Appendix E

Geotechnical Engineering Investigation

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COAST GEOTECHNICAL, INC.

Geotechnical Engineering Investigation

for

Proposed Tilt-Up Commercial Building

at

11298 Jersey Boulevard
Rancho Cucamonga, California

BY:

COAST GEOTECHNICAL, INC.
W. O. 599020-01, dated September 2, 2020

FOR:

Mr. Ralph Karubian
1801 South Mountain Avenue
Monrovia, CA 91016

COAST GEOTECHNICAL, INC.
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September 2, 2020 W.O. 599020-01

Mr. Ralph Karubian
1801 South Mountain Avenue
Monrovia, CA 91016

Subject: Geotechnical Engineering Investigation for Proposed Tilt-Up Commercial Building at 11298 Jersey Boulevard, Rancho Cucamonga, California

Dear Mr. Karubian:

Pursuant to your request, a geotechnical engineering investigation has been performed at the subject site. The purposes of the investigation were to determine the general engineering characteristics of the near surface earth materials on and underlying the site and to provide recommendations for the design of foundations and underground improvements.

The conclusions and recommendations contained in this report are based upon our understanding of the proposed development and analyses of the data obtained from our field and laboratory testing programs.

This report completes our scope of geotechnical engineering services authorized by you in our executed proposal dated June 22, 2020.

PROJECT DESCRIPTION

It is our understanding the proposed development will consist of the construction of a four unit, tilt-up industrial warehouse building, with a total building area of 159,580 square feet. A depiction of the proposed development layout, prepared by William Simpson and Associates, Inc., is presented on the attached Site Plan, Figure 2. Structural loads are anticipated to be moderate.

PROJECT WORK SCOPE

The purpose of our services was to evaluate the project near subsurface conditions and to provide geotechnical engineering conclusions and recommendations relative to the proposed development. Our scope of services consisted of the following:

1. A cursory reconnaissance of the site and surrounding areas.

2. Excavation of five exploratory borings to determine the subsurface earth materials and groundwater conditions.

3. Collection of representative bulk and/or undisturbed earth material samples for laboratory analysis.

4. Laboratory analyses of earth material samples including determination of in-situ and maximum density, in-situ and optimum moisture content, shear strength characteristics, expansion potential, liquefaction analysis, and chemical analysis.

5. Preparation of this report presenting results of our investigation and recommendations for the proposed development.

SITE CONDITIONS

The subject site is located at 11298 Jersey Boulevard in the City of Rancho Cucamonga and is shown on the appended Site Vicinity Map, Figure 1.

The lot is rectangular in shape and is bound by developed industrial property to the north and west, Jersey Boulevard on the south, and Milken Avenue on the east.

Documented remediation actions were conducted to remove heavy metal-impacted soil and associated slag material. The excavated area/pit of removal was approximately ten feet in depth below existing grade. The pit was not backfilled and still is open as of this investigation. The location of the pit is shown on the attached Site Plan, Figure 2.

The property is nearly rectangular in shape, does not show a discernible gradient, and is vacant.

Site configuration is depicted on the attached Site Plan, Figure 2.

FIELD INVESTIGATION

The field investigation was performed on August 12, 2020 consisting of the excavation of five exploratory borings, placed by a hollow stem auger drill rig, at the location shown on the attached Site Plan, Figure 2. As excavations progressed, a representative from this office visually classified the earth materials encountered, and secured representative samples for laboratory testing.

Geotechnical characteristics of subsurface conditions were assessed by driving a split spoon ring sampler into the earth material.

The split spoon sampler was driven into the earth material to obtain undisturbed ring samples for detailed testing in our laboratory. A solid barrel-type spoon sampler was used having an inside diameter of 2.5 inches with a tapered cutting tip at the lower end and a ball valve at the upper end. The barrel was lined with thin brass rings, each one inch in length. The spoon penetrated into the earth material below the depth of the boring approximately twelve inches. The end portion of this sample was retained for testing. All samples in their natural field condition were sealed in airtight containers and transported to the laboratory.

The sampler was driven into the earth material at the bottom of the borehole by means of hammer blows. The hammer blows are given at the top of the drilling rod. The blows are by a down-hole hammer weighing 140 pounds and dropped a distance of 30 inches.

EARTH MATERIALS

Earth materials encountered within the exploratory borings were visually logged by a representative of COAST GEOTECHNICAL, Inc. The materials were classified as minor artificial fill and native earth material.

Artificial fills encountered consisted of brown, tan brown and light gray tan silty sand, fine to medium-grained, gravelly, dry to damp and loose to medium dense.

The underlying native earth material consisted of tan light gray, light gray, light gray brown, brown, yellow, and tan sand, fine to course-grained, silty, gravelly, dry to damp, to the maximum depth explored of 16 feet.

Descriptions of the earth materials encountered are presented on the attached Boring Logs, Plates B through F. The data presented on this log is a simplification of actual subsurface conditions encountered and applies only at the specific boring location on the date excavated. It is not warranted to be representative of subsurface conditions at other times and locations.

GROUNDWATER

Groundwater was not encountered in the borings and is not anticipated to affect the proposed construction as currently understood.

SEISMICITY

Southern California is located in an active seismic region. Moderate to strong earthquakes can occur on numerous faults. The United States Geological Survey, California Division of Mines and Geology, private consultants, and universities have been studying earthquakes in Southern California for several decades. Early studies were directed toward earthquake prediction estimation of the effects of strong ground shaking. Studies indicate that earthquake prediction is not practical and not sufficiently accurate to benefit the general public. Governmental agencies are shifting their focus to earthquake resistant structures as opposed to prediction. The purpose of the code seismic design parameters is to prevent collapse during strong ground shaking. Some damage should be expected.

Within the past 49 years, Southern California and vicinity have experienced an increase in seismic activity beginning with the San Fernando earthquake in 1971. In 1987, a moderate earthquake struck the Whittier area and was located on a previously unknown fault. Ground shaking from this event caused substantial damage to the City of Whittier, and surrounding cities. The January 17, 1994, Northridge earthquake was initiated along a previously unrecognized fault below the San Fernando Valley. The energy released by the earthquake propagated to the southeast, northwest, and northeast in the form of shear and compression waves, which caused the strong ground shaking in portions of the San Fernando Valley, Santa Monica Mountains, Simi Valley, City of Santa Clarita, and City of Santa Monica.

Southern California faults are classified as: active, potentially active, or inactive. Faults from past geologic periods of mountain building that do not display any evidence of recent offset are considered "inactive" or "potentially active". The Faults that have historically produced earthquakes or show evidence of movement within the past 11,000 years are known as "active faults". There are no known active faults within the subject property. The nearest active faults are the Red Hill and Cucamonga Faults located north of the subject site.

Red Hill Fault

- The Red Hill Fault is north of the subject site and is known as the geologic divide between the Cucamonga and Chino groundwater basins, as it curves around the southern portion of Red Hill in the northern section of the City. This fault is defined by a prominent scarp in the alluvial fan south of Day Canyon and at the southern edge of Red Hill. A large number of small earthquakes (magnitudes [M] 1 to 3) have historically occurred beneath the City of Rancho Cucamonga, some which have epicenters on or near the trace of the Red Hill Fault. A maximum credible magnitude of 6.5 is possible on this fault.

Cucamonga Fault

- The site is located south of the Cucamonga Fault, which runs along the base of the San Gabriel Mountains near the boundary between the Peninsular and Transverse Ranges. The Cucamonga Fault is considered the eastern extension of the Sierra Madre Fault and dips to the north at about 45 degrees. This fault has scarps that indicate offset in recent alluvial deposits along the northern edge of the City of Rancho Cucamonga. It has been mapped along the base of the San Gabriel Mountains, from the Lytle Creek area to the San Antonio Canyon, as a single line near Cucamonga Creek to a zone that is ½ mile wide, with a significant offset across the Deer Creek alluvial deposits. A maximum credible earthquake of magnitude 7.0 is possible on this fault.

SEISMIC HAZARDS

The potential hazards to be evaluated with regard to seismic conditions include fault rupture, landslides triggered by ground shaking, soil liquefaction, earthquake-induced vertical and lateral displacements, earthquake-induced flooding due to the failure of water containment structures, seiches, and tsunamis. Comment on these seismic hazards follows.

Fault Rupture

The project is not located within a currently designated Alquist-Priolo Earthquake Zone. No known active faults are mapped within the site. Based on this consideration, the potential for surface fault rupture at the site is considered to be remote.

Ground Shaking

The site is located in a seismically active area that has historically been affected by moderate to occasionally high levels of ground motion, and the site lies in relatively close proximity to several active faults; therefore, during the life of the proposed development, the property will

probably experience moderate to occasionally high ground shaking from these fault zones, as well as some background shaking from other seismically active areas of the Southern California region. Designs of structures are typically to maintain structural integrity not to prevent damage. Earthquake insurance is available where the damage risk is not acceptable to the client.

Seismic Induced Landslide

Earthquake-induced landslide zones were delineated by the State of California using criteria adopted by the California State Mining and Geology Board. Under those criteria, earthquake-induced landslide zones are areas meeting one or more of the following:

1. Areas known to have experienced earthquake-induced slope failure during historic earthquakes.

2. Areas identified as having past landslide movement, including both landslide deposits and source areas.

3. Areas where CDMG's analyses of geologic and geotechnical data indicate that the geologic materials are susceptible to earthquake-induced slope failure.

The site does not exhibit sloped conditions, adverse geologic conditions, or weak earth materials and is opinioned not to have a risk for seismic induced landslides.

Seismic Induced Liquefaction

Liquefaction is a seismic phenomenon in which loose, saturated, non-cohesive granular soils exhibit severe reduction in strength and stability when subjected to high-intensity ground shaking. The mechanism by which liquefaction occurs is the progressive increase in excess pore pressure generated by the shaking associated with the seismic event and the tendency for loose non-cohesive soils to consolidate. As the excess pore fluid pressure approaches the in-situ overburden pressure, the soils exhibit behavior similar to a dense fluid with a corresponding significant decrease in shear strength and increase in compressibility. Liquefaction occurs when three general conditions exist: 1) shallow groundwater; 2) low density, non-cohesive sandy soils; and 3) high-intensity ground motion.

Based on the lack of near surface ground waters and dense subsurface soil conditions the risk of liquefaction induced hazards is opinioned remote.

