IFB C-7-2018
EXHIBIT J

UPDATED FINAL GEOTECHNICAL REPORT
FOR
ORANGE COUNTY TRANSPORTION AUTHORITY
METROLINK PASSING SIDING

MP 193.74 TO 195.68
LAGUNA NIGUEL TO SAN JUAN CAPISTRANO, CALIFORNIA

EMI Project No. 15-123
Date: June 15, 2018

EARTH MECHANICS, INC.

IFB C-7-2018
EXHIBIT J

Earth Mechanics, Inc.
Geotechnical & Earthquake Engineering

Jun 15, 2018

EMI Project No. 15-123

HNTB Corp.
200 E. Sandpointe Avenue, Suite 200
Santa Ana, CA 92707

Attention: Mr. Graham Christie, Project Manager

Subject: **UPDATED FINAL GEOTECHNICAL REPORT for Orange County Transportation Authority, Metrolink Passing Siding Project, MP 193.74 to 195.68, Laguna Niguel to San Juan Capistrano, California**

Dear Mr. Christie:

Attached please find the Final Geotechnical Report for the subject Metrolink Passing Siding project documenting our field investigation, laboratory testing, and providing our evaluation and recommendations for design and construction of this project. This report includes additional roadway design for the proposed raise in roadway grade on Camino Capistrano at Rancho Cucamonga Drive as part of WQMP requirements.

We appreciate the opportunity to provide geotechnical design services for this project. If you have any questions, please call our office.

Sincerely,
EARTH MECHANICS, INC.

Mike Kapuskar

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IFB C-7-2018
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UPDATE FINAL GEOTECHNICAL REPORT
FOR
ORANGE COUNTY TRANSPORTION AUTHORITY
METROLINK PASSING SIDING
MP 193.74 TO 195.68

LAGUNA NIGUEL TO SAN JUAN CAPISTRANO, CALIFORNIA

Prepared for:

HNTB Corp.
200 E. Sandpointe Avenue, Suite 200
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Prepared By:

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EMI Project No. 15-123
June 15, 2018

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1.0 INTRODUCTION

1.1 PURPOSE AND SCOPE OF STUDY

This updated Final Geotechnical Report has been prepared to support final design and construction of proposed improvements to the Metrolink Commuter Rail Line in Laguna Niguel and San Juan Capistrano, Orange County. The location of the project is shown in Figure 1. The evaluation and recommendations provided in this memorandum are based on a review of existing data consisting of current design information provided by the designer HNTB Corp., site reconnaissance visits, supplemental geotechnical investigation, and available geologic and geotechnical sources.

The geotechnical services provided for this project included the following tasks:

- Field exploration consisting of nine (9) supplementary exploratory borings,
- Laboratory testing of selected soil samples,
- Soil corrosivity evaluation,
- Engineering calculations and analysis to develop foundation design and construction recommendations,
- Pavement structural section design, and
- Preparation of this report presenting our findings, conclusions, and recommendations.

The evaluation and recommendations contained herein may be revised when design changes or additional data become available.

1.2 PROJECT DESCRIPTION

Based on the current design plans, the project is approximately 9,350 ft long and in existing Metrolink right of way (ROW). The project adds a new track and requires the addition of three retaining walls, a culvert extension, minor storm drain upgrades, and poles. The project will require cuts and fills of embankment slopes, and for the culvert extension and wall footing construction. Other improvements include improvements to storm drains and street improvements which include raising a portion of Camino Capistrano roadway.

1.3 EXISTING DATA

This report makes use of and supplements the Geotechnical Investigation Report (GIR) prepared by Kleinfelder (2011) for Orange County Transportation Authority (OCTA) for the subject project. The GIR includes a geotechnical investigation of soil borings, laboratory testing of samples, and general conclusions and recommendations for geotechnical design and construction. Other subsurface data was researched and the Escolar Storm Drain utility plans reviewed but not found relevant to the project areas addressed in this report.

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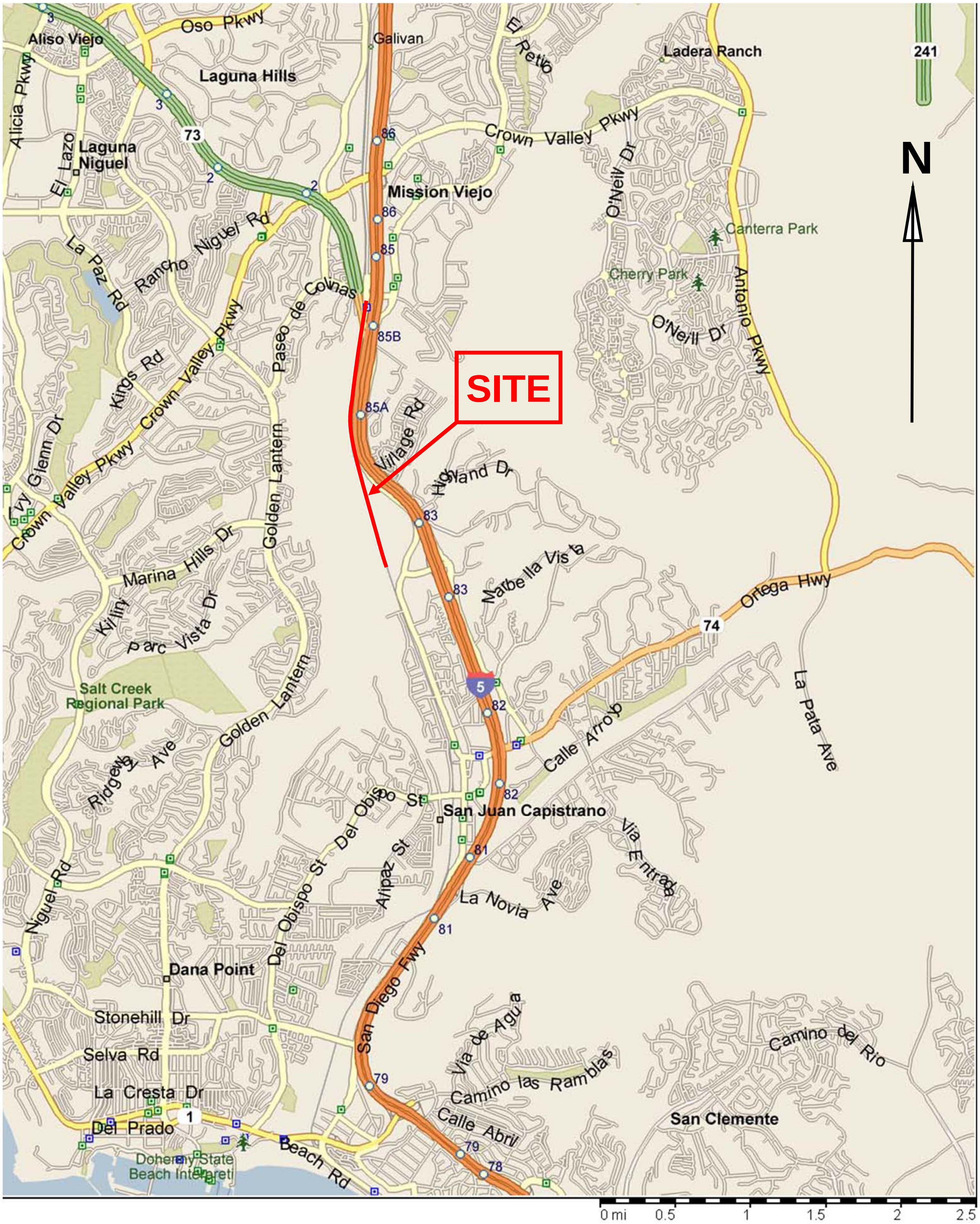

(Map Source: Microsoft Streets and Trips)

OCTA METROLINK PASSING SIDING

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SITE LOCATION MAP

Figure 1

Project No. 15-123

Date: 4-8-2016

2.0 FIELD INVESTIGATION AND LABORATORY TESTING

2.1 EXISTING DATA

The GIR (2011) documents an initial geotechnical investigation conducted by Kleinfelder in June 2011 for the subject project consisting of 13 auger borings drilled along the entire length of the project with a maximum depth of 18 ft, and laboratory testing.

2.2 SUPPLEMENTAL FIELD INVESTIGATION

A limited supplemental geotechnical investigation consisting of nine (9) exploratory borings was conducted in August 2015 and January 2016 to obtain and analyze soil samples and determine engineering properties. The investigation was designed to verify existing geotechnical data, to fill in gaps where geotechnical data was lacking, and to verify soil types found in nearby existing soil borings, and determine the existing pavement structure. Key borehole information of both investigations is summarized in Table 1. The approximate locations of the borings are shown on Figure 2.

Borings EMI-1 and EMI-2 were drilled at the culvert crossing to perform consolidation tests and settlement calculation for culvert design. Borings EMI-1, 3, 5, 11A and 12A were drilled to obtain samples for pavement design. All other borings were drilled for wall design.

Borehole locations were submitted to HNTB for review. The actual locations were determined during site reconnaissance visits to address site accessibility, permit constraints, overhead and underground conflicts, and Metrolink and traffic control restrictions. Borings EMI-2, 6, 7, and 8 required flagging services provided by Metrolink and partial use of SafeProbe’s vacuum truck to pothole and confirm utility clearance. Borings EMI-9 and 10 are in private property and were marked, but access was not allowed for drilling.

EMI conducted three site reconnaissance visits to mark the exploratory locations and clear underground utilities through Underground Service Alert. Borings EMI-1, 3, 5, 11A, and 12A were drilled on Camino Capistrano. EMI prepared traffic control plans and obtained encroachment permits from the city of Laguna Niguel. The permit required of an archeological and Native American monitors. This service was provided by Paleo Solutions to observe drilling and prepare an archeologic report. EMI arranged for traffic control during the field work. Boreholes will be capped with cold patch or black-dye cement.

Hollow-stem auger borings were conducted to target depths or refusal, whichever occurred first. The approximate locations and ground surface elevations were based on field measurements and topographic design plans with support by the project land surveyor.

Table 1. Soil Exploration Information

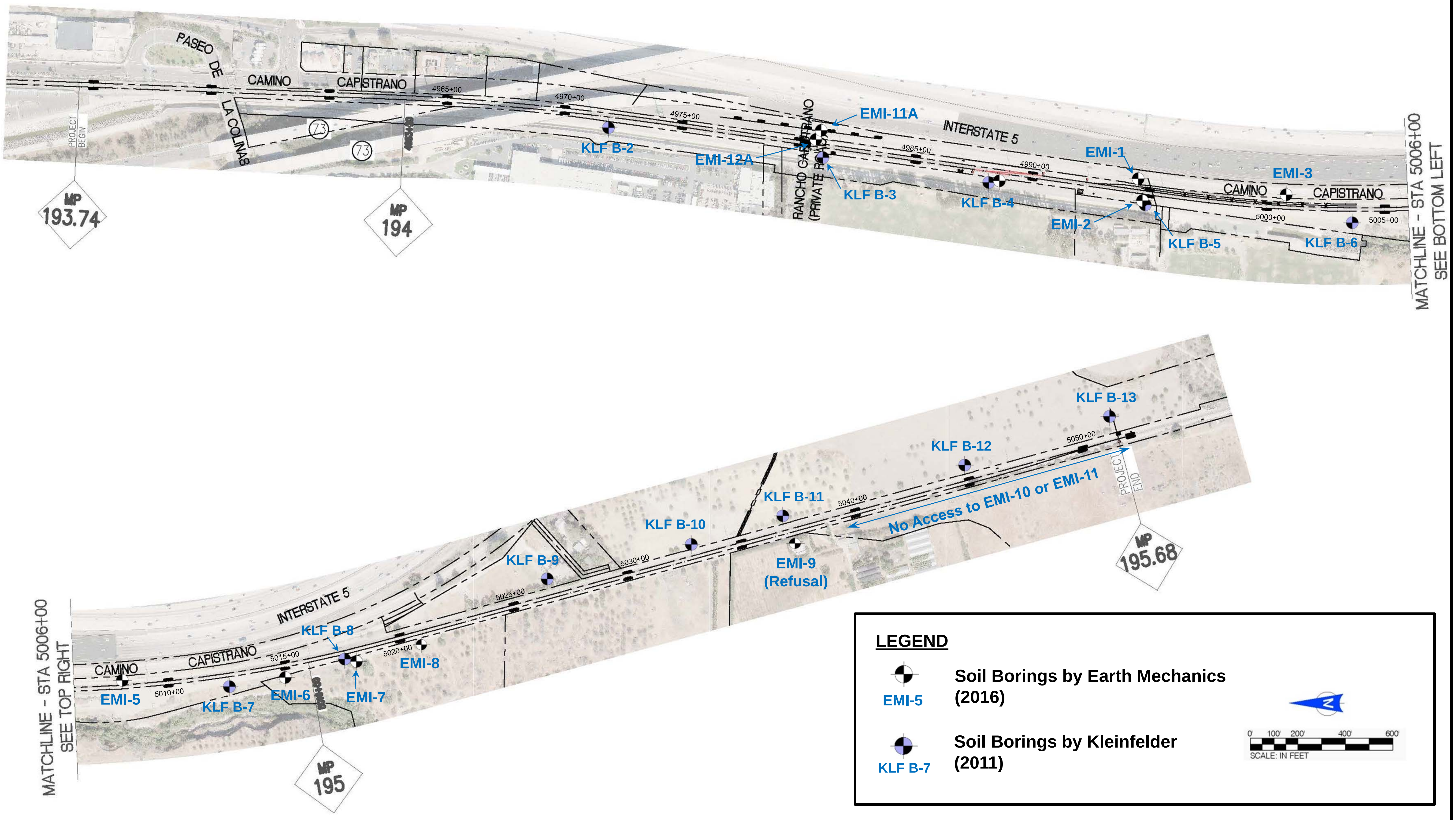
Boring	Approx. Station	Approx. Offset (ft)	Approx. GSE (ft)	Boring Depth (ft)	GWD (ft)
EMI-1	4994+70	60 Lt.	221	36.5	33.0
EMI-2	4994+92	40 Rt.	216	76.5	19.0
EMI-3	5001+82	58 Lt.	233	46.5	NE
EMI-5	5008+12	60 Lt.	239	51.5	NE
EMI-6	5015+00	40 Rt.	209	26.5	NE
EMI-7	5018+00	42 Rt.	210	26.5	NE
EMI-8	5021+00	30 Rt.	211	26.5	NE
EMI-11A	4980+77	50 Lt.	225	5.0	NE
EMI-12A	4980+72	30 Lt.	225	5.0	NE

Notes:

1. Stations and offsets are approximate based on physical measurements and plans or were provided by the land surveyor
2. GSE = Approximate Ground Surface Elevation
3. GWD = Approximate Groundwater Depth
4. NE = Not Encountered During Drilling

The borings were drilled to collect soil samples for geotechnical testing. The upper 5 ft of soil at each exploratory location was hand-augered to clear utilities. EMI's field representatives visually classified the soil cuttings in accordance with Caltrans Soil and Rock Logging Classification Manual (2010) and recorded detailed field logs of subsurface materials and groundwater levels (if any) encountered in the borings.

Bulk soil samples and relatively undisturbed samples were collected for geotechnical laboratory testing. The large bulk samples were obtained from soil cuttings at shallow depths where future excavations are expected. The relatively undisturbed samples were collected using a 3"outside diameter Modified California split-spoon sampler lined with 1-inch high, 2.5" outside diameter brass rings. Standard Penetration Tests (SPT) were also performed in alternating manner with relatively undisturbed sampling at every 5-ft vertical interval using a 1.4" inside diameter split-spoon sampler to obtain small bulk soil samples. Both samplers were driven into the ground using a 140-lb automatic trip hammer free-falling from a height of 30". The numbers of blows to advance the samplers for every 6" of penetration or less was recorded. The blowcounts required to drive the SPT sampler for the last 12" or less are referred to as the Standard Penetration Resistance (N) value. The Log of Test Boring sheets (LOTB's) are provided in Appendix A.



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EXPLORATORY BORING LOCATION MAP

FIGURE 2

2.3 LABORATORY TESTING

Representative soil samples from the supplemental field investigation were collected in all soil borings for soil classification and laboratory testing to obtain or derive relevant physical and engineering soil properties. Laboratory testing was conducted in general accordance with California Test Methods (CTM) or American Society for Testing and Materials (ASTM) Standards. The following laboratory testing was performed:

- In-situ Moisture Content and Unit Weight (ASTM D-2937, D-2216),
- Atterberg Limits (ASTM D-4318),
- Gradation Analysis/Hydrometer (ASTM D-422),
- Strength Tests (Direct Shear (ASTM D-3080),
- Unconfined Compression (ASTM D-2166),
- Soil Corrosivity (pH, minimum resistivity, chloride and sulfate contents (CTM-417, 422, 532 and 643),
- Expansion Index (ASTM D-4829),
- Consolidation Tests (ASTM D-2435),
- Compaction (ASTM D-1557),
- R-Value Tests (ASTM D-2844/CTM-301),
- Pocket Penetrometer and Pocket Torvane.

All test results are provided in Appendix B. Some of the test results such as in-situ moisture contents, total unit weights, and pocket penetrometer and torvane are also shown on the boring logs in Appendix A. Corrosion, Expansion Index, and R-values test results are presented and discussed in various subsections in Section 4.0.

3.0 GEOLOGICAL FINDINGS AND GEOTECHNICAL CONDITIONS

3.1 GEOLOGIC SETTING

Site geologic setting and seismicity was addressed in Section 2.1 of the GIR (Kleinfelder, 2011).

3.2 SOIL CONDITIONS

General subsurface conditions were described in Sections 2.1 and 3.1 of the GIR (Kleinfelder, 2011). Based on the report and the supplemental boring logs in Appendix A, the geologic units underlying the project corridor consist of artificial fills (Af) and Young Alluvial Landslide Deposits (Qya) and Capistrano Formation. The units that are expected to be encountered during excavation consist of artificial fills (Af) and alluvial deposits (Qya).

The man-made fills consist of up to about 10 ft of loose to medium dense poorly to well graded sands, sandy gravel, silty and clayey sands, soft to firm sand clays, and construction debris.

The Young alluvial deposits consist of interbedded silty to clayey sands, soft to firm sandy silts and clays. These deposits were placed primarily as axial channel deposits, and unconformably overlie bedrock.

The design properties based on the available data vary for each design element and area in Section 4.0.

3.3 GROUNDWATER CONDITIONS

Regional groundwater conditions were described in Section 3.2 of the GIR (Kleinfelder, 2011). Design groundwater levels are provided in relevant subsections in Section 4.0.

Groundwater levels can fluctuate due to natural or and man-made causes during the design life of the proposed structures including irrigation and wet seasons. Construction should expect possible changes in ground moisture due to such causes and verify current groundwater levels at the time of construction and to dewater as required.

3.4 GEOLOGIC HAZARDS

Geologic hazards such as scour and landslides have been discussed in Sections 3.6, 3.7, and 4.4 of the GIR (Kleinfelder, 2011).

3.5 EXPANSIVE SOILS

Section 3.3 of the GIR (Kleinfelder, 2011) included a total of seven (7) tests project-wide on clayey soils to evaluate the potential for undesirable settlement or heave of foundations supported on grade. Six among all seven tests resulted in a very low to low expansion potential and only one had a medium potential according to ASTM D-4829 expansion soil classification.

Two (2) additional samples were collected from the supplemental borings and tested along the Camino Capistrano roadway where new pavement is proposed. The test results (Appendix B) also showed low expansion potentials.

The project corridor does not lie within a region known to contain abundant clay with a high swelling potential (Olive et al, 1989). As a result, the impact of expansive soils on the proposed foundations design is considered to be low.

4.0 CONCLUSIONS AND RECOMMENDATIONS

4.1 SEISMIC DESIGN CRITERIA

Sections 3.5, 3.6, and 4 of the GIR (Kleinfelder, 2011) discussed seismic hazards such as regional seismicity, fault rupture, soil liquefaction, and landslides. The following sections discuss issues as they relate to the proposed structure design.

Seismic design parameters were provided in Section 4.4 of the GIR (Kleinfelder, 2011) using the California Building Code (CBC) 2010. A cursory check of the parameters provided in that report was conducted. The original recommended design Peak Ground Acceleration (PGA) of 0.36g and a maximum moment magnitude of 7.5 were used for subsequent geotechnical design.

4.2 SOIL LIQUEFACTION AND STRENGTH REDUCTION

Soil liquefaction was discussed in the Section 3.5 of the GIR (Kleinfelder, 2011). Liquefaction is a phenomenon whereby saturated granular soils with low relative density (loose) lose their inherent shear strength due to increased pore water pressures induced by cyclic loading such as that caused by an earthquake.

At the main culvert crossing, groundwater was encountered in borings EMI-1 and EMI-2. The site soils are fine-grained soils (silts and clays with medium to high plasticity) that are not susceptible to soil liquefaction using current screening criteria (Section C10.5.4.2 in AASHTO, 2012).

In the three wall areas, groundwater and saturated granular soils susceptible to soil liquefaction were not encountered in any of the remaining borings within the depths explored. In addition, the design PGA from Section 4.1 is relatively low. As a result, the site soil liquefaction potential is found to be low. Any seismically-induced settlements will be relatively small and remedial grading will be used to address any surface manifestations. The structure foundations areas are proposed to be overexcavated and backfilled with engineered (compacted) materials to create a foundation base that is not subject to soil liquefaction and that will limit ground settlements within tolerable levels.

Soil strength loss due to liquefaction will be low. The cohesive soils found in the project areas explored in this report have stiff to hard consistencies and cyclic strength degradation will be small.

4.3 SOIL CORROSIVITY

4.3.1 Corrosivity Testing

Section 3.4 of the GIR (Kleinfelder, 2011) included four (4) corrosion test results in the areas addressed in this report to evaluate the potential for deleterious effects of the on-site soils on structural concrete and steel and on other metals in contact with soil.

A total of four (4) additional representative samples were collected from the supplemental borings and tested for pH, minimum resistivity, soluble chloride content and soluble sulfate content. The test results are shown in Table 2.

TABLE 2. SOIL CORROSIVITY TEST RESULTS

Boring No.	Approx. Depth (ft)	Predominant Soil Type (USCS)	Minimum Resistivity (ohm-cm)	pH	Sulfate Content (ppm)	Chloride Content (ppm)
Initial Investigation (Kleinfelder, 2011)						
B-3	0-4	SC	1,890	8.6	6	90
B-6	3-5	CL/SC	1,320	8.5	41	126
B-9	0-4	SP	2,440	8.4	0	90
B-11	0-5	CL	1,520	8.2	35	258
EMI Supplemental Investigation						
EMI-2	10	CL	780	8.0	8.5	112
EMI-3	20	SM to CL	920	7.5	589	137
EMI-6	0-5	SC	1,600	7.5	172	68
EMI-8	5	ML	1,050	7.8	185	179

4.3.2 Structure Foundation Design

For design of structure foundations, the Caltrans Corrosion Guidelines (2012) classify soil as corrosive if the soluble chloride content is higher than 500 ppm, or if the soluble sulfate content is more than 2,000 ppm, or if the pH value is less than 5.5. Minimum resistivity is not used for structure foundation design per Section 6.1 of the guidelines.

Based on the existing test results found and the Caltrans criteria, the on-site soils in contact with proposed improvements such as walls and box culverts are not expected to be corrosive to bare metals and concrete. Corrosion-resistant Type II modified cement and the minimum required concrete cover for non-corrosive soil per Table 5.12.3-1 in AASHTO, 2012) should be sufficient for concrete foundations in contact with soil. The minimum concrete cover for drilled concrete piles should also meet Section 10.8.1.3-1 of the Caltrans State Amendments (2014a) to AASHTO. All materials should also meet minimum concrete covers and thicknesses required by applicable railroad and local codes.

4.3.3 Culvert Design

Culvert pipe materials in *direct* contact with existing soils were evaluated using the Caltrans AltPipe culvert selection tool (Caltrans, 2016) for diameters of 24” and 30”, worst-case design corrosion values, a design soil cover of 2.5 ft, Level-1 abrasion, a 2-5 year flow velocity of

5 ft/sec, and a design life of 50 years. The AltPipe results indicate that for Reinforced Concrete Pipe (RCP), standard mix design should be suitable using Type II modified Cement. The minimum required concrete cover given in Table 5.12.3-1 AASHTO (2012) should be sufficient. Corrugated plain galvanized steel pipe (CSP) with minimum 0.109” wall thickness and CSP with bituminous coating having minimum 0.079” thickness are acceptable. Aluminum pipe or aluminized steel pipe is not recommended. Concrete headwalls and concrete or metal end treatment should be used.

The proposed culvert crossings (Section 4.7) and extensions (Section 4.8) are proposed to be a reinforced concrete box culvert embedded in import fill materials or in direct contact with existing soil. Section 10 of the Caltrans Corrosion Guidelines (2012a) specify the minimum concrete cover per Chapter 850 of the Caltrans Highway Design Manual (2014b). Culvert pipe materials were evaluated using AltPipe (2016) using worst-case design corrosion values and lowest minimum resistivity value tested (780 ohm-cm). Based on the AltPipe results, the above recommendations for non-corrosive soil can also be used for the main culvert crossing. Should the design include any pipe materials and they will be in *direct* contact with existing soil, aluminum pipe or aluminized steel pipes should not be allowed. Per Section 10.5 of the Caltrans Corrosion Guidelines, for concrete backfill using admixtures to accelerate concrete set time, only non-chloride admixtures should be used.

The above evaluation addresses the corrosivity on the soil side only. Thicker pipe may be needed for potential abrasion, higher flow velocities, strength and overfill requirements. All materials should also meet minimum concrete covers and thicknesses per applicable railroad and local codes. The backfill materials used should be non-corrosive (see Section 5.4). For new metal pipes and concrete structures, and modification of existing pipes or concrete structures, that will be embedded in soils not tested, site-specific corrosion tests of the soils surrounding the pipe or structure is recommended or otherwise the design should be based on corrosive soil conditions. Corrosion mitigation measures may involve using chloride-resistant cement, non-standard cement mix and water content, increased concrete cover and pipe thickness, bituminous coating, and concrete headwalls and concrete or metal end treatment following Caltrans Corrosion Guidelines (2012a), and Chapter 850 of Caltrans HDM (2012b).

4.4 RETAINING WALL NO. 1

A new wall is proposed along the east side of the R/R corridor between approximately Sta. 4998+50 and 5009+00 with variable wall heights ranging from 3 to 13 ft. Track grade is near El. 218 to 220 ft. An existing embankment slope exists with heights rising from nil in the north up to 19 ft above track grade in the southern segment of the wall. The toe of the slope is to be cut and retained by the northern segment of this wall to accommodate a new third track up to about near Sta. 5003+75. In the southern segment, the setback from track is reduced. The designer indicated that the new track will be placed approximately six months after wall construction.

4.4.1 Ground Conditions

The following is based on findings from EMI Borings EMI-1, EMI-3, and EMI-5, and Kleinfelder (2011) borings B-5, B-6, and B-7, geologic maps, and field observations during site visits.

In the northern wall segment (approx. Sta. 4998+50 to 5003+75), the existing soils underlying the roadway that will be retained by the proposed wall is predominantly cohesive soils (sandy clays/silts) with layers of sand. The wall will retain granular fill. The soil below the track grade consists of clays and silts. Groundwater was encountered at 33 ft depth in the deepest boring EMI-1 but not in other four borings. Based on ground surface elevation of 221 ft at boring EMI-1, a design groundwater elevation of 188 ft was used.

In the southern segment (Sta. 5003+75 to 5009+00), the existing fill behind wall and under roadway is a few feet of sandy clay and silts followed by dense granular soils with pockets of clay. The soil below the track grade is clays and silts. The design ground surface is El. 218 ft.

The design soil strength parameters are summarized in Table 3 and can be used for static and seismic design.

TABLE 3. ENGINEERING DESIGN PROPERTIES FOR WALL NO. 1

Layer (USCS)	Elev. (ft)	Total Unit weight, γ (pcf)	Design Friction Angle, ϕ (deg)	Design Undrained Shear Strength, S_u (psf)
North Segment (Sta. 4998+50 to 5003+75)				
Fill (Af) CL/ML/SC	GSE-210	120	32 34	50 100
Young Alluvium (Qya) CL/ML	210-184	120	0	1,000
South Segment (Sta. 5003+75 to 5009+00)				
Fill (Af) Dense Granular (SP)	GSE-214	120	32 35	50 100
Young Alluvium (Qya) CL/ML/SC/SM	214-188	120	0	1,000

Note: GSE = Approximate Ground Surface Elevation.

4.4.2 Northern Segment From Sta. 4998+50 To 5003+75

The design plans show a small grade change less than 3 ft between roadway and track finish grades and level ground to gentle (2H:1V) backslope.

4.4.2.1 Foundation

Where the ground cannot be sloped back, a small modular block on a pad of engineered (compacted) soil or cast-in-place concrete wall on shallow footing is feasible. The footing or pad will bear on competent native soil. A Caltrans standard Wall Type 1 (H=4 ft) is feasible.

4.4.2.2 Design

The wall can be designed for the active earth pressures (triangular distribution) given in Section 4.4.3.2. A footing pad can be created by overexcavation of existing soils to minimum 2 ft depth and replacing with compacted granular backfill to provide adequate bearing. It is assumed that the soil behind the wall is drained so no hydrostatic pressures occur.

Lateral sliding resistance can be based on a passive earth pressure at footing/pad of 300 pcf and should be ignored within the upper 1 ft of soil. A conservative friction coefficient between bottom of footing and soil of 0.4 can be used. Passive resistance can be assumed to be fully mobilized at a displacement equal to 2% of the footing depth below adjacent finished grade. For smaller lateral displacements, the passive pressure may be determined by linear interpolation. For static loading, only base friction is recommended and passive resistance should be ignored. For seismic loading, base friction and passive resistance may be combined.

For a footing or pad with minimum 4 ft width, the allowable bearing pressure is 1.5 ksf. The recommended bearing capacity is a net value and includes a factor of safety of 3. This design value can be increased by one-third for short-term loads such as wind and seismic forces. The total settlement of footings up to 6 ft wide is estimated to be less than 1”.

For LRFD design, the applied footing bearing pressures for the Service-I, Strength Limit, and Extreme Limit States should be checked against the bearing resistance which is the ultimate resistance multiplied with a resistance factor per AASHTO (2012) with Caltrans amendments (2011). The total settlement and the differential settlement due to the applied bearing stress for the Service-I Limit State should be checked against the permissible settlement required by the design (typically ½” differential settlement and 1” total settlement).

4.4.3 Southern Segment From Sta. 5003+75 To 5009+00

4.4.3.1 Foundations

Wall types considered were cantilevered soldier pile, tie-back soldier pile, reinforced earth, prefabricated modular block wall (T-Wall) and gravity wall (Enviro Block Wall). Selection criteria included reduction in earthwork, ROW take, construction time, cost, proximity to track and constructability. Due to the presence of soft compressible clayey soils and portions of the slope are steep, wall types on shallow footings are not recommended. Deep foundations are recommended. A cantilever soldier pile wall type was selected due to limited ROW and up to 13 ft of wall height required. Anchored wall types including soil nail walls are also feasible but were not selected due to limited ROW and to avoid anchor installation issues adjacent to live track. Steel soldier piles with HP and W steel sections embedded in Cast-In-Drilled-Holes (CIDH) are feasible. Slope grading will be implemented to reduce required wall heights and to achieve a stable slope face.

4.4.3.2 Design

For a cantilevered wall, the maximum exposed height is typically limited to about 14 ft to be economical. Lateral pressures against the wall backface consist of (1) active static and seismic earth pressures behind the wall, (2) pressures from any temporary or permanent (traffic) surcharges, and seismic pressures. The design approach can follow SCRRA Design Criteria

Manual (2010) and Section 6.3 of the SCRRA Excavation Support Guidelines (2009). Lateral design earth pressures are shown in Figure 3 and the design pressures per applicable code using the parameters in Table 4 and Table 5. Roadway surcharge should be added if it is within 20 ft lateral setback behind the north wall. Roadway surcharge appears to be setback 30 ft or more behind the south wall and can be ignored. Future ground conditions were accounted for by discounting the ballast, subballast and top 12" of native soil for passive resistance calculation.

If water pressure is allowed to build up behind the walls, hydrostatic pressure should be added in the undrained zone. If there are any other lateral pressures such as due to surcharge or live load, they should be added. Seismic earth pressures were estimated using the trial-wedge method and the PGA from Section 4.1 with a one-half reduction of the acceleration as allowed by AASHTO (2012). Figure 3 provides the seismic incremental uniform pressure distribution.

General recommendations for wall construction are provided Section 5.0.

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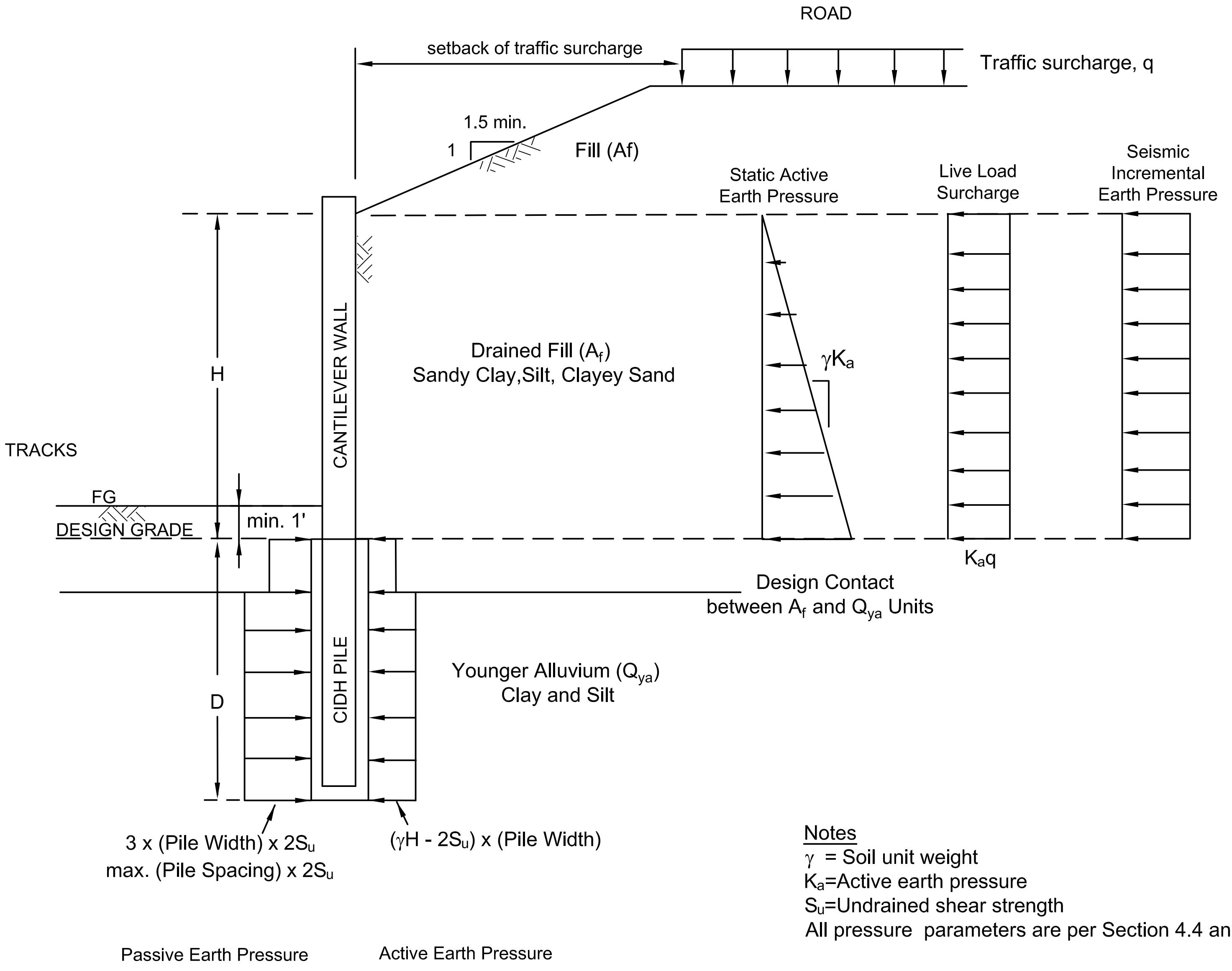

Notes

γ = Soil unit weight
K_a=Active earth pressure
S_u=Undrained shear strength
All pressure parameters are per Section 4.4 and Tables 3 to 5.

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Project No. 15-123
Date: 9/9/16

DESIGN LATERAL EARTH PRESSURES FOR SOLDIER PILE WALL NO. 1

FIGURE 3

TABLE 4. DESIGN PRESSURES FOR WALL NO. 1, NORTHERN SEGMENT (STA. 4998+50 TO 5003+75)

Exposed Wall Height, H (ft)	Active Earth Pressure Coefficient (Equivalent Fluid Pressure in pcf)	Seismic Increment (psf)
Retaining Level Ground		
Up to 12	.30 (38)	2H
14 to 16	.30 (38)	4H
Retaining 1.5H:1V Slope and Roadway		
Up to 6	.30 (36)	3H
8	.35 (42)	6H
10	.41 (49)	9H
12	.44 (53)	10H
14	.45 (54)	11H
16	.50 (60)	11H

TABLE 5. DESIGN PRESSURES FOR WALL NO. 1, SOUTHERN SEGMENT (STA. 5003+75 TO 5009+00)

Exposed Wall Height, H (ft)	Active Earth Pressure Coefficient (Equivalent Fluid Pressure in pcf)	Seismic Increment (psf)
Retaining Level Ground		
12 to 18	.30 (38)	3H
Retaining 1.5H:1V Slope and Roadway		
12	.44 (53)	13H
14	.45 (54)	13H
16	.50 (60)	12H
18	.51 (61)	11H

4.4.4 Pile Design

The CIDH piles will be embedded in medium to stiff cohesive soils. A minimum drilled hole diameter of 24” is recommended. The on-center pile spacing is recommended to not exceed 8 ft. Wall design can follow SCRRA Excavation Support Guidelines (Sections 4.2.4 and 6.3, 2009) using a simplified approach using apparent earth pressure distributions for cantilevered walls or other approved methods. For pile design, a reduction factor of 1.5 can be applied against the passive shear strength to consider potential long-term effects.

The lateral active and passive soil resistance acting against the side of the CIDH piles can be based on soil and wall design parameters provided in Table 3 to Table 5, and Figure 3. Passive resistance is recommended to be neglected within the upper 1 ft below lowest adjacent finish soil grade 4.4.3.2. The passive pressure is applied over an effective width equal to 3 times the pile width or the pile spacing, whichever is less.

The minimum recommended embedment depth for the cantilevered CIDH piles is 1.5H where H is the exposed wall height. The pile embedment should be sufficiently deep below bottom of excavation to meet or exceed the vertical allowable design load. The axial ultimate soil capacity of CIDH pile can be calculated per the Reese method (FHWA, 2010) using:

$$R_u = 0.55 \text{ x (Undrained Shear Strength) x } \beta \text{ x (Hole Diameter) x (Pile Length)}$$

where β = 1.2 at 0 ft depth, 1.0 at 15 ft depth, 0.83 at 25 ft depth (interpolate for intermediate depths). The Reese procedure ignores skin friction in the upper 5 ft of pile, and end bearing. Apply a factor of safety of at least 2 (or LRFD resistance factor of 1/.7=1.43) to obtain allowable soil capacity. Lateral pile capacity controls the pile length. A concrete cover of 3” should be considered per Table 10.8.1.3.-1 of AASHTO (2012).

General recommendations for construction are provided Section 5.0.

4.4.5 Slopes

<u>Final Grading</u>. In the area of Wall No. 1, the existing slope gradients vary from 2H:1V to as steep as 1:1. Where gradients are steeper than 1.5H:1V, the wall is proposed to be built first then fills are proposed to be placed against the existing slopes to bring final grade to 1.5H:1V. Fills placed against sloping ground should be properly benched into the existing sloping ground and placed following Section 19-6 of the Caltrans Standard Specifications (2015), Greenbook (2015), or local code as applicable and compacted to minimum 90% relative compaction based on maximum densities determined in accordance with ASTM D-1557 or equivalent. A maximum temporary cut height of 4 ft is recommended. The cuts should conform to the existing grades to remove unsuitable soil and expose competent soil. Actual depths and extent of the required removals should be determined in the field by qualified geotechnical personnel. Design of any temporary construction slopes and shoring if required is the contractor’s responsibility during construction.

<u>Slope Stability</u>. Geotechnically, the finished slope with properly placed fills as described above and a finish gradient of 1.5H:1V or flatter are expected to be globally and surficially stable for the static and seismic condition.

Slope Protection. The finished slope face graded to 1.5H:1V requires long-term protection against surficial instability and erosion. This can include placing stable fills and/or proper erosion control measures in accordance with Section 20 of Caltrans Standard Specifications (2015) or slope paving such as Caltrans Standard Detail Sheet XS4-210. For the purpose of providing surficially stable slopes, fill soil placed within the outer 6 ft of the slope face, measured horizontally, should have a minimum friction angle of 32^o and cohesion of 125 psf. To meet these requirements, soil in the outer 6 ft of the slope face should be specified to have a fines content between 20% and 40% and a minimum Plasticity Index of 12.

Erosion control measures should include provisions for site drainage and slope planting. To minimize potential erosion, all finish slopes should be planted as soon as practical after grading. Local areas may require additional measures at the discretion of the resident engineer during construction.

4.5 RETAINING WALL NO. 2

A new permanent wall is required between Sta. 5016+01.45 and 5020+94.50 to accommodate widening of the existing R/R embankment to the western ROW line. The wall will be maximum 5 ft high and retain near-level or gently sloped embankment fills. The wall location is in relatively flat terrain. The grade elevation is near El. 210 ft. The wall will include a pocket to accommodate a future SDGE pole by others along the wall layout line.

4.5.1 Ground Condition

Borings EMI-6 to EMI-8 were drilled at feasible locations near the wall layout line. Kleinfelder (2011) borings B-7 and B-8 were also drilled in the area. Based on the borehole data, the soils consist of clayey to silty sands, and sandy clays. Groundwater was not encountered above El. 184 ft explored.

4.5.2 Foundations

For this wall, ROW is not a limiting constraint and wall heights involved are relatively short. The proposed wall will bear on loose to medium dense clayey to silty sand (SC/SM) and stiff sandy clay (CL) and retain fill soils. A battered Enviro Block Wall was chosen as the wall type as that is the most economical wall type for these design conditions. This wall can be supported on a shallow footing or pad placed on competent soils provided the following recommendations are met.

4.5.3 Design

Between the north end and Sta. 5017+50, overexcavation of minimum 3 ft relative to lowest adjacent grade is recommended and replacement with compacted granular soils to create a uniform working surface and provide adequate bearing is recommended. Between Sta. 5017+50 and the south end, a minimum overexcavation depth of 2 ft below the footing is recommended. The extent of the excavation should extend outward a distance equal to the overexcavation depth plus 1 ft.

Design of shallow foundations (footing or pad) with the minimum embedment depth as described above can be based on a maximum allowable soil bearing pressure of 1 tsf. The recommended bearing capacity is a net value and includes a factor of safety of 3. This design value can be increased by one-third for short-term loads such as wind and seismic forces. Standard construction practices will substantially reduce the potential for ground settlement. As a result, settlements under the allowable bearing value are expected to be small. The total settlement of footings at least 2 feet wide is estimated to be less than 1”.

For the design of these walls retaining drained level on-site soil or backfill, a static active lateral earth pressure equivalent to a fluid having a density of 36 pcf can be used. If the wall cannot rotate, a pressure of 55 pcf of equivalent fluid pressure is recommended. If hydrostatic pressure is anticipated, hydrostatic lateral pressure should be added. Lateral pressures resulting from surcharges/traffic behind the wall should be added as a uniform horizontal pressure calculated using a lateral earth pressure coefficient of 0.3. Surcharges that are set back behind the wall a horizontal distance greater than the exposed wall height do not need to be added to the design pressure.

Retaining walls should be designed to accommodate an incremental seismic active lateral earth pressure in addition to the static earth pressure. A seismic earth pressure increment of 8H pcf is recommended as a triangular distribution.

The closest track will be setback behind the wall LOL at least 12 to 16 ft (well more than wall design height H). Walls can be designed for a lateral earth pressure coefficient of 0.3. A minimum lateral earth pressure of 38 pcf is recommended per SCRRA Excavation Guidelines (2009). For traffic surcharge, a uniform lateral pressure should be added based on the lateral earth pressure coefficient of 0.3. The unit weight for dry (fully drained) backfill is at least 120 pcf. For seismic design, an earth pressure increment of 50 psf can be applied in a uniform distribution.

