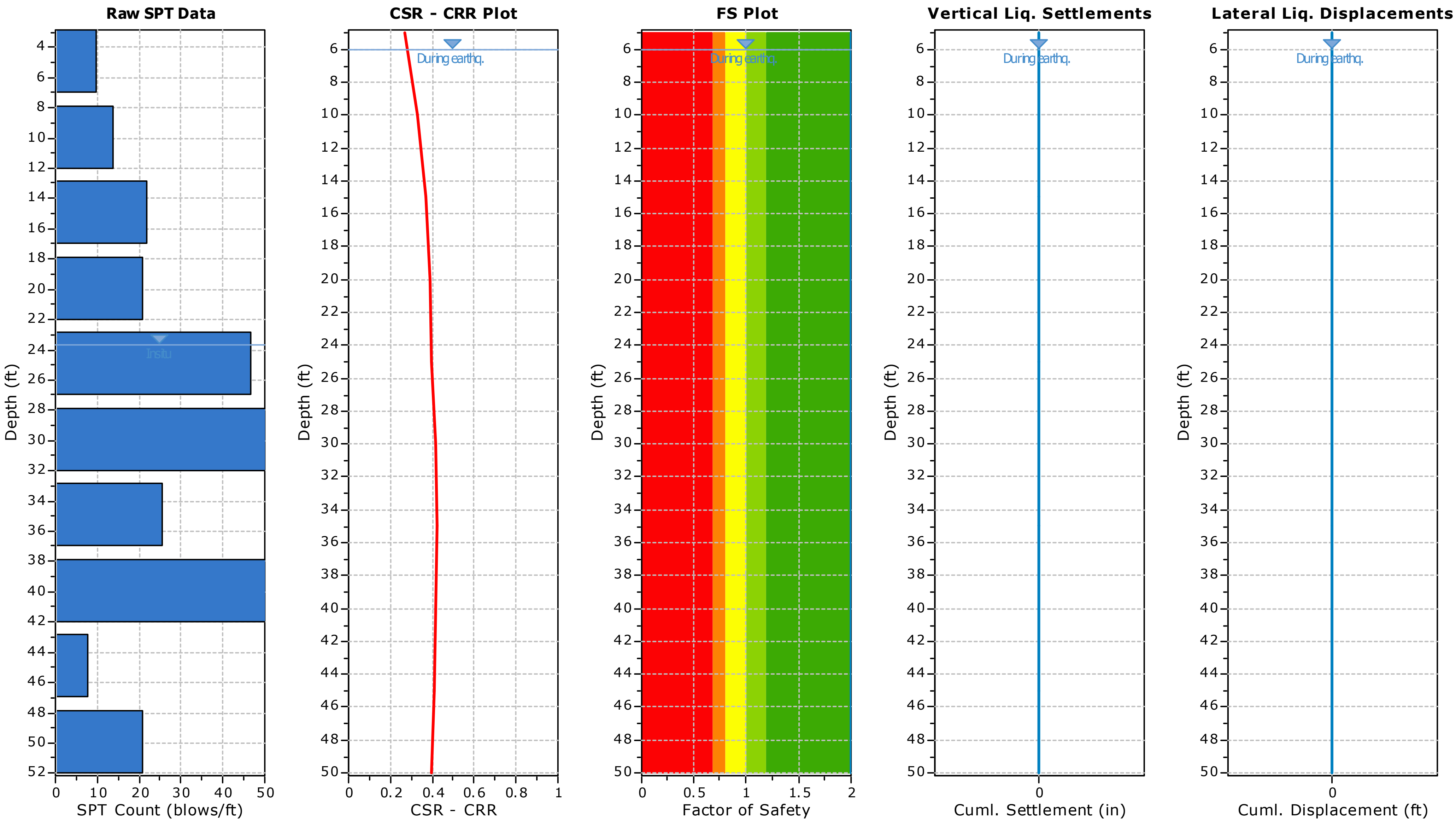
F.S. color scheme

- Almost certain it will liquefy
- Very likely to liquefy
- Liquefaction and no liq. are equally likely
- Unlike to liquefy
- Almost certain it will not liquefy

LPI color scheme

- Very high risk
- High risk
- Low risk

:: Overall Liquefaction Assessment Analysis Plots ::



:: Field input data ::

Test Depth (ft)	SPT Field Value (blows)	Fines Content (%)	Unit Weight (pcf)	Infl. Thickness (ft)	Can Liquefy
5.00	10	70.00	131.00	5.00	No
10.00	14	70.00	131.00	5.00	No
15.00	22	74.20	131.00	5.00	No
20.00	21	15.00	132.00	5.00	Yes
25.00	47	8.70	132.00	5.00	Yes
30.00	65	8.70	130.00	5.00	Yes
35.00	26	5.30	130.00	5.00	Yes
40.00	65	5.30	136.00	5.00	Yes
45.00	8	5.30	136.00	5.00	No
50.00	21	5.30	131.00	5.00	No

Abbreviations

Depth: Depth at which test was performed (ft)
SPT Field Value: Number of blows per foot
Fines Content: Fines content at test depth (%)
Unit Weight: Unit weight at test depth (pcf)
Infl. Thickness: Thickness of the soil layer to be considered in settlements analysis (ft)
Can Liquefy: User defined switch for excluding/including test depth from the analysis procedure

:: Cyclic Resistance Ratio (CRR) calculation data ::

Depth (ft)	SPT Field Value	Unit Weight (pcf)	σ_v (tsf)	u_o (tsf)	σ'_{vo} (tsf)	C_N	C_E	C_B	C_R	C_S	$(N_1)_{60}$	Fines Content (%)	α	β	$(N_1)_{60cs}$	$CRR_{7.5}$
5.00	10	131.00	0.33	0.00	0.33	1.46	1.33	1.15	0.75	1.20	20	70.00	5.00	1.20	29	4.000
10.00	14	131.00	0.66	0.00	0.66	1.21	1.33	1.15	0.85	1.20	26	70.00	5.00	1.20	36	4.000
15.00	22	131.00	0.98	0.00	0.98	1.03	1.33	1.15	0.85	1.20	35	74.20	5.00	1.20	47	4.000
20.00	21	132.00	1.31	0.00	1.31	0.90	1.33	1.15	0.95	1.20	33	15.00	2.50	1.05	37	4.000
25.00	47	132.00	1.64	0.04	1.60	0.81	1.33	1.15	0.95	1.20	66	8.70	0.47	1.02	68	4.000
30.00	65	130.00	1.97	0.20	1.77	0.77	1.33	1.15	1.00	1.20	91	8.70	0.47	1.02	93	4.000
35.00	26	130.00	2.29	0.35	1.94	0.73	1.33	1.15	1.00	1.20	35	5.30	0.01	1.00	35	4.000
40.00	65	136.00	2.63	0.51	2.12	0.69	1.33	1.15	1.00	1.20	82	5.30	0.01	1.00	82	4.000
45.00	8	136.00	2.97	0.66	2.31	0.65	1.33	1.15	1.00	1.20	10	5.30	0.01	1.00	10	4.000
50.00	21	131.00	3.30	0.82	2.48	0.62	1.33	1.15	1.00	1.20	24	5.30	0.01	1.00	24	4.000

Abbreviations

σ_v: Total stress during SPT test (tsf)
u_o: Water pore pressure during SPT test (tsf)
σ'_{vo}: Effective overburden pressure during SPT test (tsf)
C_N: Overburden corretion factor
C_E: Energy correction factor
C_B: Borehole diameter correction factor
C_R: Rod length correction factor
C_S: Liner correction factor
$N_{1(60)}$: Corrected N_{SPT} to a 60% energy ratio
α, β: Clean sand equivalent clean sand formula coefficients
$N_{1(60)cs}$: Corected $N_{1(60)}$ value for fines content
$CRR_{7.5}$: Cydic resistance ratio for M=7.5

:: Cyclic Stress Ratio calculation (CSR fully adjusted and normalized) ::

Depth (ft)	Unit Weight (pcf)	$\sigma_{v,eq}$ (tsf)	$u_{o,eq}$ (tsf)	$\sigma'_{vo,eq}$ (tsf)	r_d	α	CSR	MSF	$CSR_{eq,M=7.5}$	K_{sigma}	CSR^*	FS	
5.00	131.00	0.33	0.00	0.33	0.99	1.00	0.373	1.53	0.244	1.00	0.295	2.000	●
10.00	131.00	0.66	0.12	0.53	0.98	1.00	0.456	1.53	0.298	1.00	0.360	2.000	●

:: Cyclic Stress Ratio calculation (CSR fully adjusted and normalized) ::

Depth (ft)	Unit Weight (pcf)	$\sigma_{v,eq}$ (tsf)	$u_{o,eq}$ (tsf)	$\sigma'_{vo,eq}$ (tsf)	r_d	α	CSR	MSF	$CSR_{eq,M=7.5}$	K_{sigma}	CSR^*	FS	
15.00	131.00	0.98	0.28	0.70	0.97	1.00	0.511	1.53	0.334	1.00	0.404	2.000	●
20.00	132.00	1.31	0.44	0.88	0.96	1.00	0.541	1.53	0.353	1.00	0.427	2.000	●
25.00	132.00	1.64	0.59	1.05	0.94	1.00	0.556	1.53	0.363	1.00	0.439	2.000	●
30.00	130.00	1.97	0.75	1.22	0.92	1.00	0.560	1.53	0.366	0.97	0.456	2.000	●
35.00	130.00	2.29	0.90	1.39	0.89	1.00	0.555	1.53	0.362	0.95	0.463	2.000	●
40.00	136.00	2.63	1.06	1.57	0.85	1.00	0.537	1.53	0.351	0.92	0.460	2.000	●
45.00	136.00	2.97	1.22	1.76	0.80	1.00	0.513	1.53	0.335	0.90	0.449	2.000	●
50.00	131.00	3.30	1.37	1.93	0.75	1.00	0.486	1.53	0.317	0.89	0.433	2.000	●

Abbreviations

$\sigma_{v,eq}$: Total overburden pressure at test point, during earthquake (tsf)
$u_{o,eq}$: Water pressure at test point, during earthquake (tsf)
$\sigma'_{vo,eq}$: Effective overburden pressure, during earthquake (tsf)
r_d : Nonlinear shear mass factor
α: Improvement factor due to stone columns
CSR : Cyclic Stress Ratio (adjusted for improvement)
MSF : Magnitude Scaling Factor
$CSR_{eq,M=7.5}$: CSR adjusted for M=7.5
K_{sigma}: Effective overburden stress factor
CSR^*: CSR fully adjusted (user FS applied)***
FS: Calculated factor of safety against soil liquefaction

*** User FS: 1.10

:: Liquefaction potential according to Iwasaki ::

Depth (ft)	FS	F	wz	Thickness (ft)	I_L
5.00	2.000	0.00	9.24	5.00	0.00
10.00	2.000	0.00	8.48	5.00	0.00
15.00	2.000	0.00	7.71	5.00	0.00
20.00	2.000	0.00	6.95	5.00	0.00
25.00	2.000	0.00	6.19	5.00	0.00
30.00	2.000	0.00	5.43	5.00	0.00
35.00	2.000	0.00	4.67	5.00	0.00
40.00	2.000	0.00	3.90	5.00	0.00
45.00	2.000	0.00	3.14	5.00	0.00
50.00	2.000	0.00	2.38	5.00	0.00

Overall potential I_L : 0.00

I_L = 0.00 - No liquefaction
I_L between 0.00 and 5 - Liquefaction not probable
I_L between 5 and 15 - Liquefaction probable
I_L > 15 - Liquefaction certain

:: Vertical settlements estimation for dry sands ::

Depth (ft)	$(N_1)_{60}$	τ_{av}	p	G_{max} (tsf)	α	b	γ	ε_{15}	N_c	ε_{Nc} (%)	Δh (ft)	ΔS (in)
5.00	20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	5.00	0.000

:: Vertical settlements estimation for dry sands ::

Depth (ft)	$(N_1)_{60}$	τ_{av}	p	G_{max} (tsf)	α	b	γ	ε_{15}	N_c	ε_{Nc} (%)	Δh (ft)	ΔS (in)

Cumulative settlemetns: 0.000

Abbreviations

τ_{av}: Average cyclic shear stress
p: Average stress
G_{max}: Maximum shear modulus (tsf)
α, b: Shear strain formula variables
γ: Average shear strain
ε_{15}: Volumetric strain after 15 cycles
N_c: Number of cycles
ε_{Nc}: Volumetric strain for number of cycles N_c (%)
Δh: Thickness of soil layer (in)
ΔS: Settlement of soil layer (in)

:: Vertical settlements estimation for saturated sands ::

Depth (ft)	D_{50} (in)	q_c/N	e_v (%)	Δh (ft)	s (in)
10.00	0.00	5.00	0.00	5.00	0.000
15.00	0.00	5.00	0.00	5.00	0.000
20.00	0.00	5.00	0.00	5.00	0.000
25.00	0.00	5.00	0.00	5.00	0.000
30.00	0.00	5.00	0.00	5.00	0.000
35.00	0.00	5.00	0.00	5.00	0.000
40.00	0.00	5.00	0.00	5.00	0.000
45.00	0.00	5.00	0.00	5.00	0.000
50.00	0.00	5.00	0.00	5.00	0.000

Cumulative settlements: 0.000

Abbreviations

D_{50}: Median grain size (in)
q_c/N: Ratio of cone resistance to SPT
e_v: Post liquefaction volumetric strain (%)
Δh: Thickness of soil layer to be considered (ft)
s: Estimated settlement (in)

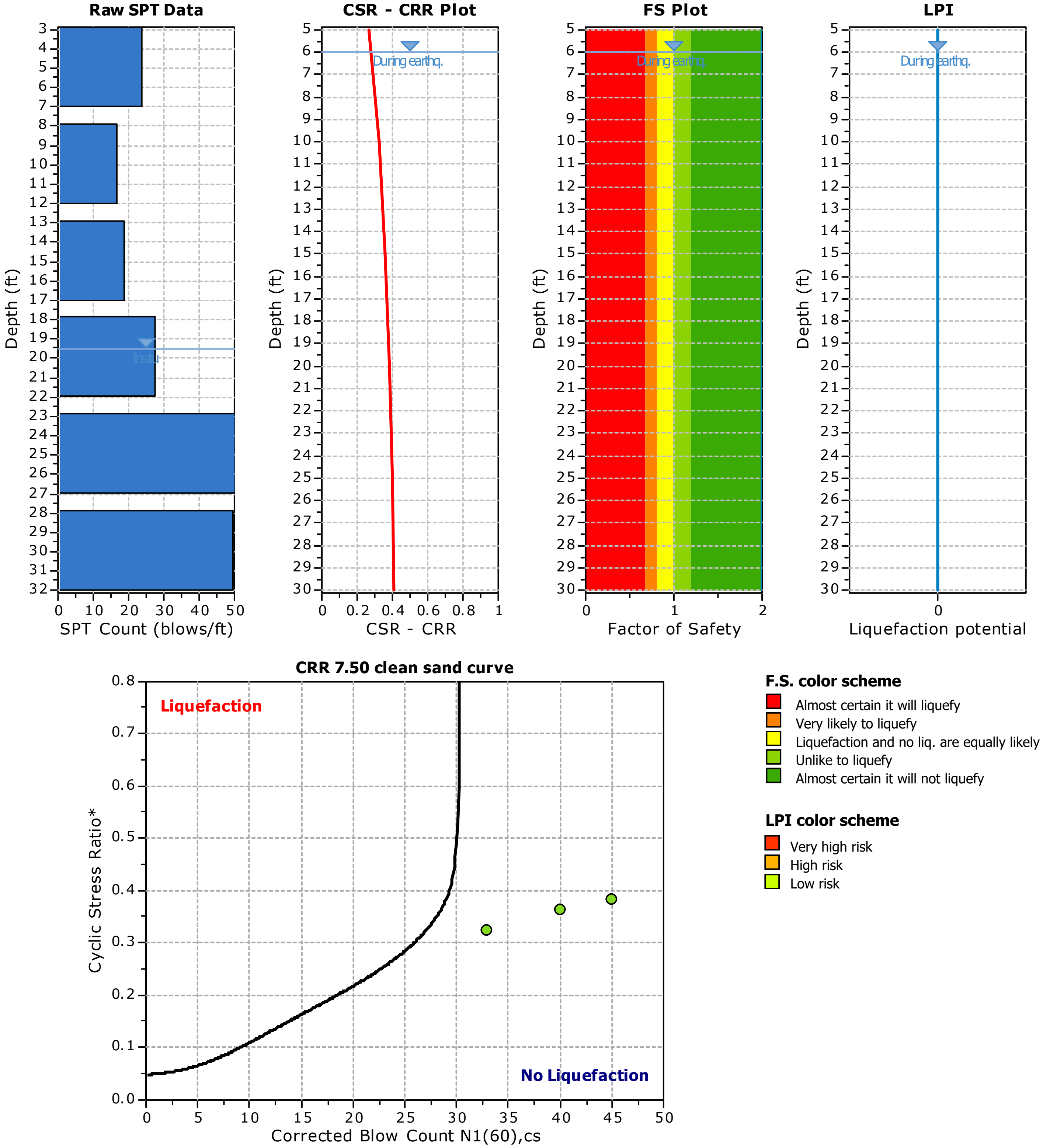
SPT BASED LIQUEFACTION ANALYSIS REPORT

Project title : Proposed Del Rey Avenue Building **SPT Name: B-3**

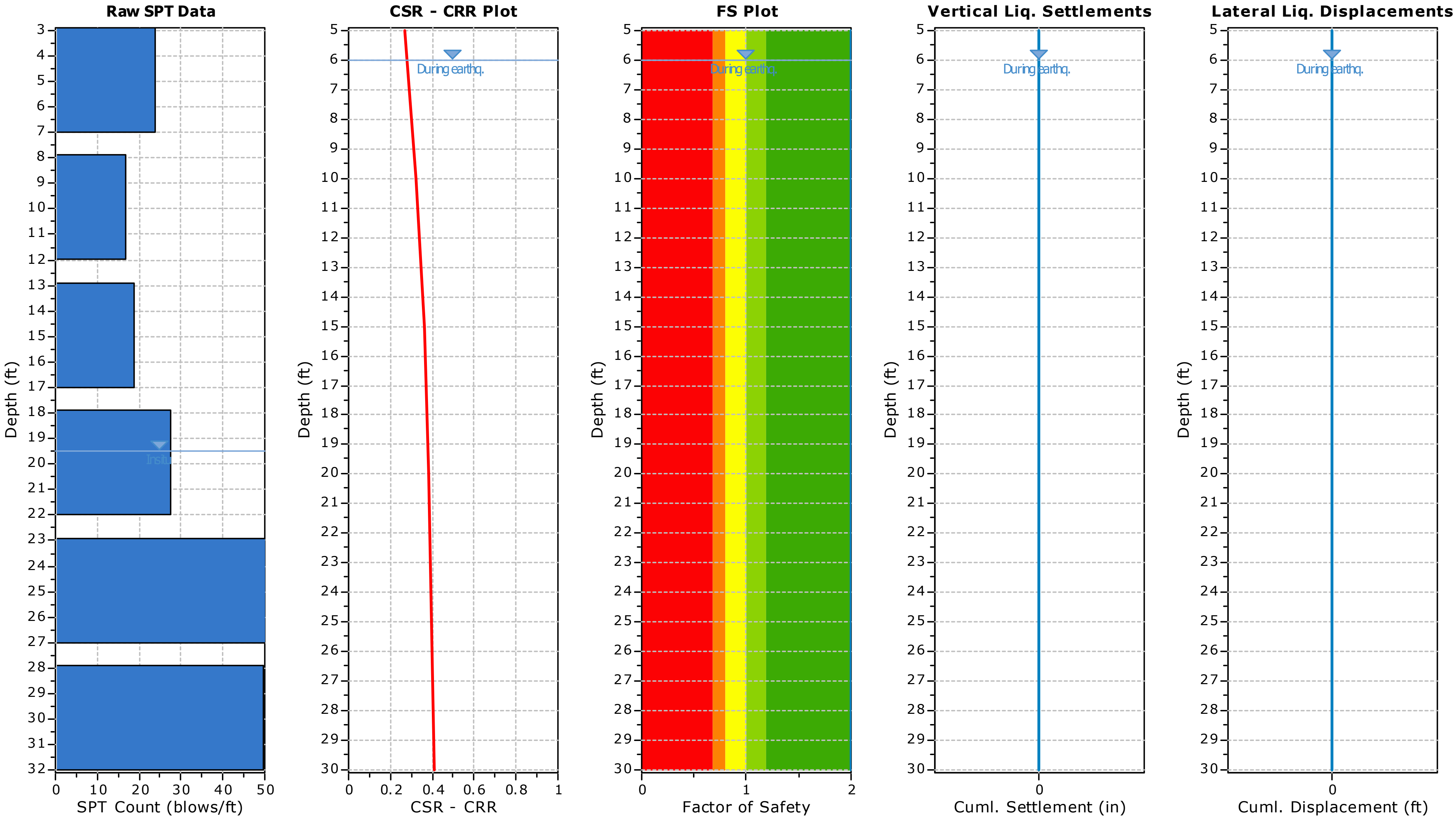
Location : 4112 Del Rey Ave, Marina Del Rey, CA

:: Input parameters and analysis properties ::

Analysis method:	NCEER 1998	G.W.T. (in-situ):	19.50 ft
Fines correction method:	NCEER 1998	G.W.T. (earthq.):	6.00 ft
Sampling method:	Sampler wo liners	Earthquake magnitude M_w:	6.35
Borehole diameter:	200mm	Peak ground acceleration:	0.58 g
Rod length:	3.30 ft	Eq. external load:	0.00 tsf
Hammer energy ratio:	1.30		



:: Overall Liquefaction Assessment Analysis Plots ::



:: Field input data ::

Test Depth (ft)	SPT Field Value (blows)	Fines Content (%)	Unit Weight (pcf)	Infl. Thickness (ft)	Can Liquefy
5.00	24	70.00	138.00	5.00	No
10.00	17	10.00	138.00	5.00	Yes
15.00	19	75.00	132.00	5.00	No
20.00	28	10.00	132.00	5.00	Yes
25.00	65	10.00	134.00	5.00	Yes
30.00	50	5.00	134.00	5.00	Yes

Abbreviations

Depth: Depth at which test was performed (ft)
SPT Field Value: Number of blows per foot
Fines Content: Fines content at test depth (%)
Unit Weight: Unit weight at test depth (pcf)
Infl. Thickness: Thickness of the soil layer to be considered in settlements analysis (ft)
Can Liquefy: User defined switch for excluding/including test depth from the analysis procedure

:: Cyclic Resistance Ratio (CRR) calculation data ::

Depth (ft)	SPT Field Value	Unit Weight (pcf)	σ_v (tsf)	u_o (tsf)	σ'_{vo} (tsf)	C_N	C_E	C_B	C_R	C_S	$(N_1)_{60}$	Fines Content (%)	α	β	$(N_1)_{60cs}$	$CRR_{7.5}$
5.00	24	138.00	0.34	0.00	0.34	1.44	1.30	1.15	0.75	1.20	47	70.00	5.00	1.20	61	4.000
10.00	17	138.00	0.69	0.00	0.69	1.19	1.30	1.15	0.85	1.20	31	10.00	0.87	1.02	33	4.000
15.00	19	132.00	1.02	0.00	1.02	1.02	1.30	1.15	0.85	1.20	29	75.00	5.00	1.20	40	4.000
20.00	28	132.00	1.35	0.02	1.33	0.89	1.30	1.15	0.95	1.20	43	10.00	0.87	1.02	45	4.000
25.00	65	134.00	1.69	0.17	1.51	0.84	1.30	1.15	0.95	1.20	93	10.00	0.87	1.02	96	4.000
30.00	50	134.00	2.02	0.33	1.69	0.79	1.30	1.15	1.00	1.20	70	5.00	0.00	1.00	70	4.000

Abbreviations

σ_v: Total stress during SPT test (tsf)
u_o: Water pore pressure during SPT test (tsf)
σ'_{vo}: Effective overburden pressure during SPT test (tsf)
C_N: Overburden corretion factor
C_E: Energy correction factor
C_B: Borehole diameter correction factor
C_R: Rod length correction factor
C_S: Liner correction factor
$N_{1(60)}$: Corrected N_{SPT} to a 60% energy ratio
α, β: Clean sand equivalent clean sand formula coefficients
$N_{1(60)cs}$: Corected $N_{1(60)}$ value for fines content
$CRR_{7.5}$: Cydic resistance ratio for M=7.5

:: Cyclic Stress Ratio calculation (CSR fully adjusted and normalized) ::

Depth (ft)	Unit Weight (pcf)	$\sigma_{v,eq}$ (tsf)	$u_{o,eq}$ (tsf)	$\sigma'_{vo,eq}$ (tsf)	r_d	α	CSR	MSF	$CSR_{eq,M=7.5}$	K_{sigma}	CSR^*	FS
5.00	138.00	0.34	0.00	0.34	0.99	1.00	0.373	1.53	0.244	1.00	0.295	2.000
10.00	138.00	0.69	0.12	0.57	0.98	1.00	0.451	1.53	0.294	1.00	0.356	2.000
15.00	132.00	1.02	0.28	0.74	0.97	1.00	0.504	1.53	0.329	1.00	0.398	2.000
20.00	132.00	1.35	0.44	0.91	0.96	1.00	0.533	1.53	0.348	1.00	0.422	2.000
25.00	134.00	1.69	0.59	1.09	0.94	1.00	0.548	1.53	0.358	0.99	0.436	2.000
30.00	134.00	2.02	0.75	1.27	0.92	1.00	0.551	1.53	0.360	0.96	0.452	2.000

:: Cyclic Stress Ratio calculation (CSR fully adjusted and normalized) ::

Depth (ft)	Unit Weight (pcf)	$\sigma_{v,eq}$ (tsf)	$u_{o,eq}$ (tsf)	$\sigma'_{vo,eq}$ (tsf)	r_d	α	CSR	MSF	$CSR_{eq,M=7.5}$	K_{sigma}	CSR^*	FS

Abbreviations

$\sigma_{v,eq}$: Total overburden pressure at test point, during earthquake (tsf)
$u_{o,eq}$: Water pressure at test point, during earthquake (tsf)
$\sigma'_{vo,eq}$: Effective overburden pressure, during earthquake (tsf)
r_d : Nonlinear shear mass factor
α: Improvement factor due to stone columns
CSR : Cyclic Stress Ratio (adjusted for improvement)
MSF : Magnitude Scaling Factor
$CSR_{eq,M=7.5}$: CSR adjusted for M=7.5
K_{sigma}: Effective overburden stress factor
CSR^*: CSR fully adjusted (user FS applied)***
FS: Calculated factor of safety against soil liquefaction

*** User FS: 1.10

:: Liquefaction potential according to Iwasaki ::

Depth (ft)	FS	F	wz	Thickness (ft)	I_L
5.00	2.000	0.00	9.24	5.00	0.00
10.00	2.000	0.00	8.48	5.00	0.00
15.00	2.000	0.00	7.71	5.00	0.00
20.00	2.000	0.00	6.95	5.00	0.00
25.00	2.000	0.00	6.19	5.00	0.00
30.00	2.000	0.00	5.43	5.00	0.00

Overall potential I_L : 0.00

I_L = 0.00 - No liquefaction
I_L between 0.00 and 5 - Liquefaction not probable
I_L between 5 and 15 - Liquefaction probable
I_L > 15 - Liquefaction certain

:: Vertical settlements estimation for dry sands ::

Depth (ft)	$(N_1)_{60}$	τ_{av}	p	G_{max} (tsf)	α	b	γ	ε_{15}	N_c	ε_{Nc} (%)	Δh (ft)	ΔS (in)
5.00	47	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	5.00	0.000

Cumulative settlemetns: 0.000

Abbreviations

τ_{av}: Average cyclic shear stress
p: Average stress
G_{max}: Maximum shear modulus (tsf)
α, b: Shear strain formula variables
γ: Average shear strain
ε_{15}: Volumetric strain after 15 cycles
N_c: Number of cycles
ε_{Nc}: Volumetric strain for number of cycles N_c (%)
Δh: Thickness of soil layer (in)
ΔS: Settlement of soil layer (in)

:: Vertical settlements estimation for saturated sands ::

Depth (ft)	D_{50} (in)	q_c/N	e_v (%)	Δh (ft)	s (in)
10.00	0.00	5.00	0.00	5.00	0.000

:: Vertical settlements estimation for saturated sands ::

Depth (ft)	D_{50} (in)	q_c/N	e_v (%)	Δh (ft)	s (in)
15.00	0.00	5.00	0.00	5.00	0.000
20.00	0.00	5.00	0.00	5.00	0.000
25.00	0.00	5.00	0.00	5.00	0.000
30.00	0.00	5.00	0.00	5.00	0.000

Cumulative settlements: 0.000

Abbreviations

D_{50}: Median grain size (in)
q_c/N: Ratio of cone resistance to SPT
e_v: Post liquefaction volumetric strain (%)
Δh: Thickness of soil layer to be considered (ft)
s: Estimated settlement (in)

Twining Consulting

TWINING

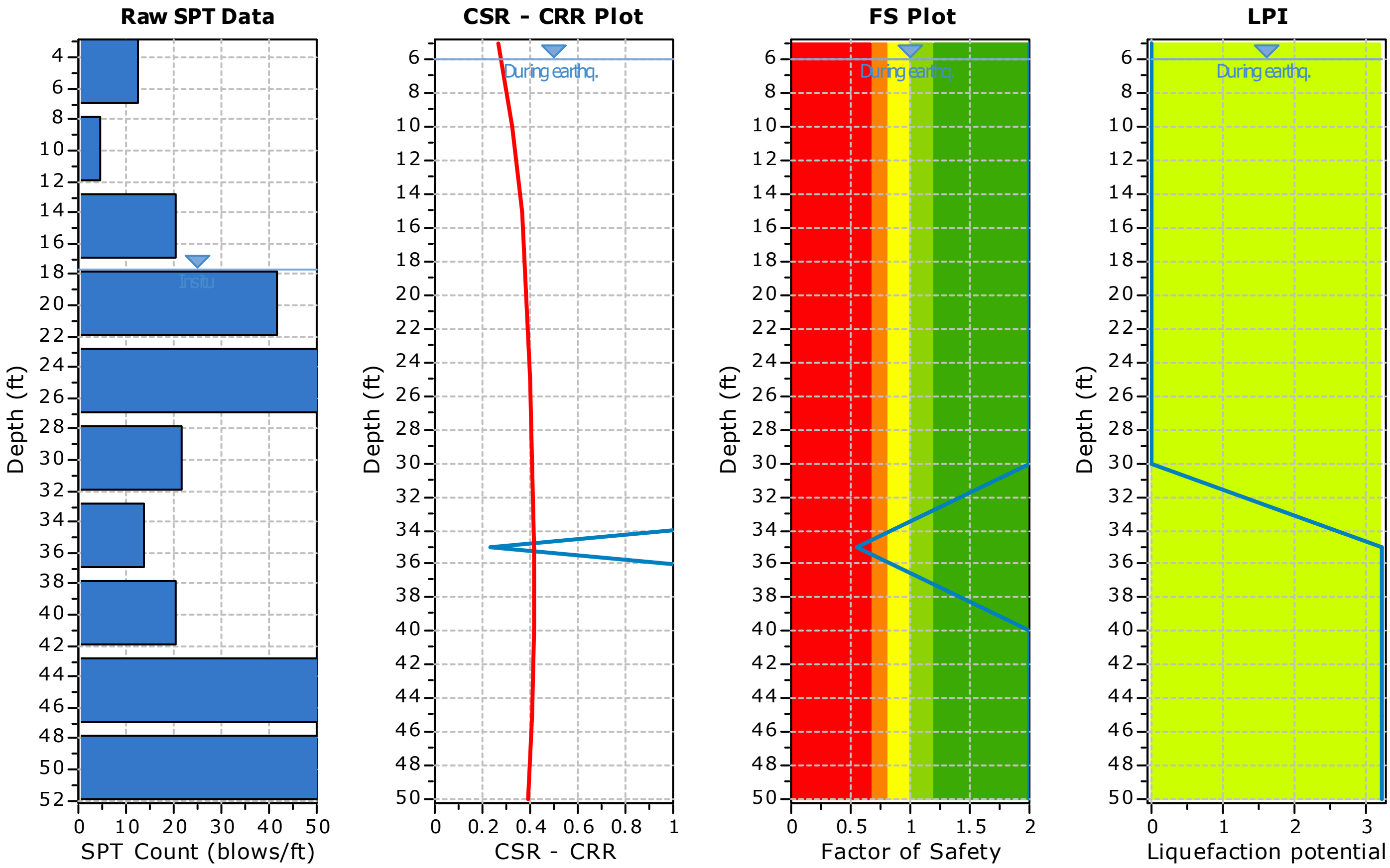
SPT BASED LIQUEFACTION ANALYSIS REPORT

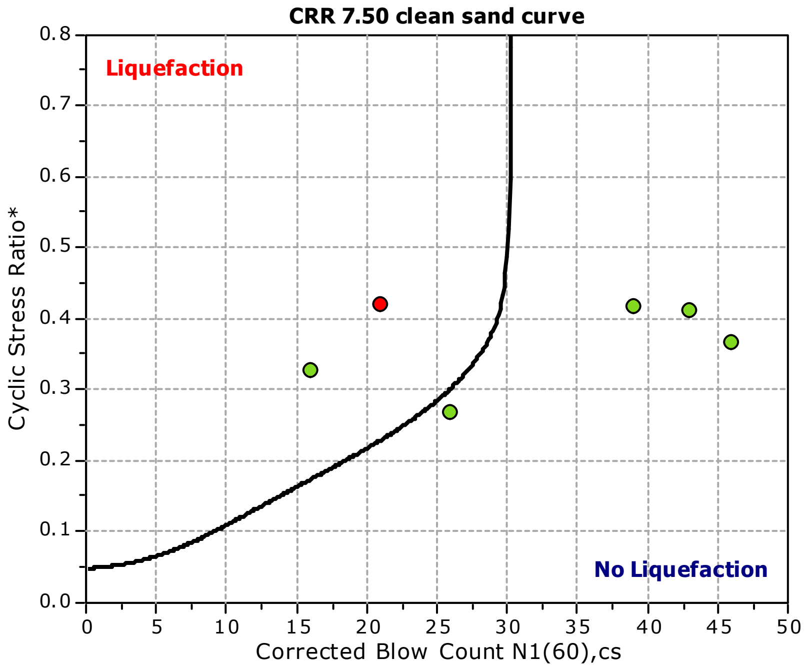
Project title : Proposed Del Rey Avenue Building **SPT Name: B-4**

Location : 4112 Del Rey Ave, Marina Del Rey, CA

:: Input parameters and analysis properties ::

Analysis method:	NCEER 1998	G.W.T. (in-situ):	17.75 ft
Fines correction method:	NCEER 1998	G.W.T. (earthq.):	6.00 ft
Sampling method:	Sampler wo liners	Earthquake magnitude M_w:	6.35
Borehole diameter:	200mm	Peak ground acceleration:	0.58 g
Rod length:	3.30 ft	Eq. external load:	0.00 tsf
Hammer energy ratio:	1.33		





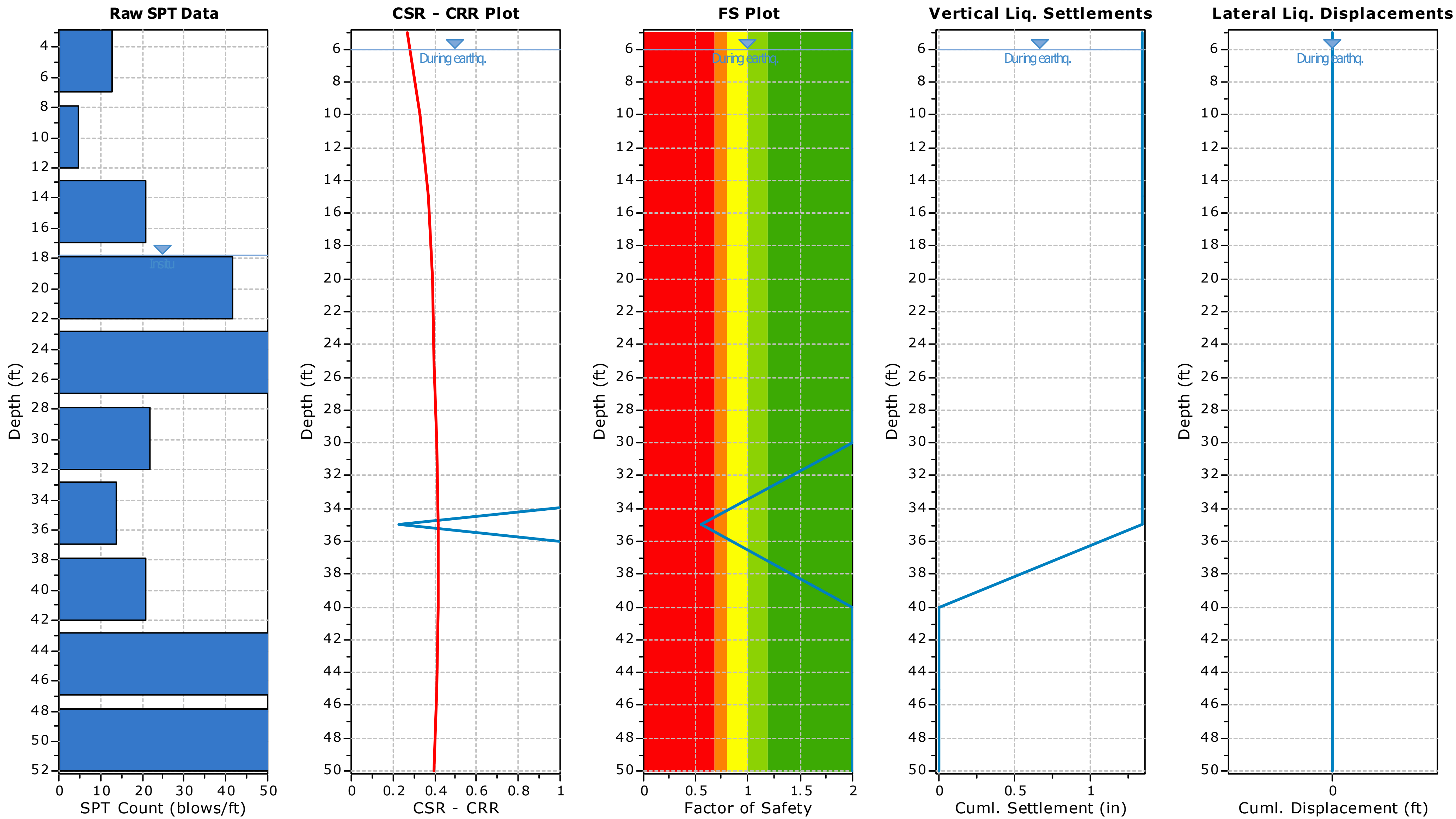
F.S. color scheme

- Almost certain it will liquefy
- Very likely to liquefy
- Liquefaction and no liq. are equally likely
- Unlike to liquefy
- Almost certain it will not liquefy

LPI color scheme

- Very high risk
- High risk
- Low risk

:: Overall Liquefaction Assessment Analysis Plots ::



:: Field input data ::

Test Depth (ft)	SPT Field Value (blows)	Fines Content (%)	Unit Weight (pcf)	Infl. Thickness (ft)	Can Liquefy
5.00	13	0.00	131.00	5.00	No
10.00	5	79.80	131.00	5.00	No
15.00	21	79.80	134.00	5.00	No
20.00	42	8.90	134.00	5.00	Yes
25.00	65	8.90	138.00	5.00	Yes
30.00	22	51.70	138.00	5.00	No
35.00	14	10.00	126.00	5.00	Yes
40.00	21	46.30	126.00	5.00	Yes
45.00	65	46.30	131.00	5.00	Yes
50.00	56	10.00	131.00	5.00	Yes

Abbreviations

Depth: Depth at which test was performed (ft)
SPT Field Value: Number of blows per foot
Fines Content: Fines content at test depth (%)
Unit Weight: Unit weight at test depth (pcf)
Infl. Thickness: Thickness of the soil layer to be considered in settlements analysis (ft)
Can Liquefy: User defined switch for excluding/including test depth from the analysis procedure

:: Cyclic Resistance Ratio (CRR) calculation data ::

Depth (ft)	SPT Field Value	Unit Weight (pcf)	σ_v (tsf)	u_o (tsf)	σ'_{vo} (tsf)	C_N	C_E	C_B	C_R	C_S	$(N_1)_{60}$	Fines Content (%)	α	β	$(N_1)_{60cs}$	$CRR_{7.5}$
5.00	13	131.00	0.33	0.00	0.33	1.46	1.33	1.15	0.75	1.20	26	0.00	0.00	1.00	26	4.000
10.00	5	131.00	0.66	0.00	0.66	1.21	1.33	1.15	0.85	1.20	9	79.80	5.00	1.20	16	4.000
15.00	21	134.00	0.99	0.00	0.99	1.03	1.33	1.15	0.85	1.20	34	79.80	5.00	1.20	46	4.000
20.00	42	134.00	1.32	0.07	1.25	0.92	1.33	1.15	0.95	1.20	68	8.90	0.53	1.02	70	4.000
25.00	65	138.00	1.67	0.23	1.44	0.86	1.33	1.15	0.95	1.20	97	8.90	0.53	1.02	99	4.000
30.00	22	138.00	2.02	0.38	1.63	0.80	1.33	1.15	1.00	1.20	32	51.70	5.00	1.20	43	4.000
35.00	14	126.00	2.33	0.54	1.79	0.76	1.33	1.15	1.00	1.20	20	10.00	0.87	1.02	21	0.229
40.00	21	126.00	2.65	0.69	1.95	0.72	1.33	1.15	1.00	1.20	28	46.30	5.00	1.20	39	4.000
45.00	65	131.00	2.97	0.85	2.12	0.69	1.33	1.15	1.00	1.20	82	46.30	5.00	1.20	103	4.000
50.00	56	131.00	3.30	1.01	2.29	0.65	1.33	1.15	1.00	1.20	67	10.00	0.87	1.02	69	4.000

Abbreviations

σ_v: Total stress during SPT test (tsf)
u_o: Water pore pressure during SPT test (tsf)
σ'_{vo}: Effective overburden pressure during SPT test (tsf)
C_N: Overburden corretion factor
C_E: Energy correction factor
C_B: Borehole diameter correction factor
C_R: Rod length correction factor
C_S: Liner correction factor
$N_{1(60)}$: Corrected N_{SPT} to a 60% energy ratio
α, β: Clean sand equivalent clean sand formula coefficients
$N_{1(60)cs}$: Corected $N_{1(60)}$ value for fines content
$CRR_{7.5}$: Cydic resistance ratio for M=7.5

:: Cyclic Stress Ratio calculation (CSR fully adjusted and normalized) ::

Depth (ft)	Unit Weight (pcf)	$\sigma_{v,eq}$ (tsf)	$u_{o,eq}$ (tsf)	$\sigma'_{vo,eq}$ (tsf)	r_d	α	CSR	MSF	$CSR_{eq,M=7.5}$	K_{sigma}	CSR^*	FS	
5.00	131.00	0.33	0.00	0.33	0.99	1.00	0.373	1.53	0.244	1.00	0.295	2.000	●
10.00	131.00	0.66	0.12	0.53	0.98	1.00	0.456	1.53	0.298	1.00	0.360	2.000	●

:: Cyclic Stress Ratio calculation (CSR fully adjusted and normalized) ::

Depth (ft)	Unit Weight (pcf)	$\sigma_{v,eq}$ (tsf)	$u_{o,eq}$ (tsf)	$\sigma'_{vo,eq}$ (tsf)	r_d	α	CSR	MSF	$CSR_{eq,M=7.5}$	K_{sigma}	CSR^*	FS
15.00	134.00	0.99	0.28	0.71	0.97	1.00	0.510	1.53	0.333	1.00	0.403	2.000
20.00	134.00	1.32	0.44	0.89	0.96	1.00	0.538	1.53	0.352	1.00	0.425	2.000
25.00	138.00	1.67	0.59	1.08	0.94	1.00	0.550	1.53	0.360	1.00	0.437	2.000
30.00	138.00	2.02	0.75	1.27	0.92	1.00	0.552	1.53	0.361	0.96	0.453	2.000
35.00	126.00	2.33	0.90	1.43	0.89	1.00	0.549	1.53	0.359	0.94	0.461	0.548
40.00	126.00	2.65	1.06	1.58	0.85	1.00	0.536	1.53	0.350	0.92	0.459	2.000
45.00	131.00	2.97	1.22	1.76	0.80	1.00	0.513	1.53	0.335	0.90	0.449	2.000
50.00	131.00	3.30	1.37	1.93	0.75	1.00	0.486	1.53	0.317	0.89	0.433	2.000

Abbreviations

$\sigma_{v,eq}$:	Total overburden pressure at test point, during earthquake (tsf)
$u_{o,eq}$:	Water pressure at test point, during earthquake (tsf)
$\sigma'_{vo,eq}$:	Effective overburden pressure, during earthquake (tsf)
r_d :	Nonlinear shear mass factor
α:	Improvement factor due to stone columns
CSR :	Cyclic Stress Ratio (adjusted for improvement)
MSF :	Magnitude Scaling Factor
$CSR_{eq,M=7.5}$:	CSR adjusted for M=7.5
K_{sigma}:	Effective overburden stress factor
CSR^*:	CSR fully adjusted (user FS applied)***
FS:	Calculated factor of safety against soil liquefaction

*** User FS: 1.10

:: Liquefaction potential according to Iwasaki ::

Depth (ft)	FS	F	wz	Thickness (ft)	I_L
5.00	2.000	0.00	9.24	5.00	0.00
10.00	2.000	0.00	8.48	5.00	0.00
15.00	2.000	0.00	7.71	5.00	0.00
20.00	2.000	0.00	6.95	5.00	0.00
25.00	2.000	0.00	6.19	5.00	0.00
30.00	2.000	0.00	5.43	5.00	0.00
35.00	0.548	0.45	4.67	5.00	3.21
40.00	2.000	0.00	3.90	5.00	0.00
45.00	2.000	0.00	3.14	5.00	0.00
50.00	2.000	0.00	2.38	5.00	0.00

Overall potential I_L : 3.21

I_L = 0.00 - No liquefaction
I_L between 0.00 and 5 - Liquefaction not probable
I_L between 5 and 15 - Liquefaction probable
I_L > 15 - Liquefaction certain

:: Vertical settlements estimation for dry sands ::

Depth (ft)	$(N_1)_{60}$	τ_{av}	p	G_{max} (tsf)	α	b	γ	ε_{15}	N_c	ε_{Nc} (%)	Δh (ft)	ΔS (in)
5.00	26	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	5.00	0.000

:: Vertical settlements estimation for dry sands ::

Depth (ft)	$(N_1)_{60}$	τ_{av}	p	G_{max} (tsf)	α	b	γ	ε_{15}	N_c	ε_{Nc} (%)	Δh (ft)	ΔS (in)

Cumulative settlemetns: 0.000

Abbreviations

τ_{av}: Average cyclic shear stress
p: Average stress
G_{max}: Maximum shear modulus (tsf)
α, b: Shear strain formula variables
γ: Average shear strain
ε_{15}: Volumetric strain after 15 cycles
N_c: Number of cycles
ε_{Nc}: Volumetric strain for number of cycles N_c (%)
Δh: Thickness of soil layer (in)
ΔS: Settlement of soil layer (in)

:: Vertical settlements estimation for saturated sands ::

Depth (ft)	D_{50} (in)	q_c/N	e_v (%)	Δh (ft)	s (in)
10.00	0.00	5.00	0.00	5.00	0.000
15.00	0.00	5.00	0.00	5.00	0.000
20.00	0.00	5.00	0.00	5.00	0.000
25.00	0.00	5.00	0.00	5.00	0.000
30.00	0.00	5.00	0.00	5.00	0.000
35.00	0.00	5.00	2.25	5.00	1.347
40.00	0.00	5.00	0.00	5.00	0.000
45.00	0.00	5.00	0.00	5.00	0.000
50.00	0.00	5.00	0.00	5.00	0.000

Cumulative settlements: 1.347

Abbreviations

D_{50}: Median grain size (in)
q_c/N: Ratio of cone resistance to SPT
e_v: Post liquefaction volumetric strain (%)
Δh: Thickness of soil layer to be considered (ft)
s: Estimated settlement (in)

Twining Consulting

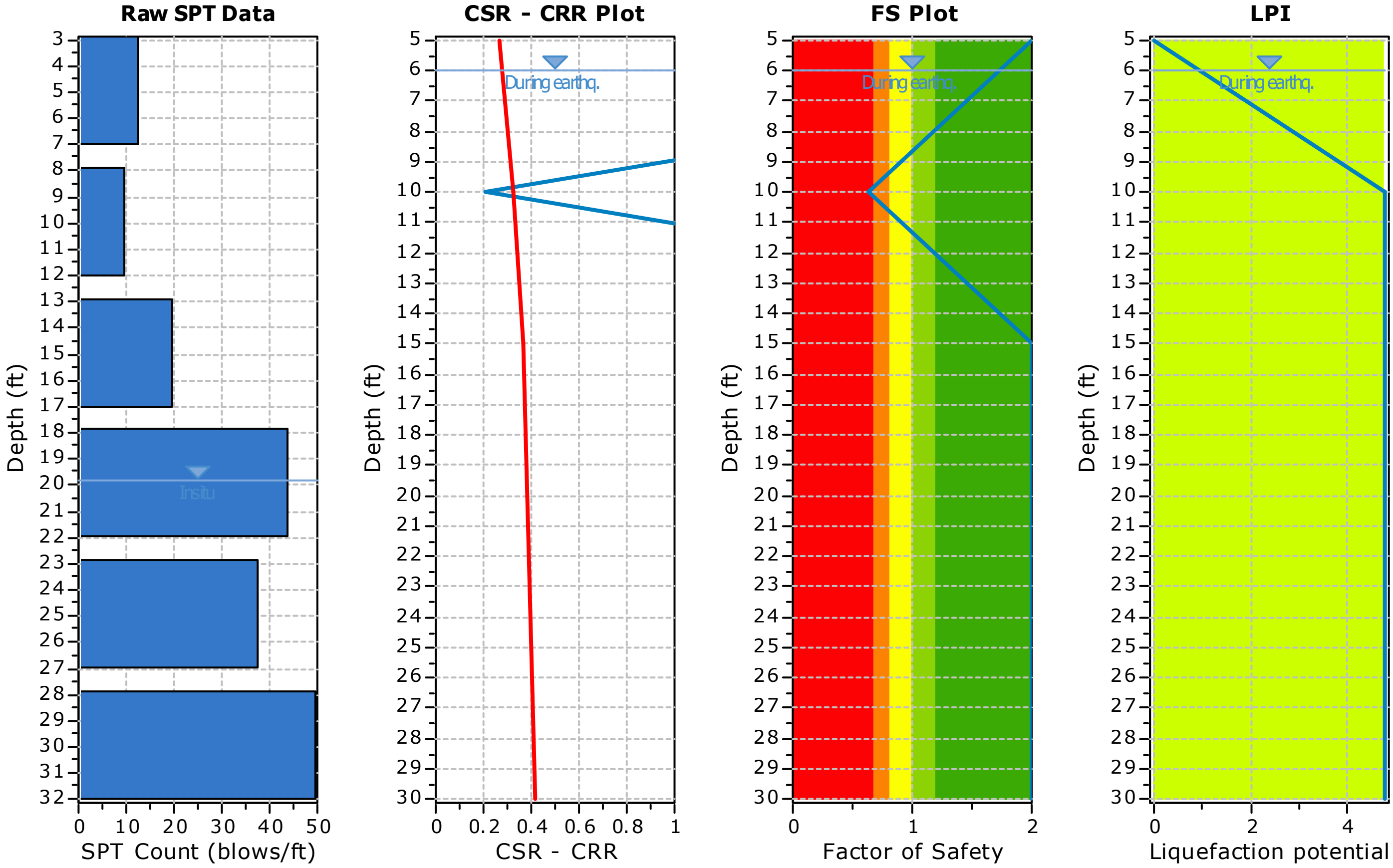
SPT BASED LIQUEFACTION ANALYSIS REPORT

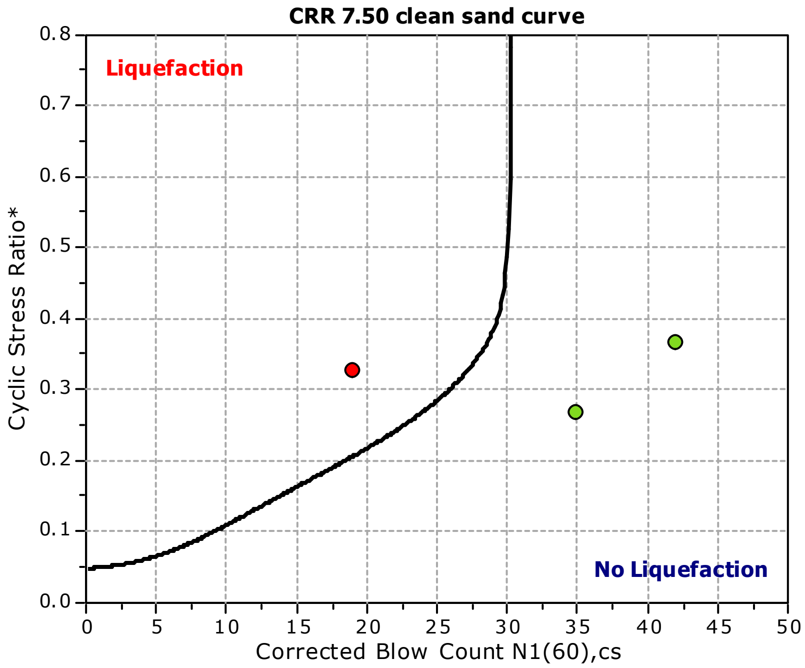
Project title : Proposed Del Rey Avenue Building **SPT Name: B-5**

Location : 4112 Del Rey Ave, Marina Del Rey, CA

:: Input parameters and analysis properties ::

Analysis method:	NCEER 1998	G.W.T. (in-situ):	19.80 ft
Fines correction method:	NCEER 1998	G.W.T. (earthq.):	6.00 ft
Sampling method:	Sampler wo liners	Earthquake magnitude M_w:	6.35
Borehole diameter:	200mm	Peak ground acceleration:	0.58 g
Rod length:	3.30 ft	Eq. external load:	0.00 tsf
Hammer energy ratio:	1.30		





F.S. color scheme

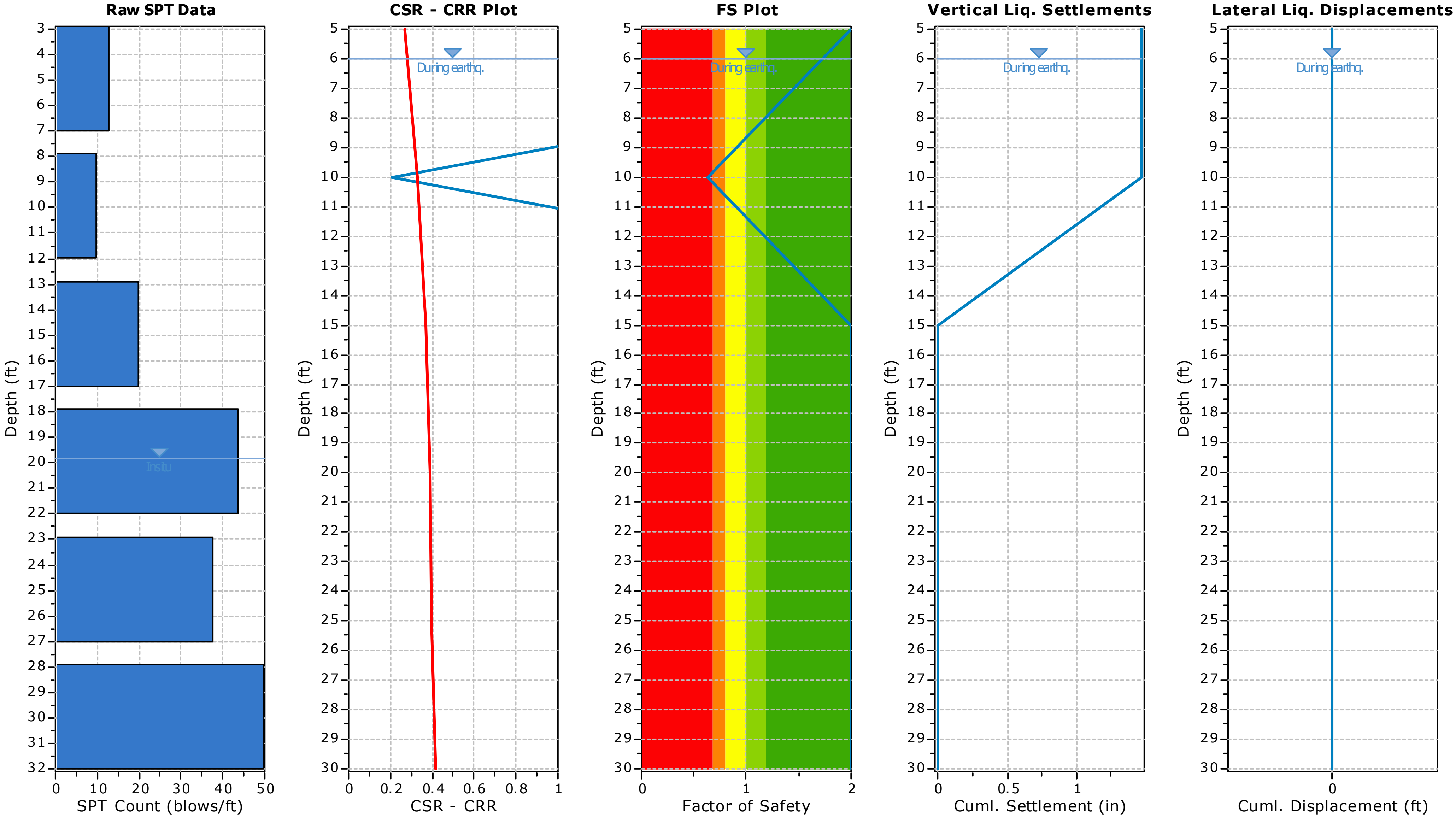
- Almost certain it will liquefy
- Very likely to liquefy
- Liquefaction and no liq. are equally likely
- Unlike to liquefy
- Almost certain it will not liquefy