Lateral Spreading

The occurrence of liquefaction may cause lateral spreading. Lateral spreading is a phenomenon in which lateral displacement can occur on the ground surface due to movement of non-liquefied soils along zones of liquefied soils. For lateral spreading to occur, the liquefiable zone must be continuous, unconstrained laterally, and free to move along sloping ground toward an unconfined area.

The area does not exhibit characteristics common to areas subject to seismic induced lateral spread. Our opinion is that the site is not subject to seismic induced lateral spread.

Earthquake-Induced Flooding

The failure of dams or other water-retaining structures as a result of earthquakes and strong ground shaking could result in the inundation of adjacent areas. Due to the lack of a major dam or water-retaining structure located near the site, the potential of earthquake-induced flooding affecting the site is considered not to be present.

Seiches

Seiches are large waves generated in enclosed bodies of water in response to ground shaking. Based on the lack of nearby enclosed bodies of water the risk from a seiche event is not present.

Tsunami

Tsunamis are waves generated in large bodies of water as a result of change of seafloor topography caused by tectonic displacement. Based on the elevation of the site the project has no potential to be affected by a tsunami.

GEOTECHNICAL DISCUSSION

Development of the site as proposed is considered feasible from a soil engineering standpoint, provided that the recommendations stated herein are incorporated in the design and are implemented in the field. General comments are as follows:

- Earthwork is anticipated to consist of grade changes to create designed pad elevations and drainage required for the proposed construction.

- Conventional earth moving equipment may be utilized. Removals will be required prior to the placement of any fills. Remedial grading will be needed to provide uniform support.

- Where structures are planned grading shall extend beneath the entire building and extend at least five feet outside the perimeter foundations. Depth of removal shall be adequate to remove all existing fill or unacceptable native materials, provide a minimum of two feet of compacted fill beneath the foundation bottoms, or to limit fill differences across the building pad to five feet over a horizontal distance of forty feet, whichever is deeper.

- An excavation pit made and left open by others in the northeastern area of the parcel exposed competent native earth material. The pit may be back filled at the time of grading after the bottom is scarified; moisture conditioned and compacted to a minimum 90% relative compaction.

- Grading beneath the proposed structures shall be such that the fill depth beneath the structure shall not differ by more than five feet in any direction.

- Care shall be taken during site construction not to remove lateral and or vertical support from adjacent properties.

- The proposed site improvements shall be supported by foundations bearing into fills placed and compacted under the observation and testing of COAST GEOTECHNICAL, Inc.

- Where pavement, interior slabs, driveway and hardscape areas are proposed depth of removal shall be adequate to remove all existing fill or unacceptable native materials, or to provide a minimum of two feet of compacted fill beneath the finish subgrade elevation, whichever is deeper, under the observation and testing of COAST GEOTECHNICAL, Inc.

- The proposed site improvements will not adversely affect adjacent properties and vice versa, provided proper construction techniques are utilized and required geotechnical observations are made.

Recommendations that follow shall be incorporated into the project as needed and are subject to change based on review of future building, foundation, and grading plans.

PROPOSED GRADING

It is anticipated that grading will consist of excavation and compaction for uniform support of foundations, pavement, and hardscape materials.

GRADING RECOMMENDATIONS

Foundations for the structure and improvements will derive support from compacted fills placed under the observation and testing of COAST GEOTECHNICAL, Inc.

Unacceptable site earth materials shall be over-excavated down to competent native earth material. Competent earth material is determined by the project soil engineer based on physical testing of soil samples obtained during exploration and proposed construction.

Based on in place densities and consolidation tests, soils found at a depth of about two feet below existing grade and deeper have adequate geotechnical properties to provide adequate support of proposed fills and the structure; as such, removals to a depth of four feet below existing grade or to two feet below proposed footing bottoms, whichever is greater, are anticipated for the structure; however, field observations made at the time of grading shall determine final removal limits.

The overexcavation areas shall include areas proposed for foundations, slabs, hardscape, asphaltic concrete or other areas as determined by the geotechnical engineer. The excavations shall extend five feet beyond the structure's outline, except where contained by property lines, and at least one foot beyond the limits of parking, driveway, and hardscape areas.

The excavation pit made and left open by others in the northeastern area of the parcel exposed competent native earth material. The pit may be back filled at the time of grading after the bottom is scarified, moisture conditioned and compacted to a minimum 90% relative compaction prior to fill placement.

Removals within the parking areas and beneath hardscape areas shall be adequate to expose competent native earth materials or provide a minimum of two feet of compacted fill as measured from subgrade elevation, whichever is deeper. Lateral removals in these areas shall extend a minimum of one foot beyond the improvement.

Exposed excavation bottoms shall be observed by the geotechnical engineer and City Grading inspector prior to processing. Field recommendations will be made depending on conditions encountered. Upon approval, the excavation bottoms shall be processed; moisture conditioned approximately to optimum moisture content and compacted to a minimum of 90% relative compaction.

Subsequent fills shall be placed in six to eight inch lifts, moisturized conditioned to approximately optimum moisture content and compacted to a minimum of 90% relative compaction. This process shall be followed to finish grade.

The project is in an area where usage of septic systems was common. If encountered during site earth work the soil engineer shall be notified for recommendations. Typically septic tanks, leach fields, and trash pits are removed and the void backfilled with compacted soil. Seepage pits are typically drilled clean and backfilled with minimum three sack slurry.

During earthwork operations, a representative of COAST GEOTECHNICAL, Inc. shall be present to verify acceptable conditions and that compaction requirements are being obtained.

GENERAL GRADING NOTES

Areas to be graded shall be cleared of vegetation, debris, and underground systems prior to grading. Excavations shall be backfilled according to the soil engineering recommendations. Generally unsuitable material shall be removed to competent earth material and the void backfilled with soils compacted to a minimum of 90% relative compaction or better. The entire grading operation shall be done in accordance with the attached "Specifications for Grading".

Any import fill materials to the site shall not have an expansion index greater than 20, and shall be tested and approved by our laboratory. Samples must be submitted 48 hours prior to import.

Grading and/or foundation recommendations are subject to modification upon review of final plans by the Geotechnical Engineer. Please submit plans to COAST GEOTECHNICAL, Inc. when available.

TEMPORARY CUTS

Temporary construction cuts are anticipated for grading and construction of the project. The following recommendations are for unsurcharged conditions, and are subject to modification based on field observations.

Temporary cuts in site earth materials are anticipated to expose artificial fill and native earth material. Cuts in the existing fill and native earth material shall be no steeper than 1:1(H:V).

No cuts shall be allowed which would remove lateral support from adjacent properties, structures, or public right of ways.

The project geotechnical engineer shall observe all cuts at the time of excavation. If adverse conditions are exposed, remedial measures will be recommended and implemented.

OSHA guidelines shall be followed where workers are to enter confined spaces, trench work, or excavations.

SUBSIDENCE AND SHRINKAGE

Subsidence over the site is anticipated to be negligible. Shrinkage of reworked materials should be in the range of twelve to sixteen percent.

FOUNDATIONS IN COMPACTED FILL

Foundations for the structure and settlement sensitive improvements will derive support from compacted fills placed under the observation and testing of COAST GEOTECHNICAL, Inc.

Continuous footings placed a minimum of 24 inches below lowest adjacent grade and bearing on compacted fill may utilize an allowable bearing value of 2,000 psf. This value is for dead plus live load and may be increased by 1/3 for total including seismic and wind loads where allowed by code. Minimum footing width shall be fifteen inches. Calculations for bearing capacity are presented on Plate I.

Bearing loads may be increased by 300 psf for each increase in foot of width and depth up to a maximum of 3,000 psf.

Isolated pads placed a minimum of 24 inches below lowest adjacent grade and bearing on acceptable existing compacted fill may utilize an allowable bearing value of 2,000 psf. This value is for dead plus live load and may be increased by 1/3 for total including seismic and wind loads where allowed by code. Where isolated pads are utilized they shall be tied into adjacent foundations in at least two directions with structural grade beams.

All footings shall be reinforced with a minimum of four #5 bars, two top and two bottom. Structural design shall be utilized where more conservative.

Foundation excavations shall be observed by a representative of COAST GEOTECHNICAL, Inc. prior to placement of steel and concrete, to verify compliance with geotechnical recommendations. Dependent on conditions exposed the project geologist or soils engineer may require the foundation excavations to be extended deeper or mitigation of exposed conditions.

FOUNDATIONS IN NATIVE EARTH MATERIAL

Foundations for property line walls or free standing retaining walls may derive support from competent native earth materials.

Continuous footings placed a minimum of 24 inches below lowest adjacent grade and bearing 12 inches into competent native earth materials may utilize an allowable bearing value 1,500 psf. This value is for dead plus live load and may be increased by 1/3 for total including seismic and wind loads where allowed by code. Minimum footing width shall be fifteen inches.

Minimum geotechnical reinforcement of foundations shall be four #4 bars, two top and two bottom.

It is recommended that all footing bottoms founded in native soils be moisture conditioned and mechanically compacted to a firm condition immediately after excavation.

Foundation excavations shall be observed and approved by COAST GEOTECHNICAL, INC. to verify compliance with project geotechnical requirements. Dependent on conditions exposed the project geologist or soils engineer may require the foundation excavations to be extended deeper or mitigation of exposed conditions.

LATERAL DESIGN

Lateral restraint at the base of footings and on slabs may be assumed to be the product of the dead load and a coefficient of friction of .35. Passive pressure on the face of footings may also be used to resist lateral forces. A passive pressure of zero at the surface of finished grade, increasing at the rate of 350 pounds per square foot of depth to a maximum value of 3,500 pounds per square foot, may be used for compacted fill and competent native earth material. If passive pressure and friction are combined when evaluating the lateral resistance, the value of the passive pressure should be limited to 2/3 of the values given above. Calculations for passive pressure are presented on Plate J.

SEISMIC DESIGN

Based on the ASCE7-16, the following seismic design parameters are provided. These seismic design values were determined utilizing latitude 34.096808 and longitude -117.558421 and calculations from the ATC seismic tool application. A printout of the ATC data is attached in Appendix B.

A conservative site class D-default was assigned to site earth materials.