Resistance to lateral loads may be provided by frictional resistance between the bottom of the shallow foundation/pad and the underlying soils or engineered fill, and by passive soil pressure against the sides of shallow foundations/pad. Lateral sliding resistance can be based on a passive earth pressure at footing/pad of 300 pcf and should be ignored within the upper 1 ft of soil. A conservative friction coefficient between bottom of footing and soil of 0.4 can be used.

Construction. The existing embankment slopes should be cut and new fills placed against the cut properly benched into the existing sloping ground per SCRRA Standard Specifications 312000/315000 and Cal/OSHA requirements. The maximum recommended cut height is 4 ft. The cuts will be in Cal/OSHA Type C soils. Cal/OSHA requires a minimum lay back of 1.5H:1V and a maximum bench height of 4 ft. General recommendations for wall construction and the backfill are provided Section 5.0.

4.6 RETAINING WALL NO. 3

A new Wall No. 3 is proposed at the southern end of the project segment between Sta. 5037+30.44 and 5045+42.44 along the western ROW line. It is approximately 812 ft long and of variable height. Based on wall elevation plans, the maximum wall height is 7 ft. The wall LOL is at the toe of the raised R/R embankment and the ROW border a fenced-in private property. The track centerline is set back behind the wall LOL about 9.5 ft. The wall will include two pockets to accommodate future SDGE poles by others along the wall layout line.

4.6.1 Ground Condition

Boring EMI-9 was drilled in the area of the wall layout line. Borings EMI-10 and EMI-11 were proposed inside private property but access was not allowed for drilling. Hand-auger borings have been proposed to verify the ground conditions shown in Kleinfelder borings B-11 to B-12 off the east side of the R/R corridor. Based on the available borehole data, the soils above El. 190 ft (south half) to 192 ft (north half) are compressible sandy silt and clay soils. The soils below those levels are predominantly silty sand with some gravel and silt layers. GWE was 180 ft in boring nearest the north end of wall. Groundwater was not encountered in the borings above El. 175 ft explored. Wall heights are moderate with a maximum height of approximately 9 ft.

4.6.2 Foundations

The wall will retain embankment fill and lateral pressures due to track (if any) and seismic earth pressures. Modular Block Walls are not suitable and not recommended.

The available workspace for wall construction is significantly constrained by the presence of the active mainline track on one side and the ROW on the other side. Wall types considered were gravity wall (T-Wall), soldier pile, and Enviro Block Walls. Enviro Block wall was found to be the most economical alternative with 4V:1H batter. Soldier pile and T-Walls can be installed vertical and maximize the available ROW. The cost is comparable. However, Section 20.6 of AREMA (2016) does not recommend permanent cantilevered walls to be used that retain track. Installation of tiebacks to a soldier pile and lagging wall will be difficult since only 18” is available from wall face to ROW limit and temporary construction easements are not available for conventional tieback installation with rigs operating in front of the wall face. In addition tiebacks increase the cost. Therefore, a T-Wall was selected for Wall No. 3. If a deviation from the Section 20.6 of AREMA is granted by OCTA in the future, a cantilevered soldier pile wall may also be a suitable alternative.

Cantilever wall and soldier pile wall types were considered and evaluated but not selected due to limited room for construction access in view of limited ROW. The T-Wall® type with cast-in-place concrete wall facing was selected and is feasible provided the requirements provided herein are met. This type of wall is a precast reinforced concrete modular wall system. This wall type is constructed by stacking the individual units and then backfilling around the units with Select backill. Each unit consists of a face and a stem that extends into the backfill. External and internal stability (bearing and settlement) will be designed by the wall manufacturer.

The T-wall is to be placed on competent soil. Overexcavation of minimum 2 ft deep below the wall base and replacement with a pad of compacted granular soils is recommended throughout the entire length of wall. An overexcavation bottom of El. 190 ft (or deeper) north of Sta. 5041 and 188 ft (or deeper) south of that station is recommended. The overexcavation should extend laterally a minimum of 2 ft on all sides and replaced with structural granular backfill compacted to least 90% relative compaction based on maximum densities determined in accordance with

ASTM D-1557 or equivalent. The intent of the overexcavation is to completely remove existing compressible soils and to create a suitable bearing pad for the T-wall and CIP wall.

4.6.3 Design

The underlying foundation soils underlying the overexcavation can be assumed to be sand with a unit weight of 120 pcf and an internal friction angle of 32^{o}.

The maximum allowable soil bearing capacity for a structural fill base pad 15 ft wide with a bottom 4 ft below lowest adjacent ground is 2 tsf at the base of the unit. The recommended bearing capacity is a net value and includes a factor of safety of 3. This design value can be increased by one-third for short-term loads such as wind and seismic forces. The estimated maximum total settlement of the base at least 15 ft wide is 1”.

Lateral pressures against the wall faces in contact with soil consist of active static and seismic earth pressures behind the wall, pressures from any temporary or permanent (traffic) surcharges, pressures from existing adjacent structures, and hydrostatic pressures if dewatering is allowed to build up behind the walls. Static earth pressure can be based on an active earth pressure of 0.3 for walls that are allowed to rotate, and 0.5 for walls that are rigid. If the walls are impacted by any other lateral pressures, those loads should be added. These applied wall pressures are equivalent fluid pressures. The unit weight for dry (fully drained) backfill is at least 120 pcf. An incremental seismic earth pressure of 50 psf can be used in a uniform distribution.

Lateral resistance is provided by friction at the bottom of the footing and passive resistance against the side of the footing. A frictional coefficient of 0.4 and a maximum allowable passive soil resistance of 300 pcf are recommended for design. Passive resistance can be based on an earth pressure coefficient of 3.25 but is recommended to be ignored in the upper 18” below finished grade and where future excavations might occur. A one-third increase in the passive pressure is permitted for wind and seismic loads. Friction and passive resistance may be combined without reduction.

The leveling concrete pad supporting the CIP wall is recommended to be at least 1 ft wide and embedded at least 0.2H deep below lowest adjacent grade where H is the height of wall. The leveling pad should be placed on the granular fill base. The allowable bearing capacity of the leveling pad meeting these requirements is 0.75 tsf.

4.7 MAIN CULVERT EXTENSION AT MP 194.6

The existing main channel crossing at MP 194.6 consists of a 3-span timber trestle structure supporting the two existing tracks. The structure is proposed to be removed and a new reinforced concrete box structure placed. The structure consists of a 7’9” wide single cell box approximately 14 ft long, that attaches to a 11-ft wide transition section at the west end and a double-cell “U” transition box at the east end with a maximum width of about 21 ft. The transition structures will connect with the existing buried culvert structures at the west and east ends. The bottom of the culvert base slabs vary from approximately El. 209’6” at the west end to El. 204’ at the east end.

The reinforced concrete box structures will be designed according to SCRRA Design Criteria (2010). The designer indicated that the available time window for construction is targeted to be approximately 30 to 48 hours.

4.7.1 Ground Conditions

The existing crossing consists of an open channel with an invert near El. 211 ft. The adjacent ground surface varies from approximately El. 216 ft at the east side to 220 ft at the east side. Based on EMI's new boring EMI-1 drilled near the east end of the crossing, EMI-2 at the west end, and Kleinfelder boring B-5, the site is underlain by moist clayey sands (El. 216 to 211 ft) at the west and east side (El. 220 to 215 ft, followed by moist cohesive compressible soils, mostly medium stiff to very stiff lean clays with variable amounts of sands, down to El. 140 ft.

Groundwater was encountered at 19 ft depth at Boring EMI-2 and 33 ft in EMI-1 on January 20, 2016. Groundwater was also encountered at 12.5 to 14.5 ft depth in Kleinfelder boring B-4 approximately 600 ft encountered north in 2011. The groundwater research study in the Kleinfelder report concluded with groundwater depths in the 5 ft to 20 ft range in the project area. A groundwater elevation of 197 ft was used for design.

4.7.2 Foundations

The new culvert will carry external loads from the soil/ballast fill and transient train loads at the top, lateral pressures on the sides, and internal stormwater pressure. The loads considered were culvert dead weight, assumed 1 ft of sustained storm water, backfill up to El. 220.5 ft, and 1.5 ft of ballast materials.

The existing medium stiff soils underlying the structures are compressible and not suitable to bear on directly. The bearing pressures caused by the above loads will result in excessive settlement. The train loading is transient in nature. The application of loads including train passes during the 30-48 hours construction window is by far too short a time frame to cause a significant portion of this settlement to occur.

As a result, two design approaches were considered:

(1) <u>Lightweight Cellular Concrete (LCC) Option</u>: A combination of overexcavation below the culvert structure and LCC backfill is used to balance the vertical loads against the existing soil deadweights. This approach is intended to result in nil or minor ground settlement due to permanent loads. This design requires an overexcavation a minimum of 3 ft deep below the main culvert and west section, and a minimum 2 ft below the east "U" section. This proposed overexcavation does not require a settlement period and ground monitoring is considered optional. The culvert can be loaded as soon as construction is completed. The bottom of the overexcavation is recommended to be level and extended 3 ft out laterally beyond the extents of the base of the structures where feasible. The excavation should extend laterally at least to existing bridge limits. Poured LCC or precast LCC blocks can be used (see Section 4.7.3). If poured LCC is used, construction needs to allow sufficient curing time before loading the LCC.

(2) <u>Granular Fill Option</u>: A smaller overexcavation of minimum 3 ft below the existing grade and minimum 2 ft below culvert bottom to remove unsuitable shallow soils and to create a

bearing pad for the culvert structures, followed by placement of compacted granular soil fill. The placement of additional overburden materials to fill the present void will result in estimated average ground settlements of 4.5 to 6” in the deep fill area and 3” at the north and south extents of the area. These settlements were estimated based on four (4) consolidation tests on clay samples and are expected to occur over an estimated period of 5 years. This option will require design of the culvert structure for ground settlements as well as post-construction settlement monitoring and periodic track re-leveling during this period of time as necessary until settlements have subsided.

4.7.3 Design

Main Culvert Structure

Structural design should consider the largest possible total weight of the materials acting on the roof of the structures following applicable SCRRA Design Criteria (2010) including total dead weight of overburden materials and surface loads.

For finite-element modelling of the structure bearing on LCC and soil, a vertical subgrade modulus of 75 kcf per 1x1 ft square base area can be used.

For the LCC option, the LCC fill requires a minimum unconfined compressive strength of 30 psi at the time when the material is first loaded. Prefabricated interlocking LCC blocks and cast materials with rapid set using an accelerator agent may be used. Typical LCC materials such as Elastizell®, Aerix®, and Throop Cellular® fills have a cast density of 30 to 36 pcf. A permanent minimum lateral design earth pressure of not less than 30 pcf equivalent fluid pressure is recommended. A seismic earth pressure increment equal to 2.5H psf (where H is the height of wall) is recommended with a triangular distribution. Continuous track will be placed in a bed of minimum 2.1 ft of ballast materials. Based on the design elevation plan, the lowest culvert structure bottom is about 208 ft. The bottom of overexcavation is assumed at El. 205 ft at the central culvert and east segment a minimum of 14 ft wide. The proposed fill placement is designed to result in zero net settlement. As a result, if the project is properly constructed, settlement monitoring is optional at this location.

For the granular fill option, lateral earth pressure should consider the following. Lateral pressures from earth fill and surcharges/traffic can be based on at-rest earth pressure coefficients (K_o) of 0.5 for granular soil backfill and existing clayey sand, and 1.0 for existing clay soil. A seismic earth pressure increment equal to 8H psf is recommended with a triangular distribution. After construction, settlement monitoring is recommended and periodic track re-leveling should be conducted as required. Estimated total and differential ground settlements due to the granular fill option averaged over the length of the excavation along track are shown in Table 6.

TABLE 6. ESTIMATED GROUND SETTLEMENTS AT MAIN CULVERT EXTENSION, MP 194.6

Time After completion of Fill (Months)	Estimated Average Settlement (in)	Estimated Average Differential Settlement (in)
1	1	1
2	1-1/2	1/2
3	2	1/2
6	2-3/4	3/4
12	3-3/4	1
24	4-3/4	1
36	5-1/2	3/4
48	5-5/6	1/3
60	6	1/6

For either option, the cuts should be laid back and properly benched into the existing sloping ground per SCRRA Engineering Standard ES 312000/315000 and Cal/OSHA requirements. The maximum recommended cut height is 4 ft. The cuts will be in Cal/Osha Type B soils. Cal/OSHA requires a minimum lay back of 1:1 and a maximum bench height of 4 ft. General recommendations for wall construction and the backfill are provided Section 5.0. Recommendations for corrosion protection are provided in Section 4.3.3.

U-Wall Design

The proposed extension includes a U-section at the west end that includes up to 11.5-ft tall reinforced concrete cantilever walls with lengths of about 15 ft and 23.5 ft. These walls are subject to pressures from earth and traffic loads. Earth pressures due to additional surcharges above top of wall were determined using the elastic stress (Boussinesq) method following AREMA and Section 5.1 of the SCRRA Excavation Guidelines (2009) for rigid walls. At this location, the Passing Siding, Mainline, and Spur Tracks will be on concrete ties embedded in 1.5 ft of ballast above top of wall elevation.

The three tracks were modeled as 8’3” wide Cooper E-80 strip loads (1,940 psf) with 100%, 100% and 50% utilization (respectively) following Section 5.2 of the SCRRA guidelines. Elastic stresses from each of these four loads were determined with respect to two lateral directions (perpendicular to track and parallel to track), then combined to obtain the pressure component acting normal to each wall. Table 7 shows the resulting lateral design earth pressures on the walls. The proposed wall structure is outside the influence zone of the west track as defined in Figure 2-1 of the SCRRA guidelines. Pressures at intermediate depths can be interpolated.

TABLE 7. DESIGN PRESSURES DUE TO SURCHARGES AT MAIN CULVERT EXTENSION, MP 194.6

Depth Below Top of Walls (ft)	Lateral Design Earth Pressure	
	Northwest U-Wall (psf)	Southwest U-Wall (psf)
0	0	0
1	30	72
2	60	142
4	118	270
6	173	379
8	223	465
10	266	531
11.5	295	568

4.8 CULVERT EXTENSIONS AT STA. 4972+95.2 AND 5017+45.62

Culvert extensions will be required at Sta. 4972+95.2 and 5017+45.62 to accommodate the widened embankment. Concrete head walls with wing walls tied into the adjacent battered modular block walls are being considered.

4.8.1 Extension at Sta. 4972+95.2

The proposed culvert extension is located at the east side of the railroad embankment. The existing wood head wall and wing wall is to be removed and the 24” RCP will be extended. The proposed reinforced concrete structure consists of a head wall approximately 7.5 ft tall and two short flared wing walls. The foundation consists of a 5.5 by 16 ft level concrete spread footing.

Wall Design

For design of the three walls, the static and seismic design parameters given in Section 4.5.3 can be used. Earth pressures due to additional surcharges were determined using the elastic stress (Boussinesq) method following AREMA and Section 5.1 of the SCRRA Excavation Guidelines (2009) for rigid walls. The Mainline track on wood ties (after relocation to the east side of the embankment) was modeled as a 9-ft wide Cooper E-80 strip load (1,780 psf). The new west Passing Siding track on concrete ties was represented as a similar load spread 8'3" wide (1,940 psf) on a 6” thick pad of ballast (above top of wall elevation). Elastic stresses from each load were determined with respect to two lateral directions (perpendicular to track and parallel to track), then combined to obtain the pressure component acting normal to each wall. Table 8 shows the resulting lateral design earth pressures on the head wall due to both tracks at 100% utilization per Section 5.2 of the SCRRA guidelines. The proposed wall structure is outside the influence zone of the west track as defined in Figure 2-1 of the SCRRA guidelines. Pressures at intermediate depths can be interpolated.

Foundation Design

The new spread footing will be at least 5.5 ft wide and buried below the invert of the RCP (embedment is assumed 5 ft below finish grade). For this footing, a maximum allowable soil bearing pressure of 1.5 tsf can be used provided the recommendations below are addressed. The recommended bearing capacity is a net value and includes a factor of safety of 3. This design value can be increased by one-third for short-term loads such as wind and seismic forces.

Based on Boring B-2 (Kleinfelder, 2011), excavation for the footing is expected to expose shallow sand and medium stiff to stiff sandy clay. The boring encountered high perched groundwater June 13, 2011 between 8 ft (initially) to 14 ft depth (El. 219 ft) below existing grade. Based on this observation, there is a potential that the excavation for the proposed footing construction may expose groundwater. Overexcavation of at least 18” of existing soils below the footing bottom elevation is recommended. The extent of the excavation should extend at least 18” laterally outward from the proposed footing edges. The overexcavation should be inspected, lined with filter fabric on all sides, and filled with self-compacting (open-graded) rock material. The purpose of the overexcavation and replacement is to create a uniform working surface and to reduce ground settlements due to the allowable bearing pressure to 1”. The headwall design should allow for differential settlements between pipe and wall structure. Sections 5.2, 5.3 and 5.4 provide further construction recommendations for dewatering, overexcavation, and fill materials. Recommendations for corrosion protection are provided in Section 4.3.3.

Resistance to lateral loads may be provided by frictional resistance at the bottom of the footing and passive soil pressure against the sides of the footing. Passive earth pressure can be based on 300 pcf and should be ignored within the buried portion of headwall and at least the upper 1 ft and in consideration of possible future excavation. A frictional coefficient at the bottom of footing of 0.35 is recommended.

4.8.2 Extension at Sta. 5017+45.62

This extension is located at the west side of the railroad embankment within the extents of proposed Wall No. 2. The existing wood wall will be removed and the 24” CMP will be extended. The new extension consists of a box-like reinforced concrete structure with an L-shaped headwall approximately 7 ft tall and two transverse wing walls that will join Wall No. 2. The foundation consists of an approximately 8 by 10.5 ft level concrete spread footing.

Wall Design

For design of these walls, the static and seismic design parameters given in Section 4.5.3 can be used. Earth pressures on the walls due to the same two track loads and 1.5 ft of ballast under both tracks were determined similarly as in Section 4.8.1. Table 8 shows the design earth pressures for both tracks at 100% utilization per Section 5.2 of the SCRRA Excavation Guidelines (2009). The proposed wall structure is located outside the 1.5H:1V influence zone of the east track as shown in Figure 2-1 of the SCRRA guidelines. Pressures at intermediate depths can be interpolated.

Foundation Design

The spread footing will have a minimum width of 8 ft and approximately 3.5-ft of embedment below finished grade. Based on these dimensions, a maximum allowable soil bearing pressure of 1 tsf is recommended. Settlements due to the allowable bearing value are estimated to be about

1”. The recommended bearing capacity is a net value and includes a factor of safety of 3. This design value can be increased by one-third for short-term loads such as wind and seismic loads. Passive earth pressure and sliding coefficient as in Section 4.8.1 can be used.

Based on boring EMI-6 (see Appendix A), excavation for footing construction is expected to expose silty sand and stiff sandy clay soils. Groundwater was not encountered within 25 ft of the existing grade during the field investigation on August 24, 2015. Standard construction practices will substantially reduce the potential for ground settlement. Overexcavation of existing soils and replacement with compacted granular soils can be performed to create a uniform working surface and reduce ground settlements. The recommended extents of the excavation is at least 1 ft below footing bottom and 1 ft outward from the footing edges. Refer to Sections 5.2 and 5.4 for further construction recommendations for overexcavation and fill materials. Recommendations for corrosion protection are given in Section 4.3.3.

TABLE 8. DESIGN PRESSURES DUE TO SURCHARGES AT CULVERT EXTENSIONS, STA. 4972+95.2 AND 5017+45.62

Depth Below Top of Head Wall (ft)	Head Wall			Wing Walls (psf)
	Due to Mainline Track (psf)	Due to Passing Siding Track (psf)	Due to Both Tracks (psf)	
Culvert Extension at Sta. 4972+95.2				
0	0	0	0	0
1	280	35	315	243
2	503	68	571	461
4	703	132	835	769
6	681	185	866	912
8	580	225	805	950
9	524	240	764	947
10	469	252	721	935
Culvert Extension at Sta. 5017+45.62				
0	0	0	0	0
1	31	181	212	68
2	63	340	403	135
4	122	556	678	257
6	172	634	806	357
8	213	620	833	433
9	231	593	824	462
9.5	238	577	815	475
10	244	560	804	487

4.9 PAVEMENT STRUCTURAL SECTION

A portion of Camino Capistrano roadway is to be filled to raise finish grades by approximately 2.5 ft. The proposed street improvement is expected to be constructed with a flexible (asphalt concrete) composite pavement structural section. The pavement structural section will be underlain by native soils and compacted fills.

4.9.1 As-built Pavement Structural Sections

The City of Laguna Niguel reported that the former El Camino Real roadway that is now buried beneath the existing roadway was a Portland cement slab about 10” thick and that City had no As-built plans.

Per HNTB’s request, a shallow boring (EMI-11A) was drilled in the roadway at the intersection of Camino Capistrano with Rancho Capistrano. The location was in the middle lanes to determine existing concrete slab depth and thickness. Based on the boring, the existing pavement section consists of 2” of asphalt concrete and 11” on concrete. The base soil is a moist to wet, lean clay with sand and low to medium plasticity fines. A second boring (EMI-12A) was drilled in the shoulder to verify existing soil conditions outside the concrete pavement section. This boring encountered 6” of silty sand fill over the same lean clay as described above.

In addition, borings EMI-1, EMI-3, and EMI-5 were drilled along the west shoulder of southbound Camino Capistrano. All three borings encountered the concrete pavement as well. Boring EMI-l also encountered a second slab of 9” thick concrete at 11.5 ft depth. Boring EMI-3 also encountered concrete at some depth; however it could not be drilled out.

The pavement cores encountered in the four borings are summarized in Table 9 in order from north to south.

TABLE 9. AS-BUILT PAVEMENT STRUCTURAL SECTIONS

Boring No.	Station (ft)	Offset (ft)	GSE (ft)	Existing Pavement Structural Section
EMI-11A	4980+77	50 Lt.	225	2” AC / 11” Concrete
EMI-1	4994+70	60 Lt.	221	6.5” Concrete At Surface 9” Older Concrete at 11.5 ft Depth
EMI-3	5001+82	58 Lt.	233	8” Concrete
EMI-5	5008+12	60 Lt.	239	8” Concrete

4.9.2 New Pavement Design

A total of four (4) bulk soil samples of shallow existing (subgrade) soils along the Camino Capistrano roadway alignment between Rancho Capistrano and near the south end of Wall No. 1 were tested to determine their R-value. Particular focus was placed on compressible soils which can control pavement design. The measured R-values are tabulated in Table 10 in order from north to south.

TABLE 10. R-VALUE TEST RESULTS

Boring No.	Station (ft)	Offset (ft)	GSE (ft)	Sampling Depth (ft)	R-Value
EMI-12A	4980+72	30 Lt.	225	Silty Sand (Fill)	49
EMI-11A	4980+77	50 Lt.	225	Sandy Silt (Subgrade)	20
EMI-1	4994+70	60 Lt.	221	Sandy Clay With Gravel (Subgrade)	11
EMI-5	5008+12	60 Lt.	239	Clay With Sand (Subgrade)	9

The high R-value of 49 was obtained on a shallow fill soil sample at the shoulder of the road at the Rancho Capistrano T-intersection. The other three values of 20, 11, and 9 are from subgrade soils samples below the existing pavement. A minimum design R-value of 10 was used as shown in Table 9 for preliminary design of new structural pavement sections. The subsequent pavement design to raise existing grades by 2.5 ft requires that the existing pavement section be removed and the new section be placed on existing material represented by the design R-value.

TI values were not available and a range of traffic indices was assumed for the new roadway and a 20-year design period. New flexible and rigid structural pavement sections were determined in accordance with Chapter 630 and 620 of the Caltrans Highway Design Manual (2012b), respectively. The resulting recommended pavement structural sections are given in Table 10. The rigid pavement sections shown are for doweled pavement based on “No Lateral Support” since the outside edge of the pavement is not structurally tied to an adjacent pavement.

General recommendations for pavement construction are provided Section 5.7.

TABLE 11. RECOMMENDED PAVEMENT STRUCTURAL SECTIONS

Traffic Index	Undrained Pavement Structural Sections		Rigid Section Thicknesses
	Minimum Design R-Value	Flexible Section Thicknesses	
8.5	10	0.45’ AC / 1.60’ AB	.75’ JPCP / 1.00’ AB
9.0	10	0.45’ AC / 1.75’ AB	.75’ JPCP / 1.00’ AB
9.5	10	0.50’ AC / 1.85’ AB	.80’ JPCP / 1.00’ AB
10.0	10	0.50’ AC / 1.95’ AB	.80’ JPCP / 1.00’ AB
10.5	10	0.55’ AC / 2.05’ AB	.85’ JPCP / 1.30’ AB
11.0	10	0.55’ AC / 2.20’ AB	.85’ JPCP / 1.30’ AB

Notes: AC = Hot-Mix Asphalt Type A per City Standards
AB = Class-2 Aggregate Base per Section 26 of Caltrans Standard Specifications
JPCP=Jointed Plain Concrete Pavement

4.9.2.1 Camino Capistrano Roadway at Rancho Cucamonga Drive

Based on design plans (see Appendix C) and borehole EMI-11A (Table 9), an approximately 670-ft long roadway segment of the present Camino Capistrano located at the T-intersection with Rancho Cucamonga Drive includes flexible and rigid pavement structural sections. The PCC section is approximately 20-ft wide and was proposed to be removed to accommodate construction of the proposed new pavement sections. To meet WQMP requirements, total removal of the existing pavement section within the site area was not allowed by the City of San Juan Capistrano. To accommodate this requirement, the designer proposes to raise finish grades by up to approximately 3 ft at the center of this area and join existing/final grades at the north and south limits of the roadway segment.

To conduct special pavement design for this segment, a site reconnaissance visit was conducted by LaBelle-Marvin, Inc. (LBM) of Santa Ana on June 7, 2018 to assess the site conditions and pavement condition of the existing AC pavement and to verify structural requirements at planned grade contacts. The evaluation was based on existing information and no additional borings or testing was conducted.

The existing concrete section was assumed to be 2” AC Type A per City Standards over 11” of PCC for the entire length of the segment. The existing adjoining pavement sections along the west and east sides of the concrete section were assumed to be 5” AC over 12” aggregate base based on information provided by the designer. The design was performed assuming the design R-value and flexible pavement structural section provided in Table 11 and a design TI of 10 provided by the City. LBM's site observations, design assumptions, evaluation and recommendations for pavement design and construction are provided in Appendix C.

5.0 CONSTRUCTION RECOMMENDATIONS

5.1 EARTHWORK

Earthwork should be performed in accordance with requirements of the SCRRA Engineering Standards (ES) and Standard Specifications, Standard Specifications for Public Works Construction (Greenbook, 2015), and local building code, and any other applicable code. Excavations and cuts should be inspected during grading. Areas to receive fill should be cleared of all vegetation, debris, loose or soft soils, and any other deleterious material to expose a firm and unyielding ground surface.

On-site materials can be excavated using conventional heavy-duty earth-moving equipment. Excavations and any compacted fill placed for the project should be observed, monitored, and tested by qualified geotechnical personnel during grading. Field and laboratory tests should be conducted in accordance with ASTM methods as specified in the Greenbook and any other applicable testing requirements such California Test methods.

For unsupported cuts in existing soils, the recommended maximum gradient should not exceed 1H:1V in Cal/OSHA Type B clay soils and 1.5H:1V in Cal/OSHA Type C sand soils. The cut face should be protected from weathering and surficial erosion. Qualified geotechnical personnel should inspect temporary cuts and backslopes for erosion and sloughing, and temporary shoring for signs of instability and deformations, during construction on a frequent (daily) basis. Soil or other construction materials should not be stockpiled adjacent to excavations. Stockpiles should be set back a minimum distance which is equal to the height of the excavation. Shoring should be designed for site-specific conditions using input from qualified geotechnical personnel during construction.

Appropriate measures should be taken to prevent damage to adjacent existing structures and utilities. Temporary excavations must be properly cut, sloped or shored in accordance with all applicable codes and regulations including OSHA standards. Any design and construction of temporary sloping, sheeting, or shoring should be made the contractor’s responsibility. Design of a shoring system can be conducted with input from a geotechnical engineer. No excavation should be performed below an imaginary plane inclined at 1:1 from the edge of any existing foundation and other structures including roadways without providing adequate support for the existing foundation. The contractor is responsible for worker safety in the field during construction. The contractor shall conform to all applicable occupational safety and health standards, rules, regulations, and orders established by the State of California. In addition, other State, County, or Municipal regulations may supersede the recommendations presented in this section. If a trench shoring design and safety plan is required, the geotechnical consultant should review the plan to confirm that recommendations presented in this report have been applied to the design.

All temporary excavation support should be designed by the contractor meeting SCRRA Engineering Standards, Cal/OSHA, and all other applicable codes. For temporary excavations, a maximum unshored cut height of 4 ft is recommended, otherwise shoring with structural bracing or ground anchors should be considered to support excavations.

5.2 DEWATERING

Based on groundwater findings as described in the Kleinfelder report (2011), perched groundwater should be expected to be encountered during excavation between 10 and 30 ft depth, and construction dewatering is anticipated. The contractor should be prepared to control any groundwater encountered during construction.

5.3 OVEREXCAVATION AND RECOMPACTION

Overexcavation may be required in certain areas to stabilize the bottom of new construction. For new footing construction, the horizontal limits of overexcavation (if any) should generally extend laterally from the footing edges outward a distance equal to 1 ft plus the overexcavation depth, unless stated otherwise.

The exposed bottom of any overexcavation should be inspected by qualified geotechnical personnel prior to placement of engineered fill to ensure that competent and unyielding subgrade has been exposed and that no additional overexcavation is necessary. Proof-rolling can be used to verify that the ground is firm and unyielding. If voids resulting from the removal of vegetation/trees or buried structures are exposed at the overexcavation limits, they should be overexcavated to a depth exposing firm and competent soil.

Should the excavation bottom expose unsuitable soil or pumping conditions, they should be removed to expose firm and competent soil a minimum of 12” below the specified excavation bottom. Permeable woven filter fabric should be placed on the exposed subgrade and granular backfill should be placed on the fabric up to the specified excavation bottom. The backfill material can be using granular soil having an SE of at least 30, aggregate base, or clean open-graded clean rock (maximum size of 1” and maximum 2% fines). If rock is used, it should be wrapped on all sides with permeable overlapping woven fabric. The intent of the fabric is to prevent intrusion of the underlying soil into the void of the rock materials over time. Structure foundation design can make use of friction between the footing base and rock material, and passive soil resistance against the sides of the rock base.

Prior to placing engineered fill on competent soil, the exposed bottom of overexcavations is recommended to be scarified to a minimum depth of 6”, conditioned as necessary to achieve near-optimum moisture content, and recompacted in-place to at least 90% relative compaction based on maximum densities determined in accordance with ASTM D-1557 or equivalent.

The granular (structure) backfill should be placed as described in Section 5.4.

5.4 FILL MATERIALS

Backfill should meet applicable SCRRA standard specifications. Fill material should not contain organic material, rocks greater than 4” in greatest dimension, debris and other deleterious materials, and be non-corrosive. All soils should be tested and approved by a geotechnically qualified person. Import soils are recommended to be tested and approved prior to delivery to the project site. On-site soil should only be re-used for fill provided all applicable requirements for fill in the Greenbook (2015), or SCRRA Standard Specifications as appropriate, are met.

Fill should be placed in uniform horizontal loose lifts not exceeding 8” in thickness, moisture-conditioned to near-optimum moisture content, and compacted to at least 90% relative compaction. If hand-directed mechanical tampers are used for compaction, the loose lift thickness should not exceed 6”. Observation, probing, and testing must be performed by qualified geotechnical personnel to verify the degree of compaction.

Any compacted fill placed for the project should be observed, monitored, and tested by qualified geotechnical personnel during grading. Field and laboratory tests should be conducted in accordance with ASTM or equivalent and any other applicable testing requirements.

Areas to receive fill should be cleared of all existing vegetation, debris, loose or soft soils, dry or wet materials, and any other deleterious material to expose a firm and unyielding ground surface. Fills placed against existing, undisturbed soil should be properly keyed and benched per current SCRRA Engineering Standards and Greenbook (2015). A minimum overexcavation of 2 ft is recommended within all areas to receive compacted fill unless stated otherwise. Where applicable, the overexcavation is recommended to extend horizontally a minimum distance of 2 ft from edges of new fills or structures. Actual depths and extent of the required removals should be determined in the field by qualified geotechnical personnel. Excavation bottoms should be firm and unyielding prior to fill placement.

Areas that are excavated below finish grade or that are disturbed by construction activities should be overexcavated to a depth where undisturbed material is exposed. Finish grades should be reestablished using fill properly compacted to a minimum of 90% relative compaction.

Materials used to backfill trenches for utilities should be placed in accordance with applicable SCRRA engineering standards or otherwise Section 306 of the Greenbook (2015). Per Greenbook, bedding material supporting, surrounding, and extending 1 foot above the top of the pipe should be sand, gravel, crushed aggregate, or existing free-draining material having a sand equivalent (SE) of at least 30. Bedding material should be placed on a firm and unyielding subgrade so that the pipe is supported for the full length of the barrel. The trench bottom should be inspected prior to placement of bedding material to ensure that a firm and unyielding subgrade is exposed. If the subgrade is soft, loose, spongy, or unstable, the unsuitable subgrade soil should be overexcavated and replaced with compacted bedding material. For backfilling the trench above the bedding material per Greenbook, native soil is considered suitable. When there are conflicts between trench backfill requirements and requirements for pavement subgrade, the more stringent requirements should apply.

5.5 PILES

CIDH piles for Wall No. 1 should be constructed in accordance with applicable SCRRA specifications or otherwise Section 49-4 of the Caltrans Standard Specifications (Caltrans, 2010) and any other applicable specifications.

Groundwater was not encountered during exploratory soil borings at Wall No. 1 above El. 188 ft. Groundwater is not expected to be encountered during construction below this elevation. However, based on the groundwater findings as described in Section 4.4.1, perched groundwater may exist locally and groundwater levels can fluctuate due to natural or and man-made causes and could be different during the time of construction. There is a potential to encounter groundwater during construction. As a result, the Contractor should be prepared to deal with moist soil or perched groundwater conditions during drilling and construction of CIDH piles. Should standing water or seepage be encountered, the hole should be protected from caving. Means and method can consist of temporary casing twisted/pushed tight against soil and construction using the water or slurry displacement method. An alternative option is to locally dewater the hole, and construct in the dry.

Soil caving may occur during drilling in the granular soils. Contractor should be prepared to deal with local caving should it occur. The contractor should have the means to control them such as temporary casings. If casing is used, the vibratory technique for casing installation may be used. Temporary casing should be placed tight in the borehole. The casing should be pulled as the concrete is being poured. In the event that any boring becomes bell-shaped and cannot be advanced due to severe caving, all loose material should be removed from the bottom of the boring and the caved region filled with a low-strength sand-cement slurry. Drilling may continue when the slurry has reached its initial set.

Loose soils should be cleaned from the bottom of the borings. Pile borings should be inspected and approved by the geotechnically qualified person prior to the installation of reinforcement. Care in drilling, placement of steel, and the pouring of concrete will be essential to avoid excessive disturbance of pile boring walls. Bottom clean-out of drilled shafts constructed using the wet method should be verified per qualified personnel. The pile reinforcing cage should be installed and the concrete pumped immediately after drilling is completed within the same work shift. No pile boring should be left open overnight. No boring should be drilled immediately adjacent to a neighboring pile as shown on the Foundation Plans until the concrete in the other pile has attained its initial set.

5.6 WALLS

Concrete footings at shallow depths can be placed directly on competent undisturbed natural granular soils. The footing subgrade should be observed by qualified geotechnical person to be firm and unyielding. If unsuitable natural soils are exposed, including existing fills that are loose and uncompacted, or exposed soils are clayey, they are recommended to be excavated a depth of at least 2 ft unless noted otherwise and replaced with properly compacted granular fill. The fill may need to be extended down to undisturbed dense natural soils. Alternatively, the designer or Contractor may choose to overexcavate and place a working pad of open-graded clean rock material wrapped in woven filter fabric.

Backfill should be performed in accordance with applicable SCRRA standard specifications, Greenbook (2015), and local building code. Where conventional backfill and compaction operations are not practical or feasible due to limited space, sand-cement slurry or pea gravel, or other selected backfill may be used. Sand-cement slurry should consist of at least 1½ sack of cement per cubic yard. Pea gravel or other materials should be placed and compacted using vibratory or mechanical equipment under the supervision of a geotechnically qualified person. Jetting or flooding to compact backfill is not recommended to be used. Heavy compaction equipment, such as vibratory rollers, dozers, or loaders, should not be used adjacent to the walls in order to avoid damaging the walls due to large lateral earth pressures.

The void between back of a soldier pile and lagging wall and existing cut soil should be filled with pervious granular sand, stone, or lean mix.

The wall design pressures assume no hydrostatic forces behind the wall (e.g., no standing water in the backfill material). The backfill should be granular in nature. Walls should have a drainage system be installed behind the walls to relieve hydrostatic pressure. Where walls will be backfilled, continuous geocomposite drain strips or filter fabric against rock backfill or soil, wrapped drain pipe behind the wall should connect to weepholes in the bottom of the wall above finished grade, or PVC collector drains via manufactured drain grates. Waterproofing behind the walls should be considered. In cut sections (soldier pile wall), free-draining material such as crushed rock can be used for backfill and collect water to weep holes using a detail that does not allow silt to enter into the collector pipe. Wall drains could consist of a 4-inch diameter, perforated Schedule 40 PVC pipe enclosed in one square foot of gravel per lineal foot of wall wrapped in a geo-fabric, or equivalent, should be provided behind the retaining wall to remove excessive water. If the wall retains sloping ground, surface drainage such as a V-ditches on top of the wall should also be considered to guide water away from the wall.

5.7 PAVEMENT

Subgrade soil for roadway pavement should have the minimum design R-value used in Section 4.9.2.

The method of placement of the new pavement structural section will depend on the thickness of the new section and City’s preference and direction. If the new section is too thick for an overlay, grinding down or complete removal of the existing pavement will be required. If overlay is desired and per City direction, the existing pavement is usually subjected to a Crack-And-Seat procedure to break up and work/vibrate the pavement into the subgrade prior to placing the overlay. Related details are beyond the scope of this geotechnical report and should be directed to a pavement rehabilitation specialist/contractor.

Subgrade should be inspected and tested by qualified geotechnical personnel during grading to verify the design R-value, and the required minimum relative compaction. Materials and construction methods for pavement sections and subgrade preparation should conform to City and Greenbook requirements. Final grading and placement of the structural pavement sections is recommended to be performed at the end of construction in order to minimize potential distress to the pavement and buried utilities due to soil settlement and/or repeated passage of heavy construction equipment.

5.8 REVIEW OF CONSTRUCTION PLANS

Recommendations contained in this report are based on current design plans. The geotechnical consultant should review the final construction plans and specifications in order to confirm that the general intent of the recommendations contained in this report have been incorporated into the final construction documents. The recommendations contained in this report may require modification or additional recommendations may be necessary based on the final design.

5.9 GEOTECHNICAL OBSERVATION AND TESTING

It is recommended that qualified geotechnical personnel perform inspections and testing during the following stages of construction:

- Grading operations, including excavations and compacted fill placement,
- Temporary cuts and shoring installation,
- Removal or installation of support of buried utilities or structures,
- Pile drilling prior to placement of steel reinforcement and pile installation,
- Footing excavations,
- Wall foundation,
- Backdrain installation and backfilling of walls,
- Preparation of pavement subgrade and placement of aggregate bases, and
- When any unusual subsurface conditions are encountered.

6.0 LIMITATIONS

This report is intended for the use by HNTB Corp., OCTA, and the Cities of Laguna Niguel and San Juan Capistrano for the proposed Metrolink Passing Siding project in Laguna Niguel/San Juan Capistrano, Orange County, California. This report is based on the project as described and the information obtained from the exploratory borings at the approximate locations indicated on the attached plans. The findings and recommendations contained in this report are based on the results of the field investigation, laboratory tests, and engineering analyses. In addition, soils and subsurface conditions encountered in the exploratory borings are presumed to be representative of the project site. However, subsurface conditions and characteristics of soils between exploratory borings can vary. The findings reflect an interpretation of the direct evidence obtained. The recommendations presented in this report are based on the assumption that an appropriate level of quality control and quality assurance (inspections and tests) will be provided during construction. EMI should be notified of any pertinent changes in the project plans or if subsurface conditions are found to vary from those described herein. Such changes or variations may require a re-evaluation of the recommendations contained in this report.

The data, opinions, and recommendations contained in this report are applicable to the specific design element(s) and location(s) which is (are) the subject of this report. They have no applicability to any other design elements or to any other locations and any and all subsequent users accept any and all liability resulting from any use or reuse of the data, opinions, and recommendations without the prior written consent of EMI.

EMI has no responsibility for construction means, methods, techniques, sequences, or procedures; for safety precautions or programs in connection with the construction; for the acts or omissions of the CONTRACTOR or any other person performing any of the construction; or for the failure of any worker to carry out the construction in accordance with the Final Construction Drawings and Specifications.

Services performed by EMI have been 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. No other representation, expressed or implied, and no warranty or guarantee is included or intended.