LPI color scheme

- Very high risk
- High risk
- Low risk

Project File: \\TC-FS-01\Qai_Shares\COMPANY\PROJECTS\2022 TWINING CONSULTING PROJECTS\220205.1 - 4112 Del Rey Ave\Geotech Report\Appendix C - Liquefaction Ana

:: Overall Liquefaction Assessment Analysis Plots ::



:: Field input data ::

Test Depth (ft)	SPT Field Value (blows)	Fines Content (%)	Unit Weight (pcf)	Infl. Thickness (ft)	Can Liquefy
5.00	13	70.00	132.00	5.00	No
10.00	10	10.00	132.00	5.00	Yes
15.00	20	75.00	132.00	5.00	No
20.00	44	10.00	132.00	5.00	Yes
25.00	38	5.00	132.00	5.00	Yes
30.00	50	5.00	132.00	5.00	Yes

Abbreviations

Depth: Depth at which test was performed (ft)
SPT Field Value: Number of blows per foot
Fines Content: Fines content at test depth (%)
Unit Weight: Unit weight at test depth (pcf)
Infl. Thickness: Thickness of the soil layer to be considered in settlements analysis (ft)
Can Liquefy: User defined switch for excluding/including test depth from the analysis procedure

:: Cyclic Resistance Ratio (CRR) calculation data ::

Depth (ft)	SPT Field Value	Unit Weight (pcf)	σ_v (tsf)	u_o (tsf)	σ'_{vo} (tsf)	C_N	C_E	C_B	C_R	C_S	$(N_1)_{60}$	Fines Content (%)	α	β	$(N_1)_{60cs}$	$CRR_{7.5}$
5.00	13	132.00	0.33	0.00	0.33	1.46	1.30	1.15	0.75	1.20	25	70.00	5.00	1.20	35	4.000
10.00	10	132.00	0.66	0.00	0.66	1.21	1.30	1.15	0.85	1.20	18	10.00	0.87	1.02	19	0.206
15.00	20	132.00	0.99	0.00	0.99	1.03	1.30	1.15	0.85	1.20	31	75.00	5.00	1.20	42	4.000
20.00	44	132.00	1.32	0.01	1.31	0.90	1.30	1.15	0.95	1.20	68	10.00	0.87	1.02	70	4.000
25.00	38	132.00	1.65	0.16	1.49	0.84	1.30	1.15	0.95	1.20	55	5.00	0.00	1.00	55	4.000
30.00	50	132.00	1.98	0.32	1.66	0.79	1.30	1.15	1.00	1.20	71	5.00	0.00	1.00	71	4.000

Abbreviations

σ_v: Total stress during SPT test (tsf)
u_o: Water pore pressure during SPT test (tsf)
σ'_{vo}: Effective overburden pressure during SPT test (tsf)
C_N: Overburden corretion factor
C_E: Energy correction factor
C_B: Borehole diameter correction factor
C_R: Rod length correction factor
C_S: Liner correction factor
$N_{1(60)}$: Corrected N_{SPT} to a 60% energy ratio
α, β: Clean sand equivalent clean sand formula coefficients
$N_{1(60)cs}$: Corected $N_{1(60)}$ value for fines content
$CRR_{7.5}$: Cydic resistance ratio for M=7.5

:: Cyclic Stress Ratio calculation (CSR fully adjusted and normalized) ::

Depth (ft)	Unit Weight (pcf)	$\sigma_{v,eq}$ (tsf)	$u_{o,eq}$ (tsf)	$\sigma'_{vo,eq}$ (tsf)	r_d	α	CSR	MSF	$CSR_{eq,M=7.5}$	K_{sigma}	CSR^*	FS	
5.00	132.00	0.33	0.00	0.33	0.99	1.00	0.373	1.53	0.244	1.00	0.295	2.000	●
10.00	132.00	0.66	0.12	0.54	0.98	1.00	0.455	1.53	0.297	1.00	0.360	0.631	●
15.00	132.00	0.99	0.28	0.71	0.97	1.00	0.510	1.53	0.333	1.00	0.403	2.000	●
20.00	132.00	1.32	0.44	0.88	0.96	1.00	0.539	1.53	0.352	1.00	0.426	2.000	●
25.00	132.00	1.65	0.59	1.06	0.94	1.00	0.554	1.53	0.362	1.00	0.438	2.000	●
30.00	132.00	1.98	0.75	1.23	0.92	1.00	0.558	1.53	0.365	0.97	0.455	2.000	●

:: Cyclic Stress Ratio calculation (CSR fully adjusted and normalized) ::

Depth (ft)	Unit Weight (pcf)	$\sigma_{v,eq}$ (tsf)	$u_{o,eq}$ (tsf)	$\sigma'_{vo,eq}$ (tsf)	r_d	α	CSR	MSF	$CSR_{eq,M=7.5}$	K_{sigma}	CSR^*	FS

Abbreviations

$\sigma_{v,eq}$: Total overburden pressure at test point, during earthquake (tsf)
$u_{o,eq}$: Water pressure at test point, during earthquake (tsf)
$\sigma'_{vo,eq}$: Effective overburden pressure, during earthquake (tsf)
r_d : Nonlinear shear mass factor
α: Improvement factor due to stone columns
CSR : Cyclic Stress Ratio (adjusted for improvement)
MSF : Magnitude Scaling Factor
$CSR_{eq,M=7.5}$: CSR adjusted for M=7.5
K_{sigma}: Effective overburden stress factor
CSR^*: CSR fully adjusted (user FS applied)***
FS: Calculated factor of safety against soil liquefaction

*** User FS: 1.10

:: Liquefaction potential according to Iwasaki ::

Depth (ft)	FS	F	wz	Thickness (ft)	I_L
5.00	2.000	0.00	9.24	5.00	0.00
10.00	0.631	0.37	8.48	5.00	4.77
15.00	2.000	0.00	7.71	5.00	0.00
20.00	2.000	0.00	6.95	5.00	0.00
25.00	2.000	0.00	6.19	5.00	0.00
30.00	2.000	0.00	5.43	5.00	0.00

Overall potential I_L : 4.77

I_L = 0.00 - No liquefaction
I_L between 0.00 and 5 - Liquefaction not probable
I_L between 5 and 15 - Liquefaction probable
I_L > 15 - Liquefaction certain

:: Vertical settlements estimation for dry sands ::

Depth (ft)	$(N_1)_{60}$	τ_{av}	p	G_{max} (tsf)	α	b	γ	ε_{15}	N_c	ε_{Nc} (%)	Δh (ft)	ΔS (in)
5.00	25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	5.00	0.000

Cumulative settlemetns: 0.000

Abbreviations

τ_{av}: Average cyclic shear stress
p: Average stress
G_{max}: Maximum shear modulus (tsf)
α, b: Shear strain formula variables
γ: Average shear strain
ε_{15}: Volumetric strain after 15 cycles
N_c: Number of cycles
ε_{Nc}: Volumetric strain for number of cycles N_c (%)
Δh: Thickness of soil layer (in)
ΔS: Settlement of soil layer (in)

:: Vertical settlements estimation for saturated sands ::

Depth (ft)	D_{50} (in)	q_c/N	e_v (%)	Δh (ft)	s (in)
10.00	0.00	5.00	2.44	5.00	1.462

:: Vertical settlements estimation for saturated sands ::

Depth (ft)	D_{50} (in)	q_c/N	e_v (%)	Δh (ft)	s (in)
15.00	0.00	5.00	0.00	5.00	0.000
20.00	0.00	5.00	0.00	5.00	0.000
25.00	0.00	5.00	0.00	5.00	0.000
30.00	0.00	5.00	0.00	5.00	0.000

Cumulative settlements: 1.462

Abbreviations

D_{50}: Median grain size (in)
q_c/N: Ratio of cone resistance to SPT
e_v: Post liquefaction volumetric strain (%)
Δh: Thickness of soil layer to be considered (ft)
s: Estimated settlement (in)

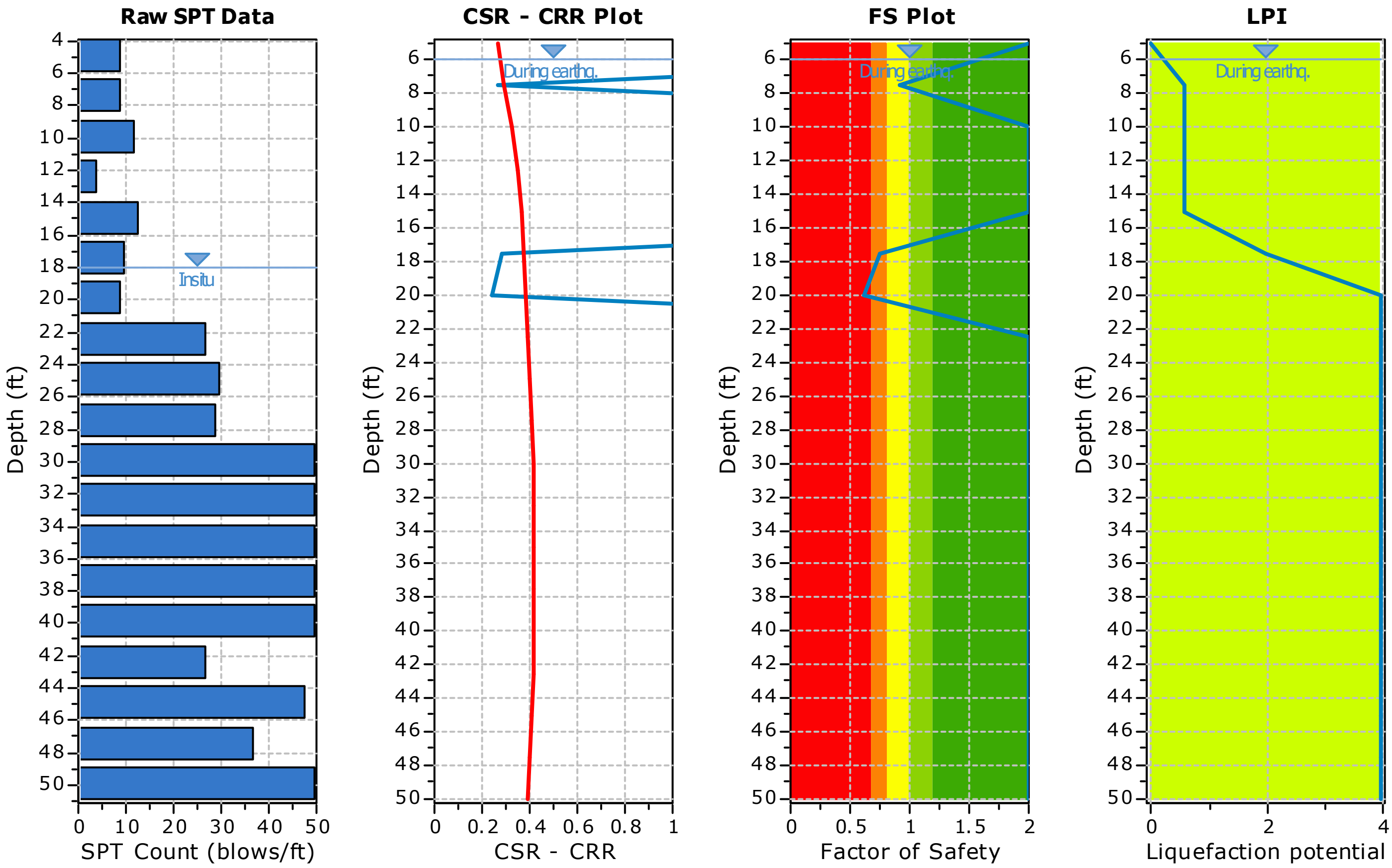
SPT BASED LIQUEFACTION ANALYSIS REPORT

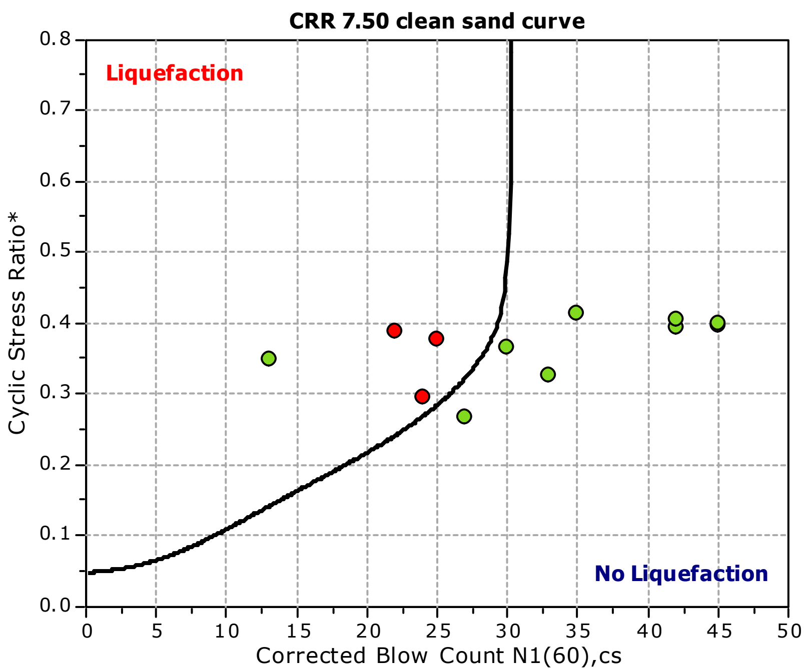
Project title : Proposed Del Rey Avenue Building **SPT Name: IGI B1**

Location : 4112 Del Rey Ave, Marina Del Rey, CA

:: Input parameters and analysis properties ::

Analysis method:	NCEER 1998	G.W.T. (in-situ):	18.00 ft
Fines correction method:	NCEER 1998	G.W.T. (earthq.):	6.00 ft
Sampling method:	Sampler wo liners	Earthquake magnitude M_w:	6.35
Borehole diameter:	200mm	Peak ground acceleration:	0.58 g
Rod length:	3.30 ft	Eq. external load:	0.00 tsf
Hammer energy ratio:	1.33		





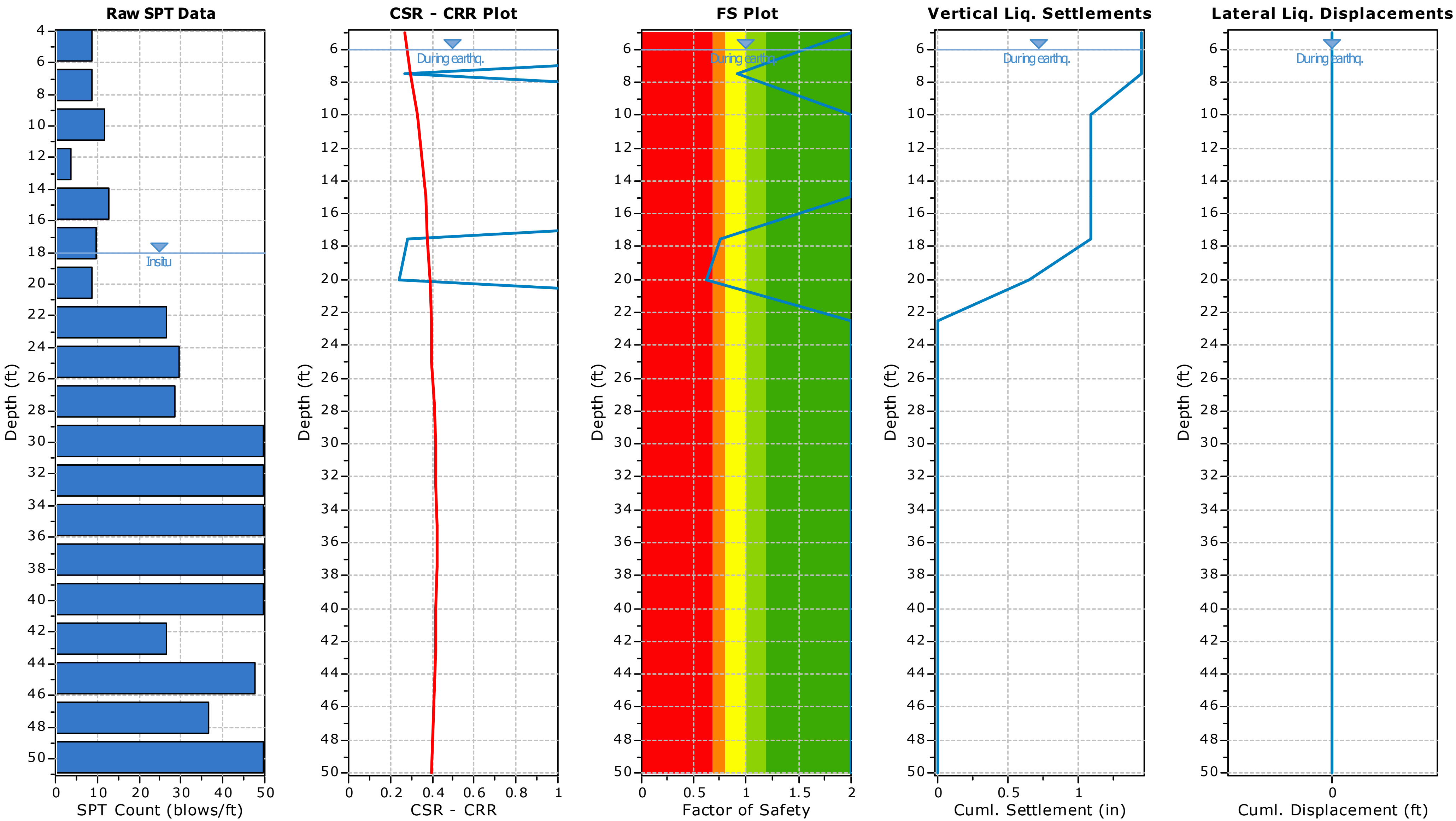
F.S. color scheme

- Almost certain it will liquefy
- Very likely to liquefy
- Liquefaction and no liq. are equally likely
- Unlike to liquefy
- Almost certain it will not liquefy

LPI color scheme

- Very high risk
- High risk
- Low risk

:: Overall Liquefaction Assessment Analysis Plots ::



:: Field input data ::

Test Depth (ft)	SPT Field Value (blows)	Fines Content (%)	Unit Weight (pcf)	Infl. Thickness (ft)	Can Liquefy
5.00	9	70.00	132.00	2.50	No
7.50	9	47.80	132.00	2.50	Yes
10.00	12	55.00	132.00	2.50	Yes
12.50	4	70.00	132.00	2.50	No
15.00	13	70.00	132.00	2.50	No
17.50	10	33.20	132.00	2.50	Yes
20.00	9	34.40	132.00	2.50	Yes
22.50	27	1.00	132.00	2.50	Yes
25.00	30	1.00	132.00	2.50	Yes
27.50	29	1.00	132.00	2.50	Yes
30.00	50	1.00	132.00	2.50	Yes
32.50	50	1.00	132.00	2.50	Yes
35.00	50	1.00	132.00	2.50	Yes
37.50	50	1.00	132.00	2.50	Yes
40.00	50	1.00	132.00	2.50	Yes
42.50	27	1.00	132.00	2.50	Yes
45.00	48	15.00	132.00	2.50	Yes
47.50	37	1.00	132.00	2.50	Yes
50.00	50	1.00	132.00	2.50	Yes

Abbreviations

Depth: Depth at which test was performed (ft)
SPT Field Value: Number of blows per foot
Fines Content: Fines content at test depth (%)
Unit Weight: Unit weight at test depth (pcf)
Infl. Thickness: Thickness of the soil layer to be considered in settlements analysis (ft)
Can Liquefy: User defined switch for excluding/including test depth from the analysis procedure

:: Cyclic Resistance Ratio (CRR) calculation data ::

Depth (ft)	SPT Field Value	Unit Weight (pcf)	σ_v (tsf)	u_o (tsf)	σ'_{vo} (tsf)	C_N	C_E	C_B	C_R	C_S	$(N_1)_{60}$	Fines Content (%)	α	β	$(N_1)_{60cs}$	$CRR_{7.5}$
5.00	9	132.00	0.33	0.00	0.33	1.46	1.33	1.15	0.75	1.20	18	70.00	5.00	1.20	27	4.000
7.50	9	132.00	0.49	0.00	0.49	1.32	1.33	1.15	0.75	1.20	16	47.80	5.00	1.20	24	0.269
10.00	12	132.00	0.66	0.00	0.66	1.21	1.33	1.15	0.85	1.20	23	55.00	5.00	1.20	33	4.000
12.50	4	132.00	0.82	0.00	0.82	1.11	1.33	1.15	0.85	1.20	7	70.00	5.00	1.20	13	4.000
15.00	13	132.00	0.99	0.00	0.99	1.03	1.33	1.15	0.85	1.20	21	70.00	5.00	1.20	30	4.000
17.50	10	132.00	1.16	0.00	1.16	0.96	1.33	1.15	0.95	1.20	17	33.20	4.89	1.18	25	0.285
20.00	9	132.00	1.32	0.06	1.26	0.92	1.33	1.15	0.95	1.20	14	34.40	4.95	1.19	22	0.242
22.50	27	132.00	1.49	0.14	1.34	0.89	1.33	1.15	0.95	1.20	42	1.00	0.00	1.00	42	4.000
25.00	30	132.00	1.65	0.22	1.43	0.86	1.33	1.15	0.95	1.20	45	1.00	0.00	1.00	45	4.000
27.50	29	132.00	1.81	0.30	1.52	0.83	1.33	1.15	0.95	1.20	42	1.00	0.00	1.00	42	4.000
30.00	50	132.00	1.98	0.37	1.61	0.81	1.33	1.15	1.00	1.20	74	1.00	0.00	1.00	74	4.000
32.50	50	132.00	2.15	0.45	1.69	0.79	1.33	1.15	1.00	1.20	72	1.00	0.00	1.00	72	4.000
35.00	50	132.00	2.31	0.53	1.78	0.76	1.33	1.15	1.00	1.20	70	1.00	0.00	1.00	70	4.000
37.50	50	132.00	2.48	0.61	1.87	0.74	1.33	1.15	1.00	1.20	68	1.00	0.00	1.00	68	4.000
40.00	50	132.00	2.64	0.69	1.95	0.72	1.33	1.15	1.00	1.20	66	1.00	0.00	1.00	66	4.000
42.50	27	132.00	2.81	0.76	2.04	0.70	1.33	1.15	1.00	1.20	35	1.00	0.00	1.00	35	4.000
45.00	48	132.00	2.97	0.84	2.13	0.69	1.33	1.15	1.00	1.20	60	15.00	2.50	1.05	65	4.000
47.50	37	132.00	3.13	0.92	2.21	0.67	1.33	1.15	1.00	1.20	45	1.00	0.00	1.00	45	4.000

:: Cyclic Resistance Ratio (CRR) calculation data ::

Depth (ft)	SPT Field Value	Unit Weight (pcf)	σ_v (tsf)	u_o (tsf)	σ'_{vo} (tsf)	C_N	C_E	C_B	C_R	C_S	$(N_1)_{60}$	Fines Content (%)	α	β	$(N_1)_{60cs}$	$CRR_{7.5}$
50.00	50	132.00	3.30	1.00	2.30	0.65	1.33	1.15	1.00	1.20	60	1.00	0.00	1.00	60	4.000

Abbreviations

σ_v: Total stress during SPT test (tsf)
u_o: Water pore pressure during SPT test (tsf)
σ'_{vo}: Effective overburden pressure during SPT test (tsf)
C_N: Overburden corretion factor
C_E: Energy correction factor
C_B: Borehole diameter correction factor
C_R: Rod length correction factor
C_S: Liner correction factor
$N_{1(60)}$: Corrected N_{SPT} to a 60% energy ratio
α, β: Clean sand equivalent clean sand formula coefficients
$N_{1(60)cs}$: Corected $N_{1(60)}$ value for fines content
$CRR_{7.5}$: Cydic resistance ratio for M=7.5

:: Cyclic Stress Ratio calculation (CSR fully adjusted and normalized) ::

Depth (ft)	Unit Weight (pcf)	$\sigma_{v,eq}$ (tsf)	$u_{o,eq}$ (tsf)	$\sigma'_{vo,eq}$ (tsf)	r_d	α	CSR	MSF	$CSR_{eq,M=7.5}$	K_{sigma}	CSR^*	FS
5.00	132.00	0.33	0.00	0.33	0.99	1.00	0.373	1.53	0.244	1.00	0.295	2.000
7.50	132.00	0.49	0.05	0.45	0.98	1.00	0.410	1.53	0.268	1.00	0.324	0.914
10.00	132.00	0.66	0.12	0.54	0.98	1.00	0.455	1.53	0.297	1.00	0.360	2.000
12.50	132.00	0.82	0.20	0.62	0.97	1.00	0.487	1.53	0.318	1.00	0.385	2.000
15.00	132.00	0.99	0.28	0.71	0.97	1.00	0.510	1.53	0.333	1.00	0.403	2.000
17.50	132.00	1.16	0.36	0.80	0.96	1.00	0.527	1.53	0.344	1.00	0.416	0.753
20.00	132.00	1.32	0.44	0.88	0.96	1.00	0.539	1.53	0.352	1.00	0.426	0.624
22.50	132.00	1.49	0.51	0.97	0.95	1.00	0.548	1.53	0.358	1.00	0.433	2.000
25.00	132.00	1.65	0.59	1.06	0.94	1.00	0.554	1.53	0.362	1.00	0.438	2.000
27.50	132.00	1.81	0.67	1.14	0.93	1.00	0.557	1.53	0.364	0.98	0.448	2.000
30.00	132.00	1.98	0.75	1.23	0.92	1.00	0.558	1.53	0.365	0.97	0.455	2.000
32.50	132.00	2.15	0.83	1.32	0.91	1.00	0.556	1.53	0.363	0.96	0.459	2.000
35.00	132.00	2.31	0.90	1.41	0.89	1.00	0.552	1.53	0.361	0.94	0.462	2.000
37.50	132.00	2.48	0.98	1.49	0.87	1.00	0.545	1.53	0.356	0.93	0.462	2.000
40.00	132.00	2.64	1.06	1.58	0.85	1.00	0.536	1.53	0.350	0.92	0.459	2.000
42.50	132.00	2.81	1.14	1.67	0.83	1.00	0.526	1.53	0.343	0.91	0.455	2.000
45.00	132.00	2.97	1.22	1.75	0.80	1.00	0.513	1.53	0.335	0.90	0.449	2.000
47.50	132.00	3.13	1.29	1.84	0.78	1.00	0.500	1.53	0.327	0.90	0.441	2.000
50.00	132.00	3.30	1.37	1.93	0.75	1.00	0.486	1.53	0.317	0.89	0.433	2.000

Abbreviations

$\sigma_{v,eq}$: Total overburden pressure at test point, during earthquake (tsf)
$u_{o,eq}$: Water pressure at test point, during earthquake (tsf)
$\sigma'_{vo,eq}$: Effective overburden pressure, during earthquake (tsf)
r_d : Nonlinear shear mass factor
α: Improvement factor due to stone columns
CSR : Cyclic Stress Ratio (adjusted for improvement)
MSF : Magnitude Scaling Factor
$CSR_{eq,M=7.5}$: CSR adjusted for M=7.5
K_{sigma}: Effective overburden stress factor
CSR^*: CSR fully adjusted (user FS applied)***
FS: Calculated factor of safety against soil liquefaction

*** User FS: 1.10

:: Liquefaction potential according to Iwasaki ::

Depth (ft)	FS	F	wz	Thickness (ft)	I_L
5.00	2.000	0.00	9.24	2.50	0.00
7.50	0.914	0.09	8.86	2.50	0.58
10.00	2.000	0.00	8.48	2.50	0.00
12.50	2.000	0.00	8.10	2.50	0.00
15.00	2.000	0.00	7.71	2.50	0.00
17.50	0.753	0.25	7.33	2.50	1.38
20.00	0.624	0.38	6.95	2.50	1.99
22.50	2.000	0.00	6.57	2.50	0.00
25.00	2.000	0.00	6.19	2.50	0.00
27.50	2.000	0.00	5.81	2.50	0.00
30.00	2.000	0.00	5.43	2.50	0.00
32.50	2.000	0.00	5.05	2.50	0.00
35.00	2.000	0.00	4.67	2.50	0.00
37.50	2.000	0.00	4.29	2.50	0.00
40.00	2.000	0.00	3.90	2.50	0.00
42.50	2.000	0.00	3.52	2.50	0.00
45.00	2.000	0.00	3.14	2.50	0.00
47.50	2.000	0.00	2.76	2.50	0.00
50.00	2.000	0.00	2.38	2.50	0.00

Overall potential I_L : 3.95

I_L = 0.00 - No liquefaction
I_L between 0.00 and 5 - Liquefaction not probable
I_L between 5 and 15 - Liquefaction probable
I_L > 15 - Liquefaction certain

:: Vertical settlements estimation for dry sands ::

Depth (ft)	$(N_1)_{60}$	τ_{av}	p	G_{max} (tsf)	α	b	γ	ε_{15}	N_c	ε_{Nc} (%)	Δh (ft)	ΔS (in)
5.00	18	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.50	0.000

Cumulative settlemetns: 0.000

Abbreviations

τ_{av}: Average cyclic shear stress
p: Average stress
G_{max}: Maximum shear modulus (tsf)
α, b: Shear strain formula variables
γ: Average shear strain
ε_{15}: Volumetric strain after 15 cycles
N_c: Number of cycles
ε_{Nc}: Volumetric strain for number of cycles N_c (%)
Δh: Thickness of soil layer (in)
ΔS: Settlement of soil layer (in)

:: Vertical settlements estimation for saturated sands ::

Depth (ft)	D_{50} (in)	q_c/N	e_v (%)	Δh (ft)	s (in)
7.50	0.00	5.00	1.20	2.50	0.359
10.00	0.00	5.00	0.00	2.50	0.000
12.50	0.00	5.00	0.00	2.50	0.000

:: Vertical settlements estimation for saturated sands ::

Depth (ft)	D_{50} (in)	q_c/N	e_v (%)	Δh (ft)	s (in)
15.00	0.00	5.00	0.00	2.50	0.000
17.50	0.00	5.00	1.47	2.50	0.440
20.00	0.00	5.00	2.16	2.50	0.648
22.50	0.00	5.00	0.00	2.50	0.000
25.00	0.00	5.00	0.00	2.50	0.000
27.50	0.00	5.00	0.00	2.50	0.000
30.00	0.00	5.00	0.00	2.50	0.000
32.50	0.00	5.00	0.00	2.50	0.000
35.00	0.00	5.00	0.00	2.50	0.000
37.50	0.00	5.00	0.00	2.50	0.000
40.00	0.00	5.00	0.00	2.50	0.000
42.50	0.00	5.00	0.00	2.50	0.000
45.00	0.00	5.00	0.00	2.50	0.000
47.50	0.00	5.00	0.00	2.50	0.000
50.00	0.00	5.00	0.00	2.50	0.000

Cumulative settlements: 1.448

Abbreviations

D_{50}: Median grain size (in)
q_c/N: Ratio of cone resistance to SPT
e_v: Post liquefaction volumetric strain (%)
Δh: Thickness of soil layer to be considered (ft)
s: Estimated settlement (in)

Twining Consulting

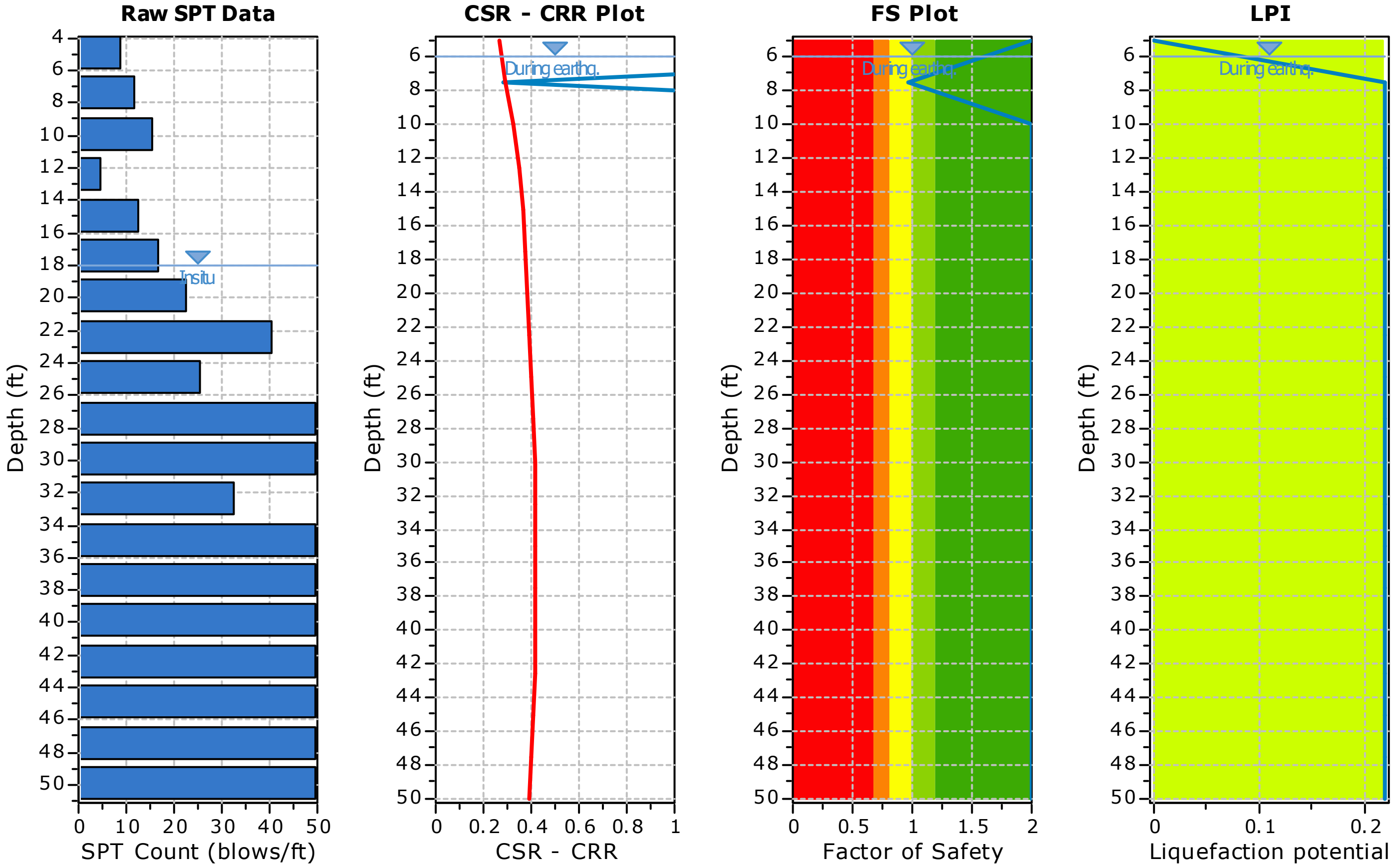
SPT BASED LIQUEFACTION ANALYSIS REPORT

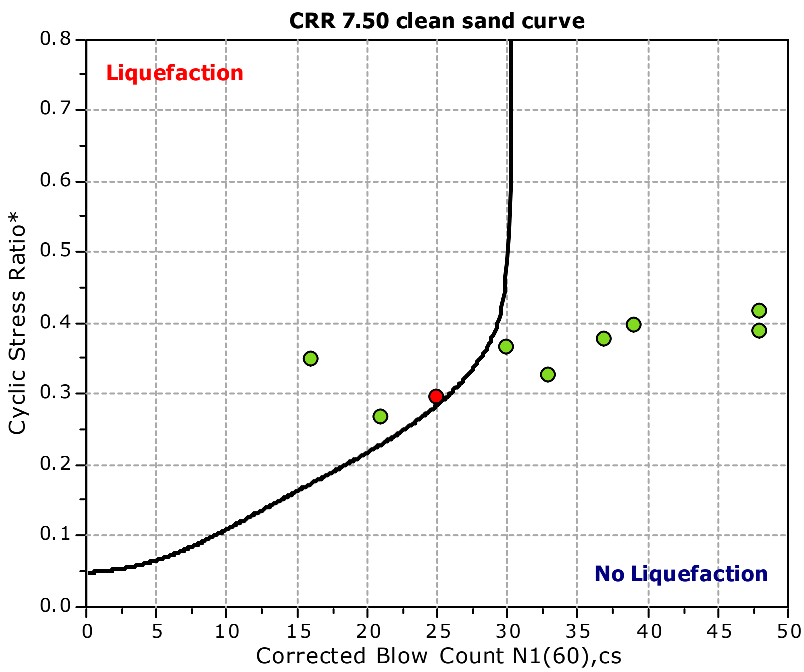
Project title : Proposed Del Rey Avenue Building **SPT Name: IGI B2**

Location : 4112 Del Rey Ave, Marina Del Rey, CA

:: Input parameters and analysis properties ::

Analysis method:	NCEER 1998	G.W.T. (in-situ):	18.00 ft
Fines correction method:	NCEER 1998	G.W.T. (earthq.):	6.00 ft
Sampling method:	Sampler wo liners	Earthquake magnitude M_w:	6.35
Borehole diameter:	200mm	Peak ground acceleration:	0.58 g
Rod length:	3.30 ft	Eq. external load:	0.00 tsf
Hammer energy ratio:	1.33		





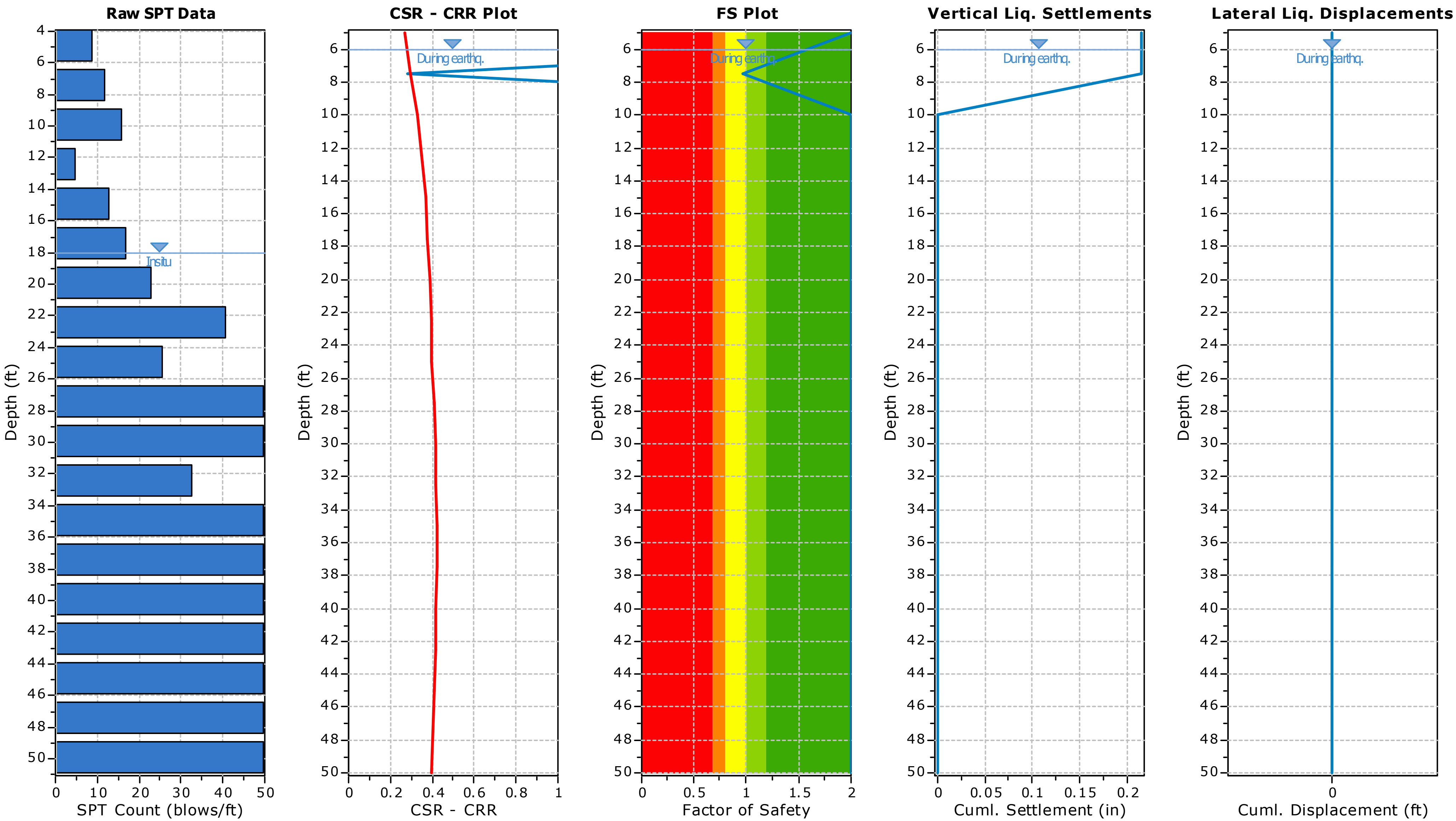
F.S. color scheme

- Almost certain it will liquefy
- Very likely to liquefy
- Liquefaction and no liq. are equally likely
- Unlike to liquefy
- Almost certain it will not liquefy

LPI color scheme

- Very high risk
- High risk
- Low risk

:: Overall Liquefaction Assessment Analysis Plots ::



:: Field input data ::

Test Depth (ft)	SPT Field Value (blows)	Fines Content (%)	Unit Weight (pcf)	Infl. Thickness (ft)	Can Liquefy
5.00	9	15.00	132.00	2.50	No
7.50	12	14.20	132.00	2.50	Yes
10.00	16	12.60	132.00	2.50	Yes
12.50	5	70.00	132.00	2.50	No
15.00	13	70.00	132.00	2.50	No
17.50	17	30.60	132.00	2.50	Yes
20.00	23	30.60	132.00	2.50	Yes
22.50	41	1.00	132.00	2.50	Yes
25.00	26	1.00	132.00	2.50	Yes
27.50	50	1.00	132.00	2.50	Yes
30.00	50	1.00	132.00	2.50	Yes
32.50	33	1.00	132.00	2.50	Yes
35.00	50	1.00	132.00	2.50	Yes
37.50	50	1.00	132.00	2.50	Yes
40.00	50	1.00	132.00	2.50	Yes
42.50	50	1.00	132.00	2.50	Yes
45.00	50	1.00	132.00	2.50	Yes
47.50	50	1.00	132.00	2.50	Yes
50.00	50	1.00	132.00	2.50	Yes

Abbreviations

Depth:	Depth at which test was performed (ft)
SPT Field Value:	Number of blows per foot
Fines Content:	Fines content at test depth (%)
Unit Weight:	Unit weight at test depth (pcf)
Infl. Thickness:	Thickness of the soil layer to be considered in settlements analysis (ft)
Can Liquefy:	User defined switch for excluding/including test depth from the analysis procedure

:: Cyclic Resistance Ratio (CRR) calculation data ::

Depth (ft)	SPT Field Value	Unit Weight (pcf)	σ_v (tsf)	u_o (tsf)	σ'_{vo} (tsf)	C_N	C_E	C_B	C_R	C_S	$(N_1)_{60}$	Fines Content (%)	α	β	$(N_1)_{60cs}$	$CRR_{7.5}$
5.00	9	132.00	0.33	0.00	0.33	1.46	1.33	1.15	0.75	1.20	18	15.00	2.50	1.05	21	4.000
7.50	12	132.00	0.49	0.00	0.49	1.32	1.33	1.15	0.75	1.20	22	14.20	2.27	1.04	25	0.285
10.00	16	132.00	0.66	0.00	0.66	1.21	1.33	1.15	0.85	1.20	30	12.60	1.76	1.03	33	4.000
12.50	5	132.00	0.82	0.00	0.82	1.11	1.33	1.15	0.85	1.20	9	70.00	5.00	1.20	16	4.000
15.00	13	132.00	0.99	0.00	0.99	1.03	1.33	1.15	0.85	1.20	21	70.00	5.00	1.20	30	4.000
17.50	17	132.00	1.16	0.00	1.16	0.96	1.33	1.15	0.95	1.20	28	30.60	4.74	1.16	37	4.000
20.00	23	132.00	1.32	0.06	1.26	0.92	1.33	1.15	0.95	1.20	37	30.60	4.74	1.16	48	4.000
22.50	41	132.00	1.49	0.14	1.34	0.89	1.33	1.15	0.95	1.20	64	1.00	0.00	1.00	64	4.000
25.00	26	132.00	1.65	0.22	1.43	0.86	1.33	1.15	0.95	1.20	39	1.00	0.00	1.00	39	4.000
27.50	50	132.00	1.81	0.30	1.52	0.83	1.33	1.15	0.95	1.20	73	1.00	0.00	1.00	73	4.000
30.00	50	132.00	1.98	0.37	1.61	0.81	1.33	1.15	1.00	1.20	74	1.00	0.00	1.00	74	4.000
32.50	33	132.00	2.15	0.45	1.69	0.79	1.33	1.15	1.00	1.20	48	1.00	0.00	1.00	48	4.000
35.00	50	132.00	2.31	0.53	1.78	0.76	1.33	1.15	1.00	1.20	70	1.00	0.00	1.00	70	4.000
37.50	50	132.00	2.48	0.61	1.87	0.74	1.33	1.15	1.00	1.20	68	1.00	0.00	1.00	68	4.000
40.00	50	132.00	2.64	0.69	1.95	0.72	1.33	1.15	1.00	1.20	66	1.00	0.00	1.00	66	4.000
42.50	50	132.00	2.81	0.76	2.04	0.70	1.33	1.15	1.00	1.20	65	1.00	0.00	1.00	65	4.000
45.00	50	132.00	2.97	0.84	2.13	0.69	1.33	1.15	1.00	1.20	63	1.00	0.00	1.00	63	4.000
47.50	50	132.00	3.13	0.92	2.21	0.67	1.33	1.15	1.00	1.20	61	1.00	0.00	1.00	61	4.000

:: Cyclic Resistance Ratio (CRR) calculation data ::

Depth (ft)	SPT Field Value	Unit Weight (pcf)	σ_v (tsf)	u_o (tsf)	σ'_{vo} (tsf)	C_N	C_E	C_B	C_R	C_S	$(N_1)_{60}$	Fines Content (%)	α	β	$(N_1)_{60cs}$	$CRR_{7.5}$
50.00	50	132.00	3.30	1.00	2.30	0.65	1.33	1.15	1.00	1.20	60	1.00	0.00	1.00	60	4.000

Abbreviations

σ_v: Total stress during SPT test (tsf)
u_o: Water pore pressure during SPT test (tsf)
σ'_{vo}: Effective overburden pressure during SPT test (tsf)
C_N: Overburden corretion factor
C_E: Energy correction factor
C_B: Borehole diameter correction factor
C_R: Rod length correction factor
C_S: Liner correction factor
$N_{1(60)}$: Corrected N_{SPT} to a 60% energy ratio
α, β: Clean sand equivalent clean sand formula coefficients
$N_{1(60)cs}$: Corected $N_{1(60)}$ value for fines content
$CRR_{7.5}$: Cydic resistance ratio for M=7.5

:: Cyclic Stress Ratio calculation (CSR fully adjusted and normalized) ::

Depth (ft)	Unit Weight (pcf)	$\sigma_{v,eq}$ (tsf)	$u_{o,eq}$ (tsf)	$\sigma'_{vo,eq}$ (tsf)	r_d	α	CSR	MSF	$CSR_{eq,M=7.5}$	K_{sigma}	CSR^*	FS	
5.00	132.00	0.33	0.00	0.33	0.99	1.00	0.373	1.53	0.244	1.00	0.295	2.000	●
7.50	132.00	0.49	0.05	0.45	0.98	1.00	0.410	1.53	0.268	1.00	0.324	0.968	●
10.00	132.00	0.66	0.12	0.54	0.98	1.00	0.455	1.53	0.297	1.00	0.360	2.000	●
12.50	132.00	0.82	0.20	0.62	0.97	1.00	0.487	1.53	0.318	1.00	0.385	2.000	●
15.00	132.00	0.99	0.28	0.71	0.97	1.00	0.510	1.53	0.333	1.00	0.403	2.000	●
17.50	132.00	1.16	0.36	0.80	0.96	1.00	0.527	1.53	0.344	1.00	0.416	2.000	●
20.00	132.00	1.32	0.44	0.88	0.96	1.00	0.539	1.53	0.352	1.00	0.426	2.000	●
22.50	132.00	1.49	0.51	0.97	0.95	1.00	0.548	1.53	0.358	1.00	0.433	2.000	●
25.00	132.00	1.65	0.59	1.06	0.94	1.00	0.554	1.53	0.362	1.00	0.438	2.000	●
27.50	132.00	1.81	0.67	1.14	0.93	1.00	0.557	1.53	0.364	0.98	0.448	2.000	●
30.00	132.00	1.98	0.75	1.23	0.92	1.00	0.558	1.53	0.365	0.97	0.455	2.000	●
32.50	132.00	2.15	0.83	1.32	0.91	1.00	0.556	1.53	0.363	0.96	0.459	2.000	●
35.00	132.00	2.31	0.90	1.41	0.89	1.00	0.552	1.53	0.361	0.94	0.462	2.000	●
37.50	132.00	2.48	0.98	1.49	0.87	1.00	0.545	1.53	0.356	0.93	0.462	2.000	●
40.00	132.00	2.64	1.06	1.58	0.85	1.00	0.536	1.53	0.350	0.92	0.459	2.000	●
42.50	132.00	2.81	1.14	1.67	0.83	1.00	0.526	1.53	0.343	0.91	0.455	2.000	●
45.00	132.00	2.97	1.22	1.75	0.80	1.00	0.513	1.53	0.335	0.90	0.449	2.000	●
47.50	132.00	3.13	1.29	1.84	0.78	1.00	0.500	1.53	0.327	0.90	0.441	2.000	●
50.00	132.00	3.30	1.37	1.93	0.75	1.00	0.486	1.53	0.317	0.89	0.433	2.000	●

Abbreviations

$\sigma_{v,eq}$: Total overburden pressure at test point, during earthquake (tsf)
$u_{o,eq}$: Water pressure at test point, during earthquake (tsf)
$\sigma'_{vo,eq}$: Effective overburden pressure, during earthquake (tsf)
r_d : Nonlinear shear mass factor
α: Improvement factor due to stone columns
CSR : Cyclic Stress Ratio (adjusted for improvement)
MSF : Magnitude Scaling Factor
$CSR_{eq,M=7.5}$: CSR adjusted for M=7.5
K_{sigma}: Effective overburden stress factor
CSR^*: CSR fully adjusted (user FS applied)***
FS: Calculated factor of safety against soil liquefaction

*** User FS: 1.10

:: Liquefaction potential according to Iwasaki ::

Depth (ft)	FS	F	wz	Thickness (ft)	I_L
5.00	2.000	0.00	9.24	2.50	0.00
7.50	0.968	0.03	8.86	2.50	0.22
10.00	2.000	0.00	8.48	2.50	0.00
12.50	2.000	0.00	8.10	2.50	0.00
15.00	2.000	0.00	7.71	2.50	0.00
17.50	2.000	0.00	7.33	2.50	0.00
20.00	2.000	0.00	6.95	2.50	0.00
22.50	2.000	0.00	6.57	2.50	0.00
25.00	2.000	0.00	6.19	2.50	0.00
27.50	2.000	0.00	5.81	2.50	0.00
30.00	2.000	0.00	5.43	2.50	0.00
32.50	2.000	0.00	5.05	2.50	0.00
35.00	2.000	0.00	4.67	2.50	0.00
37.50	2.000	0.00	4.29	2.50	0.00
40.00	2.000	0.00	3.90	2.50	0.00
42.50	2.000	0.00	3.52	2.50	0.00
45.00	2.000	0.00	3.14	2.50	0.00
47.50	2.000	0.00	2.76	2.50	0.00
50.00	2.000	0.00	2.38	2.50	0.00

Overall potential I_L : 0.22

I_L = 0.00 - No liquefaction
I_L between 0.00 and 5 - Liquefaction not probable
I_L between 5 and 15 - Liquefaction probable
I_L > 15 - Liquefaction certain

:: Vertical settlements estimation for dry sands ::

Depth (ft)	$(N_1)_{60}$	τ_{av}	p	G_{max} (tsf)	α	b	γ	ε_{15}	N_c	ε_{Nc} (%)	Δh (ft)	ΔS (in)
5.00	18	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.50	0.000

Cumulative settlemetns: 0.000

Abbreviations

τ_{av}: Average cyclic shear stress
p: Average stress
G_{max}: Maximum shear modulus (tsf)
α, b: Shear strain formula variables
γ: Average shear strain
ε_{15}: Volumetric strain after 15 cycles
N_c: Number of cycles
ε_{Nc}: Volumetric strain for number of cycles N_c (%)
Δh: Thickness of soil layer (in)
ΔS: Settlement of soil layer (in)

:: Vertical settlements estimation for saturated sands ::

Depth (ft)	D_{50} (in)	q_c/N	e_v (%)	Δh (ft)	s (in)
7.50	0.00	5.00	0.72	2.50	0.215
10.00	0.00	5.00	0.00	2.50	0.000
12.50	0.00	5.00	0.00	2.50	0.000

:: Vertical settlements estimation for saturated sands ::

Depth (ft)	D_{50} (in)	q_c/N	e_v (%)	Δh (ft)	s (in)
15.00	0.00	5.00	0.00	2.50	0.000
17.50	0.00	5.00	0.00	2.50	0.000
20.00	0.00	5.00	0.00	2.50	0.000
22.50	0.00	5.00	0.00	2.50	0.000
25.00	0.00	5.00	0.00	2.50	0.000
27.50	0.00	5.00	0.00	2.50	0.000
30.00	0.00	5.00	0.00	2.50	0.000
32.50	0.00	5.00	0.00	2.50	0.000
35.00	0.00	5.00	0.00	2.50	0.000
37.50	0.00	5.00	0.00	2.50	0.000
40.00	0.00	5.00	0.00	2.50	0.000
42.50	0.00	5.00	0.00	2.50	0.000
45.00	0.00	5.00	0.00	2.50	0.000
47.50	0.00	5.00	0.00	2.50	0.000
50.00	0.00	5.00	0.00	2.50	0.000

Cumulative settlements: 0.215

Abbreviations

D_{50}: Median grain size (in)
q_c/N: Ratio of cone resistance to SPT
e_v: Post liquefaction volumetric strain (%)
Δh: Thickness of soil layer to be considered (ft)
s: Estimated settlement (in)