- Site Class = D-default
- Mapped 0.2 Second Spectral Response Acceleration, Ss = 1.612g
- Mapped One Second Spectral Response Acceleration S_1 = 0.600g
- Site Coefficient from Table 1613A.3.3(1), Fa = 1.2
- Site Coefficient from Table 1613A.3.3(2), Fv = *null
- Maximum Design Spectral Response Acceleration for short period, S_{MS} = 1.934g
- Maximum Design Spectral Response Acceleration for one-second period, S_{M1} = *null

- 5% Design Spectral Response Acceleration for short period, S_{DS} = 1.290g
- 5% Design Spectral Response Acceleration for one-second period, S_{D1} = *null

*null- See Section 11.4.8 of the ASCE7-16 for Site Specific Ground Motion Procedures

STATIC SETTLEMENT

The maximum total post-construction static settlement is anticipated to be on the order of 1/2-inch. Differential static settlements are expected to be less than 1/2-inch, measured between adjacent structural elements over a distance of forty feet.

EXPANSIVE SOILS

Results of expansion tests indicate that near surface earth materials have a low expansion potential.

SOIL CORROSIVITY

A near surface soil sample was analyzed for corrosion with the following results, soluble chlorides of 64 ppm, minimum resistivity of max 4,700 ohm-cm, and a pH of 7.9.

No special precautions are required for plastic and vitrified clay pipe placed underground.

Pipes below grade or for venting shall be PVC pipes with solvent joints.

According to minimum resistivity on-site soils are considered to be mildly corrosive to metal piping. Protection of buried metal piping can normally be accomplished by the following:

- Placement inside plastic tubing
- Wrapping of pipe with protective tape system
- Cathodic protection system

Where metal pipes penetrate concrete floors, use plastic sleeves, rubber seals, or other dielectric material to prevent pipes from contacting concrete and reinforcing steel.

SOLUBLE SULFATES

An on-site soil sample showed a soluble sulfate content of 156 ppm, which is a moderate sulfate exposure. Concrete with Type II 4,000 psi and a water to cement ratio of 0.50 may be utilized; however, structural design shall be followed where more conservative.

UTILITY LINE BACKFILLS

All utility line backfills, both interior and exterior, shall be compacted to a minimum of 90% relative compaction and shall require testing at a maximum of two-foot vertical intervals.

Where utility lines enter a structure the utility trench shall have an impermeable plug of backfill placed to mitigate the potential migration of waters through the backfill zone underneath the slab.

FLOOR SLABS

Concrete slabs supported by engineered fill soil shall be designed utilizing values of 1.0 for C_O, 1.0 for C_S, non plastic soils, and in accordance with publications or methods stated in the CBC or referenced publications.

Minimum geotechnical recommendations for a commercial industrial concrete floor are six inches actual thickness with #4 bars at twelve-inches on center each way. Design for anticipated floor loads and usage should be evaluated by the project structural engineer and could result in a thicker floor and or more reinforcement.

Minimum geotechnical recommendations for office usage slab on grade design are four inches actual thickness with #3 bars at twelve-inches on center each way. Structural design could be more conservative.

Prior to placement of the capillary break or vapor retarder COAST GEOTECHNICAL, Inc. shall test the slab subgrade soils for moisture content. If the subgrade soils do not exhibit the recommendations on Plate A they shall be moisture conditioned to the required depth and content.

The capillary break material shall comply with the requirements of the local jurisdiction and shall be a minimum of four inches in thickness. The capillary break shall consist of open graded 1/2 inch or larger gravel. The gravels shall be vibrated smooth. Vibration of the gravels shall be verified by COAST GEOTECHNICAL. The gravels shall be covered with a heavy filter fabric prior to placement of the vapor retarder to minimize puncturing of the vapor retarder. A minimum 15-mil thick vapor retarder in accordance with requirements of ASTM E:1745 and E:1643 is recommended.

The vapor retarder is recommended for all slab on grade areas and shall be properly lapped and sealed in accordance with code. The vapor barrier shall be in contact with the slab bottom.

PAVEMENT SECTION

The parking lot subgrade will require over-excavation and compaction to provide a minimum of two feet of compacted fill placed in accordance will recommendations of this report. An R-Value of 70 has been determined for near surface site soils; although, for analysis a maximum R-Value of 50 is utilized. Based on assumed traffic indexes and this R-value the following sections may be utilized. Import material for future grading of the parking and driveways should consist of earth material similar to onsite soils. Additional R-values should be determined upon completion of grading. The following pavement sections may be subject to change based on these results.

AREA	FLEXIBLE PAVEMENT SECTION				
	T. I.	GE	AC	AB	SUBGRADE
Auto Parking	5.0	0.80	3.5"	4.0"**	* 24"
Auto Drives	6.0	0.96	4.0"	4.0"**	* 24"
Truck Drives	7.0	1.12	4.0"	6.0"**	*24"

Truck loading dock concrete slab areas shall be at least 6 inches thick over soil compacted to 90% minimum. Added reinforcement and increased concrete strength should be considered.

* *Compacted to 90% relative compaction.*
** *Compacted to 95% relative compaction.*

If concrete pavement is used, the concrete should be at least six inches thick underlain by at least four inches of base material compacted to a minimum of 95% relative compaction. Reinforcement is highly advised and at a minimum should consist of #3 bars on 18 inch center both ways. To minimize cracking of concrete pavement recommendations of the PCA should be utilized as guidelines for placement, curing, jointing, saw cutting, etc. Increased pavement sections and/or reinforced concrete aprons should be utilized where heavy axle loads from trash or delivery trucks will be encountered.

UNRESTRAINED RETAINING WALLS

Unrestrained retaining walls may utilize bearing values stated previously in this report and shall have foundations bearing in compacted earth materials or competent native earth materials. Retaining walls with varied backfill conditions may be designed using the following criteria:

Surface Slope of Retained Material Horizontal to Vertical	Equivalent Fluid Pressure Pounds per Cubic Foot
Level	37.2
5 to 1	43.4
4 to 1	45.5
3 to 1	49.8
2 to 1	65.6

For a retaining wall under earthquake loading, the designed equivalent fluid pressure is as follows:

Surface Slope of Retained Material Horizontal to Vertical	Equivalent Fluid Pressure Pounds per Cubic Foot
Level	50.9
5 to 1	63.9
4 to 1	69.2
3 to 1	83.6
2 to 1	124.6

Our current understanding is that use of seismic design values are not required for walls less than six feet in height; although, local building officials may determine otherwise. It is the responsibility of the structural engineer to verify with the local authorities applicable use of earthquake loadings on retaining walls.

Calculations for the stated equivalent fluid pressures are based on the Coulomb theory and the Mononobe-Okabe method provided on Plates K and L. The point of resultant force under static loading is at H/3 above the base of the retaining wall. For a retaining wall with different slope angles, the point of the resultant force under earthquake loading is provided on Plate M.

The design values provided are based on the use of select, very low expansive, granular soils or gravels as backfill and justify the use of stated design values rather than that provided in the CBC. The structural engineer shall designate on the plans the use of select backfill materials. Select onsite earth materials are acceptable as use for retaining wall backfills.

The retaining walls shall be designed with adequate drainage to prevent the buildup of hydrostatic pressure.

Retaining walls shall be waterproofed to the degree desired by the owner.

Retaining wall backfill shall be placed in six to eight-inch loose; moisture conditioned lifts and mechanically compacted to a minimum of 90% relative compaction. Backfills require testing at two-foot vertical intervals during placement. Select onsite very low expansive soils approved by COAST GEOTECHNICAL, Inc. are acceptable for use as backfill.

Footing excavation, subdrain placement, and compaction of backfills requires observation and approval by COAST GEOTECHNICAL, Inc. and the City grading inspector.

SUBDRAINS

Subdrain systems shall be installed behind retaining walls and at a minimum they shall consist of four-inch diameter SCH 40 or SDR 35 perforated pipe surrounded with one cubic foot, per lineal pipe foot, of 3/4-inch gravel. The gravel shall be wrapped in filter fabric. Outlet pipes shall be solid pipe of similar material. Typical subdrain details are shown on Plate N.

The wall subdrain system shall be separate from area, surface, and roof drain systems.

WATERPROOFING

There is an inherent risk associated with moisture-induced problems when constructing earth retaining structures. The client, the design consultant of the waterproofing system, and the contractor responsible for installation, assumes this risk. The geotechnical consultant is only responsible for identification of adverse moisture conditions. None were observed in the proposed construction areas, but undiscovered conditions could exist and conditions do change

with time as lots are developed and irrigation begins. Site retaining walls and slabs shall be waterproofed to the degree desired by the client.

HARDSCAPE SLABS

Hardscape slab subgrade areas shall exhibit a minimum of 90% relative compaction and moisture content 3-4% over optimum moisture content to a depth of at least one foot. Deeper removal and recompaction may be required if unacceptable conditions are encountered. These areas require testing just prior to placing concrete.

Exterior hardscape slabs will be subject to stress from volume changes due to variations in subgrade soils, which could lead to cracking. The followings recommendations will minimize cracking and offsets, but will not eliminate concrete cracks.

Doweling slabs to perimeter footings can mitigate movement of slabs adjacent to structures. Doweling should consist of No. 4 bars bent around exterior slabs Doweling should be spaced no farther than 36 inches on centers. As an option to doweling, an architectural separation could be provided between the main structure and abutting appurtenance improvements. Pre-saturation of exterior slab areas is also desirable. At exterior edges of patios and other flatwork, a cut-off wall to the same depth and containing the same reinforcement as exterior footings is highly recommended. If no significant load is associated with the edge of the slab, the width of the cut-off wall may be limited to eight inches. Reinforcement adopted for the main structure may be applied to the appurtenances.

Exterior hardscape shall be a minimum of four inches in thickness and reinforced with # 3 bars at twelve inches OCEW.

As an alternative to rigid hardscape or brickwork, flexible pavers may be utilized.

DRAINAGE

Positive drainage should be planned for the site. Drainage should be directed away from structures via non-erodible conduits to suitable disposal areas. The structure should utilize roof gutters and down spouts tied directly to yard drainage.

Unlined flowerbeds, planters, and lawns should not be constructed against the perimeter of the structure. If such landscaping (against the perimeter of a structure) is planned, it should be properly drained and lined or provided with an underground moisture barrier. Irrigation should be kept to a minimum.

The CBC recommends 5% slope away from structures for landscape areas and 2% slope away for hardscape areas, within ten feet of a structure. Minimum drainage shall be one percent for hardscape areas and two percent for landscape areas for all other areas.