7.0 REFERENCES

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APPENDIX A

LOG OF TEST BORING SHEETS

LOGGED BY **CP**	BEGIN DATE **1-20-16**	COMPLETION DATE **1-20-16**	BOREHOLE LOCATION (Lat/Long or North/East and Datum)	HOLE ID **EMI-1**
DRILLING CONTRACTOR **2R Drilling**			BOREHOLE LOCATION (Offset, Station, Line) **60 ft Lt Sta 4994+70 Approx.**	SURFACE ELEVATION **Approx. 221 ft**
DRILLING METHOD **Hollow-Stem Auger**			DRILL RIG **CME 75**	BOREHOLE DIAMETER **8"**
SAMPLER TYPE(S) AND SIZE(S) (ID) **Bulk, Mod Cal (2"), SPT (1.4")**			SPT HAMMER TYPE **Automatic hammer; 140 lbs / 30-inch drop**	HAMMER EFFICIENCY, ERi **80%**
BOREHOLE BACKFILL AND COMPLETION **Soil Cutting & Cement**			GROUNDWATER READINGS DURING DRILLING **33.0 ft** AFTER DRILLING (DATE)	TOTAL DEPTH OF BORING **36.5 ft**

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per foot	Recovery (%)	RQD (%)	Moisture Content (%)	Dry Unit Weight (pcf)	Shear Strength (tsf)	Drilling Method	Casing Depth	Remarks
	0		CONCRETE (6.5").												
			CLAYEY SAND with GRAVEL (SC); olive brown; moist to wet; few coarse to fine GRAVEL, max. 2 in. dia.; mostly medium SAND; some low plasticity fines.		0			100							
	5		SANDY lean CLAY (CL); stiff; olive brown; moist to wet; about 9% GRAVEL, max. 3/4 in. dia.; about 40% fine SAND; about 51% low plasticity fines.		1	3 5 5	10	100		18					PA
	10		Lean CLAY with SAND (CL); very stiff; dark gray; moist; trace coarse to fine GRAVEL, max. 1/2 in. dia.; little fine SAND; mostly low plasticity fines; (stopped sampling due to CONCRETE).		2	5 9 16/5"		100		17	132	PP = 2.75			
			CONCRETE (9").												
			Lean CLAY with SAND (CL).												
	15		Medium stiff; gray; moist; trace coarse to fine GRAVEL, max. 1/2 in. dia.; little fine SAND; mostly low plasticity fines.		3	2 2 3	5	100		26					
	16		Lean CLAY (CL); medium stiff; dark gray; moist; few fine SAND; mostly medium plasticity fines.							27					
	20		Fat CLAY (CH); stiff; dark gray; moist to wet; few fine SAND; mostly high plasticity fines.		4	3 6 9	15	100		30	122	PP = 1.0			
	25														

(continued)

CALTRANS BORING RECORD MET+ENG FIXED LOTB-6-7-8.GPJ EMI CALTRANS 2013.GLB 8/10/16

Earth Mechanics, Inc.
Geotechnical and Earthquake Engineering

REPORT TITLE **BORING RECORD**				HOLE ID **EMI-1**
				PROJECT NUMBER **15-123**
PROJECT OR BRIDGE NAME **OCTA Laguna Niguel Passing Siding**				
BRIDGE NUMBER	PREPARED BY **CP**		DATE **2-23-16**	SHEET **1 of 2**

IFB C-7-2018
EXHIBIT J

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per foot	Recovery (%)	RQD (%)	Moisture Content (%)	Dry Unit Weight (pcf)	Shear Strength (tsf)	Drilling Method	Casing Depth	Remarks
	25		Lean CLAY (CL); stiff; dark gray; moist; few fine SAND; mostly medium plasticity fines.	☒	5	3 4 5	9	100		28					
	26														
	27														
	28														
	29														
	30			☒	6	4 3 4	7	100		29					
	31														
	32														
	33	▽													
	34														
	35			☒	7	3 3 5	8	100		35					
	36														
			Bottom of borehole at 36.5 ft bgs												
	37														
	38														
	39														
	40														
	41														
	42														
	43														
	44														
	45														
	46														
	47														
	48														
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	50														
	51														
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	54														
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Earth Mechanics, Inc.
Geotechnical and Earthquake Engineering

REPORT TITLE **BORING RECORD**			HOLE ID **EMI-1**
			PROJECT NUMBER **15-123**
PROJECT OR BRIDGE NAME **OCTA Laguna Niguel Passing Siding**			
BRIDGE NUMBER	PREPARED BY **CP**	DATE **2-23-16**	SHEET **2 of 2**

IFB C-7-2018
EXHIBIT J

LOGGED BY **CP**	BEGIN DATE **1-20-16**	COMPLETION DATE **1-20-16**	BOREHOLE LOCATION (Lat/Long or North/East and Datum)	HOLE ID **EMI-11A**
DRILLING CONTRACTOR **2R Drilling**			BOREHOLE LOCATION (Offset, Station, Line) **50 ft Lt Sta 4980+77 Approx.**	SURFACE ELEVATION **Approx. 225 ft**
DRILLING METHOD **Hollow-Stem Auger**			DRILL RIG **CME 75**	BOREHOLE DIAMETER **8"**
SAMPLER TYPE(S) AND SIZE(S) (ID) **Bulk**			SPT HAMMER TYPE **Automatic hammer; 140 lbs / 30-inch drop**	HAMMER EFFICIENCY, ERi **80%**
BOREHOLE BACKFILL AND COMPLETION **Soil Cutting & Cement**			GROUNDWATER READINGS DURING DRILLING AFTER DRILLING (DATE) **Not Encountered**	TOTAL DEPTH OF BORING **5.0 ft**

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per foot	Recovery (%)	RQD (%)	Moisture Content (%)	Dry Unit Weight (pcf)	Shear Strength (tsf)	Drilling Method	Casing Depth	Remarks
	0		ASPHALT CONCRETE (2").												
			CONCRETE (11").												
	1		Lean CLAY with SAND (CL); brown; moist to wet; few fine SAND; mostly low to medium plasticity fines.	▨	0			100							
	2														
	3														
	4														
	5		Bottom of borehole at 5.0 ft bgs												
	6														
	7														
	8														
	9														
	10														
	11														
	12														
	13														
	14														
	15														
	16														
	17														
	18														
	19														
	20														
	21														
	22														
	23														
	24														
	25														

Earth Mechanics, Inc.
Geotechnical and Earthquake Engineering

REPORT TITLE **BORING RECORD**				HOLE ID **EMI-11A**
				PROJECT NUMBER **15-123**
PROJECT OR BRIDGE NAME **OCTA Laguna Niguel Passing Siding**				
BRIDGE NUMBER	PREPARED BY **CP**		DATE **2-23-16**	SHEET **1 of 1**

IFB C-7-2018
EXHIBIT J

LOGGED BY **CP**	BEGIN DATE **1-20-16**	COMPLETION DATE **1-20-16**	BOREHOLE LOCATION (Lat/Long or North/East and Datum)	HOLE ID **EMI-12A**
DRILLING CONTRACTOR **2R Drilling**			BOREHOLE LOCATION (Offset, Station, Line) **30 ft Lt Sta 4980+72 Approx.**	SURFACE ELEVATION **Approx. 225 ft**
DRILLING METHOD **Hollow-Stem Auger**			DRILL RIG **CME 75**	BOREHOLE DIAMETER **8"**
SAMPLER TYPE(S) AND SIZE(S) (ID) **Bulk**			SPT HAMMER TYPE **Automatic hammer; 140 lbs / 30-inch drop**	HAMMER EFFICIENCY, ERi **80%**
BOREHOLE BACKFILL AND COMPLETION **Soil Cutting & Cement**			GROUNDWATER READINGS DURING DRILLING AFTER DRILLING (DATE) **Not Encountered**	TOTAL DEPTH OF BORING **5.0 ft**

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per foot	Recovery (%)	RQD (%)	Moisture Content (%)	Dry Unit Weight (pcf)	Shear Strength (tsf)	Drilling Method	Casing Depth	Remarks
	0		SILTY SAND (SM); yellowish brown; moist; mostly fine SAND; some nonplastic fines. Lean CLAY (CL); yellowish brown; moist; trace fine SAND; mostly low to medium plasticity fines.	▨	0			100							
	1														
	2														
	3														
	4														
	5		Bottom of borehole at 5.0 ft bgs												
	6														
	7														
	8														
	9														
	10														
	11														
	12														
	13														
	14														
	15														
	16														
	17														
	18														
	19														
	20														
	21														
	22														
	23														
	24														
	25														

Earth Mechanics, Inc.
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REPORT TITLE **BORING RECORD**			HOLE ID **EMI-12A**
			PROJECT NUMBER **15-123**
PROJECT OR BRIDGE NAME **OCTA Laguna Niguel Passing Siding**			
BRIDGE NUMBER	PREPARED BY **CP**	DATE **2-23-16**	SHEET **1 of 1**

CALTRANS BORING RECORD MET+ENG FIXED LOTB-6-7-8.GPJ EMI CALTRANS 2013.GLB 8/10/16

LOGGED BY **CP** BEGIN DATE **1-22-16** COMPLETION DATE **1-22-16**	BOREHOLE LOCATION (Lat/Long or North/East and Datum)	HOLE ID **EMI-2**
DRILLING CONTRACTOR **2R Drilling**	BOREHOLE LOCATION (Offset, Station, Line) **40 ft Rt Sta 4994+92 Approx.**	SURFACE ELEVATION **Approx. 216 ft**
DRILLING METHOD **Hollow-Stem Auger**	DRILL RIG **CME 75**	BOREHOLE DIAMETER **8"**
SAMPLER TYPE(S) AND SIZE(S) (ID) **Bulk, Mod Cal (2"), SPT (1.4")**	SPT HAMMER TYPE **Automatic hammer; 140 lbs / 30-inch drop**	HAMMER EFFICIENCY, ERi **80%**
BOREHOLE BACKFILL AND COMPLETION **Soil Cutting & Cement**	GROUNDWATER READINGS DURING DRILLING **19.0 ft** AFTER DRILLING (DATE)	TOTAL DEPTH OF BORING **76.5 ft**

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per foot	Recovery (%)	RQD (%)	Moisture Content (%)	Dry Unit Weight (pcf)	Shear Strength (tsf)	Drilling Method	Casing Depth	Remarks
	0		SILTY SAND (SM); dark brown; moist; mostly medium to fine SAND; some low plasticity fines.	▨	0			100							
	1														
	2														
	3														
	4														
	5		Medium dense; about 61% medium to fine SAND; about 39% low plasticity fines.	⊠	1	4 4 4	8	100		11					PA
	6		About 78% medium to fine SAND; about 22% nonplastic fines.							7					PA
	7		Lean CLAY (CL).												
	8														
	9														
	10		Stiff; dark gray; moist; few fine SAND; mostly medium plasticity fines.	⧓	2	5 5 7	12	100		28	118				CR, PI
	11														
	12														
	13														
	14														
	15			⊠	3	3 4 4	8	100		27					
	16														
	17														
	18														
	19	▽													
	20		Lean CLAY with SAND (CL); medium stiff; little fine SAND; mostly medium plasticity fines.	⧓	4	4 5 4	9	100		28	120	PP = .5			
	21														
	22														
	23														
	24														
	25														

(continued)

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REPORT TITLE **BORING RECORD**	HOLE ID **EMI-2**
	PROJECT NUMBER **15-123**
PROJECT OR BRIDGE NAME **OCTA Laguna Niguel Passing Siding**	
BRIDGE NUMBER PREPARED BY **CP**	DATE **2-23-16** SHEET **1 of 3**

IFB C-7-2018
EXHIBIT J

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per foot	Recovery (%)	RQD (%)	Moisture Content (%)	Dry Unit Weight (pcf)	Shear Strength (tsf)	Drilling Method	Casing Depth	Remarks
	25		Lean CLAY (CL); stiff; few fine SAND; mostly medium plasticity fines.	☒	5	2 3 4	7	100		28					
	30			⧗	6	3 3 4	7	100		26	123	PP = .5			
			SANDY lean CLAY (CL); medium stiff; wet; low to medium plasticity fines. Thin layer of SILTY SAND (SM).												
	35		SILT (ML); grayish brown; moist to wet; few fine SAND; mostly low plasticity fines.	☒	7	3 4 4	8	100		38					
			Lean CLAY (CL); stiff; dark gray; wet; few fine SAND; mostly medium plasticity fines.												
	40			⧗	8	5 6 7	13	100		31	119	PP = 1.0			
	45		Medium stiff.	☒	9	P 1 4	5	100		32					
	50		SANDY lean CLAY (CL); stiff; dark olive gray; moist; some fine SAND; mostly medium plasticity fines.	⧗	10	10 12 15	27	100		23	123	PP = 1.0			
	55														

(continued)

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REPORT TITLE
BORING RECORD

HOLE ID
EMI-2

PROJECT NUMBER
15-123

PROJECT OR BRIDGE NAME
OCTA Laguna Niguel Passing Siding

BRIDGE NUMBER

PREPARED BY
CP

DATE
2-23-16

SHEET
2 of 3

CALTRANS BORING RECORD MET+ENG FIXED LOTB-6-7-8.GPJ EMI CALTRANS 2013.GLB 8/10/16

IFB C-7-2018
EXHIBIT J

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per foot	Recovery (%)	RQD (%)	Moisture Content (%)	Dry Unit Weight (pcf)	Shear Strength (tsf)	Drilling Method	Casing Depth	Remarks
	55		Moist to wet. SANDY lean CLAY (CL) *(continued)*.	☒	11	P 4 6	10	100		22					
	60		Lean CLAY with SAND (CL); stiff; dark gray; moist to wet; little fine SAND; mostly medium plasticity fines.	⧓	12	7 12 13	25	100		23	126	PP = 1.25			
	65		CLAYEY SAND (SC); dense; dark gray; moist to wet; mostly fine SAND; some medium plasticity fines.	☒	13	4 9 15	24	100		23					
	70		Medium dense.	⧓	14	10 11 13	24	100		20					
	75		Mostly medium to fine SAND; little nonplastic to low plasticity fines.	⧓	15	6 9 8	17	11							
	76.5		Bottom of borehole at 76.5 ft bgs												

DEPTH scale: 55, 56, 57, 58, 59, 60, 61, 62, 63, 64, 65, 66, 67, 68, 69, 70, 71, 72, 73, 74, 75, 76, 77, 78, 79, 80, 81, 82, 83, 84, 85

Earth Mechanics, Inc.
Geotechnical and Earthquake Engineering

REPORT TITLE	**BORING RECORD**
HOLE ID	**EMI-2**
PROJECT NUMBER	**15-123**
PROJECT OR BRIDGE NAME	**OCTA Laguna Niguel Passing Siding**
BRIDGE NUMBER	
PREPARED BY	**CP**
DATE	**2-23-16**
SHEET	**3 of 3**

LOGGED BY **CP**	BEGIN DATE **1-22-16**	COMPLETION DATE **1-22-16**	BOREHOLE LOCATION (Lat/Long or North/East and Datum)	HOLE ID **EMI-3**
DRILLING CONTRACTOR **2R Drilling**			BOREHOLE LOCATION (Offset, Station, Line) **58 ft Lt Sta 5001+82 Approx.**	SURFACE ELEVATION **Approx. 233 ft**
DRILLING METHOD **Hollow-Stem Auger**			DRILL RIG **CME 75**	BOREHOLE DIAMETER **8"**
SAMPLER TYPE(S) AND SIZE(S) (ID) **Bulk, Mod Cal (2"), SPT (1.4")**			SPT HAMMER TYPE **Automatic hammer; 140 lbs / 30-inch drop**	HAMMER EFFICIENCY, ERi **80%**
BOREHOLE BACKFILL AND COMPLETION **Soil Cutting & Cement**			GROUNDWATER READINGS DURING DRILLING AFTER DRILLING (DATE) **Not Encountered**	TOTAL DEPTH OF BORING **46.5 ft**

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per foot	Recovery (%)	RQD (%)	Moisture Content (%)	Dry Unit Weight (pcf)	Shear Strength (tsf)	Drilling Method	Casing Depth	Remarks
	0		CONCRETE (8").												
	1		CLAYEY SAND with GRAVEL (SC); brown; moist; few coarse to fine, subrounded to rounded GRAVEL, max. 3 in. dia.; mostly medium to fine SAND; little low plasticity fines; COBBLES up to 6".		0			100							
	2		Lean CLAY with SAND (CL); brown; moist; few fine, subrounded to rounded GRAVEL, max. 3/8 in. dia.; few medium to fine SAND; mostly low plasticity fines.												
	3														
	4														
	5		Stiff; olive brown; little medium to fine SAND; mostly low plasticity fines.		1	3 5 7	12	100		15					CR
	6														
	7														
	8														
	9														
	10		No Recovery.		2	8 13 14	27	0							
	11														
	12														
	13														
	14														
	15		Poorly graded SAND with SILT and GRAVEL (SP-SM); medium dense; brown; moist; few coarse to fine GRAVEL, max. 1/2 in. dia.; mostly medium to fine SAND; few nonplastic fines; lens of lean CLAY.		3	6 4 3	7	100		6 19					
	16														
	17		Lean CLAY (CL); stiff; olive brown; moist; few fine SAND; mostly medium plasticity fines.												
	18														
	19														
	20		SILTY SAND (SM); medium dense; olive brown; moist; mostly fine SAND; some nonplastic fines.		4	12 12 12	24	100		5	114	PP = .5			
	21														
	22		Lean CLAY with SAND (CL); medium stiff; brown; moist to wet; little fine SAND; mostly nonplastic to low plasticity fines.												
	23														
	24														
	25														

(continued)

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REPORT TITLE **BORING RECORD**			HOLE ID **EMI-3**
			PROJECT NUMBER **15-123**
PROJECT OR BRIDGE NAME **OCTA Laguna Niguel Passing Siding**			
BRIDGE NUMBER	PREPARED BY **CP**	DATE **2-23-16**	SHEET **1 of 2**

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per foot	Recovery (%)	RQD (%)	Moisture Content (%)	Dry Unit Weight (pcf)	Shear Strength (tsf)	Drilling Method	Casing Depth	Remarks
	25	▨	Very stiff; dark gray; moist; little medium to fine SAND; mostly low plasticity fines. Lean CLAY with SAND (CL) *(continued)*.	☒	5	3 5 8	13	100		23 22					
	26	▨	Lean CLAY (CL); dark yellowish brown; few fine SAND; mostly medium plasticity fines.												
	30	░	SILTY SAND (SM); medium dense; yellowish brown mottled with olive gray; moist; mostly fine SAND; some nonplastic fines.	⧓	6	10 18 20	38	100		12	112				
	35	░		☒	7	5 5 8	13	100		7					
	40	▨	SANDY lean CLAY (CL); stiff; olive brown; moist; some fine SAND; mostly medium plasticity fines; interbedded with SILTY SAND.	⧓	8	3 8 9	17	100		15	111				
	45	▨	Lean CLAY (CL); few fine SAND; mostly medium plasticity fines.	☒	9	4 4 6	10	100		28					
	46.5		Bottom of borehole at 46.5 ft bgs												

CALTRANS BORING RECORD MET+ENG FIXED LOTB-6-7-8.GPJ EMI CALTRANS 2013.GLB 8/10/16

Earth Mechanics, Inc.
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REPORT TITLE
BORING RECORD

HOLE ID
EMI-3

PROJECT NUMBER
15-123

PROJECT OR BRIDGE NAME
OCTA Laguna Niguel Passing Siding

BRIDGE NUMBER

PREPARED BY
CP

DATE
2-23-16

SHEET
2 of 2

IFB C-7-2018
EXHIBIT J

LOGGED BY **CP**	BEGIN DATE **1-20-16**	COMPLETION DATE **1-20-16**	BOREHOLE LOCATION (Lat/Long or North/East and Datum)	HOLE ID **EMI-5**
DRILLING CONTRACTOR **2R Drilling**			BOREHOLE LOCATION (Offset, Station, Line) **60 ft Lt Sta 5008+00 Approx.**	SURFACE ELEVATION **Approx. 239 ft**
DRILLING METHOD **Hollow-Stem Auger**			DRILL RIG **CME 75**	BOREHOLE DIAMETER **8"**
SAMPLER TYPE(S) AND SIZE(S) (ID) **Bulk, Mod Cal (2"), SPT (1.4")**			SPT HAMMER TYPE **Automatic hammer; 140 lbs / 30-inch drop**	HAMMER EFFICIENCY, ERi **80%**
BOREHOLE BACKFILL AND COMPLETION **Soil Cutting & Cement**			GROUNDWATER READINGS DURING DRILLING AFTER DRILLING (DATE) **Not Encountered**	TOTAL DEPTH OF BORING **51.5 ft**

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per foot	Recovery (%)	RQD (%)	Moisture Content (%)	Dry Unit Weight (pcf)	Shear Strength (tsf)	Drilling Method	Casing Depth	Remarks
	0		CONCRETE (8").												
	1		SANDY lean CLAY (CL); olive brown; moist to wet; little fine SAND; mostly low plasticity fines.	▨	0			100							
	2														
	3														
	4														
	5		Poorly graded SAND with SILT and GRAVEL (SP-SM); dense; brown; moist; little coarse to fine GRAVEL, max. 3 in. dia.; mostly medium to fine SAND; few nonplastic fines; COBBLES up to 3".	☒	1	11 23 26	49	100		3					
	6														
	7														
	8														
	9														
	10		Very dense; about 13% GRAVEL, max. 3/4 in. dia.; about 81% medium to fine SAND; about 6% nonplastic fines.	⧓	2	25 50/5"		100		2	115				PA
	11														
	12														
	13														
	14														
	15		Dense; trace fine GRAVEL, max. 3/8 in. dia.; mostly medium to fine SAND; few nonplastic fines.	☒	3	9 15 18	33	100		2					
	16														
	17														
	18														
	19														
	20		Lean CLAY (CL); stiff; dark gray; moist; trace fine SAND; mostly low to medium plasticity fines.	⧓	4	8 20 50/4"		100		6	115				
	21		Poorly graded SAND (SP); very dense; dark yellowish brown; moist; mostly fine SAND; trace nonplastic fines.												
	22														
	23														
	24														
	25														

(continued)

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REPORT TITLE **BORING RECORD**				HOLE ID **EMI-5**
				PROJECT NUMBER **15-123**
PROJECT OR BRIDGE NAME **OCTA Laguna Niguel Passing Siding**				
BRIDGE NUMBER	PREPARED BY **CP**		DATE **2-23-16**	SHEET **1 of 2**

IFB C-7-2018
EXHIBIT J

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per foot	Recovery (%)	RQD (%)	Moisture Content (%)	Dry Unit Weight (pcf)	Shear Strength (tsf)	Drilling Method	Casing Depth	Remarks
	25		Poorly graded SAND (SP) *(continued)*.												
	30		SANDY SILT (ML); stiff; olive gray; moist; some fine SAND; mostly nonplastic to low plasticity fines.		5	5 8 13	21	100		19					
	31		SILTY SAND (SM); medium dense; brown; moist; mostly fine SAND; little nonplastic fines.							7					
	40		Very dense.		6	17 28 50/5"		100		10	116				
	50		Poorly graded SAND with SILT (SP-SM); very dense; brown; moist; trace fine GRAVEL, max. 3/8 in. dia.; mostly medium to fine SAND; few nonplastic fines.		7	12 32 31	63	100		2					
	51.5		Bottom of borehole at 51.5 ft bgs												

Depth scale: 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49, 50, 51, 52, 53, 54, 55

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REPORT TITLE
BORING RECORD

HOLE ID
EMI-5

PROJECT NUMBER
15-123

PROJECT OR BRIDGE NAME
OCTA Laguna Niguel Passing Siding

BRIDGE NUMBER

PREPARED BY
CP

DATE
2-23-16

SHEET
2 of 2

LOGGED BY **CP**	BEGIN DATE **8-24-15**	COMPLETION DATE **8-24-15**	BOREHOLE LOCATION (Lat/Long or North/East and Datum)	HOLE ID **EMI-6**
DRILLING CONTRACTOR **2R Drilling**			BOREHOLE LOCATION (Offset, Station, Line) **40 ft Rt Sta 5015+00 Approx.**	SURFACE ELEVATION **Approx. 209 ft**
DRILLING METHOD **Hollow-Stem Auger**			DRILL RIG **CME 75**	BOREHOLE DIAMETER **8"**
SAMPLER TYPE(S) AND SIZE(S) (ID) **Bulk, Mod Cal (2"), SPT (1.4")**			SPT HAMMER TYPE **Automatic hammer; 140 lbs / 30-inch drop**	HAMMER EFFICIENCY, ERi **80%**
BOREHOLE BACKFILL AND COMPLETION **Soil Cutting & Cement**			GROUNDWATER READINGS DURING DRILLING AFTER DRILLING (DATE) **Not Encountered**	TOTAL DEPTH OF BORING **26.5 ft**

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per foot	Recovery (%)	RQD (%)	Moisture Content (%)	Dry Unit Weight (pcf)	Shear Strength (tsf)	Drilling Method	Casing Depth	Remarks
	0		CLAYEY SAND with GRAVEL (SC); dry to moist; about 20% GRAVEL, max. 3 in. dia.; about 43% medium to fine SAND; about 37% low plasticity fines.		0			100							CR, PA
	1														
	2														
	3		CLAYEY SAND (SC); very stiff; olive brown; dry to moist; few GRAVEL, max. 2 in. dia.; medium to fine SAND; little low plasticity fines.		1	16 15 9	24	100		8	98	PP = 2.75			PI
	4														
	5		SANDY lean CLAY (CL); little fine SAND.		2	8 5 6	11	100		12					PI
	6														
	7														
	8		Lean CLAY with SAND (CL); hard; dark olive brown; few SAND.		3	10 11 14	25	100		13	113	PP = >4.5			
	9														
	10				4	5 6 7	13	100		17					
	11														
	12														
	13														
	14														
	15		SILTY SAND (SM/CL); dark yellowish brown; moist; fine SAND; some nonplastic fines.		5	10 12 13	25	100		8	112				
	16														
	17														
	18														
	19														
	20		SILTY SAND (SM); dark yellowish brown; moist; about 77% fine SAND; about 23% nonplastic fines.		6	4 4 6	10	100		9					PA
	21														
	22														
	23														
	24														
	25														

(continued)

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REPORT TITLE **BORING RECORD**			HOLE ID **EMI-6**
			PROJECT NUMBER **15-123**
PROJECT OR BRIDGE NAME **OCTA Laguna Niguel Passing Siding**			
BRIDGE NUMBER	PREPARED BY **DL**	DATE **2-23-16**	SHEET **1 of 2**

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per foot	Recovery (%)	RQD (%)	Moisture Content (%)	Dry Unit Weight (pcf)	Shear Strength (tsf)	Drilling Method	Casing Depth	Remarks
	25		Poorly graded SAND (SP); dark yellowish brown; moist; trace GRAVEL; medium to fine SAND; trace nonplastic fines.		7	17 17 17	34	100		3	109				
	26														
	27		Bottom of borehole at 26.5 ft bgs												
	28														
	29														
	30														
	31														
	32														
	33														
	34														
	35														
	36														
	37														
	38														
	39														
	40														
	41														
	42														
	43														
	44														
	45														
	46														
	47														
	48														
	49														
	50														
	51														
	52														
	53														
	54														
	55														

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REPORT TITLE **BORING RECORD**	HOLE ID **EMI-6**
	PROJECT NUMBER **15-123**

PROJECT OR BRIDGE NAME
OCTA Laguna Niguel Passing Siding

BRIDGE NUMBER	PREPARED BY	DATE	SHEET
	DL	**2-23-16**	**2 of 2**

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EXHIBIT J

LOGGED BY **CP**	BEGIN DATE **8-24-15**	COMPLETION DATE **8-24-15**	BOREHOLE LOCATION (Lat/Long or North/East and Datum)	HOLE ID **EMI-7**
DRILLING CONTRACTOR **2R Drilling**			BOREHOLE LOCATION (Offset, Station, Line) **42 ft Rt Sta 5018+00 Approx.**	SURFACE ELEVATION **Approx. 210 ft**
DRILLING METHOD **Hollow-Stem Auger**			DRILL RIG **CME 75**	BOREHOLE DIAMETER **8"**
SAMPLER TYPE(S) AND SIZE(S) (ID) **Bulk, Mod Cal (2"), SPT (1.4")**			SPT HAMMER TYPE **Automatic hammer; 140 lbs / 30-inch drop**	HAMMER EFFICIENCY, ERi **80%**
BOREHOLE BACKFILL AND COMPLETION **Soil Cutting & Cement**			GROUNDWATER READINGS DURING DRILLING AFTER DRILLING (DATE) **Not Encountered**	TOTAL DEPTH OF BORING **26.5 ft**

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per foot	Recovery (%)	RQD (%)	Moisture Content (%)	Dry Unit Weight (pcf)	Shear Strength (tsf)	Drilling Method	Casing Depth	Remarks
	0		CLAYEY SAND with GRAVEL (SC); olive brown; moist; about 8% GRAVEL, max. 3 in. dia.; about 49% medium to fine SAND; about 43% low plasticity fines.		0			100							PA, PI
	3		Very stiff; few GRAVEL, max. 1 in. dia.; some fines.		1	10 11 12	23	100		11	117	PP = 2.75			
	5		SILTY SAND (SM); olive brown; moist; about 1% GRAVEL; about 61% medium to fine SAND; about 38% low plasticity fines.		2	3 4 3	7	100		10					PA
	8		Trace GRAVEL, max. 3/8 in. dia.; little nonplastic fines.		3	7 7 7	14	100		6	109				
	10		Dark yellowish brown; about 67% fine SAND; about 33% fines.		4	3 2 4	6	100		9					PA
	15		SANDY lean CLAY (CL); very stiff; dark yellowish brown; moist; about 31% fine SAND; about 69% nonplastic fines.		5	5 6 7	13	100		13	97	PP = 2.75			PA, PI
	20		Lean CLAY (CL); brown; moist; trace medium SAND; low plasticity fines.		6	3 3 4	7	100		16					
	25														

(continued)

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Geotechnical and Earthquake Engineering

REPORT TITLE **BORING RECORD**			HOLE ID **EMI-7**
			PROJECT NUMBER **15-123**
PROJECT OR BRIDGE NAME **OCTA Laguna Niguel Passing Siding**			
BRIDGE NUMBER	PREPARED BY **DL**	DATE **2-23-16**	SHEET **1 of 2**

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per foot	Recovery (%)	RQD (%)	Moisture Content (%)	Dry Unit Weight (pcf)	Shear Strength (tsf)	Drilling Method	Casing Depth	Remarks
	25 26	▨	Hard; dark yellowish brown; trace GRAVEL, max. 3/8 in. dia.; fine SAND. Lean CLAY (CL) *(continued)*.	⧗	7	8 11 14	25	100		14	118	PP = >4.5			
	27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55		Bottom of borehole at 26.5 ft bgs												

CALTRANS BORING RECORD MET+ENG FIXED LOTB-6-7-8.GPJ EMI CALTRANS 2013.GLB 8/10/16

Earth Mechanics, Inc.
Geotechnical and Earthquake Engineering

REPORT TITLE **BORING RECORD**	HOLE ID **EMI-7**
	PROJECT NUMBER **15-123**
PROJECT OR BRIDGE NAME **OCTA Laguna Niguel Passing Siding**	

BRIDGE NUMBER	PREPARED BY	DATE	SHEET
	DL	**2-23-16**	**2 of 2**

LOGGED BY **CP** BEGIN DATE **8-24-15** COMPLETION DATE **8-24-15**	BOREHOLE LOCATION (Lat/Long or North/East and Datum)	HOLE ID **EMI-8**
DRILLING CONTRACTOR **2R Drilling**	BOREHOLE LOCATION (Offset, Station, Line) **30 ft Rt Sta 5021+00 Approx.**	SURFACE ELEVATION **Approx. 211 ft**
DRILLING METHOD **Hollow-Stem Auger**	DRILL RIG **CME 75**	BOREHOLE DIAMETER **8"**
SAMPLER TYPE(S) AND SIZE(S) (ID) **Bulk, Mod Cal (2"), SPT (1.4")**	SPT HAMMER TYPE **Automatic hammer; 140 lbs / 30-inch drop**	HAMMER EFFICIENCY, ERi **80%**
BOREHOLE BACKFILL AND COMPLETION **Soil Cutting & Cement**	GROUNDWATER READINGS DURING DRILLING AFTER DRILLING (DATE) **Not Encountered**	TOTAL DEPTH OF BORING **26.5 ft**

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per foot	Recovery (%)	RQD (%)	Moisture Content (%)	Dry Unit Weight (pcf)	Shear Strength (tsf)	Drilling Method	Casing Depth	Remarks
	0 1 2		SILTY SAND with GRAVEL (SM); yellowish brown; moist; about 10% GRAVEL, max. 3 in. dia.; about 64% medium to fine SAND; about 26% nonplastic fines.		0			100							PA
	3 4		SILT (ML); soft; yellowish brown; dry; few GRAVEL, max. 3/8 in. dia.; coarse to fine SAND; trace nonplastic fines.		1	3 11 12	23	67		35	88	PP = <0.5			
	5 6		Well-graded SAND with SILT and GRAVEL (SW-SM); yellowish brown; dry; few GRAVEL, max. 3/8 in. dia.; coarse to fine SAND; trace nonplastic fines.		2	2 2 2	4	100		2					CR
	7		SILT (ML); dark olive brown; moist; some fine SAND; low plasticity fines.							16					
	8 9		SILTY SAND with GRAVEL (SM); yellowish brown; moist; few GRAVEL; fine SAND; some nonplastic fines.		3	4 6 8	14	100		6	113				
	10 11 12 13 14		SILTY SAND (SM); dark yellowish brown; moist; fine SAND; some nonplastic fines.		4	4 3 2	5	100		15					
	15 16 17 18 19		SILT (ML); dark yellowish brown; moist to wet; fine SAND; some low plasticity fines.		5	4 5 4	9	100		26	92				
	20		Lean CLAY (CL); dark yellowish brown; moist; trace fine SAND; low plasticity fines.		6	4 4 3	7	100		29					
	21 22 23 24 25		SILTY SAND (SM); dark yellowish brown; moist; fine SAND; little low plasticity fines.							11					

(continued)

Earth Mechanics, Inc.
Geotechnical and Earthquake Engineering

REPORT TITLE **BORING RECORD**			HOLE ID **EMI-8**
			PROJECT NUMBER **15-123**
PROJECT OR BRIDGE NAME **OCTA Laguna Niguel Passing Siding**			
BRIDGE NUMBER	PREPARED BY **DL**	DATE **2-23-16**	SHEET **1 of 2**

IFB C-7-2018
EXHIBIT J

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per foot	Recovery (%)	RQD (%)	Moisture Content (%)	Dry Unit Weight (pcf)	Shear Strength (tsf)	Drilling Method	Casing Depth	Remarks
	25 26	▨	SANDY lean CLAY (CL); hard; yellowish brown; moist; little fine SAND; low plasticity fines.	⧗	7	9 13 18	31	100		15	93	PP = 4.0			
	27		Bottom of borehole at 26.5 ft bgs												
	28														
	29														
	30														
	31														
	32														
	33														
	34														
	35														
	36														
	37														
	38														
	39														
	40														
	41														
	42														
	43														
	44														
	45														
	46														
	47														
	48														
	49														
	50														
	51														
	52														
	53														
	54														
	55														

CALTRANS BORING RECORD MET+ENG FIXED LOTB-6-7-8.GPJ EMI CALTRANS 2013.GLB 8/10/16

Earth Mechanics, Inc.
Geotechnical and Earthquake Engineering

REPORT TITLE **BORING RECORD**			HOLE ID **EMI-8**
			PROJECT NUMBER **15-123**
PROJECT OR BRIDGE NAME **OCTA Laguna Niguel Passing Siding**			
BRIDGE NUMBER	PREPARED BY **DL**	DATE **2-23-16**	SHEET **2 of 2**

IFB C-7-2018
EXHIBIT J

APPENDIX B

LABORATORY TEST RESULTS

TABLE B-1 SUMMARY OF LABORATORY TEST RESULTS

Project No.: 15-123 **Project Name :** OCTA Laguna Niguel Passing Siding

Boring No .	Sample No.	Sample Depth (ft)	Soil Identification (group symbol) ASTM D2488/D2487	Moisture Content ASTM D2216 (%)	Total Unit Weight ASTM D2937 (pcf)	Pocket Penetrometer (tsf)	Torvane Shear (tsf)	Grain Size Distribution GR:SA:FI (%)	Sand Equivalent (CT-217)	Atterberg Limits ASTM D4318 (LL/PL/PI)	Soil-Minimum Resistivity CT-643 (ohm-cm)	Soil-pH CT-643	Soil-Soluble Sulfate Content CT-417 (ppm)	Soil-Moisture Free Chloride Content CT-422 (ppm)
EMI-1	S-1	5	CL	17.9				9:40:51						
EMI-1	D-2	10	CL	16.7	132.0	2.75								
EMI-1	S-3Top	15	CL	26.1										
EMI-1	S-3Bot.	15	CL	27.0										
EMI-1	D-4	20	CH	29.8	122.1	1.0								
EMI-1	S-5	25	CL	28.2										
EMI-1	S-6	30	CL	29.4										
EMI-1	S-7	35	CL	35.3										
EMI-2	S-1top	5	SM	11.3				0:61:39						
EMI-2	S-1bot.	5	SM	7.1				0:78:22						
EMI-2	D-2	10	CL	28.4	117.9	1.0				42/19/23	780	8.0	8.48	112
EMI-2	S-3	15	CL	26.9										
EMI-2	D-4	20	CL	28.1	119.6	0.5								
EMI-2	S-5	25	CL	27.5										
EMI-2	D-6	30	CL to SM	26.0	122.8	0.5								
EMI-2	S-7top	35	ML	27.2										
EMI-2	S-7bot.	35	CL	37.7										
EMI-2	D-8	40	CL	31.0	118.6	1.0								
EMI-2	S-9	45	CL	31.7										
EMI-2	D-10	50	CL	22.7	122.6	1.0								
EMI-2	S-11	55	CL	21.7										
EMI-2	D-12	60	CL	22.9	126.4	1.25								
EMI-2	S-13	65	SC	22.9										
EMI-2	D-14	70	SC	20.1	128.8									
EMI-2	Bulk	0~5	SM					1:57:42						
EMI-3	Bulk	0~5	CL					3:47:50						
EMI-3	S-1	5	CL	15.0										
EMI-3	S-3top	15	SP-SM	5.8										
EMI-3	S-3bot.	15	CL	18.7										
EMI-3	D-4	20	SM to CL	5.0	114.0	0.5					920	7.5	589	137
EMI-3	S-5top	25	CL	22.9										
EMI-3	S-5bot.	25	CL	22.1										
EMI-3	D-6	30	SM	12.3	111.8									
EMI-3	S-7	35	SM	6.7										
EMI-3	D-8	40	CL	15.1	110.7									
EMI-3	S-9	45	CL	27.7										

TABLE B-1 SUMMARY OF LABORATORY TEST RESULTS (CONT'D)

Project No.: *15-123* **Project Name :** OCTA Laguna Niguel Passing Siding

Boring No .	Sample No.	Sample Depth (ft)	Soil Identification (group symbol) ASTM D2488/D2487	Moisture Content ASTM D2216 (%)	Total Unit Weight ASTM D2937 (pcf)	Pocket Penetrometer (tsf)	Torvane Shear (tsf)	Grain Size Distribution GR:SA:FI (%)	Sand Equivalent (CT-217)	Atterberg Limits ASTM D4318 (LL/PL/PI)	Soil-Minimum Resistivity CT-643 (ohm-cm)	Soil-pH CT-643	Soil-Soluble Sulfate Content CT-417 (ppm)	Soil-Moisture Free Chloride Content CT-422 (ppm)
EMI-5	*S-1*	5	SP-SM	3.1										
EMI-5	*D-2*	10	SP-SM	2.4	115.3			13:81:6						
EMI-5	*S-3*	15	SP-SM	2.1										
EMI-5	*D-4*	20	SM to CL	5.8	115.2									
EMI-5	*S-5*	30	ML	19.3										
EMI-5	*S-5*	30	SM	7.1										
EMI-5	*D-6*	40	SM	10.4	115.8									
EMI-5	*S-7*	50	SP-SM	2.4										

TABLE B-1 SUMMARY OF LABORATORY TEST RESULTS (CONT'D)

Project No.: *15-123* **Project Name :** OCTA Laguna Niguel Passing Siding

Boring No .	**Sample No.**	**Sample Depth (ft)**	**Soil Identification (group symbol) ASTM D2488/D2487**	**Moisture Content ASTM D2216 (%)**	**Total Unit Weight ASTM D2937 (pcf)**	**Pocket Penetrometer (tsf)**	**Torvane Shear (tsf)**	**Grain Size Distribution GR:SA:FI (%)**	**Sand Equivalent (CT-217)**	**Atterberg Limits ASTM D4318 (LL/PL/PI)**	**Soil-Minimum Resistivity CT-643 (ohm-cm)**	**Soil-pH CT-643**	**Soil-Soluble Sulfate Content CT-417 (ppm)**	**Soil-Moisture Free Chloride Content CT-422 (ppm)**
EMI-6	*D-1*	2.5	CL	8.0	106.0	2.75				26/16/10				
EMI-6	*S-2*	5	CL	12.3						30/13/17				
EMI-6	*D-3*	7.5	CL	12.9	127.2	>4.5								
EMI-6	*S-4*	10	CL	17.3										
EMI-6	*D-5*	15	SM/CL	8.2	121.2									
EMI-6	*S-6*	20	SM	8.6				0:77:23						
EMI-6	*D-7*	25	SP	3.2	112.0									
EMI-6	*B-0*	0-5	SC					20:43:37			1600	7.5	172	68
EMI-7	*D-1*	2.5	SC	11.3	130.2	2.75								
EMI-7	*S-2*	5	SM	10.4				1:61:38						
EMI-7	*D-3*	7.5	SM	5.6	114.9									
EMI-7	*S-4*	10	SM	8.9				0:67:33						
EMI-7	*D-5*	15	CL	12.7	109.7	2.75		0:31:69		30/21/9				
EMI-7	*S-6*	20	CL	15.5										
EMI-7	*D-7*	25	CL	14.4	135.4	>4.5								
EMI-7	*B-0*	0-5	SC					8:49:43		27/13/14				
EMI-8	*D-1*	2.5	ML	35.2	118.7	<0.5								
EMI-8	*S-2 top*	5	SP-SM	1.8										
EMI-8	*S-2 bot.*	5	ML	16.0							1050	7.8	185	179
EMI-8	*D-3*	7.5	SM	5.6	119.5									
EMI-8	*S-4*	10	SM	15.4										
EMI-8	*D-5*	15	ML	26.4	116.2									
EMI-8	*S-6 top*	20	CL	28.8										
EMI-8	*S-6 bot.*	20	SM	11.0										
EMI-8	*D-7*	25	CL	15.3	107.3	4.0								
EMI-8	*B-0*	0-5	SM					10:64:26						
EMI-11A	*B-0*	0-5	ML	16.2										
EMI-12A	*B-0*	0-5	SM	11.5										

IFB C-7-2018
EXHIBIT J

Cobbles	Gravel		Sand			Silt or Clay
	Coarse	Fine	Coarse	Medium	Fine	

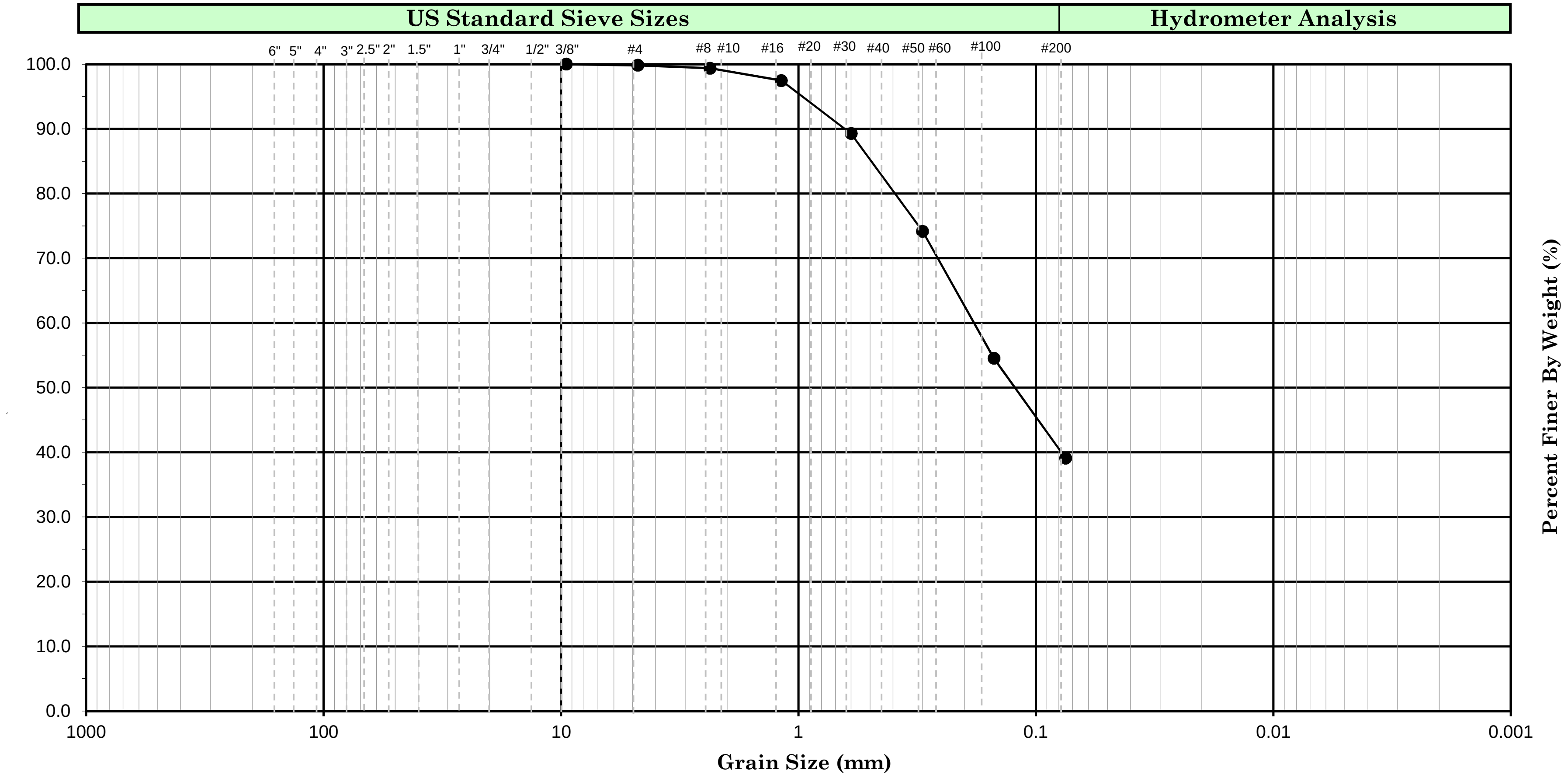
Symbol	Boring Number	Sample Number	Depth (ft)		Depth (m)		Soil Color	Soil Description	U.S.C.S.
●	EMI-2	Bulk	0~5				dark brown	Silty sand	SM
Remark									

Earth Mechanics, Inc.
Geotechnical and Earthquake Engineering

OCTA Laguna Niguel Passing Siding

Project No. : *15-123*
Date : *02/13/16*

GRAIN SIZE ANALYSIS
(ASTM D-422)



Cobbles	Gravel		Sand			Silt or Clay
	Coarse	Fine	Coarse	Medium	Fine	

Symbol	Boring Number	Sample Number	Depth				Soil Color	Soil Description	U.S.C.S.
			(ft)		(m)				
●	*EMI-2*	*S-1 Top*	*5*				*olive brown*	*Clayey sand*	*SC*
Remark									