Twining Consulting

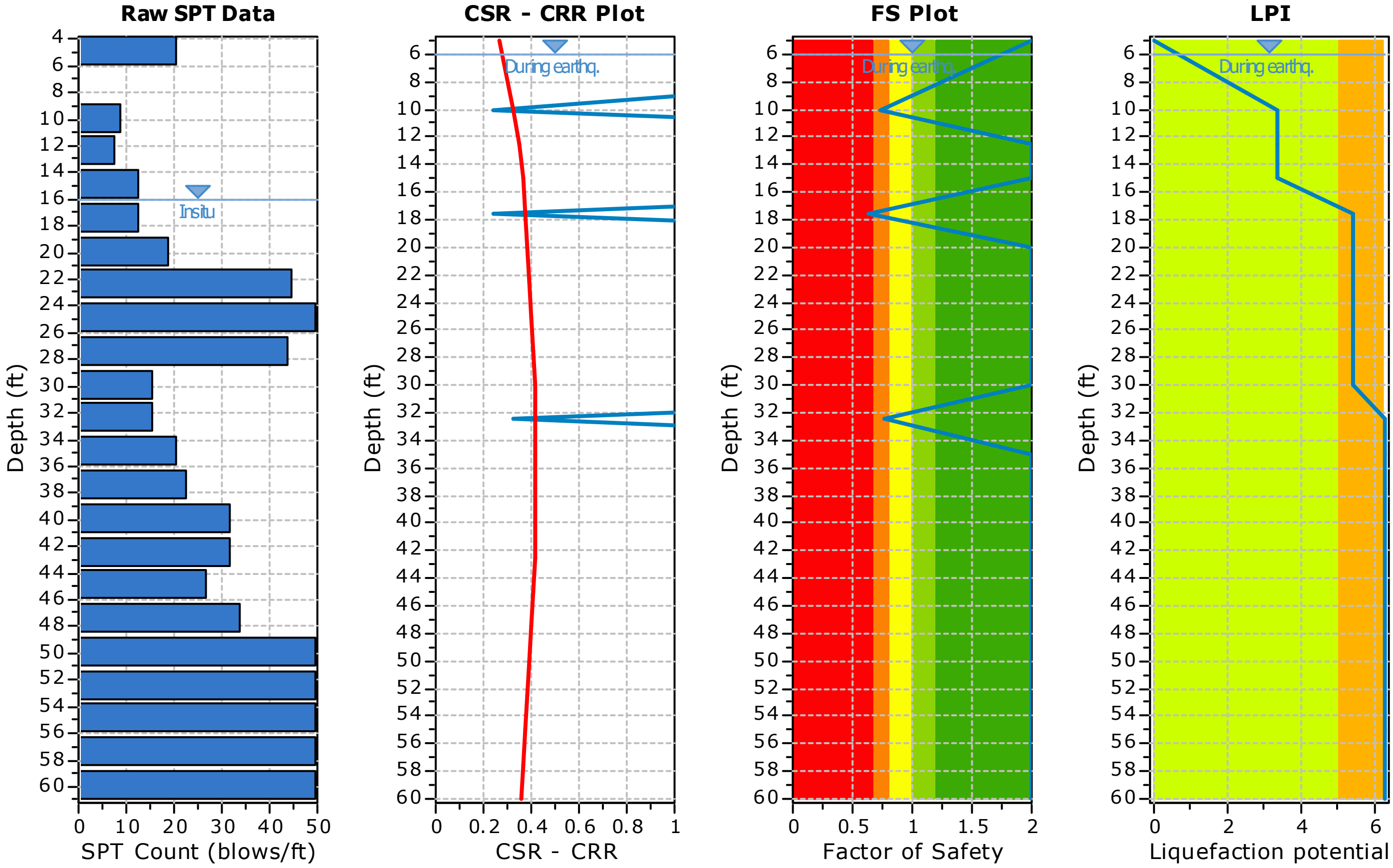
SPT BASED LIQUEFACTION ANALYSIS REPORT

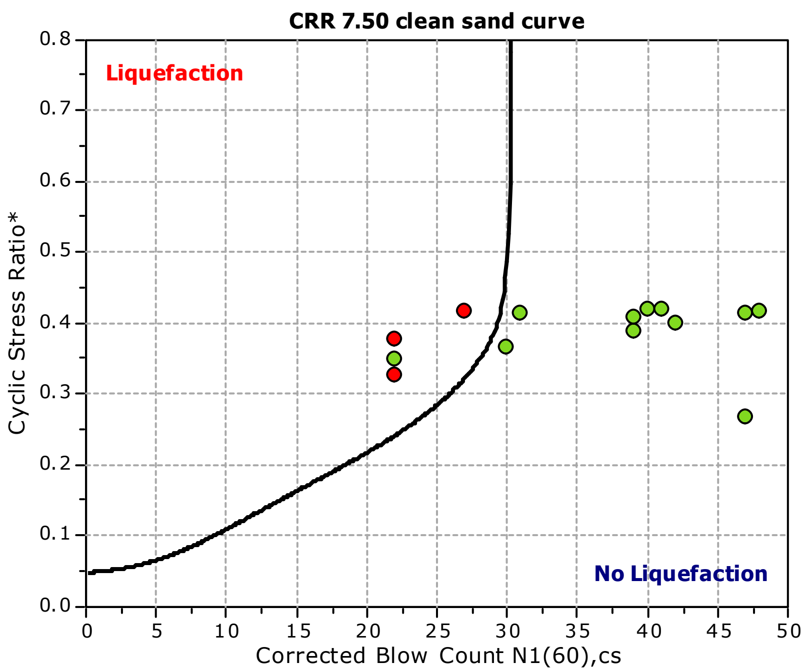
Project title : Proposed Del Rey Avenue Building **SPT Name: IGI B3**

Location : 4112 Del Rey Ave, Marina Del Rey, CA

:: Input parameters and analysis properties ::

Analysis method:	NCEER 1998	G.W.T. (in-situ):	16.00 ft
Fines correction method:	NCEER 1998	G.W.T. (earthq.):	6.00 ft
Sampling method:	Sampler wo liners	Earthquake magnitude M_w:	6.35
Borehole diameter:	200mm	Peak ground acceleration:	0.58 g
Rod length:	3.30 ft	Eq. external load:	0.00 tsf
Hammer energy ratio:	1.33		





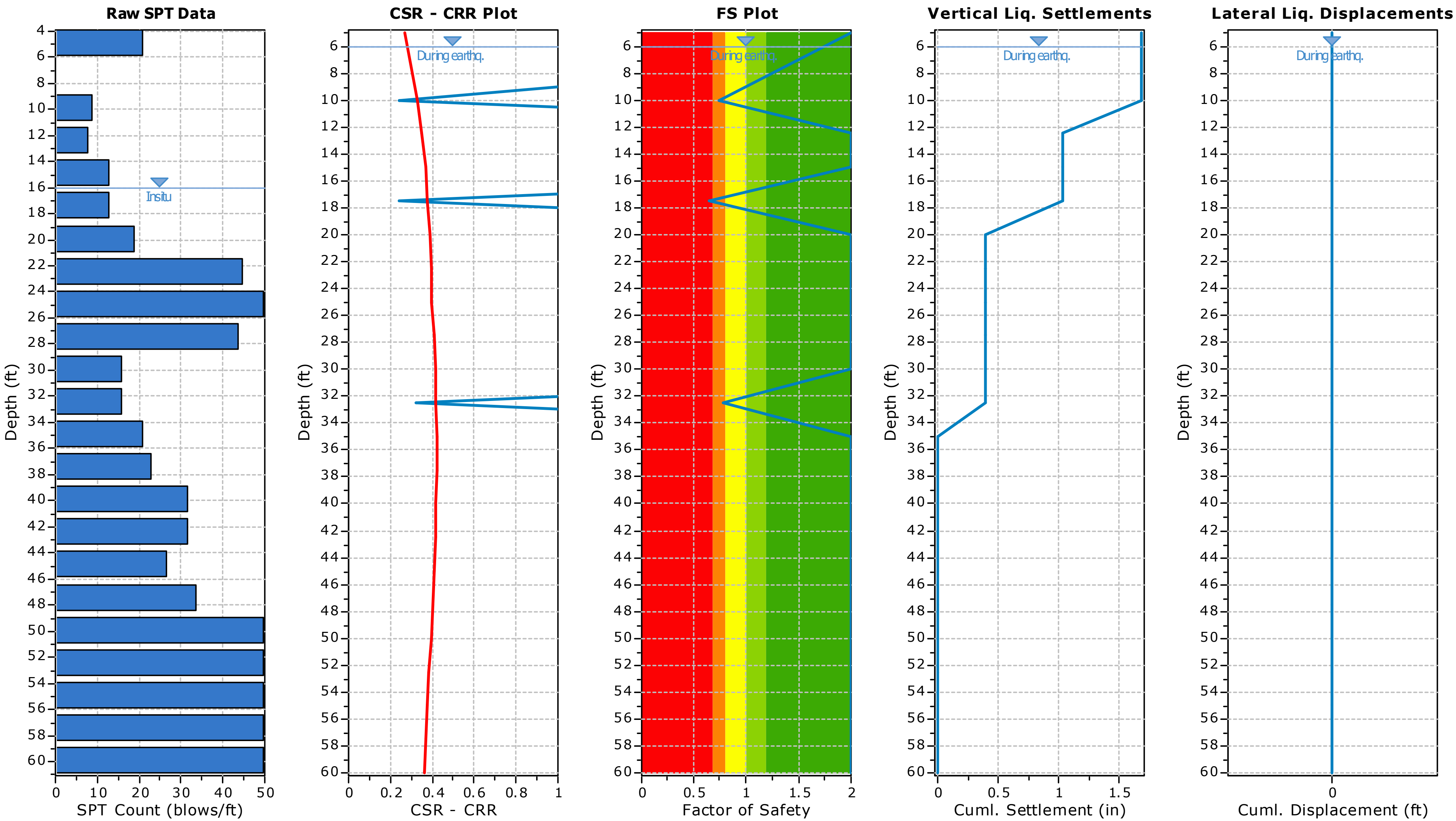
F.S. color scheme

- Almost certain it will liquefy
- Very likely to liquefy
- Liquefaction and no liq. are equally likely
- Unlike to liquefy
- Almost certain it will not liquefy

LPI color scheme

- Very high risk
- High risk
- Low risk

:: Overall Liquefaction Assessment Analysis Plots ::



:: Field input data ::

Test Depth (ft)	SPT Field Value (blows)	Fines Content (%)	Unit Weight (pcf)	Infl. Thickness (ft)	Can Liquefy
5.00	21	15.00	132.00	2.50	No
10.00	9	18.70	132.00	2.50	Yes
12.50	8	70.00	132.00	2.50	No
15.00	13	70.00	132.00	2.50	No
17.50	13	6.30	132.00	2.50	Yes
20.00	19	26.60	132.00	2.50	Yes
22.50	45	1.00	132.00	2.50	Yes
25.00	50	1.00	132.00	2.50	Yes
27.50	44	1.00	132.00	2.50	Yes
30.00	16	23.40	132.00	2.50	Yes
32.50	16	13.30	132.00	2.50	Yes
35.00	21	33.40	132.00	2.50	Yes
37.50	23	27.90	132.00	2.50	Yes
40.00	32	15.00	132.00	2.50	Yes
42.50	32	15.00	132.00	2.50	Yes
45.00	27	15.00	132.00	2.50	Yes
47.50	34	1.00	132.00	2.50	Yes
50.00	50	1.00	132.00	2.50	Yes
52.50	50	1.00	132.00	2.50	Yes
55.00	50	1.00	132.00	2.50	Yes
57.50	50	1.00	132.00	2.50	Yes
60.00	50	1.00	132.00	2.50	Yes

Abbreviations

Depth:	Depth at which test was performed (ft)
SPT Field Value:	Number of blows per foot
Fines Content:	Fines content at test depth (%)
Unit Weight:	Unit weight at test depth (pcf)
Infl. Thickness:	Thickness of the soil layer to be considered in settlements analysis (ft)
Can Liquefy:	User defined switch for excluding/including test depth from the analysis procedure

:: Cyclic Resistance Ratio (CRR) calculation data ::

Depth (ft)	SPT Field Value	Unit Weight (pcf)	σ_v (tsf)	u_o (tsf)	σ'_{vo} (tsf)	C_N	C_E	C_B	C_R	C_S	$(N_1)_{60}$	Fines Content (%)	α	β	$(N_1)_{60cs}$	$CRR_{7.5}$
5.00	21	132.00	0.33	0.00	0.33	1.46	1.33	1.15	0.75	1.20	42	15.00	2.50	1.05	47	4.000
10.00	9	132.00	0.66	0.00	0.66	1.21	1.33	1.15	0.85	1.20	17	18.70	3.38	1.07	22	0.242
12.50	8	132.00	0.82	0.00	0.82	1.11	1.33	1.15	0.85	1.20	14	70.00	5.00	1.20	22	4.000
15.00	13	132.00	0.99	0.00	0.99	1.03	1.33	1.15	0.85	1.20	21	70.00	5.00	1.20	30	4.000
17.50	13	132.00	1.16	0.05	1.11	0.98	1.33	1.15	0.95	1.20	22	6.30	0.05	1.01	22	0.242
20.00	19	132.00	1.32	0.12	1.20	0.94	1.33	1.15	0.95	1.20	31	26.60	4.44	1.13	39	4.000
22.50	45	132.00	1.49	0.20	1.28	0.91	1.33	1.15	0.95	1.20	72	1.00	0.00	1.00	72	4.000
25.00	50	132.00	1.65	0.28	1.37	0.88	1.33	1.15	0.95	1.20	77	1.00	0.00	1.00	77	4.000
27.50	44	132.00	1.81	0.36	1.46	0.85	1.33	1.15	0.95	1.20	66	1.00	0.00	1.00	66	4.000
30.00	16	132.00	1.98	0.44	1.54	0.83	1.33	1.15	1.00	1.20	24	23.40	4.11	1.10	31	4.000
32.50	16	132.00	2.15	0.51	1.63	0.80	1.33	1.15	1.00	1.20	24	13.30	1.99	1.04	27	0.323
35.00	21	132.00	2.31	0.59	1.72	0.78	1.33	1.15	1.00	1.20	30	33.40	4.90	1.18	40	4.000
37.50	23	132.00	2.48	0.67	1.80	0.76	1.33	1.15	1.00	1.20	32	27.90	4.55	1.14	41	4.000
40.00	32	132.00	2.64	0.75	1.89	0.74	1.33	1.15	1.00	1.20	43	15.00	2.50	1.05	48	4.000
42.50	32	132.00	2.81	0.83	1.98	0.72	1.33	1.15	1.00	1.20	42	15.00	2.50	1.05	47	4.000

:: Cyclic Resistance Ratio (CRR) calculation data ::

Depth (ft)	SPT Field Value	Unit Weight (pcf)	σ_v (tsf)	u_o (tsf)	σ'_{vo} (tsf)	C_N	C_E	C_B	C_R	C_S	$(N_1)_{60}$	Fines Content (%)	α	β	$(N_1)_{60cs}$	$CRR_{7.5}$
45.00	27	132.00	2.97	0.90	2.07	0.70	1.33	1.15	1.00	1.20	35	15.00	2.50	1.05	39	4.000
47.50	34	132.00	3.13	0.98	2.15	0.68	1.33	1.15	1.00	1.20	42	1.00	0.00	1.00	42	4.000
50.00	50	132.00	3.30	1.06	2.24	0.66	1.33	1.15	1.00	1.20	61	1.00	0.00	1.00	61	4.000
52.50	50	132.00	3.46	1.14	2.33	0.65	1.33	1.15	1.00	1.20	59	1.00	0.00	1.00	59	4.000
55.00	50	132.00	3.63	1.22	2.41	0.63	1.33	1.15	1.00	1.20	58	1.00	0.00	1.00	58	4.000
57.50	50	132.00	3.79	1.29	2.50	0.62	1.33	1.15	1.00	1.20	57	1.00	0.00	1.00	57	4.000
60.00	50	132.00	3.96	1.37	2.59	0.60	1.33	1.15	1.00	1.20	55	1.00	0.00	1.00	55	4.000

Abbreviations

σ_v: Total stress during SPT test (tsf)
u_o: Water pore pressure during SPT test (tsf)
σ'_{vo}: Effective overburden pressure during SPT test (tsf)
C_N: Overburden corretion factor
C_E: Energy correction factor
C_B: Borehole diameter correction factor
C_R: Rod length correction factor
C_S: Liner correction factor
$N_{1(60)}$: Corrected N_{SPT} to a 60% energy ratio
α, β: Clean sand equivalent clean sand formula coefficients
$N_{1(60)cs}$: Corected $N_{1(60)}$ value for fines content
$CRR_{7.5}$: Cydic resistance ratio for M=7.5

:: Cyclic Stress Ratio calculation (CSR fully adjusted and normalized) ::

Depth (ft)	Unit Weight (pcf)	$\sigma_{v,eq}$ (tsf)	$u_{o,eq}$ (tsf)	$\sigma'_{vo,eq}$ (tsf)	r_d	α	CSR	MSF	$CSR_{eq,M=7.5}$	K_{sigma}	CSR*	FS
5.00	132.00	0.33	0.00	0.33	0.99	1.00	0.373	1.53	0.244	1.00	0.295	2.000
10.00	132.00	0.66	0.12	0.54	0.98	1.00	0.455	1.53	0.297	1.00	0.360	0.739
12.50	132.00	0.82	0.20	0.62	0.97	1.00	0.487	1.53	0.318	1.00	0.385	2.000
15.00	132.00	0.99	0.28	0.71	0.97	1.00	0.510	1.53	0.333	1.00	0.403	2.000
17.50	132.00	1.16	0.36	0.80	0.96	1.00	0.527	1.53	0.344	1.00	0.416	0.639
20.00	132.00	1.32	0.44	0.88	0.96	1.00	0.539	1.53	0.352	1.00	0.426	2.000
22.50	132.00	1.49	0.51	0.97	0.95	1.00	0.548	1.53	0.358	1.00	0.433	2.000
25.00	132.00	1.65	0.59	1.06	0.94	1.00	0.554	1.53	0.362	1.00	0.438	2.000
27.50	132.00	1.81	0.67	1.14	0.93	1.00	0.557	1.53	0.364	0.98	0.448	2.000
30.00	132.00	1.98	0.75	1.23	0.92	1.00	0.558	1.53	0.365	0.97	0.455	2.000
32.50	132.00	2.15	0.83	1.32	0.91	1.00	0.556	1.53	0.363	0.96	0.459	0.774
35.00	132.00	2.31	0.90	1.41	0.89	1.00	0.552	1.53	0.361	0.94	0.462	2.000
37.50	132.00	2.48	0.98	1.49	0.87	1.00	0.545	1.53	0.356	0.93	0.462	2.000
40.00	132.00	2.64	1.06	1.58	0.85	1.00	0.536	1.53	0.350	0.92	0.459	2.000
42.50	132.00	2.81	1.14	1.67	0.83	1.00	0.526	1.53	0.343	0.91	0.455	2.000
45.00	132.00	2.97	1.22	1.75	0.80	1.00	0.513	1.53	0.335	0.90	0.449	2.000
47.50	132.00	3.13	1.29	1.84	0.78	1.00	0.500	1.53	0.327	0.90	0.441	2.000
50.00	132.00	3.30	1.37	1.93	0.75	1.00	0.486	1.53	0.317	0.89	0.433	2.000
52.50	132.00	3.46	1.45	2.01	0.73	1.00	0.472	1.53	0.308	0.88	0.424	2.000
55.00	132.00	3.63	1.53	2.10	0.70	1.00	0.458	1.53	0.299	0.87	0.415	2.000
57.50	132.00	3.79	1.61	2.19	0.68	1.00	0.445	1.53	0.291	0.86	0.407	2.000
60.00	132.00	3.96	1.68	2.28	0.66	1.00	0.433	1.53	0.283	0.86	0.399	2.000

:: Cyclic Stress Ratio calculation (CSR fully adjusted and normalized) ::

Depth (ft)	Unit Weight (pcf)	$\sigma_{v,eq}$ (tsf)	$u_{o,eq}$ (tsf)	$\sigma'_{vo,eq}$ (tsf)	r_d	α	CSR	MSF	$CSR_{eq,M=7.5}$	K_{sigma}	CSR^*	FS

Abbreviations

$\sigma_{v,eq}$: Total overburden pressure at test point, during earthquake (tsf)
$u_{o,eq}$: Water pressure at test point, during earthquake (tsf)
$\sigma'_{vo,eq}$: Effective overburden pressure, during earthquake (tsf)
r_d : Nonlinear shear mass factor
α: Improvement factor due to stone columns
CSR : Cyclic Stress Ratio (adjusted for improvement)
MSF : Magnitude Scaling Factor
$CSR_{eq,M=7.5}$: CSR adjusted for M=7.5
K_{sigma}: Effective overburden stress factor
CSR^*: CSR fully adjusted (user FS applied)***
FS: Calculated factor of safety against soil liquefaction

*** User FS: 1.10

:: Liquefaction potential according to Iwasaki ::

Depth (ft)	FS	F	wz	Thickness (ft)	I_L
5.00	2.000	0.00	9.24	5.00	0.00
10.00	0.739	0.26	8.48	5.00	3.37
12.50	2.000	0.00	8.10	2.50	0.00
15.00	2.000	0.00	7.71	2.50	0.00
17.50	0.639	0.36	7.33	2.50	2.02
20.00	2.000	0.00	6.95	2.50	0.00
22.50	2.000	0.00	6.57	2.50	0.00
25.00	2.000	0.00	6.19	2.50	0.00
27.50	2.000	0.00	5.81	2.50	0.00
30.00	2.000	0.00	5.43	2.50	0.00
32.50	0.774	0.23	5.05	2.50	0.87
35.00	2.000	0.00	4.67	2.50	0.00
37.50	2.000	0.00	4.29	2.50	0.00
40.00	2.000	0.00	3.90	2.50	0.00
42.50	2.000	0.00	3.52	2.50	0.00
45.00	2.000	0.00	3.14	2.50	0.00
47.50	2.000	0.00	2.76	2.50	0.00
50.00	2.000	0.00	2.38	2.50	0.00
52.50	2.000	0.00	2.00	2.50	0.00
55.00	2.000	0.00	1.62	2.50	0.00
57.50	2.000	0.00	1.24	2.50	0.00
60.00	2.000	0.00	0.86	2.50	0.00

Overall potential I_L : 6.26

I_L = 0.00 - No liquefaction
I_L between 0.00 and 5 - Liquefaction not probable
I_L between 5 and 15 - Liquefaction probable
I_L > 15 - Liquefaction certain

:: Vertical settlements estimation for dry sands ::

Depth (ft)	$(N_1)_{60}$	τ_{av}	p	G_{max} (tsf)	α	b	γ	ε_{15}	N_c	ε_{Nc} (%)	Δh (ft)	ΔS (in)
5.00	42	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.50	0.000

:: Vertical settlements estimation for dry sands ::

Depth (ft)	$(N_1)_{60}$	τ_{av}	p	G_{max} (tsf)	α	b	γ	ε_{15}	N_c	ε_{Nc} (%)	Δh (ft)	ΔS (in)

Cumulative settlemetns: 0.000

Abbreviations

τ_{av}: Average cyclic shear stress
p: Average stress
G_{max}: Maximum shear modulus (tsf)
α, b: Shear strain formula variables
γ: Average shear strain
ε_{15}: Volumetric strain after 15 cycles
N_c: Number of cycles
ε_{Nc}: Volumetric strain for number of cycles N_c (%)
Δh: Thickness of soil layer (in)
ΔS: Settlement of soil layer (in)

:: Vertical settlements estimation for saturated sands ::

Depth (ft)	D_{50} (in)	q_c/N	e_v (%)	Δh (ft)	s (in)
10.00	0.00	5.00	2.16	2.50	0.648
12.50	0.00	5.00	0.00	2.50	0.000
15.00	0.00	5.00	0.00	2.50	0.000
17.50	0.00	5.00	2.16	2.50	0.648
20.00	0.00	5.00	0.00	2.50	0.000
22.50	0.00	5.00	0.00	2.50	0.000
25.00	0.00	5.00	0.00	2.50	0.000
27.50	0.00	5.00	0.00	2.50	0.000
30.00	0.00	5.00	0.00	2.50	0.000
32.50	0.00	5.00	1.31	2.50	0.393
35.00	0.00	5.00	0.00	2.50	0.000
37.50	0.00	5.00	0.00	2.50	0.000
40.00	0.00	5.00	0.00	2.50	0.000
42.50	0.00	5.00	0.00	2.50	0.000
45.00	0.00	5.00	0.00	2.50	0.000
47.50	0.00	5.00	0.00	2.50	0.000
50.00	0.00	5.00	0.00	2.50	0.000
52.50	0.00	5.00	0.00	2.50	0.000
55.00	0.00	5.00	0.00	2.50	0.000
57.50	0.00	5.00	0.00	2.50	0.000
60.00	0.00	5.00	0.00	2.50	0.000

Cumulative settlements: 1.690

Abbreviations

D_{50}: Median grain size (in)
q_c/N: Ratio of cone resistance to SPT
e_v: Post liquefaction volumetric strain (%)
Δh: Thickness of soil layer to be considered (ft)
s: Estimated settlement (in)

Twining Consulting

TWINING

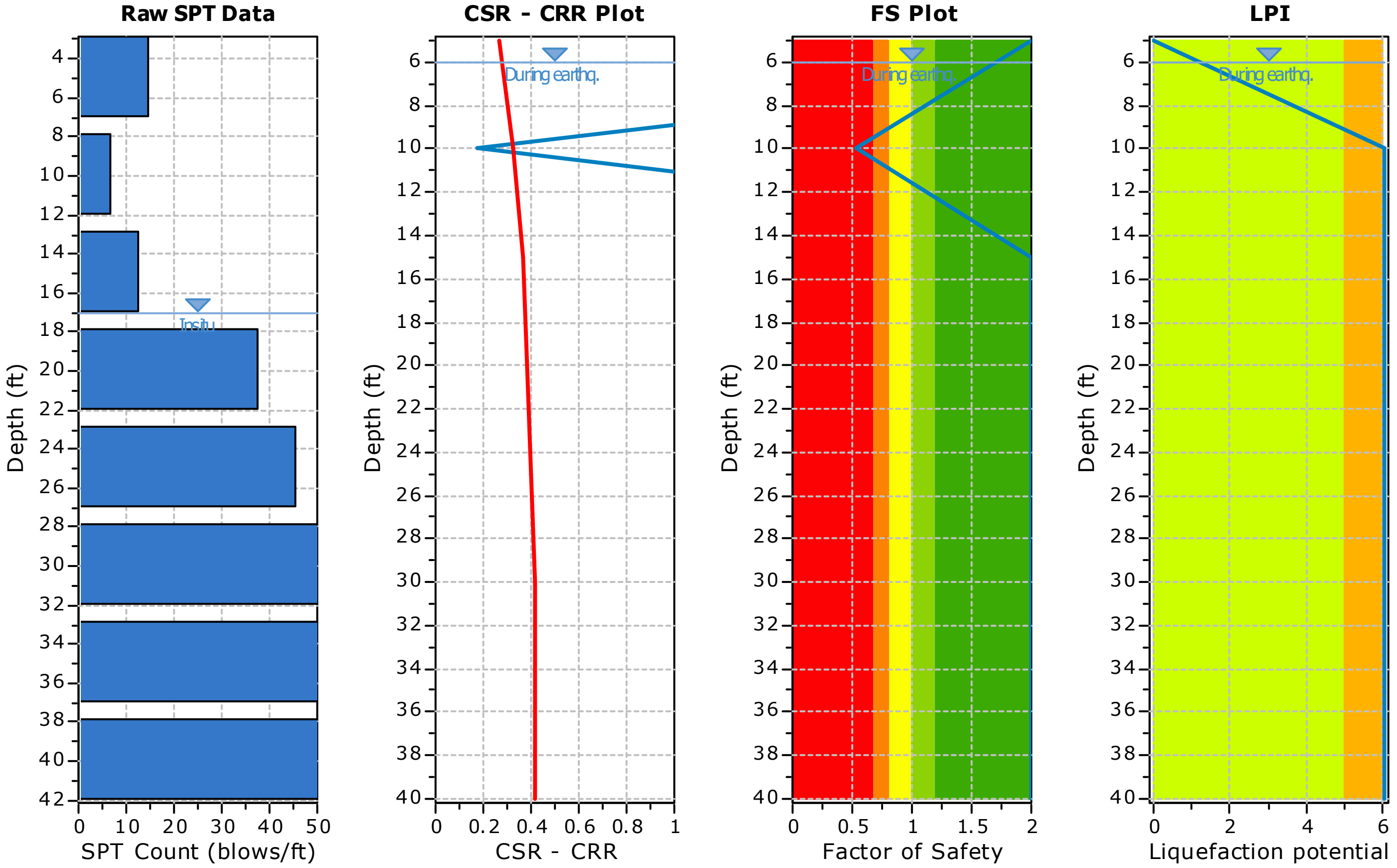
SPT BASED LIQUEFACTION ANALYSIS REPORT

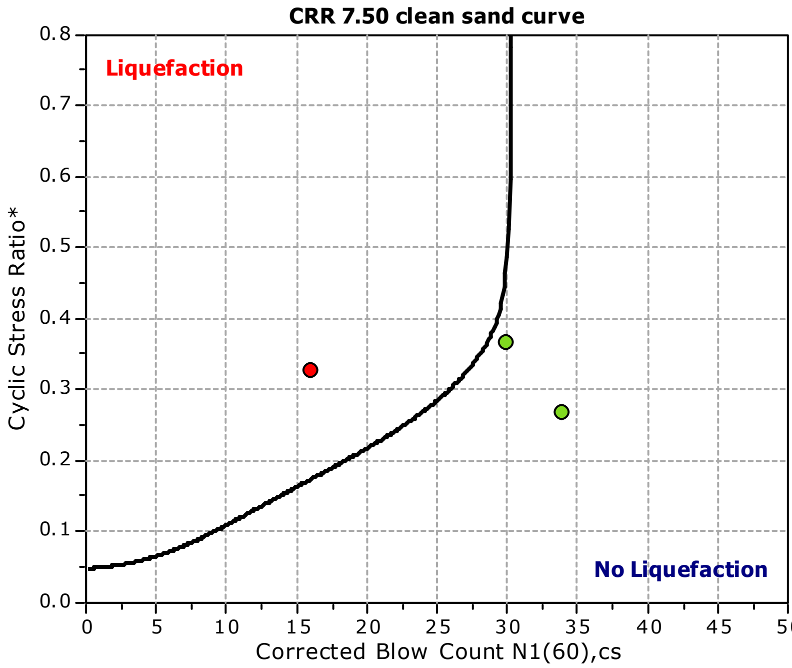
Project title : Proposed Del Rey Avenue Building **SPT Name: IGI B4**

Location : 4112 Del Rey Ave, Marina Del Rey, CA

:: Input parameters and analysis properties ::

Analysis method:	NCEER 1998	G.W.T. (in-situ):	17.00 ft
Fines correction method:	NCEER 1998	G.W.T. (earthq.):	6.00 ft
Sampling method:	Sampler wo liners	Earthquake magnitude M_w:	6.35
Borehole diameter:	200mm	Peak ground acceleration:	0.58 g
Rod length:	3.30 ft	Eq. external load:	0.00 tsf
Hammer energy ratio:	1.33		





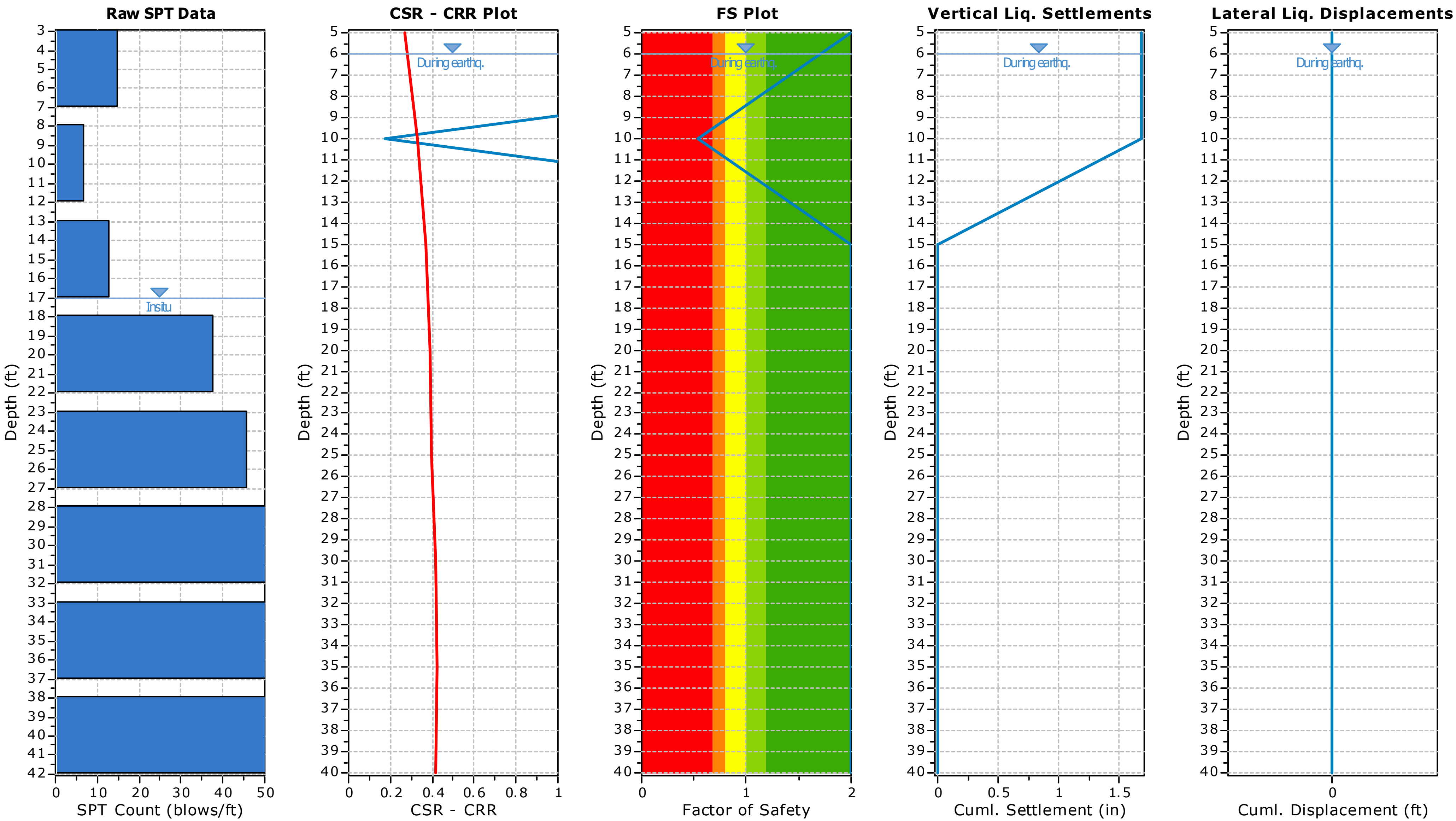
F.S. color scheme

- Almost certain it will liquefy
- Very likely to liquefy
- Liquefaction and no liq. are equally likely
- Unlike to liquefy
- Almost certain it will not liquefy

LPI color scheme

- Very high risk
- High risk
- Low risk

:: Overall Liquefaction Assessment Analysis Plots ::



:: Field input data ::

Test Depth (ft)	SPT Field Value (blows)	Fines Content (%)	Unit Weight (pcf)	Infl. Thickness (ft)	Can Liquefy
5.00	15	15.00	132.00	5.00	No
10.00	7	15.00	132.00	5.00	Yes
15.00	13	70.00	132.00	5.00	No
20.00	38	1.00	132.00	5.00	Yes
25.00	46	1.00	132.00	5.00	Yes
30.00	65	1.00	132.00	5.00	Yes
35.00	65	15.00	132.00	5.00	Yes
40.00	65	15.00	132.00	5.00	Yes

Abbreviations

Depth: Depth at which test was performed (ft)
SPT Field Value: Number of blows per foot
Fines Content: Fines content at test depth (%)
Unit Weight: Unit weight at test depth (pcf)
Infl. Thickness: Thickness of the soil layer to be considered in settlements analysis (ft)
Can Liquefy: User defined switch for excluding/including test depth from the analysis procedure

:: Cyclic Resistance Ratio (CRR) calculation data ::

Depth (ft)	SPT Field Value	Unit Weight (pcf)	σ_v (tsf)	u_o (tsf)	σ'_{vo} (tsf)	C_N	C_E	C_B	C_R	C_S	$(N_1)_{60}$	Fines Content (%)	α	β	$(N_1)_{60cs}$	$CRR_{7.5}$
5.00	15	132.00	0.33	0.00	0.33	1.46	1.33	1.15	0.75	1.20	30	15.00	2.50	1.05	34	4.000
10.00	7	132.00	0.66	0.00	0.66	1.21	1.33	1.15	0.85	1.20	13	15.00	2.50	1.05	16	0.174
15.00	13	132.00	0.99	0.00	0.99	1.03	1.33	1.15	0.85	1.20	21	70.00	5.00	1.20	30	4.000
20.00	38	132.00	1.32	0.09	1.23	0.93	1.33	1.15	0.95	1.20	62	1.00	0.00	1.00	62	4.000
25.00	46	132.00	1.65	0.25	1.40	0.87	1.33	1.15	0.95	1.20	70	1.00	0.00	1.00	70	4.000
30.00	65	132.00	1.98	0.41	1.57	0.82	1.33	1.15	1.00	1.20	98	1.00	0.00	1.00	98	4.000
35.00	65	132.00	2.31	0.56	1.75	0.77	1.33	1.15	1.00	1.20	92	15.00	2.50	1.05	99	4.000
40.00	65	132.00	2.64	0.72	1.92	0.73	1.33	1.15	1.00	1.20	87	15.00	2.50	1.05	94	4.000

Abbreviations

σ_v: Total stress during SPT test (tsf)
u_o: Water pore pressure during SPT test (tsf)
σ'_{vo}: Effective overburden pressure during SPT test (tsf)
C_N: Overburden corretion factor
C_E: Energy correction factor
C_B: Borehole diameter correction factor
C_R: Rod length correction factor
C_S: Liner correction factor
$N_{1(60)}$: Corrected N_{SPT} to a 60% energy ratio
α, β: Clean sand equivalent clean sand formula coefficients
$N_{1(60)cs}$: Corected $N_{1(60)}$ value for fines content
$CRR_{7.5}$: Cydic resistance ratio for M=7.5

:: Cyclic Stress Ratio calculation (CSR fully adjusted and normalized) ::

Depth (ft)	Unit Weight (pcf)	$\sigma_{v,eq}$ (tsf)	$u_{o,eq}$ (tsf)	$\sigma'_{vo,eq}$ (tsf)	r_d	α	CSR	MSF	$CSR_{eq,M=7.5}$	K_{sigma}	CSR^*	FS
5.00	132.00	0.33	0.00	0.33	0.99	1.00	0.373	1.53	0.244	1.00	0.295	2.000
10.00	132.00	0.66	0.12	0.54	0.98	1.00	0.455	1.53	0.297	1.00	0.360	0.532
15.00	132.00	0.99	0.28	0.71	0.97	1.00	0.510	1.53	0.333	1.00	0.403	2.000
20.00	132.00	1.32	0.44	0.88	0.96	1.00	0.539	1.53	0.352	1.00	0.426	2.000
25.00	132.00	1.65	0.59	1.06	0.94	1.00	0.554	1.53	0.362	1.00	0.438	2.000
30.00	132.00	1.98	0.75	1.23	0.92	1.00	0.558	1.53	0.365	0.97	0.455	2.000

:: Cyclic Stress Ratio calculation (CSR fully adjusted and normalized) ::

Depth (ft)	Unit Weight (pcf)	$\sigma_{v,eq}$ (tsf)	$u_{o,eq}$ (tsf)	$\sigma'_{vo,eq}$ (tsf)	r_d	α	CSR	MSF	$CSR_{eq,M=7.5}$	K_{sigma}	CSR^*	FS	
35.00	132.00	2.31	0.90	1.41	0.89	1.00	0.552	1.53	0.361	0.94	0.462	2.000	●
40.00	132.00	2.64	1.06	1.58	0.85	1.00	0.536	1.53	0.350	0.92	0.459	2.000	●

Abbreviations

$\sigma_{v,eq}$: Total overburden pressure at test point, during earthquake (tsf)
$u_{o,eq}$: Water pressure at test point, during earthquake (tsf)
$\sigma'_{vo,eq}$: Effective overburden pressure, during earthquake (tsf)
r_d : Nonlinear shear mass factor
α: Improvement factor due to stone columns
CSR : Cyclic Stress Ratio (adjusted for improvement)
MSF : Magnitude Scaling Factor
$CSR_{eq,M=7.5}$: CSR adjusted for M=7.5
K_{sigma}: Effective overburden stress factor
CSR^*: CSR fully adjusted (user FS applied)***
FS: Calculated factor of safety against soil liquefaction

*** User FS: 1.10

:: Liquefaction potential according to Iwasaki ::

Depth (ft)	FS	F	wz	Thickness (ft)	I_L
5.00	2.000	0.00	9.24	5.00	0.00
10.00	0.532	0.47	8.48	5.00	6.04
15.00	2.000	0.00	7.71	5.00	0.00
20.00	2.000	0.00	6.95	5.00	0.00
25.00	2.000	0.00	6.19	5.00	0.00
30.00	2.000	0.00	5.43	5.00	0.00
35.00	2.000	0.00	4.67	5.00	0.00
40.00	2.000	0.00	3.90	5.00	0.00

Overall potential I_L : 6.04

I_L = 0.00 - No liquefaction
I_L between 0.00 and 5 - Liquefaction not probable
I_L between 5 and 15 - Liquefaction probable
I_L > 15 - Liquefaction certain

:: Vertical settlements estimation for dry sands ::

Depth (ft)	$(N_1)_{60}$	τ_{av}	p	G_{max} (tsf)	α	b	γ	ε_{15}	N_c	ε_{Nc} (%)	Δh (ft)	ΔS (in)
5.00	30	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	5.00	0.000

Cumulative settlemetns: 0.000

Abbreviations

τ_{av}: Average cyclic shear stress
p: Average stress
G_{max}: Maximum shear modulus (tsf)
α, b: Shear strain formula variables
γ: Average shear strain
ε_{15}: Volumetric strain after 15 cycles
N_c: Number of cycles
ε_{Nc}: Volumetric strain for number of cycles N_c (%)
Δh: Thickness of soil layer (in)
ΔS: Settlement of soil layer (in)

:: Vertical settlements estimation for saturated sands ::

Depth (ft)	D_{50} (in)	q_c/N	e_v (%)	Δh (ft)	s (in)
10.00	0.00	5.00	2.81	5.00	1.684
15.00	0.00	5.00	0.00	5.00	0.000
20.00	0.00	5.00	0.00	5.00	0.000
25.00	0.00	5.00	0.00	5.00	0.000
30.00	0.00	5.00	0.00	5.00	0.000
35.00	0.00	5.00	0.00	5.00	0.000
40.00	0.00	5.00	0.00	5.00	0.000

Cumulative settlements: 1.684

Abbreviations

D_{50}: Median grain size (in)
q_c/N: Ratio of cone resistance to SPT
e_v: Post liquefaction volumetric strain (%)
Δh: Thickness of soil layer to be considered (ft)
s: Estimated settlement (in)

Twining Consulting

TWINING

SPT BASED LIQUEFACTION ANALYSIS REPORT

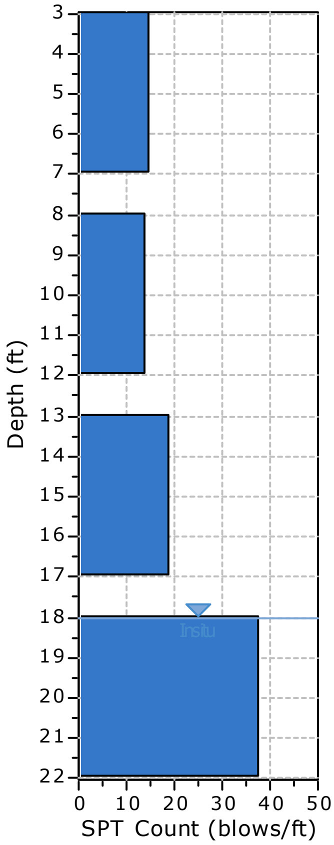
Project title : Proposed Del Rey Avenue Building **SPT Name: IGI B5**

Location : 4112 Del Rey Ave, Marina Del Rey, CA

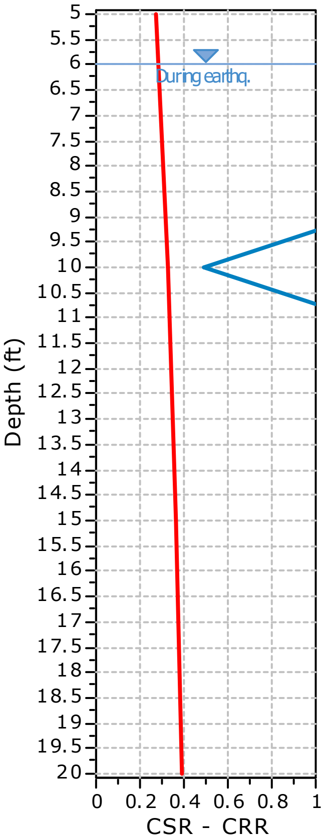
:: Input parameters and analysis properties ::

Analysis method:	NCEER 1998	G.W.T. (in-situ):	18.00 ft
Fines correction method:	NCEER 1998	G.W.T. (earthq.):	6.00 ft
Sampling method:	Sampler wo liners	Earthquake magnitude M_w:	6.35
Borehole diameter:	200mm	Peak ground acceleration:	0.58 g
Rod length:	3.30 ft	Eq. external load:	0.00 tsf
Hammer energy ratio:	1.33		

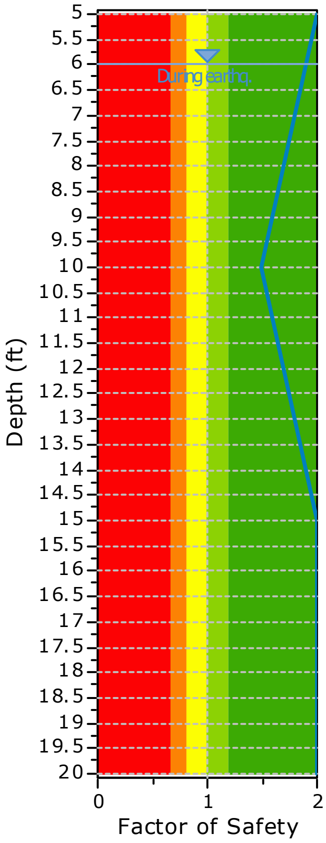
Raw SPT Data



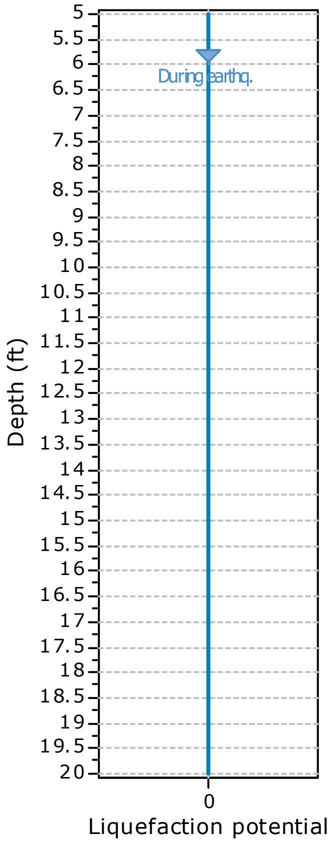
CSR - CRR Plot



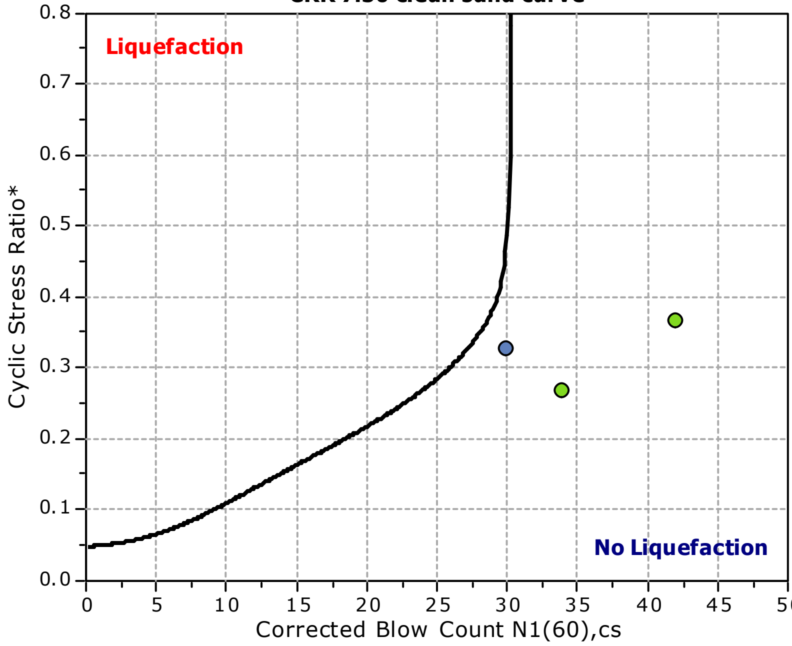
FS Plot



LPI



CRR 7.50 clean sand curve



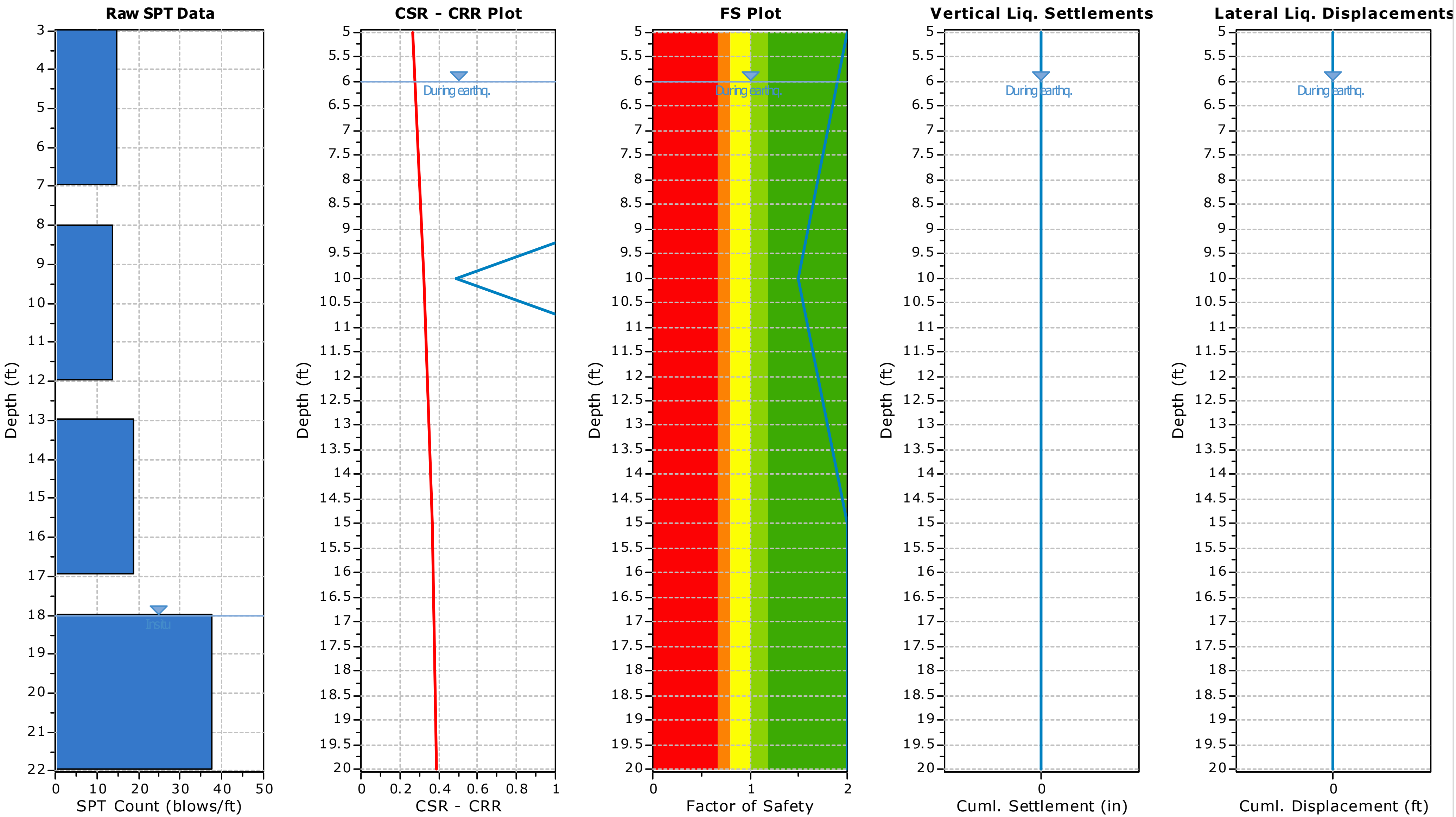
F.S. color scheme

- Almost certain it will liquefy
- Very likely to liquefy
- Liquefaction and no liq. are equally likely
- Unlike to liquefy
- Almost certain it will not liquefy

LPI color scheme

- Very high risk
- High risk
- Low risk

:: Overall Liquefaction Assessment Analysis Plots ::



:: Field input data ::

Test Depth (ft)	SPT Field Value (blows)	Fines Content (%)	Unit Weight (pcf)	Infl. Thickness (ft)	Can Liquefy
5.00	15	15.00	132.00	5.00	No
10.00	14	15.00	132.00	5.00	Yes
15.00	19	70.00	132.00	5.00	No
20.00	38	15.00	132.00	5.00	Yes

Abbreviations

Depth: Depth at which test was performed (ft)
SPT Field Value: Number of blows per foot
Fines Content: Fines content at test depth (%)
Unit Weight: Unit weight at test depth (pcf)
Infl. Thickness: Thickness of the soil layer to be considered in settlements analysis (ft)
Can Liquefy: User defined switch for excluding/including test depth from the analysis procedure

:: Cyclic Resistance Ratio (CRR) calculation data ::

Depth (ft)	SPT Field Value	Unit Weight (pcf)	σ_v (tsf)	u_o (tsf)	σ'_{vo} (tsf)	C_N	C_E	C_B	C_R	C_S	$(N_1)_{60}$	Fines Content (%)	α	β	$(N_1)_{60cs}$	$CRR_{7.5}$
5.00	15	132.00	0.33	0.00	0.33	1.46	1.33	1.15	0.75	1.20	30	15.00	2.50	1.05	34	4.000
10.00	14	132.00	0.66	0.00	0.66	1.21	1.33	1.15	0.85	1.20	26	15.00	2.50	1.05	30	0.488
15.00	19	132.00	0.99	0.00	0.99	1.03	1.33	1.15	0.85	1.20	31	70.00	5.00	1.20	42	4.000
20.00	38	132.00	1.32	0.06	1.26	0.92	1.33	1.15	0.95	1.20	61	15.00	2.50	1.05	66	4.000

Abbreviations

σ_v: Total stress during SPT test (tsf)
u_o: Water pore pressure during SPT test (tsf)
σ'_{vo}: Effective overburden pressure during SPT test (tsf)
C_N: Overburden corretion factor
C_E: Energy correction factor
C_B: Borehole diameter correction factor
C_R: Rod length correction factor
C_S: Liner correction factor
$N_{1(60)}$: Corrected N_{SPT} to a 60% energy ratio
α, β: Clean sand equivalent clean sand formula coefficients
$N_{1(60)cs}$: Corected $N_{1(60)}$ value for fines content
$CRR_{7.5}$: Cydic resistance ratio for M=7.5

:: Cyclic Stress Ratio calculation (CSR fully adjusted and normalized) ::

Depth (ft)	Unit Weight (pcf)	$\sigma_{v,eq}$ (tsf)	$u_{o,eq}$ (tsf)	$\sigma'_{vo,eq}$ (tsf)	r_d	α	CSR	MSF	$CSR_{eq,M=7.5}$	K_{sigma}	CSR^*	FS	
5.00	132.00	0.33	0.00	0.33	0.99	1.00	0.373	1.53	0.244	1.00	0.295	2.000	●
10.00	132.00	0.66	0.12	0.54	0.98	1.00	0.455	1.53	0.297	1.00	0.360	1.492	●
15.00	132.00	0.99	0.28	0.71	0.97	1.00	0.510	1.53	0.333	1.00	0.403	2.000	●
20.00	132.00	1.32	0.44	0.88	0.96	1.00	0.539	1.53	0.352	1.00	0.426	2.000	●

Abbreviations

$\sigma_{v,eq}$: Total overburden pressure at test point, during earthquake (tsf)
$u_{o,eq}$: Water pressure at test point, during earthquake (tsf)
$\sigma'_{vo,eq}$: Effective overburden pressure, during earthquake (tsf)
r_d : Nonlinear shear mass factor
α: Improvement factor due to stone columns
CSR : Cyclic Stress Ratio (adjusted for improvement)
MSF : Magnitude Scaling Factor
$CSR_{eq,M=7.5}$: CSR adjusted for M=7.5
K_{sigma}: Effective overburden stress factor
CSR^*: CSR fully adjusted (user FS applied)***
FS: Calculated factor of safety against soil liquefaction

*** User FS: 1.10

:: Liquefaction potential according to Iwasaki ::

Depth (ft)	FS	F	wz	Thickness (ft)	I_L
5.00	2.000	0.00	9.24	5.00	0.00
10.00	1.492	0.00	8.48	5.00	0.00
15.00	2.000	0.00	7.71	5.00	0.00
20.00	2.000	0.00	6.95	5.00	0.00

Overall potential I_L : 0.00

I_L = 0.00 - No liquefaction
I_L between 0.00 and 5 - Liquefaction not probable
I_L between 5 and 15 - Liquefaction probable
I_L > 15 - Liquefaction certain

:: Vertical settlements estimation for dry sands ::

Depth (ft)	$(N_1)_{60}$	τ_{av}	p	G_{max} (tsf)	α	b	γ	ε_{15}	N_c	ε_{Nc} (%)	Δh (ft)	ΔS (in)
5.00	30	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	5.00	0.000

Cumulative settlemetns: 0.000

Abbreviations

τ_{av}: Average cyclic shear stress
p: Average stress
G_{max}: Maximum shear modulus (tsf)
α, b: Shear strain formula variables
γ: Average shear strain
ε_{15}: Volumetric strain after 15 cycles
N_c: Number of cycles
ε_{Nc}: Volumetric strain for number of cycles N_c (%)
Δh: Thickness of soil layer (in)
ΔS: Settlement of soil layer (in)

:: Vertical settlements estimation for saturated sands ::

Depth (ft)	D_{50} (in)	q_c/N	e_v (%)	Δh (ft)	s (in)
10.00	0.00	5.00	0.00	5.00	0.000
15.00	0.00	5.00	0.00	5.00	0.000
20.00	0.00	5.00	0.00	5.00	0.000

Cumulative settlements: 0.000

Abbreviations

D_{50}: Median grain size (in)
q_c/N: Ratio of cone resistance to SPT
e_v: Post liquefaction volumetric strain (%)
Δh: Thickness of soil layer to be considered (ft)
s: Estimated settlement (in)

References

- Ronald D. Andrus, Hossein Hayati, Nisha P. Mohanan, 2009. Correcting Liquefaction Resistance for Aged Sands Using Measured to Estimated Velocity Ratio, Journal of Geotechnical and Geoenvironmental Engineering, Vol. 135, No. 6, June 1