We do not recommend the use of infiltration best management practice (BMP) such as infiltration trenches, bottomless trench drains, infiltration basins, dry wells, permeable pavements or similar systems designed primarily to percolate water into the subsurface soils within ten feet of foundations.

PRELIMINARY INFILTRATION ASSESSMENT

Site explorations placed by this consultant did not encounter groundwater to a depth of fifteen feet below existing grade. The upper earth materials in this area consist of silty, fine to coarse-grained sand, with gravel and cobbles, which are opinioned to have favorable; although, variable infiltration rates. Infiltration systems should be kept a minimum of fifteen feet away from structures.

Actual infiltration rates will require testing which can be performed, when system type and location(s) are known, under separate contract.

ENGINEERING CONSULTATION, TESTING & OBSERVATION

We will be pleased to provide additional input with respect to foundation design once methods of construction have been determined.

Grading and foundation plans should be reviewed by this office prior to commencement of grading so that appropriate recommendations, if needed, can be made.

Areas to receive fill should be observed when unsuitable materials have been removed and prior to placement of fill, and fill should be observed and tested for compaction as it is placed.

SUPPLEMENTAL CONSULTING

During construction, a number of reviews by this office are recommended to verify site geotechnical conditions and conformance with the intentions of the recommendations for construction. Although not all possible geotechnical observation and testing services are required. The following site reviews are advised, some of which will probably be required by the City of Rancho Cucamonga.

- Grading and excavations
- Foundation excavations and slab subgrade compaction testing
- Slab steel placement, primary and appurtenant structures
- Compaction of utility trench backfill
- Parking lot subgrade and base testing
- Hardscape subgrade compaction

AGENCY REVIEW

All soil and structural aspects of the proposed development are subject to the review and approval of the governing agency(s). It should be recognized that the governing agency(s) can dictate the manner in which the project proceeds. They could approve or deny any aspect of the proposed improvements and/or could dictate which foundation and grading options are acceptable.

Supplemental geotechnical consulting in response to agency requests for additional information could be required and will be charged on a time and materials basis.

LIMITATIONS

This report presents recommendations pertaining to the subject site based on the assumption that the subsurface conditions do not deviate appreciably from those disclosed by our exploratory excavations. Our recommendations are based on the technical information, our understanding of the proposed construction, and our experience in the geotechnical field. We do not guarantee the performance of the project, only that our engineering work and judgments meet the standard of care of our profession at this time. In view of the general conditions in the area, the possibility of different local soil conditions may exist. Any deviation or unexpected condition observed during construction should be brought to the attention of the Geotechnical Engineer. In this way, any supplemental recommendations can be made with a minimum of delay necessary to the project.

If the proposed construction will differ from our present understanding of the project, the existing information and possibly new factors may have to be evaluated. Any design changes and the finished plans should be reviewed by the Geotechnical Consultant. Of particular importance would be extending development to new areas, changes in structural loading conditions, postponed development for more than a year, or changes in ownership.

This report is issued with the understanding that it is the responsibility of the owner, or of his representative, to ensure that the information and recommendations contained herein are called to the attention of the Architects and Engineers for the project, and incorporated into the plans and that the necessary steps are taken to see that the Contractors and Subcontractors carry out such recommendations in the field.

This report is subject to review by the controlling authorities for this project.

We appreciate this opportunity to be of service to you.

Respectfully submitted:
COAST GEOTECHNICAL, INC.

Ming-Tarng Chen
RCE 54011

REGISTERED PROFESSIONAL ENGINEER
MING-TARNG CHEN
No. 54011
Exp. 12/31/21
CIVIL
STATE OF CALIFORNIA

APPENDIX A

This appendix contains a description of the field investigation, laboratory testing procedures and results, outside lab testing, site plan, exploratory logs and expansive soil recommendations.

FIELD INVESTIGATION

The field investigation was performed on August 12, 2020, and consisted of the excavation of five borings by a hollow stem auger drilling rig at the locations shown on the attached Site Plan. As drilling progressed, personnel from this office visually classified the earth materials encountered, and secured representative samples for laboratory testing.

Undisturbed samples for detailed testing in our laboratory were obtained by pushing or driving a sampling spoon into the material. A solid barrel-type spoon was used having an inside diameter of 2.5 inches with a tapered cutting tip at the lower end and a ball valve at the upper end. The barrel is lined with thin brass rings, each one inch in length. The spoon penetrated into the earth material below the depth of boring approximately twelve inches. The central portion of this sample was retained for testing. All samples in their natural field condition were sealed in airtight containers and transported to the laboratory.

Description of the earth material encountered is presented on the attached Boring Logs. The data presented on these logs is a simplification of actual subsurface conditions encountered and applies only at the specific boring location on the date excavated. It is not warranted to be representative of subsurface conditions at other locations and times.

LABORATORY TESTING

Field samples were examined in the laboratory and a testing program was then established to develop data for preliminary evaluation of geotechnical conditions.

Field moisture and dry densities were calculated for each undisturbed sample. The samples were obtained per ASTM:D-2937 and tested under ASTM:D-2216.

Maximum density-optimum moisture relationships were established per ASTM:D-1557 for use in evaluation of in-situ conditions and for future use during grading operations.

Direct shear tests were performed in accordance with ASTM:D-3080, on specimens at near saturation under various normal loads. The results of tests are based on an 80% peak strength or ultimate strength, whichever is lower, and are attached.

Expansion tests were performed on typical specimens of earth materials in accordance with the procedures outlined in ASTM D-4829.

TEST RESULTS

Maximum Density/Optimum Moisture (ASTM:D-1557)

Boring	Depth in Feet	Maximum Density, pcf	Optimum Moisture, %
2	0 - 5	127.0	9.0

Direct Shear (ASTM:D-3080)

Boring	Depth in Feet	Cohesion (lbs./sq. ft.)	Angle of Internal Friction (Degrees)
2	0 – 5 (remolded)	250	30
3	2.5	300	29

Expansion Index (ASTM:D-4829)

Boring	Depth in Feet	Expansion Index	Expansion Potential
2	0 – 5	25	Low
2	5.5 - 10	25	Low

Soluble Sulfate Analysis (CT 417)

Boring	Depth in Feet	Soluble Sulfate (ppm)
3	0 – 5	156

SPECIFICATIONS FOR GRADING

SITE CLEARING

All existing vegetation shall be stripped and hauled from the site.

PREPARATION

After the foundation for the fill has been cleared, plowed or scarified, it shall be disced or bladed until it is uniform and free from large clods, brought to a proper moisture content and compacted to not less than ninety percent of the maximum dry density in accordance with ASTM:D-1557 (5 layers - 25 blows per layer; 10 lb. hammer dropped 18"; 4" diameter mold).

MATERIALS

On-site materials may be used for fill, or fill materials shall consist of materials approved by the Soils Engineer and may be obtained from the excavation of banks, borrow pits or any other approved source. **The materials used should be free of vegetable matter and other deleterious substances and shall not contain rocks or lumps greater than six inches in maximum dimension.**

PLACING, SPREADING AND COMPACTING FILL MATERIALS

The selected fill material shall be placed in layers which, when compacted, shall not exceed six inches in thickness. Each layer shall be spread evenly and shall be thoroughly mixed during the spreading to ensure uniformity of material and moisture of each layer.

Where moisture of the fill material is below the limits specified by the Soils Engineer, water shall be added until the moisture content is as required to ensure thorough bonding and thorough compaction.

Where moisture content of the fill material is above the limits specified by the Soils Engineer, the fill materials shall be aerated by blading or other satisfactory methods until the moisture content is as specified.

After each layer has been placed, mixed and spread evenly, it shall be thoroughly compacted to not less than 90 percent of the maximum dry density in accordance with ASTM:D-1557 (5 layers -25 blows per layer; 10 lbs. hammer dropped 18 inches; 4" diameter mold) or other density tests which will attain equivalent results.

Compaction shall be by sheepfoot roller, multi-wheel pneumatic tire roller, track loader or other types of acceptable rollers.

Rollers shall be of such design that they will be able to compact the fill to the specified density. Rolling shall be accomplished while the fill material is at the specified moisture content. Rolling of each layer shall be continuous over the entire area and the roller shall make sufficient trips to ensure that the desired density has been obtained. The final surface of the lot areas to receive slabs on grade should be rolled to a dense, smooth surface.

The outside of all fill slopes shall be compacted by means of sheepfoot rollers or other suitable equipment. Compaction operations shall be continued until the outer nine inches of the slope is at least 90 percent compacted. Compacting of the slopes may be progressively in increments of three feet to five feet of fill height as the fill is brought to grade, or after the fill is brought to its total height.

Field density tests shall be made by the Soils Engineer of the compaction of each layer of fill. Density tests shall be made at intervals not to exceed two feet of fill height provided all layers are tested. Where the sheepfoot rollers are used, the soil may be disturbed to a depth of several inches and density readings shall be taken in the compacted material below the disturbed surface. When these readings indicate that the density of any layer of fill or portion there is below the required 90 percent density, the particular layer or portion shall be reworked until the required density has been obtained.

The grading specifications should be a part of the project specifications.

The Soil Engineer shall review the grading plans prior to grading.

INSPECTION

The Soil Engineer shall provide continuous supervision of the site clearing and grading operation so that he can verify the grading was done in accordance with the accepted plans and specifications.