Earth Mechanics, Inc.
Geotechnical and Earthquake Engineering

OCTA Laguna Niguel Passing Siding

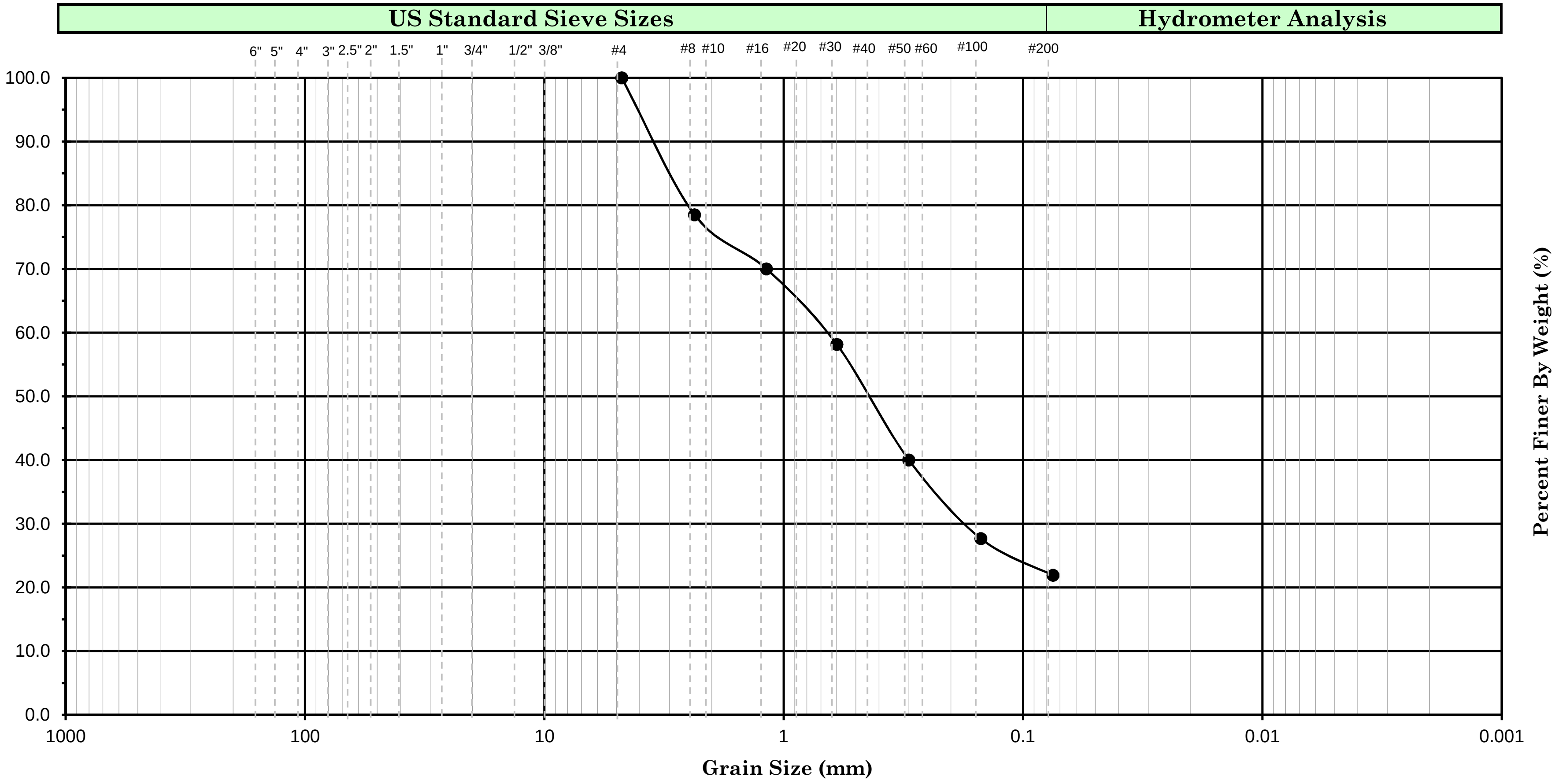
Project No. : *15-123*

Date : *02/13/16*

GRAIN SIZE ANALYSIS

(ASTM D-422)

IFB C-7-2018
EXHIBIT J



Cobbles	Gravel		Sand			Silt or Clay
	Coarse	Fine	Coarse	Medium	Fine	

Symbol	Boring Number	Sample Number	Depth (ft)	Depth (m)	Soil Color	Soil Description	U.S.C.S.
●	EMI-2	S-1 Bot.	5		brown	Silty sand	SM
Remark							

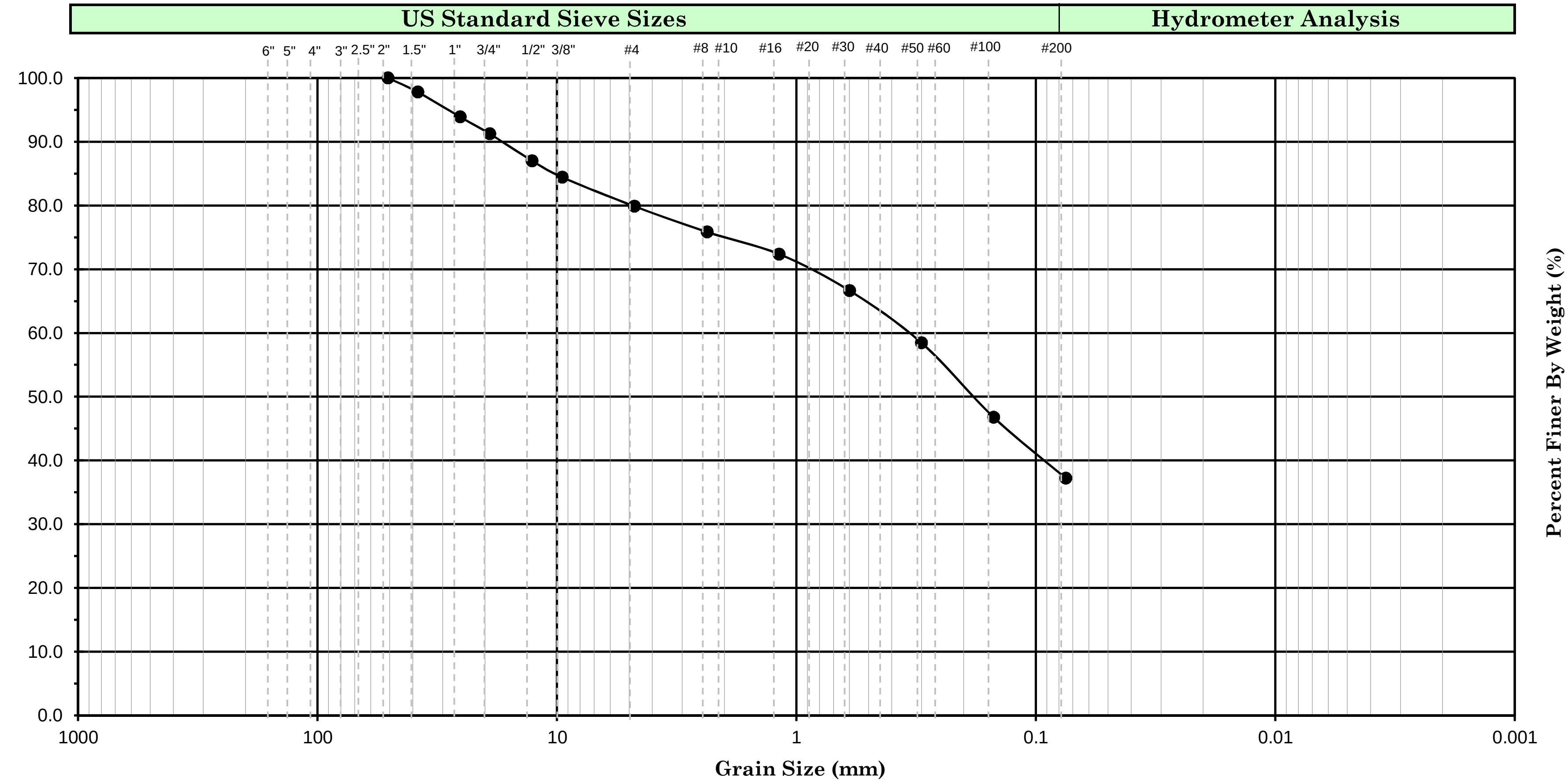
Earth Mechanics, Inc.
Geotechnical and Earthquake Engineering

OCTA Laguna Niguel Passing Siding

Project No. : *15-123*

Date : *02/13/16*

GRAIN SIZE ANALYSIS
(ASTM D-422)



Cobbles	Gravel		Sand			Silt or Clay
	Coarse	Fine	Coarse	Medium	Fine	

Symbol	Boring Number	Sample Number	Depth (ft)		Depth (m)		Soil Color	Soil Description	U.S.C.S.
●	*EMI-6*	*B-0*	*0-5*				*dark brown*	*Clayey sand with gravel*	*SC*
Remark									

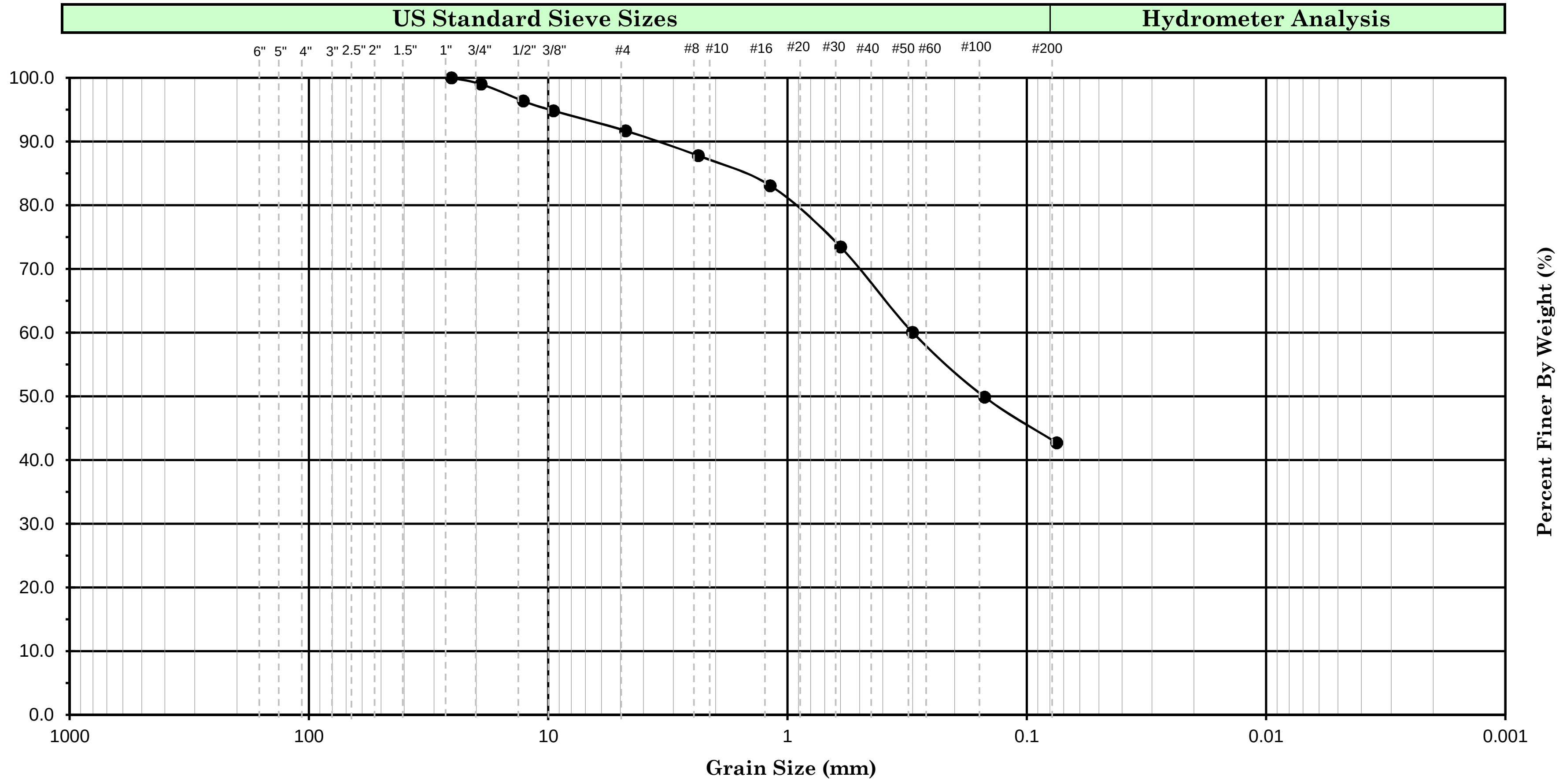
Earth Mechanics, Inc.
Geotechnical and Earthquake Engineering

HNTB, OCTA Laguna Niguel Passing Siding

Project No. : *15-123* **Date :** *10/03/15*

GRAIN SIZE ANALYSIS
(ASTM D-422)

IFB C-7-2018
EXHIBIT J



Cobbles	Gravel		Sand			Silt or Clay
	Coarse	Fine	Coarse	Medium	Fine	

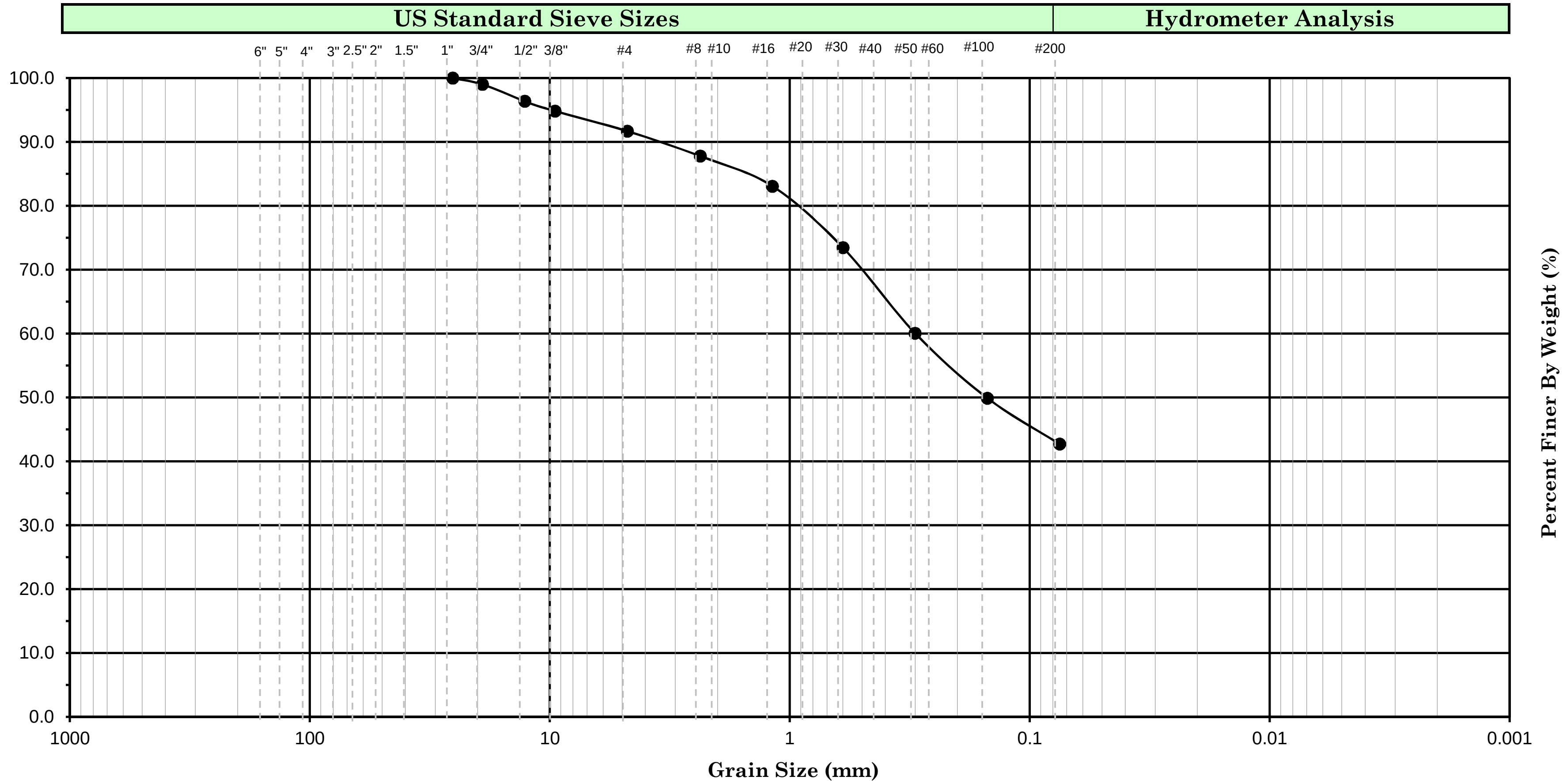
Symbol	Boring Number	Sample Number	Depth (ft)	Depth (m)	Soil Color	Soil Description	U.S.C.S.
●	EMI-7	B-0	0-5		dark olive-brown	Clayey sand	SC
Remark							

Earth Mechanics, Inc.
Geotechnical and Earthquake Engineering

HNTB, OCTA Laguna Niguel Passing Siding

Project No. : *15-123*
Date : *10/03/15*

GRAIN SIZE ANALYSIS
(ASTM D-422)



Cobbles	Gravel		Sand			Silt or Clay
	Coarse	Fine	Coarse	Medium	Fine	

Symbol	Boring Number	Sample Number	Depth (ft)	Depth (m)	Soil Color	Soil Description	U.S.C.S.
●	*EMI-7*	*B-0*	*0-5*		*dark olive-brown*	*Clayey sand*	*SC*
Remark							

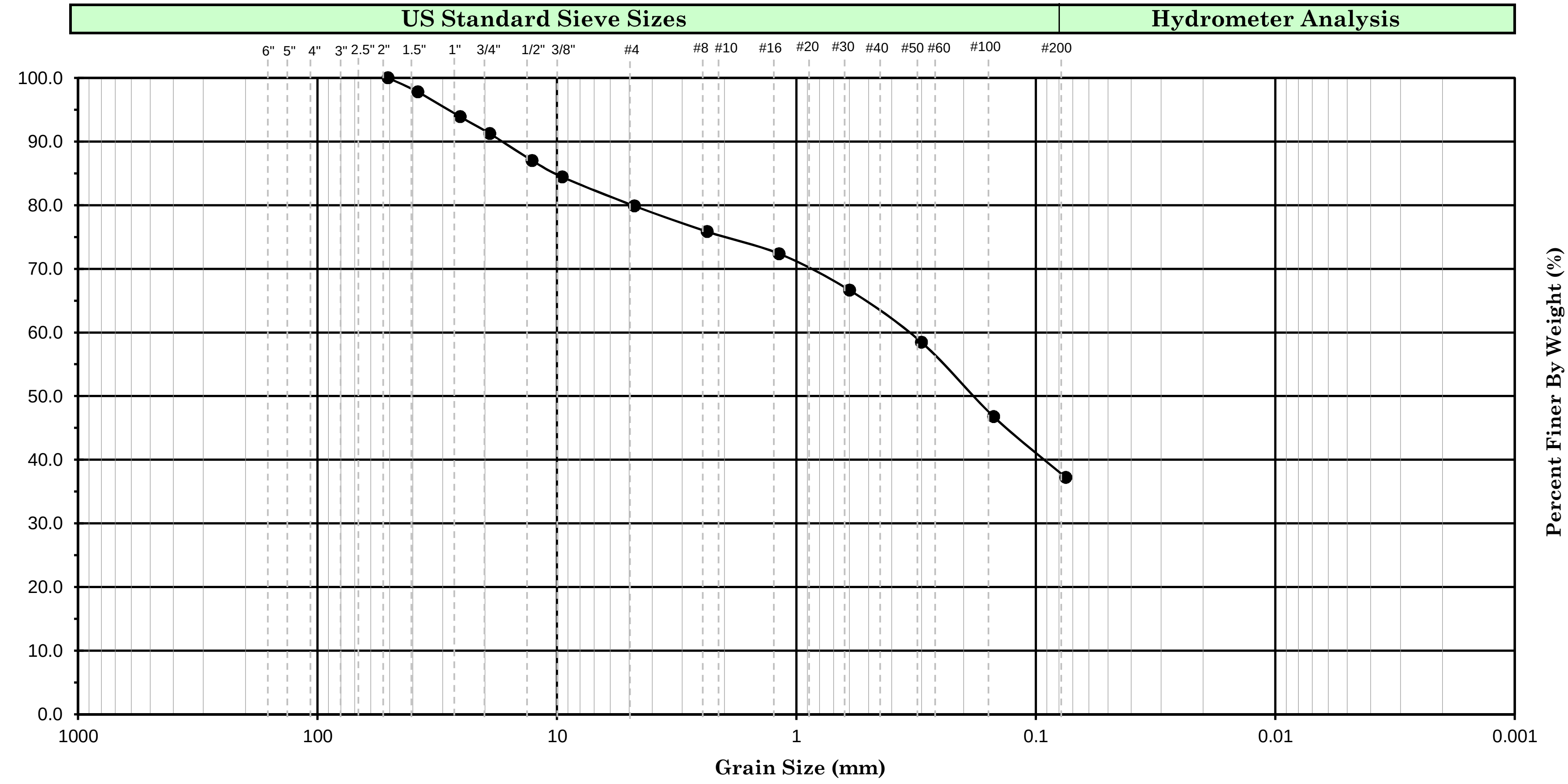
Earth Mechanics, Inc.
Geotechnical and Earthquake Engineering

HNTB, OCTA Laguna Niguel Passing Siding

Project No. : *15-123*
Date : *10/03/15*

GRAIN SIZE ANALYSIS
(ASTM D-422)

IFB C-7-2018
EXHIBIT J



Cobbles	Gravel		Sand			Silt or Clay
	Coarse	Fine	Coarse	Medium	Fine	

Symbol	Boring Number	Sample Number	Depth (ft)	Depth (m)	Soil Color	Soil Description	U.S.C.S.
●	*EMI-6*	*B-0*	*0-5*		*dark brown*	*Clayey sand with gravel*	*SC*
Remark							

Earth Mechanics, Inc.
Geotechnical and Earthquake Engineering

HNTB, OCTA Laguna Niguel Passing Siding

Project No. : *15-123*

Date : *10/03/15*

GRAIN SIZE ANALYSIS
(ASTM D-422)

AP Engineering and Testing, Inc.
DBE|MBE|SBE
2607 Pomona Boulevard | Pomona, CA 91768
t. 909.869.6316 | f. 909.869.6318 | www.aplaboratory.com

GRAIN SIZE DISTRIBUTION CURVE
ASTM D 6913

Client Name:	Earth Mechanics Inc.	Tested by:	JT	Date:	02/16/16
Project Name:	HNTB/OCTA Laguna Niguel Passing Sidin	Computed by:	NN	Date:	02/22/16
Project No.:	15-123	Checked by:	AP	Date:	02/22/16

Symbol	Boring No.	Sample No.	Sample Depth (feet)	Percent			Atterberg Limits LL:PL:PI	Soil Symbol ASTM D 2487
				Gravel	Sand	Fines		
○	EMI-11A	B-0	0-5	5	45	50	N/A	ML
□	EMI-12A	B-0	0-5	2	67	31	N/A	SM

AP Engineering and Testing, Inc.
DBE|MBE|SBE
2607 Pomona Boulevard | Pomona, CA 91768
t. 909.869.6316 | f. 909.869.6318 | www.aplaboratory.com

EXPANSION INDEX TEST RESULTS

ASTM D 4829

Client Name: Earth Mechanics, Inc.

Project Name: HNTB/OCTA Laguna Niguel Passing Siding

Project No.: 15-123

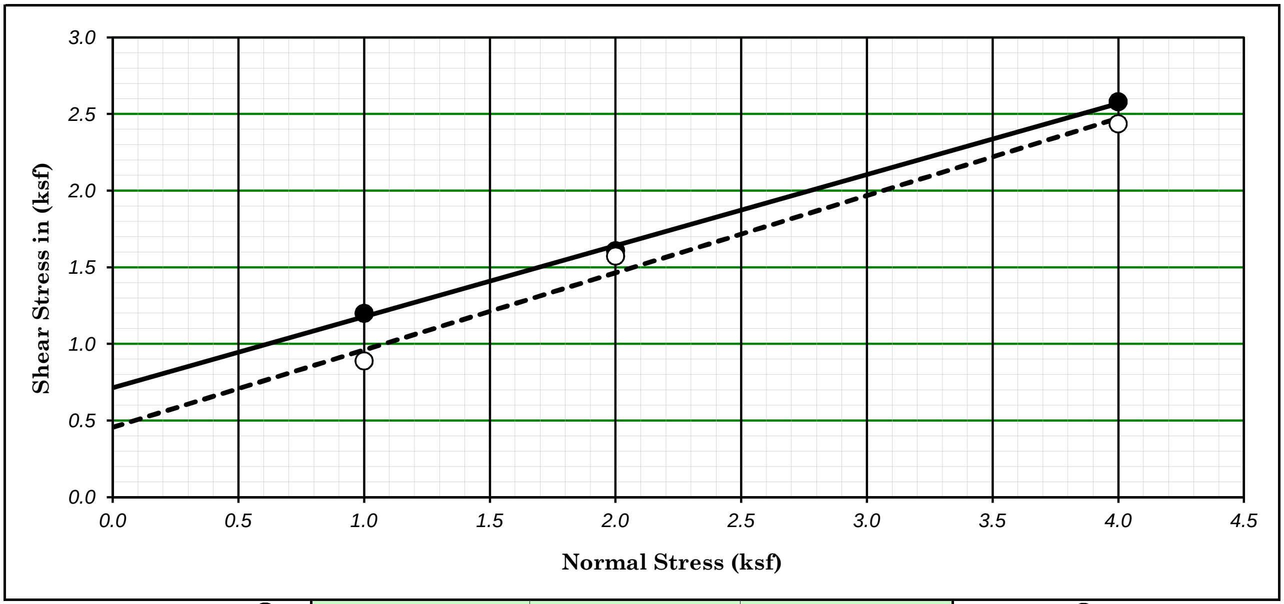
AP Job No.: 16-0233

Date: 02/21/16

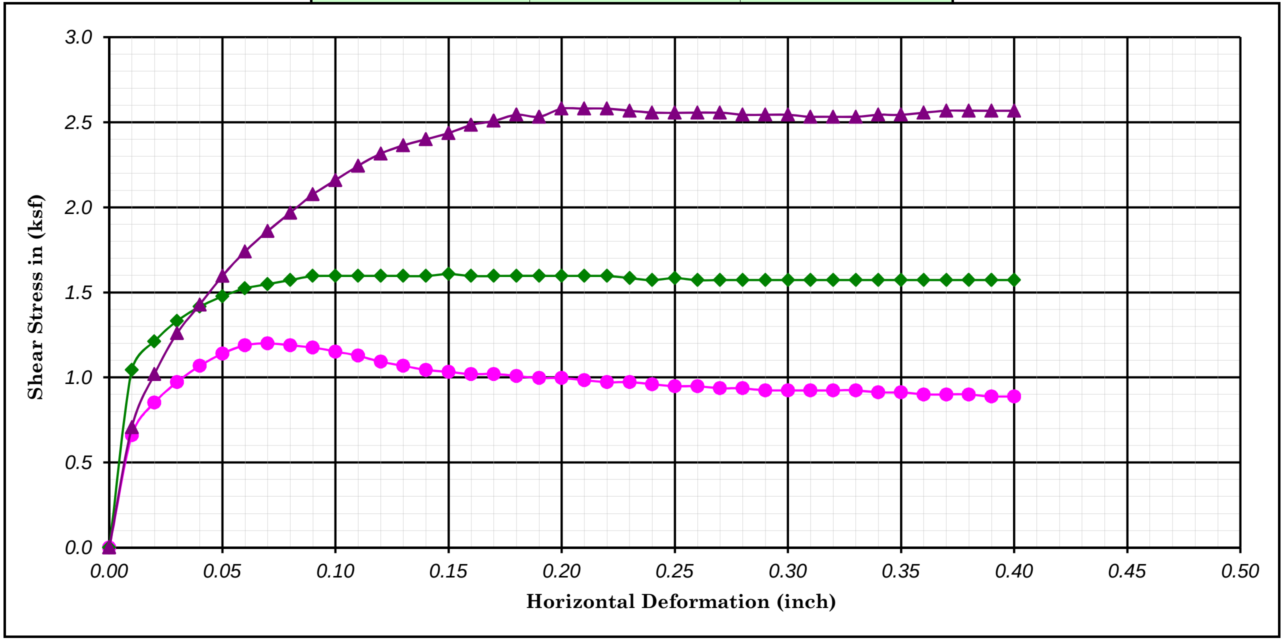
Boring No.	Sample No.	Depth (ft)	Soil Description	Molded Dry Density (pcf)	Molded Moisture Content (%)	Init. Degree Saturation (%)	Measured Expansion Index	Corrected Expansion Index
EMI-5	B-0	0-5	Clay w/sand	111.6	9.6	50.7	35	36
EMI-11A	B-0	0-5	Sandy Silt	108.9	10.9	53.7	24	26

ASTM EXPANSION CLASSIFICATION

Expansion Index	Classification
0-20	V. Low
21-50	Low
51-90	Medium
91-130	High
>130	V. High



Ultimate : ○ | **Shear Type :** *Field Moisiture* *Undisturbed* | **Peak :** ●



Boring No.	: *EMI-3*		**Strength Intercept (C) :**	*0.71*	(ksf)	**Peak**	*0.46*	(ksf)	**Ultimate**
Sample No.	: *D-4*			*34.19*	(kPa)		*21.83*	(kPa)	
Depth (ft/m)	: *20.0*	*0.00*	**Friction Angle (ϕ) :**	*24.88*	Degree		*26.75*	Degree	

Description : *Olive-brown with yellowish brown, Lean CLAY with SAND (CL)* **Shear Rate** (inch/minute) **:** *0.02*

SYMBOL	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	DRY DENSITY (kN/m^3)	VOID RATIO	NORMAL STRESS (ksf)	NORMAL STRESS (kPa)	PEAK STRESS (ksf)	PEAK STRESS (kPa)	ULTIMATE STRESS (ksf)	ULTIMATE STRESS (kPa)
●	*28.36*	*93.94*	*14.79*	*0.79*	*1.00*	*47.88*	*1.20*	*57.46*	*0.89*	*42.52*
◆	*29.81*	*90.50*	*14.24*	*0.86*	*2.00*	*95.76*	*1.61*	*76.99*	*1.57*	*75.27*
▲	*32.04*	*87.23*	*13.73*	*0.93*	*4.00*	*191.52*	*2.58*	*123.53*	*2.44*	*116.64*
					0.00	*0.00*	*0.71*	*34.19*	*0.46*	*21.83*

Earth Mechanics, Inc.
Geotechnical and Earthquake Engineering

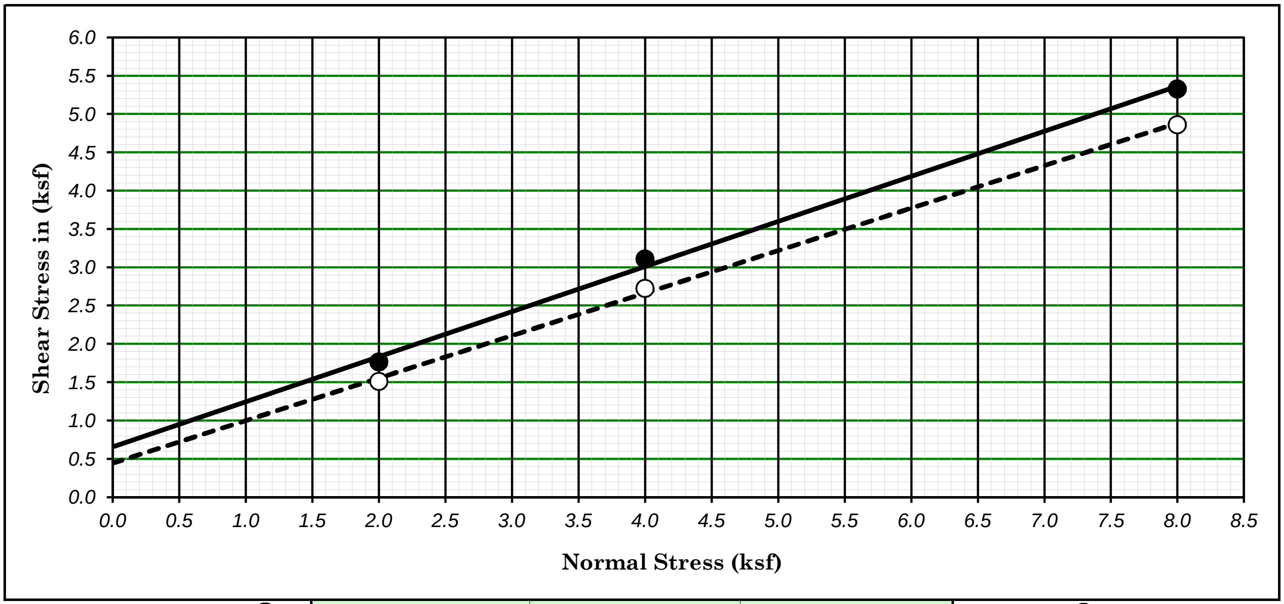
OCTA Laguna Niguel Passing Siding

Project No. : *15-123*

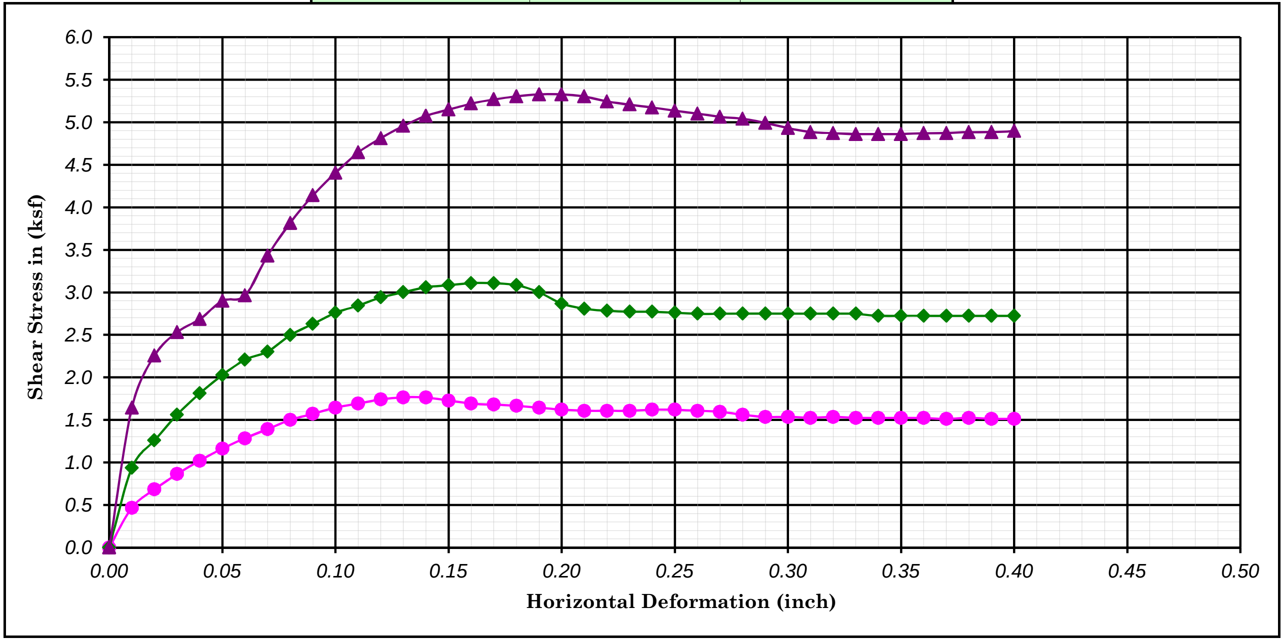
Date : *02/15/16*

DIRECT SHEAR TEST

(ASTM D-3080)



Ultimate : ○	Shear Type :	Field Moisiture	Undisturbed	Peak : ●



Boring No.	: *EMI-3*	**Strength Intercept (C) :**	0.65	(ksf)	**Peak**	0.44	(ksf)	**Ultimate**
Sample No.	: *D-8*		31.31	(kPa)		21.26	(kPa)	
Depth (ft/m)	: 40.0 | 0.00	**Friction Angle (ϕ) :**	30.47	Degree		29.01	Degree	

Description : *Olive-brown with yellowish brown, Lean CLAY interbedded SILTY SAND (CL* **Shear Rate** (inch/minute) : 0.02

SYMBOL	MOISTURE CONTENT (%)	DRY DENSITY		VOID RATIO	NORMAL STRESS		PEAK STRESS		ULTIMATE STRESS	
		(pcf)	(kN/m^3)		(ksf)	(kPa)	(ksf)	(kPa)	(ksf)	(kPa)
●	15.14	93.93	14.79	0.79	2.00	95.76	1.76	84.46	1.51	72.39
◆	15.73	95.64	15.05	0.76	4.00	191.52	3.11	148.81	2.72	130.43
▲	21.58	91.34	14.38	0.85	8.00	383.04	5.33	255.10	4.86	232.70
					0.00	0.00	0.65	31.31	0.44	21.26

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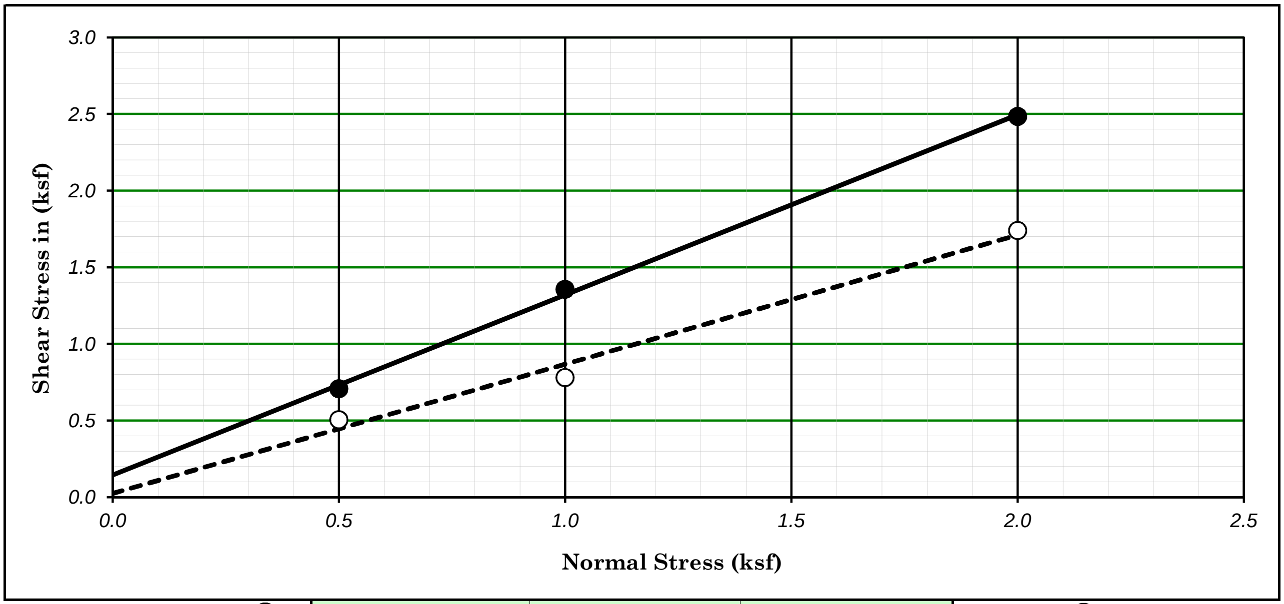
OCTA Laguna Niguel Passing Siding

Project No. : *15-123* **Date :** *02/15/16*

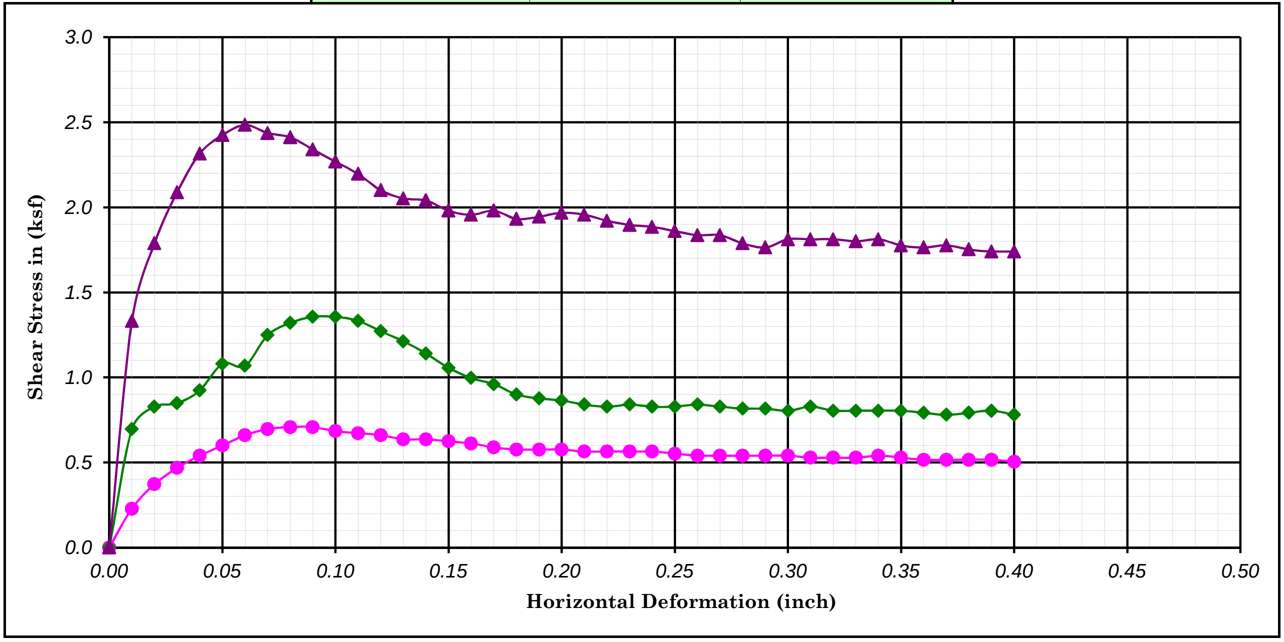
DIRECT SHEAR TEST

(ASTM D-3080)

IFB C-7-2018
EXHIBIT J



Ultimate : ○ **Shear Type :** *Field Moisiture* *Undisturbed* **Peak :** ●



Boring No.	: *EMI-5*	**Strength Intercept (C) :**	*0.14*	(ksf)	**Peak**	*0.02*	(ksf)	**Ultimate**
Sample No.	: *D-2*		*6.89*	(kPa)		*1.15*	(kPa)	
Depth (ft/m)	: *10.0* *0.00*	**Friction Angle (ϕ) :**	*49.62*	Degree		*40.15*	Degree	
Description	: *Brown, SILTY SAND (SM)*				**Shear Rate (inch/minute) :**			*0.02*

SYMBOL	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	DRY DENSITY (kN/m^3)	VOID RATIO	NORMAL STRESS (ksf)	NORMAL STRESS (kPa)	PEAK STRESS (ksf)	PEAK STRESS (kPa)	ULTIMATE STRESS (ksf)	ULTIMATE STRESS (kPa)
●	4.70	111.45	17.54	0.51	0.50	23.94	0.71	33.90	0.50	24.13
◆	2.76	112.85	17.76	0.49	1.00	47.88	1.36	64.93	0.78	37.35
▲	2.97	111.37	17.53	0.51	2.00	95.76	2.48	118.93	1.74	83.31
					0.00	0.00	0.14	6.89	0.02	1.15

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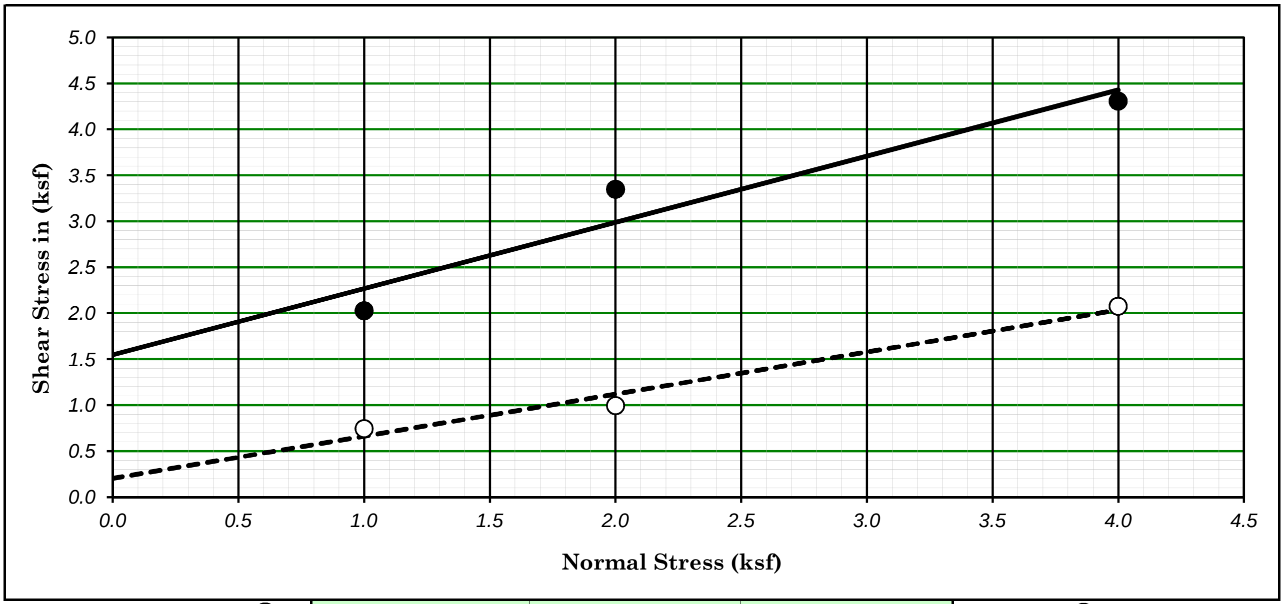
OCTA Laguna Niguel Passing Siding