- Boulanger, R.W. and Idriss, I. M., 2014. CPT AND SPT BASED LIQUEFACTION TRIGGERING PROCEDURES. DEPARTMENT OF CIVIL & ENVIRONMENTAL ENGINEERING COLLEGE OF ENGINEERING UNIVERSITY OF CALIFORNIA AT DAVIS

- Dipl.-Ing. Heinz J. Priebe, Vibro Replacement to Prevent Earthquake Induced Liquefaction, Proceedings of the Geotechnique-Colloquium at Darmstadt, Germany, on March 19th, 1998 (also published in Ground Engineering, September 1998), Technical paper 12-57E

- Robertson, P.K. and Cabal, K.L., 2007, Guide to Cone Penetration Testing for Geotechnical Engineering. Available at no cost at http://www.geologismiki.gr/

- Youd, T.L., Idriss, I.M., Andrus, R.D., Arango, I., Castro, G., Christian, J.T., Dobry, R., Finn, W.D.L., Harder, L.F., Hynes, M.E., Ishihara, K., Koester, J., Liao, S., Marcuson III, W.F., Martin, G.R., Mitchell, J.K., Moriwaki, Y., Power, M.S., Robertson, P.K., Seed, R., and Stokoe, K.H., Liquefaction Resistance of Soils: Summary Report from the 1996 NCEER and 1998 NCEER/NSF Workshop on Evaluation of Liquefaction Resistance of Soils, ASCE, Journal of Geotechnical & Geoenvironmental Engineering, Vol. 127, October, pp 817-833

- Zhang, G., Robertson. P.K., Brachman, R., 2002, Estimating Liquefaction Induced Ground Settlements from the CPT, Canadian Geotechnical Journal, 39: pp 1168-1180

- Zhang, G., Robertson. P.K., Brachman, R., 2004, Estimating Liquefaction Induced Lateral Displacements using the SPT and CPT, ASCE, Journal of Geotechnical & Geoenvironmental Engineering, Vol. 130, No. 8, 861-871

- Pradel, D., 1998, Procedure to Evaluate Earthquake-Induced Settlements in Dry Sandy Soils, ASCE, Journal of Geotechnical & Geoenvironmental Engineering, Vol. 124, No. 4, 364-368

- R. Kayen, R. E. S. Moss, E. M. Thompson, R. B. Seed, K. O. Cetin, A. Der Kiureghian, Y. Tanaka, K. Tokimatsu, 2013. Shear-Wave Velocity–Based Probabilistic and Deterministic Assessment of Seismic Soil Liquefaction Potential, Journal of Geotechnical and Geoenvironmental Engineering, Vol. 139, No. 3, March 1

Twining Consulting

TWINING

SPT BASED LIQUEFACTION ANALYSIS REPORT

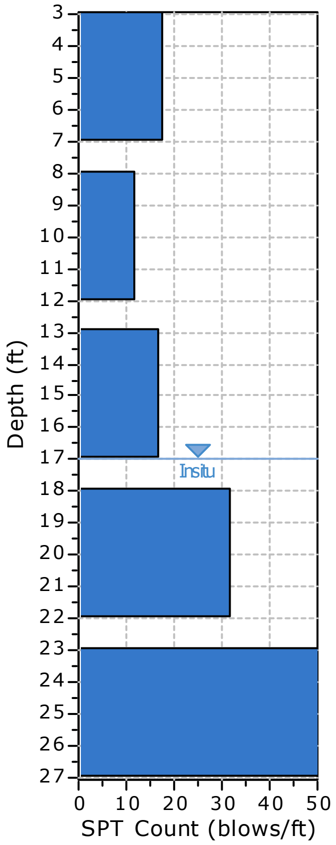
Project title : Proposed Del Rey Avenue Building **SPT Name: B-1**

Location : 4112 Del Rey Ave, Marina Del Rey, CA

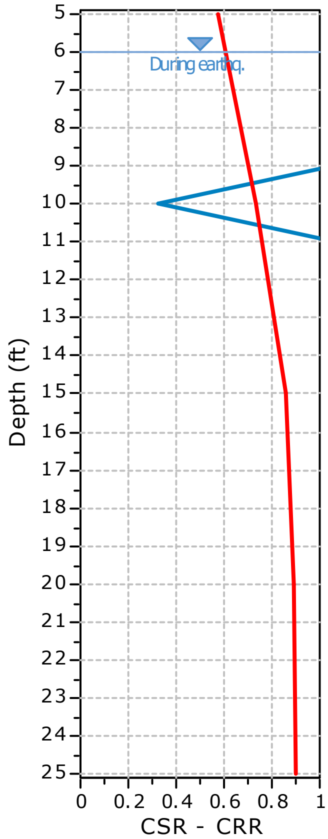
:: Input parameters and analysis properties ::

Analysis method:	NCEER 1998	G.W.T. (in-situ):	17.00 ft
Fines correction method:	NCEER 1998	G.W.T. (earthq.):	6.00 ft
Sampling method:	Sampler wo liners	Earthquake magnitude M_w:	7.31
Borehole diameter:	200mm	Peak ground acceleration:	0.87 g
Rod length:	3.30 ft	Eq. external load:	0.00 tsf
Hammer energy ratio:	1.30		

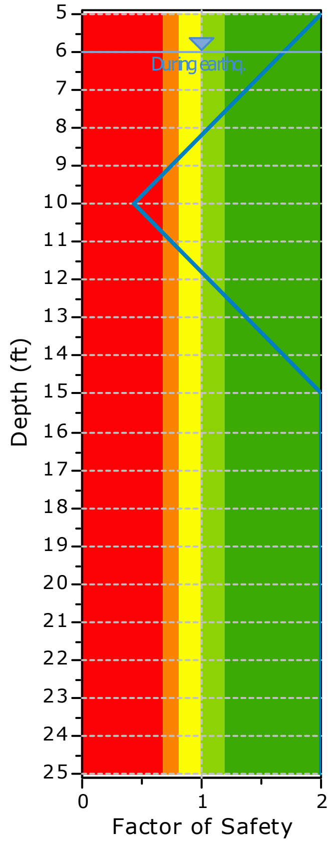
Raw SPT Data



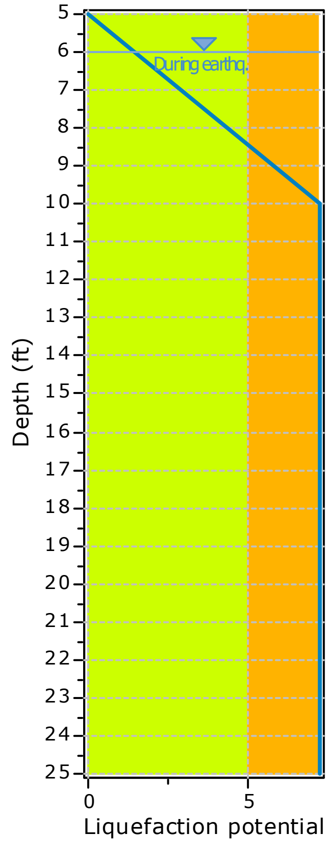
CSR - CRR Plot



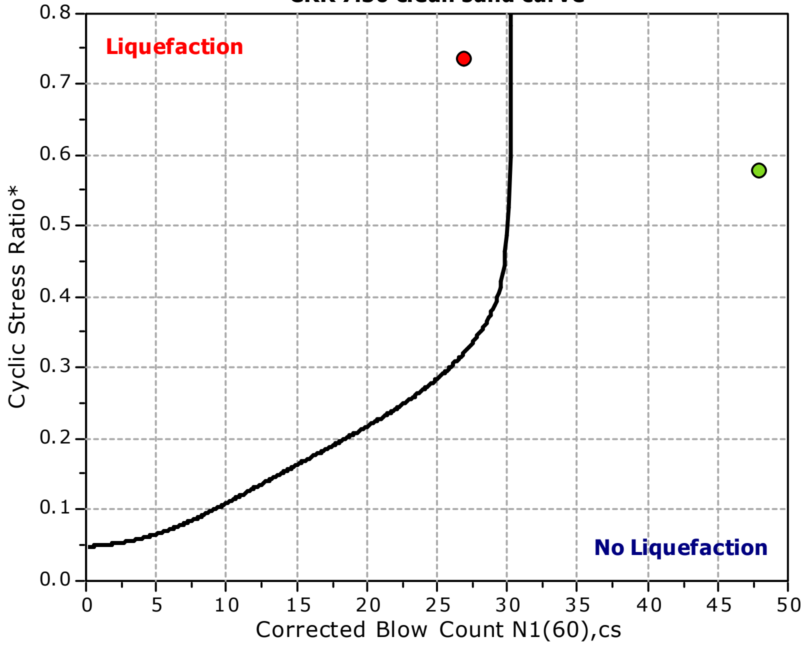
FS Plot



LPI



CRR 7.50 clean sand curve



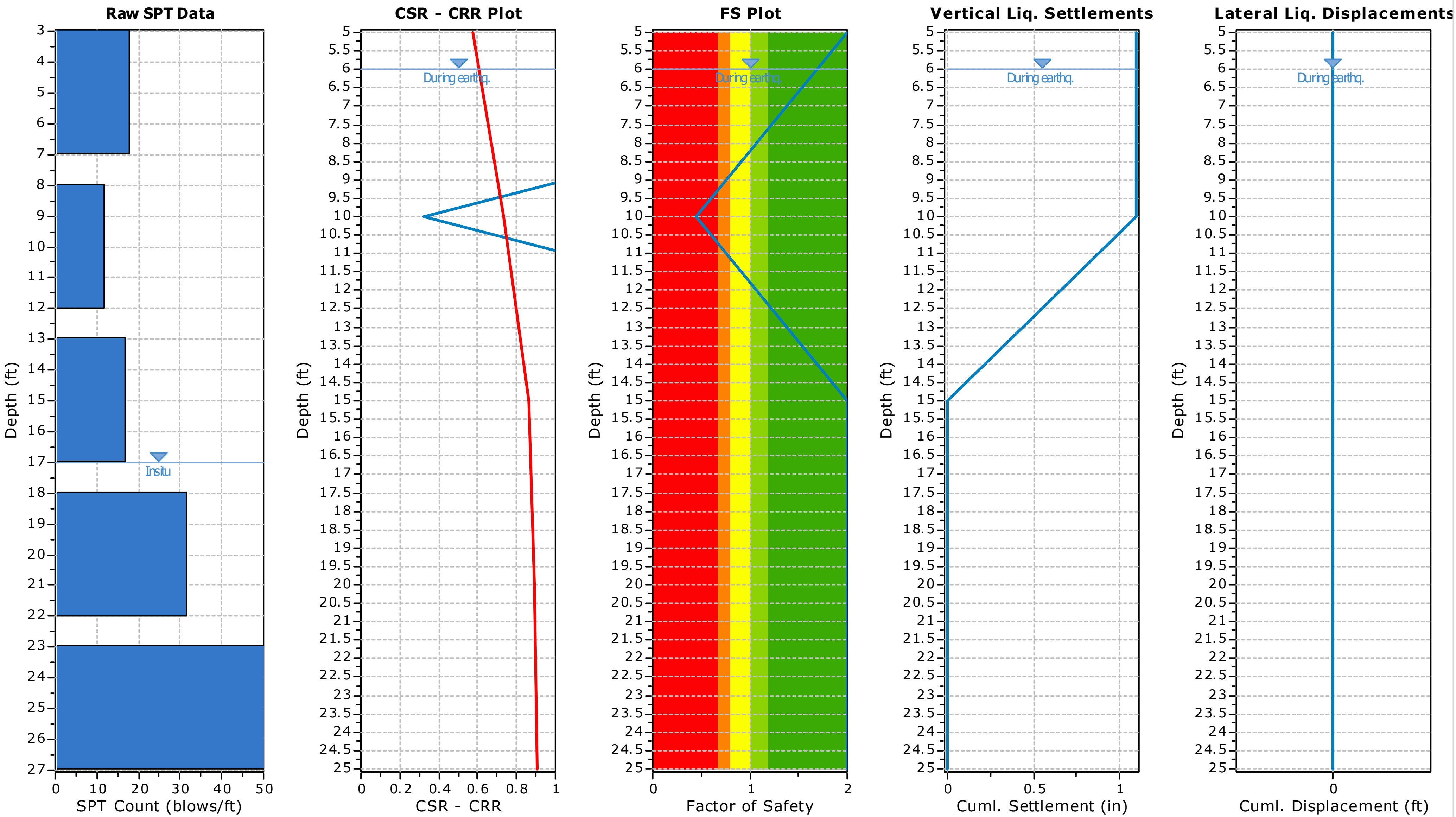
F.S. color scheme

- Almost certain it will liquefy
- Very likely to liquefy
- Liquefaction and no liq. are equally likely
- Unlike to liquefy
- Almost certain it will not liquefy

LPI color scheme

- Very high risk
- High risk
- Low risk

:: Overall Liquefaction Assessment Analysis Plots ::



:: Field input data ::

Test Depth (ft)	SPT Field Value (blows)	Fines Content (%)	Unit Weight (pcf)	Infl. Thickness (ft)	Can Liquefy
5.00	18	70.00	120.00	5.00	No
10.00	12	15.00	103.00	5.00	Yes
15.00	17	70.00	103.00	5.00	No
20.00	32	10.00	139.00	5.00	Yes
25.00	100	10.00	139.00	5.00	Yes

Abbreviations

Depth: Depth at which test was performed (ft)
SPT Field Value: Number of blows per foot
Fines Content: Fines content at test depth (%)
Unit Weight: Unit weight at test depth (pcf)
Infl. Thickness: Thickness of the soil layer to be considered in settlements analysis (ft)
Can Liquefy: User defined switch for excluding/including test depth from the analysis procedure

:: Cyclic Resistance Ratio (CRR) calculation data ::

Depth (ft)	SPT Field Value	Unit Weight (pcf)	σ_v (tsf)	u_o (tsf)	σ'_{vo} (tsf)	C_N	C_E	C_B	C_R	C_S	$(N_1)_{60}$	Fines Content (%)	α	β	$(N_1)_{60cs}$	$CRR_{7.5}$
5.00	18	120.00	0.30	0.00	0.30	1.48	1.30	1.15	0.75	1.20	36	70.00	5.00	1.20	48	4.000
10.00	12	103.00	0.56	0.00	0.56	1.27	1.30	1.15	0.85	1.20	23	15.00	2.50	1.05	27	0.323
15.00	17	103.00	0.81	0.00	0.81	1.12	1.30	1.15	0.85	1.20	29	70.00	5.00	1.20	40	4.000
20.00	32	139.00	1.16	0.09	1.07	1.00	1.30	1.15	0.95	1.20	54	10.00	0.87	1.02	56	4.000
25.00	100	139.00	1.51	0.25	1.26	0.92	1.30	1.15	0.95	1.20	157	10.00	0.87	1.02	161	4.000

Abbreviations

σ_v: Total stress during SPT test (tsf)
u_o: Water pore pressure during SPT test (tsf)
σ'_{vo}: Effective overburden pressure during SPT test (tsf)
C_N: Overburden corretion factor
C_E: Energy correction factor
C_B: Borehole diameter correction factor
C_R: Rod length correction factor
C_S: Liner correction factor
$N_{1(60)}$: Corrected N_{SPT} to a 60% energy ratio
α, β: Clean sand equivalent clean sand formula coefficients
$N_{1(60)cs}$: Corected $N_{1(60)}$ value for fines content
$CRR_{7.5}$: Cydic resistance ratio for M=7.5

:: Cyclic Stress Ratio calculation (CSR fully adjusted and normalized) ::

Depth (ft)	Unit Weight (pcf)	$\sigma_{v,eq}$ (tsf)	$u_{o,eq}$ (tsf)	$\sigma'_{vo,eq}$ (tsf)	r_d	α	CSR	MSF	$CSR_{eq,M=7.5}$	K_{sigma}	CSR^*	FS
5.00	120.00	0.30	0.00	0.30	0.99	1.00	0.560	1.07	0.525	1.00	0.635	2.000
10.00	103.00	0.56	0.12	0.43	0.98	1.00	0.713	1.07	0.668	1.00	0.809	0.440
15.00	103.00	0.81	0.28	0.53	0.97	1.00	0.836	1.07	0.783	1.00	0.947	2.000
20.00	139.00	1.16	0.44	0.73	0.96	1.00	0.867	1.07	0.812	1.00	0.983	2.000
25.00	139.00	1.51	0.59	0.92	0.94	1.00	0.877	1.07	0.821	1.00	0.994	2.000

:: Cyclic Stress Ratio calculation (CSR fully adjusted and normalized) ::

Depth (ft)	Unit Weight (pcf)	$\sigma_{v,eq}$ (tsf)	$u_{o,eq}$ (tsf)	$\sigma'_{vo,eq}$ (tsf)	r_d	α	CSR	MSF	$CSR_{eq,M=7.5}$	K_{sigma}	CSR^*	FS

Abbreviations

$\sigma_{v,eq}$: Total overburden pressure at test point, during earthquake (tsf)
$u_{o,eq}$: Water pressure at test point, during earthquake (tsf)
$\sigma'_{vo,eq}$: Effective overburden pressure, during earthquake (tsf)
r_d : Nonlinear shear mass factor
α: Improvement factor due to stone columns
CSR : Cyclic Stress Ratio (adjusted for improvement)
MSF : Magnitude Scaling Factor
$CSR_{eq,M=7.5}$: CSR adjusted for M=7.5
K_{sigma}: Effective overburden stress factor
CSR^*: CSR fully adjusted (user FS applied)***
FS: Calculated factor of safety against soil liquefaction

*** User FS: 1.10

:: Liquefaction potential according to Iwasaki ::

Depth (ft)	FS	F	wz	Thickness (ft)	I_L
5.00	2.000	0.00	9.24	5.00	0.00
10.00	0.440	0.56	8.48	5.00	7.24
15.00	2.000	0.00	7.71	5.00	0.00
20.00	2.000	0.00	6.95	5.00	0.00
25.00	2.000	0.00	6.19	5.00	0.00

Overall potential I_L : 7.24

I_L = 0.00 - No liquefaction
I_L between 0.00 and 5 - Liquefaction not probable
I_L between 5 and 15 - Liquefaction probable
I_L > 15 - Liquefaction certain

:: Vertical settlements estimation for dry sands ::

Depth (ft)	$(N_1)_{60}$	τ_{av}	p	G_{max} (tsf)	α	b	γ	ε_{15}	N_c	ε_{Nc} (%)	Δh (ft)	ΔS (in)
5.00	36	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	5.00	0.000

Cumulative settlemetns: 0.000

Abbreviations

τ_{av}: Average cyclic shear stress
p: Average stress
G_{max}: Maximum shear modulus (tsf)
α, b: Shear strain formula variables
γ: Average shear strain
ε_{15}: Volumetric strain after 15 cycles
N_c: Number of cycles
ε_{Nc}: Volumetric strain for number of cycles N_c (%)
Δh: Thickness of soil layer (in)
ΔS: Settlement of soil layer (in)

:: Vertical settlements estimation for saturated sands ::

Depth (ft)	D_{50} (in)	q_c/N	e_v (%)	Δh (ft)	s (in)
10.00	0.00	5.00	1.83	5.00	1.096
15.00	0.00	5.00	0.00	5.00	0.000

:: Vertical settlements estimation for saturated sands ::

Depth (ft)	D_{50} (in)	q_c/N	e_v (%)	Δh (ft)	s (in)
20.00	0.00	5.00	0.00	5.00	0.000
25.00	0.00	5.00	0.00	5.00	0.000

Cumulative settlements: 1.096

Abbreviations

D_{50}: Median grain size (in)
q_c/N: Ratio of cone resistance to SPT
e_v: Post liquefaction volumetric strain (%)
Δh: Thickness of soil layer to be considered (ft)
s: Estimated settlement (in)

Twining Consulting

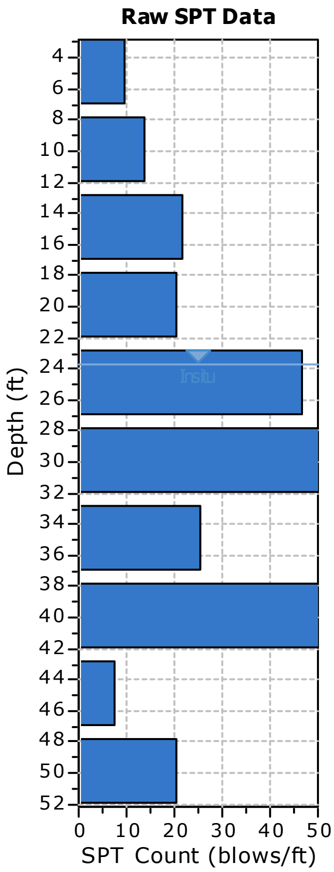
SPT BASED LIQUEFACTION ANALYSIS REPORT

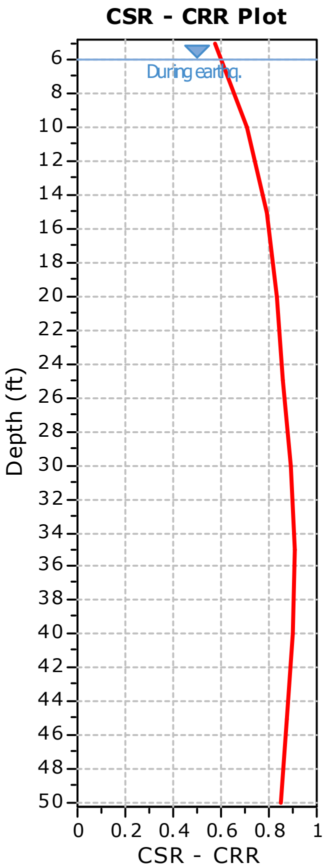
Project title : Proposed Del Rey Avenue Building **SPT Name: B-2**

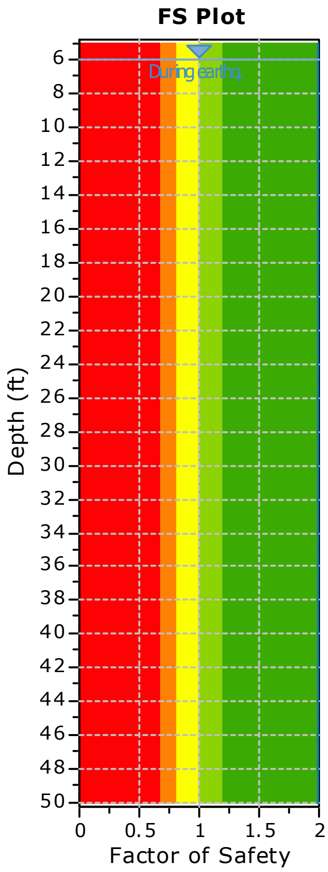
Location : 4112 Del Rey Ave, Marina Del Rey, CA

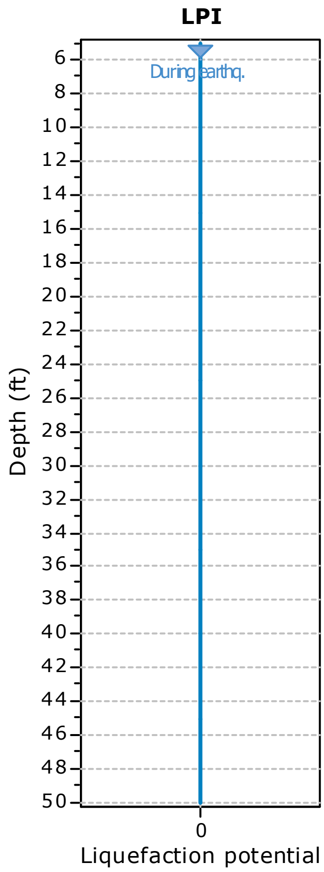
:: Input parameters and analysis properties ::

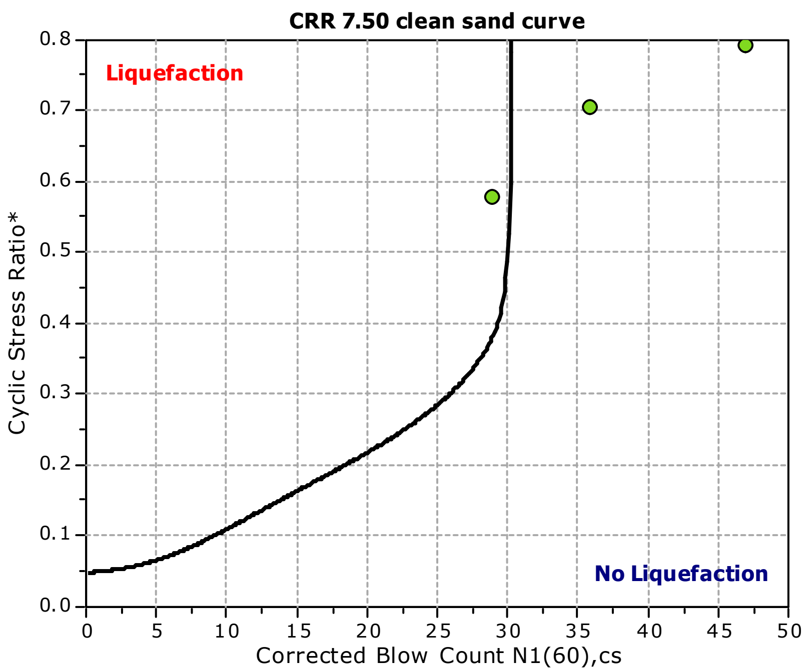
Analysis method:	NCEER 1998	G.W.T. (in-situ):	23.70 ft
Fines correction method:	NCEER 1998	G.W.T. (earthq.):	6.00 ft
Sampling method:	Sampler wo liners	Earthquake magnitude M_w:	7.31
Borehole diameter:	200mm	Peak ground acceleration:	0.87 g
Rod length:	3.30 ft	Eq. external load:	0.00 tsf
Hammer energy ratio:	1.33		











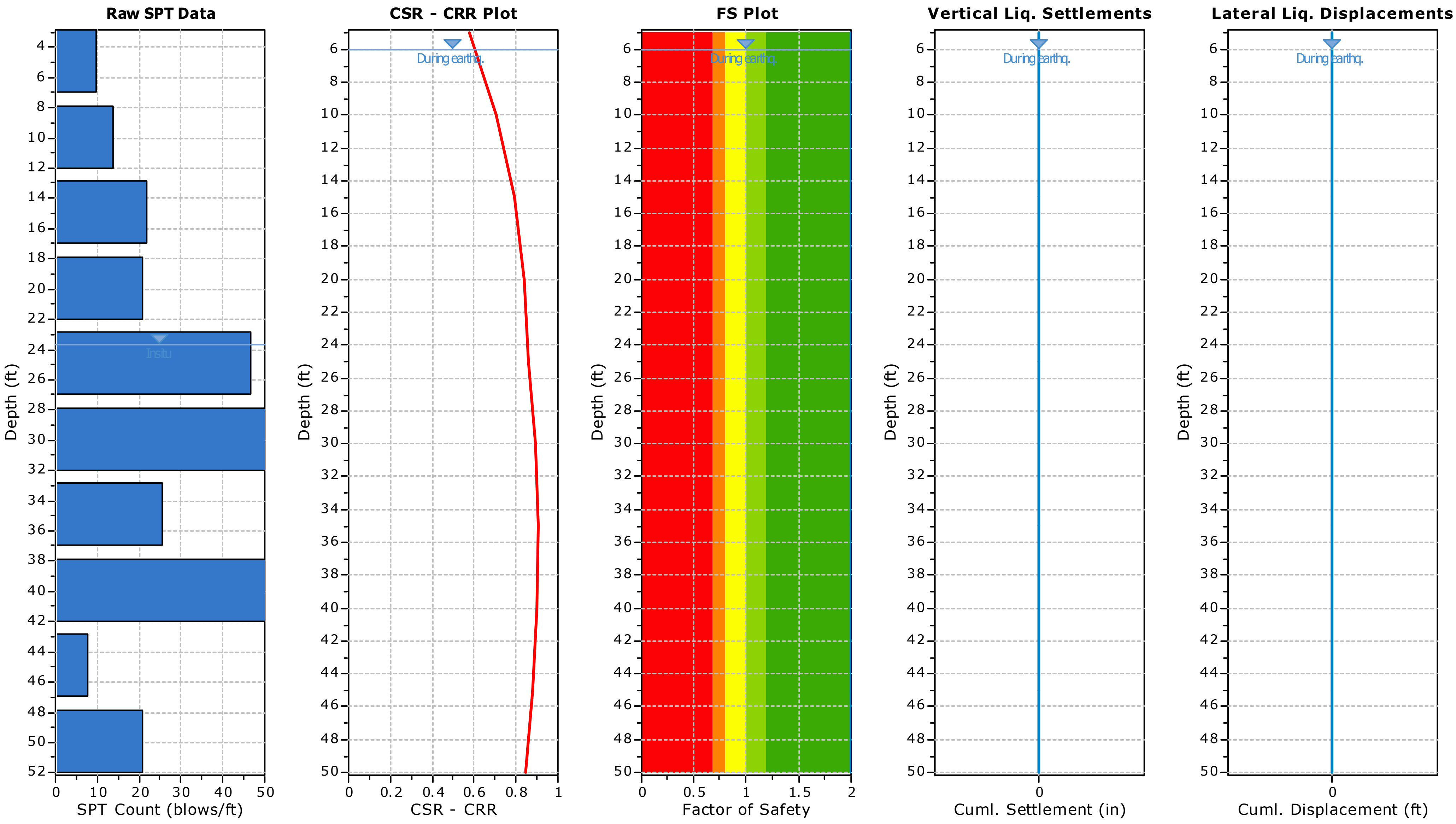
F.S. color scheme

- Almost certain it will liquefy
- Very likely to liquefy
- Liquefaction and no liq. are equally likely
- Unlike to liquefy
- Almost certain it will not liquefy

LPI color scheme

- Very high risk
- High risk
- Low risk

:: Overall Liquefaction Assessment Analysis Plots ::



:: Field input data ::

Test Depth (ft)	SPT Field Value (blows)	Fines Content (%)	Unit Weight (pcf)	Infl. Thickness (ft)	Can Liquefy
5.00	10	70.00	131.00	5.00	No
10.00	14	70.00	131.00	5.00	No
15.00	22	74.20	131.00	5.00	No
20.00	21	15.00	132.00	5.00	Yes
25.00	47	8.70	132.00	5.00	Yes
30.00	65	8.70	130.00	5.00	Yes
35.00	26	5.30	130.00	5.00	Yes
40.00	65	5.30	136.00	5.00	Yes
45.00	8	5.30	136.00	5.00	No
50.00	21	5.30	131.00	5.00	No

Abbreviations

Depth:	Depth at which test was performed (ft)
SPT Field Value:	Number of blows per foot
Fines Content:	Fines content at test depth (%)
Unit Weight:	Unit weight at test depth (pcf)
Infl. Thickness:	Thickness of the soil layer to be considered in settlements analysis (ft)
Can Liquefy:	User defined switch for excluding/including test depth from the analysis procedure

:: Cyclic Resistance Ratio (CRR) calculation data ::

Depth (ft)	SPT Field Value	Unit Weight (pcf)	σ_v (tsf)	u_o (tsf)	σ'_{vo} (tsf)	C_N	C_E	C_B	C_R	C_S	$(N_1)_{60}$	Fines Content (%)	α	β	$(N_1)_{60cs}$	$CRR_{7.5}$
5.00	10	131.00	0.33	0.00	0.33	1.46	1.33	1.15	0.75	1.20	20	70.00	5.00	1.20	29	4.000
10.00	14	131.00	0.66	0.00	0.66	1.21	1.33	1.15	0.85	1.20	26	70.00	5.00	1.20	36	4.000
15.00	22	131.00	0.98	0.00	0.98	1.03	1.33	1.15	0.85	1.20	35	74.20	5.00	1.20	47	4.000
20.00	21	132.00	1.31	0.00	1.31	0.90	1.33	1.15	0.95	1.20	33	15.00	2.50	1.05	37	4.000
25.00	47	132.00	1.64	0.04	1.60	0.81	1.33	1.15	0.95	1.20	66	8.70	0.47	1.02	68	4.000
30.00	65	130.00	1.97	0.20	1.77	0.77	1.33	1.15	1.00	1.20	91	8.70	0.47	1.02	93	4.000
35.00	26	130.00	2.29	0.35	1.94	0.73	1.33	1.15	1.00	1.20	35	5.30	0.01	1.00	35	4.000
40.00	65	136.00	2.63	0.51	2.12	0.69	1.33	1.15	1.00	1.20	82	5.30	0.01	1.00	82	4.000
45.00	8	136.00	2.97	0.66	2.31	0.65	1.33	1.15	1.00	1.20	10	5.30	0.01	1.00	10	4.000
50.00	21	131.00	3.30	0.82	2.48	0.62	1.33	1.15	1.00	1.20	24	5.30	0.01	1.00	24	4.000

Abbreviations

σ_v:	Total stress during SPT test (tsf)
u_o:	Water pore pressure during SPT test (tsf)
σ'_{vo}:	Effective overburden pressure during SPT test (tsf)
C_N:	Overburden corretion factor
C_E:	Energy correction factor
C_B:	Borehole diameter correction factor
C_R:	Rod length correction factor
C_S:	Liner correction factor
$N_{1(60)}$:	Corrected N_{SPT} to a 60% energy ratio
α, β:	Clean sand equivalent clean sand formula coefficients
$N_{1(60)cs}$:	Corected $N_{1(60)}$ value for fines content
$CRR_{7.5}$:	Cydic resistance ratio for M=7.5

:: Cyclic Stress Ratio calculation (CSR fully adjusted and normalized) ::

Depth (ft)	Unit Weight (pcf)	$\sigma_{v,eq}$ (tsf)	$u_{o,eq}$ (tsf)	$\sigma'_{vo,eq}$ (tsf)	r_d	α	CSR	MSF	$CSR_{eq,M=7.5}$	K_{sigma}	CSR^*	FS
5.00	131.00	0.33	0.00	0.33	0.99	1.00	0.560	1.07	0.525	1.00	0.635	2.000
10.00	131.00	0.66	0.12	0.53	0.98	1.00	0.684	1.07	0.641	1.00	0.775	2.000

:: Cyclic Stress Ratio calculation (CSR fully adjusted and normalized) ::

Depth (ft)	Unit Weight (pcf)	$\sigma_{v,eq}$ (tsf)	$u_{o,eq}$ (tsf)	$\sigma'_{vo,eq}$ (tsf)	r_d	α	CSR	MSF	$CSR_{eq,M=7.5}$	K_{sigma}	CSR^*	FS	
15.00	131.00	0.98	0.28	0.70	0.97	1.00	0.767	1.07	0.718	1.00	0.869	2.000	●
20.00	132.00	1.31	0.44	0.88	0.96	1.00	0.811	1.07	0.760	1.00	0.919	2.000	●
25.00	132.00	1.64	0.59	1.05	0.94	1.00	0.833	1.07	0.781	1.00	0.945	2.000	●
30.00	130.00	1.97	0.75	1.22	0.92	1.00	0.840	1.07	0.787	0.97	0.980	2.000	●
35.00	130.00	2.29	0.90	1.39	0.89	1.00	0.832	1.07	0.779	0.95	0.996	2.000	●
40.00	136.00	2.63	1.06	1.57	0.85	1.00	0.806	1.07	0.755	0.92	0.989	2.000	●
45.00	136.00	2.97	1.22	1.76	0.80	1.00	0.769	1.07	0.721	0.90	0.965	2.000	●
50.00	131.00	3.30	1.37	1.93	0.75	1.00	0.729	1.07	0.683	0.89	0.931	2.000	●

Abbreviations

$\sigma_{v,eq}$:	Total overburden pressure at test point, during earthquake (tsf)
$u_{o,eq}$:	Water pressure at test point, during earthquake (tsf)
$\sigma'_{vo,eq}$:	Effective overburden pressure, during earthquake (tsf)
r_d :	Nonlinear shear mass factor
α:	Improvement factor due to stone columns
CSR :	Cyclic Stress Ratio (adjusted for improvement)
MSF :	Magnitude Scaling Factor
$CSR_{eq,M=7.5}$:	CSR adjusted for M=7.5
K_{sigma}:	Effective overburden stress factor
CSR^*:	CSR fully adjusted (user FS applied)***
FS:	Calculated factor of safety against soil liquefaction
*** User FS:	1.10

:: Liquefaction potential according to Iwasaki ::

Depth (ft)	FS	F	wz	Thickness (ft)	I_L
5.00	2.000	0.00	9.24	5.00	0.00
10.00	2.000	0.00	8.48	5.00	0.00
15.00	2.000	0.00	7.71	5.00	0.00
20.00	2.000	0.00	6.95	5.00	0.00
25.00	2.000	0.00	6.19	5.00	0.00
30.00	2.000	0.00	5.43	5.00	0.00
35.00	2.000	0.00	4.67	5.00	0.00
40.00	2.000	0.00	3.90	5.00	0.00
45.00	2.000	0.00	3.14	5.00	0.00
50.00	2.000	0.00	2.38	5.00	0.00

Overall potential I_L : 0.00

I_L = 0.00 - No liquefaction
I_L between 0.00 and 5 - Liquefaction not probable
I_L between 5 and 15 - Liquefaction probable
I_L > 15 - Liquefaction certain

:: Vertical settlements estimation for dry sands ::

Depth (ft)	$(N_1)_{60}$	τ_{av}	p	G_{max} (tsf)	α	b	γ	ε_{15}	N_c	ε_{Nc} (%)	Δh (ft)	ΔS (in)
5.00	20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	5.00	0.000

:: Vertical settlements estimation for dry sands ::

Depth (ft)	$(N_1)_{60}$	τ_{av}	p	G_{max} (tsf)	α	b	γ	ε_{15}	N_c	ε_{Nc} (%)	Δh (ft)	ΔS (in)

Cumulative settlemetns: 0.000

Abbreviations

τ_{av}: Average cyclic shear stress
p: Average stress
G_{max}: Maximum shear modulus (tsf)
α, b: Shear strain formula variables
γ: Average shear strain
ε_{15}: Volumetric strain after 15 cycles
N_c: Number of cycles
ε_{Nc}: Volumetric strain for number of cycles N_c (%)
Δh: Thickness of soil layer (in)
ΔS: Settlement of soil layer (in)

:: Vertical settlements estimation for saturated sands ::

Depth (ft)	D_{50} (in)	q_c/N	e_v (%)	Δh (ft)	s (in)
10.00	0.00	5.00	0.00	5.00	0.000
15.00	0.00	5.00	0.00	5.00	0.000
20.00	0.00	5.00	0.00	5.00	0.000
25.00	0.00	5.00	0.00	5.00	0.000
30.00	0.00	5.00	0.00	5.00	0.000
35.00	0.00	5.00	0.00	5.00	0.000
40.00	0.00	5.00	0.00	5.00	0.000
45.00	0.00	5.00	0.00	5.00	0.000
50.00	0.00	5.00	0.00	5.00	0.000

Cumulative settlements: 0.000

Abbreviations

D_{50}: Median grain size (in)
q_c/N: Ratio of cone resistance to SPT
e_v: Post liquefaction volumetric strain (%)
Δh: Thickness of soil layer to be considered (ft)
s: Estimated settlement (in)

Twining Consulting

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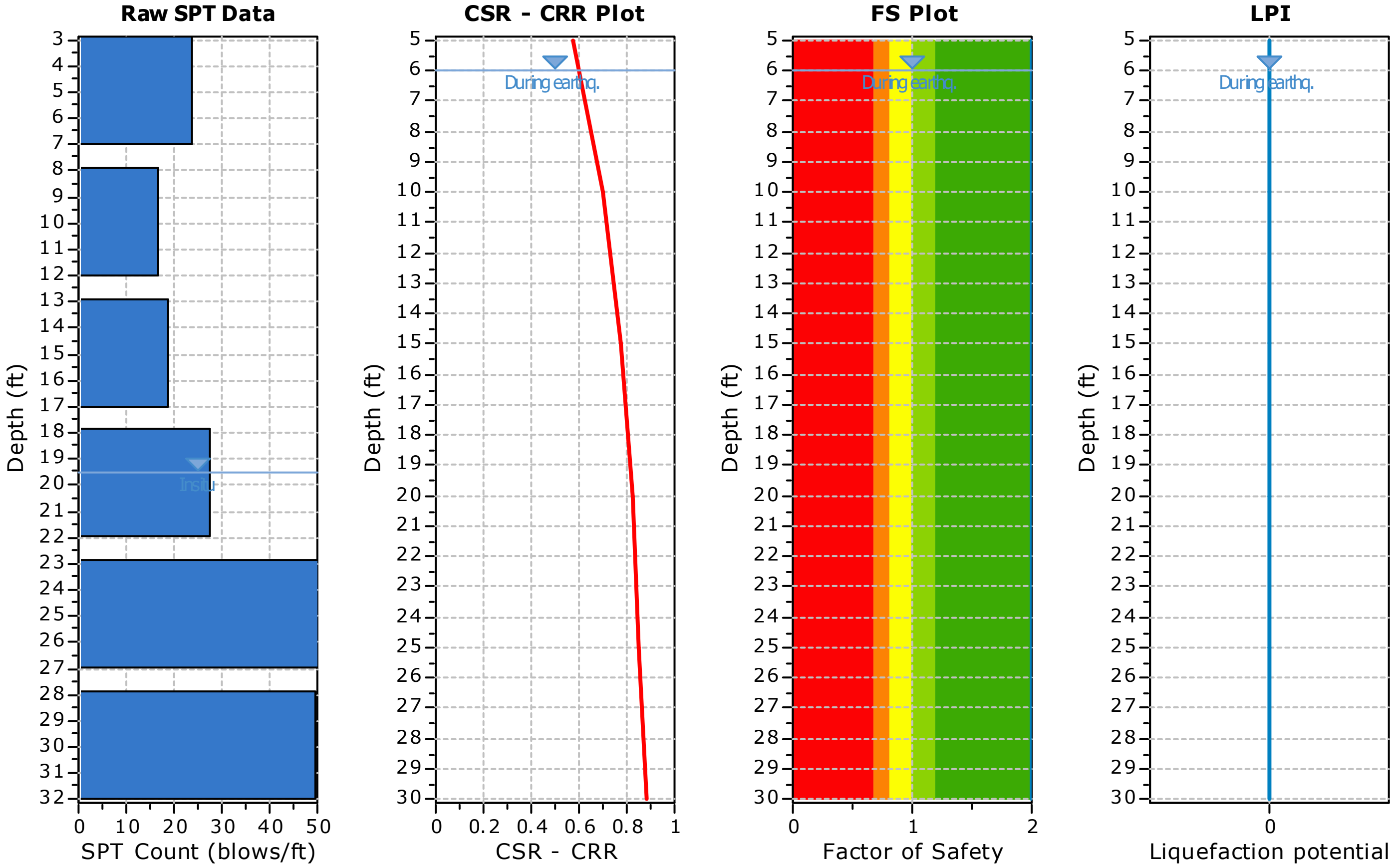
SPT BASED LIQUEFACTION ANALYSIS REPORT

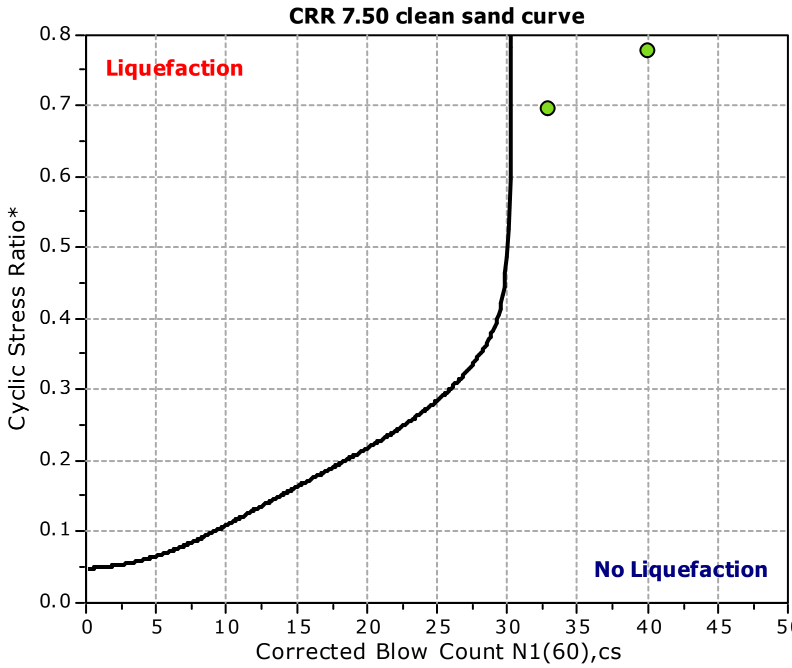
Project title : Proposed Del Rey Avenue Building **SPT Name: B-3**

Location : 4112 Del Rey Ave, Marina Del Rey, CA

:: Input parameters and analysis properties ::

Analysis method:	NCEER 1998	G.W.T. (in-situ):	19.50 ft
Fines correction method:	NCEER 1998	G.W.T. (earthq.):	6.00 ft
Sampling method:	Sampler wo liners	Earthquake magnitude M_w:	7.31
Borehole diameter:	200mm	Peak ground acceleration:	0.87 g
Rod length:	3.30 ft	Eq. external load:	0.00 tsf
Hammer energy ratio:	1.30		





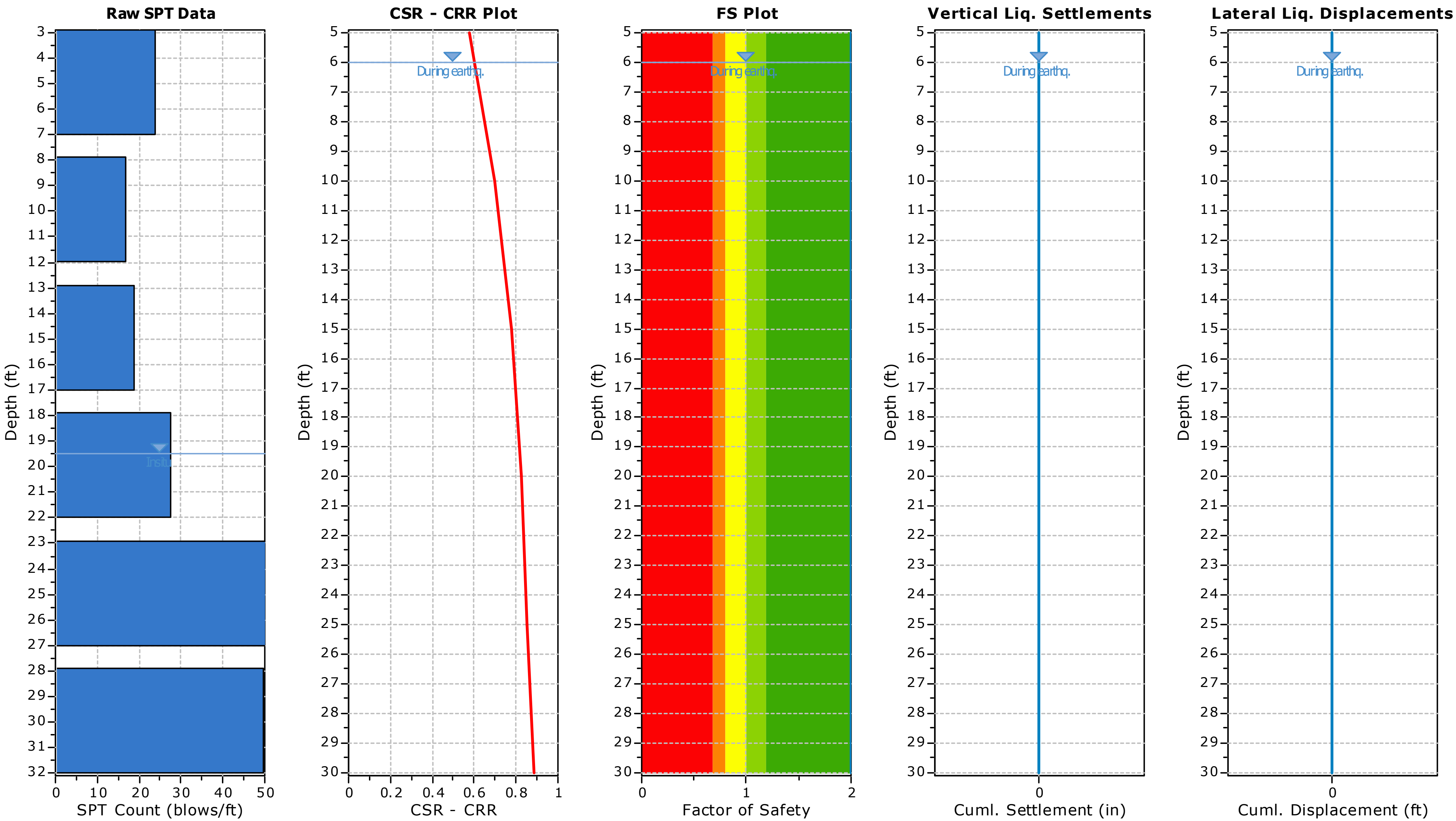
F.S. color scheme

- Almost certain it will liquefy
- Very likely to liquefy
- Liquefaction and no liq. are equally likely
- Unlike to liquefy
- Almost certain it will not liquefy

LPI color scheme

- Very high risk
- High risk
- Low risk

:: Overall Liquefaction Assessment Analysis Plots ::



:: Field input data ::

Test Depth (ft)	SPT Field Value (blows)	Fines Content (%)	Unit Weight (pcf)	Infl. Thickness (ft)	Can Liquefy
5.00	24	70.00	138.00	5.00	No
10.00	17	10.00	138.00	5.00	Yes
15.00	19	75.00	132.00	5.00	No
20.00	28	10.00	132.00	5.00	Yes
25.00	65	10.00	134.00	5.00	Yes
30.00	50	5.00	134.00	5.00	Yes

Abbreviations

Depth: Depth at which test was performed (ft)
SPT Field Value: Number of blows per foot
Fines Content: Fines content at test depth (%)
Unit Weight: Unit weight at test depth (pcf)
Infl. Thickness: Thickness of the soil layer to be considered in settlements analysis (ft)
Can Liquefy: User defined switch for excluding/including test depth from the analysis procedure

:: Cyclic Resistance Ratio (CRR) calculation data ::

Depth (ft)	SPT Field Value	Unit Weight (pcf)	σ_v (tsf)	u_o (tsf)	σ'_{vo} (tsf)	C_N	C_E	C_B	C_R	C_S	$(N_1)_{60}$	Fines Content (%)	α	β	$(N_1)_{60cs}$	$CRR_{7.5}$
5.00	24	138.00	0.34	0.00	0.34	1.44	1.30	1.15	0.75	1.20	47	70.00	5.00	1.20	61	4.000
10.00	17	138.00	0.69	0.00	0.69	1.19	1.30	1.15	0.85	1.20	31	10.00	0.87	1.02	33	4.000
15.00	19	132.00	1.02	0.00	1.02	1.02	1.30	1.15	0.85	1.20	29	75.00	5.00	1.20	40	4.000
20.00	28	132.00	1.35	0.02	1.33	0.89	1.30	1.15	0.95	1.20	43	10.00	0.87	1.02	45	4.000
25.00	65	134.00	1.69	0.17	1.51	0.84	1.30	1.15	0.95	1.20	93	10.00	0.87	1.02	96	4.000
30.00	50	134.00	2.02	0.33	1.69	0.79	1.30	1.15	1.00	1.20	70	5.00	0.00	1.00	70	4.000

Abbreviations

σ_v: Total stress during SPT test (tsf)
u_o: Water pore pressure during SPT test (tsf)
σ'_{vo}: Effective overburden pressure during SPT test (tsf)
C_N: Overburden corretion factor
C_E: Energy correction factor
C_B: Borehole diameter correction factor
C_R: Rod length correction factor
C_S: Liner correction factor
$N_{1(60)}$: Corrected N_{SPT} to a 60% energy ratio
α, β: Clean sand equivalent clean sand formula coefficients
$N_{1(60)cs}$: Corected $N_{1(60)}$ value for fines content
$CRR_{7.5}$: Cydic resistance ratio for M=7.5

:: Cyclic Stress Ratio calculation (CSR fully adjusted and normalized) ::

Depth (ft)	Unit Weight (pcf)	$\sigma_{v,eq}$ (tsf)	$u_{o,eq}$ (tsf)	$\sigma'_{vo,eq}$ (tsf)	r_d	α	CSR	MSF	$CSR_{eq,M=7.5}$	K_{sigma}	CSR^*	FS	
5.00	138.00	0.34	0.00	0.34	0.99	1.00	0.560	1.07	0.525	1.00	0.635	2.000	●
10.00	138.00	0.69	0.12	0.57	0.98	1.00	0.676	1.07	0.633	1.00	0.766	2.000	●
15.00	132.00	1.02	0.28	0.74	0.97	1.00	0.756	1.07	0.708	1.00	0.857	2.000	●
20.00	132.00	1.35	0.44	0.91	0.96	1.00	0.800	1.07	0.749	1.00	0.907	2.000	●
25.00	134.00	1.69	0.59	1.09	0.94	1.00	0.822	1.07	0.770	0.99	0.937	2.000	●
30.00	134.00	2.02	0.75	1.27	0.92	1.00	0.827	1.07	0.775	0.96	0.973	2.000	●

:: Cyclic Stress Ratio calculation (CSR fully adjusted and normalized) ::

Depth (ft)	Unit Weight (pcf)	$\sigma_{v,eq}$ (tsf)	$u_{o,eq}$ (tsf)	$\sigma'_{vo,eq}$ (tsf)	r_d	α	CSR	MSF	$CSR_{eq,M=7.5}$	K_{sigma}	CSR*	FS

Abbreviations

$\sigma_{v,eq}$: Total overburden pressure at test point, during earthquake (tsf)
$u_{o,eq}$: Water pressure at test point, during earthquake (tsf)
$\sigma'_{vo,eq}$: Effective overburden pressure, during earthquake (tsf)
r_d : Nonlinear shear mass factor
α: Improvement factor due to stone columns
CSR : Cyclic Stress Ratio (adjusted for improvement)
MSF : Magnitude Scaling Factor
$CSR_{eq,M=7.5}$: CSR adjusted for M=7.5
K_{sigma}: Effective overburden stress factor
CSR*: CSR fully adjusted (user FS applied)***
FS: Calculated factor of safety against soil liquefaction

*** User FS: 1.10

:: Liquefaction potential according to Iwasaki ::

Depth (ft)	FS	F	wz	Thickness (ft)	I_L
5.00	2.000	0.00	9.24	5.00	0.00
10.00	2.000	0.00	8.48	5.00	0.00
15.00	2.000	0.00	7.71	5.00	0.00
20.00	2.000	0.00	6.95	5.00	0.00
25.00	2.000	0.00	6.19	5.00	0.00
30.00	2.000	0.00	5.43	5.00	0.00

Overall potential I_L : 0.00

I_L = 0.00 - No liquefaction
I_L between 0.00 and 5 - Liquefaction not probable
I_L between 5 and 15 - Liquefaction probable
I_L > 15 - Liquefaction certain

:: Vertical settlements estimation for dry sands ::

Depth (ft)	$(N_1)_{60}$	τ_{av}	p	G_{max} (tsf)	α	b	γ	ε_{15}	N_c	ε_{Nc} (%)	Δh (ft)	ΔS (in)
5.00	47	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	5.00	0.000

Cumulative settlemetns: 0.000

Abbreviations

τ_{av}: Average cyclic shear stress
p: Average stress
G_{max}: Maximum shear modulus (tsf)
α, b: Shear strain formula variables
γ: Average shear strain
ε_{15}: Volumetric strain after 15 cycles
N_c: Number of cycles
ε_{Nc}: Volumetric strain for number of cycles N_c (%)
Δh: Thickness of soil layer (in)
ΔS: Settlement of soil layer (in)

:: Vertical settlements estimation for saturated sands ::

Depth (ft)	D_{50} (in)	q_c/N	e_v (%)	Δh (ft)	s (in)
10.00	0.00	5.00	0.00	5.00	0.000

:: Vertical settlements estimation for saturated sands ::

Depth (ft)	D_{50} (in)	q_c/N	e_v (%)	Δh (ft)	s (in)
15.00	0.00	5.00	0.00	5.00	0.000
20.00	0.00	5.00	0.00	5.00	0.000
25.00	0.00	5.00	0.00	5.00	0.000
30.00	0.00	5.00	0.00	5.00	0.000

Cumulative settlements: 0.000

Abbreviations

D_{50}: Median grain size (in)
q_c/N: Ratio of cone resistance to SPT
e_v: Post liquefaction volumetric strain (%)
Δh: Thickness of soil layer to be considered (ft)
s: Estimated settlement (in)