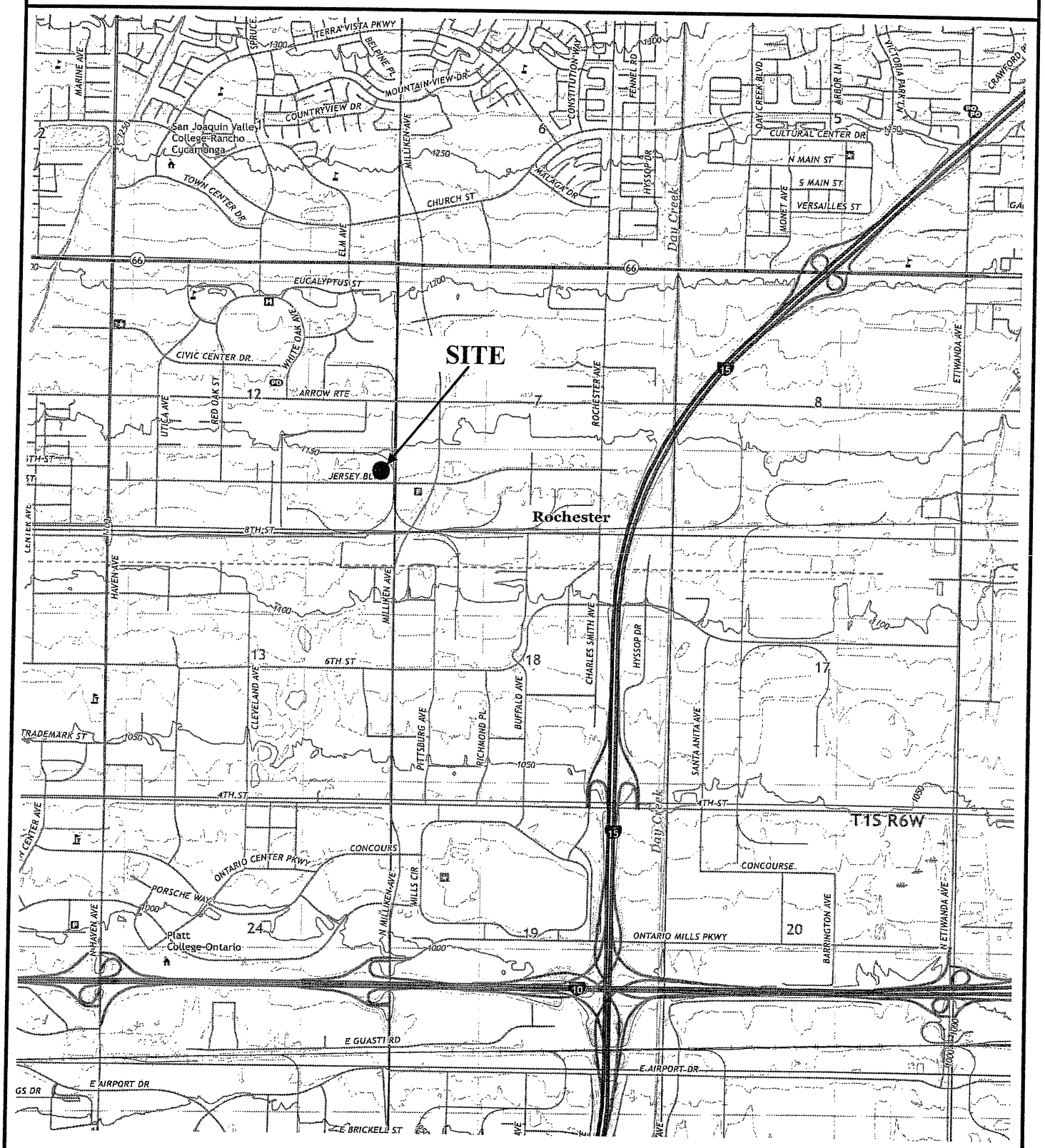
SEASONAL LIMITATIONS

No fill material shall be placed, spread or rolled during unfavorable weather conditions. When heavy rains interrupt work, fill operations shall not be resumed until the field tests by the Soils Engineer indicate the moisture content and density of the fill are as previously specified.

EXPANSIVE SOIL CONDITIONS

Whenever expansive soil conditions are encountered, the moisture content of the fill or recompacted soil shall be as recommended in the expansive soil recommendations included herewith.

SITE VICINITY MAP



U.S. DEPARTMENT OF THE INTERIOR
U.S. GEOLOGICAL SURVEY

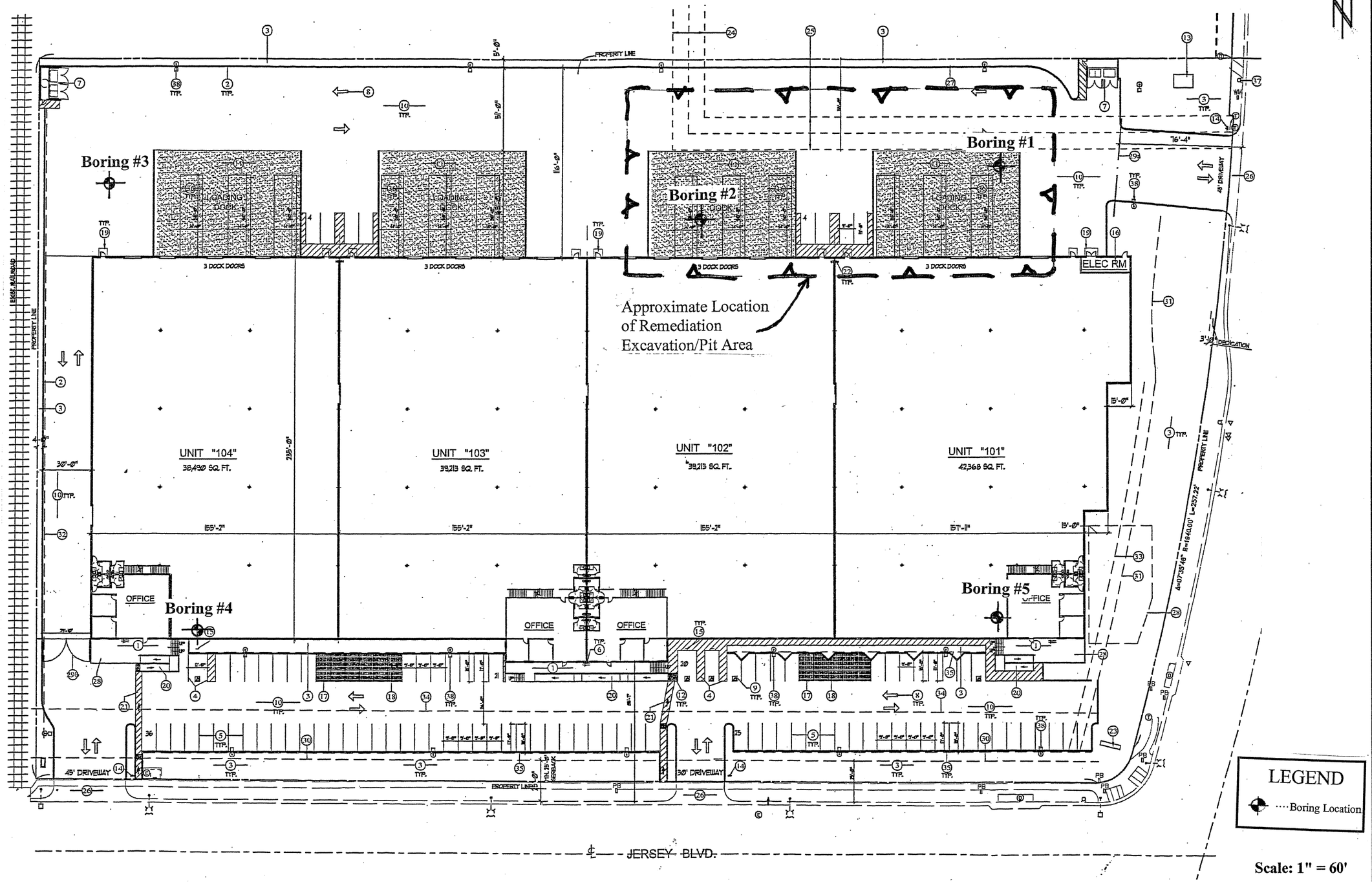
GUASTI, CA
2018

GUASTI QUADRANGLE
CALIFORNIA
7.5-MINUTE SERIES

COAST GEOTECHNICAL, INC.

W.O. 599020 Figure 1

SITE PLAN



WILLIAM SIMPSON & ASSOCIATES, INC.
CONSULTING STRUCTURAL ENGINEERS

COAST GEOTECHNICAL, INC.	W.O. 599020	Figure 2

(Text Supercedes)

EXPANSION INDEX	VERY LOW 0 - 20	LOW 21 - 50	MEDIUM 51 - 90	HIGH 91 - 130	VERY HIGH 130+
Footing Width 1 Story 2 Story 3 Story	12" 15" 18"	12" 15" 18"	12" 15" 18"	15" 15" 18"	15" 15" 18"
Exterior Footing Depth 1 Story 2&3 Story	18" 24"	24" 24"	24" 24"	24" 24"	30" 36"
Interior Footing Depth 1 Story 2&3 Story	18" 24"	18" 24"	24" 24"	24" 24"	30" 36"
Footing Reinforcement	4 #4 Bars 2 Top 2 Bottom	4 #4 Bars 2 Top 2 Bottom	4 #5 Bars 2 Top 2 Bottom	4 #5 Bars 2 Top 2 Bottom	4#5 Bars 2 Top 2 Bottom
Slab Thickness (1)	4" Nominal	4" Nominal	5" Actual	5" Actual	5" Actual
Slab Reinforcement	#3 Bars on 18" Centers Both Ways	#3Bars on 12" Centers Both Ways	#4 Bars on 12" Centers Both Ways	#4 Bars on 12" Centers Both Ways	#4 Bars on 12" Centers Both Ways
Vapor Retarder (2)	15 mil Membrane	15 mil Membrane	15 mil Membrane	15 mil Membrane	15 mil Membrane
Garage Reinforcement	#3 Bars on 18" Centers Both Ways	#3 Bars on 12" Centers Both Ways	#4 Bars on 12" Centers Both Ways	#4 Bars on 12" Center Both Ways Free Floating	#4 Bars on 12" Center Both Ways Free Floating
Grade Beam - Garage Entrance	Same as Adj. Ext. Ftg.	Same as Adj. Ext. Ftg.	Same as Adj. Ext. Ftg.	Same as Adj. Ext. Ftg.	Same as Adj. Ext. Ftg.
Capillary Break (3)	4" Clean Aggregate	4" Clean Aggregate	4" Clean Aggregate	4" Clean Aggregate	4" Clean Aggregate
Presaturation	Not Required	Above Opt. To Depth of Ftg. (No Testing)	110% of Opt M/C to Depth Footing	130% of Opt M/C to Depth Footing	130% of Opt M/C to Depth Footing

1. Basement slabs shall have a minimum thickness of six inches.
2. Floor slab shall be constructed over a 15 mil plastic membrane. The membrane shall be properly lapped, sealed and in contact with the slab bottom.
3. Aggregate shall be 1/2-inch or larger.

PLATE A

SUMMARY OF BORING NO. 1

Date: 8/12/2020

Elevation: E.G.

