geomat GeoMat Testing Laboratories, Inc.

Soil Engineering, Environmental Engineering, Materials Testing, Geology

October 6, 2020

Project No.: 20229-01

TO:
San Bernardino City Unified School District
Facilities Planning and Development
956 West 9th Street
San Bernardino, California 92411

SUBJECT: Preliminary Soil Investigation Report for Access Ramp at Kimbark Elementary School, 18021 West Kenwood Avenue, San Bernardino, California

In accordance with your authorization, GeoMat Testing Laboratories, Inc. (GeoMat) is pleased to present our Preliminary Soil Investigation Report for the proposed access ramp at 18021 West Kenwood Avenue, San Bernardino, California. This report is in fulfillment of our proposal dated September 29, 2020 and your subsequent authorization. The accompanying report presents a summary of our findings, recommendations and limitation of work for the proposed site development.

The primary purpose of this investigation and report is to provide an evaluation of the existing geotechnical conditions at the site as they relate to the design and construction of the proposed development. More specifically, this investigation was to address geotechnical conditions for the preliminary design of the foundation for the proposed ramp structure.

Based on the results of our investigation, the proposed development is feasible from a geotechnical standpoint and it is our professional opinion that the proposed development will not be subject to a hazard from settlement, slippage, or landslide, provided the recommendations of this report are incorporated into the proposed development. It is also our opinion that the proposed development will not adversely affect the geologic stability of the site or adjacent properties provided the recommendations contained in this report are incorporated into the proposed construction.

We appreciate the opportunity to assist you and look forward to future projects. If you should have any questions regarding this report, please do not hesitate to call our office. We appreciate this opportunity to be of service.

Submitted for GeoMat Testing Laboratories, Inc.

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EXP. 12/31/20

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1.0 INTRODUCTION

1.1 EXISTING SITE CONDITIONS

The subject site is located on the south side of Kenwood Avenue between Kimbark Avenue and Woodlawn Avenue in San Bernardino, California. More specifically, the subject site is the sloped landscaping area located between the school building and the Kenwood Avenue street parking spaces.

This sloped landscaped area generally consists of grass ground cover and several mature trees. The slope gradient is approximately 3H:1V for a total height of 12 feet.

1.2 PROPOSED DEVELOPMENT

We understand that the site is proposed for an access ramp connecting the upper street level parking spaces to the lower school building level. The ramp will be of a switchback form and be constructed from concrete slab-on-grade and founded on continuous shallow footings.

1.3 FIELD WORK

Three exploratory borings were excavated on October 4, 2020 to maximum depth of 4 feet below existing ground surface utilizing manual digging and auguring tools. Sampling was conducted with a Dames and Moore California Ring Sampler (see Exploratory Boring Location Map, Plate 1). This sampler has three inches external diameter, 2.5 inches inside diameter, and is lined with one-inch high brass rings, with an inside diameter of 2.41-inches. The sample barrel was driven into the ground at the bottom of the excavation with 35-pound hammer with a free fall of approximately 24-inches. Sampler driving resistance, expressed as number of blows for 12-inch of penetration, was recorded. To convert the field blow count to an SPT equivalent, we have utilized the following conversion formula by D.M. Burmister, 1948, “The importance and practical use of relative density in soil mechanics: Proceedings of ASTM, v. 48:1249” and the correlating SPT “N” values can be found in the borehole logs.

1.4 LABORATORY TESTING

Laboratory tests were performed on selected soil samples. The tests consisted primarily of the following:

• Moisture Content	(ASTM D2216)
• Dry Density	(ASTM D2937)
• Sieve Analysis	(ASTM D422)
• Direct Shear	(ASTM D3080)
• Soluble Sulfate Content	(Extinction/Turbidimetric Method)

The soil classifications are in conformance with the Unified Soil Classifications System (USCS), as outlined in the Classification and Symbols Chart (Appendix B). A summary of our laboratory testing, ASTM designation, and graphical presentation of test results is presented in Appendix C.

2.0 GEOTECHNICAL CONDITIONS

2.1 REGIONAL GEOLOGIC FINDINGS

Based on the Geologic Map of the Devore quadrangle (Dibblee Foundation Map DF-105) the site is located in an area mapped as older alluvial fan deposits (Qoa). These deposits are generally described as consisting of low elevated remnants of alluvial gravel and sand.

2.2 SUBSURFACE CONDITIONS

Detailed log of the exploratory excavation is presented in Appendix B of this report. The earth materials encountered within the exploratory excavations are generally described below.

Based on our exploratory boreholes, the site soil generally consists of silty sand with gravel (USCS “SM”) to the total depth explored of 4 feet below existing ground surface. This material is generally described as loose in the upper 18 inches and become medium dense, dry to slightly moist, and contains few to some gravel.

2.3 GROUNDWATER

Groundwater study is not within the scope of our work. Groundwater was not encountered in our exploratory borings excavated onsite to a depth of 4’ below ground surface.

A contour map showing minimum depths to ground water in the Santa Ana River Valley Region was constructed by the United States Geological Survey (USGS) and subsequently, a report (USGS Map MF-1802) was published in 1985. The map was constructed by contouring the shallowest water level measurements reported to the California Department of Water Resources (CDWR) for the period from 1973-1979. Based on our review of the map, the minimum depth to ground water in the project site area, during this period, may be around 10 feet below ground surface.