Twining Consulting

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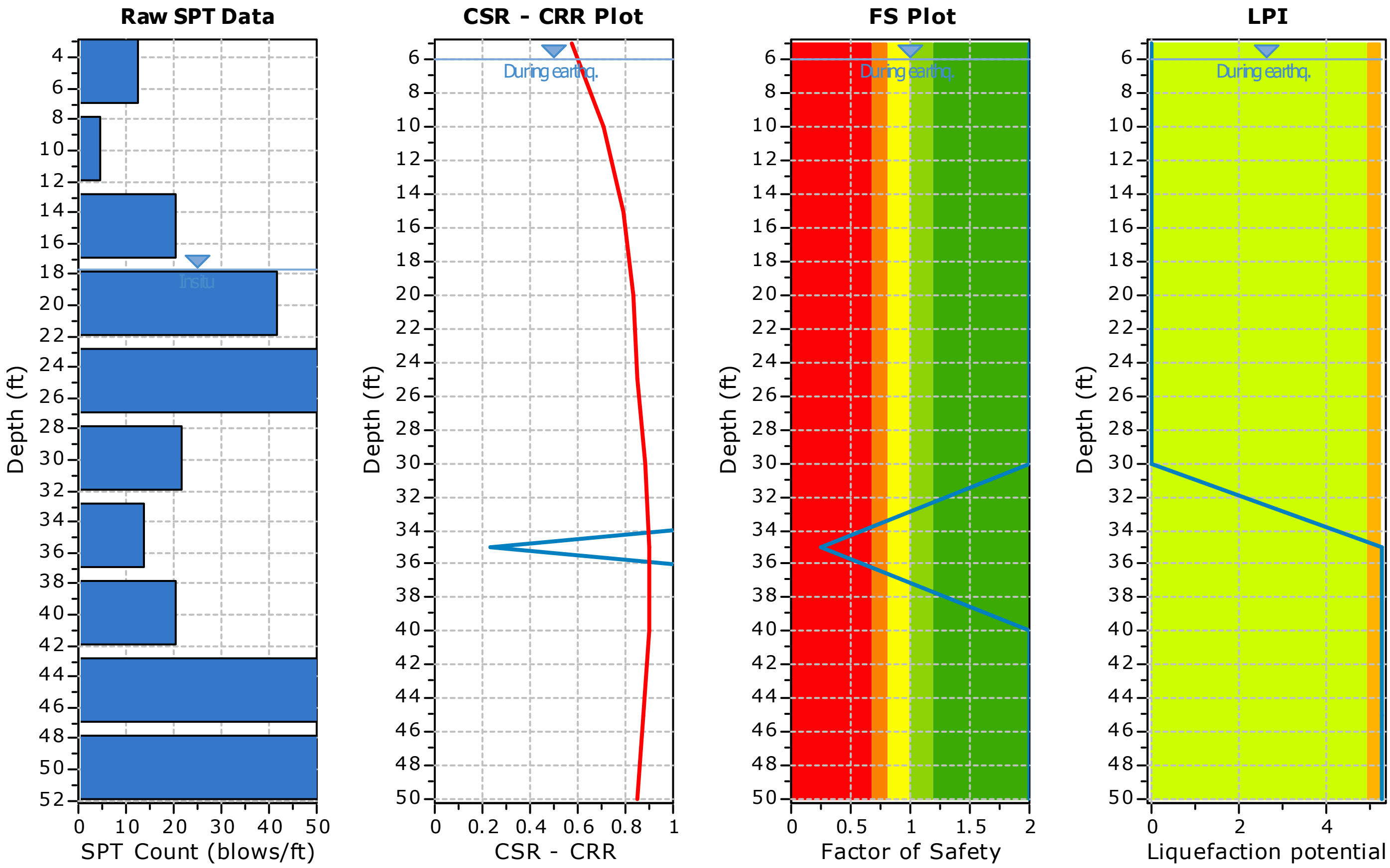
SPT BASED LIQUEFACTION ANALYSIS REPORT

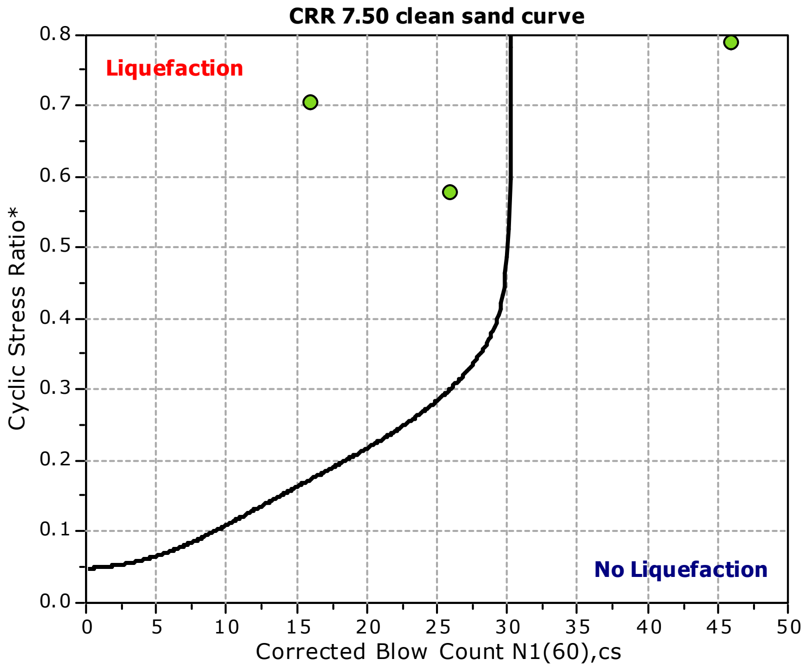
Project title : Proposed Del Rey Avenue Building **SPT Name: B-4**

Location : 4112 Del Rey Ave, Marina Del Rey, CA

:: Input parameters and analysis properties ::

Analysis method:	NCEER 1998	G.W.T. (in-situ):	17.75 ft
Fines correction method:	NCEER 1998	G.W.T. (earthq.):	6.00 ft
Sampling method:	Sampler wo liners	Earthquake magnitude M_w:	7.31
Borehole diameter:	200mm	Peak ground acceleration:	0.87 g
Rod length:	3.30 ft	Eq. external load:	0.00 tsf
Hammer energy ratio:	1.33		





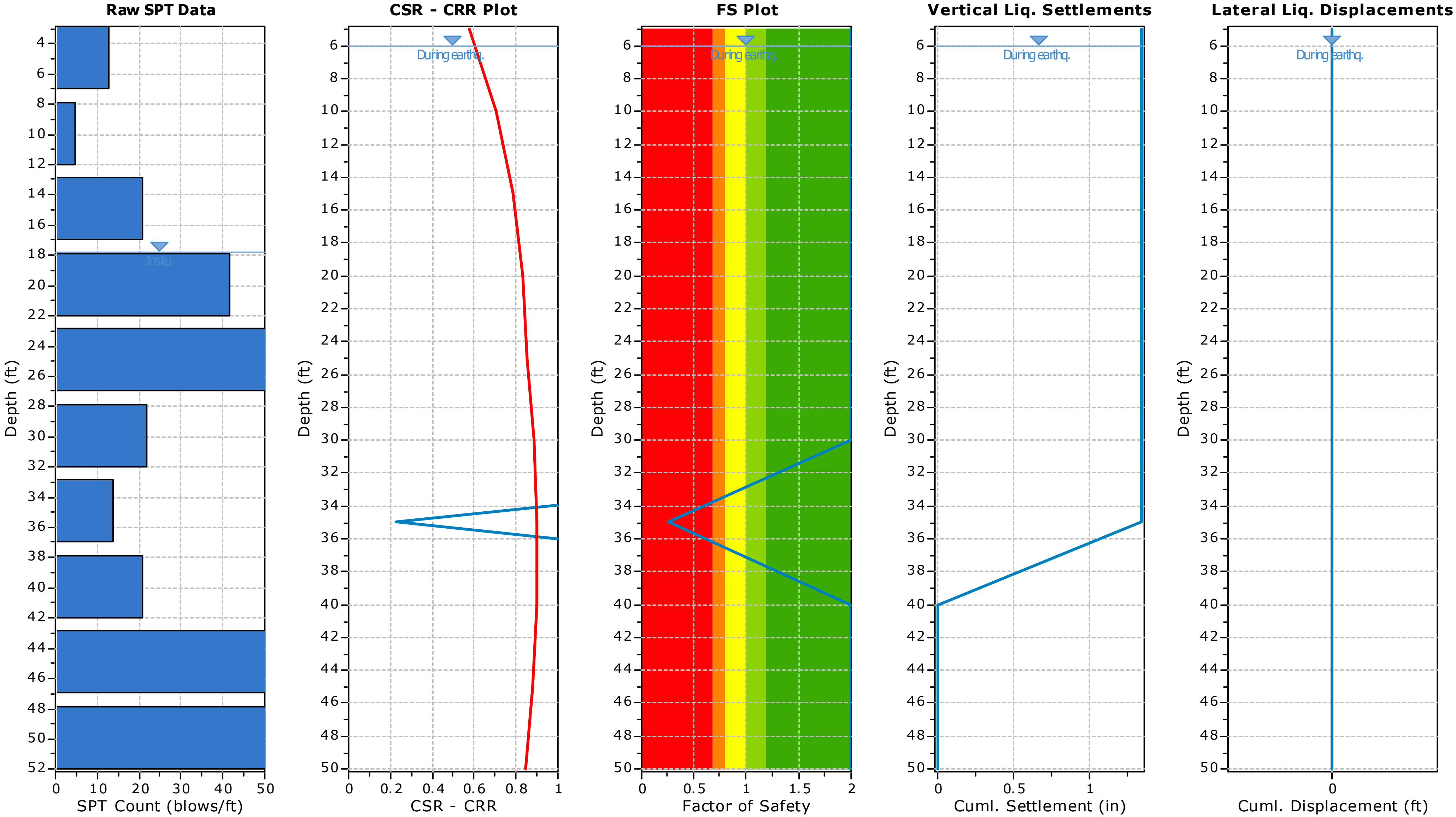
F.S. color scheme

- Almost certain it will liquefy
- Very likely to liquefy
- Liquefaction and no liq. are equally likely
- Unlike to liquefy
- Almost certain it will not liquefy

LPI color scheme

- Very high risk
- High risk
- Low risk

:: Overall Liquefaction Assessment Analysis Plots ::



:: Field input data ::

Test Depth (ft)	SPT Field Value (blows)	Fines Content (%)	Unit Weight (pcf)	Infl. Thickness (ft)	Can Liquefy
5.00	13	0.00	131.00	5.00	No
10.00	5	79.80	131.00	5.00	No
15.00	21	79.80	134.00	5.00	No
20.00	42	8.90	134.00	5.00	Yes
25.00	65	8.90	138.00	5.00	Yes
30.00	22	51.70	138.00	5.00	No
35.00	14	10.00	126.00	5.00	Yes
40.00	21	46.30	126.00	5.00	Yes
45.00	65	46.30	131.00	5.00	Yes
50.00	56	10.00	131.00	5.00	Yes

Abbreviations

Depth: Depth at which test was performed (ft)
SPT Field Value: Number of blows per foot
Fines Content: Fines content at test depth (%)
Unit Weight: Unit weight at test depth (pcf)
Infl. Thickness: Thickness of the soil layer to be considered in settlements analysis (ft)
Can Liquefy: User defined switch for excluding/including test depth from the analysis procedure

:: Cyclic Resistance Ratio (CRR) calculation data ::

Depth (ft)	SPT Field Value	Unit Weight (pcf)	σ_v (tsf)	u_o (tsf)	σ'_{vo} (tsf)	C_N	C_E	C_B	C_R	C_S	$(N_1)_{60}$	Fines Content (%)	α	β	$(N_1)_{60cs}$	$CRR_{7.5}$
5.00	13	131.00	0.33	0.00	0.33	1.46	1.33	1.15	0.75	1.20	26	0.00	0.00	1.00	26	4.000
10.00	5	131.00	0.66	0.00	0.66	1.21	1.33	1.15	0.85	1.20	9	79.80	5.00	1.20	16	4.000
15.00	21	134.00	0.99	0.00	0.99	1.03	1.33	1.15	0.85	1.20	34	79.80	5.00	1.20	46	4.000
20.00	42	134.00	1.32	0.07	1.25	0.92	1.33	1.15	0.95	1.20	68	8.90	0.53	1.02	70	4.000
25.00	65	138.00	1.67	0.23	1.44	0.86	1.33	1.15	0.95	1.20	97	8.90	0.53	1.02	99	4.000
30.00	22	138.00	2.02	0.38	1.63	0.80	1.33	1.15	1.00	1.20	32	51.70	5.00	1.20	43	4.000
35.00	14	126.00	2.33	0.54	1.79	0.76	1.33	1.15	1.00	1.20	20	10.00	0.87	1.02	21	0.229
40.00	21	126.00	2.65	0.69	1.95	0.72	1.33	1.15	1.00	1.20	28	46.30	5.00	1.20	39	4.000
45.00	65	131.00	2.97	0.85	2.12	0.69	1.33	1.15	1.00	1.20	82	46.30	5.00	1.20	103	4.000
50.00	56	131.00	3.30	1.01	2.29	0.65	1.33	1.15	1.00	1.20	67	10.00	0.87	1.02	69	4.000

Abbreviations

σ_v: Total stress during SPT test (tsf)
u_o: Water pore pressure during SPT test (tsf)
σ'_{vo}: Effective overburden pressure during SPT test (tsf)
C_N: Overburden corretion factor
C_E: Energy correction factor
C_B: Borehole diameter correction factor
C_R: Rod length correction factor
C_S: Liner correction factor
$N_{1(60)}$: Corrected N_{SPT} to a 60% energy ratio
α, β: Clean sand equivalent clean sand formula coefficients
$N_{1(60)cs}$: Corected $N_{1(60)}$ value for fines content
$CRR_{7.5}$: Cyclic resistance ratio for M=7.5

:: Cyclic Stress Ratio calculation (CSR fully adjusted and normalized) ::

Depth (ft)	Unit Weight (pcf)	$\sigma_{v,eq}$ (tsf)	$u_{o,eq}$ (tsf)	$\sigma'_{vo,eq}$ (tsf)	r_d	α	CSR	MSF	$CSR_{eq,M=7.5}$	K_{sigma}	CSR^*	FS	
5.00	131.00	0.33	0.00	0.33	0.99	1.00	0.560	1.07	0.525	1.00	0.635	2.000	●
10.00	131.00	0.66	0.12	0.53	0.98	1.00	0.684	1.07	0.641	1.00	0.775	2.000	●

:: Cyclic Stress Ratio calculation (CSR fully adjusted and normalized) ::

Depth (ft)	Unit Weight (pcf)	$\sigma_{v,eq}$ (tsf)	$u_{o,eq}$ (tsf)	$\sigma'_{vo,eq}$ (tsf)	r_d	α	CSR	MSF	$CSR_{eq,M=7.5}$	K_{sigma}	CSR^*	FS	
15.00	134.00	0.99	0.28	0.71	0.97	1.00	0.765	1.07	0.716	1.00	0.867	2.000	●
20.00	134.00	1.32	0.44	0.89	0.96	1.00	0.807	1.07	0.756	1.00	0.915	2.000	●
25.00	138.00	1.67	0.59	1.08	0.94	1.00	0.826	1.07	0.773	1.00	0.939	2.000	●
30.00	138.00	2.02	0.75	1.27	0.92	1.00	0.828	1.07	0.776	0.96	0.973	2.000	●
35.00	126.00	2.33	0.90	1.43	0.89	1.00	0.823	1.07	0.771	0.94	0.991	0.255	●
40.00	126.00	2.65	1.06	1.58	0.85	1.00	0.804	1.07	0.753	0.92	0.987	2.000	●
45.00	131.00	2.97	1.22	1.76	0.80	1.00	0.769	1.07	0.721	0.90	0.965	2.000	●
50.00	131.00	3.30	1.37	1.93	0.75	1.00	0.729	1.07	0.683	0.89	0.931	2.000	●

Abbreviations

$\sigma_{v,eq}$:	Total overburden pressure at test point, during earthquake (tsf)
$u_{o,eq}$:	Water pressure at test point, during earthquake (tsf)
$\sigma'_{vo,eq}$:	Effective overburden pressure, during earthquake (tsf)
r_d :	Nonlinear shear mass factor
α:	Improvement factor due to stone columns
CSR :	Cyclic Stress Ratio (adjusted for improvement)
MSF :	Magnitude Scaling Factor
$CSR_{eq,M=7.5}$:	CSR adjusted for M=7.5
K_{sigma}:	Effective overburden stress factor
CSR^*:	CSR fully adjusted (user FS applied)***
FS:	Calculated factor of safety against soil liquefaction

*** User FS: 1.10

:: Liquefaction potential according to Iwasaki ::

Depth (ft)	FS	F	wz	Thickness (ft)	I_L
5.00	2.000	0.00	9.24	5.00	0.00
10.00	2.000	0.00	8.48	5.00	0.00
15.00	2.000	0.00	7.71	5.00	0.00
20.00	2.000	0.00	6.95	5.00	0.00
25.00	2.000	0.00	6.19	5.00	0.00
30.00	2.000	0.00	5.43	5.00	0.00
35.00	0.255	0.75	4.67	5.00	5.30
40.00	2.000	0.00	3.90	5.00	0.00
45.00	2.000	0.00	3.14	5.00	0.00
50.00	2.000	0.00	2.38	5.00	0.00

Overall potential I_L : 5.30

I_L = 0.00 - No liquefaction
I_L between 0.00 and 5 - Liquefaction not probable
I_L between 5 and 15 - Liquefaction probable
I_L > 15 - Liquefaction certain

:: Vertical settlements estimation for dry sands ::

Depth (ft)	$(N_1)_{60}$	τ_{av}	p	G_{max} (tsf)	α	b	γ	ε_{15}	N_c	ε_{Nc} (%)	Δh (ft)	ΔS (in)
5.00	26	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	5.00	0.000

:: Vertical settlements estimation for dry sands ::

Depth (ft)	$(N_1)_{60}$	τ_{av}	p	G_{max} (tsf)	α	b	γ	ε_{15}	N_c	ε_{Nc} (%)	Δh (ft)	ΔS (in)

Cumulative settlemetns: 0.000

Abbreviations

τ_{av}: Average cyclic shear stress
p: Average stress
G_{max}: Maximum shear modulus (tsf)
α, b: Shear strain formula variables
γ: Average shear strain
ε_{15}: Volumetric strain after 15 cycles
N_c: Number of cycles
ε_{Nc}: Volumetric strain for number of cycles N_c (%)
Δh: Thickness of soil layer (in)
ΔS: Settlement of soil layer (in)

:: Vertical settlements estimation for saturated sands ::

Depth (ft)	D_{50} (in)	q_c/N	e_v (%)	Δh (ft)	s (in)
10.00	0.00	5.00	0.00	5.00	0.000
15.00	0.00	5.00	0.00	5.00	0.000
20.00	0.00	5.00	0.00	5.00	0.000
25.00	0.00	5.00	0.00	5.00	0.000
30.00	0.00	5.00	0.00	5.00	0.000
35.00	0.00	5.00	2.25	5.00	1.347
40.00	0.00	5.00	0.00	5.00	0.000
45.00	0.00	5.00	0.00	5.00	0.000
50.00	0.00	5.00	0.00	5.00	0.000

Cumulative settlements: 1.347

Abbreviations

D_{50}: Median grain size (in)
q_c/N: Ratio of cone resistance to SPT
e_v: Post liquefaction volumetric strain (%)
Δh: Thickness of soil layer to be considered (ft)
s: Estimated settlement (in)

Twining Consulting

TWINING

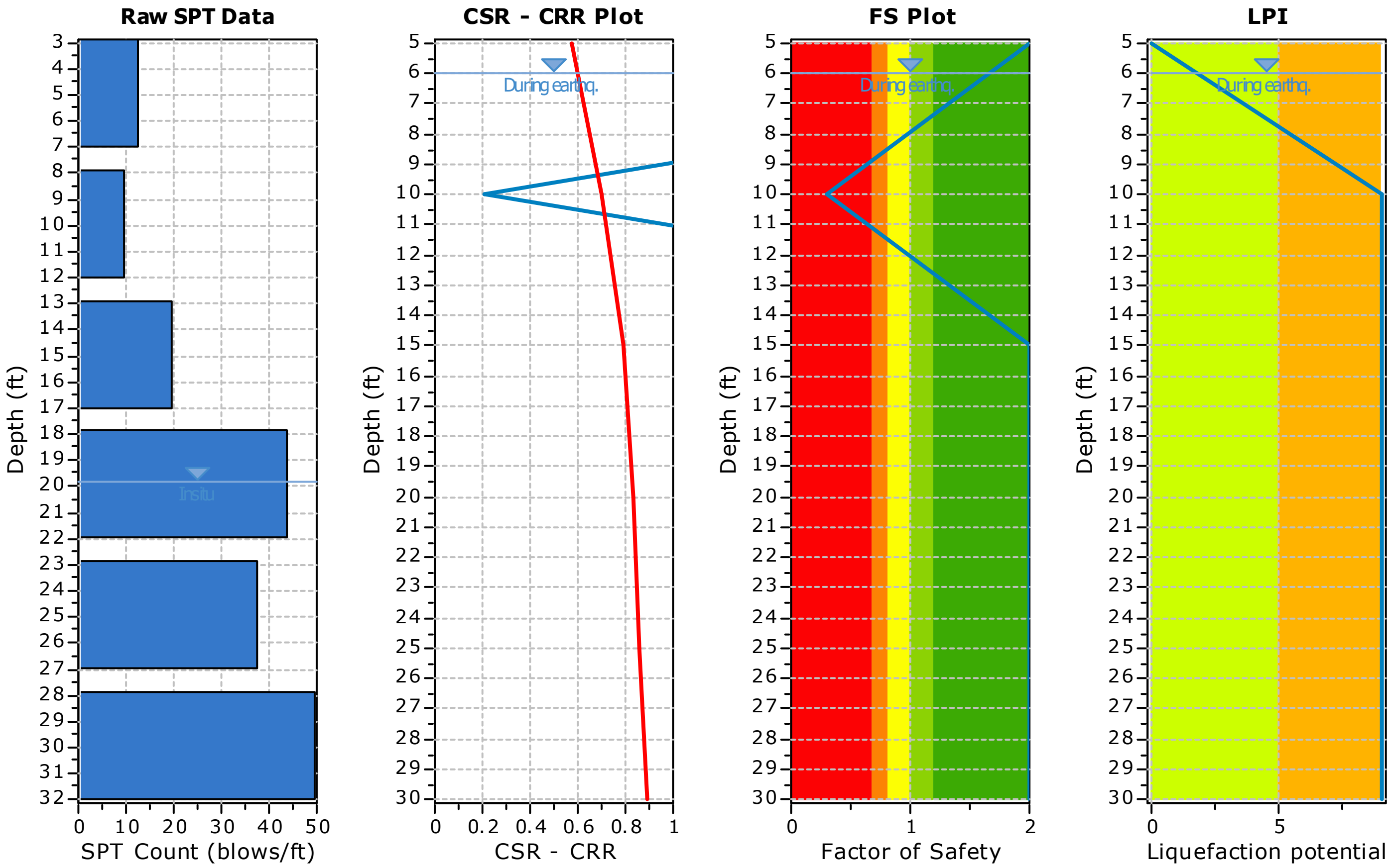
SPT BASED LIQUEFACTION ANALYSIS REPORT

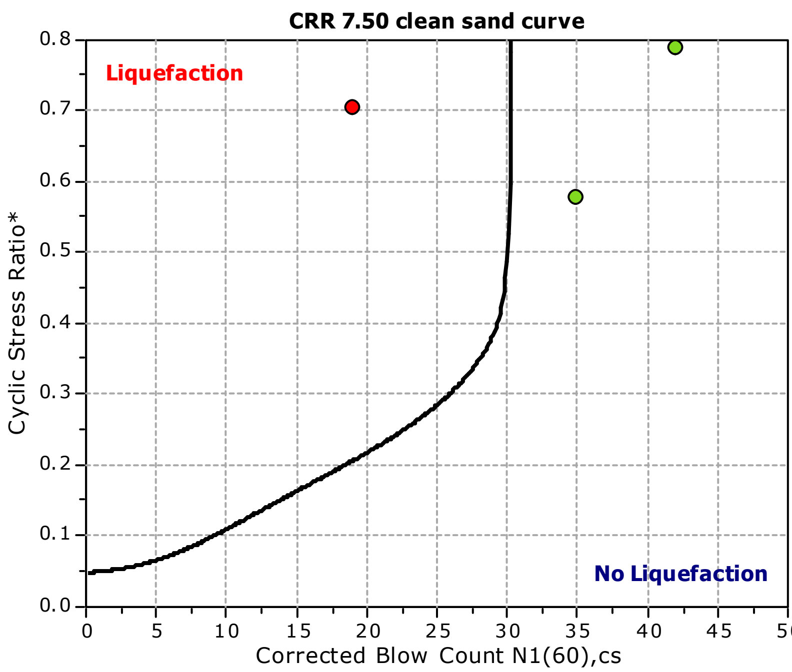
Project title : Proposed Del Rey Avenue Building **SPT Name: B-5**

Location : 4112 Del Rey Ave, Marina Del Rey, CA

:: Input parameters and analysis properties ::

Analysis method:	NCEER 1998	G.W.T. (in-situ):	19.80 ft
Fines correction method:	NCEER 1998	G.W.T. (earthq.):	6.00 ft
Sampling method:	Sampler wo liners	Earthquake magnitude M_w:	7.31
Borehole diameter:	200mm	Peak ground acceleration:	0.87 g
Rod length:	3.30 ft	Eq. external load:	0.00 tsf
Hammer energy ratio:	1.30		





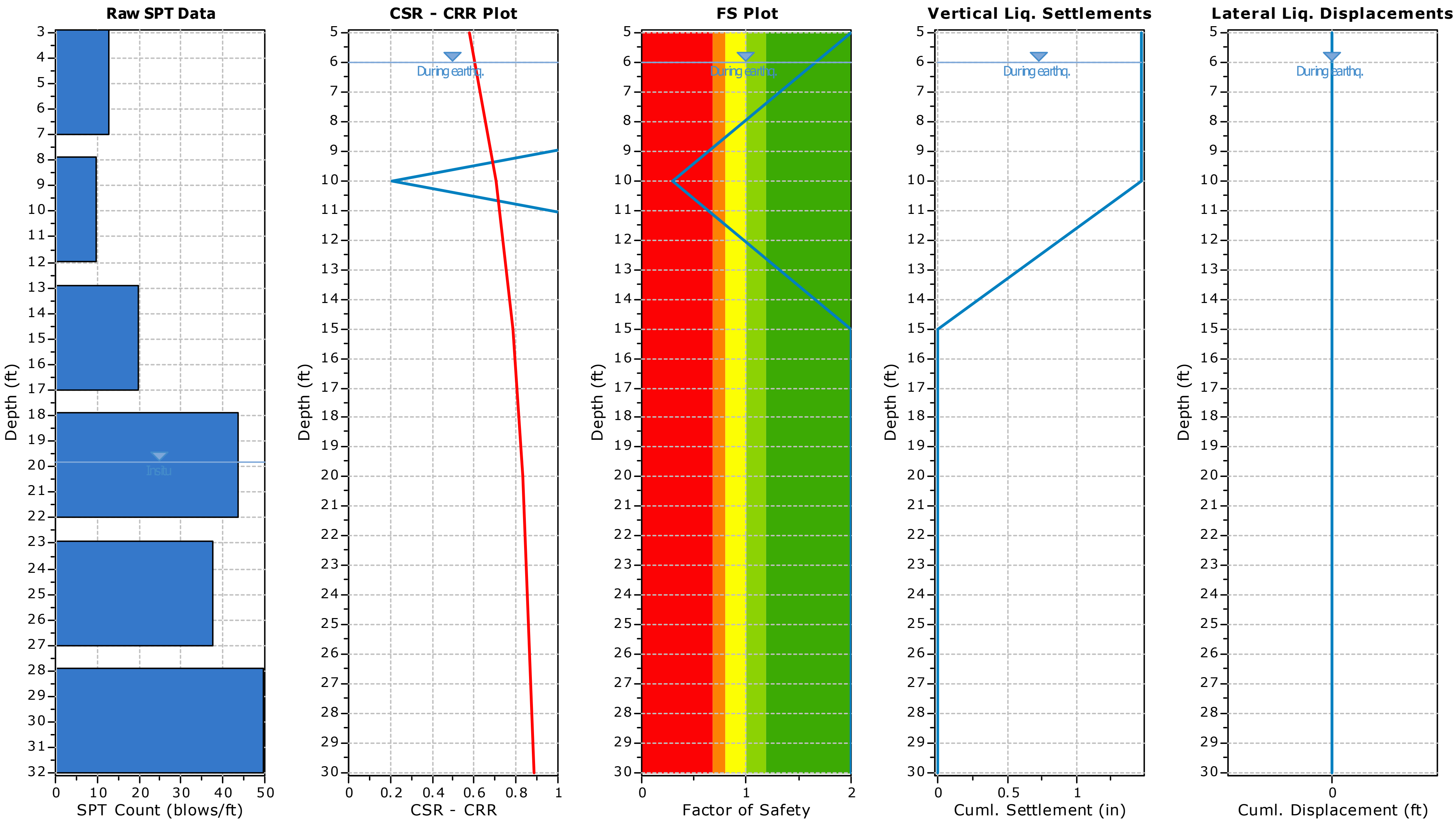
F.S. color scheme

- Almost certain it will liquefy
- Very likely to liquefy
- Liquefaction and no liq. are equally likely
- Unlike to liquefy
- Almost certain it will not liquefy

LPI color scheme

- Very high risk
- High risk
- Low risk

:: Overall Liquefaction Assessment Analysis Plots ::



:: Field input data ::

Test Depth (ft)	SPT Field Value (blows)	Fines Content (%)	Unit Weight (pcf)	Infl. Thickness (ft)	Can Liquefy
5.00	13	70.00	132.00	5.00	No
10.00	10	10.00	132.00	5.00	Yes
15.00	20	75.00	132.00	5.00	No
20.00	44	10.00	132.00	5.00	Yes
25.00	38	5.00	132.00	5.00	Yes
30.00	50	5.00	132.00	5.00	Yes

Abbreviations

Depth: Depth at which test was performed (ft)
SPT Field Value: Number of blows per foot
Fines Content: Fines content at test depth (%)
Unit Weight: Unit weight at test depth (pcf)
Infl. Thickness: Thickness of the soil layer to be considered in settlements analysis (ft)
Can Liquefy: User defined switch for excluding/including test depth from the analysis procedure

:: Cyclic Resistance Ratio (CRR) calculation data ::

Depth (ft)	SPT Field Value	Unit Weight (pcf)	σ_v (tsf)	u_o (tsf)	σ'_{vo} (tsf)	C_N	C_E	C_B	C_R	C_S	$(N_1)_{60}$	Fines Content (%)	α	β	$(N_1)_{60cs}$	$CRR_{7.5}$
5.00	13	132.00	0.33	0.00	0.33	1.46	1.30	1.15	0.75	1.20	25	70.00	5.00	1.20	35	4.000
10.00	10	132.00	0.66	0.00	0.66	1.21	1.30	1.15	0.85	1.20	18	10.00	0.87	1.02	19	0.206
15.00	20	132.00	0.99	0.00	0.99	1.03	1.30	1.15	0.85	1.20	31	75.00	5.00	1.20	42	4.000
20.00	44	132.00	1.32	0.01	1.31	0.90	1.30	1.15	0.95	1.20	68	10.00	0.87	1.02	70	4.000
25.00	38	132.00	1.65	0.16	1.49	0.84	1.30	1.15	0.95	1.20	55	5.00	0.00	1.00	55	4.000
30.00	50	132.00	1.98	0.32	1.66	0.79	1.30	1.15	1.00	1.20	71	5.00	0.00	1.00	71	4.000

Abbreviations

σ_v: Total stress during SPT test (tsf)
u_o: Water pore pressure during SPT test (tsf)
σ'_{vo}: Effective overburden pressure during SPT test (tsf)
C_N: Overburden corretion factor
C_E: Energy correction factor
C_B: Borehole diameter correction factor
C_R: Rod length correction factor
C_S: Liner correction factor
$N_{1(60)}$: Corrected N_{SPT} to a 60% energy ratio
α, β: Clean sand equivalent clean sand formula coefficients
$N_{1(60)cs}$: Corected $N_{1(60)}$ value for fines content
$CRR_{7.5}$: Cydic resistance ratio for M=7.5

:: Cyclic Stress Ratio calculation (CSR fully adjusted and normalized) ::

Depth (ft)	Unit Weight (pcf)	$\sigma_{v,eq}$ (tsf)	$u_{o,eq}$ (tsf)	$\sigma'_{vo,eq}$ (tsf)	r_d	α	CSR	MSF	$CSR_{eq,M=7.5}$	K_{sigma}	CSR^*	FS	
5.00	132.00	0.33	0.00	0.33	0.99	1.00	0.560	1.07	0.525	1.00	0.635	2.000	●
10.00	132.00	0.66	0.12	0.54	0.98	1.00	0.683	1.07	0.640	1.00	0.774	0.293	●
15.00	132.00	0.99	0.28	0.71	0.97	1.00	0.765	1.07	0.716	1.00	0.867	2.000	●
20.00	132.00	1.32	0.44	0.88	0.96	1.00	0.809	1.07	0.758	1.00	0.917	2.000	●
25.00	132.00	1.65	0.59	1.06	0.94	1.00	0.831	1.07	0.779	1.00	0.942	2.000	●
30.00	132.00	1.98	0.75	1.23	0.92	1.00	0.837	1.07	0.784	0.97	0.978	2.000	●

:: Cyclic Stress Ratio calculation (CSR fully adjusted and normalized) ::

Depth (ft)	Unit Weight (pcf)	$\sigma_{v,eq}$ (tsf)	$u_{o,eq}$ (tsf)	$\sigma'_{vo,eq}$ (tsf)	r_d	α	CSR	MSF	$CSR_{eq,M=7.5}$	K_{sigma}	CSR^*	FS

Abbreviations

$\sigma_{v,eq}$: Total overburden pressure at test point, during earthquake (tsf)
$u_{o,eq}$: Water pressure at test point, during earthquake (tsf)
$\sigma'_{vo,eq}$: Effective overburden pressure, during earthquake (tsf)
r_d : Nonlinear shear mass factor
α: Improvement factor due to stone columns
CSR : Cyclic Stress Ratio (adjusted for improvement)
MSF : Magnitude Scaling Factor
$CSR_{eq,M=7.5}$: CSR adjusted for M=7.5
K_{sigma}: Effective overburden stress factor
CSR^*: CSR fully adjusted (user FS applied)***
FS: Calculated factor of safety against soil liquefaction

*** User FS: 1.10

:: Liquefaction potential according to Iwasaki ::

Depth (ft)	FS	F	wz	Thickness (ft)	I_L
5.00	2.000	0.00	9.24	5.00	0.00
10.00	0.293	0.71	8.48	5.00	9.13
15.00	2.000	0.00	7.71	5.00	0.00
20.00	2.000	0.00	6.95	5.00	0.00
25.00	2.000	0.00	6.19	5.00	0.00
30.00	2.000	0.00	5.43	5.00	0.00

Overall potential I_L : 9.13

I_L = 0.00 - No liquefaction
I_L between 0.00 and 5 - Liquefaction not probable
I_L between 5 and 15 - Liquefaction probable
I_L > 15 - Liquefaction certain

:: Vertical settlements estimation for dry sands ::

Depth (ft)	$(N_1)_{60}$	τ_{av}	p	G_{max} (tsf)	α	b	γ	ε_{15}	N_c	ε_{Nc} (%)	Δh (ft)	ΔS (in)
5.00	25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	5.00	0.000

Cumulative settlemetns: 0.000

Abbreviations

τ_{av}: Average cyclic shear stress
p: Average stress
G_{max}: Maximum shear modulus (tsf)
α, b: Shear strain formula variables
γ: Average shear strain
ε_{15}: Volumetric strain after 15 cycles
N_c: Number of cycles
ε_{Nc}: Volumetric strain for number of cycles N_c (%)
Δh: Thickness of soil layer (in)
ΔS: Settlement of soil layer (in)

:: Vertical settlements estimation for saturated sands ::

Depth (ft)	D_{50} (in)	q_c/N	e_v (%)	Δh (ft)	s (in)
10.00	0.00	5.00	2.44	5.00	1.462

:: Vertical settlements estimation for saturated sands ::

Depth (ft)	D_{50} (in)	q_c/N	e_v (%)	Δh (ft)	s (in)
15.00	0.00	5.00	0.00	5.00	0.000
20.00	0.00	5.00	0.00	5.00	0.000
25.00	0.00	5.00	0.00	5.00	0.000
30.00	0.00	5.00	0.00	5.00	0.000

Cumulative settlements: 1.462

Abbreviations

D_{50}: Median grain size (in)
q_c/N: Ratio of cone resistance to SPT
e_v: Post liquefaction volumetric strain (%)
Δh: Thickness of soil layer to be considered (ft)
s: Estimated settlement (in)

Twining Consulting

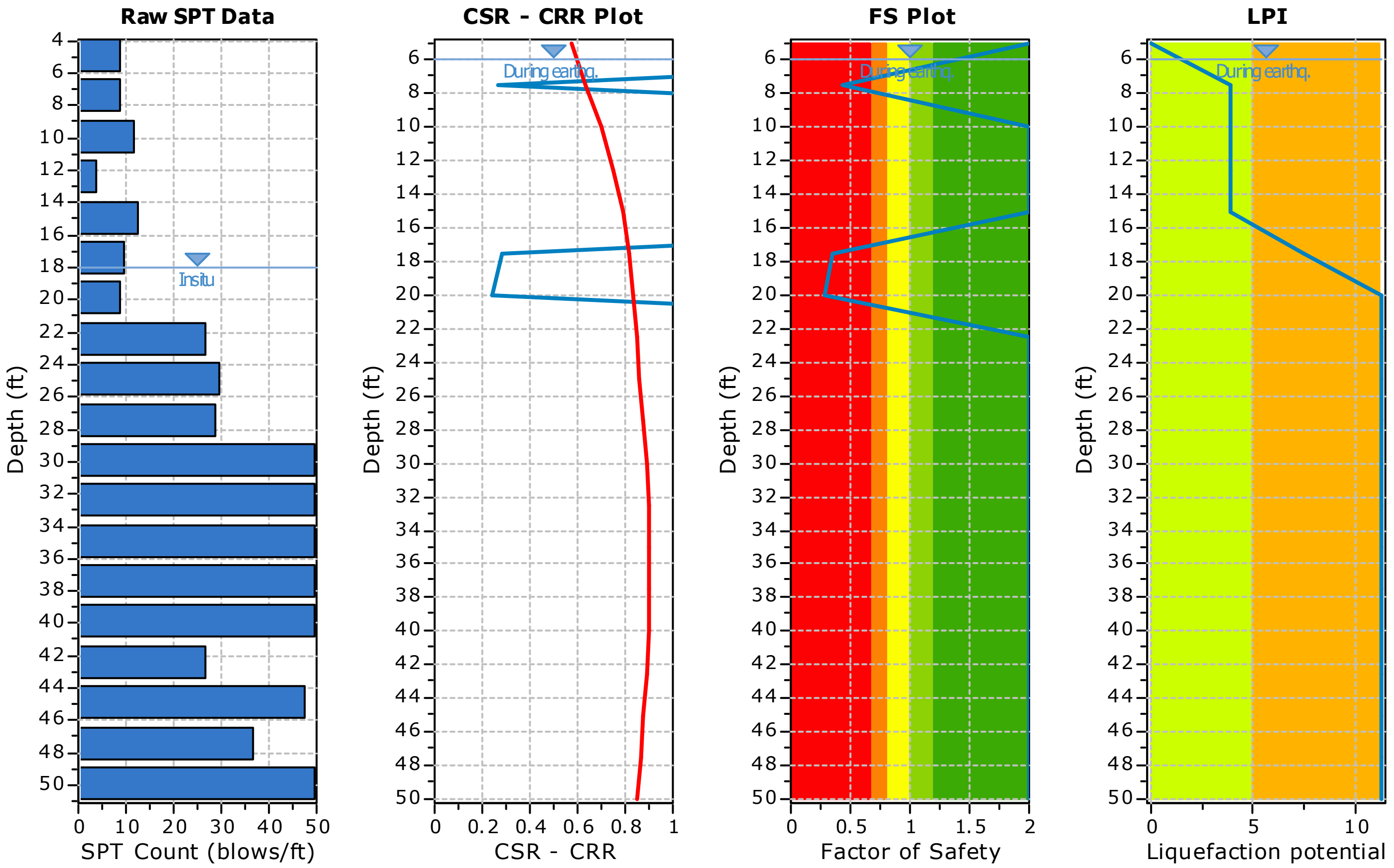
SPT BASED LIQUEFACTION ANALYSIS REPORT

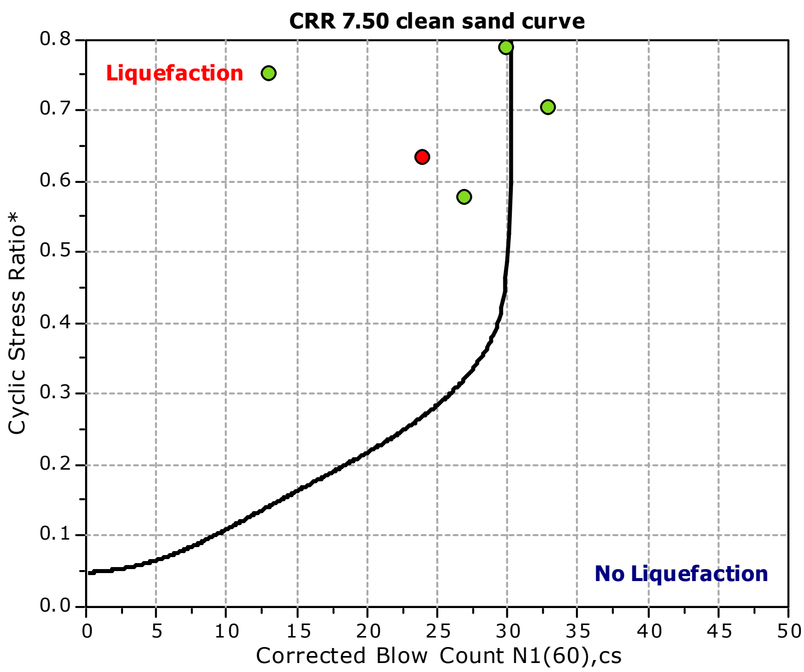
Project title : Proposed Del Rey Avenue Building **SPT Name: IGI B1**

Location : 4112 Del Rey Ave, Marina Del Rey, CA

:: Input parameters and analysis properties ::

Analysis method:	NCEER 1998	G.W.T. (in-situ):	18.00 ft
Fines correction method:	NCEER 1998	G.W.T. (earthq.):	6.00 ft
Sampling method:	Sampler wo liners	Earthquake magnitude M_w:	7.31
Borehole diameter:	200mm	Peak ground acceleration:	0.87 g
Rod length:	3.30 ft	Eq. external load:	0.00 tsf
Hammer energy ratio:	1.33		





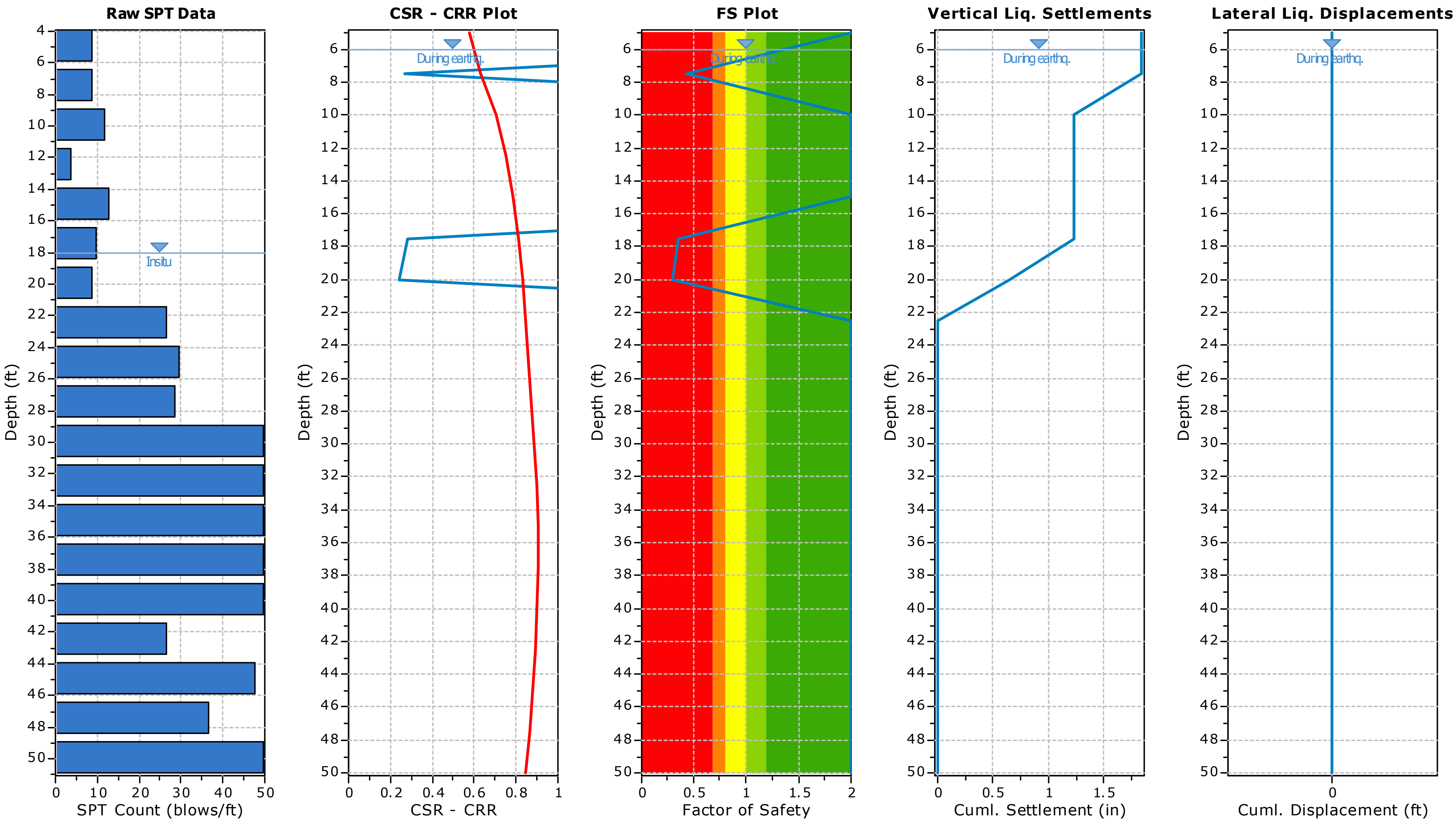
F.S. color scheme

- Almost certain it will liquefy
- Very likely to liquefy
- Liquefaction and no liq. are equally likely
- Unlike to liquefy
- Almost certain it will not liquefy

LPI color scheme

- Very high risk
- High risk
- Low risk

:: Overall Liquefaction Assessment Analysis Plots ::



:: Field input data ::

Test Depth (ft)	SPT Field Value (blows)	Fines Content (%)	Unit Weight (pcf)	Infl. Thickness (ft)	Can Liquefy
5.00	9	70.00	132.00	2.50	No
7.50	9	47.80	132.00	2.50	Yes
10.00	12	55.00	132.00	2.50	Yes
12.50	4	70.00	132.00	2.50	No
15.00	13	70.00	132.00	2.50	No
17.50	10	33.20	132.00	2.50	Yes
20.00	9	34.40	132.00	2.50	Yes
22.50	27	1.00	132.00	2.50	Yes
25.00	30	1.00	132.00	2.50	Yes
27.50	29	1.00	132.00	2.50	Yes
30.00	50	1.00	132.00	2.50	Yes
32.50	50	1.00	132.00	2.50	Yes
35.00	50	1.00	132.00	2.50	Yes
37.50	50	1.00	132.00	2.50	Yes
40.00	50	1.00	132.00	2.50	Yes
42.50	27	1.00	132.00	2.50	Yes
45.00	48	15.00	132.00	2.50	Yes
47.50	37	1.00	132.00	2.50	Yes
50.00	50	1.00	132.00	2.50	Yes

Abbreviations

Depth: Depth at which test was performed (ft)
SPT Field Value: Number of blows per foot
Fines Content: Fines content at test depth (%)
Unit Weight: Unit weight at test depth (pcf)
Infl. Thickness: Thickness of the soil layer to be considered in settlements analysis (ft)
Can Liquefy: User defined switch for excluding/including test depth from the analysis procedure

:: Cyclic Resistance Ratio (CRR) calculation data ::

Depth (ft)	SPT Field Value	Unit Weight (pcf)	σ_v (tsf)	u_o (tsf)	σ'_{vo} (tsf)	C_N	C_E	C_B	C_R	C_S	$(N_1)_{60}$	Fines Content (%)	α	β	$(N_1)_{60cs}$	$CRR_{7.5}$
5.00	9	132.00	0.33	0.00	0.33	1.46	1.33	1.15	0.75	1.20	18	70.00	5.00	1.20	27	4.000
7.50	9	132.00	0.49	0.00	0.49	1.32	1.33	1.15	0.75	1.20	16	47.80	5.00	1.20	24	0.269
10.00	12	132.00	0.66	0.00	0.66	1.21	1.33	1.15	0.85	1.20	23	55.00	5.00	1.20	33	4.000
12.50	4	132.00	0.82	0.00	0.82	1.11	1.33	1.15	0.85	1.20	7	70.00	5.00	1.20	13	4.000
15.00	13	132.00	0.99	0.00	0.99	1.03	1.33	1.15	0.85	1.20	21	70.00	5.00	1.20	30	4.000
17.50	10	132.00	1.16	0.00	1.16	0.96	1.33	1.15	0.95	1.20	17	33.20	4.89	1.18	25	0.285
20.00	9	132.00	1.32	0.06	1.26	0.92	1.33	1.15	0.95	1.20	14	34.40	4.95	1.19	22	0.242
22.50	27	132.00	1.49	0.14	1.34	0.89	1.33	1.15	0.95	1.20	42	1.00	0.00	1.00	42	4.000
25.00	30	132.00	1.65	0.22	1.43	0.86	1.33	1.15	0.95	1.20	45	1.00	0.00	1.00	45	4.000
27.50	29	132.00	1.81	0.30	1.52	0.83	1.33	1.15	0.95	1.20	42	1.00	0.00	1.00	42	4.000
30.00	50	132.00	1.98	0.37	1.61	0.81	1.33	1.15	1.00	1.20	74	1.00	0.00	1.00	74	4.000
32.50	50	132.00	2.15	0.45	1.69	0.79	1.33	1.15	1.00	1.20	72	1.00	0.00	1.00	72	4.000
35.00	50	132.00	2.31	0.53	1.78	0.76	1.33	1.15	1.00	1.20	70	1.00	0.00	1.00	70	4.000
37.50	50	132.00	2.48	0.61	1.87	0.74	1.33	1.15	1.00	1.20	68	1.00	0.00	1.00	68	4.000
40.00	50	132.00	2.64	0.69	1.95	0.72	1.33	1.15	1.00	1.20	66	1.00	0.00	1.00	66	4.000
42.50	27	132.00	2.81	0.76	2.04	0.70	1.33	1.15	1.00	1.20	35	1.00	0.00	1.00	35	4.000
45.00	48	132.00	2.97	0.84	2.13	0.69	1.33	1.15	1.00	1.20	60	15.00	2.50	1.05	65	4.000
47.50	37	132.00	3.13	0.92	2.21	0.67	1.33	1.15	1.00	1.20	45	1.00	0.00	1.00	45	4.000

:: Cyclic Resistance Ratio (CRR) calculation data ::

Depth (ft)	SPT Field Value	Unit Weight (pcf)	σ_v (tsf)	u_o (tsf)	σ'_{vo} (tsf)	C_N	C_E	C_B	C_R	C_S	$(N_1)_{60}$	Fines Content (%)	α	β	$(N_1)_{60cs}$	$CRR_{7.5}$
50.00	50	132.00	3.30	1.00	2.30	0.65	1.33	1.15	1.00	1.20	60	1.00	0.00	1.00	60	4.000

Abbreviations

σ_v: Total stress during SPT test (tsf)
u_o: Water pore pressure during SPT test (tsf)
σ'_{vo}: Effective overburden pressure during SPT test (tsf)
C_N: Overburden corretion factor
C_E: Energy correction factor
C_B: Borehole diameter correction factor
C_R: Rod length correction factor
C_S: Liner correction factor
$N_{1(60)}$: Corrected N_{SPT} to a 60% energy ratio
α, β: Clean sand equivalent clean sand formula coefficients
$N_{1(60)cs}$: Corected $N_{1(60)}$ value for fines content
$CRR_{7.5}$: Cydic resistance ratio for M=7.5

:: Cyclic Stress Ratio calculation (CSR fully adjusted and normalized) ::

Depth (ft)	Unit Weight (pcf)	$\sigma_{v,eq}$ (tsf)	$u_{o,eq}$ (tsf)	$\sigma'_{vo,eq}$ (tsf)	r_d	α	CSR	MSF	$CSR_{eq,M=7.5}$	K_{sigma}	CSR^*	FS
5.00	132.00	0.33	0.00	0.33	0.99	1.00	0.560	1.07	0.525	1.00	0.635	2.000
7.50	132.00	0.49	0.05	0.45	0.98	1.00	0.615	1.07	0.576	1.00	0.697	0.425
10.00	132.00	0.66	0.12	0.54	0.98	1.00	0.683	1.07	0.640	1.00	0.774	2.000
12.50	132.00	0.82	0.20	0.62	0.97	1.00	0.730	1.07	0.684	1.00	0.828	2.000
15.00	132.00	0.99	0.28	0.71	0.97	1.00	0.765	1.07	0.716	1.00	0.867	2.000
17.50	132.00	1.16	0.36	0.80	0.96	1.00	0.790	1.07	0.740	1.00	0.895	0.350
20.00	132.00	1.32	0.44	0.88	0.96	1.00	0.809	1.07	0.758	1.00	0.917	0.290
22.50	132.00	1.49	0.51	0.97	0.95	1.00	0.822	1.07	0.770	1.00	0.932	2.000
25.00	132.00	1.65	0.59	1.06	0.94	1.00	0.831	1.07	0.779	1.00	0.942	2.000
27.50	132.00	1.81	0.67	1.14	0.93	1.00	0.836	1.07	0.783	0.98	0.963	2.000
30.00	132.00	1.98	0.75	1.23	0.92	1.00	0.837	1.07	0.784	0.97	0.978	2.000
32.50	132.00	2.15	0.83	1.32	0.91	1.00	0.834	1.07	0.782	0.96	0.988	2.000
35.00	132.00	2.31	0.90	1.41	0.89	1.00	0.828	1.07	0.776	0.94	0.993	2.000
37.50	132.00	2.48	0.98	1.49	0.87	1.00	0.818	1.07	0.766	0.93	0.993	2.000
40.00	132.00	2.64	1.06	1.58	0.85	1.00	0.805	1.07	0.754	0.92	0.988	2.000
42.50	132.00	2.81	1.14	1.67	0.83	1.00	0.788	1.07	0.738	0.91	0.979	2.000
45.00	132.00	2.97	1.22	1.75	0.80	1.00	0.770	1.07	0.721	0.90	0.965	2.000
47.50	132.00	3.13	1.29	1.84	0.78	1.00	0.750	1.07	0.702	0.90	0.949	2.000
50.00	132.00	3.30	1.37	1.93	0.75	1.00	0.729	1.07	0.683	0.89	0.931	2.000

Abbreviations

$\sigma_{v,eq}$: Total overburden pressure at test point, during earthquake (tsf)
$u_{o,eq}$: Water pressure at test point, during earthquake (tsf)
$\sigma'_{vo,eq}$: Effective overburden pressure, during earthquake (tsf)
r_d : Nonlinear shear mass factor
α: Improvement factor due to stone columns
CSR : Cyclic Stress Ratio (adjusted for improvement)
MSF : Magnitude Scaling Factor
$CSR_{eq,M=7.5}$: CSR adjusted for M=7.5
K_{sigma}: Effective overburden stress factor
CSR^*: CSR fully adjusted (user FS applied)***
FS: Calculated factor of safety against soil liquefaction

*** User FS: 1.10

:: Liquefaction potential according to Iwasaki ::

Depth (ft)	FS	F	wz	Thickness (ft)	I_L
5.00	2.000	0.00	9.24	2.50	0.00
7.50	0.425	0.57	8.86	2.50	3.88
10.00	2.000	0.00	8.48	2.50	0.00
12.50	2.000	0.00	8.10	2.50	0.00
15.00	2.000	0.00	7.71	2.50	0.00
17.50	0.350	0.65	7.33	2.50	3.63
20.00	0.290	0.71	6.95	2.50	3.76
22.50	2.000	0.00	6.57	2.50	0.00
25.00	2.000	0.00	6.19	2.50	0.00
27.50	2.000	0.00	5.81	2.50	0.00
30.00	2.000	0.00	5.43	2.50	0.00
32.50	2.000	0.00	5.05	2.50	0.00
35.00	2.000	0.00	4.67	2.50	0.00
37.50	2.000	0.00	4.29	2.50	0.00
40.00	2.000	0.00	3.90	2.50	0.00
42.50	2.000	0.00	3.52	2.50	0.00
45.00	2.000	0.00	3.14	2.50	0.00
47.50	2.000	0.00	2.76	2.50	0.00
50.00	2.000	0.00	2.38	2.50	0.00

Overall potential I_L : 11.27

I_L = 0.00 - No liquefaction
I_L between 0.00 and 5 - Liquefaction not probable
I_L between 5 and 15 - Liquefaction probable
I_L > 15 - Liquefaction certain

:: Vertical settlements estimation for dry sands ::

Depth (ft)	$(N_1)_{60}$	τ_{av}	p	G_{max} (tsf)	α	b	γ	ε_{15}	N_c	ε_{Nc} (%)	Δh (ft)	ΔS (in)
5.00	18	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.50	0.000