Blow Count (Ring)	Dry Density (Pcf)	Moisture (% Dry Wt.)	Samples U	Samples B	Depth (Ft.)	Description	Color	Compactness
						NATIVE: SAND --- silty, fine to medium-grained, damp	Tan Light Gray	Loose
37	119.2	2.6	■			SAND --- silty, with gravels, medium to coarse-grained, damp	Light Gray	Medium Dense
28	123.9	1.1	■		5	SAND --- silty, with gravels, medium to coarse-grained, damp	Brown	Medium Dense
						End of boring at 7.5 feet Terminated due to refusal No groundwater No caving		
					10			

Geotechnical Engineering Investigation
11298 Jersey Boulevard
Rancho Cucamonga, California

Work Order 599020

Plate No. B

COAST GEOTECHNICAL, INC.

SUMMARY OF BORING NO. 2

Date: 8/12/2020

Elevation: E.G.

Blow Count (Ring)	Dry Density (Pcf)	Moisture (% Dry Wt.)	Samples (U / B)	Depth (Ft.)	Description	Color	Compactness
					NATIVE: SAND --- silty, fine to medium-grained, damp	Tan Brown	Medium Dense
25	111.3	1.7			SAND --- with gravels, medium to coarse-grained, damp	Light Gray	Medium Dense
44	117.7	2.0		5	SAND --- with gravels, medium to coarse-grained, damp	Light Gray Brown	Dense
50	N.R.	2.0		10	SAND --- with gravels, medium to coarse-grained, damp	Light Gray Brown	Very Dense
					End of boring at 11 feet Terminated due to refusal No groundwater No caving		

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Plate No. C

COAST GEOTECHNICAL, INC.

SUMMARY OF BORING NO. 3

Date: 8/12/2020

Elevation: E.G.

Blow Count (Ring)	Dry Density (Pcf)	Moisture (% Dry Wt.)	Samples U	Samples B	Depth (Ft.)	Description	Color	Consistency
						FILL: SAND --- silty, fine to medium-grained, damp	Tan Brown	Loose to Medium Dense
11	111.6	3.5				NATIVE: SAND --- silty, fine to medium-grained, damp	Brown	Medium Dense
					5			
13	110.9	3.2				SAND --- silty, fine to medium-grained, damp	Brown	Medium Dense
						SAND --- silty, with gravels, fine to medium-grained, damp	Brown	Medium Dense
					10			
27	112.6	2.5				NATIVE: SAND --- silty, fine to medium-grained, damp	Yellow Tan	Medium Dense
					15			
52	107.9	3.3				NATIVE: SAND --- silty, with gravels, fine to medium-grained, damp	Yellow Tan	Medium Dense
						End of boring at 16 feet Terminated due to refusal No groundwater No caving		

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Plate D

COAST GEOTECHNICAL, INC.

SUMMARY OF BORING NO. 4

Date: 8/12/2020

Elevation: E.G.

Blow Count (Ring)	Dry Density (Pcf)	Moisture (% Dry Wt.)	Samples U	Samples B	Depth (Ft.)	Description	Color	Compactness
						FILL: SAND --- silty, with gravels, medium-grained, damp	Brown	Medium Dense
18	109.0	2.7	■			NATIVE: SAND --- silty, medium-grained, damp	Brown	Medium Dense
27	117.1	7.4	■		5	SAND --- silty, fine to medium-grained, damp	Yellow Brown	Medium Dense
						SAND --- silty, fine to medium-grained, damp	Yellow Brown	Medium Dense
29	112.2	2.3	■		10	SAND --- silty, fine to medium-grained, damp	Yellow Brown	Medium Dense
						End of boring at 11 feet Terminated due to refusal No groundwater No caving		

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Plate No. E

COAST GEOTECHNICAL, INC.

SUMMARY OF BORING NO. 5

Date: 8/12/2020

Elevation: E.G.

Blow Count (Ring)	Dry Density (Pcf)	Moisture (% Dry Wt.)	Samples U	Samples B	Depth (Ft.)	Description	Color	Compactness
						FILL: SAND --- silty, fine-grained, damp	Light Gray Tan	Loose
						NATIVE: SAND --- silty, fine to medium-grained, damp	Brown	Medium Dense
21	112.4	3.7	■					
					5	SAND --- silty, fine to medium-grained, damp	Brown	Medium Dense
20	109.6	2.2	■			SAND --- silty, with gravels, medium to coarse-grained, damp	Light Gray	Medium Dense
					10	End of boring at 9 feet Terminated due to refusal No groundwater No caving		

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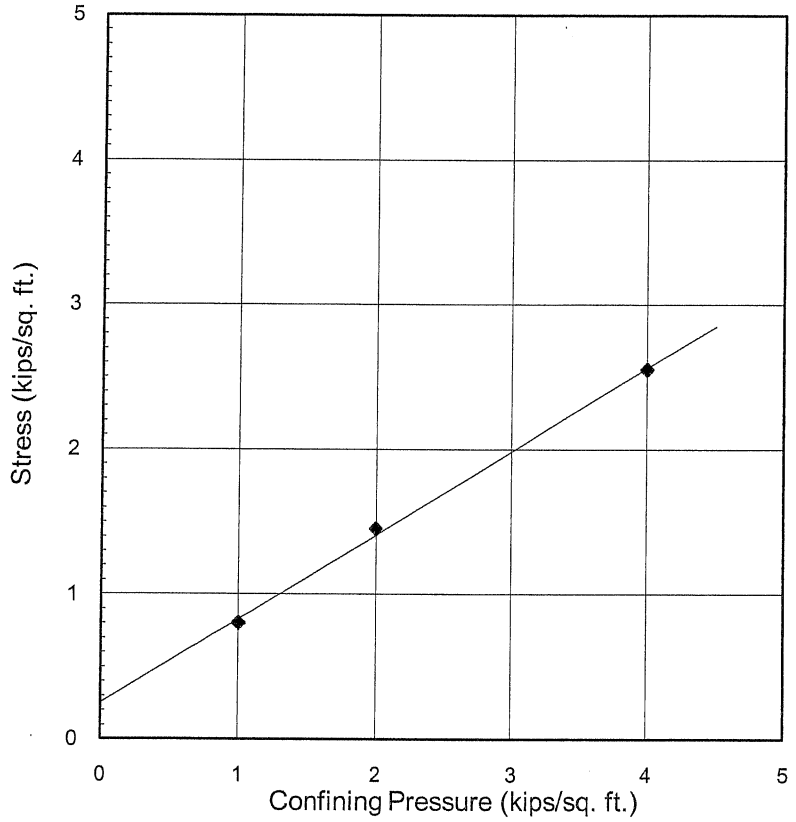
Work Order 599020

Plate No. F

COAST GEOTECHNICAL, INC.

SHEAR TEST RESULT

Boring No.2 @ 0 to 5 Feet (Remolded to 90%)



Remolded soil samples were tested at saturated conditions.

The sample had a dry density of 115 lbs./cu.ft. and a moisture content of 17.1 %.

Cohesion = 250 psf

Friction Angle = 30 degrees

Based on 80% peak strength or ultimate strength, whichever is lower

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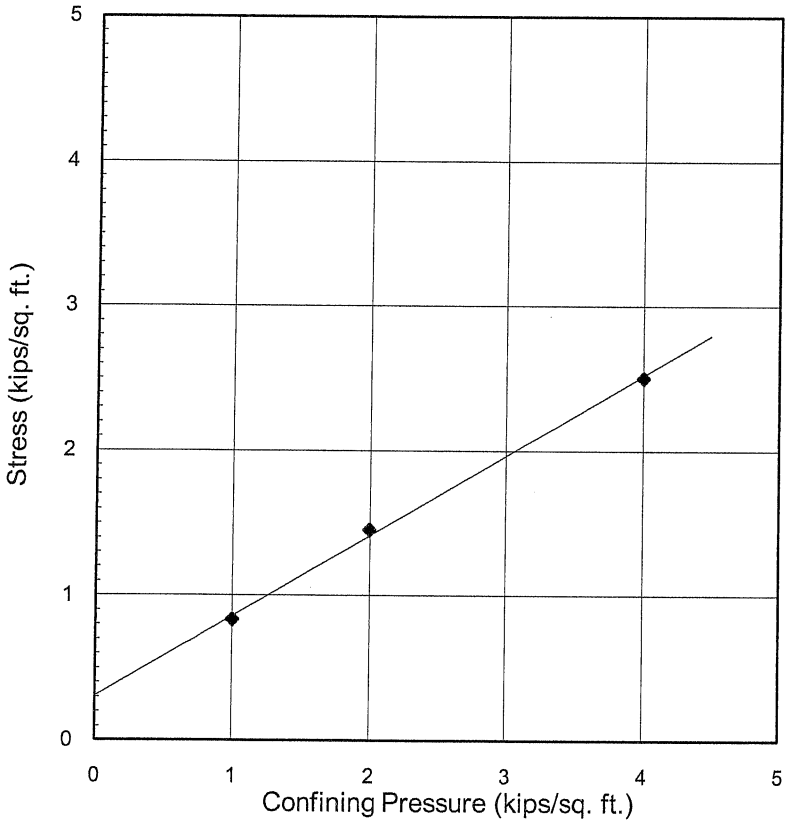
COAST GEOTECHNICAL, INC.

SHEAR TEST RESULT

Boring No.3 @ 2.5 Feet



Native Soil samples were tested at saturated conditions.

The sample had a dry density of 111.6 lbs./cu.ft. and a moisture content of 18.6 %.

Cohesion = 300 psf

Friction Angle = 29 degrees

Based on 80% peak strength or ultimate strength, whichever is lower

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COAST GEOTECHNICAL, INC.