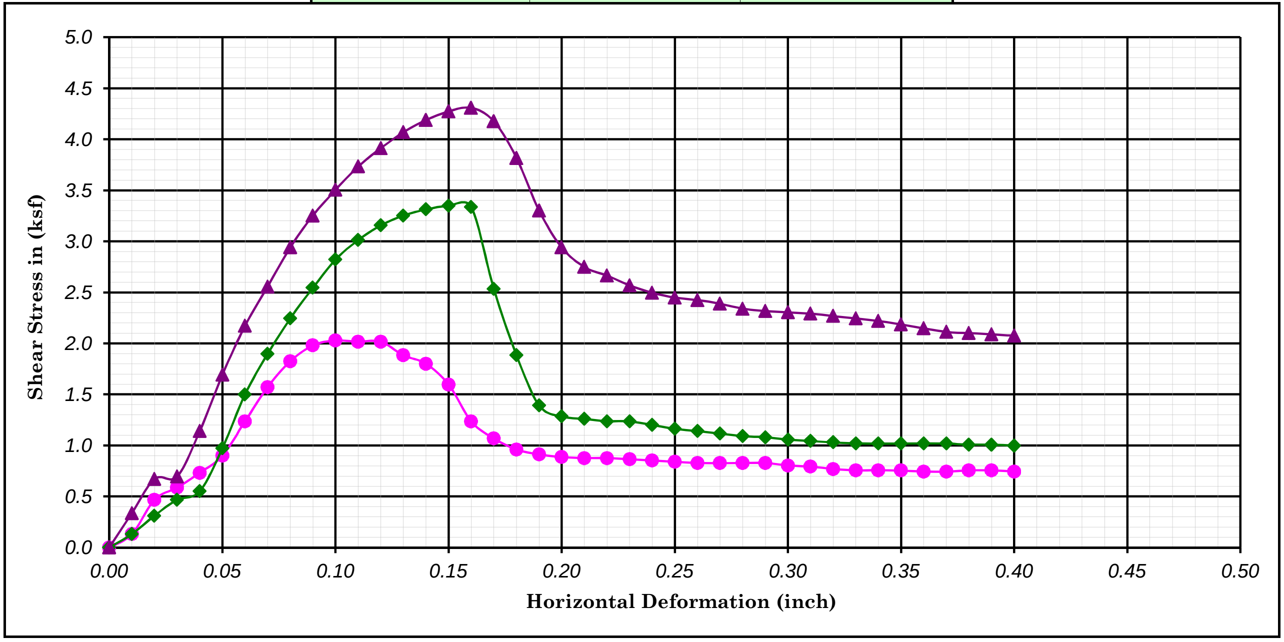
Project No. : *15-123* **Date :** *02/15/16*

DIRECT SHEAR TEST

(ASTM D-3080)



Ultimate : ○	**Shear Type :**	*Field Moisiture*	*Undisturbed*	**Peak :** ●



Boring No. : *EMI-6*		**Strength Intercept (C) :**	*1.55*	(ksf)	**Peak**	*0.20*	(ksf)	**Ultimate**
Sample No. : *D-3*			*74.12*	(kPa)		*9.77*	(kPa)	
Depth (ft/m) : *7.5*	*0.00*	**Friction Angle (ϕ) :**	*35.75*	Degree		*24.59*	Degree	
Description : *Olive-brown, Lean CLAY with SAND (CL)*						**Shear Rate** (inch/minute) **:**	*0.02*	

SYMBOL	MOISTURE CONTENT (%)	DRY DENSITY		VOID RATIO	NORMAL STRESS		PEAK STRESS		ULTIMATE STRESS	
		(pcf)	(kN/m^3)		(ksf)	(kPa)	(ksf)	(kPa)	(ksf)	(kPa)
●	*12.14*	*73.61*	*11.59*	*1.29*	*1.00*	*47.88*	*2.03*	*97.10*	*0.74*	*35.62*
◆	*13.58*	*111.69*	*17.58*	*0.51*	*2.00*	*95.76*	*3.35*	*160.30*	*1.00*	*47.69*
▲	*12.15*	*110.64*	*17.41*	*0.52*	*4.00*	*191.52*	*4.31*	*206.27*	*2.08*	*99.40*
					0.00	*0.00*	*1.55*	*74.12*	*0.20*	*9.77*
					4.0	*191.52*	*4.43*	*212.01*	*2.03*	*97.43*

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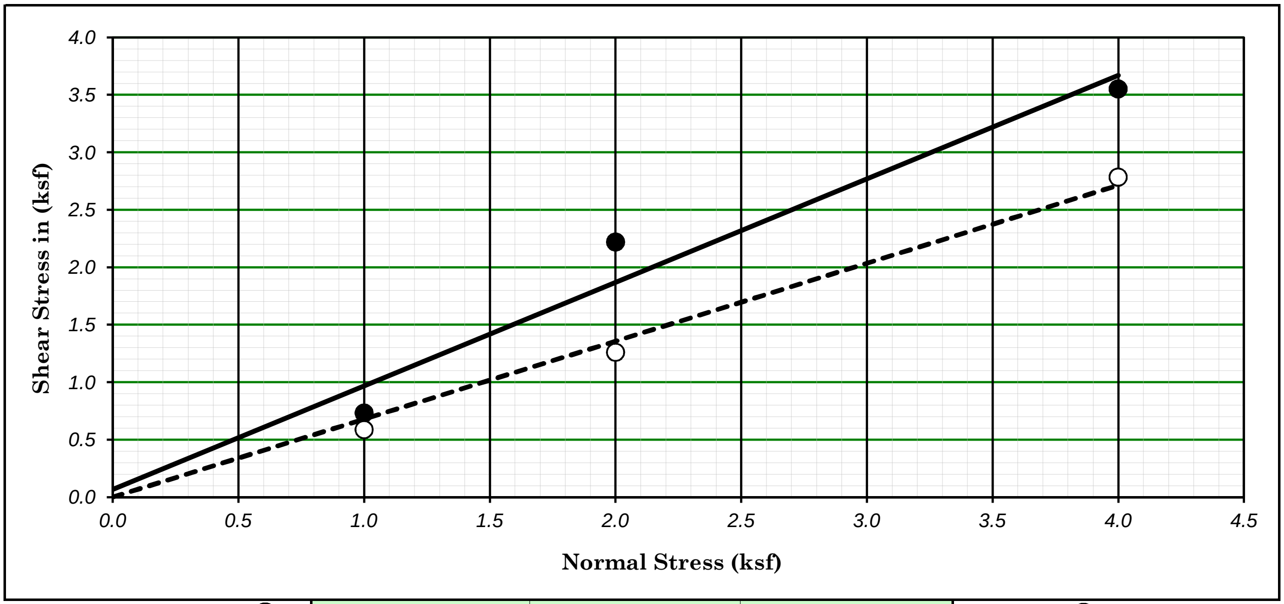
OCTA Laguna Niguel Passing Siding

Project No. : *15-123*

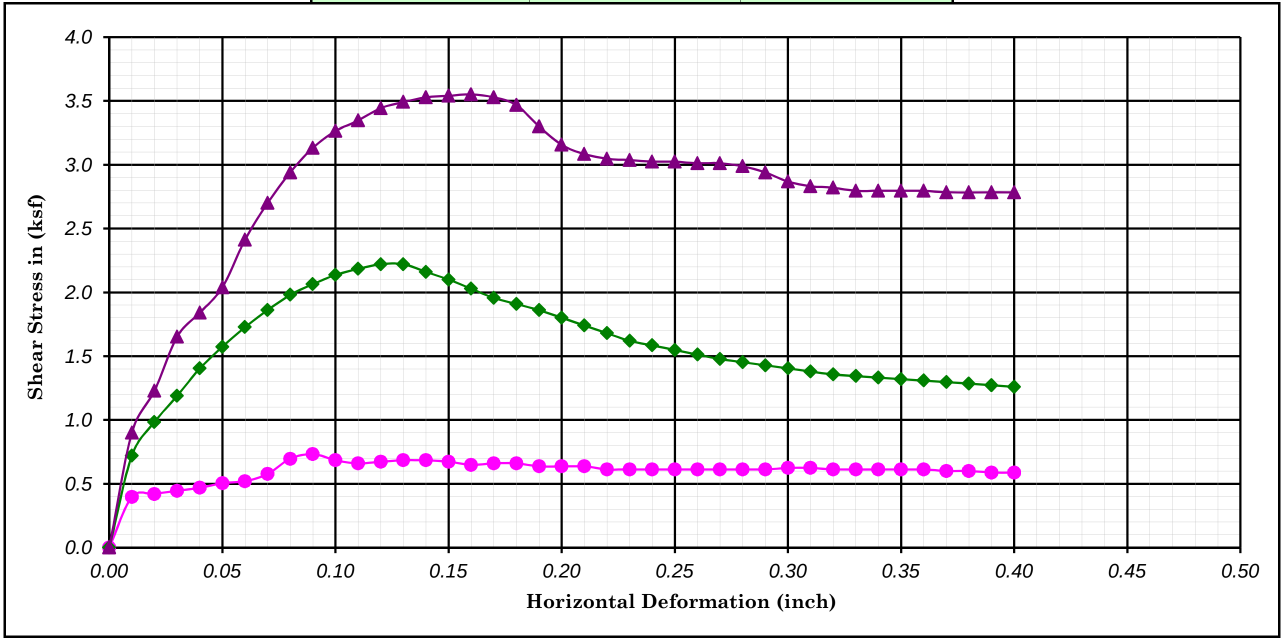
Date : *09/20/15*

DIRECT SHEAR TEST

(ASTM D-3080)



Ultimate : ○ **Shear Type :** *Field Moisture* *Undisturbed* **Peak :** ●



Boring No.	: *EMI-6*	**Strength Intercept (C) :**	*0.07*	(ksf)	**Peak**	*0.00*	(ksf)	**Ultimate**
Sample No.	: *D-5*		*3.16*	(kPa)		*0.00*	(kPa)	
Depth (ft/m)	: *15.0* *0.00*	**Friction Angle (ϕ) :**	*42.01*	Degree		*34.15*	Degree	
Description	: *Dark yellowish brown, SILTY SAND (SM)*				**Shear Rate** (inch/minute) **:**	*0.02*		

SYMBOL	MOISTURE CONTENT (%)	DRY DENSITY		VOID RATIO	NORMAL STRESS		PEAK STRESS		ULTIMATE STRESS	
		(pcf)	(kN/m^3)		(ksf)	(kPa)	(ksf)	(kPa)	(ksf)	(kPa)
●	*7.88*	*101.81*	*16.02*	*0.66*	*1.00*	*47.88*	*0.73*	*35.05*	*0.59*	*28.15*
◆	*21.58*	*102.64*	*16.16*	*0.64*	*2.00*	*95.76*	*2.22*	*106.29*	*1.26*	*60.33*
▲	*11.11*	*104.27*	*16.41*	*0.62*	*4.00*	*191.52*	*3.55*	*170.07*	*2.78*	*133.30*
					0.00	*0.00*	*0.07*	*3.16*	*0.00*	*0.00*
					4.0	*191.52*	*3.67*	*175.69*	*2.71*	*129.91*

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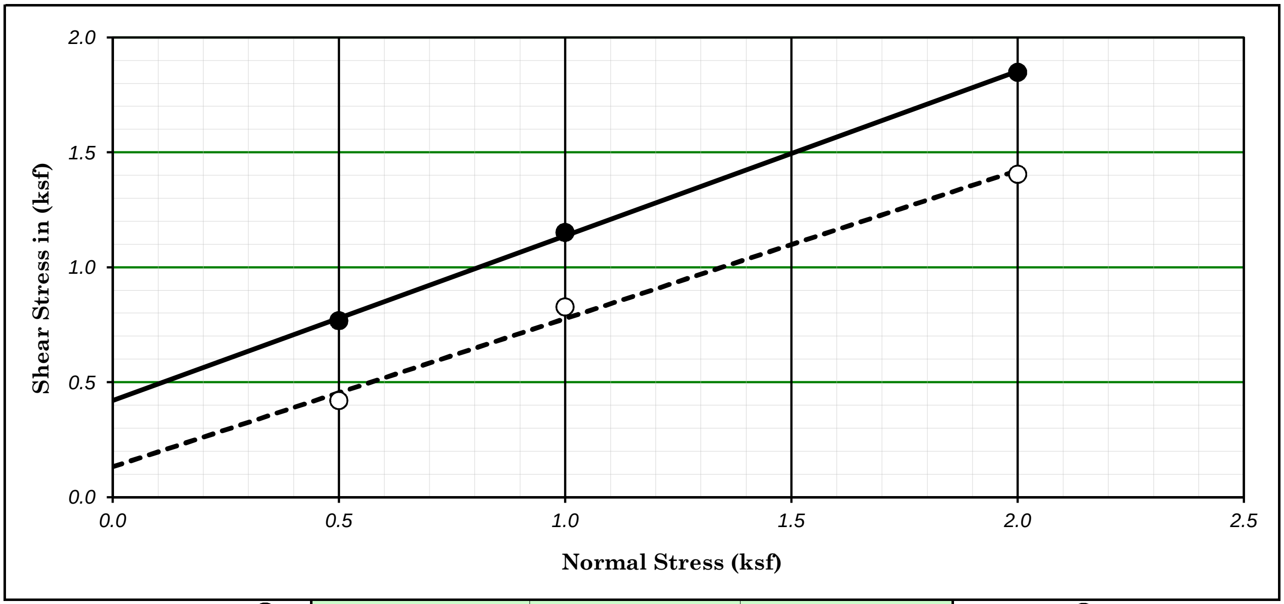
OCTA Laguna Niguel Passing Siding

DIRECT SHEAR TEST

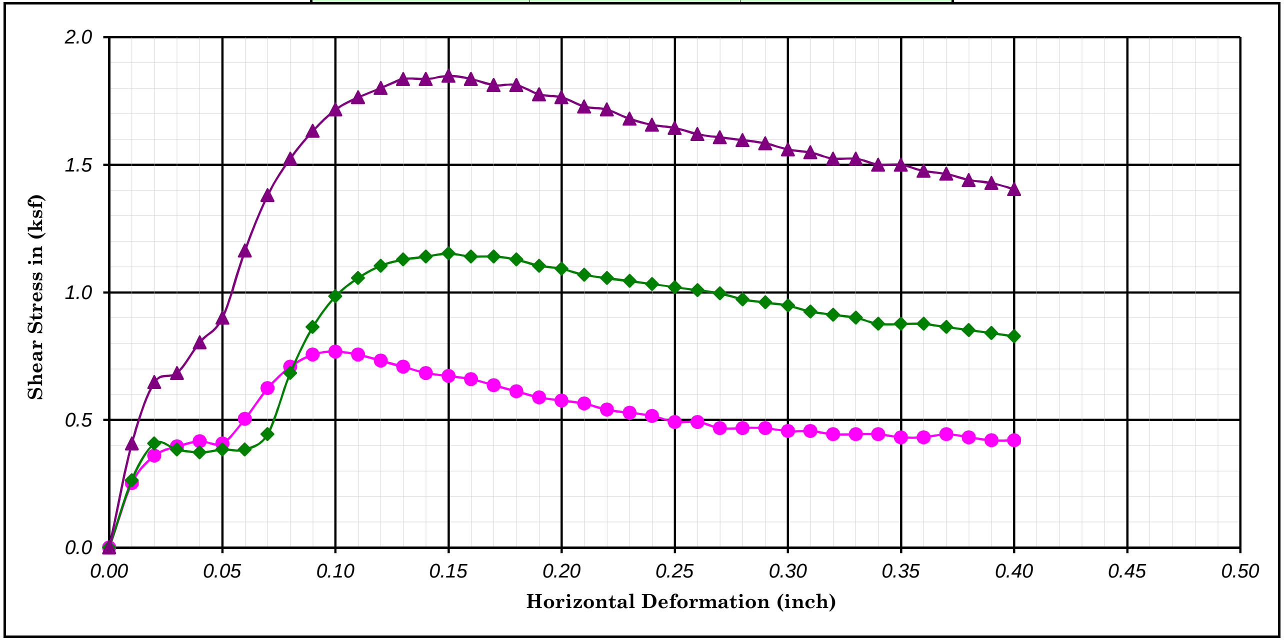
(ASTM D-3080)

Project No. : *15-123* **Date :** *09/20/15*

IFB C-7-2018
EXHIBIT J



Ultimate : ○ **Shear Type :** *Field Moisiture* *Undisturbed* **Peak :** ●



Boring No.	: *EMI-7*		**Strength Intercept (C) :**	*0.42*	(ksf)	**Peak**	*0.13*	(ksf)	**Ultimate**
Sample No.	: *D-3*			*20.11*	(kPa)		*6.32*	(kPa)	
Depth (ft/m)	: *7.5*	*0.00*	**Friction Angle (ϕ) :**	*35.62*	Degree		*32.80*	Degree	
Description	: *Yellowish brown, SILTY SAND (SM)*					**Shear Rate** (inch/minute) **:**		*0.02*	

SYMBOL	MOISTURE CONTENT (%)	DRY DENSITY		VOID RATIO	NORMAL STRESS		PEAK STRESS		ULTIMATE STRESS	
		(pcf)	(kN/m^3)		(ksf)	(kPa)	(ksf)	(kPa)	(ksf)	(kPa)
●	5.70	105.71	16.64	0.59	0.50	23.94	0.77	36.77	0.42	20.11
◆	6.11	111.87	17.61	0.51	1.00	47.88	1.15	55.16	0.83	39.64
▲	5.95	109.89	17.30	0.53	2.00	95.76	1.85	88.48	1.40	67.22
					0.00	0.00	0.42	20.11	0.13	6.32
					2.0	95.76	1.85	88.73	1.42	68.04

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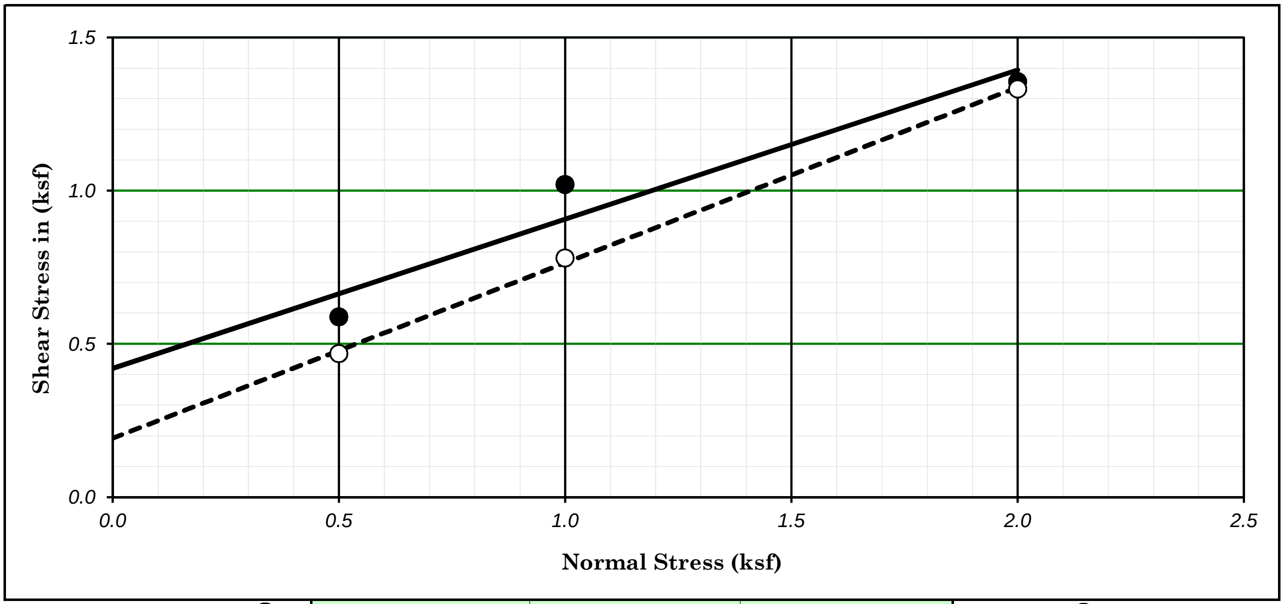
OCTA Laguna Niguel Passing Siding

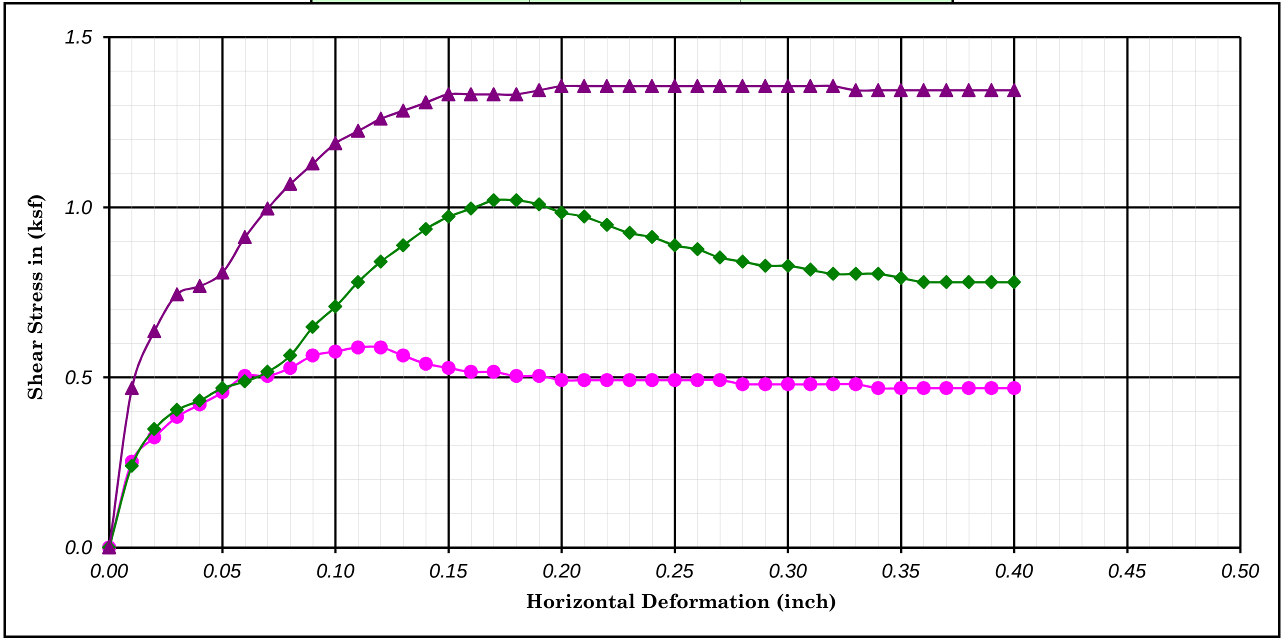
Project No. : *15-123* **Date :** *09/20/15*

DIRECT SHEAR TEST

(ASTM D-3080)



Ultimate : ○ **Shear Type :** *Field Moisiture* *Undisturbed* **Peak :** ●



Boring No.	: *EMI-8*		**Strength Intercept (C) :**	*0.42*	(ksf)	**Peak**	*0.19*	(ksf)	**Ultimate**
Sample No.	: *D-1*			*20.11*	(kPa)		*9.19*	(kPa)	
Depth (ft/m)	: *2.5*	*0.00*	**Friction Angle (ϕ) :**	*25.96*	Degree		*29.79*	Degree	
Description	: *Brown, SANDY SILT (ML)*					**Shear Rate** (inch/minute) **:**	*0.02*		

SYMBOL	MOISTURE CONTENT (%)	DRY DENSITY		VOID RATIO	NORMAL STRESS		PEAK STRESS		ULTIMATE STRESS	
		(pcf)	(kN/m^3)		(ksf)	(kPa)	(ksf)	(kPa)	(ksf)	(kPa)
●	18.71	92.56	14.57	0.82	0.50	23.94	0.59	28.15	0.47	22.41
◆	19.65	96.48	15.19	0.75	1.00	47.88	1.02	48.84	0.78	37.35
▲	31.21	86.54	13.62	0.95	2.00	95.76	1.36	64.93	1.33	63.78
					0.00	0.00	0.42	20.11	0.19	9.19
					2.0	95.76	1.39	66.73	1.34	64.02

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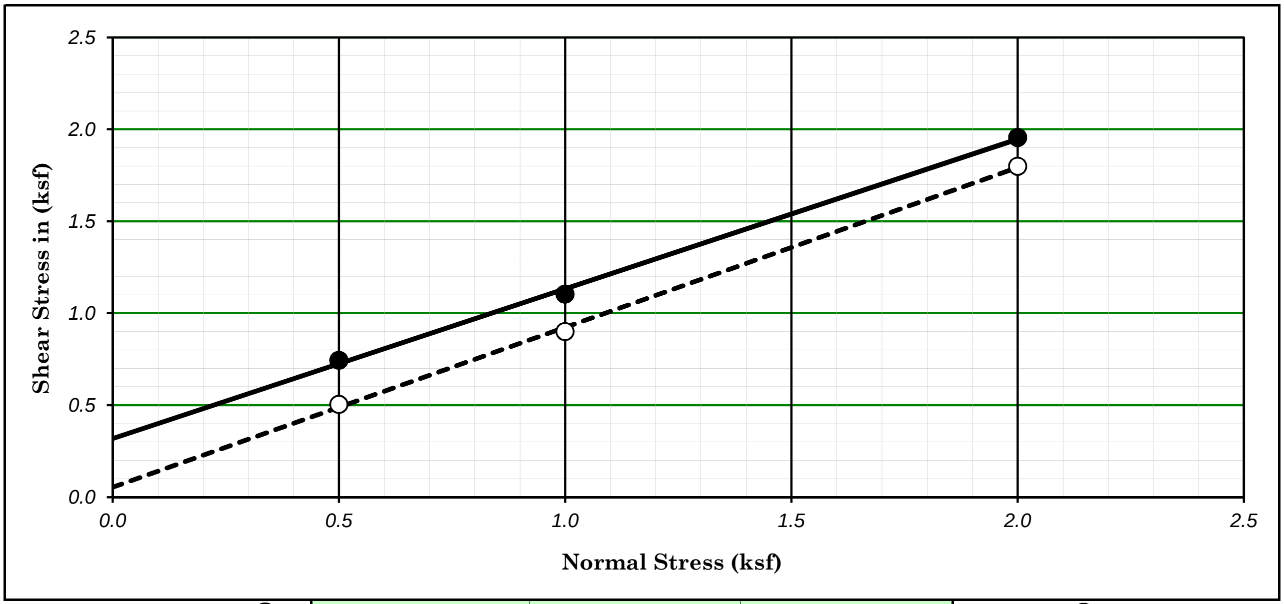
OCTA Laguna Niguel Passing Siding

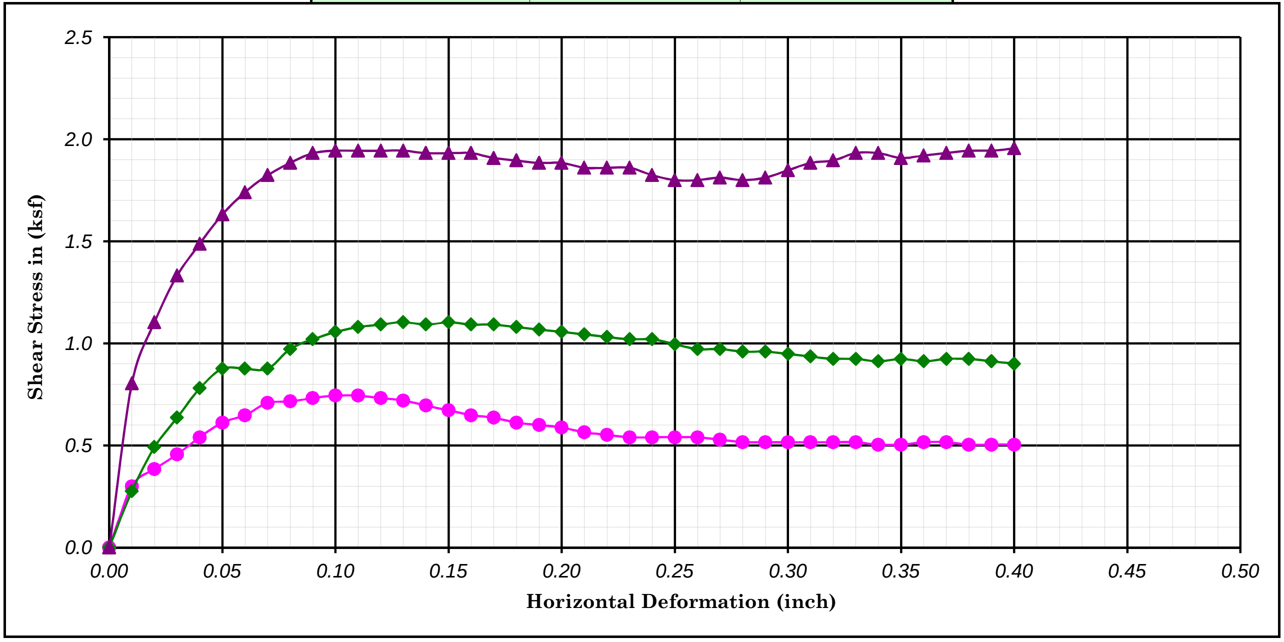
Project No. : *15-123* **Date :** *09/20/15*

DIRECT SHEAR TEST

(ASTM D-3080)



Ultimate : ○ **Shear Type :** *Field Moisiture* *Undisturbed* **Peak :** ●



Boring No.	: *EMI-8*		**Strength Intercept (C) :**	*0.32*	**(ksf)**	**Peak**	*0.05*	**(ksf)**	**Ultimate**
Sample No.	: *D-3*			*15.23*	**(kPa)**		*2.59*	**(kPa)**	
Depth (ft/m)	: *7.5*	*0.00*	**Friction Angle (ϕ) :**	*39.16*	**Degree**		*41.00*	**Degree**	

Description : *Dark yellowish brown, SILTY SAND (SM)* **Shear Rate (inch/minute) :** *0.02*

SYMBOL	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	DRY DENSITY (kN/m^3)	VOID RATIO	NORMAL STRESS (ksf)	NORMAL STRESS (kPa)	PEAK STRESS (ksf)	PEAK STRESS (kPa)	ULTIMATE STRESS (ksf)	ULTIMATE STRESS (kPa)
●	6.49	108.25	17.04	0.56	0.50	23.94	0.74	35.62	0.50	24.13
◆	5.69	114.15	17.97	0.48	1.00	47.88	1.10	52.86	0.90	43.09
▲	5.52	110.72	17.43	0.52	2.00	95.76	1.96	93.65	1.80	86.18
					0.00	0.00	0.32	15.23	0.05	2.59
					2.0	95.76	1.95	93.20	1.79	85.81

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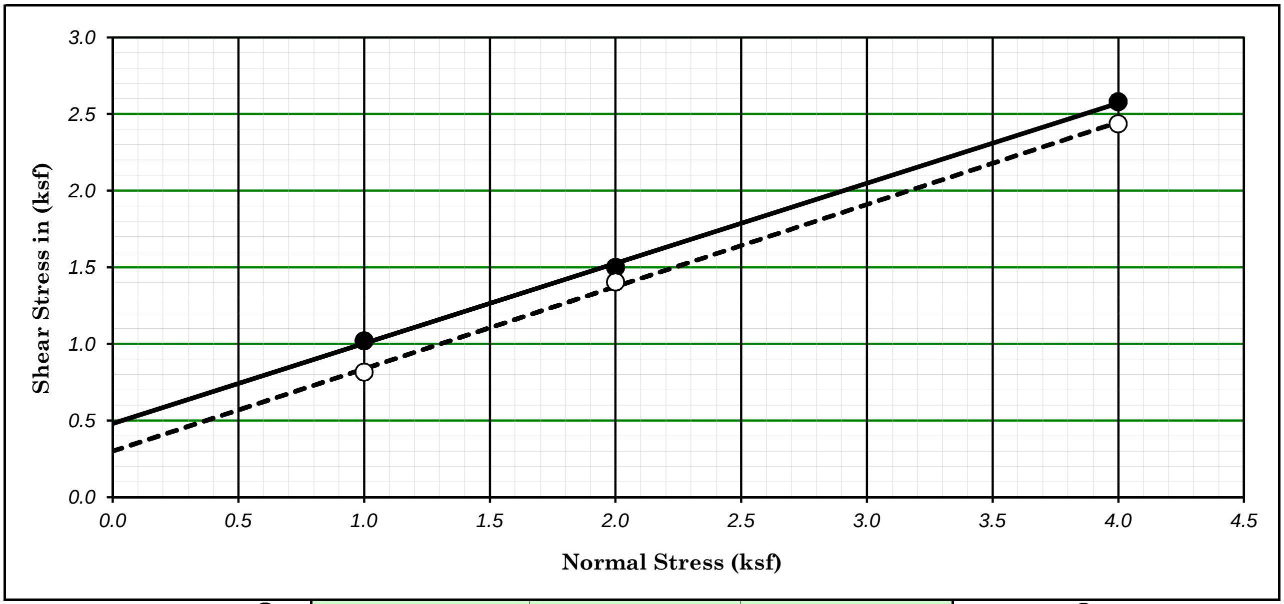
OCTA Laguna Niguel Passing Siding

DIRECT SHEAR TEST

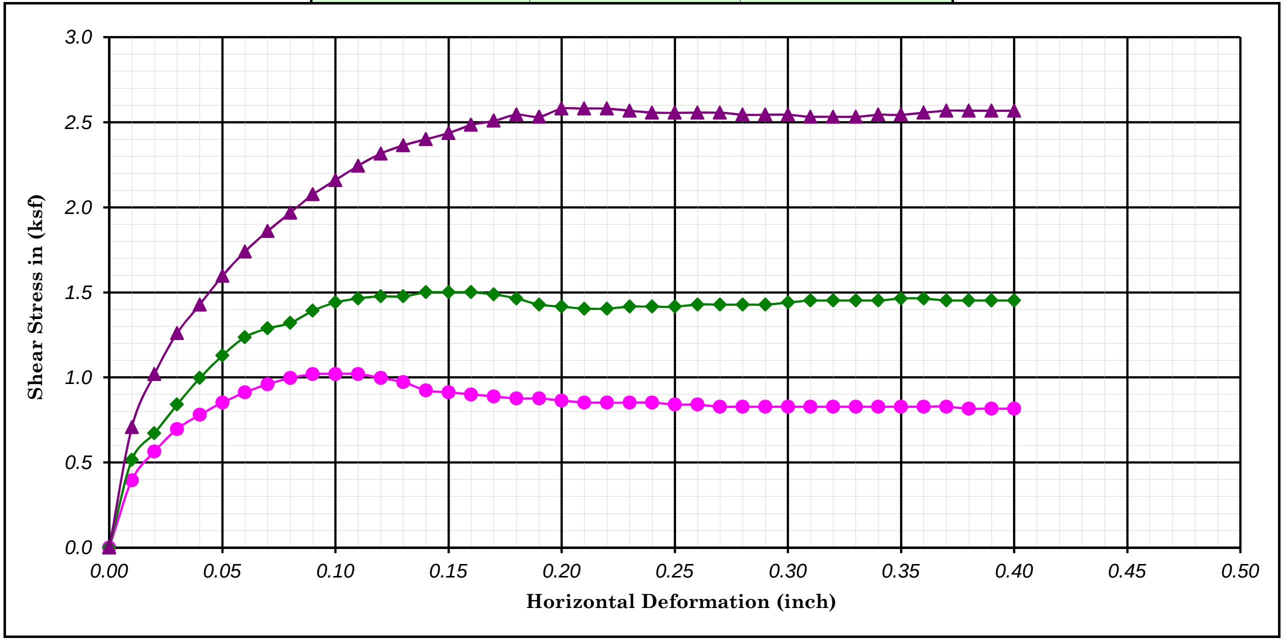
(ASTM D-3080)

Project No. : *15-123* **Date :** *09/20/15*

IFB C-7-2018
EXHIBIT J



Ultimate : ○ | **Shear Type :** *Field Moisiture* | *Undisturbed* | **Peak :** ●



Boring No. : *EMI-8*
Sample No. : *D-5*
Depth (ft/m) : *15.0* | *0.00*

			Peak			Ultimate
Strength Intercept (C) :	0.48	(ksf)		0.30	(ksf)	
	22.98	(kPa)		14.36	(kPa)	
Friction Angle (ϕ) :	27.60	Degree		28.22	Degree	

Description : *Yellowish brown, SILT (ML)*
Shear Rate (inch/minute) : 0.02

SYMBOL	MOISTURE CONTENT (%)	DRY DENSITY		VOID RATIO	NORMAL STRESS		PEAK STRESS		ULTIMATE STRESS	
		(pcf)	(kN/m^3)		(ksf)	(kPa)	(ksf)	(kPa)	(ksf)	(kPa)
●	29.77	88.26	13.89	0.91	1.00	47.88	1.02	48.84	0.82	39.07
◆	23.55	88.26	13.89	0.91	2.00	95.76	1.50	71.82	1.40	67.22
▲	25.60	87.92	13.84	0.92	4.00	191.52	2.58	123.53	2.44	116.64
					0.00	0.00	0.48	22.98	0.30	14.36
					4.0	191.52	2.57	123.12	2.45	117.13

Earth Mechanics, Inc.
Geotechnical and Earthquake Engineering

OCTA Laguna Niguel Passing Siding

DIRECT SHEAR TEST

(ASTM D-3080)

Project No. : 15-123 | **Date :** 09/20/15

UNCONSOLIDATED UNDRAINED TRIAXIAL TEST

ASTM D2850

Project Name:	OCTA Laguna Niguel Passing Siding			**Project No:**	15-123
Boring No.: ☐	EMI-1	**Tested by:**	KK	**Date:**	02/15/16
Depth (ft):	10	**Checked by:**		**Date:**	
Sample No.	D-2	**Sample Type:**	R		

Sample Description: Gray , LEAN CLAY (CL)

	1	2	3		
Diameter (in.):	2.423	2.425	2.425	Average:	2.424
Height (in.):	5.000	4.985	4.985	Average:	4.990

Moisture Content Calculation		
Wt. Wet Sample + Container (gms):		229.32
Wt. Dry Sample + Container (gms):		204.86
Container (gms)	No. 31	58.61
Moisture Content (%)		**16.7**

Density and Saturation	
Wt. Wet Sample + Container (gms)	1026.56
Container (gms)	228.92
Wet Density (pcf)	**131.8**
Dry Density (pcf)	**112.9**
Void Ratio	**0.492**
% Saturation	**91.8**

Assume Gs=2.70

Test Data Filename: 15123EMI1D2.xls

SKETCH / PHOTO AFTER TEST:

PHOTO FILE NAME: est In Process\15-123 - HNTB, OCTA Laguna Niguel Pa

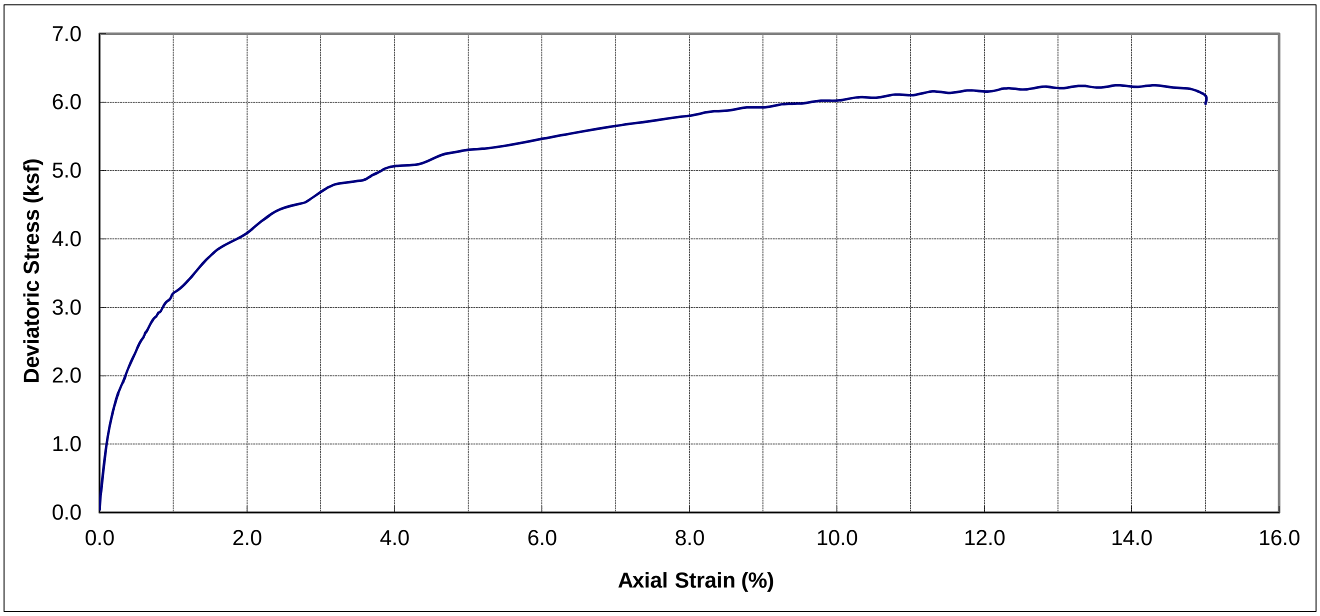
Shear	
Rate of Deformation (% strain / min) =	**1**
Confining Stress (ksf):	**0.88**

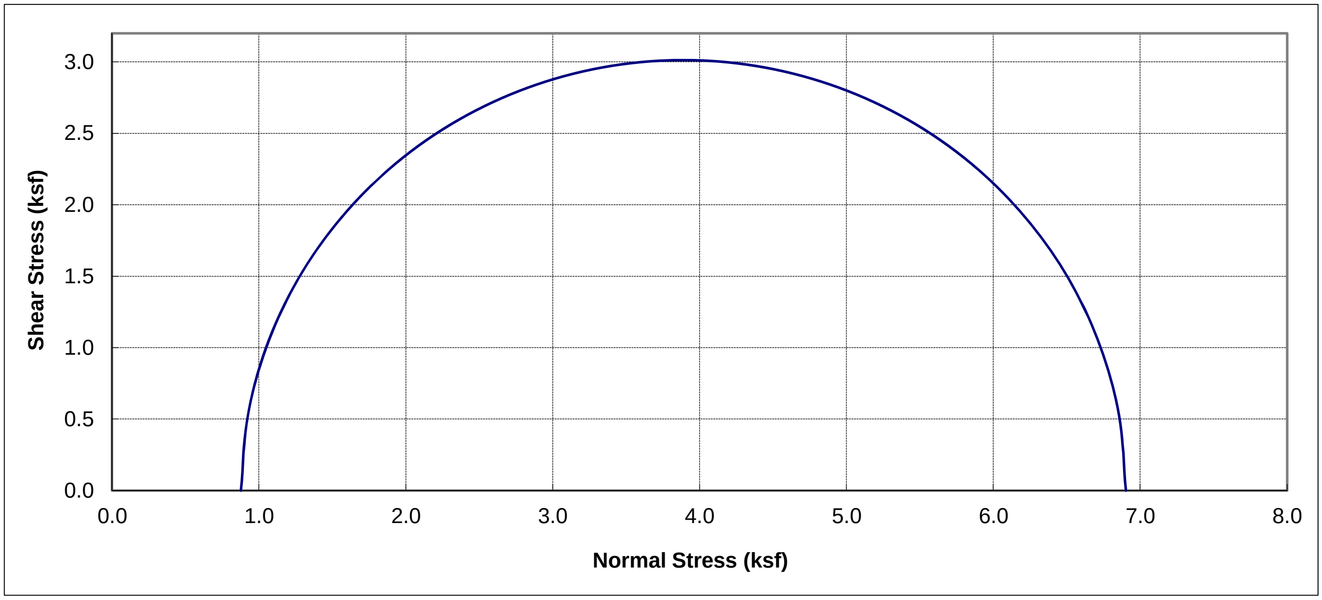
Failure Criterion: **criterion 2 is used**

1. the maximum deviator stress within 15% strain
2. the stress at 10% strain for no peak stress.