Cumulative settlemetns: 0.000

Abbreviations

τ_{av}: Average cyclic shear stress
p: Average stress
G_{max}: Maximum shear modulus (tsf)
α, b: Shear strain formula variables
γ: Average shear strain
ε_{15}: Volumetric strain after 15 cycles
N_c: Number of cycles
ε_{Nc}: Volumetric strain for number of cycles N_c (%)
Δh: Thickness of soil layer (in)
ΔS: Settlement of soil layer (in)

:: Vertical settlements estimation for saturated sands ::

Depth (ft)	D_{50} (in)	q_c/N	e_v (%)	Δh (ft)	s (in)
7.50	0.00	5.00	2.01	2.50	0.604
10.00	0.00	5.00	0.00	2.50	0.000
12.50	0.00	5.00	0.00	2.50	0.000

:: Vertical settlements estimation for saturated sands ::

Depth (ft)	D_{50} (in)	q_c/N	e_v (%)	Δh (ft)	s (in)
15.00	0.00	5.00	0.00	2.50	0.000
17.50	0.00	5.00	1.95	2.50	0.584
20.00	0.00	5.00	2.16	2.50	0.648
22.50	0.00	5.00	0.00	2.50	0.000
25.00	0.00	5.00	0.00	2.50	0.000
27.50	0.00	5.00	0.00	2.50	0.000
30.00	0.00	5.00	0.00	2.50	0.000
32.50	0.00	5.00	0.00	2.50	0.000
35.00	0.00	5.00	0.00	2.50	0.000
37.50	0.00	5.00	0.00	2.50	0.000
40.00	0.00	5.00	0.00	2.50	0.000
42.50	0.00	5.00	0.00	2.50	0.000
45.00	0.00	5.00	0.00	2.50	0.000
47.50	0.00	5.00	0.00	2.50	0.000
50.00	0.00	5.00	0.00	2.50	0.000

Cumulative settlements: 1.836

Abbreviations

D_{50}: Median grain size (in)
q_c/N: Ratio of cone resistance to SPT
e_v: Post liquefaction volumetric strain (%)
Δh: Thickness of soil layer to be considered (ft)
s: Estimated settlement (in)

Twining Consulting

TWINING

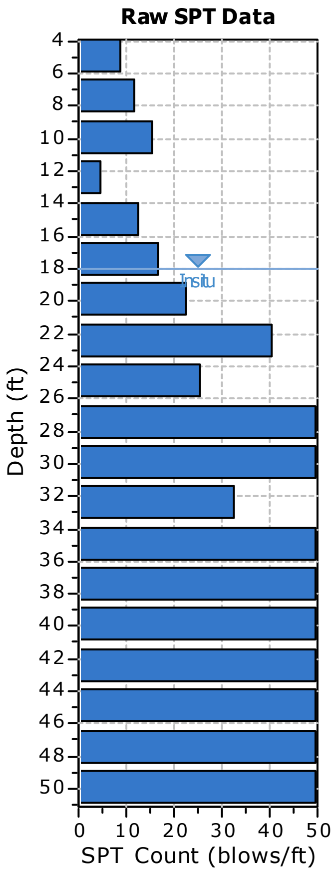
SPT BASED LIQUEFACTION ANALYSIS REPORT

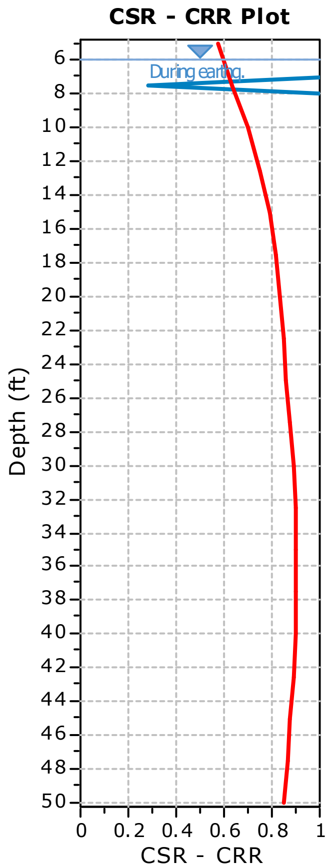
Project title : Proposed Del Rey Avenue Building **SPT Name: IGI B2**

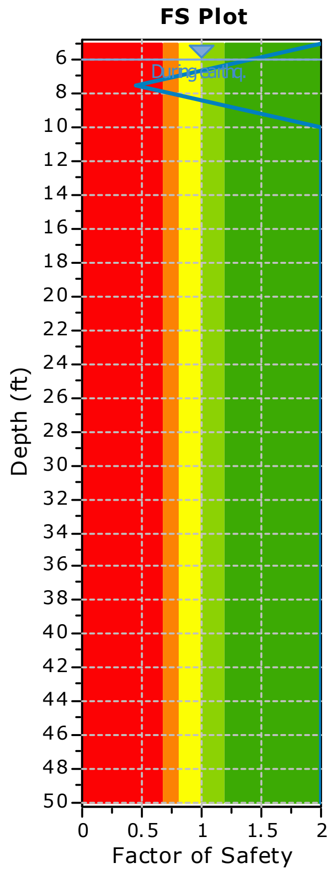
Location : 4112 Del Rey Ave, Marina Del Rey, CA

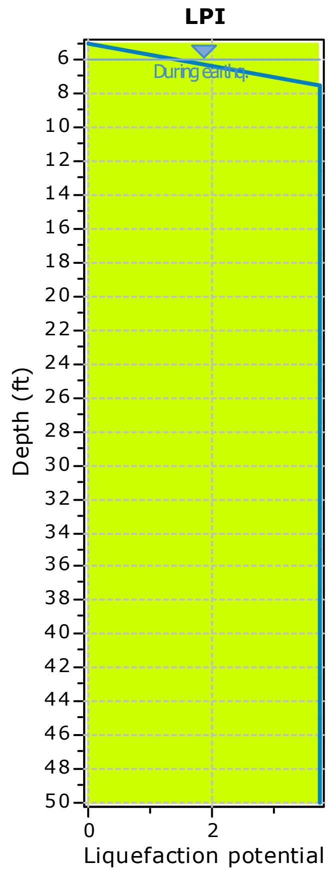
:: Input parameters and analysis properties ::

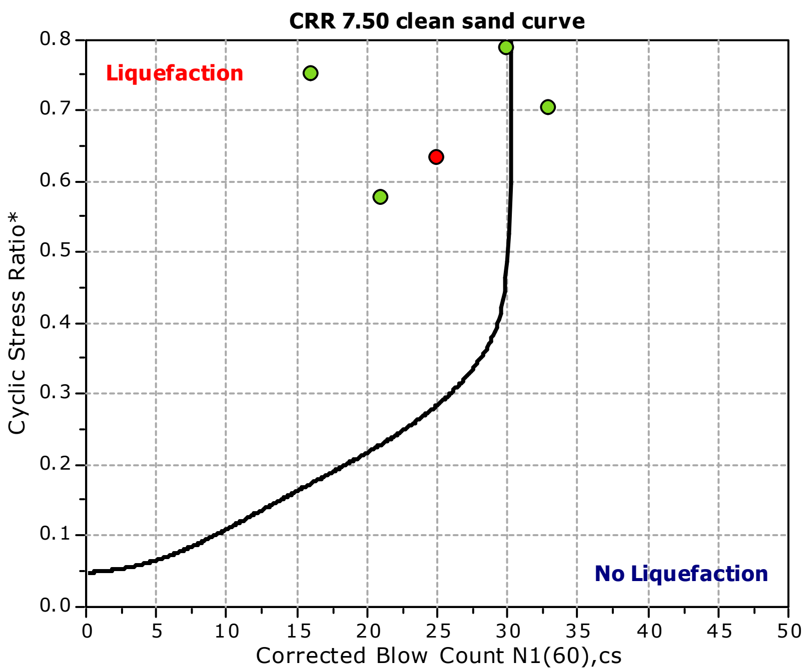
Analysis method:	NCEER 1998	G.W.T. (in-situ):	18.00 ft
Fines correction method:	NCEER 1998	G.W.T. (earthq.):	6.00 ft
Sampling method:	Sampler wo liners	Earthquake magnitude M_w:	7.31
Borehole diameter:	200mm	Peak ground acceleration:	0.87 g
Rod length:	3.30 ft	Eq. external load:	0.00 tsf
Hammer energy ratio:	1.33		











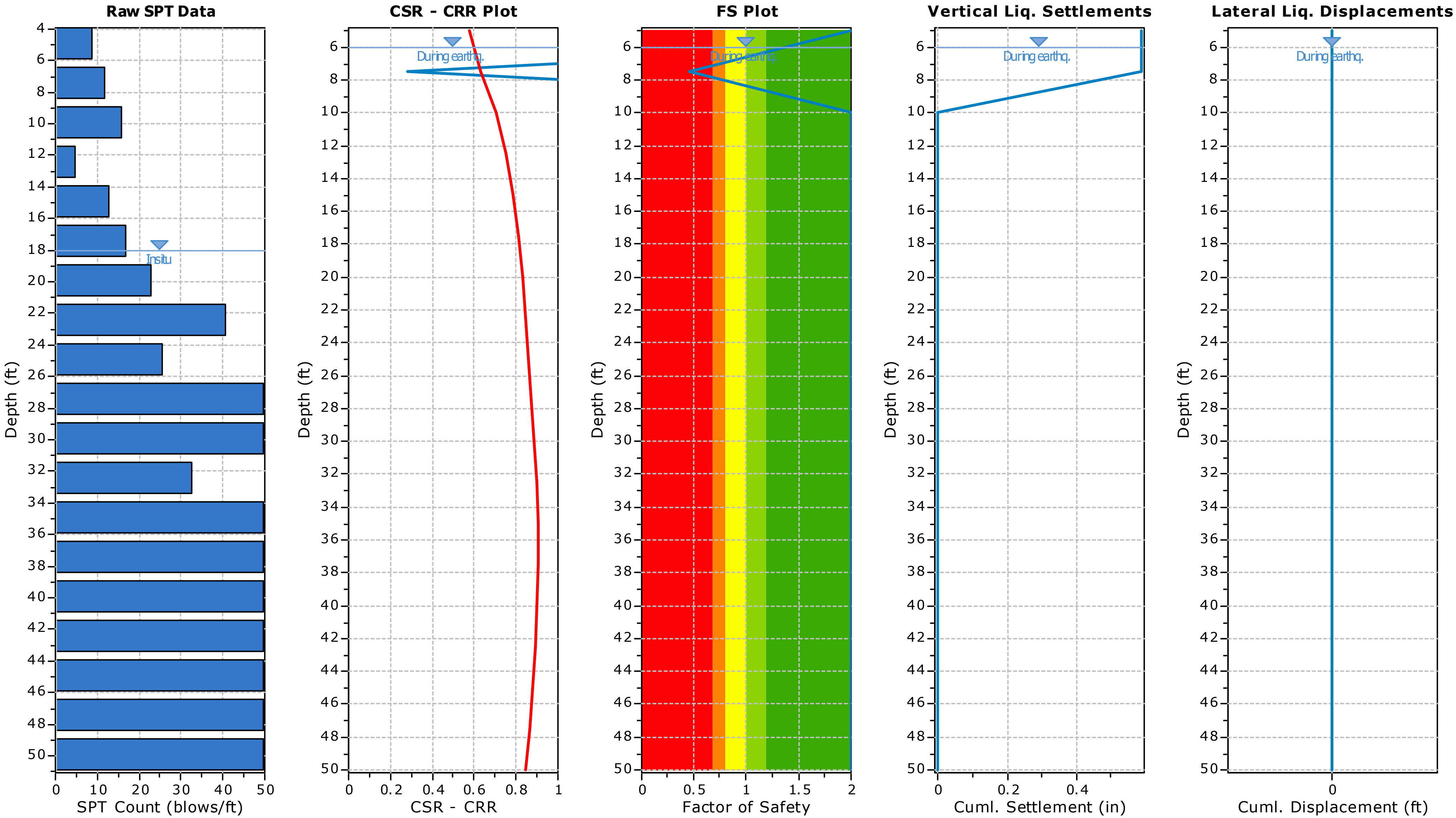
F.S. color scheme

- Almost certain it will liquefy
- Very likely to liquefy
- Liquefaction and no liq. are equally likely
- Unlike to liquefy
- Almost certain it will not liquefy

LPI color scheme

- Very high risk
- High risk
- Low risk

:: Overall Liquefaction Assessment Analysis Plots ::



:: Field input data ::

Test Depth (ft)	SPT Field Value (blows)	Fines Content (%)	Unit Weight (pcf)	Infl. Thickness (ft)	Can Liquefy
5.00	9	15.00	132.00	2.50	No
7.50	12	14.20	132.00	2.50	Yes
10.00	16	12.60	132.00	2.50	Yes
12.50	5	70.00	132.00	2.50	No
15.00	13	70.00	132.00	2.50	No
17.50	17	30.60	132.00	2.50	Yes
20.00	23	30.60	132.00	2.50	Yes
22.50	41	1.00	132.00	2.50	Yes
25.00	26	1.00	132.00	2.50	Yes
27.50	50	1.00	132.00	2.50	Yes
30.00	50	1.00	132.00	2.50	Yes
32.50	33	1.00	132.00	2.50	Yes
35.00	50	1.00	132.00	2.50	Yes
37.50	50	1.00	132.00	2.50	Yes
40.00	50	1.00	132.00	2.50	Yes
42.50	50	1.00	132.00	2.50	Yes
45.00	50	1.00	132.00	2.50	Yes
47.50	50	1.00	132.00	2.50	Yes
50.00	50	1.00	132.00	2.50	Yes

Abbreviations

Depth:	Depth at which test was performed (ft)
SPT Field Value:	Number of blows per foot
Fines Content:	Fines content at test depth (%)
Unit Weight:	Unit weight at test depth (pcf)
Infl. Thickness:	Thickness of the soil layer to be considered in settlements analysis (ft)
Can Liquefy:	User defined switch for excluding/including test depth from the analysis procedure

:: Cyclic Resistance Ratio (CRR) calculation data ::

Depth (ft)	SPT Field Value	Unit Weight (pcf)	σ_v (tsf)	u_o (tsf)	σ'_{vo} (tsf)	C_N	C_E	C_B	C_R	C_S	$(N_1)_{60}$	Fines Content (%)	α	β	$(N_1)_{60cs}$	$CRR_{7.5}$
5.00	9	132.00	0.33	0.00	0.33	1.46	1.33	1.15	0.75	1.20	18	15.00	2.50	1.05	21	4.000
7.50	12	132.00	0.49	0.00	0.49	1.32	1.33	1.15	0.75	1.20	22	14.20	2.27	1.04	25	0.285
10.00	16	132.00	0.66	0.00	0.66	1.21	1.33	1.15	0.85	1.20	30	12.60	1.76	1.03	33	4.000
12.50	5	132.00	0.82	0.00	0.82	1.11	1.33	1.15	0.85	1.20	9	70.00	5.00	1.20	16	4.000
15.00	13	132.00	0.99	0.00	0.99	1.03	1.33	1.15	0.85	1.20	21	70.00	5.00	1.20	30	4.000
17.50	17	132.00	1.16	0.00	1.16	0.96	1.33	1.15	0.95	1.20	28	30.60	4.74	1.16	37	4.000
20.00	23	132.00	1.32	0.06	1.26	0.92	1.33	1.15	0.95	1.20	37	30.60	4.74	1.16	48	4.000
22.50	41	132.00	1.49	0.14	1.34	0.89	1.33	1.15	0.95	1.20	64	1.00	0.00	1.00	64	4.000
25.00	26	132.00	1.65	0.22	1.43	0.86	1.33	1.15	0.95	1.20	39	1.00	0.00	1.00	39	4.000
27.50	50	132.00	1.81	0.30	1.52	0.83	1.33	1.15	0.95	1.20	73	1.00	0.00	1.00	73	4.000
30.00	50	132.00	1.98	0.37	1.61	0.81	1.33	1.15	1.00	1.20	74	1.00	0.00	1.00	74	4.000
32.50	33	132.00	2.15	0.45	1.69	0.79	1.33	1.15	1.00	1.20	48	1.00	0.00	1.00	48	4.000
35.00	50	132.00	2.31	0.53	1.78	0.76	1.33	1.15	1.00	1.20	70	1.00	0.00	1.00	70	4.000
37.50	50	132.00	2.48	0.61	1.87	0.74	1.33	1.15	1.00	1.20	68	1.00	0.00	1.00	68	4.000
40.00	50	132.00	2.64	0.69	1.95	0.72	1.33	1.15	1.00	1.20	66	1.00	0.00	1.00	66	4.000
42.50	50	132.00	2.81	0.76	2.04	0.70	1.33	1.15	1.00	1.20	65	1.00	0.00	1.00	65	4.000
45.00	50	132.00	2.97	0.84	2.13	0.69	1.33	1.15	1.00	1.20	63	1.00	0.00	1.00	63	4.000
47.50	50	132.00	3.13	0.92	2.21	0.67	1.33	1.15	1.00	1.20	61	1.00	0.00	1.00	61	4.000

:: Cyclic Resistance Ratio (CRR) calculation data ::

Depth (ft)	SPT Field Value	Unit Weight (pcf)	σ_v (tsf)	u_o (tsf)	σ'_{vo} (tsf)	C_N	C_E	C_B	C_R	C_S	$(N_1)_{60}$	Fines Content (%)	α	β	$(N_1)_{60cs}$	$CRR_{7.5}$
50.00	50	132.00	3.30	1.00	2.30	0.65	1.33	1.15	1.00	1.20	60	1.00	0.00	1.00	60	4.000

Abbreviations

σ_v:	Total stress during SPT test (tsf)
u_o:	Water pore pressure during SPT test (tsf)
σ'_{vo}:	Effective overburden pressure during SPT test (tsf)
C_N:	Overburden corretion factor
C_E:	Energy correction factor
C_B:	Borehole diameter correction factor
C_R:	Rod length correction factor
C_S:	Liner correction factor
$N_{1(60)}$:	Corrected N_{SPT} to a 60% energy ratio
α, β:	Clean sand equivalent clean sand formula coefficients
$N_{1(60)cs}$:	Corected $N_{1(60)}$ value for fines content
$CRR_{7.5}$:	Cydic resistance ratio for M=7.5

:: Cyclic Stress Ratio calculation (CSR fully adjusted and normalized) ::

Depth (ft)	Unit Weight (pcf)	$\sigma_{v,eq}$ (tsf)	$u_{o,eq}$ (tsf)	$\sigma'_{vo,eq}$ (tsf)	r_d	α	CSR	MSF	$CSR_{eq,M=7.5}$	K_{sigma}	CSR^*	FS
5.00	132.00	0.33	0.00	0.33	0.99	1.00	0.560	1.07	0.525	1.00	0.635	2.000
7.50	132.00	0.49	0.05	0.45	0.98	1.00	0.615	1.07	0.576	1.00	0.697	0.450
10.00	132.00	0.66	0.12	0.54	0.98	1.00	0.683	1.07	0.640	1.00	0.774	2.000
12.50	132.00	0.82	0.20	0.62	0.97	1.00	0.730	1.07	0.684	1.00	0.828	2.000
15.00	132.00	0.99	0.28	0.71	0.97	1.00	0.765	1.07	0.716	1.00	0.867	2.000
17.50	132.00	1.16	0.36	0.80	0.96	1.00	0.790	1.07	0.740	1.00	0.895	2.000
20.00	132.00	1.32	0.44	0.88	0.96	1.00	0.809	1.07	0.758	1.00	0.917	2.000
22.50	132.00	1.49	0.51	0.97	0.95	1.00	0.822	1.07	0.770	1.00	0.932	2.000
25.00	132.00	1.65	0.59	1.06	0.94	1.00	0.831	1.07	0.779	1.00	0.942	2.000
27.50	132.00	1.81	0.67	1.14	0.93	1.00	0.836	1.07	0.783	0.98	0.963	2.000
30.00	132.00	1.98	0.75	1.23	0.92	1.00	0.837	1.07	0.784	0.97	0.978	2.000
32.50	132.00	2.15	0.83	1.32	0.91	1.00	0.834	1.07	0.782	0.96	0.988	2.000
35.00	132.00	2.31	0.90	1.41	0.89	1.00	0.828	1.07	0.776	0.94	0.993	2.000
37.50	132.00	2.48	0.98	1.49	0.87	1.00	0.818	1.07	0.766	0.93	0.993	2.000
40.00	132.00	2.64	1.06	1.58	0.85	1.00	0.805	1.07	0.754	0.92	0.988	2.000
42.50	132.00	2.81	1.14	1.67	0.83	1.00	0.788	1.07	0.738	0.91	0.979	2.000
45.00	132.00	2.97	1.22	1.75	0.80	1.00	0.770	1.07	0.721	0.90	0.965	2.000
47.50	132.00	3.13	1.29	1.84	0.78	1.00	0.750	1.07	0.702	0.90	0.949	2.000
50.00	132.00	3.30	1.37	1.93	0.75	1.00	0.729	1.07	0.683	0.89	0.931	2.000

Abbreviations

$\sigma_{v,eq}$:	Total overburden pressure at test point, during earthquake (tsf)
$u_{o,eq}$:	Water pressure at test point, during earthquake (tsf)
$\sigma'_{vo,eq}$:	Effective overburden pressure, during earthquake (tsf)
r_d :	Nonlinear shear mass factor
α:	Improvement factor due to stone columns
CSR :	Cyclic Stress Ratio (adjusted for improvement)
MSF :	Magnitude Scaling Factor
$CSR_{eq,M=7.5}$:	CSR adjusted for M=7.5
K_{sigma}:	Effective overburden stress factor
CSR^*:	CSR fully adjusted (user FS applied)***
FS:	Calculated factor of safety against soil liquefaction

*** User FS: 1.10

:: Liquefaction potential according to Iwasaki ::

Depth (ft)	FS	F	wz	Thickness (ft)	I_L
5.00	2.000	0.00	9.24	2.50	0.00
7.50	0.450	0.55	8.86	2.50	3.71
10.00	2.000	0.00	8.48	2.50	0.00
12.50	2.000	0.00	8.10	2.50	0.00
15.00	2.000	0.00	7.71	2.50	0.00
17.50	2.000	0.00	7.33	2.50	0.00
20.00	2.000	0.00	6.95	2.50	0.00
22.50	2.000	0.00	6.57	2.50	0.00
25.00	2.000	0.00	6.19	2.50	0.00
27.50	2.000	0.00	5.81	2.50	0.00
30.00	2.000	0.00	5.43	2.50	0.00
32.50	2.000	0.00	5.05	2.50	0.00
35.00	2.000	0.00	4.67	2.50	0.00
37.50	2.000	0.00	4.29	2.50	0.00
40.00	2.000	0.00	3.90	2.50	0.00
42.50	2.000	0.00	3.52	2.50	0.00
45.00	2.000	0.00	3.14	2.50	0.00
47.50	2.000	0.00	2.76	2.50	0.00
50.00	2.000	0.00	2.38	2.50	0.00

Overall potential I_L: 3.71

I_L = 0.00 - No liquefaction
I_L between 0.00 and 5 - Liquefaction not probable
I_L between 5 and 15 - Liquefaction probable
I_L > 15 - Liquefaction certain

:: Vertical settlements estimation for dry sands ::

Depth (ft)	$(N_1)_{60}$	τ_{av}	p	G_{max} (tsf)	α	b	γ	ε_{15}	N_c	ε_{Nc} (%)	Δh (ft)	ΔS (in)
5.00	18	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.50	0.000

Cumulative settlemetns: 0.000

Abbreviations

τ_{av}: Average cyclic shear stress
p: Average stress
G_{max}: Maximum shear modulus (tsf)
α, b: Shear strain formula variables
γ: Average shear strain
ε_{15}: Volumetric strain after 15 cycles
N_c: Number of cycles
ε_{Nc}: Volumetric strain for number of cycles N_c (%)
Δh: Thickness of soil layer (in)
ΔS: Settlement of soil layer (in)

:: Vertical settlements estimation for saturated sands ::

Depth (ft)	D_{50} (in)	q_c/N	e_v (%)	Δh (ft)	s (in)
7.50	0.00	5.00	1.95	2.50	0.584
10.00	0.00	5.00	0.00	2.50	0.000
12.50	0.00	5.00	0.00	2.50	0.000

:: Vertical settlements estimation for saturated sands ::

Depth (ft)	D_{50} (in)	q_c/N	e_v (%)	Δh (ft)	s (in)
15.00	0.00	5.00	0.00	2.50	0.000
17.50	0.00	5.00	0.00	2.50	0.000
20.00	0.00	5.00	0.00	2.50	0.000
22.50	0.00	5.00	0.00	2.50	0.000
25.00	0.00	5.00	0.00	2.50	0.000
27.50	0.00	5.00	0.00	2.50	0.000
30.00	0.00	5.00	0.00	2.50	0.000
32.50	0.00	5.00	0.00	2.50	0.000
35.00	0.00	5.00	0.00	2.50	0.000
37.50	0.00	5.00	0.00	2.50	0.000
40.00	0.00	5.00	0.00	2.50	0.000
42.50	0.00	5.00	0.00	2.50	0.000
45.00	0.00	5.00	0.00	2.50	0.000
47.50	0.00	5.00	0.00	2.50	0.000
50.00	0.00	5.00	0.00	2.50	0.000

Cumulative settlements: 0.584

Abbreviations

D_{50}: Median grain size (in)
q_c/N: Ratio of cone resistance to SPT
e_v: Post liquefaction volumetric strain (%)
Δh: Thickness of soil layer to be considered (ft)
s: Estimated settlement (in)

Twining Consulting

TWINING

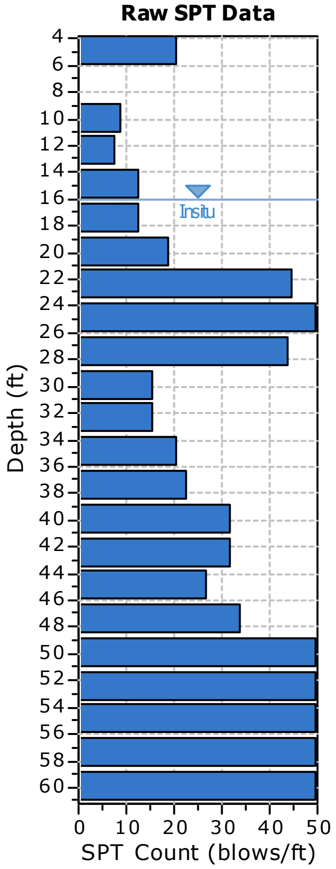
SPT BASED LIQUEFACTION ANALYSIS REPORT

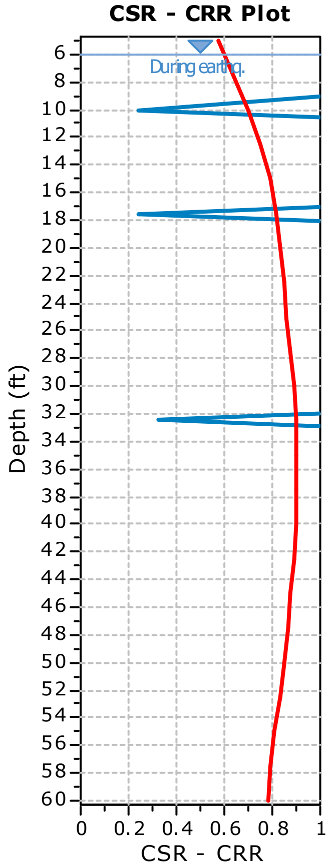
Project title : Proposed Del Rey Avenue Building **SPT Name: IGI B3**

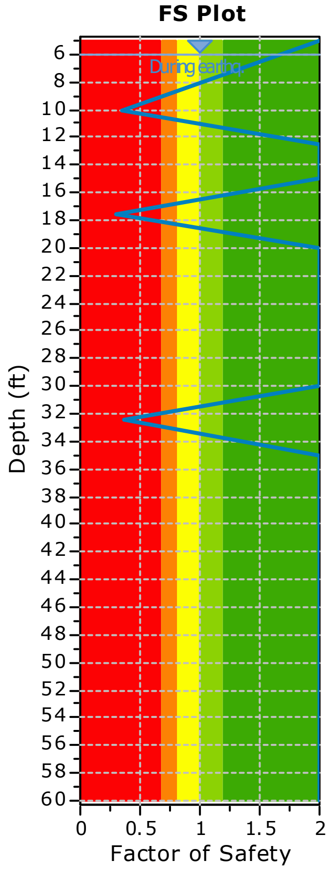
Location : 4112 Del Rey Ave, Marina Del Rey, CA

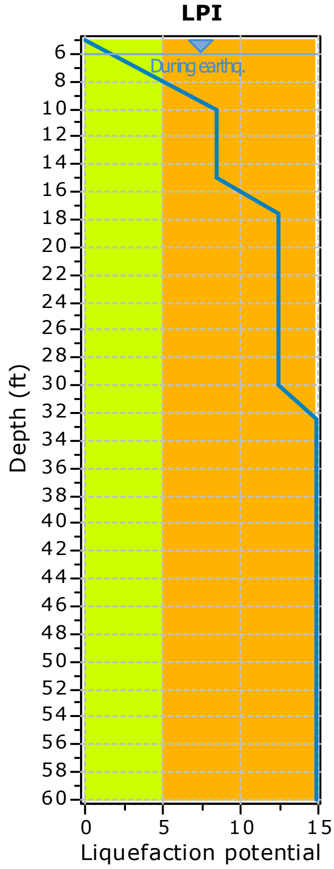
:: Input parameters and analysis properties ::

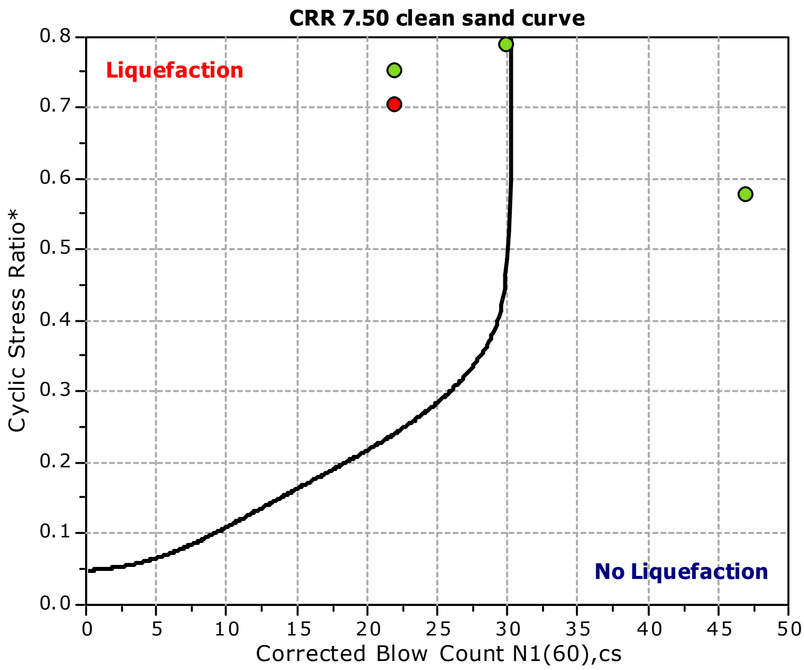
Analysis method:	NCEER 1998	G.W.T. (in-situ):	16.00 ft
Fines correction method:	NCEER 1998	G.W.T. (earthq.):	6.00 ft
Sampling method:	Sampler wo liners	Earthquake magnitude M_w:	7.31
Borehole diameter:	200mm	Peak ground acceleration:	0.87 g
Rod length:	3.30 ft	Eq. external load:	0.00 tsf
Hammer energy ratio:	1.33		











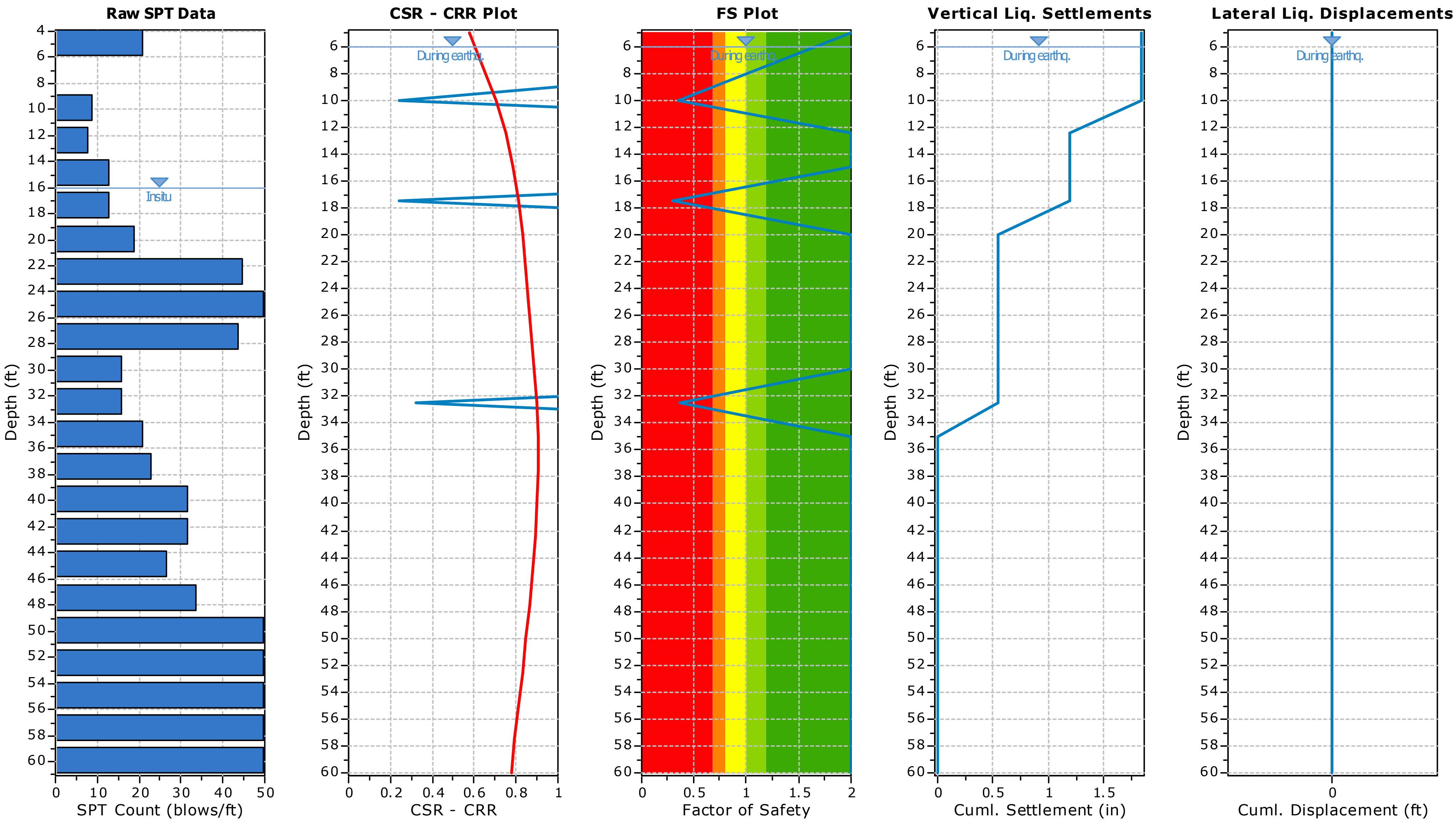
F.S. color scheme

- Almost certain it will liquefy
- Very likely to liquefy
- Liquefaction and no liq. are equally likely
- Unlike to liquefy
- Almost certain it will not liquefy

LPI color scheme

- Very high risk
- High risk
- Low risk

:: Overall Liquefaction Assessment Analysis Plots ::



:: Field input data ::

Test Depth (ft)	SPT Field Value (blows)	Fines Content (%)	Unit Weight (pcf)	Infl. Thickness (ft)	Can Liquefy
5.00	21	15.00	132.00	2.50	No
10.00	9	18.70	132.00	2.50	Yes
12.50	8	70.00	132.00	2.50	No
15.00	13	70.00	132.00	2.50	No
17.50	13	6.30	132.00	2.50	Yes
20.00	19	26.60	132.00	2.50	Yes
22.50	45	1.00	132.00	2.50	Yes
25.00	50	1.00	132.00	2.50	Yes
27.50	44	1.00	132.00	2.50	Yes
30.00	16	23.40	132.00	2.50	Yes
32.50	16	13.30	132.00	2.50	Yes
35.00	21	33.40	132.00	2.50	Yes
37.50	23	27.90	132.00	2.50	Yes
40.00	32	15.00	132.00	2.50	Yes
42.50	32	15.00	132.00	2.50	Yes
45.00	27	15.00	132.00	2.50	Yes
47.50	34	1.00	132.00	2.50	Yes
50.00	50	1.00	132.00	2.50	Yes
52.50	50	1.00	132.00	2.50	Yes
55.00	50	1.00	132.00	2.50	Yes
57.50	50	1.00	132.00	2.50	Yes
60.00	50	1.00	132.00	2.50	Yes

Abbreviations

Depth:	Depth at which test was performed (ft)
SPT Field Value:	Number of blows per foot
Fines Content:	Fines content at test depth (%)
Unit Weight:	Unit weight at test depth (pcf)
Infl. Thickness:	Thickness of the soil layer to be considered in settlements analysis (ft)
Can Liquefy:	User defined switch for excluding/including test depth from the analysis procedure

:: Cyclic Resistance Ratio (CRR) calculation data ::

Depth (ft)	SPT Field Value	Unit Weight (pcf)	σ_v (tsf)	u_o (tsf)	σ'_{vo} (tsf)	C_N	C_E	C_B	C_R	C_S	$(N_1)_{60}$	Fines Content (%)	α	β	$(N_1)_{60cs}$	$CRR_{7.5}$
5.00	21	132.00	0.33	0.00	0.33	1.46	1.33	1.15	0.75	1.20	42	15.00	2.50	1.05	47	4.000
10.00	9	132.00	0.66	0.00	0.66	1.21	1.33	1.15	0.85	1.20	17	18.70	3.38	1.07	22	0.242
12.50	8	132.00	0.82	0.00	0.82	1.11	1.33	1.15	0.85	1.20	14	70.00	5.00	1.20	22	4.000
15.00	13	132.00	0.99	0.00	0.99	1.03	1.33	1.15	0.85	1.20	21	70.00	5.00	1.20	30	4.000
17.50	13	132.00	1.16	0.05	1.11	0.98	1.33	1.15	0.95	1.20	22	6.30	0.05	1.01	22	0.242
20.00	19	132.00	1.32	0.12	1.20	0.94	1.33	1.15	0.95	1.20	31	26.60	4.44	1.13	39	4.000
22.50	45	132.00	1.49	0.20	1.28	0.91	1.33	1.15	0.95	1.20	72	1.00	0.00	1.00	72	4.000
25.00	50	132.00	1.65	0.28	1.37	0.88	1.33	1.15	0.95	1.20	77	1.00	0.00	1.00	77	4.000
27.50	44	132.00	1.81	0.36	1.46	0.85	1.33	1.15	0.95	1.20	66	1.00	0.00	1.00	66	4.000
30.00	16	132.00	1.98	0.44	1.54	0.83	1.33	1.15	1.00	1.20	24	23.40	4.11	1.10	31	4.000
32.50	16	132.00	2.15	0.51	1.63	0.80	1.33	1.15	1.00	1.20	24	13.30	1.99	1.04	27	0.323
35.00	21	132.00	2.31	0.59	1.72	0.78	1.33	1.15	1.00	1.20	30	33.40	4.90	1.18	40	4.000
37.50	23	132.00	2.48	0.67	1.80	0.76	1.33	1.15	1.00	1.20	32	27.90	4.55	1.14	41	4.000
40.00	32	132.00	2.64	0.75	1.89	0.74	1.33	1.15	1.00	1.20	43	15.00	2.50	1.05	48	4.000
42.50	32	132.00	2.81	0.83	1.98	0.72	1.33	1.15	1.00	1.20	42	15.00	2.50	1.05	47	4.000

:: Cyclic Resistance Ratio (CRR) calculation data ::

Depth (ft)	SPT Field Value	Unit Weight (pcf)	σ_v (tsf)	u_o (tsf)	σ'_{vo} (tsf)	C_N	C_E	C_B	C_R	C_S	$(N_1)_{60}$	Fines Content (%)	α	β	$(N_1)_{60cs}$	$CRR_{7.5}$
45.00	27	132.00	2.97	0.90	2.07	0.70	1.33	1.15	1.00	1.20	35	15.00	2.50	1.05	39	4.000
47.50	34	132.00	3.13	0.98	2.15	0.68	1.33	1.15	1.00	1.20	42	1.00	0.00	1.00	42	4.000
50.00	50	132.00	3.30	1.06	2.24	0.66	1.33	1.15	1.00	1.20	61	1.00	0.00	1.00	61	4.000
52.50	50	132.00	3.46	1.14	2.33	0.65	1.33	1.15	1.00	1.20	59	1.00	0.00	1.00	59	4.000
55.00	50	132.00	3.63	1.22	2.41	0.63	1.33	1.15	1.00	1.20	58	1.00	0.00	1.00	58	4.000
57.50	50	132.00	3.79	1.29	2.50	0.62	1.33	1.15	1.00	1.20	57	1.00	0.00	1.00	57	4.000
60.00	50	132.00	3.96	1.37	2.59	0.60	1.33	1.15	1.00	1.20	55	1.00	0.00	1.00	55	4.000

Abbreviations

σ_v:	Total stress during SPT test (tsf)
u_o:	Water pore pressure during SPT test (tsf)
σ'_{vo}:	Effective overburden pressure during SPT test (tsf)
C_N:	Overburden corretion factor
C_E:	Energy correction factor
C_B:	Borehole diameter correction factor
C_R:	Rod length correction factor
C_S:	Liner correction factor
$N_{1(60)}$:	Corrected N_{SPT} to a 60% energy ratio
α, β:	Clean sand equivalent clean sand formula coefficients
$N_{1(60)cs}$:	Corected $N_{1(60)}$ value for fines content
$CRR_{7.5}$:	Cydic resistance ratio for M=7.5

:: Cyclic Stress Ratio calculation (CSR fully adjusted and normalized) ::

Depth (ft)	Unit Weight (pcf)	$\sigma_{v,eq}$ (tsf)	$u_{o,eq}$ (tsf)	$\sigma'_{vo,eq}$ (tsf)	r_d	α	CSR	MSF	$CSR_{eq,M=7.5}$	K_{sigma}	CSR^*	FS
5.00	132.00	0.33	0.00	0.33	0.99	1.00	0.560	1.07	0.525	1.00	0.635	2.000
10.00	132.00	0.66	0.12	0.54	0.98	1.00	0.683	1.07	0.640	1.00	0.774	0.344
12.50	132.00	0.82	0.20	0.62	0.97	1.00	0.730	1.07	0.684	1.00	0.828	2.000
15.00	132.00	0.99	0.28	0.71	0.97	1.00	0.765	1.07	0.716	1.00	0.867	2.000
17.50	132.00	1.16	0.36	0.80	0.96	1.00	0.790	1.07	0.740	1.00	0.895	0.297
20.00	132.00	1.32	0.44	0.88	0.96	1.00	0.809	1.07	0.758	1.00	0.917	2.000
22.50	132.00	1.49	0.51	0.97	0.95	1.00	0.822	1.07	0.770	1.00	0.932	2.000
25.00	132.00	1.65	0.59	1.06	0.94	1.00	0.831	1.07	0.779	1.00	0.942	2.000
27.50	132.00	1.81	0.67	1.14	0.93	1.00	0.836	1.07	0.783	0.98	0.963	2.000
30.00	132.00	1.98	0.75	1.23	0.92	1.00	0.837	1.07	0.784	0.97	0.978	2.000
32.50	132.00	2.15	0.83	1.32	0.91	1.00	0.834	1.07	0.782	0.96	0.988	0.360
35.00	132.00	2.31	0.90	1.41	0.89	1.00	0.828	1.07	0.776	0.94	0.993	2.000
37.50	132.00	2.48	0.98	1.49	0.87	1.00	0.818	1.07	0.766	0.93	0.993	2.000
40.00	132.00	2.64	1.06	1.58	0.85	1.00	0.805	1.07	0.754	0.92	0.988	2.000
42.50	132.00	2.81	1.14	1.67	0.83	1.00	0.788	1.07	0.738	0.91	0.979	2.000
45.00	132.00	2.97	1.22	1.75	0.80	1.00	0.770	1.07	0.721	0.90	0.965	2.000
47.50	132.00	3.13	1.29	1.84	0.78	1.00	0.750	1.07	0.702	0.90	0.949	2.000
50.00	132.00	3.30	1.37	1.93	0.75	1.00	0.729	1.07	0.683	0.89	0.931	2.000
52.50	132.00	3.46	1.45	2.01	0.73	1.00	0.708	1.07	0.663	0.88	0.912	2.000
55.00	132.00	3.63	1.53	2.10	0.70	1.00	0.687	1.07	0.644	0.87	0.893	2.000
57.50	132.00	3.79	1.61	2.19	0.68	1.00	0.667	1.07	0.625	0.86	0.875	2.000
60.00	132.00	3.96	1.68	2.28	0.66	1.00	0.649	1.07	0.608	0.86	0.857	2.000

:: Cyclic Stress Ratio calculation (CSR fully adjusted and normalized) ::

Depth (ft)	Unit Weight (pcf)	$\sigma_{v,eq}$ (tsf)	$u_{o,eq}$ (tsf)	$\sigma'_{vo,eq}$ (tsf)	r_d	α	CSR	MSF	$CSR_{eq,M=7.5}$	K_{sigma}	CSR^*	FS

Abbreviations

$\sigma_{v,eq}$: Total overburden pressure at test point, during earthquake (tsf)
$u_{o,eq}$: Water pressure at test point, during earthquake (tsf)
$\sigma'_{vo,eq}$: Effective overburden pressure, during earthquake (tsf)
r_d : Nonlinear shear mass factor
α: Improvement factor due to stone columns
CSR : Cyclic Stress Ratio (adjusted for improvement)
MSF : Magnitude Scaling Factor
$CSR_{eq,M=7.5}$: CSR adjusted for M=7.5
K_{sigma}: Effective overburden stress factor
CSR^*: CSR fully adjusted (user FS applied)***
FS: Calculated factor of safety against soil liquefaction

*** User FS: 1.10

:: Liquefaction potential according to Iwasaki ::

Depth (ft)	FS	F	wz	Thickness (ft)	I_L
5.00	2.000	0.00	9.24	5.00	0.00
10.00	0.344	0.66	8.48	5.00	8.48
12.50	2.000	0.00	8.10	2.50	0.00
15.00	2.000	0.00	7.71	2.50	0.00
17.50	0.297	0.70	7.33	2.50	3.93
20.00	2.000	0.00	6.95	2.50	0.00
22.50	2.000	0.00	6.57	2.50	0.00
25.00	2.000	0.00	6.19	2.50	0.00
27.50	2.000	0.00	5.81	2.50	0.00
30.00	2.000	0.00	5.43	2.50	0.00
32.50	0.360	0.64	5.05	2.50	2.46
35.00	2.000	0.00	4.67	2.50	0.00
37.50	2.000	0.00	4.29	2.50	0.00
40.00	2.000	0.00	3.90	2.50	0.00
42.50	2.000	0.00	3.52	2.50	0.00
45.00	2.000	0.00	3.14	2.50	0.00
47.50	2.000	0.00	2.76	2.50	0.00
50.00	2.000	0.00	2.38	2.50	0.00
52.50	2.000	0.00	2.00	2.50	0.00
55.00	2.000	0.00	1.62	2.50	0.00
57.50	2.000	0.00	1.24	2.50	0.00
60.00	2.000	0.00	0.86	2.50	0.00

Overall potential I_L : 14.87

I_L = 0.00 - No liquefaction
I_L between 0.00 and 5 - Liquefaction not probable
I_L between 5 and 15 - Liquefaction probable
I_L > 15 - Liquefaction certain

:: Vertical settlements estimation for dry sands ::

Depth (ft)	$(N_1)_{60}$	τ_{av}	p	G_{max} (tsf)	α	b	γ	ε_{15}	N_c	ε_{Nc} (%)	Δh (ft)	ΔS (in)
5.00	42	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.50	0.000

:: Vertical settlements estimation for dry sands ::

Depth (ft)	$(N_1)_{60}$	τ_{av}	p	G_{max} (tsf)	α	b	γ	ε_{15}	N_c	ε_{Nc} (%)	Δh (ft)	ΔS (in)

Cumulative settlemetns: 0.000

Abbreviations

τ_{av}: Average cyclic shear stress
p: Average stress
G_{max}: Maximum shear modulus (tsf)
α, b: Shear strain formula variables
γ: Average shear strain
ε_{15}: Volumetric strain after 15 cycles
N_c: Number of cycles
ε_{Nc}: Volumetric strain for number of cycles N_c (%)
Δh: Thickness of soil layer (in)
ΔS: Settlement of soil layer (in)

:: Vertical settlements estimation for saturated sands ::

Depth (ft)	D_{50} (in)	q_c/N	e_v (%)	Δh (ft)	s (in)
10.00	0.00	5.00	2.16	2.50	0.648
12.50	0.00	5.00	0.00	2.50	0.000
15.00	0.00	5.00	0.00	2.50	0.000
17.50	0.00	5.00	2.16	2.50	0.648
20.00	0.00	5.00	0.00	2.50	0.000
22.50	0.00	5.00	0.00	2.50	0.000
25.00	0.00	5.00	0.00	2.50	0.000
27.50	0.00	5.00	0.00	2.50	0.000
30.00	0.00	5.00	0.00	2.50	0.000
32.50	0.00	5.00	1.83	2.50	0.548
35.00	0.00	5.00	0.00	2.50	0.000
37.50	0.00	5.00	0.00	2.50	0.000
40.00	0.00	5.00	0.00	2.50	0.000
42.50	0.00	5.00	0.00	2.50	0.000
45.00	0.00	5.00	0.00	2.50	0.000
47.50	0.00	5.00	0.00	2.50	0.000
50.00	0.00	5.00	0.00	2.50	0.000
52.50	0.00	5.00	0.00	2.50	0.000
55.00	0.00	5.00	0.00	2.50	0.000
57.50	0.00	5.00	0.00	2.50	0.000
60.00	0.00	5.00	0.00	2.50	0.000

Cumulative settlements: 1.845

Abbreviations

D_{50}: Median grain size (in)
q_c/N: Ratio of cone resistance to SPT
e_v: Post liquefaction volumetric strain (%)
Δh: Thickness of soil layer to be considered (ft)
s: Estimated settlement (in)

Twining Consulting

TWINING

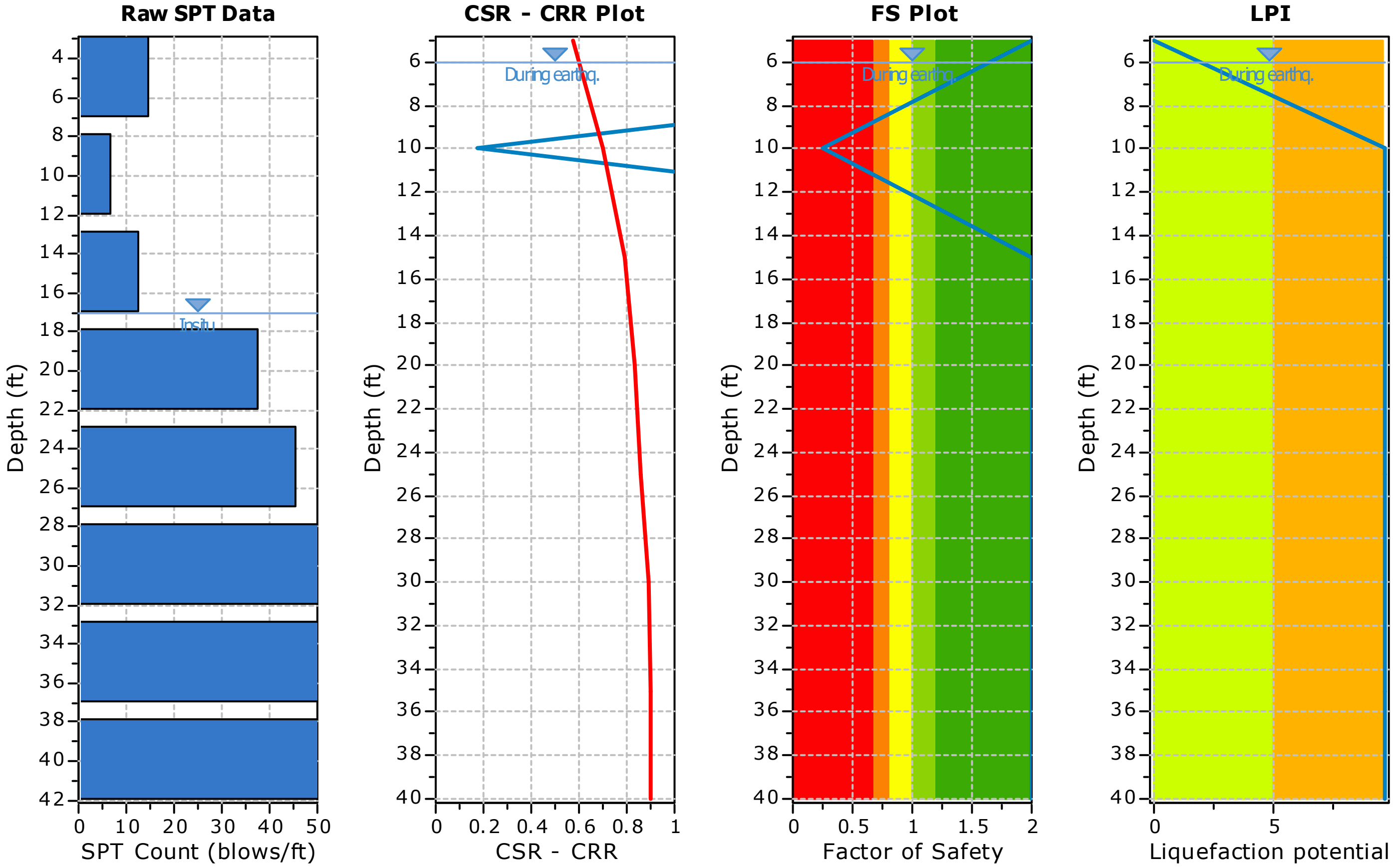
SPT BASED LIQUEFACTION ANALYSIS REPORT

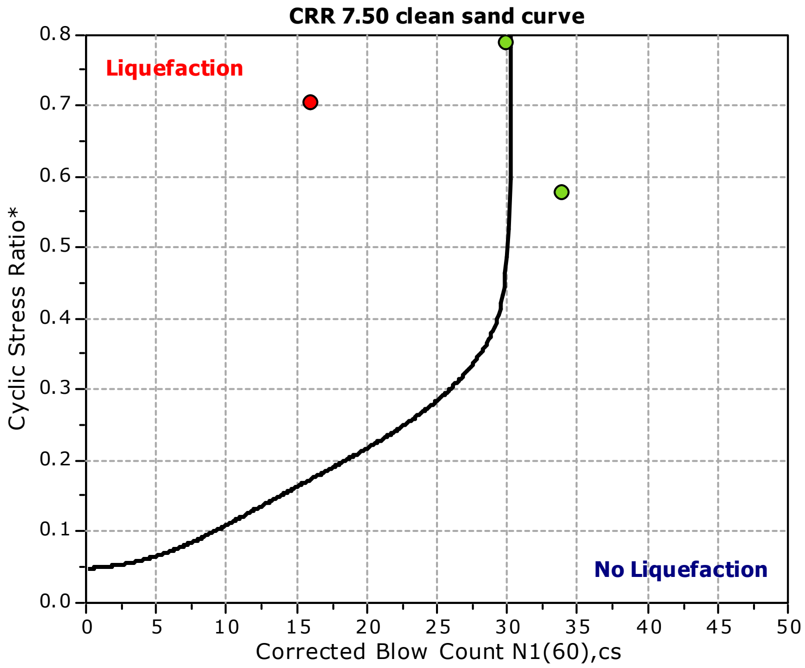
Project title : Proposed Del Rey Avenue Building **SPT Name: IGI B4**

Location : 4112 Del Rey Ave, Marina Del Rey, CA

:: Input parameters and analysis properties ::

Analysis method:	NCEER 1998	G.W.T. (in-situ):	17.00 ft
Fines correction method:	NCEER 1998	G.W.T. (earthq.):	6.00 ft
Sampling method:	Sampler wo liners	Earthquake magnitude M_w:	7.31
Borehole diameter:	200mm	Peak ground acceleration:	0.87 g
Rod length:	3.30 ft	Eq. external load:	0.00 tsf
Hammer energy ratio:	1.33		