ALLOWABLE BEARING CAPACITY

Bearing Capacity Calculations are based on "Terzaghi's Bearing Capacity Theory"

Bearing Material: Compacted Fill

Properties:

Wet Density (γ)	=	125	pcf
Cohesion (C)	=	250	psf
Angle of Friction (ϕ)	=	30	degrees
Footing Depth (D)	=	2	feet
Footing Width (B)	=	1.0	foot
Factor of Safety	=	3.0	

Calculations - Ultimate Bearing Capacity

from Table 3.1 on page 127 of "Foundation Engineering Handbook", 1975

N_c = 30.14 N_q = 18.4 N_γ = 22.4

$Q_u = 1.3\ C\ N_c + \gamma\ D\ N_q + 0.4\ \gamma\ B\ N_\gamma$ (Square Footing)

$= 1.3 * 250 * 30.14 + 125 * 2 * 18.4 + 0.4 * 125 * 1 * 22.4$

$= 9795 + 4600 + 1120 = 15515$ psf

Allowable Bearing Capacity for Square Footing

$Q_{all} = Q_u / F.S. =$ 5171 psf

Use 2000 psf

$Q_u = 1.0\ C\ N_c + \gamma\ D\ N_q + 0.5\ \gamma\ B\ N_\gamma$ (Continuous Footing)

$= 1.0 * 250 * 30.14 + 125 * 2 * 18.4 + 0.5 * 125 * 1 * 22.4$

$= 7535 + 4600 + 1400 = 13535$ psf

Allowable Bearing Capacity for Continuous Footing

$Q_{all} = Q_u / F.S. =$ 4511 psf

Use 2000 psf

LATERAL EARTH PRESSURE CALCULATIONS

Retaining structures such as retaining walls, basement walls, and bulk-heads are commonly used in foundation engineering, and they support almost vertical slopes of earth masses. Proper design and construction of these structures require a through knowledge of the lateral forces acting between the retaining structures and the soil masses being retained. These lateral forces are due to lateral earth pressure.

Properties of earth material:

Wet Density (γ)	=	125	pcf
Cohesion (C)	=	250	psf
Angle of Friction (ϕ)	=	30	degrees

Coefficient of earth pressure at rest (Jaky, 1944), $K_0 = 1 - \sin\phi$

K_0 = 0.500

Earth pressure at rest

$= \gamma K_0 = 62.5$ psf / LF

Assumed H = 2 feet

$P_p = 0.5\gamma H^2 \tan^2(45^0 + \phi/2) + 2 C H \tan(45^0 + \phi/2)$

$= 0.5 * 125 * 4 * 3 + 2 * 250 * 2 * 1.732$

$= 750 + 1732 = 2482$ lbs / LF

$1/2\ EFP\ H^2 = 2482$ EFP: passive pressure

EFP = 1241 psf / LF

Allowable Passive Pressure = 350 psf / LF (with F.S. = 3.55)

Coefficient of Friction = $\tan\phi$ = 0.577 Use 0.35

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COAST GEOTECHNICAL, INC.

ASPHALT CONCRETE PAVEMENT DESIGN

R value = 50

1. Design for Auto Driveway

T. I. = 6 Gf = 2.32

G.E. required = 0.0032 (T.I.) (100 - R) = 0.96 ft

Try Thickness of AC = 4 inches

G.E. from AC = 4 / 12 * 2.32 = 0.77 ft

Thickness of AB needed = (0.96 - 0.77) / 1.1 * 12 = 2.1 inches Use 4 inches

2. Design for Auto Parking Areas

T. I. = 5 Gf = 2.5

G.E. required = 0.0032 (T.I.) (100 - R) = 0.8 ft

Try Thickness of AC = 3.5 inches

G.E. from AC = 3.5 / 12 * 2.5 = 0.73 ft

Thickness of AB needed = (0.8 - 0.73) / 1.1 * 12 = 0.8 inches Use 4 inches

3. Design for Truck Drives

T. I. = 7 Gf = 2.14

G.E. required = 0.0032 (T.I.) (100 - R) = 1.12 ft

Try Thickness of AC = 4 inches

G.E. from AC = 4 / 12 * 2.14 = 0.71 ft

Thickness of AB needed = (1.12 - 0.71) / 1.1 * 12 = 4.5 inches Use 6 inches

ACTIVE EARTH PRESSURE BY COULOMB THEORY

The total active thrust can be expressed as

$P_A = 0.5\, K_A\, \gamma\, H^2$

where the active earth pressure coefficient, K_A, is given by

$$K_A = \frac{\cos^2(\phi - \theta)}{\cos^2\theta \cos(\delta + \theta)\left\{1 + \left[\dfrac{\sin(\delta + \phi)\sin(\phi - \beta)}{\cos(\delta + \theta)\cos(\beta - \theta)}\right]^{0.5}\right\}^2}$$

Where:

θ = slope of the back of the wall with respect to the vertical

δ = angle of friction between the wall and the soil

β = slope of the backfill with respect to the horizontal

Properties of earth material:

Wet Density (γ)	=	125	pcf
Cohesion (C)	=	250	psf
Angle of Friction (ϕ)	=	30	degrees
θ	=	0	
δ	=	20	

Caculate K_A based on slope of the backfill

Surface Slope	Slope Angle (β)	K_A	EFP [$= \gamma * K_A$], pcf
Level	0.0	0.297	37.2
5:1 (H:V)	11.3	0.347	43.4
4:1 (H:V)	14.0	0.364	45.5
3:1 (H:V)	18.4	0.399	49.8
2:1 (H:V)	26.6	0.524	65.6
1.5:1 (H:V)	33.7	0.798	99.8

ACTIVE EARTH PRESSURE BY MONONOBE-OKABE METHOD

The total active thrust with earthquake effect can be expressed as

$P_{AE} = 0.5\, K_{AE}\, \gamma\, H^2\, (1 - K_v)$

where the active earth pressure coefficient with earthquake effect, K_{AE}, is given by

$$K_{AE} = \frac{\cos^2(\phi - \theta - \psi)}{\cos\psi \cos^2\theta \cos(\delta + \theta + \psi) \left\{ 1 + \left[\dfrac{\sin(\delta + \phi)\sin(\phi - \beta - \psi)}{\cos(\delta + \theta + \psi)\cos(\beta - \theta)} \right]^{0.5} \right\}^2}$$

Where: $\phi - \beta >$ or $= \psi$

θ = slope of the back of the wall with respect to the vertical

ψ = $\tan^{-1}[k_h / (1 - k_v)]$

δ = angle of friction between the wall and the soil

β = slope of the backfill with respect to the horizontal

Properties of earth material:

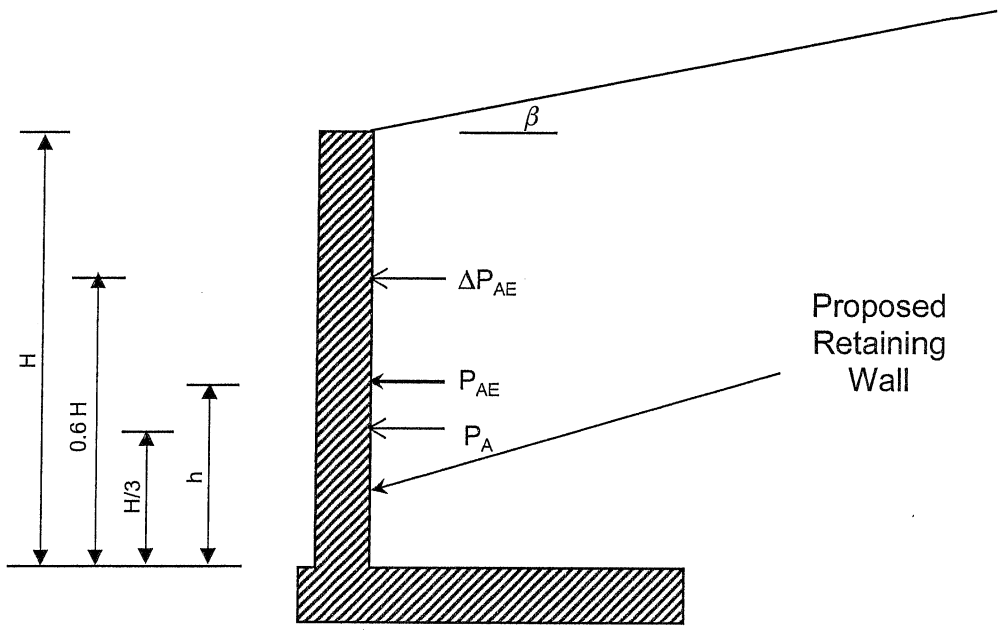
Wet Density (γ)	=	125	pcf
Cohesion (C)	=	250	psf
Angle of Friction (ϕ)	=	30	degrees
k_h	=	0.15	
k_v	=	0	
ψ	=	8.53	
θ	=	0	
δ	=	20	

Caculate K_{AE} based on slope of the backfill

Surface Slope	Slope Angle (β)	K_{AE}	EFP [$= \gamma * K_{AE} * (1 - k_v)$], pcf
Level	0.0	0.407	50.9
5:1 (H:V)	11.3	0.511	63.9
4:1 (H:V)	14.0	0.554	69.2
3:1 (H:V)	18.4	0.669	83.6
2:1 (H:V)	26.6	0.997	124.6
1.5:1 (H:V)	33.7	0.997	124.6

POINT OF RESULTANT FORCE

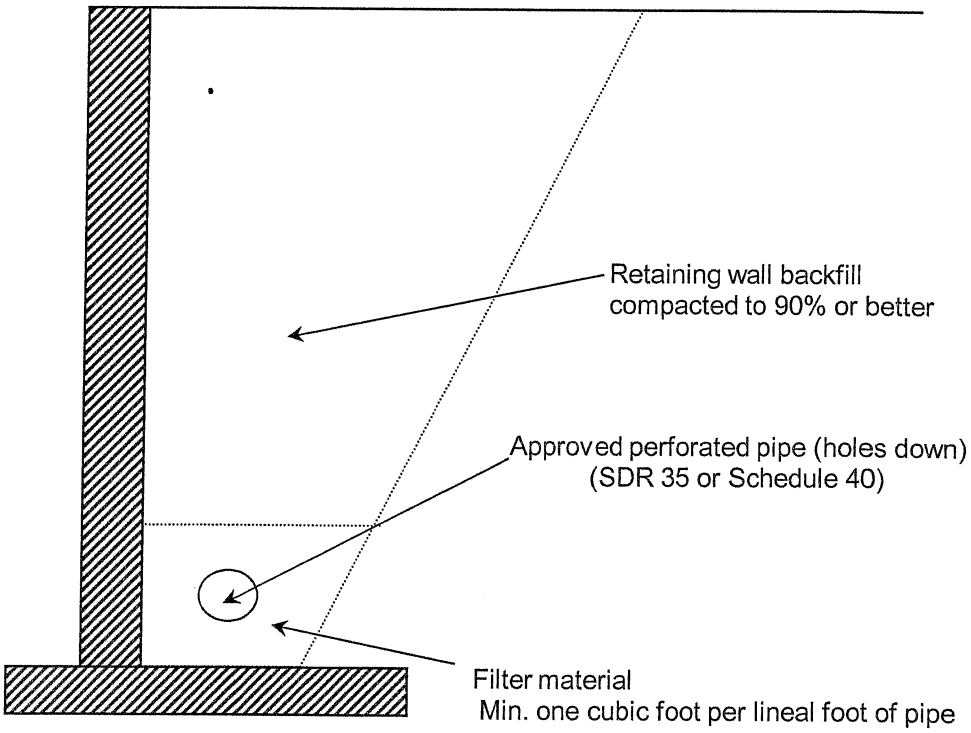
The total active thrust, P_{AE}, can be divided into a static component, P_A, and a dynamic component, ΔP_{AE}. The static component is known to act at H/3 above the base of the wall. The dynamic component is recommended by Seed and Whitman to be taken at approximately 0.6 H.