At Failure	
Deviator Stress (ksf)	**6.02**
Eff. Minor Principal Stress (ksf)=	**0.88**
Eff. Major Principal Stress (ksf)=	**6.90**
Axial Strain (%)=	**10.03**

IFB C-7-2018
EXHIBIT J





Boring No.	Sample No.	Depth (ft)	Soil Type	Dry Density (pcf)	Moisture Content (%)	Conf. Stress (ksf)	10% Axial Strain Dev. Stress (ksf)	Initial Saturation (%)
EMI-1	D-2	10	Gray , LEAN CLAY (CL)	112.9	16.72	0.88	6.02	91.8

Earth Mechanics, Inc.
Geotechnical and Earthquake Engineering

Project No. : 15-123 **Date :** 02/15/16

OCTA Laguna Niguel Passing Siding

UNCONSOLIDATED UNDRAINED TEST

(ASTM D2850) **Figure No. :**

UNCONSOLIDATED UNDRAINED TRIAXIAL TEST

ASTM D2850

Project Name:	OCTA Laguna Niguel Passing Siding			**Project No:**	15-123
Boring No.: ☐	EMI-2	**Tested by:**	KK	**Date:**	02/15/16
Depth (ft):	20	**Checked by:**		**Date:**	
Sample No.	D-4	**Sample Type:**	R		

Sample Description: Gray , LEAN CLAY (CL)

	1	2	3		
Diameter (in.):	2.425	2.425	2.425	Average:	2.425
Height (in.):	4.960	4.960	4.974	Average:	4.965

Moisture Content Calculation		
Wt. Wet Sample + Container (gms):		195.8
Wt. Dry Sample + Container (gms):		165.72
Container (gms)	No. 32	58.62
Moisture Content (%)		**28.1**

Density and Saturation	
Wt. Wet Sample + Container (gms)	948.25
Container (gms)	228.92
Wet Density (pcf)	**119.4**
Dry Density (pcf)	**93.2**
Void Ratio	**0.807**
% Saturation	**94.0**

Assume Gs=2.70

Test Data Filename:	15123EMI2D4.xls

SKETCH / PHOTO AFTER TEST:

PHOTO FILE NAME: est In Process\15-123 - HNTB, OCTA Laguna Niguel Pa

Shear	
Rate of Deformation (% strain / min) =	**1**
Confining Stress (ksf):	**1.58**

Failure Criterion: **criterion 2 is used**

1. the maximum deviator stress within 15% strain
2. the stress at 10% strain for no peak stress.

At Failure	
Deviator Stress (ksf)	**1.82**
Eff. Minor Principal Stress (ksf)=	**1.58**
Eff. Major Principal Stress (ksf)=	**3.40**
Axial Strain (%)=	**10.05**

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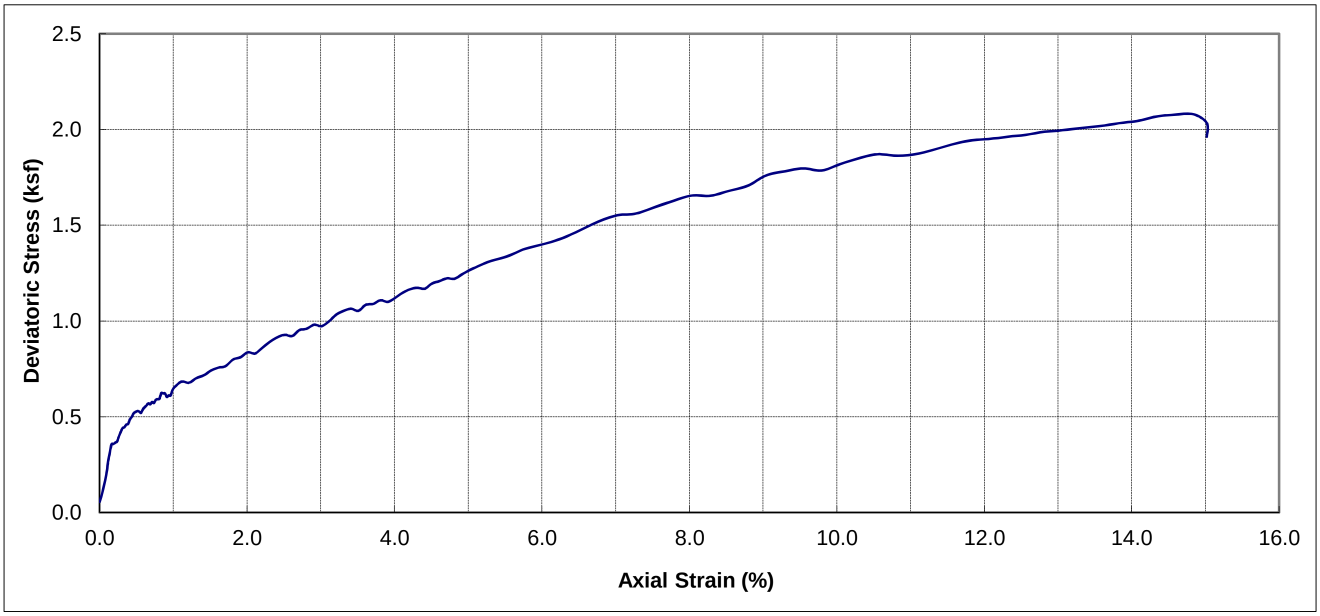
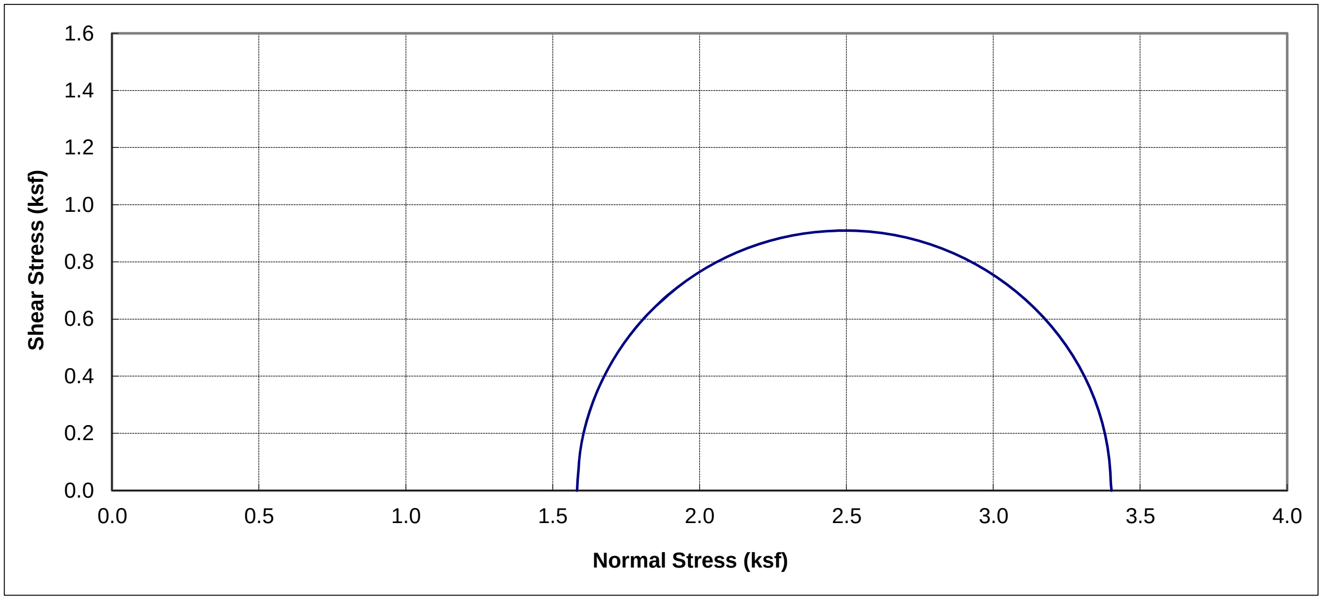
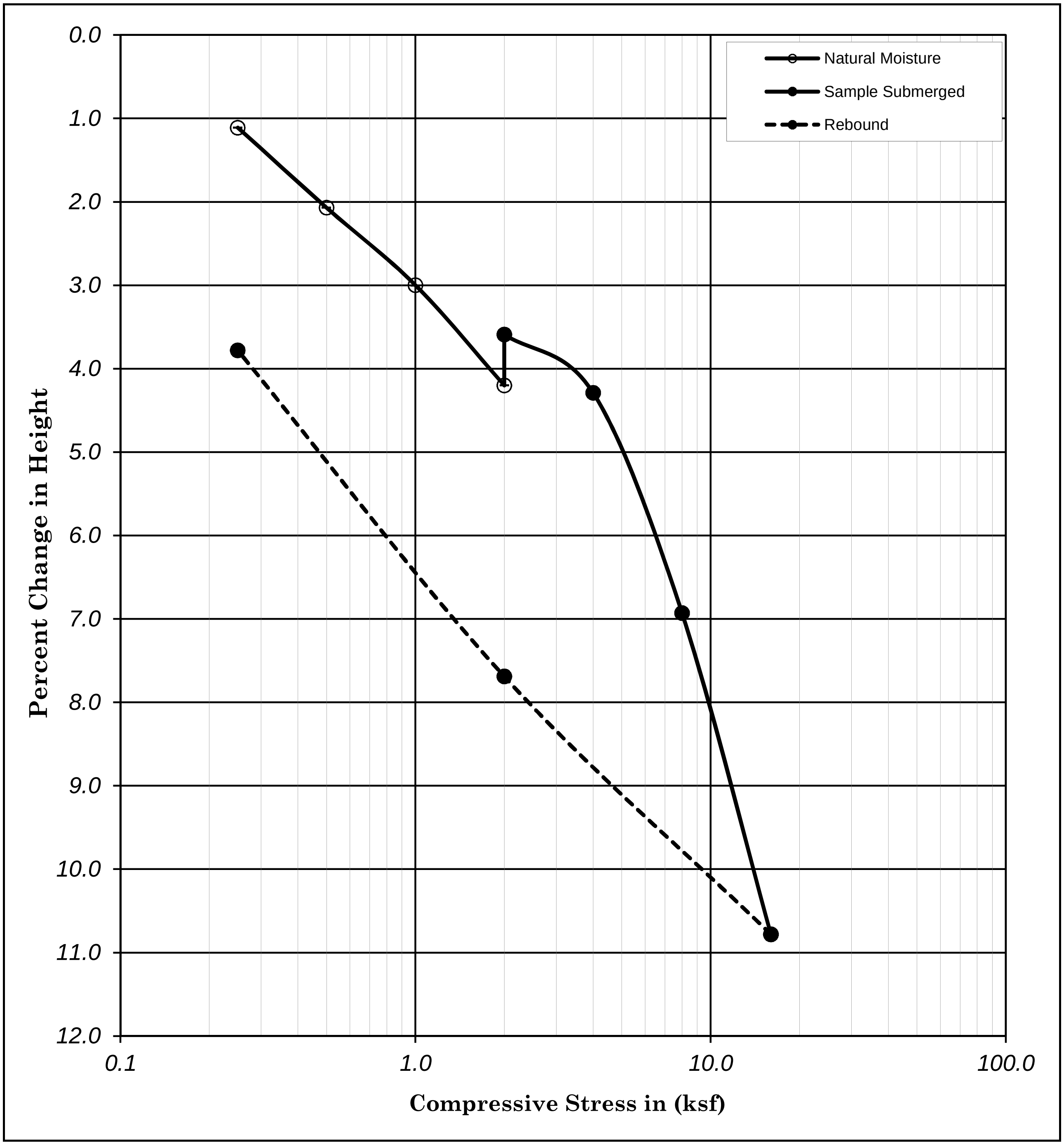




Boring No.	Sample No.	Depth (ft)	Soil Type	Dry Density (pcf)	Moisture Content (%)	Conf. Stress (ksf)	10% Axial Strain Dev. Stress (ksf)	Initial Saturation (%)
EMI-2	D-4	20	Gray , LEAN CLAY (CL)	93.2	28.09	1.58	1.82	94.0

Earth Mechanics, Inc. **Geotechnical and Earthquake Engineering**	**OCTA Laguna Niguel Passing Siding**
Project No. : 15-123 **Date :** 02/15/16	**UNCONSOLIDATED UNDRAINED TEST** **(ASTM D2850)**



Boring No.		:	EMI-1		**Liquid Limit :**	-		**Moisture Content (%)**	**Dry Density**		**Percent Saturation**	**Void Ratio**
Sample No.		:	D-4		**Plastic Limit :**	-			**(pcf)**	**(kN/m³)**		
Depth	**(ft)**	:	20.0	21.5	**Plastic Index :**	-	**Initial**	29.60	92.21	14.51	96.50	0.83
	(m)	:	6.10	6.56	**Specific Gravity :**	2.70	**Final**	28.28	95.88	15.09	100.71	0.76

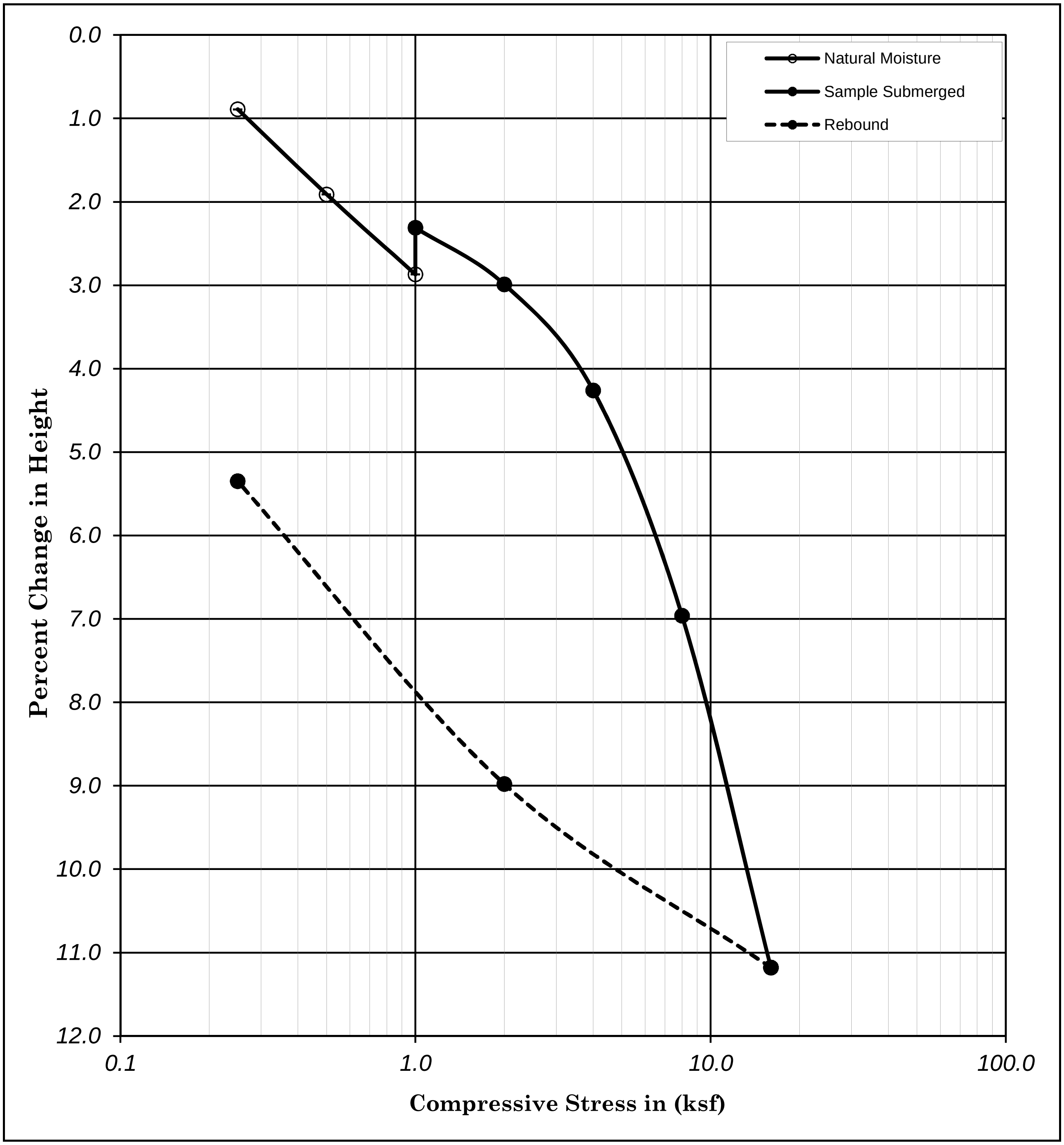
Description : Very dark gray with white dot, Fat CLAY (CH)

Earth Mechanics, Inc.
Geotechnical and Earthquake Engineering

OCTA Laguna Niguel Passing Siding

Project No. : 15-123 02/24/16

CONSOLIDATION TEST
(ASTM D-2435 / CT-219)



Boring No.		:	EMI-2		**Liquid Limit :**	-		**Moisture Content (%)**	**Dry Density**		**Percent Saturation**	**Void Ratio**
Sample No.		:	D-2		**Plastic Limit :**	-			**(pcf)**	**(kN/m^3)**		
Depth	**(ft)**	:	10.0	11.5	**Plastic Index :**	-	**Initial**	29.09	92.61	14.58	95.78	0.82
	(m)	:	3.05	3.51	**Specific Gravity :**	2.70	**Final**	27.42	97.86	15.40	102.46	0.72

Description : Olive brown, Lean CLAY (CL)

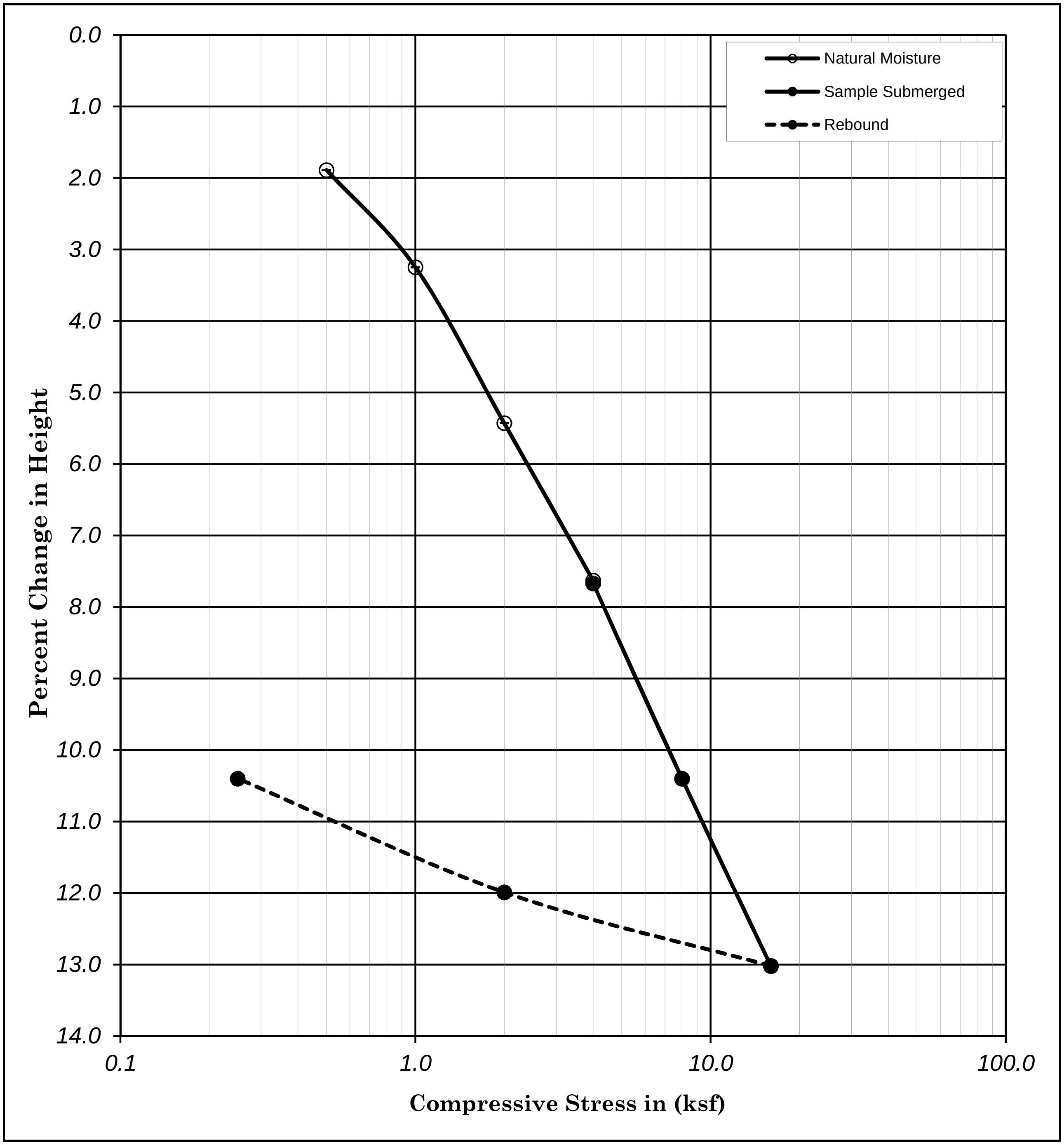
Earth Mechanics, Inc.
Geotechnical and Earthquake Engineering

OCTA Laguna Niguel Passing Siding

Project No. : 15-123 02/24/16

CONSOLIDATION TEST

(ASTM D-2435 / CT-219)



Boring No.		:	EMI-2		**Liquid Limit :**	-		**Moisture Content (%)**	**Dry Density**		**Percent Saturation**	**Void Ratio**
Sample No.		:	D-6		**Plastic Limit :**	-			**(pcf)**	**(kN/m³)**		
Depth	**(ft)**	:	30.0	31.5	**Plastic Index :**	-	**Initial**	27.02	97.28	15.31	99.58	0.73
	(m)	:	9.15	9.61	**Specific Gravity :**	2.70	**Final**	20.75	108.70	17.11	101.71	0.55

Description : *Olive-brown, SANDY lean CLAY (CL)*

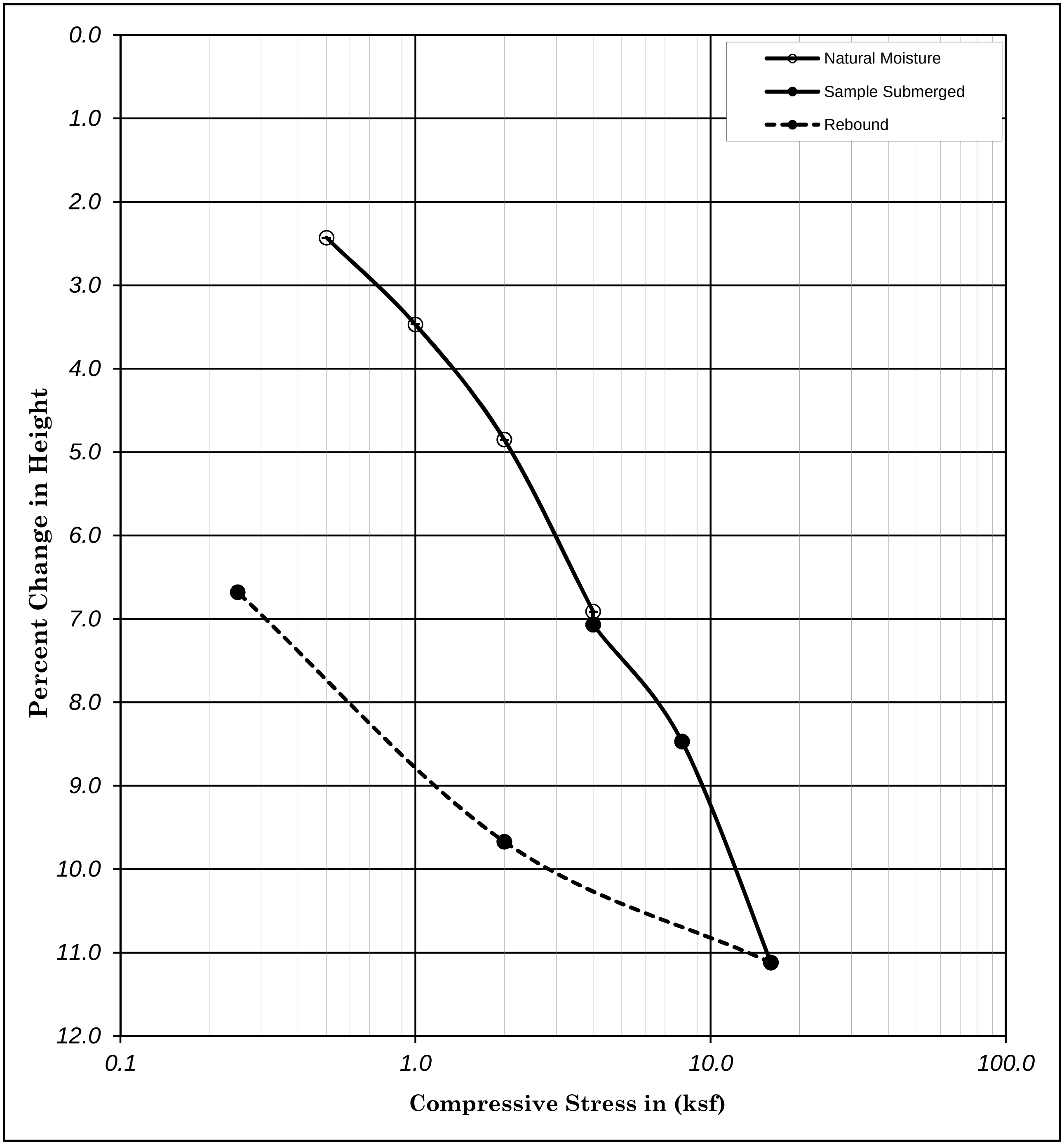
Earth Mechanics, Inc.
Geotechnical and Earthquake Engineering

OCTA Laguna Niguel Passing Siding

Project No. : 15-123 02/24/16

CONSOLIDATION TEST

(ASTM D-2435 / CT-219)



									Moisture Content (%)	Dry Density (pcf)	Dry Density (kN/m³)	Percent Saturation	Void Ratio
Boring No.		:	EMI-2		**Liquid Limit :**	-							
Sample No.		:	D-10		**Plastic Limit :**	-							
Depth	**(ft)**	:	50.0	51.5	**Plastic Index :**	-	**Initial**		25.01	99.35	15.64	96.92	0.70
	(m)	:	15.25	15.71	**Specific Gravity :**	2.70	**Final**		22.04	106.54	16.77	102.23	0.58

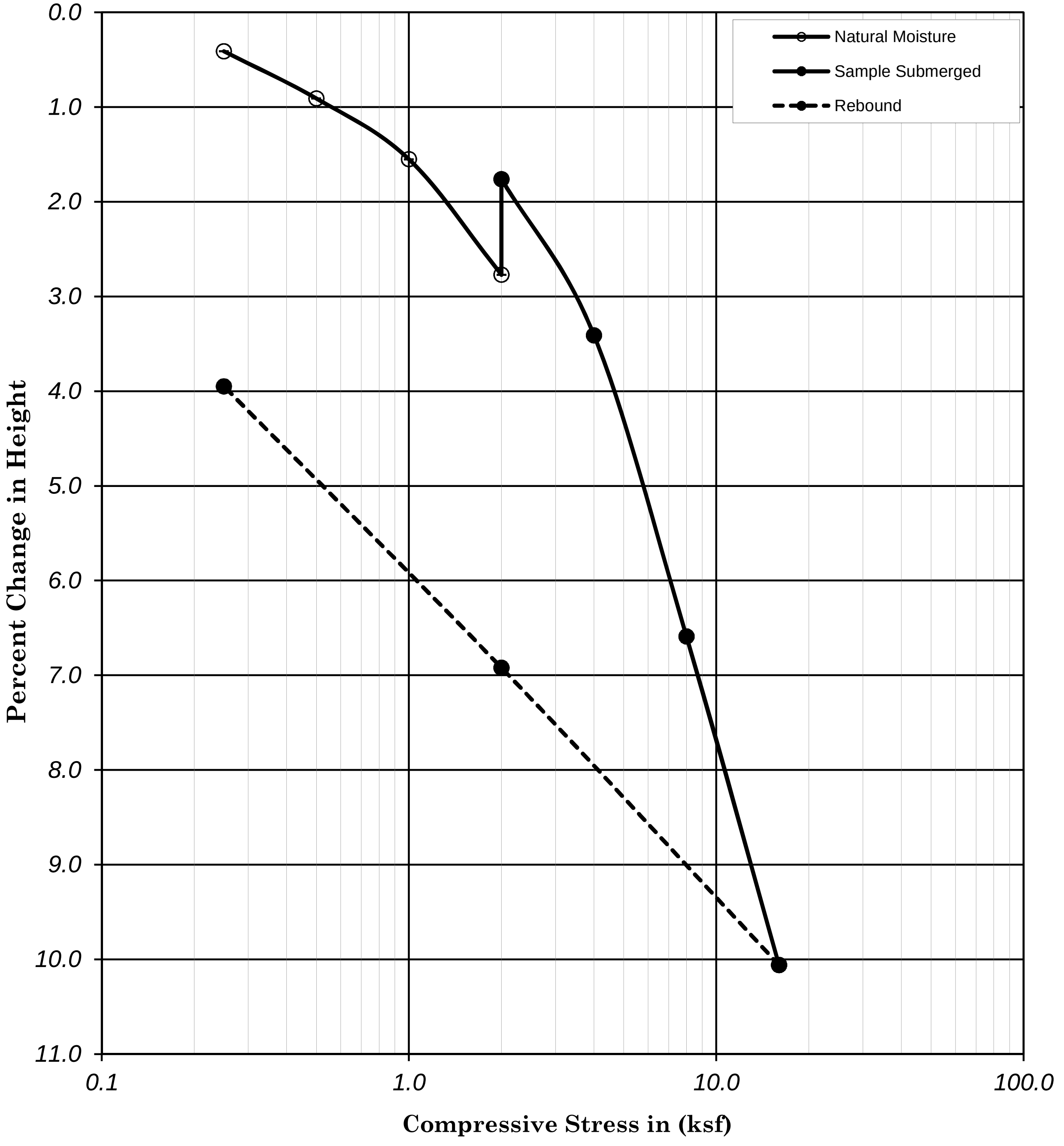
Description : *Dark olive-gray, Lean CLAY (CL)*

Earth Mechanics, Inc.
Geotechnical and Earthquake Engineering

OCTA Laguna Niguel Passing Siding

Project No. : 15-123 02/24/16

CONSOLIDATION TEST
(ASTM D-2435 / CT-219)



Boring No.		:EMI-6		**Liquid Limit :**	-		**Moisture Content (%)**	**Dry Density**		**Percent Saturation**	**Void Ratio**
Sample No.		: D-3		**Plastic Limit :**	-			**(pcf)**	**(kN/m³)**		
Depth	**(ft)**	: 7.5	9.0	**Plastic Index :**	-	**Initial**	14.70	114.38	18.00	83.78	0.47
	(m)	: 2.29	2.75	**Specific Gravity :**	2.70	**Final**	19.12	119.09	18.75	124.27	0.42

Description : Dark brown, SANDY lean CLAY

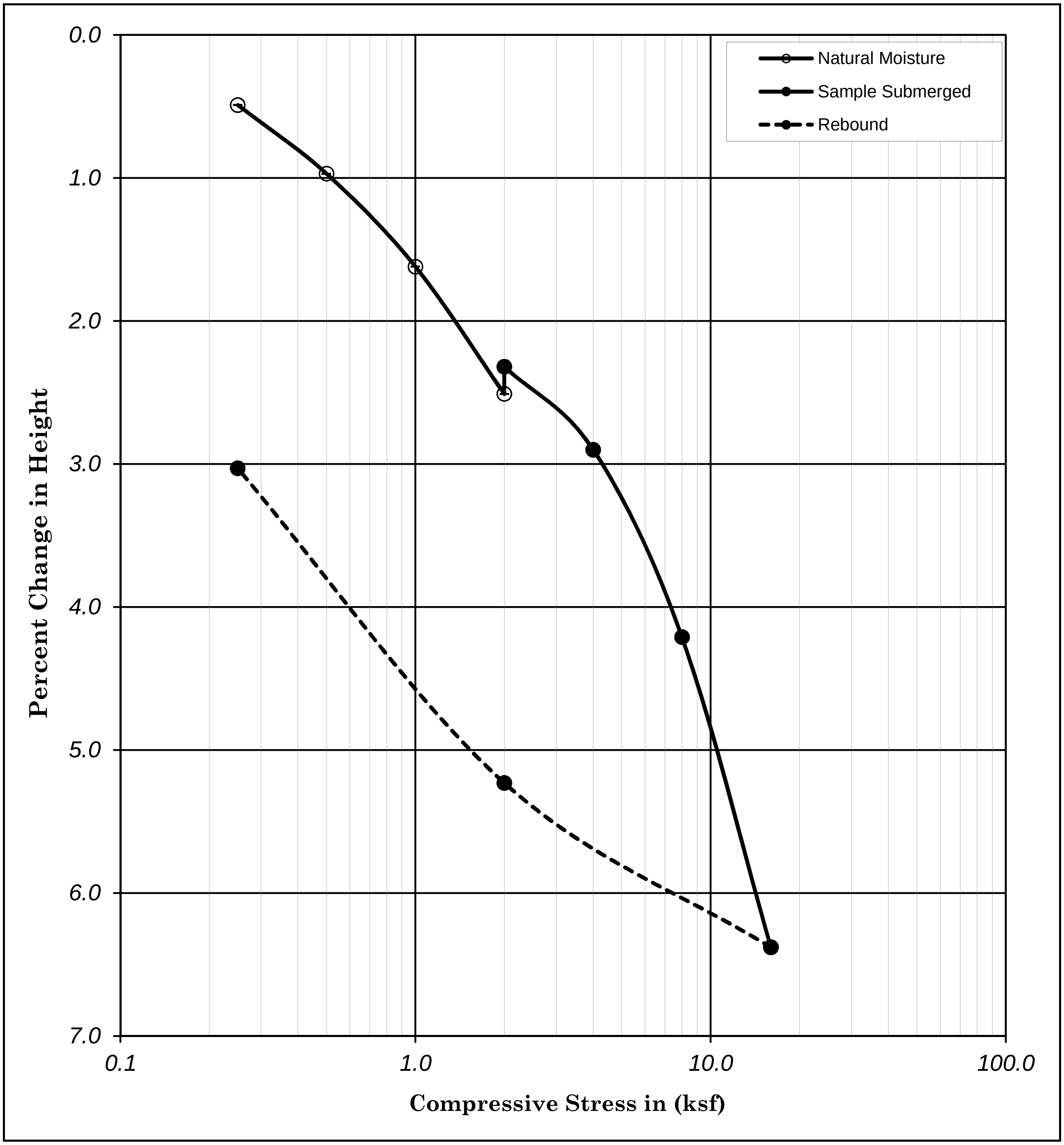
Earth Mechanics, Inc.
Geotechnical and Earthquake Engineering

OCTA Laguna Niguel Passing Siding

Project No. : 15-123 10/18/15

CONSOLIDATION TEST

(ASTM D-2435 / CT-219)



Boring No.		:	EMI-7		**Liquid Limit :**	-		**Moisture Content (%)**	**Dry Density**		**Percent Saturation**	**Void Ratio**
Sample No.		:	D-5		**Plastic Limit :**	-			**(pcf)**	**(kN/m³)**		
Depth	**(ft)**	:	15.0	16.5	**Plastic Index :**	-	**Initial**	20.17	99.02	15.59	77.53	0.70
	(m)	:	4.58	5.03	**Specific Gravity :**	2.70	**Final**	24.16	102.15	16.08	100.35	0.65

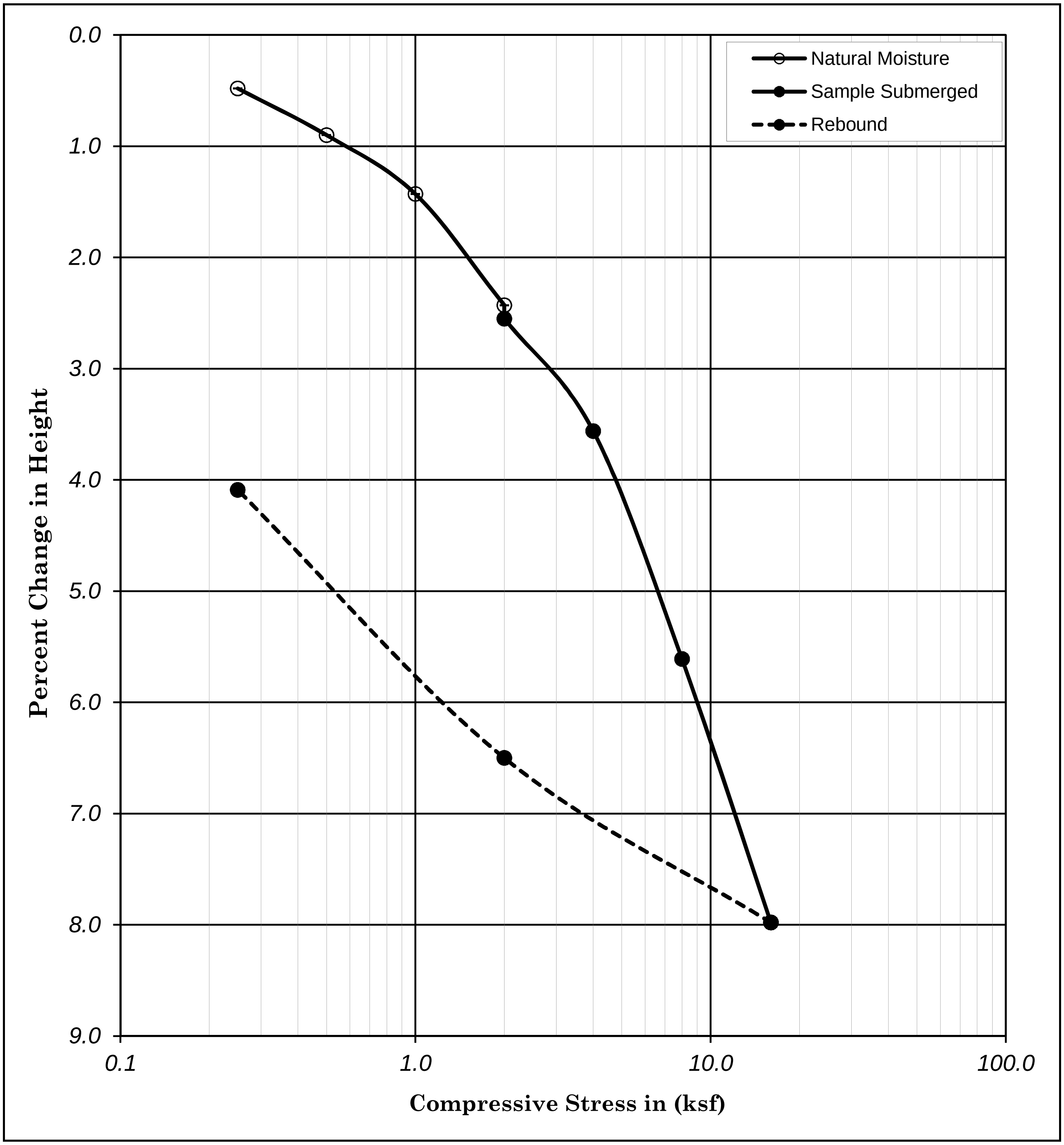
Description : *Olive-brown, SANDY lean CLAY*

Earth Mechanics, Inc.
Geotechnical and Earthquake Engineering

OCTA Laguna Niguel Passing Siding

Project No. : 15-123 10/18/15

CONSOLIDATION TEST
(ASTM D-2435 / CT-219)



Boring No.		:EMI-7		**Liquid Limit :**	-		**Moisture Content (%)**	**Dry Density (pcf)**	**(kN/m³)**	**Percent Saturation**	**Void Ratio**
Sample No.		: D-7		**Plastic Limit :**	-						
Depth	**(ft)**	: 25.0	26.5	**Plastic Index :**	-	**Initial**	15.46	116.19	18.29	92.62	0.45
	(m)	: 7.63	8.08	**Specific Gravity :**	2.70	**Final**	16.83	121.16	19.07	116.14	0.39

Description : Olive-brown, SANDY lean CLAY

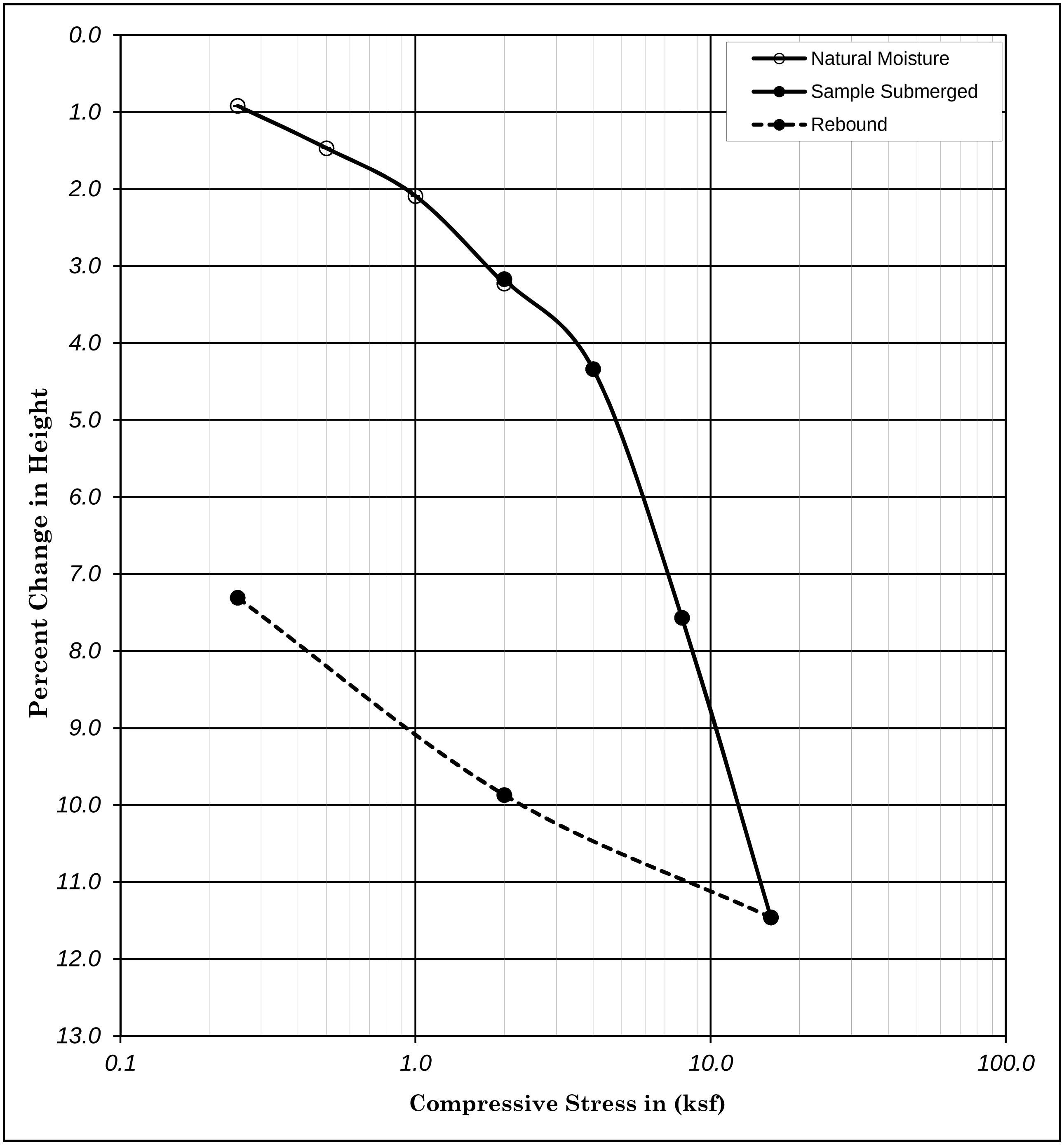
Earth Mechanics, Inc.
Geotechnical and Earthquake Engineering

OCTA Laguna Niguel Passing Siding

Project No. : 15-123 10/18/15

CONSOLIDATION TEST

(ASTM D-2435 / CT-219)



Boring No.	:EMI-8			**Liquid Limit :**	-		**Moisture Content (%)**	**Dry Density**		**Percent Saturation**	**Void Ratio**
Sample No.	: D-5			**Plastic Limit :**	-			**(pcf)**	**(kN/m³)**		
Depth	**(ft)** :	15.0	16.5	**Plastic Index :**	-	**Initial**	26.74	88.82	13.98	80.43	0.90
	(m) :	4.58	5.03	**Specific Gravity :**	2.70	**Final**	30.90	95.83	15.08	109.95	0.76

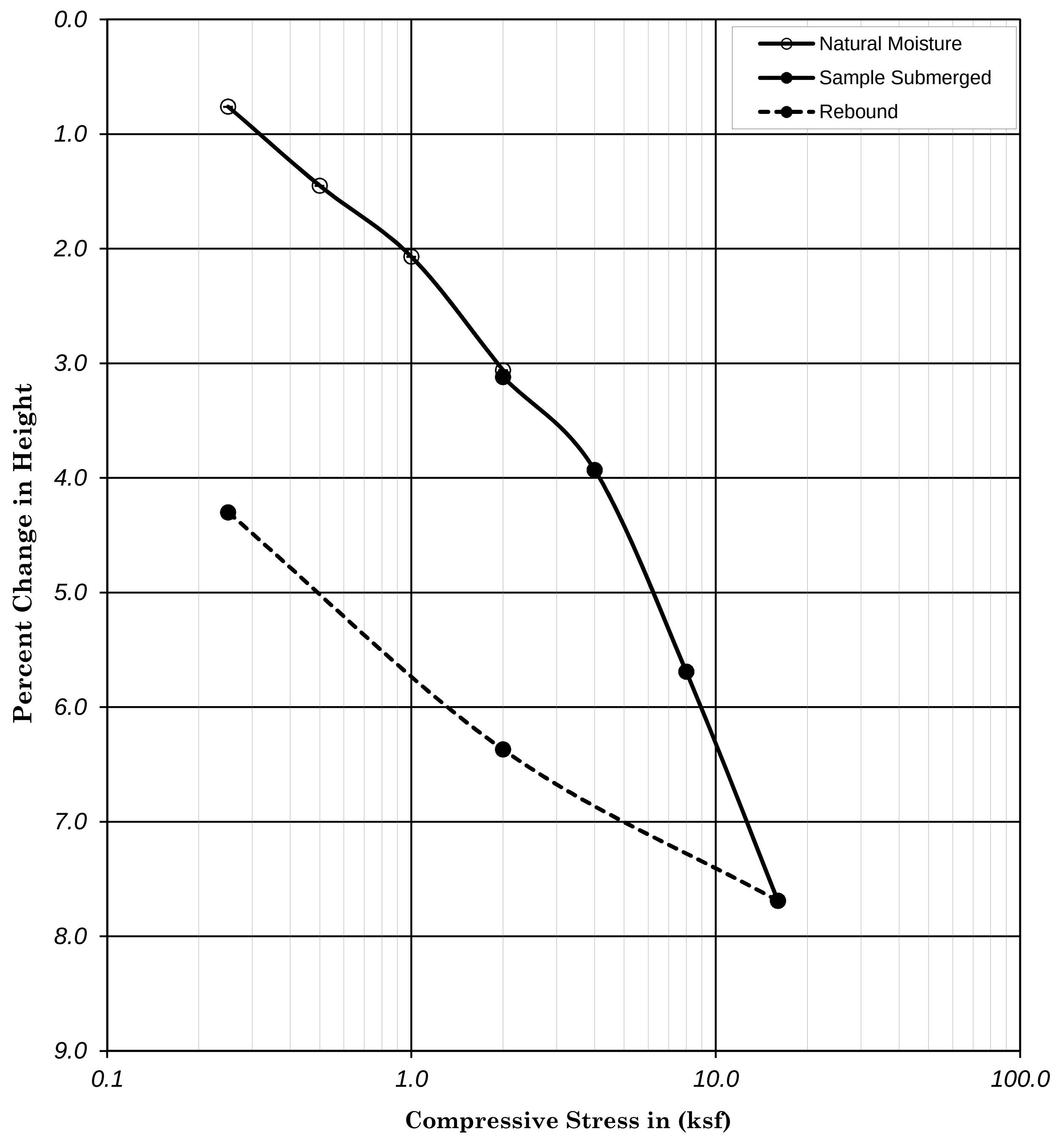
Description : Dark olive-brown with yellowish brown, SANDY lean CLAY (CL)

Earth Mechanics, Inc.
Geotechnical and Earthquake Engineering

OCTA Laguna Niguel Passing Siding

Project No. : 15-123 10/18/15

CONSOLIDATION TEST
(ASTM D-2435 / CT-219)



Boring No.	:EMI-8			**Liquid Limit :**	-		**Moisture**	**Dry Density**		**Percent**	**Void**
Sample No.	: D-7			**Plastic Limit :**	-		**Content (%)**	**(pcf)**	**(kN/m³)**	**Saturation**	**Ratio**
Depth	**(ft)** :	25.0	26.5	**Plastic Index :**	-	**Initial**	15.03	118.40	18.64	95.81	0.42
	(m) :	7.63	8.08	**Specific Gravity :**	2.70	**Final**	15.16	123.80	19.49	113.20	0.36

Description : *Dark brown, SANDY lean CLAY (CL)*

Earth Mechanics, Inc.
Geotechnical and Earthquake Engineering

OCTA Laguna Niguel Passing Siding

Project No. : *15-123* *10/18/15*

CONSOLIDATION TEST
(ASTM D-2435 / CT-219)

IFB C-7-2018
EXHIBIT J

COMPACTION TEST

(ASTM D-1557-91)

Project Name : HNTB, OCTA Laguna Niguel Passing Siding
Project No. : 15-123
Boring No. : EMI-6 Dry Density = S.G*62.43/(1+Moisture Content*.0265)
Sample No. : B-0
Depth (ft/m) : 0.0 5.0 | 0.00 1.53
Location :
Description : Dark brown, CLAYEY SAND with GRAVEL (SC)

Sampleing By :
Prepared By : KK
Test By : KK
Calculated By : JF
Checked By : MH

Date :
Date : 10/2/2015
Date : 10/2/2015
Date : 10/20/2015
Date :

Estimated Moisture Content (%)	**Field**	4	6	8	3
Container Number		S-30	S-27	S-15	S-29
Wt. of Wet Soil + Container (gm)		559.12	511.97	584.38	526.56
Wt. of Dry Soil + Container (gm)		536.98	483.48	540.85	514.06
Weight of Container (gm)		114.21	112.49	114.67	112.26
Moisture Content (%)		**5.24**	**7.68**	**10.21**	**3.11**
Weight of Wet Soil + Mold (gm)		3940.00	4055.00	4065.00	3805.00
Weight of Mold (gm)	1966.38	1966.38	1966.38	1966.38	1966.38
Wet Density (pcf)		130.66	138.27	138.94	121.72
Dry Density (pcf)		**124.16**	**128.41**	**126.06**	**118.05**

Hammer Weight : 10 (lb.)