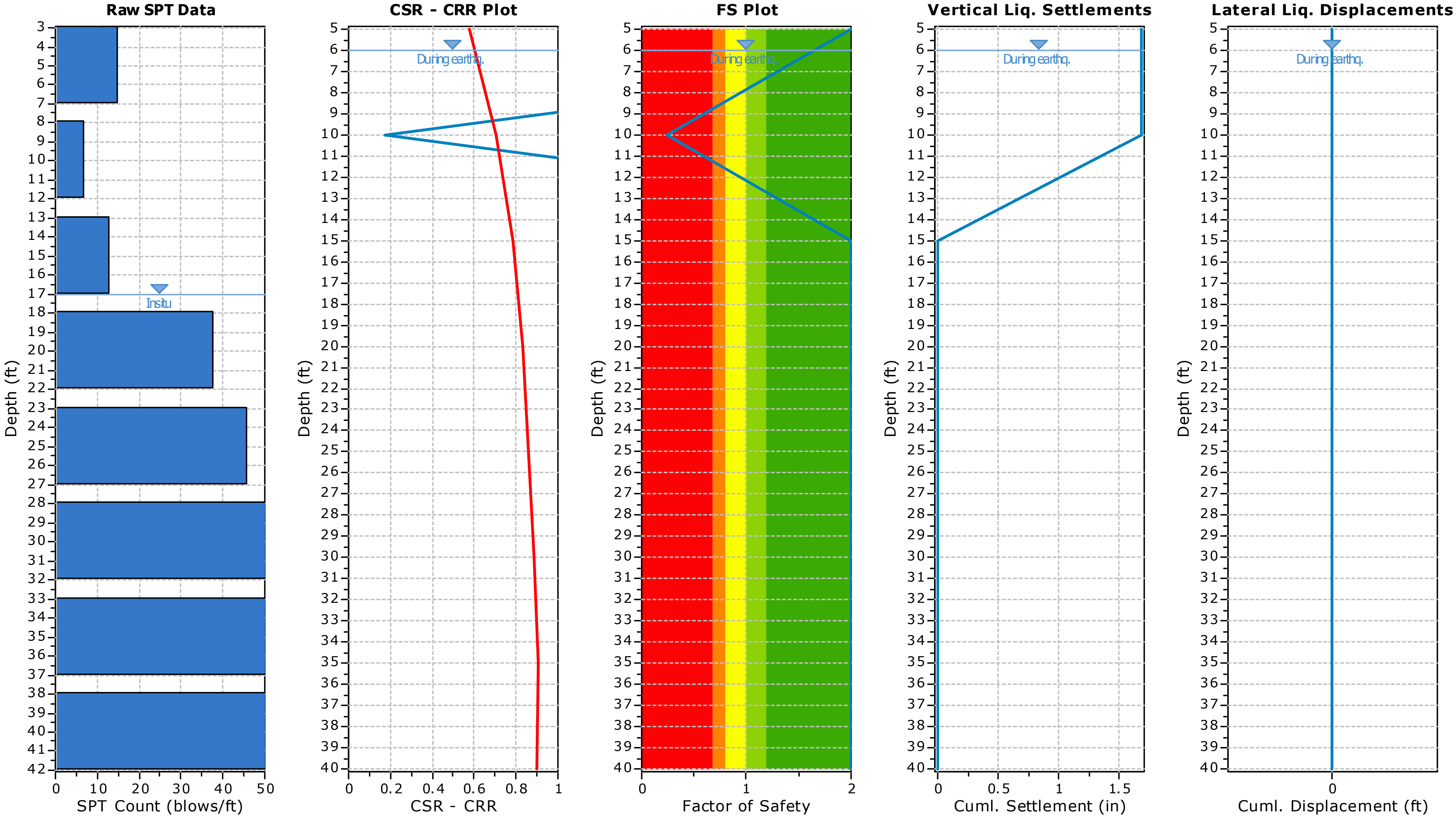
F.S. color scheme

- Almost certain it will liquefy
- Very likely to liquefy
- Liquefaction and no liq. are equally likely
- Unlike to liquefy
- Almost certain it will not liquefy

LPI color scheme

- Very high risk
- High risk
- Low risk

:: Overall Liquefaction Assessment Analysis Plots ::



:: Field input data ::

Test Depth (ft)	SPT Field Value (blows)	Fines Content (%)	Unit Weight (pcf)	Infl. Thickness (ft)	Can Liquefy
5.00	15	15.00	132.00	5.00	No
10.00	7	15.00	132.00	5.00	Yes
15.00	13	70.00	132.00	5.00	No
20.00	38	1.00	132.00	5.00	Yes
25.00	46	1.00	132.00	5.00	Yes
30.00	65	1.00	132.00	5.00	Yes
35.00	65	15.00	132.00	5.00	Yes
40.00	65	15.00	132.00	5.00	Yes

Abbreviations

Depth:	Depth at which test was performed (ft)
SPT Field Value:	Number of blows per foot
Fines Content:	Fines content at test depth (%)
Unit Weight:	Unit weight at test depth (pcf)
Infl. Thickness:	Thickness of the soil layer to be considered in settlements analysis (ft)
Can Liquefy:	User defined switch for excluding/including test depth from the analysis procedure

:: Cyclic Resistance Ratio (CRR) calculation data ::

Depth (ft)	SPT Field Value	Unit Weight (pcf)	σ_v (tsf)	u_o (tsf)	σ'_{vo} (tsf)	C_N	C_E	C_B	C_R	C_S	$(N_1)_{60}$	Fines Content (%)	α	β	$(N_1)_{60cs}$	$CRR_{7.5}$
5.00	15	132.00	0.33	0.00	0.33	1.46	1.33	1.15	0.75	1.20	30	15.00	2.50	1.05	34	4.000
10.00	7	132.00	0.66	0.00	0.66	1.21	1.33	1.15	0.85	1.20	13	15.00	2.50	1.05	16	0.174
15.00	13	132.00	0.99	0.00	0.99	1.03	1.33	1.15	0.85	1.20	21	70.00	5.00	1.20	30	4.000
20.00	38	132.00	1.32	0.09	1.23	0.93	1.33	1.15	0.95	1.20	62	1.00	0.00	1.00	62	4.000
25.00	46	132.00	1.65	0.25	1.40	0.87	1.33	1.15	0.95	1.20	70	1.00	0.00	1.00	70	4.000
30.00	65	132.00	1.98	0.41	1.57	0.82	1.33	1.15	1.00	1.20	98	1.00	0.00	1.00	98	4.000
35.00	65	132.00	2.31	0.56	1.75	0.77	1.33	1.15	1.00	1.20	92	15.00	2.50	1.05	99	4.000
40.00	65	132.00	2.64	0.72	1.92	0.73	1.33	1.15	1.00	1.20	87	15.00	2.50	1.05	94	4.000

Abbreviations

σ_v:	Total stress during SPT test (tsf)
u_o:	Water pore pressure during SPT test (tsf)
σ'_{vo}:	Effective overburden pressure during SPT test (tsf)
C_N:	Overburden corretion factor
C_E:	Energy correction factor
C_B:	Borehole diameter correction factor
C_R:	Rod length correction factor
C_S:	Liner correction factor
$N_{1(60)}$:	Corrected N_{SPT} to a 60% energy ratio
α, β:	Clean sand equivalent clean sand formula coefficients
$N_{1(60)cs}$:	Corected $N_{1(60)}$ value for fines content
$CRR_{7.5}$:	Cydic resistance ratio for M=7.5

:: Cyclic Stress Ratio calculation (CSR fully adjusted and normalized) ::

Depth (ft)	Unit Weight (pcf)	$\sigma_{v,eq}$ (tsf)	$u_{o,eq}$ (tsf)	$\sigma'_{vo,eq}$ (tsf)	r_d	α	CSR	MSF	$CSR_{eq,M=7.5}$	K_{sigma}	CSR^*	FS
5.00	132.00	0.33	0.00	0.33	0.99	1.00	0.560	1.07	0.525	1.00	0.635	2.000
10.00	132.00	0.66	0.12	0.54	0.98	1.00	0.683	1.07	0.640	1.00	0.774	0.247
15.00	132.00	0.99	0.28	0.71	0.97	1.00	0.765	1.07	0.716	1.00	0.867	2.000
20.00	132.00	1.32	0.44	0.88	0.96	1.00	0.809	1.07	0.758	1.00	0.917	2.000
25.00	132.00	1.65	0.59	1.06	0.94	1.00	0.831	1.07	0.779	1.00	0.942	2.000
30.00	132.00	1.98	0.75	1.23	0.92	1.00	0.837	1.07	0.784	0.97	0.978	2.000

:: Cyclic Stress Ratio calculation (CSR fully adjusted and normalized) ::

Depth (ft)	Unit Weight (pcf)	$\sigma_{v,eq}$ (tsf)	$u_{o,eq}$ (tsf)	$\sigma'_{vo,eq}$ (tsf)	r_d	α	CSR	MSF	$CSR_{eq,M=7.5}$	K_{sigma}	CSR^*	FS	
35.00	132.00	2.31	0.90	1.41	0.89	1.00	0.828	1.07	0.776	0.94	0.993	2.000	●
40.00	132.00	2.64	1.06	1.58	0.85	1.00	0.805	1.07	0.754	0.92	0.988	2.000	●

Abbreviations

$\sigma_{v,eq}$:	Total overburden pressure at test point, during earthquake (tsf)
$u_{o,eq}$:	Water pressure at test point, during earthquake (tsf)
$\sigma'_{vo,eq}$:	Effective overburden pressure, during earthquake (tsf)
r_d :	Nonlinear shear mass factor
α:	Improvement factor due to stone columns
CSR :	Cyclic Stress Ratio (adjusted for improvement)
MSF :	Magnitude Scaling Factor
$CSR_{eq,M=7.5}$:	CSR adjusted for M=7.5
K_{sigma}:	Effective overburden stress factor
CSR^*:	CSR fully adjusted (user FS applied)***
FS:	Calculated factor of safety against soil liquefaction

*** User FS: 1.10

:: Liquefaction potential according to Iwasaki ::

Depth (ft)	FS	F	wz	Thickness (ft)	I_L
5.00	2.000	0.00	9.24	5.00	0.00
10.00	0.247	0.75	8.48	5.00	9.72
15.00	2.000	0.00	7.71	5.00	0.00
20.00	2.000	0.00	6.95	5.00	0.00
25.00	2.000	0.00	6.19	5.00	0.00
30.00	2.000	0.00	5.43	5.00	0.00
35.00	2.000	0.00	4.67	5.00	0.00
40.00	2.000	0.00	3.90	5.00	0.00

Overall potential I_L : 9.72

I_L = 0.00 - No liquefaction
I_L between 0.00 and 5 - Liquefaction not probable
I_L between 5 and 15 - Liquefaction probable
I_L > 15 - Liquefaction certain

:: Vertical settlements estimation for dry sands ::

Depth (ft)	$(N_1)_{60}$	τ_{av}	p	G_{max} (tsf)	α	b	γ	ε_{15}	N_c	ε_{Nc} (%)	Δh (ft)	ΔS (in)
5.00	30	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	5.00	0.000

Cumulative settlemetns: 0.000

Abbreviations

τ_{av}:	Average cyclic shear stress
p:	Average stress
G_{max}:	Maximum shear modulus (tsf)
α, b:	Shear strain formula variables
γ:	Average shear strain
ε_{15}:	Volumetric strain after 15 cycles
N_c:	Number of cycles
ε_{Nc}:	Volumetric strain for number of cycles N_c (%)
Δh:	Thickness of soil layer (in)
ΔS:	Settlement of soil layer (in)

:: Vertical settlements estimation for saturated sands ::

Depth (ft)	D_{50} (in)	q_c/N	e_v (%)	Δh (ft)	s (in)
10.00	0.00	5.00	2.81	5.00	1.684
15.00	0.00	5.00	0.00	5.00	0.000
20.00	0.00	5.00	0.00	5.00	0.000
25.00	0.00	5.00	0.00	5.00	0.000
30.00	0.00	5.00	0.00	5.00	0.000
35.00	0.00	5.00	0.00	5.00	0.000
40.00	0.00	5.00	0.00	5.00	0.000

Cumulative settlements: 1.684

Abbreviations

D_{50}: Median grain size (in)
q_c/N: Ratio of cone resistance to SPT
e_v: Post liquefaction volumetric strain (%)
Δh: Thickness of soil layer to be considered (ft)
s: Estimated settlement (in)

Twining Consulting

TWINING

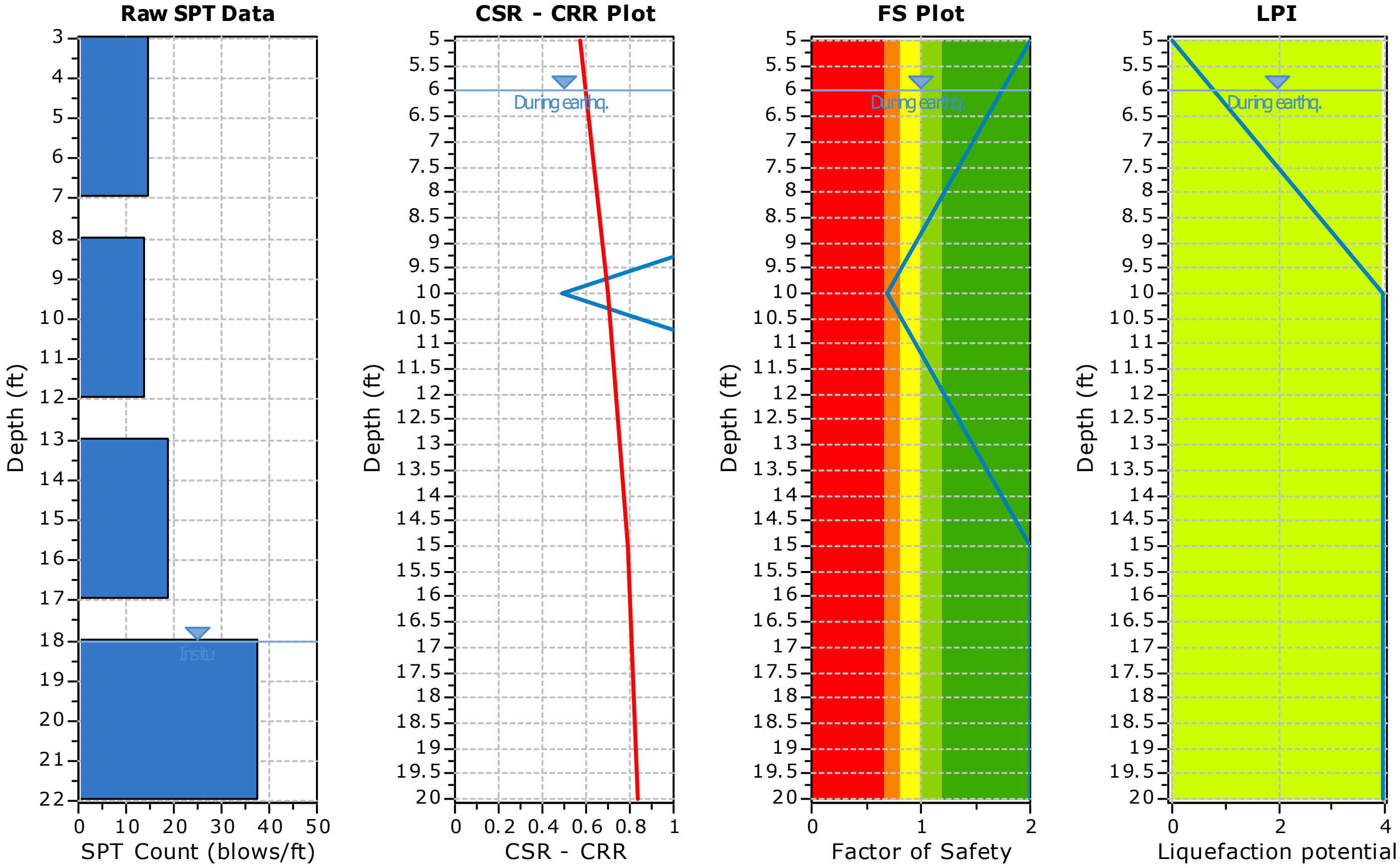
SPT BASED LIQUEFACTION ANALYSIS REPORT

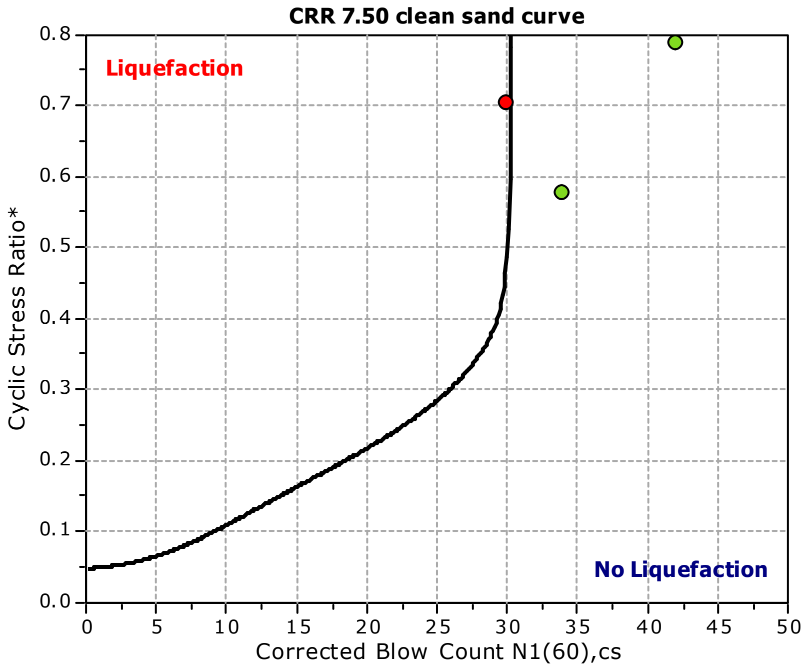
Project title : Proposed Del Rey Avenue Building **SPT Name: IGI B5**

Location : 4112 Del Rey Ave, Marina Del Rey, CA

:: Input parameters and analysis properties ::

Analysis method:	NCEER 1998	G.W.T. (in-situ):	18.00 ft
Fines correction method:	NCEER 1998	G.W.T. (earthq.):	6.00 ft
Sampling method:	Sampler wo liners	Earthquake magnitude M_w:	7.31
Borehole diameter:	200mm	Peak ground acceleration:	0.87 g
Rod length:	3.30 ft	Eq. external load:	0.00 tsf
Hammer energy ratio:	1.33		





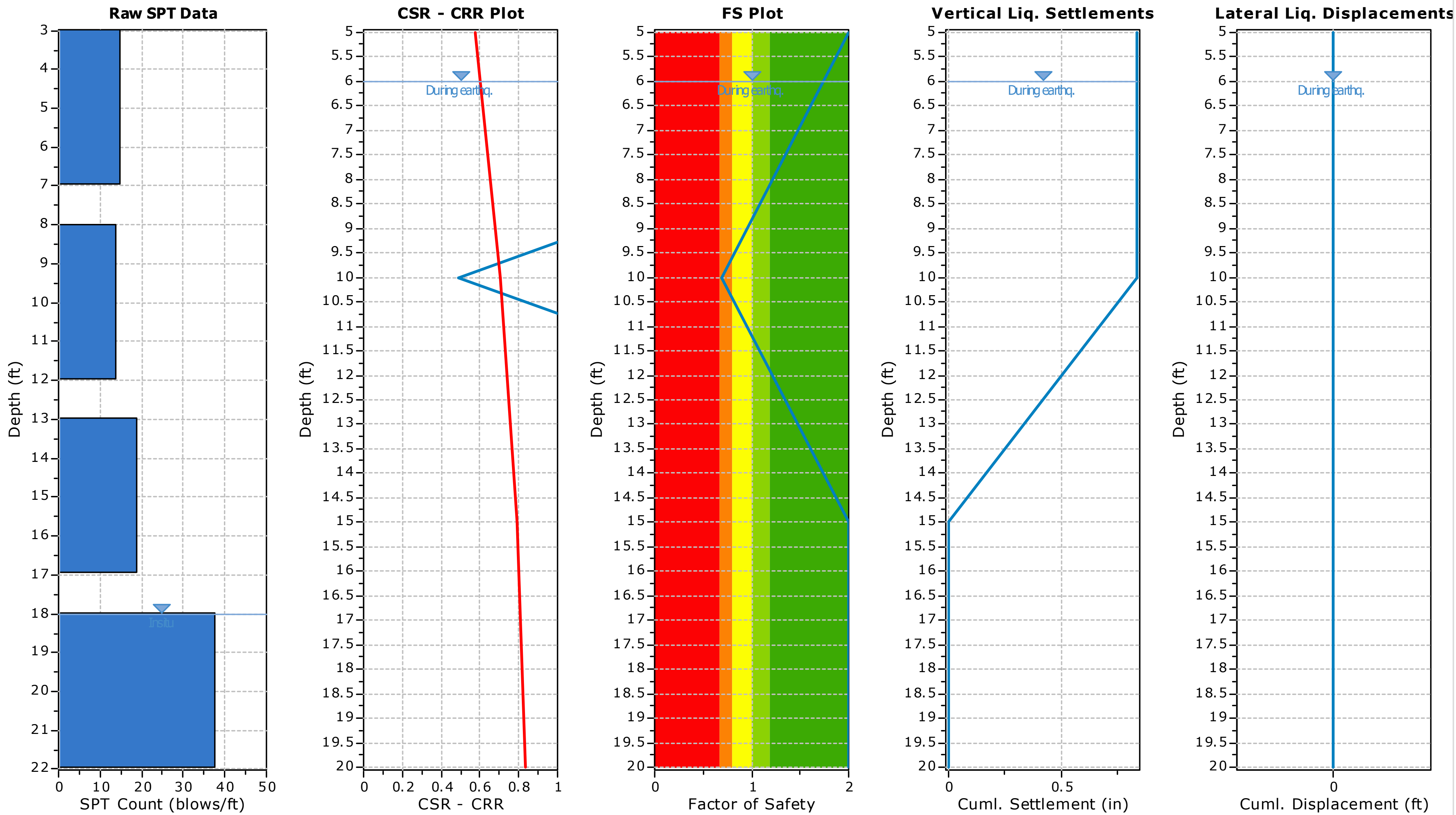
F.S. color scheme

- Almost certain it will liquefy
- Very likely to liquefy
- Liquefaction and no liq. are equally likely
- Unlike to liquefy
- Almost certain it will not liquefy

LPI color scheme

- Very high risk
- High risk
- Low risk

:: Overall Liquefaction Assessment Analysis Plots ::



:: Field input data ::

Test Depth (ft)	SPT Field Value (blows)	Fines Content (%)	Unit Weight (pcf)	Infl. Thickness (ft)	Can Liquefy
5.00	15	15.00	132.00	5.00	No
10.00	14	15.00	132.00	5.00	Yes
15.00	19	70.00	132.00	5.00	No
20.00	38	15.00	132.00	5.00	Yes

Abbreviations

Depth: Depth at which test was performed (ft)
SPT Field Value: Number of blows per foot
Fines Content: Fines content at test depth (%)
Unit Weight: Unit weight at test depth (pcf)
Infl. Thickness: Thickness of the soil layer to be considered in settlements analysis (ft)
Can Liquefy: User defined switch for excluding/including test depth from the analysis procedure

:: Cyclic Resistance Ratio (CRR) calculation data ::

Depth (ft)	SPT Field Value	Unit Weight (pcf)	σ_v (tsf)	u_o (tsf)	σ'_{vo} (tsf)	C_N	C_E	C_B	C_R	C_S	$(N_1)_{60}$	Fines Content (%)	α	β	$(N_1)_{60cs}$	$CRR_{7.5}$
5.00	15	132.00	0.33	0.00	0.33	1.46	1.33	1.15	0.75	1.20	30	15.00	2.50	1.05	34	4.000
10.00	14	132.00	0.66	0.00	0.66	1.21	1.33	1.15	0.85	1.20	26	15.00	2.50	1.05	30	0.488
15.00	19	132.00	0.99	0.00	0.99	1.03	1.33	1.15	0.85	1.20	31	70.00	5.00	1.20	42	4.000
20.00	38	132.00	1.32	0.06	1.26	0.92	1.33	1.15	0.95	1.20	61	15.00	2.50	1.05	66	4.000

Abbreviations

σ_v: Total stress during SPT test (tsf)
u_o: Water pore pressure during SPT test (tsf)
σ'_{vo}: Effective overburden pressure during SPT test (tsf)
C_N: Overburden corretion factor
C_E: Energy correction factor
C_B: Borehole diameter correction factor
C_R: Rod length correction factor
C_S: Liner correction factor
$N_{1(60)}$: Corrected N_{SPT} to a 60% energy ratio
α, β: Clean sand equivalent clean sand formula coefficients
$N_{1(60)cs}$: Corected $N_{1(60)}$ value for fines content
$CRR_{7.5}$: Cydic resistance ratio for M=7.5

:: Cyclic Stress Ratio calculation (CSR fully adjusted and normalized) ::

Depth (ft)	Unit Weight (pcf)	$\sigma_{v,eq}$ (tsf)	$u_{o,eq}$ (tsf)	$\sigma'_{vo,eq}$ (tsf)	r_d	α	CSR	MSF	$CSR_{eq,M=7.5}$	K_{sigma}	CSR^*	FS	
5.00	132.00	0.33	0.00	0.33	0.99	1.00	0.560	1.07	0.525	1.00	0.635	2.000	●
10.00	132.00	0.66	0.12	0.54	0.98	1.00	0.683	1.07	0.640	1.00	0.774	0.694	●
15.00	132.00	0.99	0.28	0.71	0.97	1.00	0.765	1.07	0.716	1.00	0.867	2.000	●
20.00	132.00	1.32	0.44	0.88	0.96	1.00	0.809	1.07	0.758	1.00	0.917	2.000	●

Abbreviations

$\sigma_{v,eq}$: Total overburden pressure at test point, during earthquake (tsf)
$u_{o,eq}$: Water pressure at test point, during earthquake (tsf)
$\sigma'_{vo,eq}$: Effective overburden pressure, during earthquake (tsf)
r_d : Nonlinear shear mass factor
α: Improvement factor due to stone columns
CSR : Cyclic Stress Ratio (adjusted for improvement)
MSF : Magnitude Scaling Factor
$CSR_{eq,M=7.5}$: CSR adjusted for M=7.5
K_{sigma}: Effective overburden stress factor
CSR^*: CSR fully adjusted (user FS applied)***
FS: Calculated factor of safety against soil liquefaction

*** User FS: 1.10

:: Liquefaction potential according to Iwasaki ::

Depth (ft)	FS	F	wz	Thickness (ft)	I_L
5.00	2.000	0.00	9.24	5.00	0.00
10.00	0.694	0.31	8.48	5.00	3.96
15.00	2.000	0.00	7.71	5.00	0.00
20.00	2.000	0.00	6.95	5.00	0.00

Overall potential I_L : 3.96

I_L = 0.00 - No liquefaction
I_L between 0.00 and 5 - Liquefaction not probable
I_L between 5 and 15 - Liquefaction probable
I_L > 15 - Liquefaction certain

:: Vertical settlements estimation for dry sands ::

Depth (ft)	$(N_1)_{60}$	τ_{av}	p	G_{max} (tsf)	α	b	γ	ε_{15}	N_c	ε_{Nc} (%)	Δh (ft)	ΔS (in)
5.00	30	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	5.00	0.000

Cumulative settlemetns: 0.000

Abbreviations

τ_{av}: Average cyclic shear stress
p: Average stress
G_{max}: Maximum shear modulus (tsf)
α, b: Shear strain formula variables
γ: Average shear strain
ε_{15}: Volumetric strain after 15 cycles
N_c: Number of cycles
ε_{Nc}: Volumetric strain for number of cycles N_c (%)
Δh: Thickness of soil layer (in)
ΔS: Settlement of soil layer (in)

:: Vertical settlements estimation for saturated sands ::

Depth (ft)	D_{50} (in)	q_c/N	e_v (%)	Δh (ft)	s (in)
10.00	0.00	5.00	1.38	5.00	0.829
15.00	0.00	5.00	0.00	5.00	0.000
20.00	0.00	5.00	0.00	5.00	0.000

Cumulative settlements: 0.829

Abbreviations

D_{50}: Median grain size (in)
q_c/N: Ratio of cone resistance to SPT
e_v: Post liquefaction volumetric strain (%)
Δh: Thickness of soil layer to be considered (ft)
s: Estimated settlement (in)

References

- Ronald D. Andrus, Hossein Hayati, Nisha P. Mohanan, 2009. Correcting Liquefaction Resistance for Aged Sands Using Measured to Estimated Velocity Ratio, Journal of Geotechnical and Geoenvironmental Engineering, Vol. 135, No. 6, June 1

- Boulanger, R.W. and Idriss, I. M., 2014. CPT AND SPT BASED LIQUEFACTION TRIGGERING PROCEDURES. DEPARTMENT OF CIVIL & ENVIRONMENTAL ENGINEERING COLLEGE OF ENGINEERING UNIVERSITY OF CALIFORNIA AT DAVIS

- Dipl.-Ing. Heinz J. Priebe, Vibro Replacement to Prevent Earthquake Induced Liquefaction, Proceedings of the Geotechnique-Colloquium at Darmstadt, Germany, on March 19th, 1998 (also published in Ground Engineering, September 1998), Technical paper 12-57E

- Robertson, P.K. and Cabal, K.L., 2007, Guide to Cone Penetration Testing for Geotechnical Engineering. Available at no cost at http://www.geologismiki.gr/

- Youd, T.L., Idriss, I.M., Andrus, R.D., Arango, I., Castro, G., Christian, J.T., Dobry, R., Finn, W.D.L., Harder, L.F., Hynes, M.E., Ishihara, K., Koester, J., Liao, S., Marcuson III, W.F., Martin, G.R., Mitchell, J.K., Moriwaki, Y., Power, M.S., Robertson, P.K., Seed, R., and Stokoe, K.H., Liquefaction Resistance of Soils: Summary Report from the 1996 NCEER and 1998 NCEER/NSF Workshop on Evaluation of Liquefaction Resistance of Soils, ASCE, Journal of Geotechnical & Geoenvironmental Engineering, Vol. 127, October, pp 817-833

- Zhang, G., Robertson. P.K., Brachman, R., 2002, Estimating Liquefaction Induced Ground Settlements from the CPT, Canadian Geotechnical Journal, 39: pp 1168-1180

- Zhang, G., Robertson. P.K., Brachman, R., 2004, Estimating Liquefaction Induced Lateral Displacements using the SPT and CPT, ASCE, Journal of Geotechnical & Geoenvironmental Engineering, Vol. 130, No. 8, 861-871

- Pradel, D., 1998, Procedure to Evaluate Earthquake-Induced Settlements in Dry Sandy Soils, ASCE, Journal of Geotechnical & Geoenvironmental Engineering, Vol. 124, No. 4, 364-368

- R. Kayen, R. E. S. Moss, E. M. Thompson, R. B. Seed, K. O. Cetin, A. Der Kiureghian, Y. Tanaka, K. Tokimatsu, 2013. Shear-Wave Velocity–Based Probabilistic and Deterministic Assessment of Seismic Soil Liquefaction Potential, Journal of Geotechnical and Geoenvironmental Engineering, Vol. 139, No. 3, March 1

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APPENDIX D

PREVIOUS INVESTIGATION BY IRVINE GEOTECHNICAL, INC.

SITE PLAN

PROJECT: IC22102 - LA TERRA - DEL REY

CONSULTANT: JAI

SCALE: 1" = 40'

LOG OF BORINGS

IRVINE GEOTECHNICAL Inc

PROJECT	IC 14150 4112 - 4132 DEL REY
DRILL DATE	8/18/2020
LOG DATE	8/18/2020
LOGGED BY	RC
DRILL TYPE	Hollow Stem Auger
DIAMETER	8 inches

SURFACE ELEVATION	24 feet
DRILLING CONTRACTOR	Choice Drilling
SURFACE CONDITIONS	A/C parking lot - 3" A/C over 6" base

BORING 1

Sample Type	Sample Depth (feet)	Blows per foot	Moisture (%)	Dry Unit Weight (pcf)	Saturation (%)	USCS Code	Elevation (feet)	Depth (feet)	Lithologic Description
						CL	24.0	0	**FILL:** Sandy Clay, yellow-dark brown, moist, soft to firm
							23.0	1	
							22.0	2	
							21.0	3	Clayey Sand, grey-brown, moist, loose to medium dense, contains wood chips
						SC	20.0	4	
R	5	6/6/8	12.0	112.4	76	SC	19.0	5	**ALLUVIUM:** Clayey Sand with some gravel, yellow-medium brown, moist, medium dense
							18.0	6	
SPT	7.5	3/4/5	---	14.8	---	SM	17.0	7	Silty Sand with Clay binder, yellow-medium brown, moist, loose to medium dense
							16.0	8	
							15.0	9	
SPT	10	2/3/9	---	15.2	---	SW/SM	14.0	10	Gravelly Sand & Silty Sand, yellow-brown, slightly moist, medium dense
							13.0	11	
SPT	12.5	1/1/3	---	16.0	---	CL	12.0	12	Sandy Clay, yellow-brown, moist, firm
							11.0	13	
							10.0	14	
SPT	15	3/5/8	---	16.2	---	CL	9.0	15	Firm to stiff
							8.0	16	
SPT	17.5	4/5/5	---	15.3	---	SM	7.0	17	Silty Sand, yellow-medium brown, wet, medium dense
							6.0	18	Groundwater at 18'
							5.0	19	
SPT	20	2/4/5	---	14.9	---	SM	4.0	20	

LOG OF BORINGS

IRVINE GEOTECHNICAL Inc

PROJECT	IC 14150 4112 - 4132 DEL REY
DRILL DATE	8/18/2020
LOG DATE	8/18/2020
LOGGED BY	RC
DRILL TYPE	Hollow Stem Auger
DIAMETER	8 inches

SURFACE ELEVATION	24 feet
DRILLING CONTRACTOR	Choice Drilling
SURFACE CONDITIONS	A/C parking lot - 3" A/C over 6" base

BORING 1

Sample Type	Sample Depth (feet)	Blows per foot	Moisture (%)	Dry Unit Weight (pcf)	Saturation (%)	USCS Code	Elevation (feet)	Depth (feet)	Lithologic Description
SPT	20	2/4/5	---	14.9	---	SM/SC	4.0	20	Silty Sand and Clayey Sand, yellow-medium brown, wet, medium dense
							3.0	21	
SPT	22.5	11/15/12	---	---	---	SW	2.0	22	Coarse Sand, yellow-brown, wet, dense
							1.0	23	
							0.0	24	
SPT	25	8/12/18	---	---	---	SW	-1.0	25	Sand, medium to coarse, yellow-brown, wet, dense
							-2.0	26	
SPT	27.5	5/11/18	---	---	---	SW	-3.0	27	
							-4.0	28	Coarse Sand, yellow-brown, wet, dense
							-5.0	29	
SPT	30	12/22/38	---	---	---	SW	-6.0	30	Coarse Sand with some gravel, yellow-brown, wet, very dense
							-7.0	31	
SPT	32.5	17/32/ 50-6"	---	---	---	SW	-8.0	32	
							-9.0	33	Very dense
							-10.0	34	
SPT	35	20/32/ 50-2"	---	---	---	SW	-11.0	35	Gravelly Sand, yellow-medium brown and orange-brown, wet, very dense
							-12.0	36	
SPT	37.5	20/22/35	---	---	---	SW	-13.0	37	
							-14.0	38	
							-15.0	39	
SPT	40	18/ 50-5.5"	---	---	---	SW	-16.0	40	

LOG OF BORINGS

IRVINE GEOTECHNICAL Inc

PROJECT	IC 14150 4112 - 4132 DEL REY
DRILL DATE	8/18/2020
LOG DATE	8/18/2020
LOGGED BY	RC
DRILL TYPE	Hollow Stem Auger
DIAMETER	8 inches

SURFACE ELEVATION	24 feet
DRILLING CONTRACTOR	Choice Drilling
SURFACE CONDITIONS	A/C parking lot - 3" A/C over 6" base

BORING 1

Sample Type	Sample Depth (feet)	Blows per foot	Moisture (%)	Dry Unit Weight (pcf)	Saturation (%)	USCS Code	Elevation (feet)	Depth (feet)	Lithologic Description
SPT	40	18/ 50-5.5"	---	---	---	SW	-16.0	40	Gravelly Sand, yellow-medium brown and orange-brown, wet, very dense
							-17.0	41	
SPT	42.5	6/15/12	---	---	---	SW	-18.0	42	
							-19.0	43	Sand, coarse, mottled orange-brown, white, black, wet, dense
							-20.0	44	
SPT	45	7/15/33	---	---	---	SM	-21.0	45	Silty Sand, yellow-brown, wet, very dense
							-22.0	46	
SPT	47.5	7/17/20	---	---	---	SW	-23.0	47	Gravelly Sand, coarse, yellow-medium brown, white and black, moist to wet, very dense
							-24.0	48	
							-25.0	49	
SPT	50	17/23/30	---	---	---	SW	-26.0	50	**END B1 @ 50':** Water at 18', No Caving, Fill to 4.5'

IRVINE GEOTECHNICAL Inc

LOG OF BORINGS

PROJECT IC 14150 4112 - 4132 DEL REY
DRILL DATE 8/18/2020
LOG DATE 8/18/2020
LOGGED BY RC
DRILL TYPE Hollow Stem Auger
DIAMETER 8 inches

SURFACE ELEVATION 24 feet
DRILLING CONTRACTOR Choice Drilling
SURFACE CONDITIONS A/C Parking - 3"A/C over 3" base

BORING 2

Sample Type	Sample Depth (feet)	Blows per foot	Moisture (%)	Dry Unit Weight (pcf)	Saturation (%)	USCS Code	Elevation (feet)	Depth (feet)	Lithologic Description
						CL	24.0	0	**FILL:** Clayey Sand/Sandy Clay, mottled grey-brown and orange-brown, moist, medium dense, abundant concrete and metal fragments
							23.0	1	
							22.0	2	
							21.0	3	Contains abundant roots
							20.0	4	
R	5	6/6/8	15.5	115.3	95	SC	19.0	5	**ALLUVIUM:** Silty Sand with Clay binder, yellow-medium brown, moist, medium dense
							18.0	6	
SPT	7.5	4/5/7	---	---	---	SW	17.0	7	Gravelly Coarse Sand, grey-medium brown, slightly moist, medium dense
							16.0	8	
							15.0	9	
SPT	10	6/7/9	---	---	---	SW	14.0	10	
							13.0	11	
SPT	12.5	2/2/3	---	---	---	CL	12.0	12	Sandy Clay/Clay, yellow-brown, moist, firm to stiff
							11.0	13	
							10.0	14	
SPT	15	3/5/8	---	---	---	CL	9.0	15	
							8.0	16	
SPT	17.5	2/5/12	---	---	---	CL	7.0	17	
							6.0	18	Water; Coarse Clayey Sand, grey, wet, medium dense
							5.0	19	
SPT	20	7/8/15	---	---	---	SC	4.0	20	

LOG OF BORINGS

PROJECT	IC 14150 4112 - 4132 DEL REY
DRILL DATE	8/18/2020
LOG DATE	8/18/2020
LOGGED BY	RC
DRILL TYPE	Hollow Stem Auger
DIAMETER	8 inches

SURFACE ELEVATION 24 feet
DRILLING CONTRACTOR Choice Drilling
SURFACE CONDITIONS A/C Parking - 3"A/C over 3" base

BORING 2

Sample Type	Sample Depth (feet)	Blows per foot	Moisture (%)	Dry Unit Weight (pcf)	Saturation (%)	USCS Code	Elevation (feet)	Depth (feet)	Lithologic Description
SPT	20	7/8/15	---	---	---	SW	4.0	20	Sand, very coarse, orange-brown, moist, dense
							3.0	21	
SPT	22.5	11/20/21	---	---	---	SW	2.0	22	
							1.0	23	Gravelly Sand, coarse grained, yellow-medium brown, white and black,moist, dense to very dense
							0.0	24	
SPT	25	7/11/15	---	---	---	SW	-1.0	25	
							-2.0	26	
SPT	27.5	15/30/31	---	---	---	SW	-3.0	27	
							-4.0	28	Very dense
							-5.0	29	
SPT	30	20/24/30	---	---	---	SW	-6.0	30	
							-7.0	31	
SPT	32.5	11/15/18	---	---	---	SW	-8.0	32	
							-9.0	33	
							-10.0	34	
SPT	35	14/23/31	---	---	---	SW	-11.0	35	
							-12.0	36	Sand, medium grained, orange-brown, very dense
SPT	37.5	25/ 50-6"	---	---	---	SW	-13.0	37	
							-14.0	38	
							-15.0	39	
SPT	40	16/38/ 50-5"	---	---	---	SW	-16.0	40	

LOG OF BORINGS

PROJECT	IC 14150 4112 - 4132 DEL REY
DRILL DATE	8/18/2020
LOG DATE	8/18/2020
LOGGED BY	RC
DRILL TYPE	Hollow Stem Auger
DIAMETER	8 inches

IRVINE GEOTECHNICAL Inc

SURFACE ELEVATION	24 feet
DRILLING CONTRACTOR	Choice Drilling
SURFACE CONDITIONS	A/C Parking - 3"A/C over 3" base

BORING 2

Sample Type	Sample Depth (feet)	Blows per foot	Moisture (%)	Dry Unit Weight (pcf)	Saturation (%)	USCS Code	Elevation (feet)	Depth (feet)	Lithologic Description
SPT	40	16/38/ 50-5"	---	---	---	SW	-16.0	40	Sand, medium grained, orange-brown, moist, very dense
							-17.0	41	
SPT	42.5	20/ 50-5.5"	---	---	---	SW	-18.0	42	
							-19.0	43	
							-20.0	44	
SPT	45	45/50-3"	---	---	---	SW	-21.0	45	
							-22.0	46	
SPT	47.5	10/35/ 50-3"	---	---	---	SW	-23.0	47	
							-24.0	48	
							-25.0	49	
SPT	50	40/40/ 50-3"	---	---	---	SW	-26.0	50	
									END B2 @ 50': Water at 18', No Caving, Fill to 4.5'

LOG OF BORINGS

PROJECT	IC 20100 California Landmark - Del Rey
DRILL DATE	8/18/2020
LOG DATE	8/18/2020
LOGGED BY	MH
DRILL TYPE	Hollow Stem Auger
DIAMETER	8 inches

SURFACE ELEVATION	23 feet
DRILLING CONTRACTOR	Choice Drilling
SURFACE CONDITIONS	A/C parking lot - 4" A/C over 4" base

BORING 3

Sample Type	Sample Depth (feet)	Blows per foot	Moisture (%)	Dry Unit Weight (pcf)	Saturation (%)	USCS Code	Elevation (feet)	Depth (feet)	Lithologic Description
						SM	23.0	0	**ALLUVIUM:** Silty Sand to Sandy Silt, grey-brown, moist, medium dense, slightly firm
							22.0	1	
							21.0	2	
							20.0	3	
							19.0	4	Silty Sand, light grey-brown, moist, dense
R	5	8/15/18	11.9	119.7	83	SM	18.0	5	
							17.0	6	
							16.0	7	
							15.0	8	
							14.0	9	
SPT	10	5/5/4	---	---	---	SM	13.0	10	Silty Sand, orange-grey, moist, medium dense
							12.0	11	
SPT	12.5	1/3/5	---	---	---	CL	11.0	12	Silty Clay, dark orange-brown, moist, firm
							10.0	13	
							9.0	14	
SPT	15	6/6/7	---	---	---	CL	8.0	15	
							7.0	16	Water at 16'
SPT	17.5	6/6/7	---	---	---	SM	6.0	17	Silty Sand with some Gravel, yellow-brown, saturated, medium dense
							5.0	18	
							4.0	19	
SPT	20	4/7/12	---	---	---	SM	3.0	20	Cont. Next Page

IRVINE GEOTECHNICAL Inc

LOG OF BORINGS

PROJECT IC 20100 California Landmark - Del Rey
DRILL DATE 8/18/2020
LOG DATE 8/18/2020
LOGGED BY MH
DRILL TYPE Hollow Stem Auger
DIAMETER 8 inches

SURFACE ELEVATION 23 feet
DRILLING CONTRACTOR Choice Drilling
SURFACE CONDITIONS A/C parking lot - 3" A/C over 6" base

Boring 3

Sample Type	Sample Depth (feet)	Blows per foot	Moisture (%)	Dry Unit Weight (pcf)	Saturation (%)	USCS Code	Elevation (feet)	Depth (feet)	Lithologic Description
SPT	20	4/7/12	---	---	---	SW	3.0	20	Sand with Gravel, yellow-brown, saturated, medium dense
							2.0	21	
SPT	22.5	8/15/30	---	---	---	SW	1.0	22	Sand with Gravel, yellow-brown to yellow-grey, saturated, very dense
							0.0	23	
							-1.0	24	
SPT	25	11/24/37	---	---	---	SW	-2.0	25	
							-3.0	26	
SPT	27.5	10/12/32	---	---	---	SW	-4.0	27	
							-5.0	28	
							-6.0	29	Silty Sand, yellow-brown to yellow-grey, saturated, medium dense to dense
SPT	30	4/7/9	---	---	---	SM	-7.0	30	
							-8.0	31	
SPT	32.5	6/7/9	---	---	---	SM	-9.0	32	
							-10.0	33	Silty to Clayey Sand, yellow-grey, saturated, medium dense
							-11.0	34	
SPT	35	5/9/12	---	---	---	SC	-12.0	35	Clayey Sand, yellow-grey, saturated, dense
							-13.0	36	
SPT	37.5	6/11/12	---	---	---	SC	-14.0	37	
							-15.0	38	Silty Sand, mottled orange-grey, saturated, dense
							-16.0	39	
SPT	40	5/11/21	---	---	---	SM	-17.0	40	

Cont. Next Page

IRVINE GEOTECHNICAL Inc

LOG OF BORINGS

PROJECT IC 20100 California Landmark - Del Rey
DRILL DATE 8/18/2020
LOG DATE 8/18/2020
LOGGED BY MH
DRILL TYPE Hollow Stem Auger
DIAMETER 8 inches

SURFACE ELEVATION 23 feet
DRILLING CONTRACTOR Choice Drilling
SURFACE CONDITIONS A/C parking lot - 3" A/C over 6" base

Boring 3

Sample Type	Sample Depth (feet)	Blows per foot	Moisture (%)	Dry Unit Weight (pcf)	Saturation (%)	USCS Code	Elevation (feet)	Depth (feet)	Lithologic Description
SPT	40	5/11/21	---	---	---	SM	-17.0	40	Silty Sand, mottled orange-grey, saturated dense
							-18.0	41	
SPT	42.5	7/12/20	---	---	---	SM	-19.0	42	
							-20.0	43	Silty very fine Sand to very fine Sand, mottled dark orange-grey, saturated, dense
							-21.0	44	
SPT	45	10/12/15	---	---	---	SM	-22.0	45	
							-23.0	46	
SPT	47.5	8/14/20	---	---	---	SW	-24.0	47	Sand, yellow-grey, saturated, dense
							-25.0	48	
							-26.0	49	
SPT	50	17/21/50	---	---	---	SW	-27.0	50	
							-28.0	51	Gravelly Sand, coarse, yellow-medium brown, white and black, moist to wet, very dense
							-29.0	52	
SPT	52.5	18/22/40	---	---	---	SW	-30.0	53	
							-31.0	54	
SPT	55	20/50-5"	---	---	---	SW	-32.0	55	Sand with Gravel, light orange-grey to yellow-grey, saturated, very dense
							-33.0	56	
							-34.0	57	
SPT	57.5	10/22/35	---	---	---	SW	-35.0	58	
							-36.0	59	
SPT	60	23/50-4"	---	---	---	SW	-37.0	60	**END B3@60':** Water @ 16', No Caving, No Fill

LOG OF BORINGS

IRVINE GEOTECHNICAL Inc

PROJECT	IC 20100 California Landmark - Del Rey
DRILL DATE	8/18/2020
LOG DATE	8/18/2020
LOGGED BY	MH
DRILL TYPE	Hollow Stem Auger
DIAMETER	8 inches

SURFACE ELEVATION	24 feet
DRILLING CONTRACTOR	Choice Drilling
SURFACE CONDITIONS	A/C parking lot - 4" A/C over 3" base

BORING 4

Sample Type	Sample Depth (feet)	Blows per foot	Moisture (%)	Dry Unit Weight (pcf)	Saturation (%)	USCS Code	Elevation (feet)	Depth (feet)	Lithologic Description
						SM	24.0	0	**FILL:** Clayey Sand, dark grey, moist, medium dense
							23.0	1	
							22.0	2	**ALLUVIUM:** Silty to Sandy Clay, dark grey, moist, firm
							21.0	3	
							20.0	4	Silty Sand, mottled grey to orange-brown, very moist, medium dense
R	5	9/10/13	15.0	115.4	92	SM	19.0	5	
							18.0	6	
							17.0	7	
							16.0	8	
							15.0	9	
R	10	4/5/6	13.9	111.8	77	SM	14.0	10	Silty Sand, mottled yellow-grey to orange-brown, moist, medium dense
							13.0	11	
							12.0	12	
							11.0	13	Silty Clay, mottled dark orange-grey, very moist, very firm to stiff
							10.0	14	
R	15	5/8/12	19.4	111.9	99	CL	9.0	15	
							8.0	16	
							7.0	17	Water at 17' Gravelly Sand with Gravel, mottled tan and orange-brown, saturated, very dense
							6.0	18	
							5.0	19	
R	20	8/27/32	6.3	135.0	100	SW	4.0	20	Cont. Next Page

LOG OF BORINGS

PROJECT	IC 20100 California Landmark - Del Rey
DRILL DATE	8/18/2020
LOG DATE	8/18/2020
LOGGED BY	MH
DRILL TYPE	Hollow Stem Auger
DIAMETER	8 inches

SURFACE ELEVATION 24 feet
DRILLING CONTRACTOR Choice Drilling
SURFACE CONDITIONS A/C parking lot - 4" A/C over 3" base

Boring 4

Sample Type	Sample Depth (feet)	Blows per foot	Moisture (%)	Dry Unit Weight (pcf)	Saturation (%)	USCS Code	Elevation (feet)	Depth (feet)	Lithologic Description
R	20	8/27/322	6.3	135.0	100	SW	4.0	20	Gravelly Sand, mottled tan and orange-brown, saturated, very dense
							3.0	21	
							2.0	22	
							1.0	23	
							0.0	24	
R	25	8/20/50	---	---	---	SW	-1.0	25	Sand, medium to coarse, mottled yellow-brown, saturated, very dense
							-2.0	26	
							-3.0	27	
							-4.0	28	
							-5.0	29	
R	30	30/50-5"	15.3	118.3	100	SW	-6.0	30	Sand, Coarse to very coarse, yellow-brown, saturated, very dense
							-7.0	31	
							-8.0	32	
							-9.0	33	
							-10.0	34	
R	35	10/50-6"	9.8	127.5	100	SM	-11.0	35	Silty to Clayey Sand, yellow-grey, saturated, very dense
							-12.0	36	
							-13.0	37	
							-14.0	38	
							-15.0	39	
R	40	25/50-5"	12.2	127.3	100	SM	-16.0	40	**END B4@40':** Water @ 17', No Caving, Fill to 1'

LOG OF BORINGS

IRVINE GEOTECHNICAL Inc

PROJECT	IC 20100 California Landmark - Del Rey
DRILL DATE	8/18/2020
LOG DATE	8/18/2020
LOGGED BY	MH
DRILL TYPE	Hollow Stem Auger
DIAMETER	8 inches

SURFACE ELEVATION	24 feet
DRILLING CONTRACTOR	Choice Drilling
SURFACE CONDITIONS	A/C parking lot - 4" A/C over 3" base

BORING 5

Sample Type	Sample Depth (feet)	Blows per foot	Moisture (%)	Dry Unit Weight (pcf)	Saturation (%)	USCS Code	Elevation (feet)	Depth (feet)	Lithologic Description
						SM	24.0	0	**FILL:** Silty Sand, dark grey to black, moist, medium dense, glass and asphalt debris
							23.0	1	
							22.0	2	
							21.0	3	
							20.0	4	
R	5	7/8/15	14.3	118.3	95	SM	19.0	5	**ALLUVIUM:** Silty Sand, mottled dark orange-grey, moist, medium dense
							18.0	6	
							17.0	7	
							16.0	8	
							15.0	9	
R	10	8/9/12	15.3	115.6	94	SM	14.0	10	Silty Sand, mottled yellow-brown to yellow-grey, moist, dense
							13.0	11	
							12.0	12	
							11.0	13	
							10.0	14	Sandy to Silty Clay, dark orange-brown,very moist, stiff
R	15	8/12/17	19.4	111.9	99	CL	9.0	15	
							8.0	16	
							7.0	17	
							6.0	18	Water at 18'
							5.0	19	Silty fine Sand, grey with orange mottling, saturated, dense
R	20	8/27/32	6.3	135.0	100	SM	4.0	20	**END B5@20':** Water @ 18', No Caving, Fill to 4.5'

SOIL LABWORKS LLC

SL20.3426
September 3, 2020

Irvine Geotechnical
145 N. Sierra Madre Boulevard
Suite 1
Pasadena, California 91107

Subject: Laboratory Testing

Site: 4112-4136 Del Rey Avenue
Marina Del Rey, California

Job: IRVINE/CALIFORNIA LANDMARK

Laboratory testing for the subject property was performed by Soil Labworks, LLC., under the supervision of the undersigned Engineer. Samples of the earth materials were obtained from the subject property by personnel of Irvine Geotechnical and transported to the laboratory of Soil Labworks for testing and analysis. The laboratory tests performed are described and results are attached.

Services performed by this facility for the subject property were conducted in a manner consistent with that level of care and skill ordinarily exercised by members of the profession currently practicing in the same locality under similar conditions.

Respectfully Submitted:

SOIL LABWORKS, LLC

REGISTERED PROFESSIONAL ENGINEER
JON ALAN IRVINE
GE 2891
Exp. 6-30-22
GEOTECHNICAL
STATE OF CALIFORNIA

JON A. IRVINE
G.E. 2891

Enc: Appendix

2500 Townsgate Road, Suite E, Westlake Village, California 91361
(805) 370-1338 FAX (805) 371-4693

APPENDIX

Laboratory Testing

Sample Retrieval - Drill Rig

Samples of earth materials were obtained at frequent intervals by driving a thick-walled steel sampler conforming to the most recent version of ASTM D 3550/D 3550M-17 with successive drops of a 140 pound hammer falling 30". The earth material was retained in brass rings of 2.416 inches inside diameter and 1.00 inch height. The central portion of the sample was stored in close-fitting, water-tight containers for transportation to the laboratory. Standard Penetration Tests (SPT) were performed at discrete intervals within the 8 inch diameter, hollow stem auger borings drilled on the site. The tests were performed using the 1-3/8 inch inside diameter, split-barrel sampler in accordance with ASTMD1586-11. Standard penetration test samples were retained in air-tight bags.

Classification

The field classification was verified in the laboratory in accordance with the Unified Soil Classification System. The classification is shown on the Plates. Tests performed in the laboratory to assist in classification include Atterberg Limits and grain size distribution.

Moisture Density

The field moisture content and dry density were determined for each of the soil samples. The dry density was determined in pounds per cubic foot following ASTM 2937-17e2. The moisture content was determined as a percentage of the dry soil weight conforming to ASTM 2216-19. The results are presented below in the following table. The percent saturation was calculated on the basis of an estimated specific gravity. Description of earth materials used in this report and shown on the attached Plates were provided by the client.

Test Pit/Boring No.	Sample Depth (Feet)	Soil Type	Dry Density (pcf)	Moisture Content (percent)	Percent Saturation (G_s=2.65)
B1	5	Alluvium	112.4	12.0	76
B1	7.5	Alluvium		14.8	
B1	10	Alluvium		15.2	
B1	12.5	Alluvium		16.0	
B1	15	Alluvium		16.2	
B1	17.5	Alluvium		15.3	
B1	20	Alluvium		14.9	
B2	5	Alluvium	115.3	15.3	95

SOIL LABWORKS LLC

Moisture Density (continued)

Test Pit/Boring No.	Sample Depth (Feet)	Soil Type	Dry Density (pcf)	Moisture Content (percent)	Percent Saturation (G_s=2.65)
B3	5	Alluvium	118.6	13.0	87
B3	10	Alluvium	-	40.0	-
B3	12½	Alluvium	-	16.3	-
B3	15	Alluvium	-	19.9	-
B4	5	Alluvium	115.4	15.0	92
B4	10	Alluvium	111.8	13.9	77
B4	15	Alluvium	111.9	19.4	100
B4	20	Alluvium	135.0	6.3	75
B4	25	Alluvium	-	29.1	-
B4	30	Alluvium	118.3	15.3	100
B4	35	Alluvium	127.5	9.8	87
B4	40	Alluvium	127.3	12.2	100
B5	5	Alluvium	118.3	14.3	95
B5	10	Alluvium	115.6	15.3	94
B5	15	Alluvium	114.9	16.2	98
B5	20	Alluvium	113.2	15.3	88

Compaction Character

Compaction tests were performed on bulk samples of the earth materials in accordance with ASTM D1557-12ei. The results of the tests are provided on the table below and on the "Moisture-Density Relationship", A-Plates. The specific gravity of the alluvium was estimated from the compaction curves.

Test Pit/Boring No.	Sample Depth (Feet)	Soil Type	Maximum Dry Density (pcf)	Optimum Moisture Content (Percent)
B3	0-5	Alluvium	127.8	8.8

Shear Strength

The peak and ultimate shear strengths of the alluvium were determined by performing consolidated and drained direct shear tests in conformance with ASTM D3080/D3080M-11. The tests were performed in a strain-controlled machine manufactured by GeoMatic. The rate of deformation was 0.01 inches per minute. Samples were sheared under varying confining pressures, as shown on the "Shear Test Diagrams," B-Plates. Remolded samples were prepared at 90 percent of the maximum density for shear tests. The remolding procedure consists of selecting a representative sample from a bulk bag and sieving it through a No. 4 sieve. The moisture content of the material is then determined. A formula is then used to calculate the weight of the material that must fit in a ring when compacted to 90 percent of the maximum density. This calculated amount of material is then weighed out and pounded into a ring until all the material is used and the ring is full. The moisture conditions during testing are shown on the following table and on the B-Plates. The samples indicated as saturated were artificially saturated in the laboratory. All saturated samples were sheared under submerged conditions.