Surface Slope	Slope Angle (β)	P_{AE}	P_A	ΔP_{AE}	h
Level	0.0	50.9 *(H^2/2)	37.2 *(H^2/2)	13.7 *(H^2/2)	0.41 H
5:1 (H:V)	11.3	63.9 *(H^2/2)	43.4 *(H^2/2)	20.5 *(H^2/2)	0.42 H
4:1 (H:V)	14.0	69.2 *(H^2/2)	45.5 *(H^2/2)	23.7 *(H^2/2)	0.42 H
3:1 (H:V)	18.4	83.6 *(H^2/2)	49.8 *(H^2/2)	33.8 *(H^2/2)	0.44 H
2:1 (H:V)	26.6	124.6 *(H^2/2)	65.6 *(H^2/2)	59.0 *(H^2/2)	0.46 H
1.5:1 (H:V)	33.7	124.6 *(H^2/2)	99.8 *(H^2/2)	24.8 *(H^2/2)	0.39 H

h: point of resultant force above the base of the wall with earthquake effects

TYPICAL RETAINING WALL SUBDRAIN DETAIL



Filter material to meet following specification or approved equal:

Sieve Size	Percentage Passing
1"	100
3/4"	90 -100
3/8"	40 -100
No.4	25 - 40
No.8	18 - 33
No.30	5 - 15
No.50	0 - 7
No.200	0 - 3

Alternate is to place pipe in pea gravel blanket which is wrapped in filter cloth.

Geotechnical Engineering Investigation 11298 Jersey Boulevard rancho Cucamonga, California	Work Order 599020 Plate N

COAST GEOTECHNICAL, INC.

ANAHEIM TEST LABORATORY

196 Technology Drive, Unit D
Irvine, CA 92618
Phone (949)336-6544

TO:

COAST GEOTECHNICAL, INC.
1200 W. COMMONWEALTH AVE.
FULLERTON, CA 92833

DATE: 08/19/2020

P.O. NO: VERBAL

LAB NO: C-4021-1

SPECIFICATION: CTM-643/417/422

MATERIAL: Silty Sand

Project: Milliten & Jersey
Rancho Cucamonga, CA
Sample ID: B-3 @ 0'-5'

ANALYTICAL REPORT

CORROSION SERIES
SUMMARY OF DATA

pH	MIN. RESISTIVITY per CT. 643 ohm-cm	SOLUBLE SULFATES per CT. 417 ppm	SOLUBLE CHLORIDES per CT. 422 ppm
7.9	4,700	156	64

RESPECTFULLY SUBMITTED

WES BRIDGER LAB MANAGER

ANAHEIM TEST LAB, INC.

196 Technology Drive, Unit D
Irvine, CA 92618
Phone (949)336-6544

TO:

COAST GEOTECHNICAL, INC.
1200 W. COMMONWEALTH AVE.
FULLERTON, CA 92833

DATE: 08/19/2020

P.O. NO.: VERBAL

LAB NO.: C-4021-2

SPECIFICATION: CA 301

MATERIAL: Brown, Silty Sand

Project: Milliten & Jersey
Rancho Cucamonga, CA
Sample ID: B-3 @ 0'-5'

ANALYTICAL REPORT

"R" VALUE

BY EXUDATION	BY EXPANSION
70	N/A

RESPECTFULLY SUBMITTED

WES BRIDGER LAB MANAGER

"R" VALUE CA 301

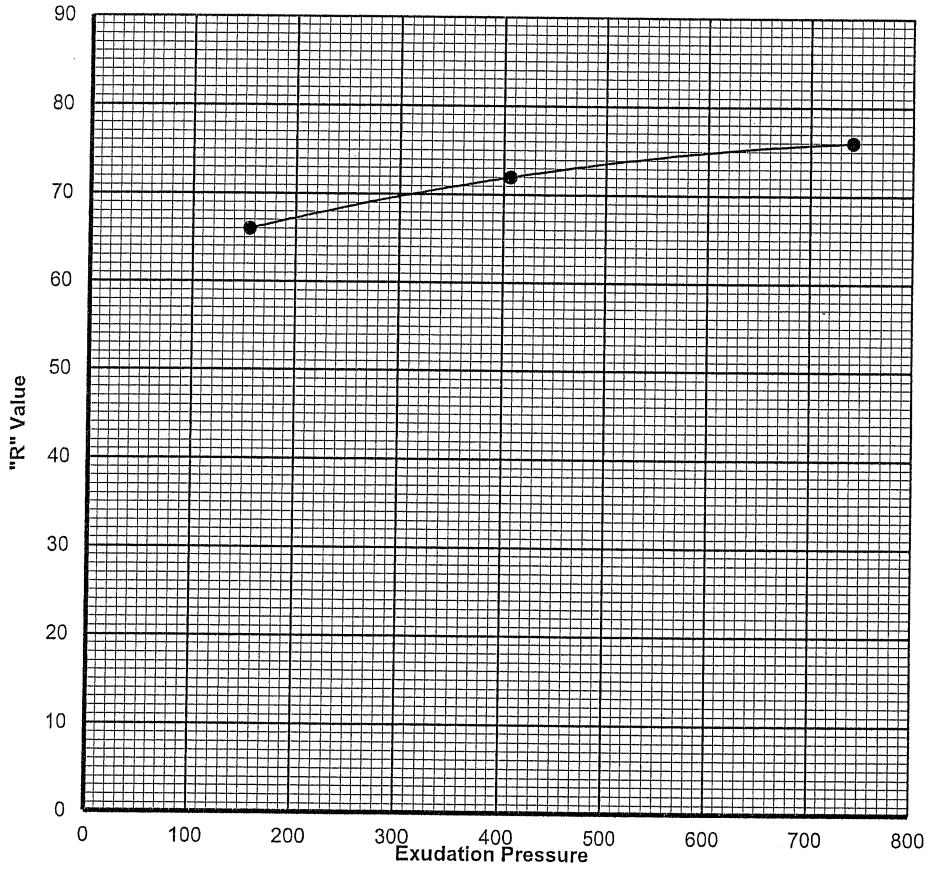
Client: Coast Geotechnical, Inc.
Client Reference No.:
Sample: B3 @ 0'-5'

ATL No.: C-4021-2 **Date:** 8/19/2020

Soil Type: Brown, Silty Sand

TEST SPECIMEN		A	B	C	D
Compactor Air Pressure	psi	350	350	350	
Initial Moisture Content	%	2.7	2.7	2.7	
Moisture at Compaction	%	10.4	10.8	9.9	
Briquette Height	in.	2.52	2.53	2.51	
Dry Density	pcf	120.8	118.8	122.3	
EXUDATION PRESSURE	psi	406	156	742	
EXPANSION dial	(x .0001)	0	0	0	
Ph at 1000 pounds	psi	17	20	15	
Ph at 2000 pounds	psi	30	37	26	
Displacement	turns	4.2	4.36	4.02	
"R" Value		72	66	76	
CORRECTED "R" VALUE		72	66	76	

Final "R" Value	
BY EXUDATION: @ 300 psi	**70**
BY EXPANSION: TI = 5.0	**N/A**



APPENDIX B

ATC Seismic Design Maps Tool Data Output

ATC Hazards by Location

Search Information

Address:	11298 Jersey Blvd, Rancho Cucamonga, CA 91730, USA
Coordinates:	34.09680879999999, -117.5584212
Elevation:	1155 ft
Timestamp:	2020-09-02T17:43:13.969Z
Hazard Type:	Seismic
Reference Document:	ASCE7-16
Risk Category:	II
Site Class:	D-default

Basic Parameters

Name	Value	Description
S_S	1.612	MCE_R ground motion (period=0.2s)
S_1	0.6	MCE_R ground motion (period=1.0s)
S_{MS}	1.934	Site-modified spectral acceleration value
S_{M1}	* null	Site-modified spectral acceleration value
S_{DS}	1.29	Numeric seismic design value at 0.2s SA
S_{D1}	* null	Numeric seismic design value at 1.0s SA

* See Section 11.4.8

Additional Information

Name	Value	Description
SDC	* null	Seismic design category
F_a	1.2	Site amplification factor at 0.2s
F_v	* null	Site amplification factor at 1.0s
CR_S	0.937	Coefficient of risk (0.2s)
CR_1	0.913	Coefficient of risk (1.0s)
PGA	0.653	MCE_G peak ground acceleration
F_{PGA}	1.2	Site amplification factor at PGA
PGA_M	0.783	Site modified peak ground acceleration
T_L	12	Long-period transition period (s)
SsRT	1.705	Probabilistic risk-targeted ground motion (0.2s)

SsUH	1.821	Factored uniform-hazard spectral acceleration (2% probability of exceedance in 50 years)
SsD	1.612	Factored deterministic acceleration value (0.2s)
S1RT	0.637	Probabilistic risk-targeted ground motion (1.0s)
S1UH	0.698	Factored uniform-hazard spectral acceleration (2% probability of exceedance in 50 years)
S1D	0.6	Factored deterministic acceleration value (1.0s)
PGAd	0.653	Factored deterministic acceleration value (PGA)

* See Section 11.4.8

The results indicated here DO NOT reflect any state or local amendments to the values or any delineation lines made during the building code adoption process. Users should confirm any output obtained from this tool with the local Authority Having Jurisdiction before proceeding with design.

Disclaimer

Hazard loads are provided by the U.S. Geological Survey Seismic Design Web Services.

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