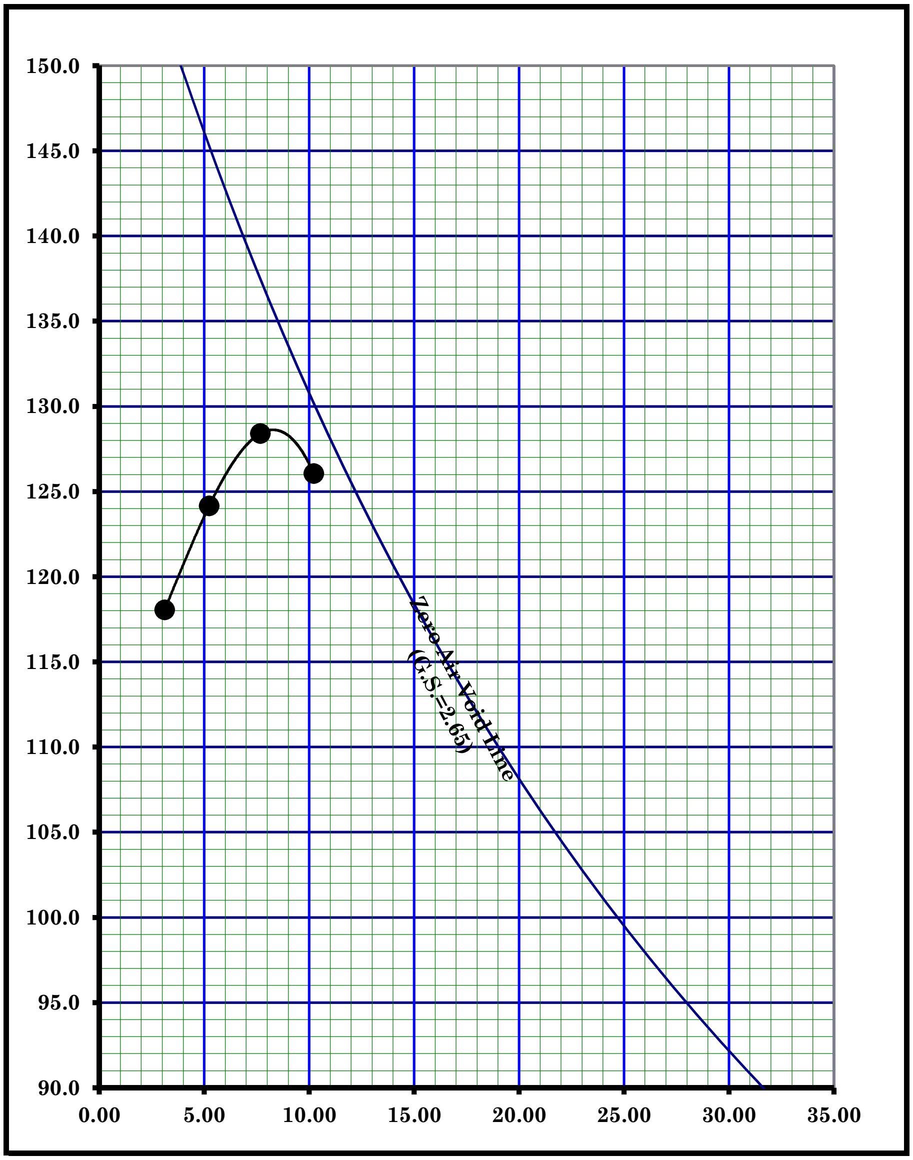
Hammer Drop : 18"

Rammer Used	**Manual**	
	Mechanical	X

Total Wt. of Soil : 17905.00

Sieve	**Weight Sample**	**% of Retained**	**% of Passing**
3/4"	1620.00	9.05	90.95
3/8"	2995.00	16.73	83.27
No. 4	4400.00	24.57	75.43

Mold Volume (ft^3) 0.0333



Test Method

A **4" Mold** **5 Layer** **25 Blow / Layer**

☐ **Material Passing No. 4 Sieve**
If < 20% Material + No. 4 Sieve
Mold Volume (ft^3) = 0.0333

B **4" Mold** **5 Layer** **25 Blow / Layer**

☒ **Material Passing 3/8" Sieve**
If > 20% Material + No. 4 Sieve
< 20% Material + 3/8" Sieve
Mold Volume (ft^3) = 0.0333

C **6" Mold** **5 Layer** **56 Blow / Layer**

Material Passing 3/4" Sieve
If > 20% Material + 3/8" Sieve
< 30% Material + 3/4" Sieve
Mold Volume (ft^3) = 0.07502

Other **6" Mold** **5 Layer** **56 Blow / Layer**

☐ **If test Specimen > 5% by weight of Oversize (Coarse Fraction) and material will not be included in the tests. (>40%+No.4, >30%+3/4" Sieve)**

Correction must be made to the unit weight and water content of test specimen

Maximun Density				**Optium Moisture (%)**
Dry		**Wet**		
(pcf)	**(kN/m^3)**	**(pcf)**	**(kN/m^3)**	
129.0	20.3	139.3	21.9	8.0

IFB C-7-2018
EXHIBIT J

COMPACTION TEST

(ASTM D-1557-91)

Project Name : *HNTB, OCTA Laguna Niguel Passing Siding*
Project No. : *15-123*
Boring No. : *EMI-7*
Dry Density = S.G*62.43/(1+Moisture Content*.0265)
Sample No. : *B-0*
Depth (ft/m) : *0.0 5.0* *0.00 1.53*
Location :
Description : *Dark brown, CLAYEY SAND (SC)*

Sampleing By :
Date :
Prepared By : *KK*
Date : *10/2/2015*
Test By : *KK*
Date : *10/2/2015*
Calculated By : *JF*
Date : *10/20/2015*
Checked By : MH
Date :

Estimated Moisture Content (%)	**Field**	10	8	6	4
Container Number		S-4	S-28	S-25	S-24
Wt. of Wet Soil + Container (gm)		418.98	595.65	510.27	600.34
Wt. of Dry Soil + Container (gm)		391.77	542.16	483.87	576.95
Weight of Container (gm)		118.03	115.03	112.78	112.99
Moisture Content (%)		**9.94**	**12.52**	**7.11**	**5.04**
Weight of Wet Soil + Mold (gm)		4100.00	4005.00	4075.00	3955.00
Weight of Mold (gm)	1966.38	1966.38	1966.38	1966.38	1966.38
Wet Density (pcf)		141.25	134.96	139.60	131.65
Dry Density (pcf)		**128.48**	**119.94**	**130.33**	**125.34**

Hammer Weight : 10 (lb.)

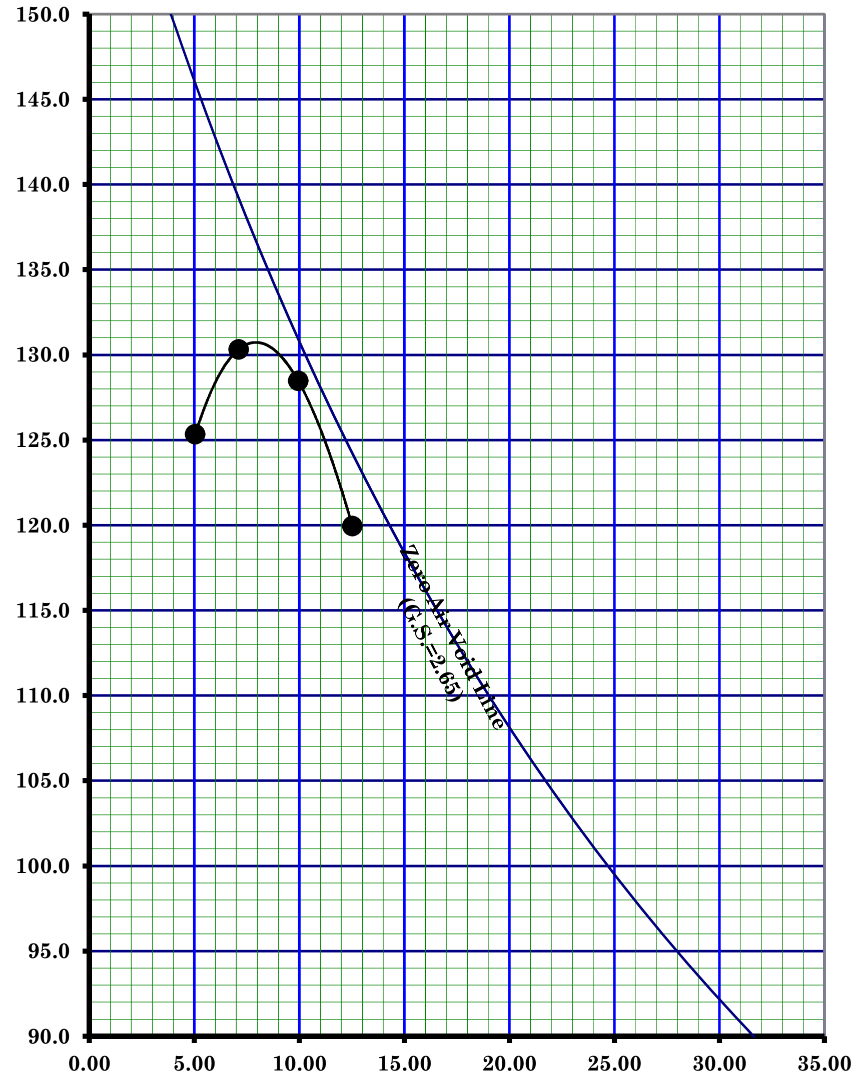
Hammer Drop : 18"

Rammer Used	**Manual**	
	Mechanical	X

Total Wt. of Soil : 19165.00

Sieve	**Weight**	**% of**	**% of Passing**
	Sample	**Retained**	
3/4"	0.00	0.00	100.00
3/8"	0.00	0.00	100.00
No. 4	1945.00	10.15	89.85

Mold Volume (ft^3) 0.0333



Test Method

A

4" Mold
5 Layer
25 Blow / Layer

X
Material Passing No. 4 Sieve
If < 20% Material + No. 4 Sieve
Mold Volume (ft^3) = **0.0333**

B

4" Mold
5 Layer
25 Blow / Layer

#
Material Passing 3/8" Sieve
If > 20% Material + No. 4 Sieve
< 20% Material + 3/8" Sieve
Mold Volume (ft^3) = **0.0333**

C

6" Mold
5 Layer
56 Blow / Layer

#
Material Passing 3/4" Sieve
If > 20% Material + 3/8" Sieve
< 30% Material + 3/4" Sieve
Mold Volume (ft^3) = **0.07502**

O_{ther}

6" Mold
5 Layer
56 Blow / Layer

☐
If test Specimen > 5% by weight of Oversize (Coarse Fraction) and material will not be included in the tests. (>40%+No.4, >30%+3/4" Sieve)

Correction must be made to the unit weight and water content of test specimen

Maximun Density				**Optium Moisture (%)**
Dry		**Wet**		
(pcf)	**(kN/m^3)**	**(pcf)**	**(kN/m^3)**	
131.0	**20.6**	**141.5**	**22.3**	**8.0**

IFB C-7-2018
EXHIBIT J

COMPACTION TEST

(ASTM D-1557-91)

Project Name : *HNTB, OCTA Laguna Niguel Passing Siding*
Project No. : *15-123*
Boring No. : *EMI-8* Dry Density = S.G*62.43/(1+Moisture Content*.0265)
Sample No. : *B-0*
Depth (ft/m) : *0.0 5.0* *0.00 1.53*
Location :
Description : *Brown, SILTY SAND (SM)*

Sampleing By :
Prepared By : *KK*
Test By : *KK*
Calculated By : *JF*
Checked By : MH

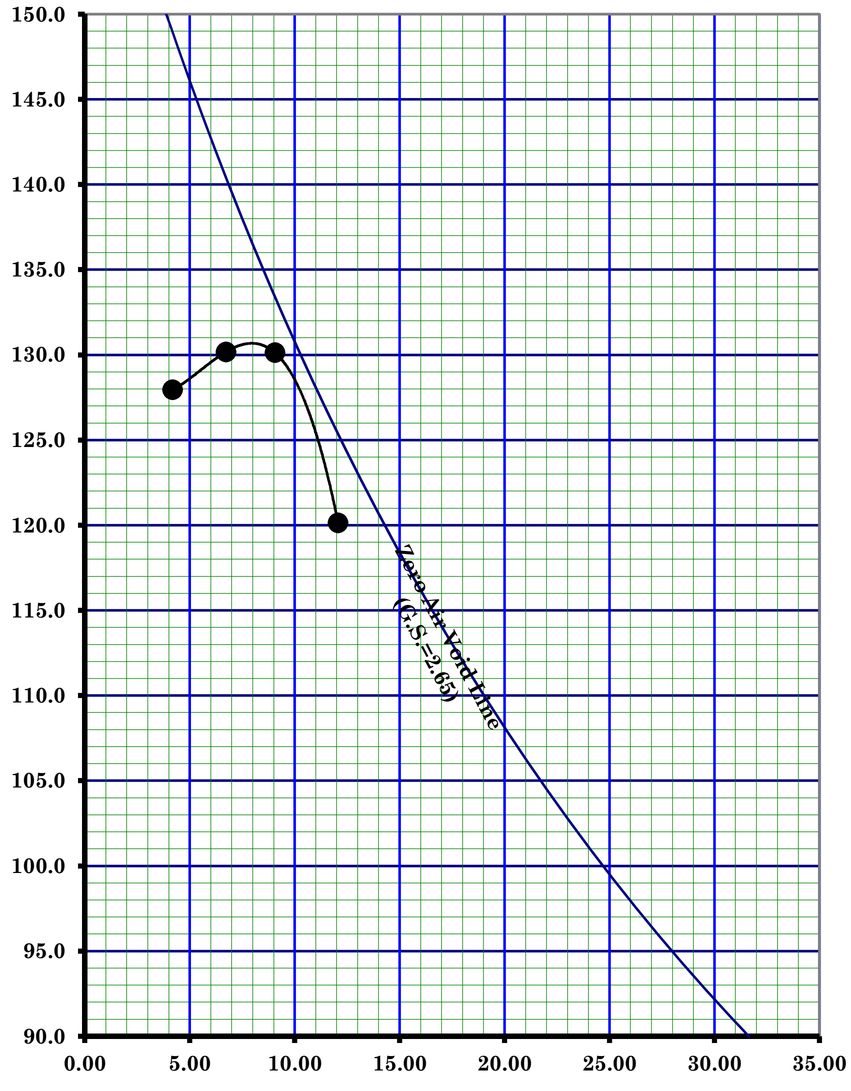
Date :
Date : *10/2/2015*
Date : *10/2/2015*
Date : *10/20/2015*
Date :

Estimated Moisture Content (%)	**Field**	4	6	8	10
Container Number		*S-30*	*S-27*	*S-15*	*S-29*
Wt. of Wet Soil + Container (gm)		*538.34*	*718.57*	*499.49*	*627.22*
Wt. of Dry Soil + Container (gm)		*521.30*	*680.36*	*467.52*	*571.76*
Weight of Container (gm)		*114.18*	*112.49*	*114.68*	*112.29*
Moisture Content (%)		***4.19***	***6.73***	***9.06***	***12.07***
Weight of Wet Soil + Mold (gm)		*3980.00*	*4065.00*	*4110.00*	*4000.00*
Weight of Mold (gm)	*1966.38*	*1966.38*	*1966.38*	*1966.38*	*1966.38*
Wet Density (pcf)		*133.31*	*138.94*	*141.92*	*134.63*
Dry Density (pcf)		***127.95***	***130.18***	***130.13***	***120.13***

Hammer Weight : 10 (lb.)		
Hammer Drop : 18"		
Rammer Used	**Manual**	
	Mechanical	*X*
Total Wt. of Soil :	*19625.00*	

Sieve	**Weight**	**% of**	**% of Passing**
	Sample	**Retained**	
3/4"	*0.00*	*0.00*	*100.00*
3/8"	*0.00*	*0.00*	*100.00*
No. 4	*2980.00*	*15.18*	*84.82*

Mold Volume (ft^3) *0.0333*



Test Method

A **4" Mold** **5 Layer**
25 Blow / Layer
☒ **Material Passing No. 4 Sieve**
If < 20% Material + No. 4 Sieve
Mold Volume (ft^3) = 0.0333

B **4" Mold** **5 Layer**
25 Blow / Layer
\# **Material Passing 3/8" Sieve**
If > 20% Material + No. 4 Sieve
< 20% Material + 3/8" Sieve
Mold Volume (ft^3) = 0.0333

C **6" Mold** **5 Layer**
56 Blow / Layer
\# **Material Passing 3/4" Sieve**
If > 20% Material + 3/8" Sieve
< 30% Material + 3/4" Sieve
Mold Volume (ft^3) = 0.07502

Other **6" Mold** **5 Layer**
56 Blow / Layer
☐ **If test Specimen > 5% by weight of Oversize (Coarse Fraction) and material will not be included in the tests. (>40%+No.4, >30%+3/4" Sieve)**

Correction must be made to the unit weight and water content of test specimen

Maximun Density				**Optium Moisture (%)**
Dry		**Wet**		
(pcf)	**(kN/m^3)**	**(pcf)**	**(kN/m^3)**	
130.5	***20.5***	***140.9***	***22.2***	***8.0***

AP Engineering and Testing, Inc.
DBE|MBE|SBE
2607 Pomona Boulevard | Pomona, CA 91768
t. 909.869.6316 | f. 909.869.6318 | www.aplaboratory.com

COMPACTION TEST

Client: Earth Mechanics, Inc.

AP Number: 16-0233

Project Name: HNTB/OCTA Laguna Niguel Passing Siding

Tested By: ALB

Date: 02/18/16

Project No. : 15-123

Calculated By: NN

Date: 02/22/16

Boring No.: EMI-11A

Checked By: AP

Date: 02/22/16

Sample No.: B-0

Depth(ft.): 0-5

Visual Sample Description: Sandy Silt

Compaction Method ☒ ASTM D1557
☐ ASTM D698

Preparation Method ☐ Moist
☒ Dry

METHOD: A

MOLD VOLUME (CU.FT): 0.0333

Wt. Comp. Soil + Mold (gm.)	3769	3842	3872	3860		
Wt. of Mold (gm.)	1845	1845	1845	1845		
Net Wt. of Soil (gm.)	1924	1997	2027	2015		
Container No.						
Wt. of Container (gm.)	144.33	148.61	149.63	152.82		
Wet Wt. of Soil + Cont. (gm.)	483.50	544.35	569.66	618.66		
Dry Wt. of Soil + Cont. (gm.)	460.15	509.46	525.13	563.23		
Moisture Content (%)	7.39	9.67	11.86	13.51		
Wet Density (pcf)	127.25	132.08	134.06	133.27		
Dry Density (pcf)	118.49	120.43	119.85	117.41		

Maximum Dry Density (pcf) **120.9**

Maximum Dry Density w/ Rock Correction (pcf) **N/A**

Optimum Moisture Content (%) **10.6**

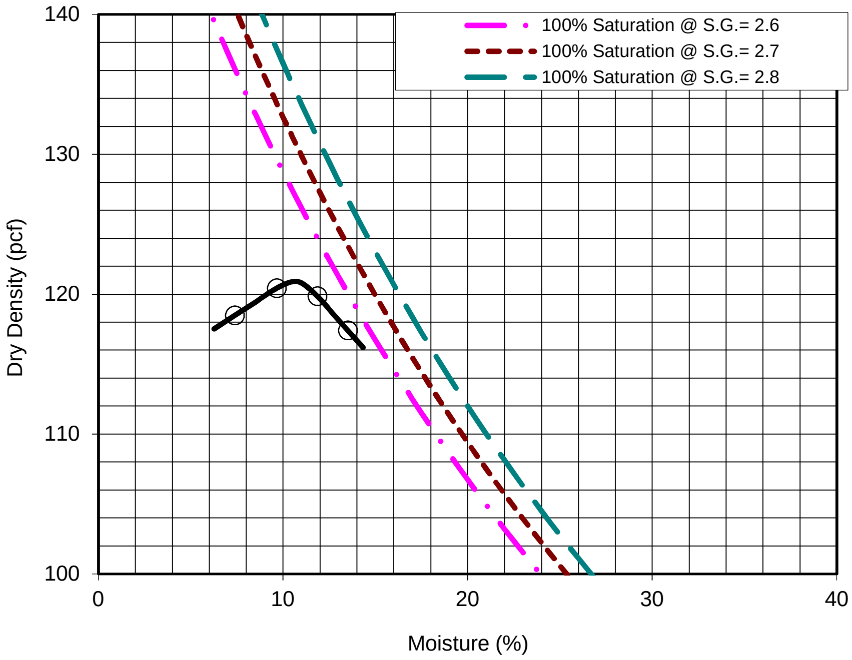
Optimum Moisture Content w/ Rock Correction (%) **N/A**

PROCEDURE USED

☒ *METHOD A: Percent of Oversize:* *4.6%*
Soil Passing No. 4 (4.75 mm) Sieve
Mold : 4 in. (101.6 mm) diameter
Layers : 5 (Five)
Blows per layer : 25 (twenty-five)

☐ *METHOD B: Percent of Oversize:* *N/A*
Soil Passing 3/8 in. (9.5 mm) Sieve
Mold : 4 in. (101.6 mm) diameter
Layers : 5 (Five)
Blows per layer : 25 (twenty-five)

☐ *METHOD C: Percent of Oversize:* *N/A*
Soil Passing 3/4 in. (19.0 mm) Sieve
Mold : 6 in. (152.4 mm) diameter
Layers : 5 (Five)
Blows per layer : 56 (fifty-six)



IFB C-7-2018
EXHIBIT J

AP Engineering and Testing, Inc.
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2607 Pomona Boulevard | Pomona, CA 91768
t. 909.869.6316 | f. 909.869.6318 | www.aplaboratory.com

COMPACTION TEST

Client: Earth Mechanics, Inc.
AP Number: 16-0233
Project Name: HNTB/OCTA Laguna Niguel Passing Siding
Tested By: JT
Date: 02/18/16
Project No. : 15-123
Calculated By: NN
Date: 02/22/16
Boring No.: EMI-12A
Checked By: AP
Date: 02/22/16
Sample No.: B-0
Depth(ft.): 0-5
Visual Sample Description: Silty Sand

Compaction Method
☒ ASTM D1557
☐ ASTM D698

METHOD: A
MOLD VOLUME (CU.FT): 0.0333

Preparation Method
☐ Moist
☒ Dry

Wt. Comp. Soil + Mold (gm.)	3769	3840	3864	3842		
Wt. of Mold (gm.)	1846	1846	1846	1846		
Net Wt. of Soil (gm.)	1923	1994	2018	1996		
Container No.						
Wt. of Container (gm.)	135.67	148.22	147.97	156.25		
Wet Wt. of Soil + Cont. (gm.)	356.97	405.86	422.55	460.71		
Dry Wt. of Soil + Cont. (gm.)	338.19	379.23	387.42	417.84		
Moisture Content (%)	9.27	11.53	14.67	16.39		
Wet Density (pcf)	127.18	131.88	133.47	132.01		
Dry Density (pcf)	116.39	118.25	116.39	113.43		

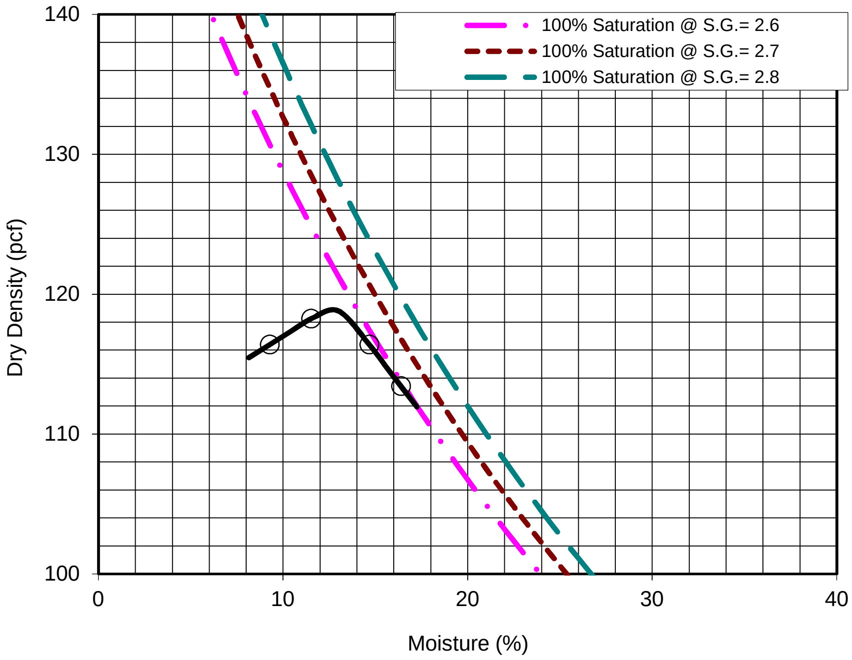
Maximum Dry Density (pcf): **118.8**
Maximum Dry Density w/ Rock Correction (pcf): **N/A**
Optimum Moisture Content (%): **12.8**
Optimum Moisture Content w/ Rock Correction (%): **N/A**

PROCEDURE USED

☒ *METHOD A: Percent of Oversize:* *2.3%*
Soil Passing No. 4 (4.75 mm) Sieve
Mold : 4 in. (101.6 mm) diameter
Layers : 5 (Five)
Blows per layer : 25 (twenty-five)

☐ *METHOD B: Percent of Oversize:* *N/A*
Soil Passing 3/8 in. (9.5 mm) Sieve
Mold : 4 in. (101.6 mm) diameter
Layers : 5 (Five)
Blows per layer : 25 (twenty-five)

☐ *METHOD C: Percent of Oversize:* *N/A*
Soil Passing 3/4 in. (19.0 mm) Sieve
Mold : 6 in. (152.4 mm) diameter
Layers : 5 (Five)
Blows per layer : 56 (fifty-six)



IFB C-7-2018
EXHIBIT J

AP Engineering and Testing, Inc.
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2607 Pomona Boulevard | Pomona, CA 91768
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R-VALUE TEST DATA

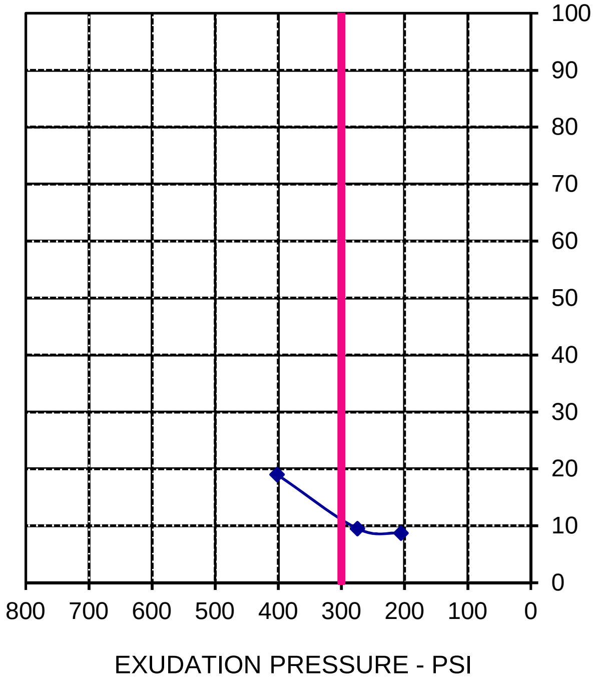
ASTM D2844

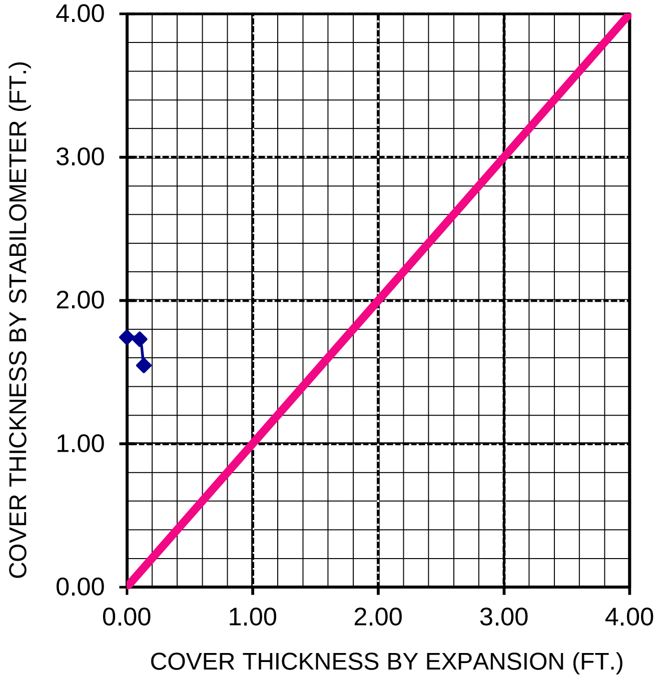
Project Name:	HNTB/OCTA Laguna Niguel Passing Siding	Tested By:	ST	Date:	02/13/16
Project Number:	15-123	Computed By:	KM	Date:	02/15/16
Boring No.:	EMI-1	Checked By:	AP	Date:	02/23/16

Sample No.: B-0 Depth (ft): 0-5
Location: N/A
Soil Description: Sandy Clay w/gravel

Mold Number	D	E	F	
Water Added, g	0	10	21	
Compact Moisture(%)	14.2	15.3	16.5	
Compaction Gage Pressure, psi	50	50	50	
Exudation Pressure, psi	402	275	206	
Sample Height, Inches	2.4	2.5	2.5	
Gross Weight Mold, g	3012	2996	2928	
Tare Weight Mold, g	1970	1956	1870	
Net Sample Weight, g	1042	1040	1058	
Expansion, inchesx10^{-4}	4	3	0	
Stability 2,000 (160 psi)	40/110	52/134	54/136	
Turns Displacement	4.61	4.62	4.62	
R-Value Uncorrected	20	10	9	
R-Value Corrected	19	10	9	
Dry Density, pcf	115.2	109.3	110.1	
Traffic Index	8.0	8.0	8.0	
G.E. by Stability	1.55	1.73	1.74	
G.E. by Expansion	0.13	0.10	0.00	

R-VALUE	By Exudation:	11
	By Expansion:	*N/A
	At Equilibrium: (by Exudation)	11
Remarks	Gf = 1.34, and 6.4 % Retained on the ¾" *Not Applicable	





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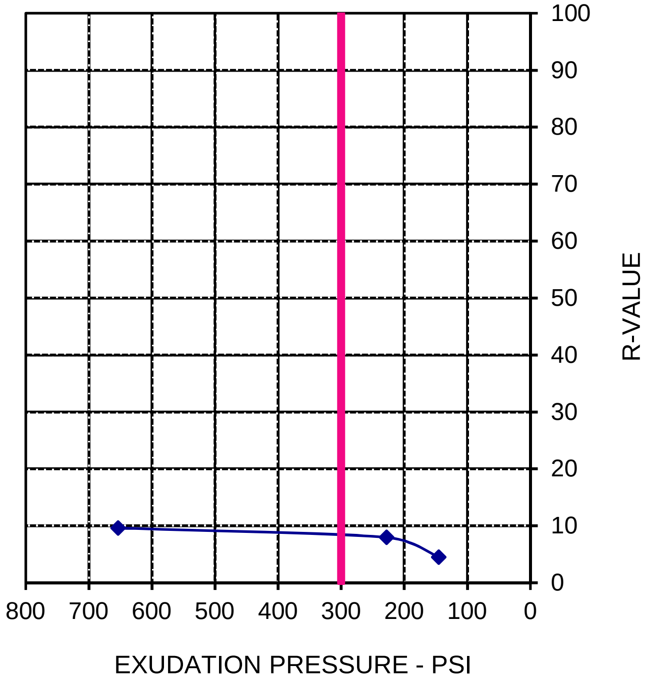
R-VALUE TEST DATA

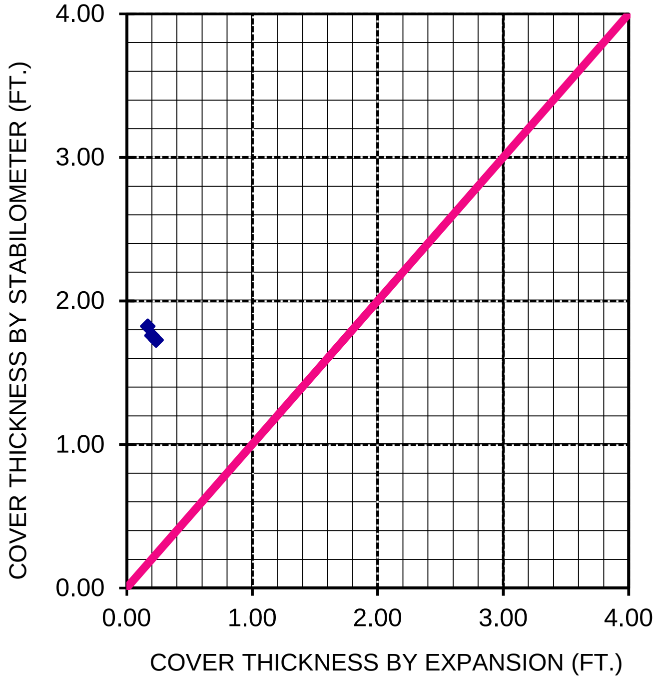
ASTM D2844

Project Name: HNTB/OCTA Laguna Niguel Passing Siding
Tested By: ST Date: 02/13/16
Project Number: 15-123
Computed By: KM Date: 02/15/16
Boring No.: EMI-5
Checked By: AP Date: 02/23/16
Sample No.: B-0 Depth (ft): 0-5
Location: N/A
Soil Description: Clay w/sand

Mold Number	A	C	B	
Water Added, g	0	10	25	
Compact Moisture(%)	18.9	20.1	21.8	
Compaction Gage Pressure, psi	50	50	50	
Exudation Pressure, psi	654	228	145	
Sample Height, Inches	2.5	2.5	2.6	
Gross Weight Mold, g	3006	3010	3026	
Tare Weight Mold, g	1969	1966	1968	
Net Sample Weight, g	1038	1044	1058	
Expansion, inchesx10^{-4}	7	6	5	
Stability 2,000 (160 psi)	55/134	60/136	64/146	
Turns Displacement	4.56	5.10	5.11	
R-Value Uncorrected	10	8	4	
R-Value Corrected	10	8	5	
Dry Density, pcf	105.7	105.4	101.3	
Traffic Index	8.0	8.0	8.0	
G.E. by Stability	1.73	1.76	1.82	
G.E. by Expansion	0.23	0.20	0.17	

R-VALUE	By Exudation:	9
	By Expansion:	*N/A
	At Equilibrium: (by Exudation)	9
Remarks	Gf = 1.34, and 1.2 % Retained on the ¾" *Not Applicable	





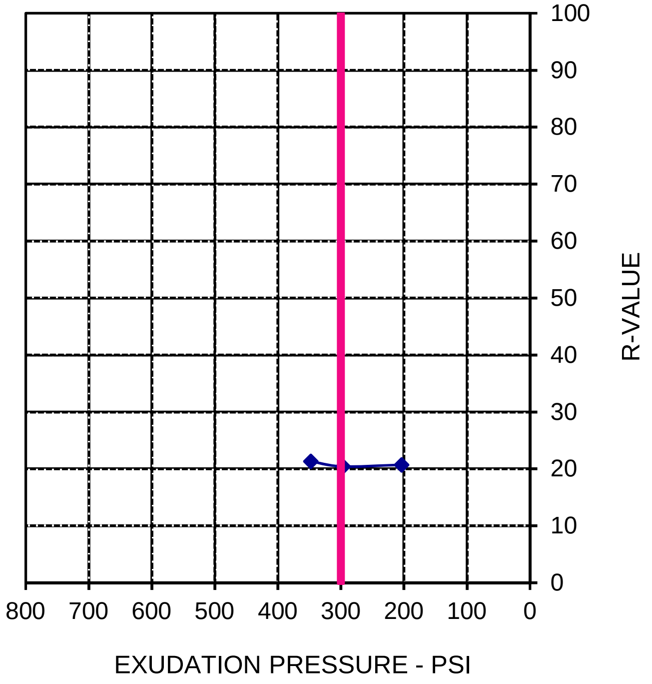
R-VALUE TEST DATA

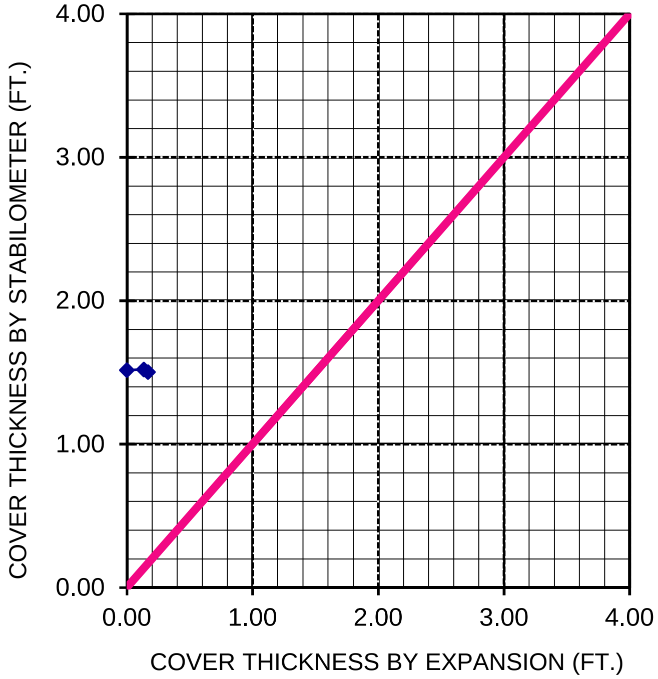
ASTM D2844

Project Name: HNTB/OCTA Laguna Niguel Passing Siding
Tested By: ST Date: 02/15/16
Project Number: 15-123
Computed By: KM Date: 02/16/16
Boring No.: EMI-11A
Checked By: AP Date: 02/23/16
Sample No.: B-0 Depth (ft): 0-5
Location: N/A
Soil Description: Sandy Silt