Shear Strength (continued)

Test Pit/ Boring No.	Sample Depth (Feet)	Dry Density (pcf)	As-Tested Moisture Content (percent)
B4	5	115.4	21.1
B4	10	111.8	18.6
B3*	0-5	115.0	17.5

* Sample remolded to 90 % of the laboratory maximum density.

Consolidation

One-dimensional consolidation tests were performed on samples of the alluvium in a consolidometer manufactured by GeoMatic in conformance with ASTM D2435/D2435M-11. The tests were performed on 1-inch high samples retained in brass rings. The samples were initially loaded to approximately ½ of the field over-burden pressure and then unloaded to compensate for the effects of possible disturbance during sampling. Loads were then applied in a geometric progression and resulting deformation recorded. Water was added at a specific load to determine the effect of saturation. The results are plotted on the "Consolidation Test," C-Plates.

Expansion Index

The expansive character of the alluvium was determined by performing Expansion Index Tests in accordance with UBC 18.2 and ASTM 4829-11. A bulk sample of earth material was compacted at a specific moisture content using one fifth the compacted energy for the modified proctor test. The sample was then saturated and the expansion measured. The results of the tests are provided on the following table.

Test Pit No.	Sample Depth (Feet)	Soil Type	Expansion Index
B1	0-5	Alluvium	8

Atterberg Limits

Atterberg limits determinations were performed on samples of the alluvium in accordance with ASTMD4318-17e1. The test results are presented on the table below.

Test Pit/Boring No.	Sample Depth (Ft)	Soil Type	Liquid Limit	Plastic Limit	Plasticity Index
B1	12½	Alluvium	36	22	14
B1	15	Alluvium	35	19	16
B3	10	Alluvium	0	0	0
B3	12½	Alluvium	36	17	19
B3	15	Alluvium	35	23	12

Grain Size Distribution

The amount of material in the soil finer than 1 No. 200 sieve was determined on selected samples in conformance with ASTM D1140-17. Wash sieving disperses clay and other fine material that are removed from the soil during the test. The percent of fine material in the soil sample is the calculated base on the loss of mass. The results are present in the table below.

Boring No	Depth	Soil Type	(%) Passing 200 Sieve
B1	7½	Alluvium	47.8
B1	10	Alluvium	55.0
B1	17½	Alluvium	33.2
B1	20	Alluvium	34.4
B2	7½	Alluvium	14.2
B2	10	Alluvium	12.6
B2	17½	Alluvium	30.6
B3	10	Alluvium	18.7
B3	17½	Alluvium	6.3
B3	30	Alluvium	23.4
B3	32½	Alluvium	13.3
B3	35	Alluvium	33.4
B3	37½	Alluvium	27.9

SOIL LABWORKS LLC

MOISTURE-DENSITY RELATIONSHIP A-1

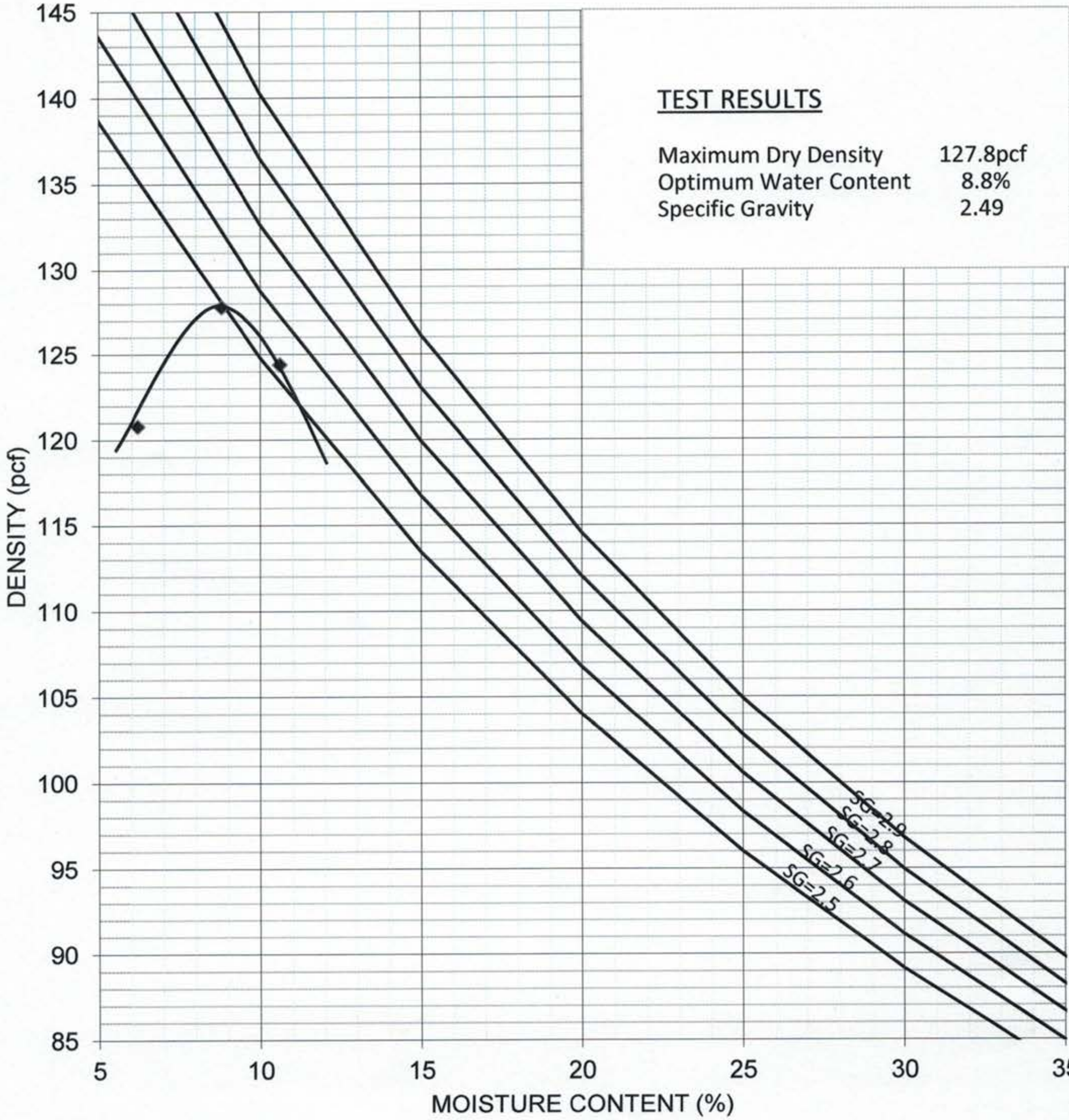
JN: **SL20.3426** CONSULTANT: **JAI**

CLIENT: **IRVINE/Calif Landmark-4112-4136 Del Rey**

B3 @ 0-5'

EARTH MATERIAL: **ALLUVIUM**

NOTE: ASTM Test Method D-1557-12



TEST RESULTS

Maximum Dry Density	127.8pcf
Optimum Water Content	8.8%
Specific Gravity	2.49

SOIL LABWORKS LLC

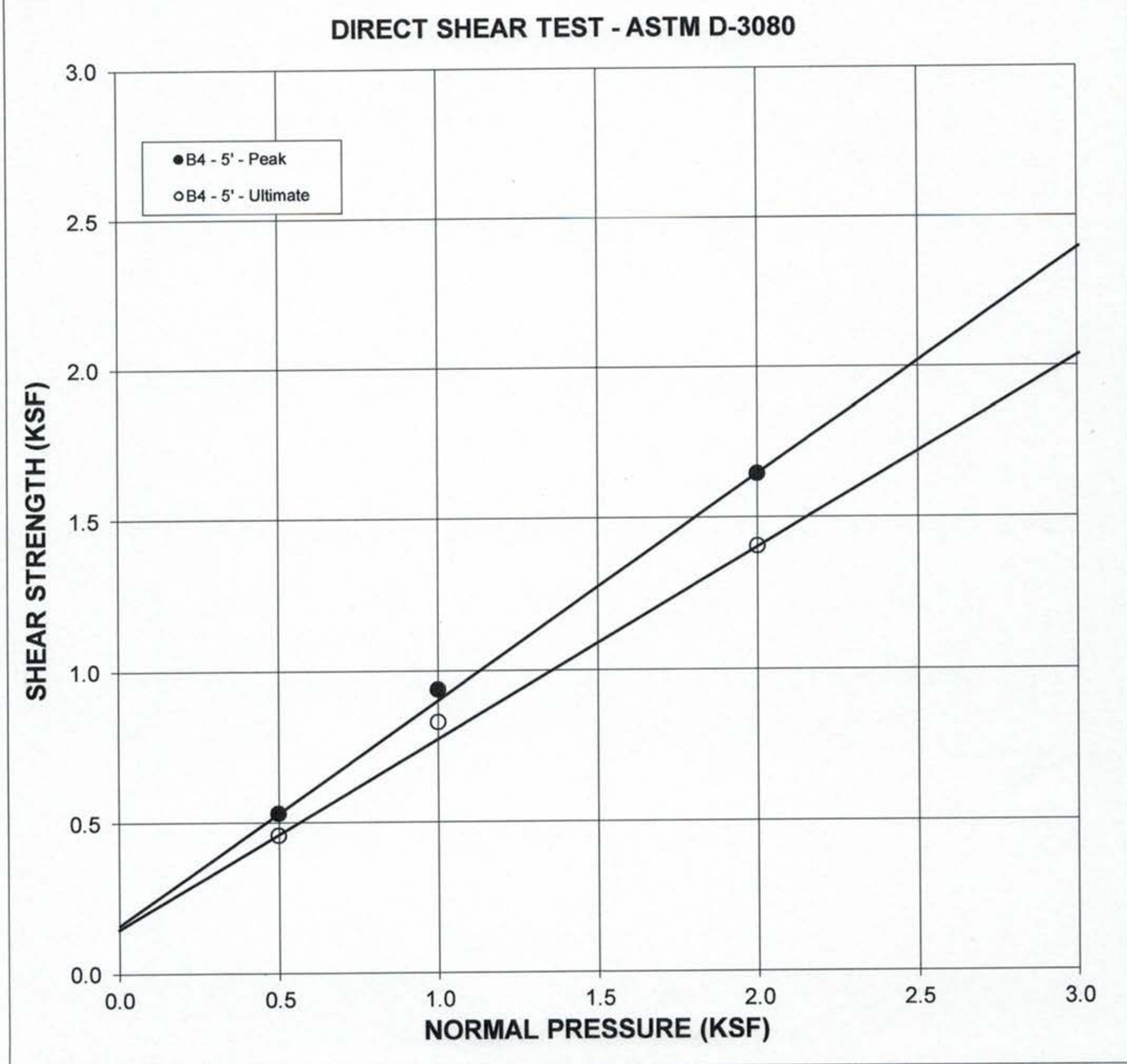
SHEAR DIAGRAM B-1

JN: SL20.3426 CONSULTANT JAI
CLIENT: Irvine/Calif. Landmark-4112-4136 Del Rey Ave

EARTH MATERIAL: ALLUVIUM

	PEAK	ULTIMATE	
Phi Angle	36	32	degrees
Cohesion	160	145	psf

Average Moisture Content	21.1%
Average Dry Density (pcf)	115.4
Percent Saturation	100.0%



SHEAR DIAGRAM B-2

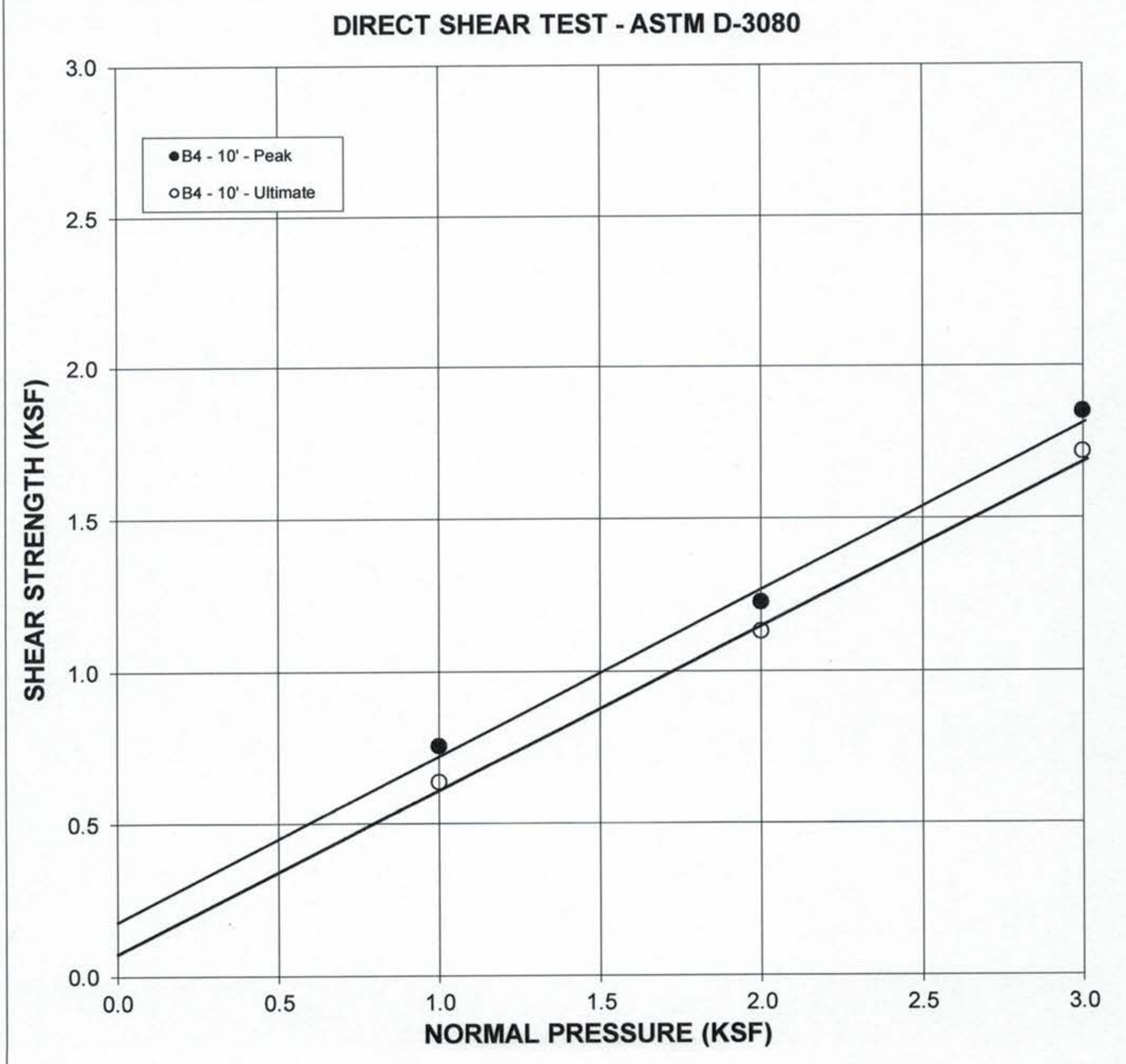
JN: **SL20.3426** CONSULTANT **JAI**

CLIENT: **Irvine/Calif. Landmark-4112-4136 Del Rey Ave**

EARTH MATERIAL: **ALLUVIUM**

	PEAK	ULTIMATE	
Phi Angle	**28**	**28**	**degrees**
Cohesion	**170**	**65**	**psf**

Average Moisture Content	**18.6%**
Average Dry Density (pcf)	**111.8**
Percent Saturation	**100.0%**



SOIL LABWORKS LLC

SHEAR DIAGRAM B-3

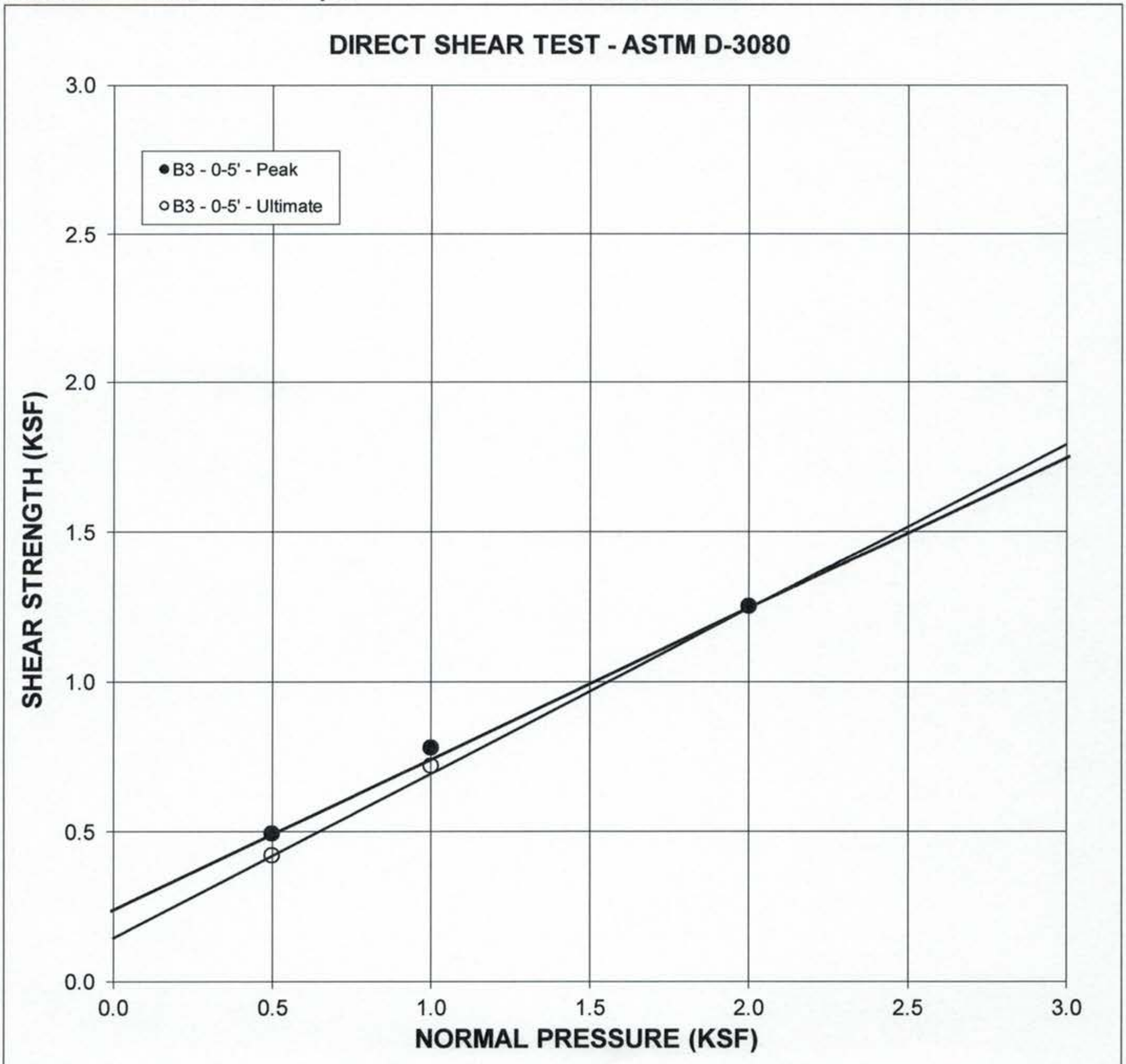
JN: SL20.3426 CONSULTANT JAI
CLIENT: Irvine/Calif Landmark-4112-4136 Del Rey Ave

EARTH MATERIAL: ALLUVIUM

Sample remolded to 90 % of the laboratory maximum density

	PEAK	ULTIMATE	
Phi Angle	26.5	28.5	degrees
Cohesion	235	145	psf

Average Moisture Content	17.5%
Average Dry Density (pcf)	115.0
Percent Saturation	100.0%



File No.: SL20.3426 September 16, 2020

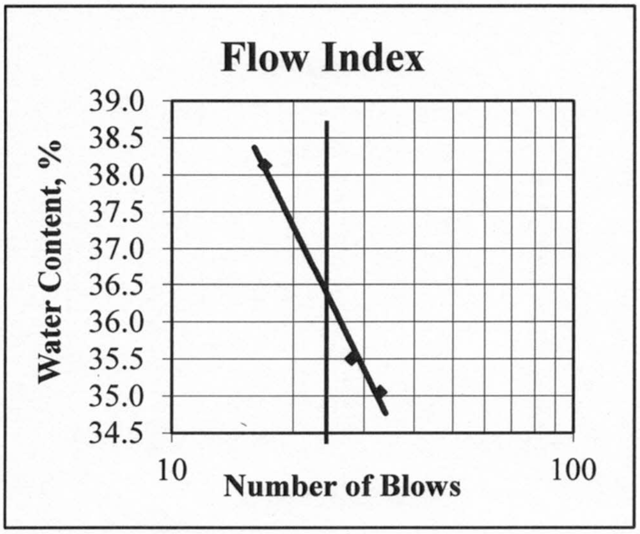
PLASTICITY INDEX

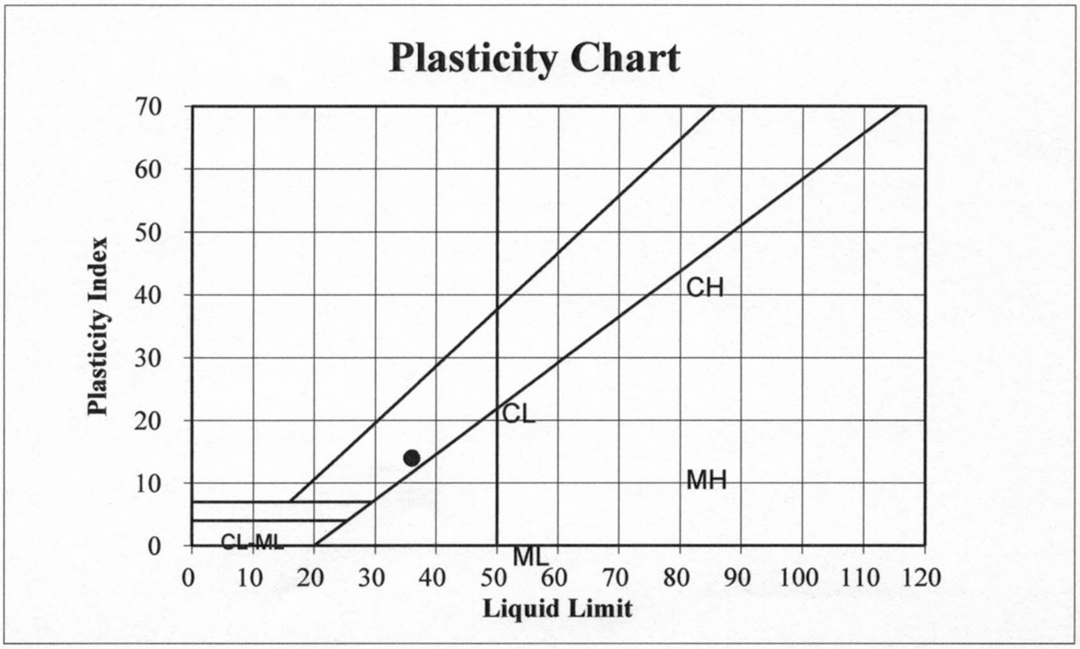
ASTM D-4318

Job Name: IRVINE/CALIF LANDMARK-4112-4136 Del Rey Ave
Sample ID: B1 @ 12.5'
Soil Description: CL

DATA SUMMARY **TEST RESULTS**

Number of Blows:	17	28	33	**LIQUID LIMIT**	**36**
Water Content, %	38.1	35.5	35.0	**PLASTIC LIMIT**	**22**
Plastic Limit:	21.9	21.2		**PLASTICITY INDEX**	**14**



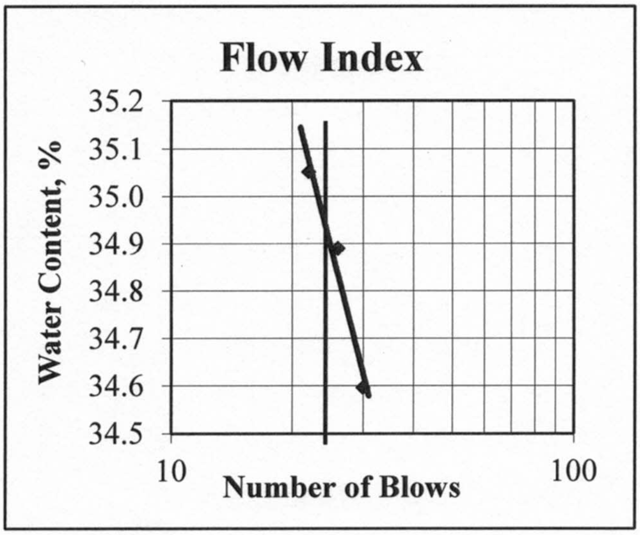


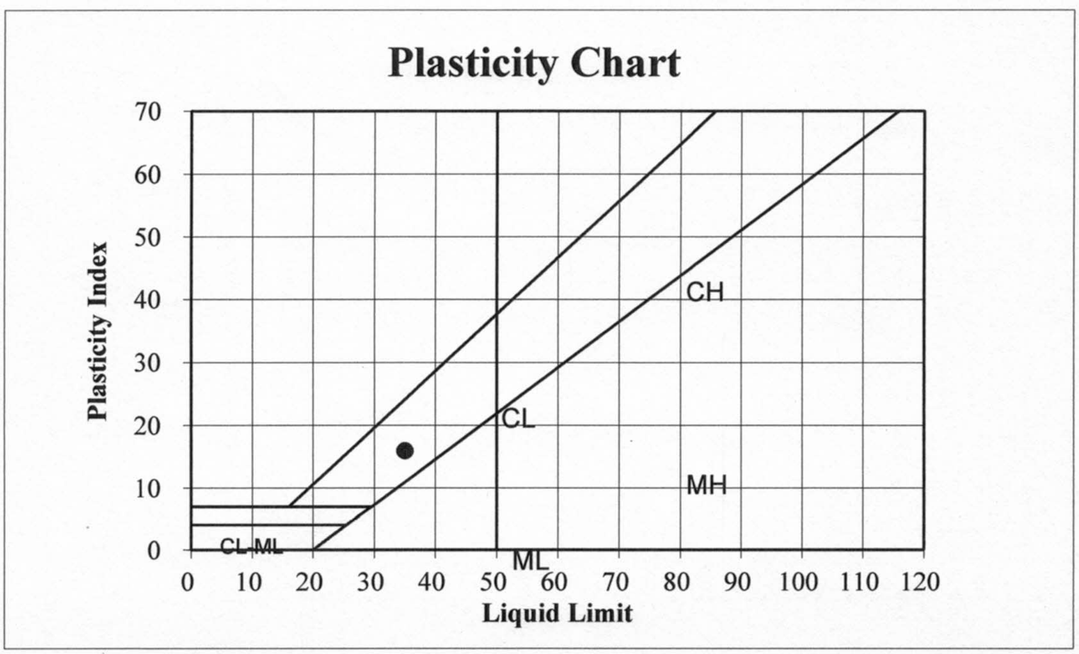
PLASTICITY INDEX

ASTM D-4318

Job Name: IRVINE/CALIF LANDMARK-4112-4136 Del Rey Ave
Sample ID: B1 @ 15'
Soil Description: CL

DATA SUMMARY				TEST RESULTS	
Number of Blows:	22	26	30	**LIQUID LIMIT**	**35**
Water Content, %	35.1	34.9	34.6	**PLASTIC LIMIT**	**19**
Plastic Limit:	18.8	18.7		**PLASTICITY INDEX**	**16**



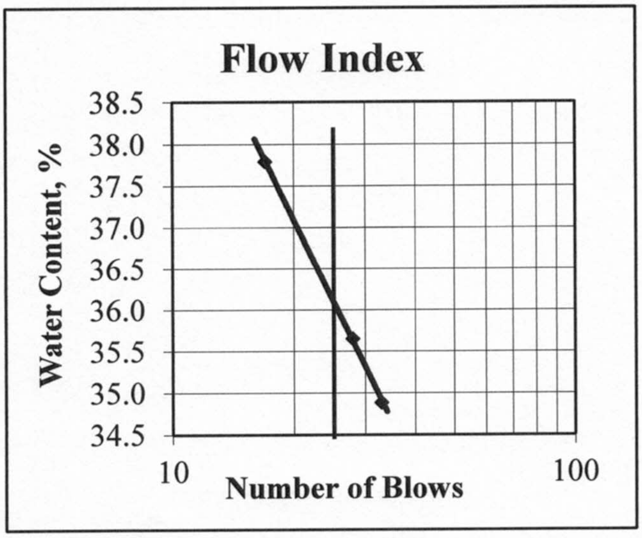


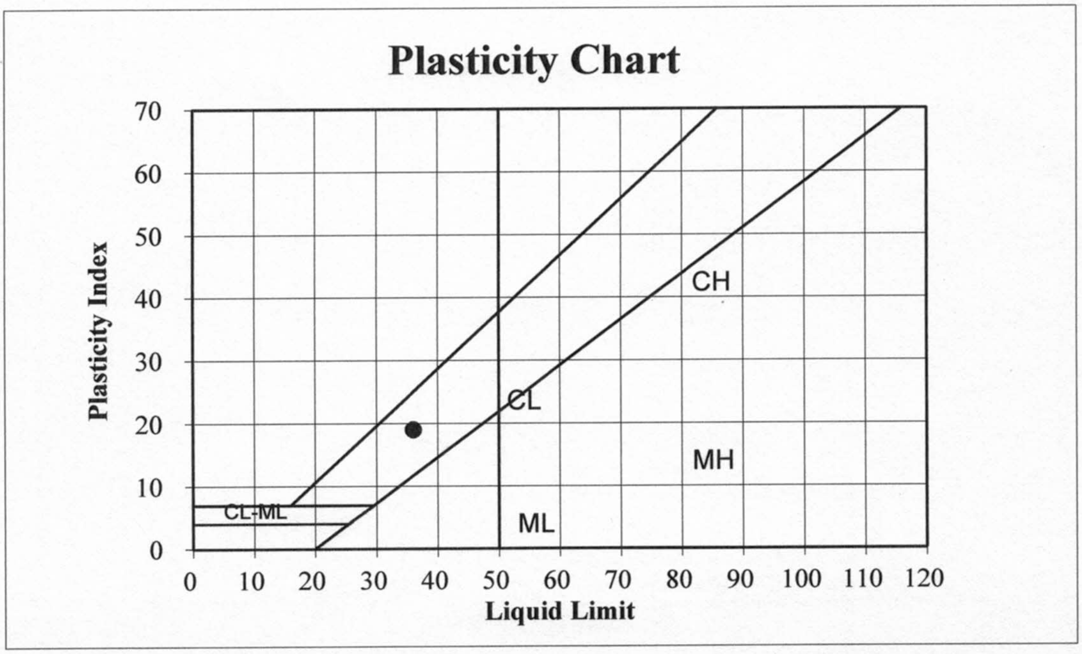
PLASTICITY INDEX

ASTM D-4318

Job Name: IRVINE/CALIF LANDMARK-4112-4136 Del Rey Ave
Sample ID: B3 @ 12.5'
Soil Description: CL

DATA SUMMARY				TEST RESULTS	
Number of Blows:	17	28	33	**LIQUID LIMIT**	**36**
Water Content, %	37.8	35.6	34.9	**PLASTIC LIMIT**	**17**
Plastic Limit:	17.1	17.1		**PLASTICITY INDEX**	**19**



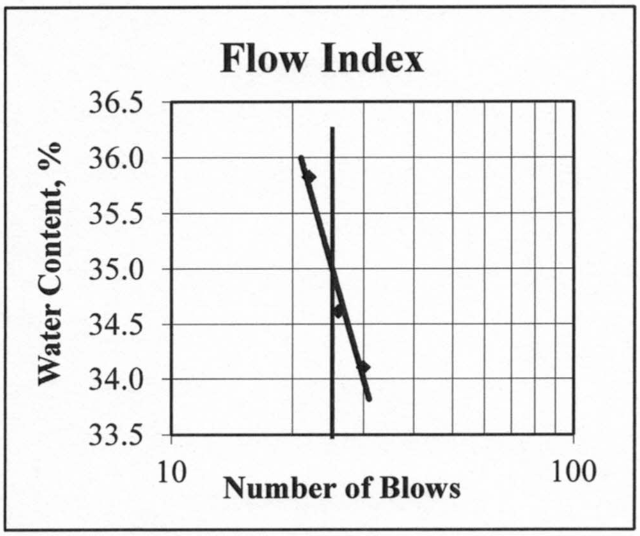


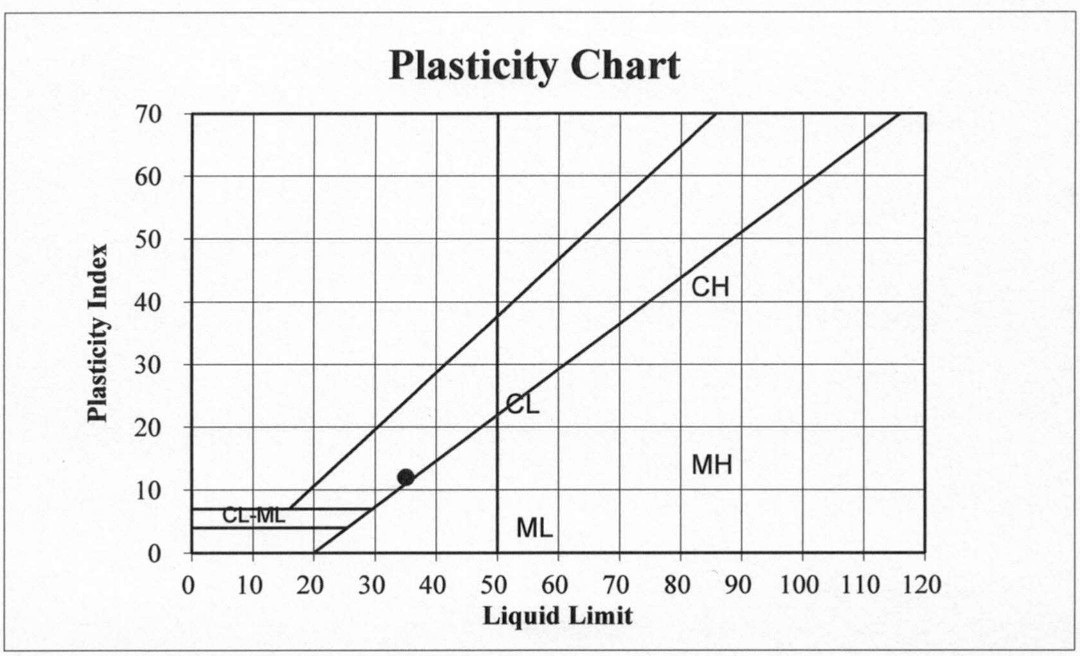
PLASTICITY INDEX

ASTM D-4318

Job Name: IRVINE/CALIF LANDMARK-4112-4136 Del Rey Ave
Sample ID: B3 @ 15'
Soil Description: ML/CL

DATA SUMMARY				TEST RESULTS	
Number of Blows:	22	26	30	**LIQUID LIMIT**	**35**
Water Content, %	35.8	34.6	34.1	**PLASTIC LIMIT**	**23**
Plastic Limit:	22.6	22.5		**PLASTICITY INDEX**	**12**





SOIL LABWORKS LLC

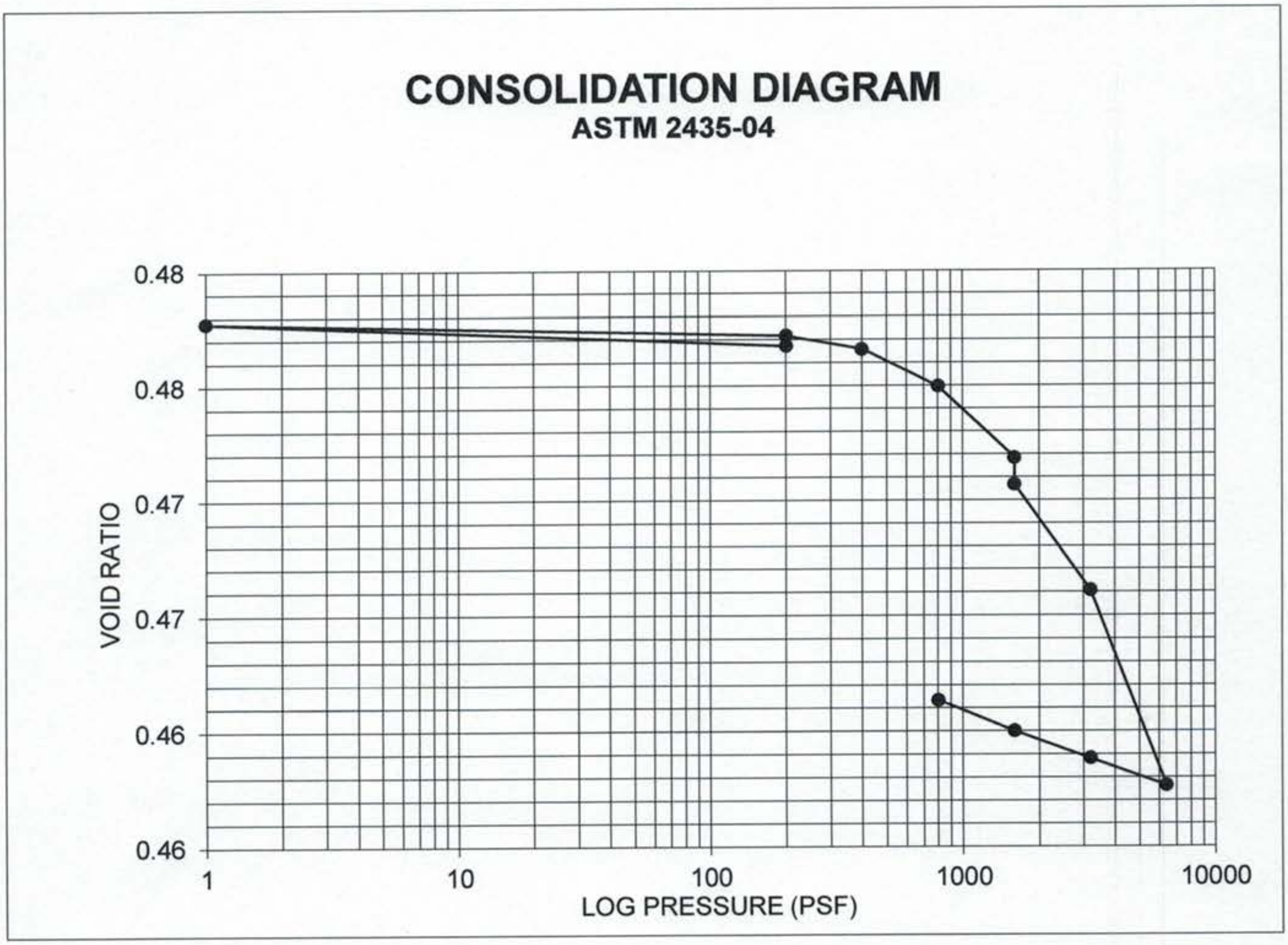
CONSOLIDATION DIAGRAM #1

IC: **20100** CONSULTANT: **JAI**

CLIENT: **CAL LANDMARK DEL REY**

PLATE C-1

Earth Material:	Alluvium		
Sample Location:	B4@10'	Specific Gravity:	2.65
Dry Weight (pcf):	111.8	Initial Void Ratio:	0.480
Initial Moisture:	13.9%	Water Added At (psf):	1600
Initial Saturation:	76.8%	Consolidation Coef. (Cc):	0.0280
		Reloading Coef. (Cr):	0.0008



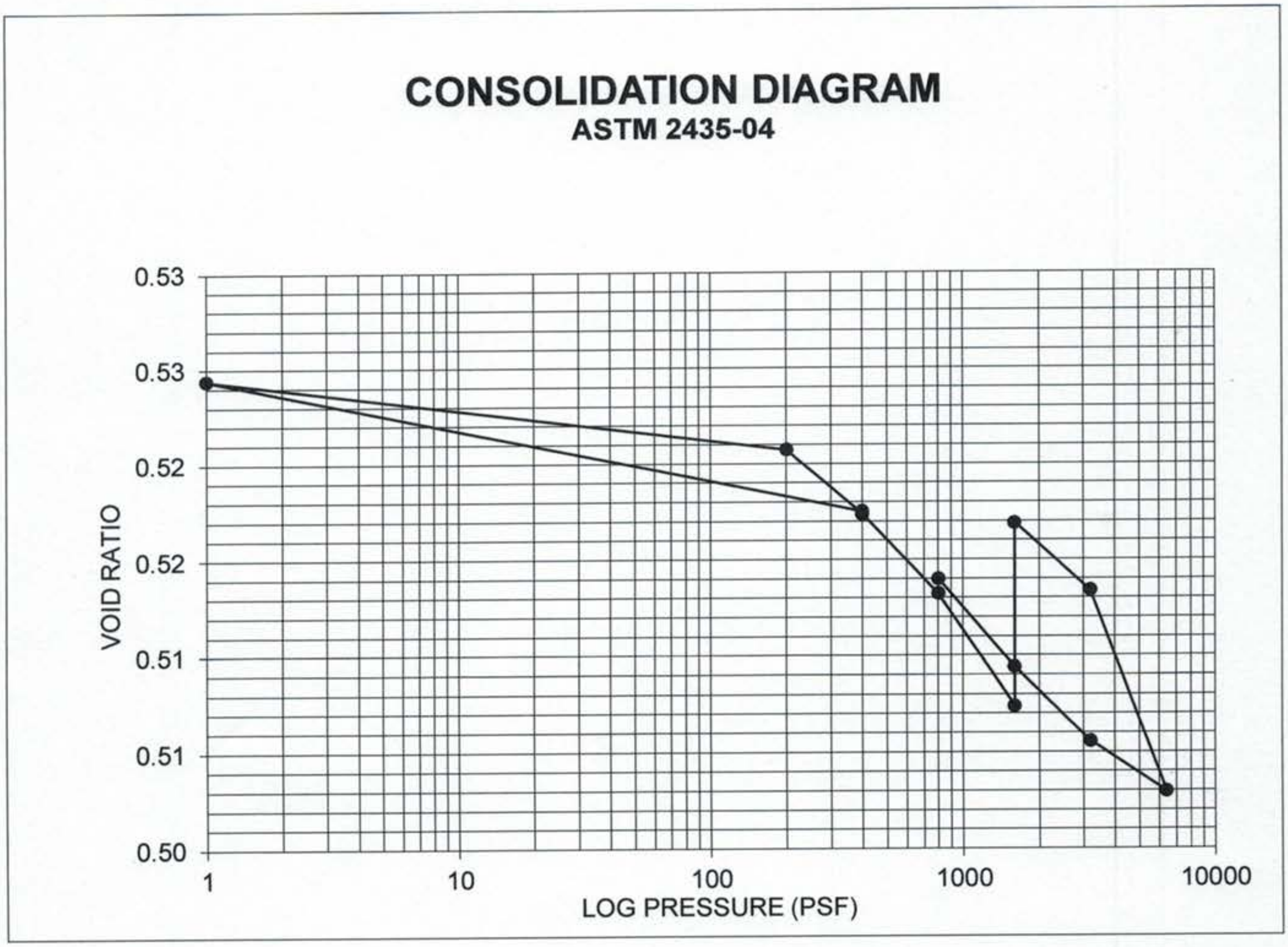
CONSOLIDATION DIAGRAM #2

IC: **20100** CONSULTANT: **JAI**

CLIENT: **CAL LANDMARK DEL REY**

PLATE C-2

Earth Material:	Alluvium		
Sample Location:	B4@15'	Specific Gravity:	2.75
Dry Weight (pcf):	111.9	Initial Void Ratio:	0.534
Initial Moisture:	19.4%	Water Added At (psf):	1600
Initial Saturation:	100.0%	Consolidation Coef. (Cc):	0.0346
		Reloading Coef. (Cr):	0.0023



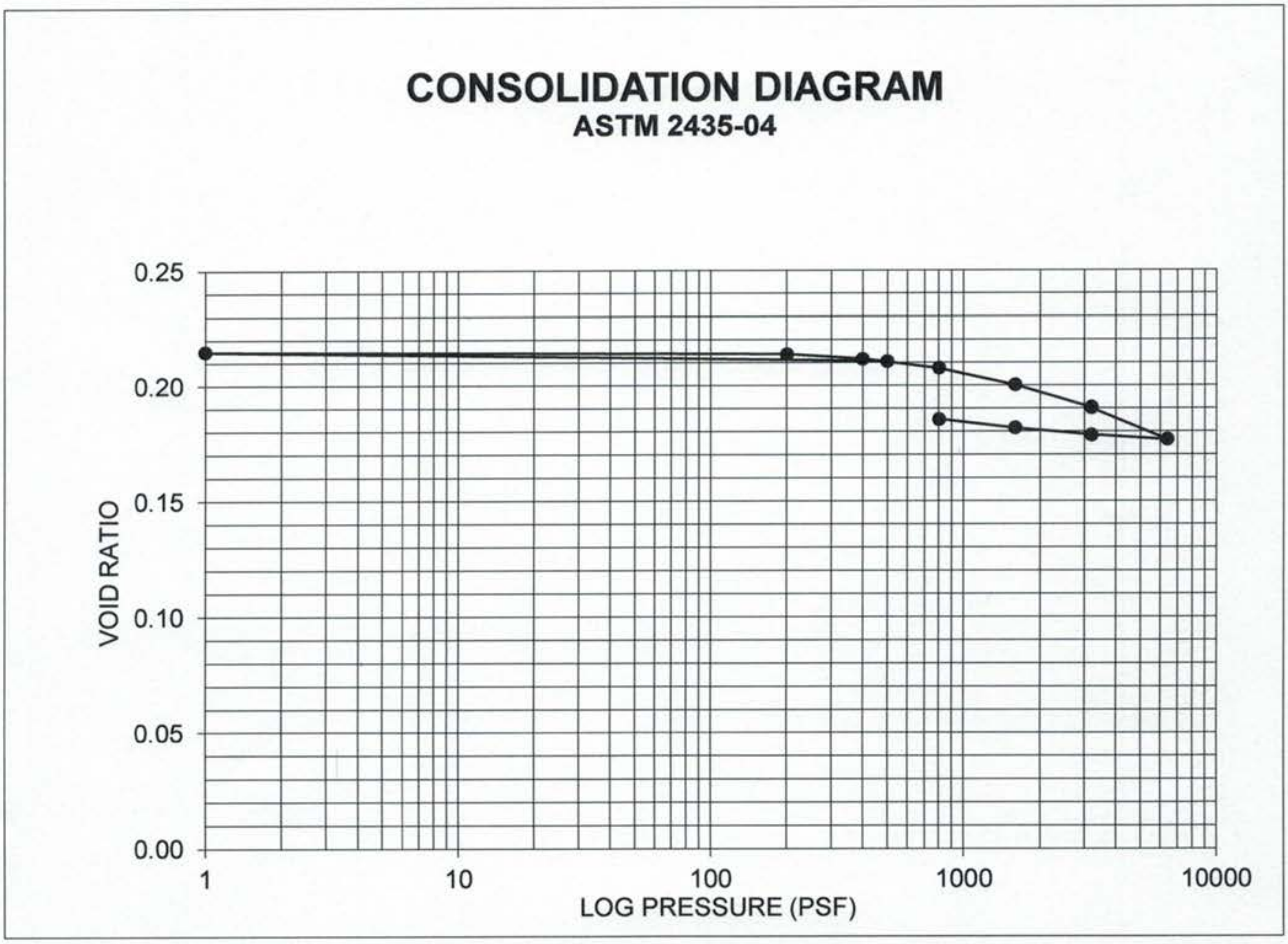
CONSOLIDATION DIAGRAM #3

IC: **20100** CONSULTANT: **JAI**

CLIENT: **CAL LANDMARK DEL REY**

PLATE C-3

Earth Material:	Alluvium		
Sample Location:	B4@20'	Specific Gravity:	2.65
Dry Weight (pcf):	135.1	Initial Void Ratio:	0.224
Initial Moisture:	6.3%	Water Added At (psf):	3200
Initial Saturation:	74.5%	Consolidation Coef. (Cc):	0.0447
		Reloading Coef. (Cr):	0.0018



SOIL LABWORKS LLC

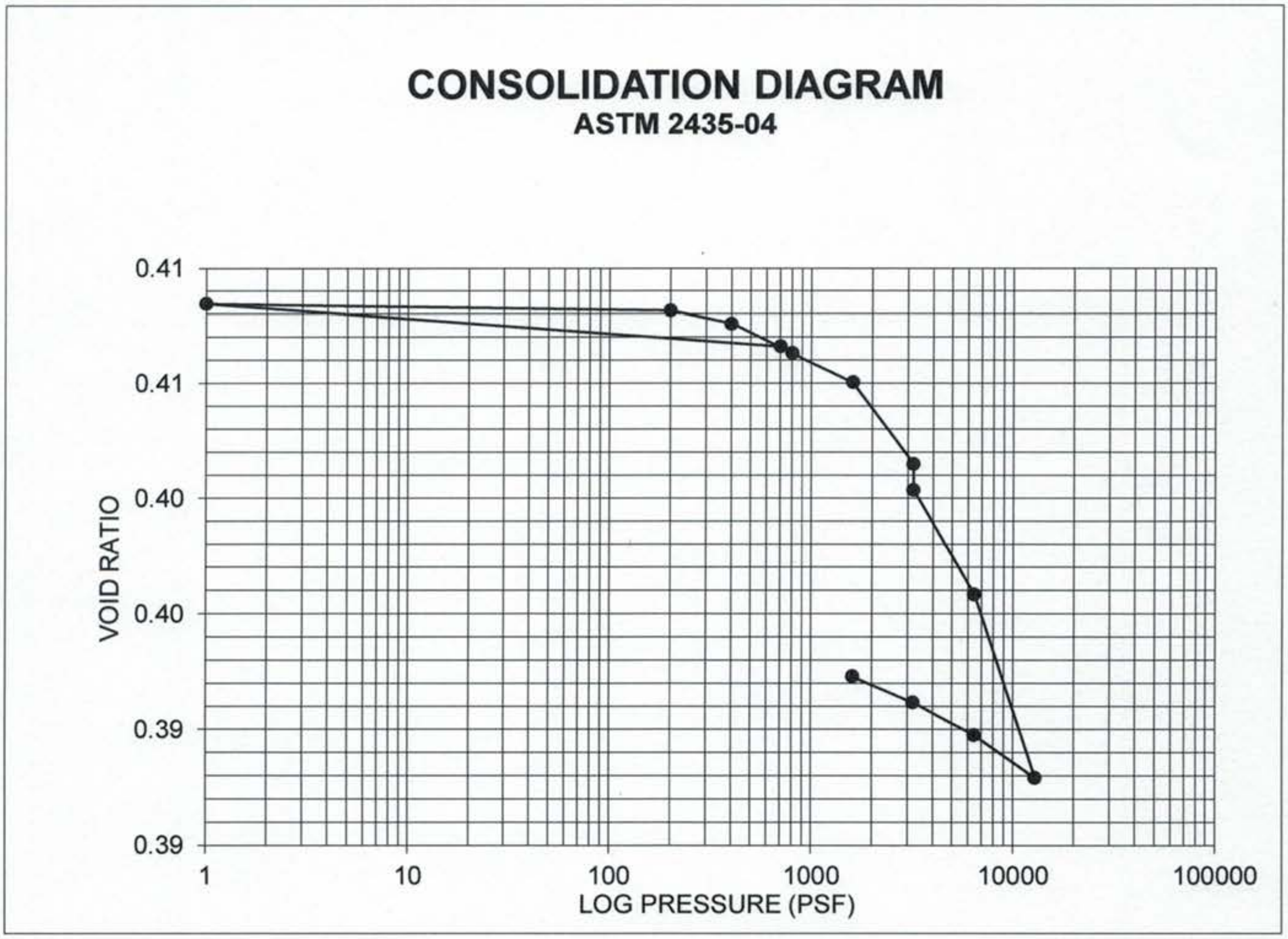
CONSOLIDATION DIAGRAM #4

IC: **20100** CONSULTANT: **JAI**

CLIENT: **CAL LANDMARK REL REY**

PLATE C-4

Earth Material:	Alluvium		
Sample Location:	B4@30'	Specific Gravity:	2.68
Dry Weight (pcf):	118.2	Initial Void Ratio:	0.415
Initial Moisture:	15.4%	Water Added At (psf):	3200
Initial Saturation:	99.6%	Consolidation Coef. (Cc):	0.0263
		Reloading Coef. (Cr):	0.0006



SOIL LABWORKS LLC

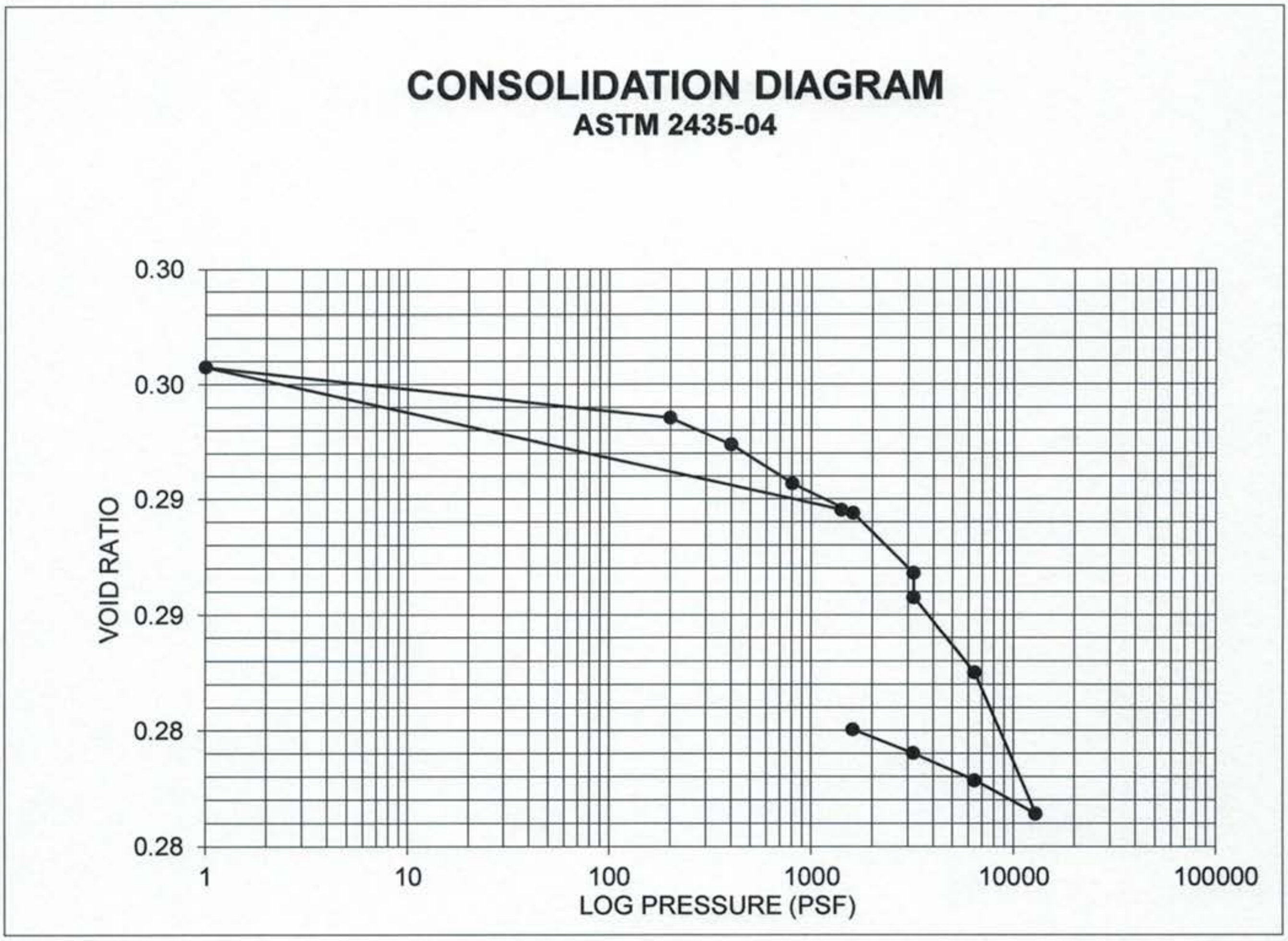
CONSOLIDATION DIAGRAM #5

IC: **20100** CONSULTANT: **JAI**

CLIENT: **CAL LANDMARK REL REY**

PLATE C-5

Earth Material:	Alluvium		
Sample Location:	B4@35'	Specific Gravity:	2.65
Dry Weight (pcf):	127.4	Initial Void Ratio:	0.298
Initial Moisture:	9.8%	Water Added At (psf):	3200
Initial Saturation:	87.2%	Consolidation Coef. (Cc):	0.0203
		Reloading Coef. (Cr):	0.0005



CONSOLIDATION DIAGRAM #6

IC: **20100** CONSULTANT: **JAI**

CLIENT: **CAL LANDMARK REL REY**

PLATE C-6

Earth Material:	Alluvium		
Sample Location:	B4@40'	Specific Gravity:	2.72
Dry Weight (pcf):	127.4	Initial Void Ratio:	0.333
Initial Moisture:	12.2%	Water Added At (psf):	6400
Initial Saturation:	99.8%	Consolidation Coef. (Cc):	0.0235
		Reloading Coef. (Cr):	0.0005