Mold Number	G	I	H	
Water Added, g	0	-10	-20	
Compact Moisture(%)	17.0	15.9	14.8	
Compaction Gage Pressure, psi	50	50	50	
Exudation Pressure, psi	204	297	348	
Sample Height, Inches	2.5	2.5	2.5	
Gross Weight Mold, g	2873	2863	2843	
Tare Weight Mold, g	1829	1838	1820	
Net Sample Weight, g	1044	1025	1023	
Expansion, inchesx10^{-4}	0	4	5	
Stability 2,000 (160 psi)	42/110	41/111	40/112	
Turns Displacement	4.35	4.30	3.95	
R-Value Uncorrected	21	20	21	
R-Value Corrected	21	20	21	
Dry Density, pcf	108.1	107.2	108.0	
Traffic Index	8.0	8.0	8.0	
G.E. by Stability	1.51	1.52	1.50	
G.E. by Expansion	0.00	0.13	0.17	

R-VALUE	By Exudation:	20
	By Expansion:	*N/A
	At Equilibrium: (by Exudation)	20
Remarks	Gf = 1.34, and 0.0 % Retained on the ¾" *Not Applicable	





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R-VALUE TEST DATA

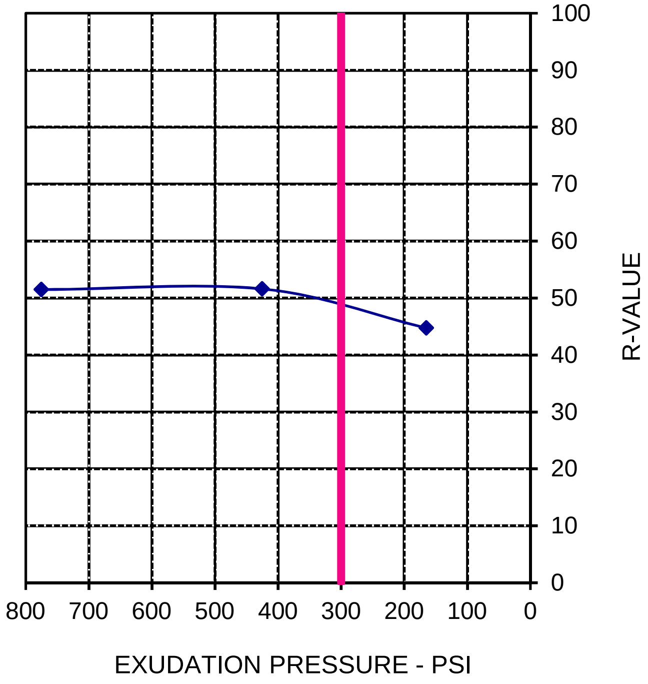
ASTM D2844

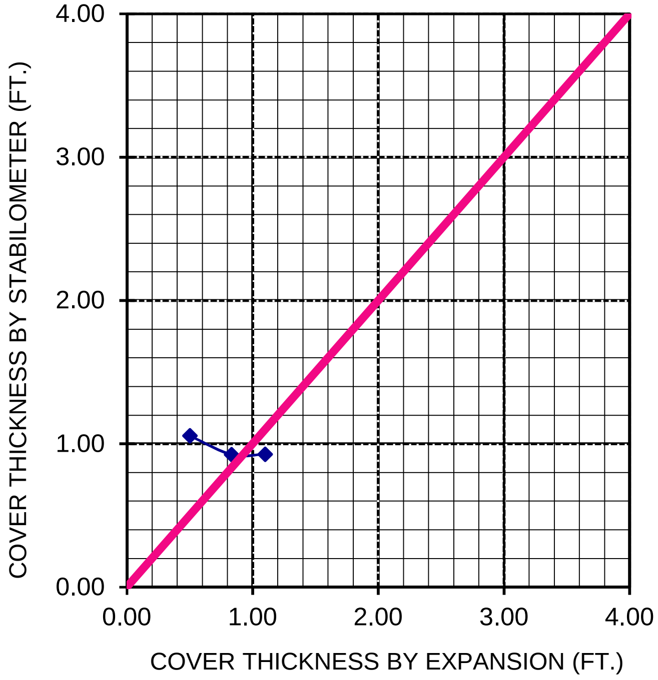
Project Name: HNTB/OCTA Laguna Niguel Passing Siding
Project Number: 15-123
Boring No.: EMI-12A
Sample No.: B-0 Depth (ft): 0-5
Location: N/A
Soil Description: Silty Sand

Tested By: ST Date: 02/15/16
Computed By: KM Date: 02/16/16
Checked By: AP Date: 02/23/16

Mold Number	A	C	B	
Water Added, g	0	10	22	
Compact Moisture(%)	13.8	14.9	16.2	
Compaction Gage Pressure, psi	50	50	50	
Exudation Pressure, psi	776	426	165	
Sample Height, Inches	2.5	2.5	2.5	
Gross Weight Mold, g	3012	3021	3034	
Tare Weight Mold, g	1969	1966	1968	
Net Sample Weight, g	1043	1055	1066	
Expansion, inchesx10^{-4}	33	25	15	
Stability 2,000 (160 psi)	22/50	23/51	24/57	
Turns Displacement	5.18	5.01	5.58	
R-Value Uncorrected	51	52	45	
R-Value Corrected	51	52	45	
Dry Density, pcf	111.1	111.3	111.2	
Traffic Index	8.0	8.0	8.0	
G.E. by Stability	0.93	0.92	1.06	
G.E. by Expansion	1.10	0.83	0.50	

R-VALUE	By Exudation:	49
	By Expansion:	53
	At Equilibrium: (by Exudation)	49
Remarks	Gf = 1.34, and 0.0 % Retained on the ¾"	

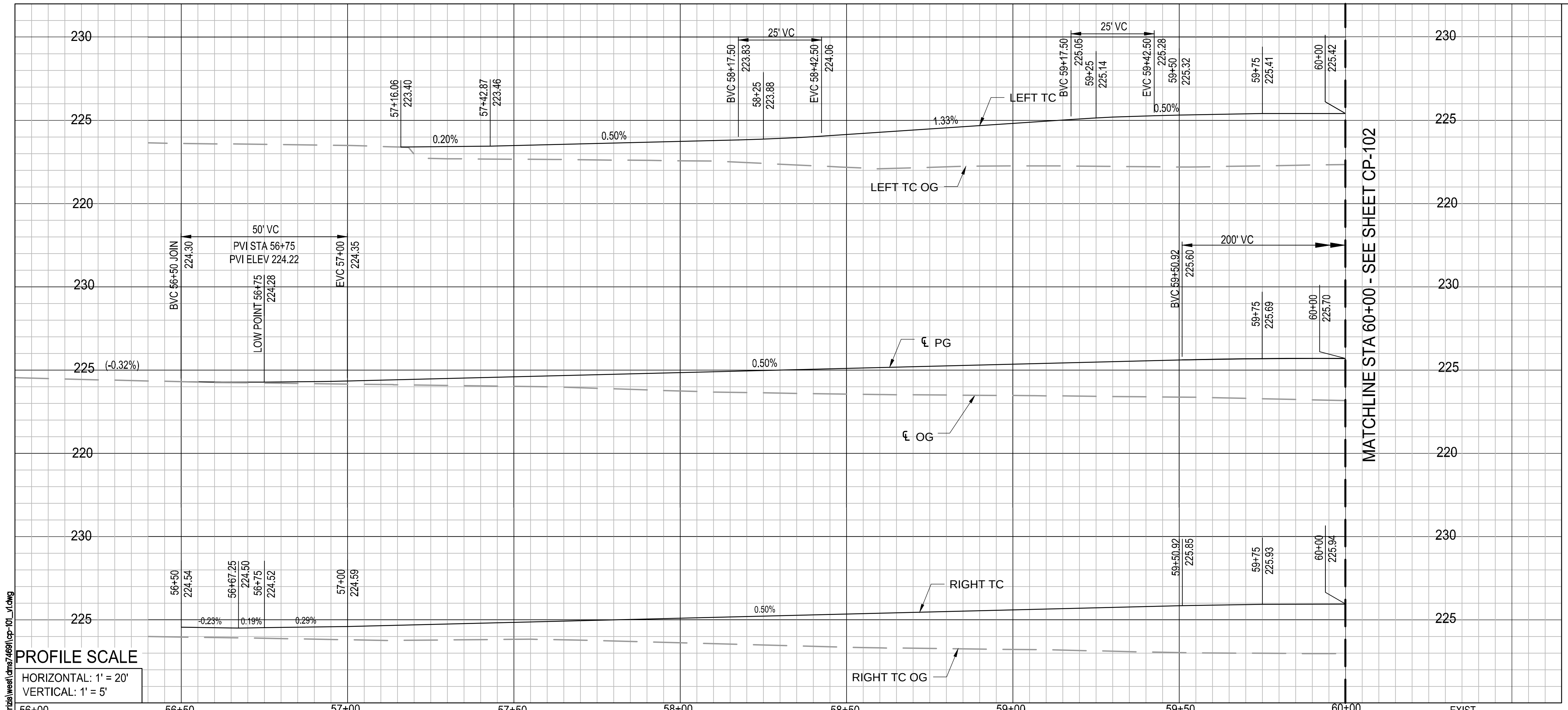




APPENDIX C

PAVEMENT DESIGN PLANS AND CONSTRUCTION RECOMMENDATIONS FOR CAMINO CAPISTRANO TRANSITION AT RANCHO CUCAMONGA DRIVE

IFB C-7-2018
EXHIBIT J

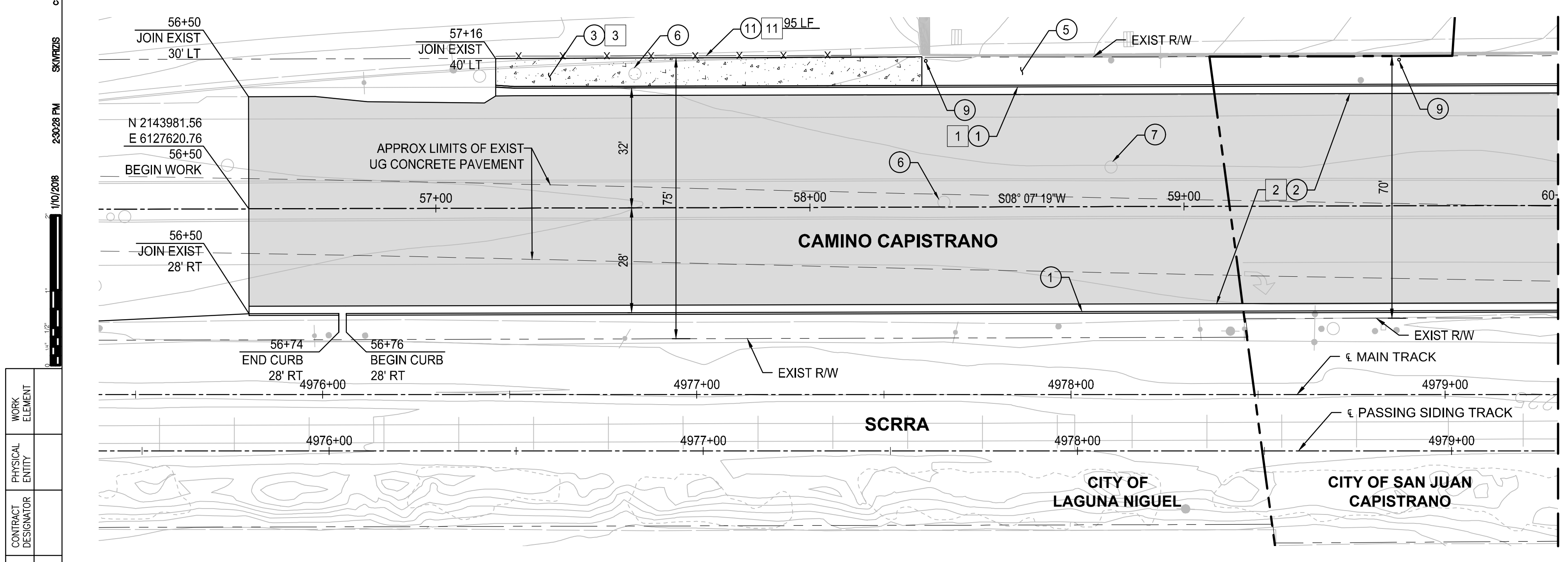


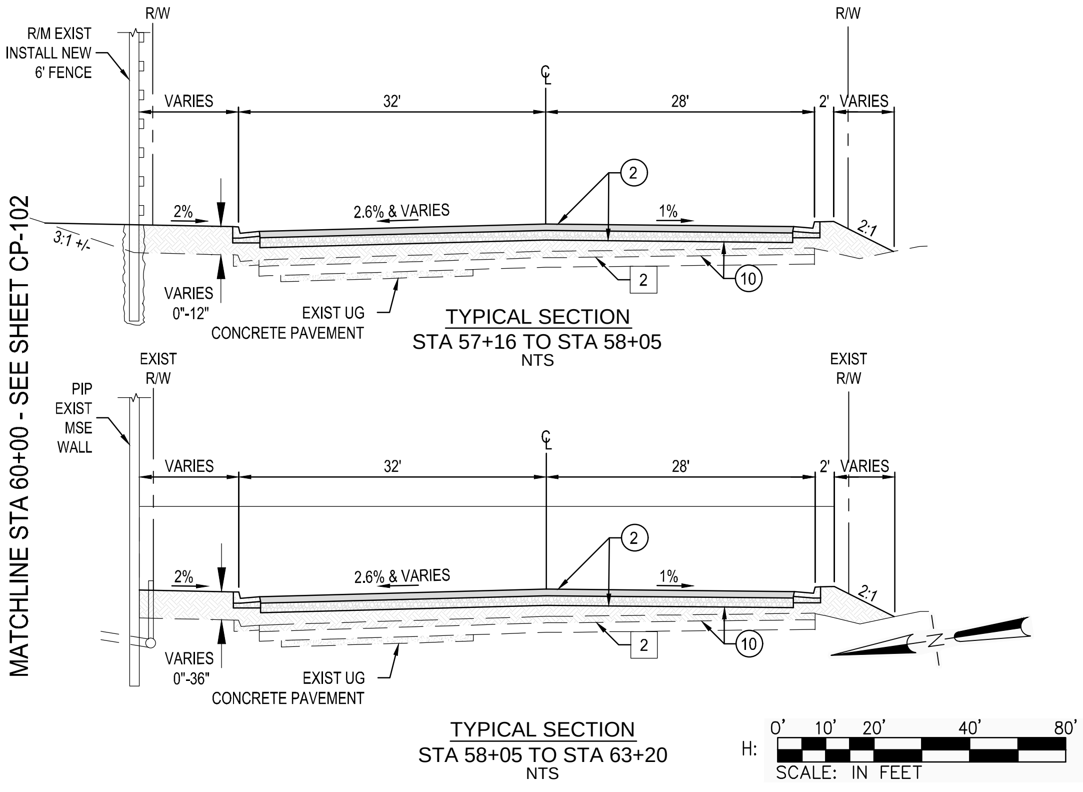
CONSTRUCTION NOTES

① CONSTRUCT 8" CURB AND GUTTER PER APWA STD PLAN 120-2, A2-8(200)
② CONSTRUCT 8" A.C. PAVEMENT OVER 12" AGGREGATE BASE
③ 4" THICK CONCRETE SIDEWALK
⑤ GRADE ONLY
⑥ ADJUST MANHOLE TO GRADE
⑦ ADJUST VALVE TO GRADE
⑨ ADJUST 4" PVC CLEANOUTS TO GRADE
⑩ UNCLASSIFIED FILL
⑪ CONSTRUCT NEW 6' FENCE, POSTS, AND FOUNDATIONS PER CALTRANS STD PLAN A85
1 REMOVE EXISTING CURB AND GUTTER
2 REMOVE EXISTING ASPHALT PAVEMENT
3 REMOVE EXISTING CONCRETE SIDEWALK
11 REMOVE EXISTING 6' FENCE, POSTS, AND FOUNDATIONS

LEGEND:

▨	AC PAVEMENT
— · —	RIGHT OF WAY





TYPICAL SECTION
STA 57+16 TO STA 58+05
NTS

TYPICAL SECTION
STA 58+05 TO STA 63+20
NTS

100% DESIGN

WORK ELEMENT
PHYSICAL ENTITY
CONTRACT DESIGNATOR
LINE ITEM
COST ELEMENT
PROJECT NUMBER

REV.	DATE	DESCRIPTION	SUB.	APP.

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DESIGNED BY X. ESPINOSA
DRAWN BY S. ALLEGRA
CHECKED BY T. BRIX
APPROVED BY P. SOMERVILLE
DATE 10/31/17

OCTA Orange County Transportation Authority

HNTB
200 Sandpointe Avenue
Suite 200
Santa Ana, CA 92707

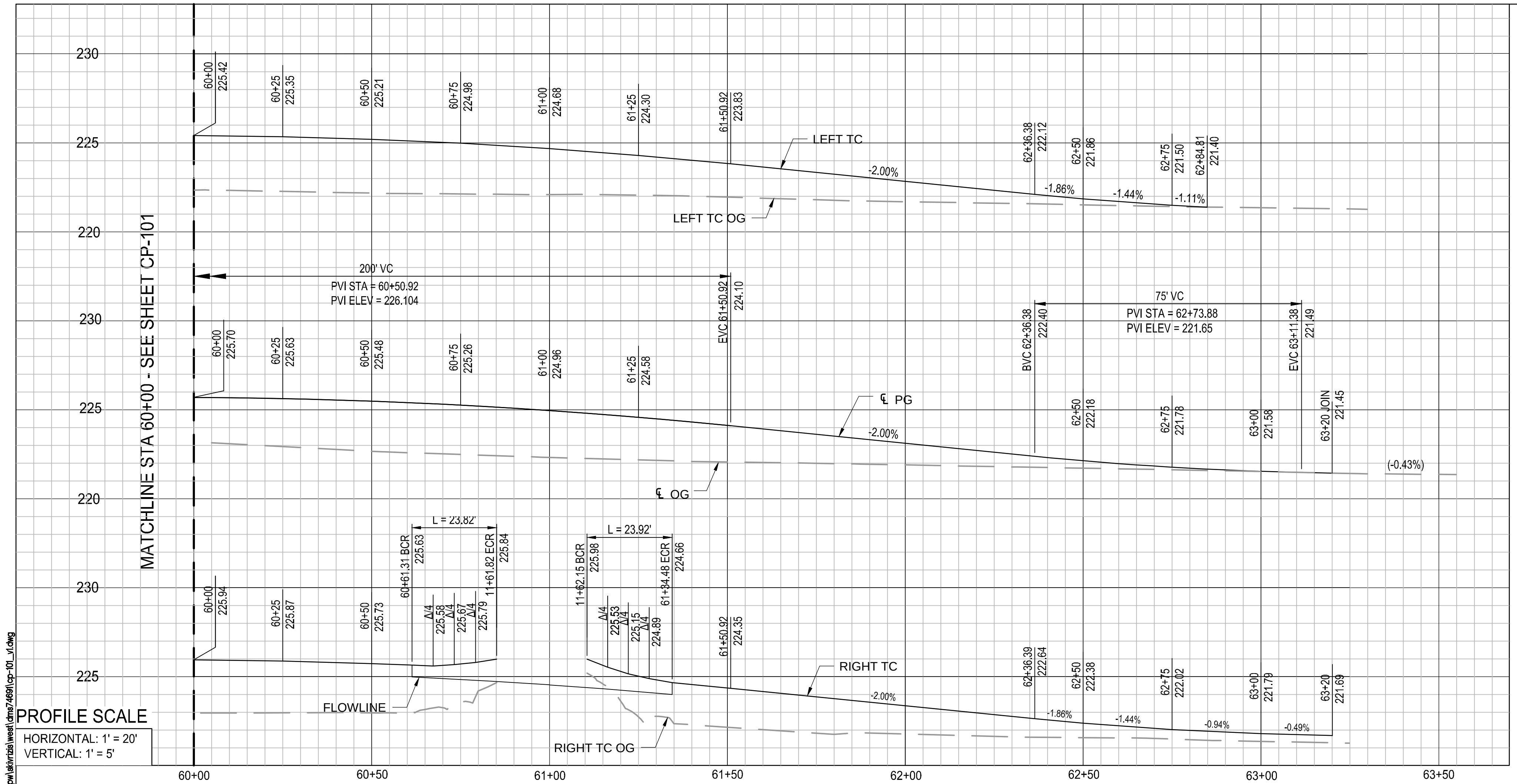
SUBMITTED: ______ TASK MANAGER
APPROVED: ______ PROJECT MANAGER - COMPANY

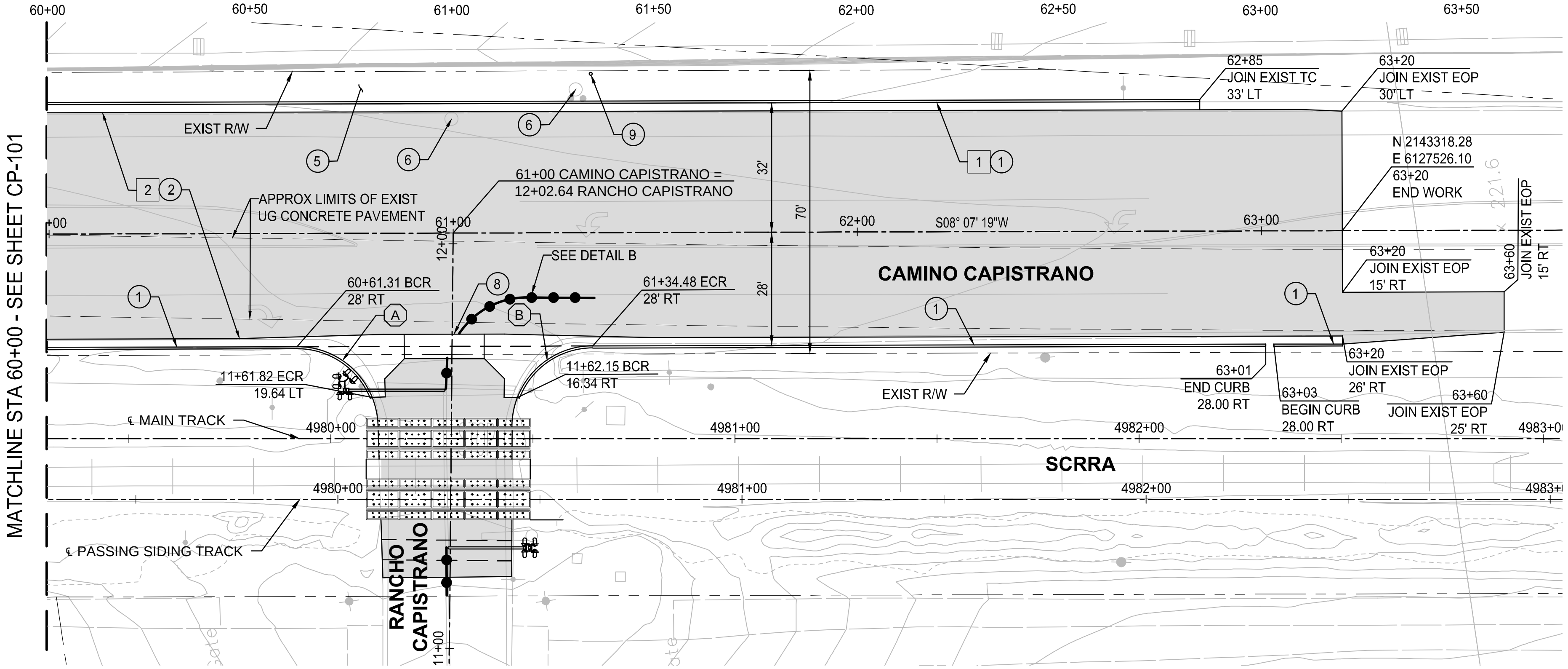
PRELIMINARY
NOT FOR CONSTRUCTION
DRAWING

METROLINK COMMUTER RAIL SYSTEM
LN - SJC PASSING SIDING
CAMINO CAPISTRANO PLAN AND PROFILE
STA 56+50 TO STA 60+00

CONTRACT NO. IFB 7-2018
DRAWING NO. OCTA -CP-101
REVISION 0
SHEET NO. 55 /93
SCALE AS SHOWN

IFB C-7-2018
EXHIBIT J





CONSTRUCTION NOTES

① CONSTRUCT 8" CURB AND GUTTER PER APWA STD PLAN 120-2, A2-8(200)

② CONSTRUCT 8" A.C. PAVEMENT OVER 12" AGGREGATE BASE

⑤ GRADE ONLY

⑥ ADJUST MANHOLE TO GRADE

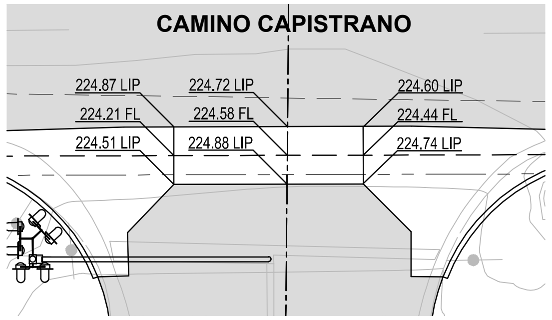
⑧ CONSTRUCT CROSS GUTTER PER APWA STD PLAN 122-2, MODIFIED PER DETAIL A

⑨ ADJUST 4" PVC CLEANOUTS TO GRADE

⑪ INSTALL LANE SEPARATOR CURB SYSTEM WITH CHANNELIZERS (QWIK KURB OR APPROVED EQUAL), PER DETAIL B

1 REMOVE EXISTING CURB AND GUTTER

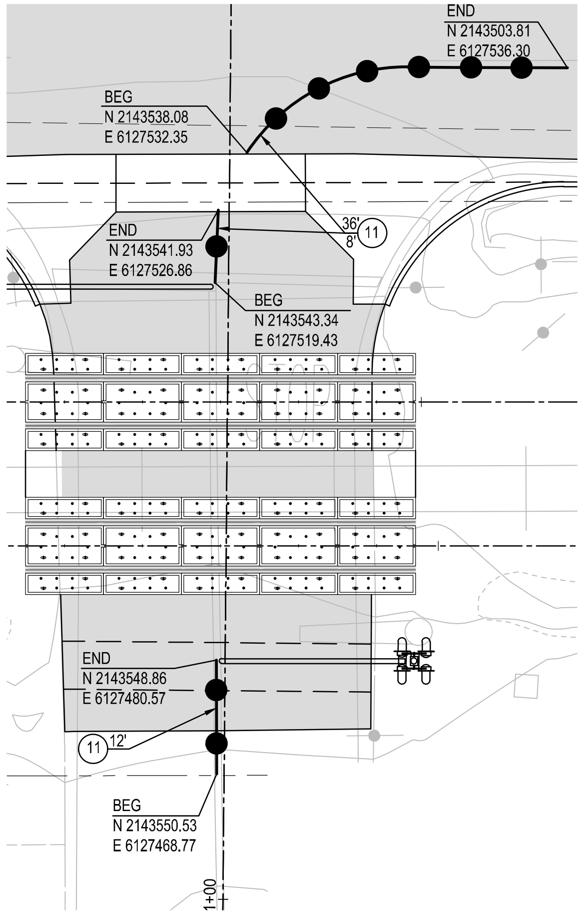
2 REMOVE EXISTING ASPHALT PAVEMENT



DETAIL A
NTS

CURVE DATA TABLE

No.	RADIUS	DELTA	LENGTH	TANGENT
Ⓐ	20.00'	68°13'25"	23.82'	13.55'
Ⓑ	20.00	68°31'09"	23.92'	13.62'



DETAIL B
NTS

LEGEND:

▨ AC PAVEMENT
-·- RIGHT OF WAY

H: 0' 10' 20' 40' 80'
SCALE: IN FEET

100% DESIGN

REV.	DATE	DESCRIPTION	SUB.	APP.	

WORK ELEMENT
PHYSICAL ENTITY
CONTRACT DESIGNATOR
LINE ITEM
COST ELEMENT
PROJECT NUMBER

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DRAWN BY S. ALLEGRA
CHECKED BY T. BRIX
APPROVED BY P. SOMERVILLE
DATE 10/31/17

OCTA Orange County Transportation Authority

HNTB
200 Sandpointe Avenue
Suite 200
Santa Ana, CA 92707

SUBMITTED: ____ TASK MANAGER
APPROVED: ____ PROJECT MANAGER – COMPANY

PRELIMINARY
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DRAWING

METROLINK COMMUTER RAIL SYSTEM
LN - SJC PASSING SIDING
CAMINO CAPISTRANO PLAN AND PROFILE
STA 60+00 TO STA 63+20

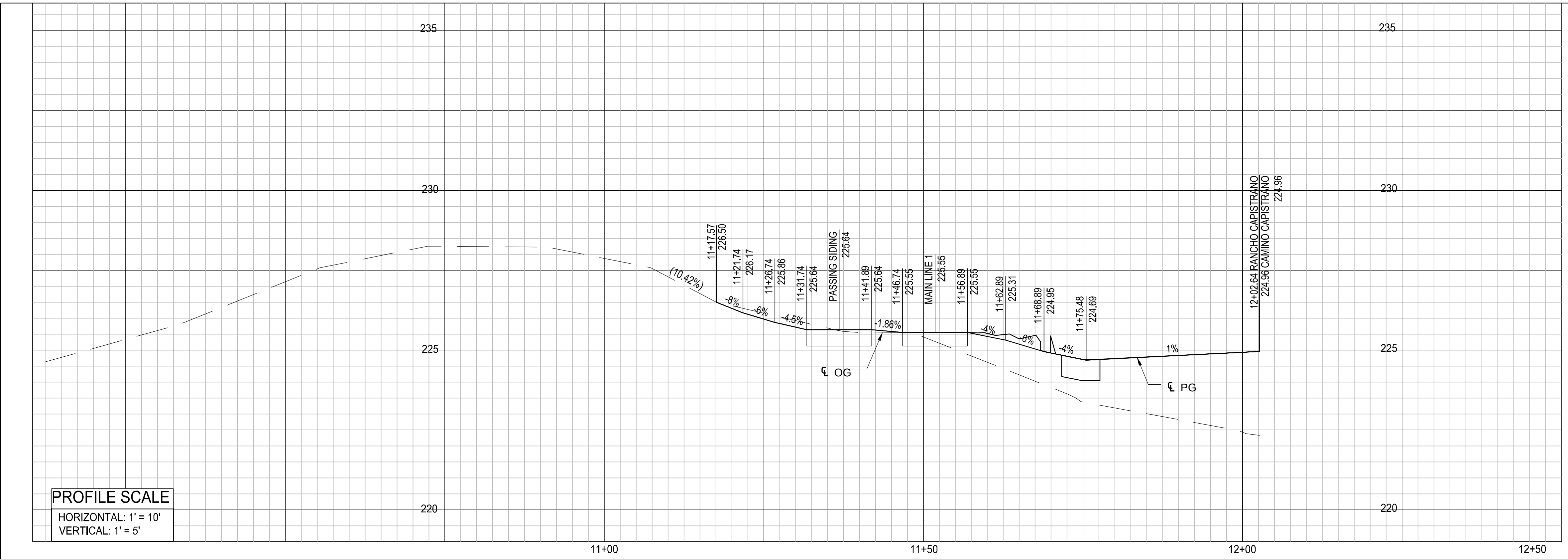
CONTRACT NO. IFB 7–2018
DRAWING NO. OCTA -CP-102
REVISION 0
SHEET NO. 56 /93
SCALE AS SHOWN

IFB C-7-2018
EXHIBIT J

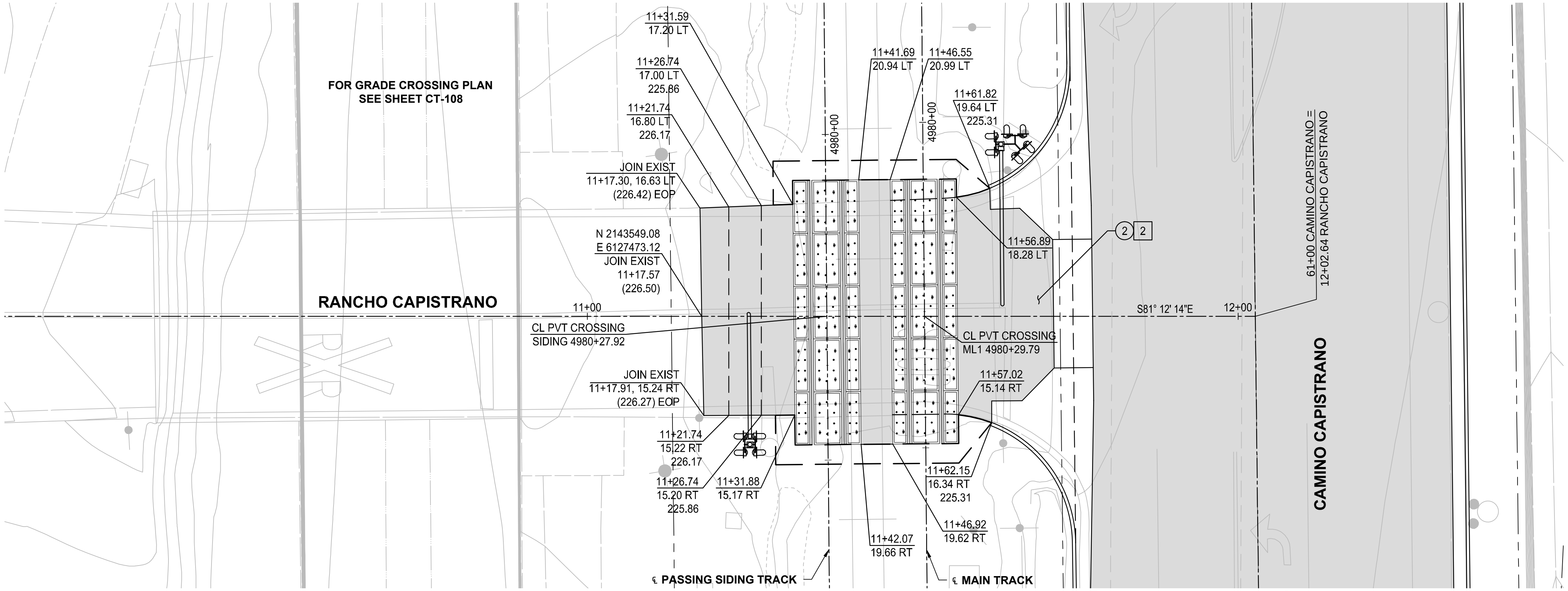
CONSTRUCTION NOTES:

② CONSTRUCT 8" A.C. PAVEMENT OVER 12" AGGREGATE BASE

[2] REMOVE EXISTING ASPHALT PAVEMENT



PROFILE SCALE
HORIZONTAL: 1' = 10'
VERTICAL: 1' = 5'



LEGEND:

▨	AC PAVEMENT
— · —	RIGHT-OF-WAY

N

H: 0' 5' 10' 20' 30'
SCALE: IN FEET

100% DESIGN

c:\caddlib\pw\jmartinez\west\dms74697\cp-103_v1.dwg JMARTINEZ 4:48:06 PM 11/2/2017

WORK ELEMENT
PHYSICAL ENTITY
CONTRACT DESIGNATOR
LINE ITEM
COST ELEMENT
PROJECT NUMBER

REV.	DATE	DESCRIPTION	SUB.	APP.

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APPROVED BY P. SOMERVILLE
DATE 10/31/17

OCTA Orange County Transportation Authority

HNTB
200 Sandpointe Avenue
Suite 200
Santa Ana, CA 92707

SUBMITTED: ______ TASK MANAGER
APPROVED: ______ PROJECT MANAGER - COMPANY

PRELIMINARY
NOT FOR CONSTRUCTION
DRAWING

METROLINK COMMUTER RAIL SYSTEM
LN - SJC PASSING SIDING
RANCHO CAPISTRANO PLAN AND PROFILE

CONTRACT NO. IFB 7-2018
DRAWING NO. OCTA -CP-103
REVISION 0
SHEET NO. 57 /93
SCALE AS SHOWN

IFB C-7-2018
EXHIBIT J

June 15, 2018

Mr. Mike Kapuskar PE, GE
Earth Mechanics, Inc.
17800 Newhope Street | Suite B
Fountain Valley, CA 92708

Re:	Pavement Transition at Camino Capistrano and Rancho Cucamonga
Subject:	OCTA MetroLink Passing Siding | City of San Juan Capistrano, CA LMI Project # 43749

Mr. Kapuskar,

Proposed roadway improvements along Camino Capistrano, related to the Metrolink Passing Siding project, at the intersection of Rancho Cucamonga include certain conflicts between the existing conditions and typical design standards. Due to regional and city requirements originally, designated reconstruction of the existing roadway, in conjunction with removal of the underlying PCC pavement, is not permitted. Efforts to avoid disturbance of the underlying PCC pavement and to meet general structural requirements the design team has proposed to raise grades within the approximately 670 ft long segment.

The purpose of this report is to provide potential roadway design alternatives which meet structural requirements along Camino Capistrano and provide grade transition details to accommodate the ~3’ increased elevation.

SITE OBSERVATIONS

The site review of the roadway was performed on June 7, 2018, by Mr. Steve Marvin of LaBelle Marvin, Inc. Visual review included the documentation of street configuration and pavement conditions, later utilized for the development of the following improvement and transition improvements.

DESIGN CHALLENGES

These recommendations were developed with the assumption the following unknowns and questions are or will be verified.

IFB C-7-2018
EXHIBIT J

Transition Zones

The specifics of vertical curves and entry/exit slopes will impact the length of transition zones. The planned vertical curves, within the transition zone, to existing and at top of grade modification will impact transition length. The entry and exit slope of new roadway versus current centerline slope will also impact the transition length. A short segment of the transition, likely in the range of 25 to 50’ in length will not be in full conformance with the prevailing design standards. The short transition portion of the resurfaced roadway (transition area) will not meet design criteria relating to reflective crack mitigation or section thickness design. Based on past performance of the roadway, the risks in these short segments appear reasonable.

Core data suggests the existing PCC alignment is buried under 2” of asphalt concrete. Immediately north of the T intersection, a more recent overlay would appear to increase the cover over the buried PCC layer. No information is provided within the support data. Where the thickness of cover increases north of the T intersection, the depth of milling should be increased to expose the underlying PCC pavement or aggregate base depending upon the location within the alignment.

The current cracking patterns indicate the buried PCC pavement is likely 20’ wide consistent with the original area of construction. A portion of the current travel lanes therefore transitions off and on the old buried alignment. Where the roadway is restriped to include more standard 12’ or 14’ lanes, 2’ to 4’ of the lane (generally the right wheel path) will be consistently on the widening area, not coinciding with the buried PCC alignment.

The deviation is particularly acute within the project limits where the striped median/left turn pocket to the subject site forces additional portions of the right wheel path of the travel way off the buried PCC and onto the widening areas. Based on initial measurements, this would appear to constitute a majority of the roadway planned for improvement. The present striping places the majority of the northbound lane on the widening area as well as a considerable portion of the left turn lane from northbound Camino Capistrano to the project site.

The design has been adjusted to address both conditions, i.e. construction of the regions underlain by the old PCC alignment and the adjoining west and east areas constructed with conventional asphalt concrete over aggregate base.

RECOMMENDATIONS

NORTH AND SOUTH TRANSITIONS AREAS

The length of the transition will be a function of the length of the vertical curves and reverse vertical curves and exit/entry slope as compared to the current roadway centerline longitudinal slope. Assuming a 2.5% to 3% difference between the existing centerline longitudinal slope and the new centerline longitudinal slope combined with transitions for vertical curves, the non-conforming areas will likely be between 50’ +/- long. The actual length will be a function of slope differentials plus the selected vertical and reverse vertical curves, etc. The length of transition will be a function of establishing 12” asphalt concrete over the existing aggregate base or 6” asphalt concrete over the buried PCC, whichever is greatest.

AREAS UNDERLAIN BY PCC (~ 20’ WIDTH)

Transition Zone |~50’ to 100’ long at North and South Project Limits

- Mill 2” and remove existing asphalt concrete.
- Clean and fill all cracking wider than ¼”.
- Place asphalt concrete level course(s) to 2” below finish.

  Note: Total level course thickness will taper a zero (0”) thickness at each end of project. The level course will then increase to a total of 10” thick at the end of the transition zone (likely ~50’ to 100’ beyond the end of the construction limits).

- Place final 2” thick wearing surface in conjunction with final 2” wearing surface in adjacent areas and central portion of project.

PROJECT CENTRAL ZONE

(~ Total length Minus 100’ to 200’ for Required End Transition Areas/Zones)

- Mill 2” and remove existing asphalt concrete.
- Clean and fill all cracking wider than ¼”.
- Place minimum 4” thick aggregate base layer (actual aggregate base thickness will increase from 4” thick at join to transition zone or finish elevation to to ~ 30” thick or finish minus 6” through central portion of project).
- Construct 4” thick asphalt concrete base course and binder course to 2” below finish elevations.
- Place final 2” thick wearing surface in concert with final 2” wearing surface in adjacent areas and central portion of project.

AREAS BEYOND THE BURIED PCC PAVEMENT**

**NOTE: Present information suggests these areas are constructed with 5” asphalt concrete over 12” aggregate base.

Transition Zone

- Mill 6” below current elevations.
- Place asphalt concrete level course(s) to 2” below finish.

  Note: Asphalt concrete section will be 6” thick at project limit join line and increase to a total of 12” thick at end of transition zone.

- Place final 2” thick wearing surface in concert with final 2” wearing surface in adjacent areas and central portion of project.

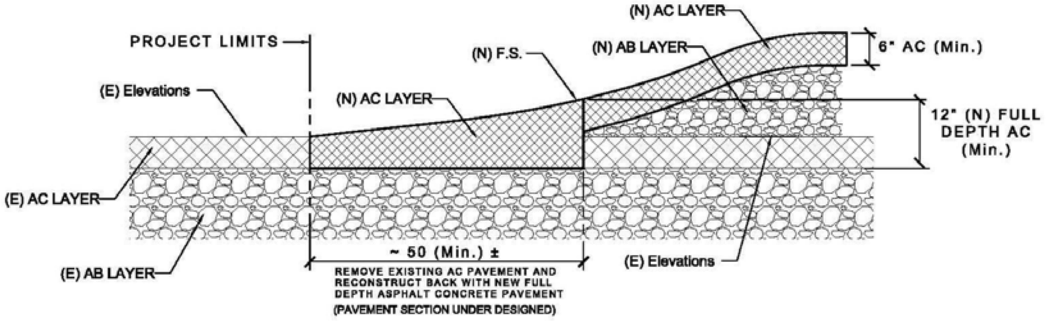
Project Central Zone

(~ Total length minus 100’ to 200’ for required end transition areas)

- Mill 6” below current elevations.
- Place minimum 4” thick aggregate base layer (actual aggregate base thickness will increase from 4” thick at join to transition zone or finish elevation to ~ 30” thick or finish minus 6” through central portion of project).
- Construct 4” thick asphalt concrete base course and binder course to 2” below finish elevations.
- Place final 2” thick wearing surface in concert with final 2” wearing surface in adjacent areas and central portion of project.

IFB C-7-2018
EXHIBIT J

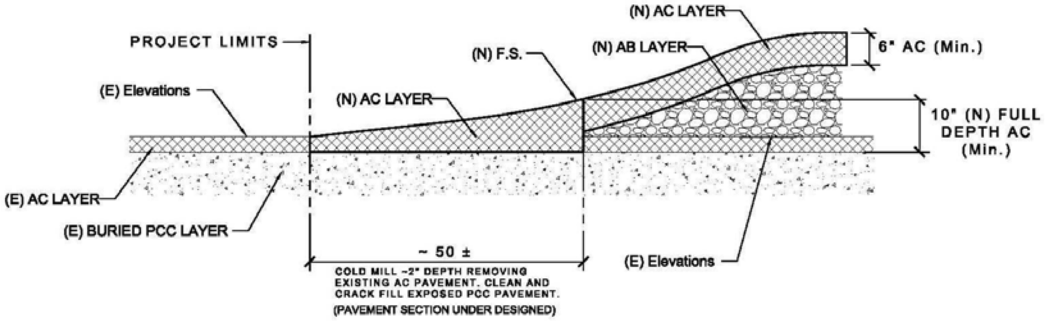
TYPICAL DETAILS



TYPICAL TRANSITION DETAIL

ASPHALT CONCRETE / AGGREGATE BASE SECTION

NOT TO SCALE



TYPICAL TRANSITION DETAIL

ASPHALT CONCRETE / BURIED PCC SECTION

NOT TO SCALE

(N) = New (E) = Existing

The verification of as-built records and development of costs associated with these recommendations are beyond the current scope of this initial report. We welcome the opportunity to provide additional engineering services in the form of pavement testing and design services, if needed.

The opportunity to be of service is appreciated and should you have any questions, kindly call.

Sincerely

C 30659

Steven R Marvin, PE
President/Principal