Please note that the potential for rain or irrigation water locally seeping through from elevated areas and showing up near grades cannot be precluded. Our experience indicates that surface or near-surface groundwater conditions can develop in areas where groundwater conditions did not exist prior to site development, especially in areas where a substantial increase in surface water infiltration results from landscape irrigation. Fluctuations in perched water elevations are likely to occur in the future due to variations in precipitation, temperature, consumptive uses, and other factors including mounding of perched water over bedrock or natural soil. Mitigation for nuisance shallow seeps moving from elevated lower areas will be needed if encountered. These mitigations may include subdrains, horizontal drains, toe drains, french drains, heel drains or other devices.

2.4 EXPANSIVE SOIL

Expansive soils are characterized by their ability to undergo significant volume changes (shrink or swell) due to variations in moisture content. Changes in soil moisture content can result from precipitation, landscape irrigation, utility leakage, roof drainage, perched groundwater, drought, or other factors and may result in unacceptable settlement or heave of structures or concrete slabs supported on grade.

Based on laboratory classification, the upper foundation soil onsite is expected to have a very low expansion potential (EI<20), as defined in ASTM D4829. This would require verification subsequent to completion of new footing excavations.

2.5 CORROSIVE SOIL

To preliminarily assess the sulfate exposure of concrete in contact with the site soils, a representative soil sample was tested for water-soluble sulfate content. The test results suggest the site soils have a negligible potential for sulfate attack (less than 0.015 percent) based on commonly accepted criteria. We recommend following the procedures provided in ACI 318-19, Section 19.3, Table 19.3.2.1 for exposure "S0". We recommend Type II cement for all concrete work in contact with soil.

Ferrous metal pipes should be protected from potential corrosion by bituminous coating, etc. We recommend that all utility pipes be nonmetallic and/or corrosion resistant. Recommendations should be verified by soluble sulfate and corrosion testing of soil samples obtained from specific locations at the completion of rough grading.

2.6 SEISMIC DESIGN PARAMETERS

Based on current standards, the proposed development is expected to be designed in accordance with the requirements of the 2019 California Building Code (CBC). The 2019 California Building Code (CBC) provides procedures for earthquake resistant structural design that include considerations for on-site soil conditions, occupancy, and the configuration of the structure including the structural system and height.

Based on the soils encountered in the exploratory borehole within the subject site and with consideration of the geologic units mapped in the area, it is our opinion that the site soil profile corresponds to Site Class D in accordance with Section 1613.2.2 of the California Building Code (CBC 2019) and Chapter 20 of ASCE/SEI 7-16.

We have downloaded the seismic design parameters in accordance with the provisions of the current California Building Code (CBC, 2019) and ASCE/SEI 7-16 Standard using the Structural Engineers Association of California, OSHPD Seismic Design Maps Web Application (https://seismicmaps.org). The mapped seismic parameters are attached to this report in Appendix D.

The 2019 CBC requires that a site-specific ground motion study be performed in accordance with Section 11.4.8 of ASCE 7-16 for Site Class D sites with a mapped S1 value greater than 0.2. However, Section 11.4.8 of ASCE 7-16 also indicates an exception (exception 2) to the requirement for a site specific ground motion hazard analysis for certain structures on Site Class D sites. Also, the commentary for Section 11 of ASCE 7-16 (Page 534 of Section C11 of ASCE 7-16) indicates that "In general, this exception effectively limits the requirements for site-specific hazard analysis to very tall and or flexible structures at Site Class D sites."

Based on our understanding of the proposed development, the seismic design parameters presented below were calculated assuming that the exception in Section 11.4.8 applies to the proposed structure at this site. However, the structural engineer should verify that this exception is applicable to the proposed structure. Based on the exception, the spectral response accelerations presented below were calculated using the site coefficients Fa and Fv from ASCE 7-16 Tables 11.4-1 and 11.4-2.

2019 CBC SEISMIC DESIGN PARAMETERS

Short Period Site Coefficient Fa	1.200
Long Period Site Coefficient Fv	1.700
Mapped Spectral Acceleration at 0.2 sec Period Ss	2.454
Mapped Spectral Acceleration at 1.0 sec Period S1	1.045
Site Class	D
Site Modified Spectral Acceleration at 0.2 sec Period SMS	2.945
Site Modified Spectral Acceleration at 1.0 sec Period SM1	1.777
Design Spectral Acceleration at 0.2 sec Period SDS	1.964
Design Spectral Acceleration at 1.0 sec Period SD1	1.184

The above tabulated values as well as the values obtained from the website seismicmaps.org (US seismic design maps) are sufficient assuming a site specific ground motion hazard analysis is not required per exception 2 of ASCE 7-16 Section 11.4.8 and Section 11 commentary of ASCE 7-16.

2.7 SLOPE STABILITY

The stability of the proposed slope and ramp configuration at the subject site was evaluated by analyzing the elevations obtained from Civil Grading Plan prepared by Sitetech, Inc (Sheet C-3, 06/24/2020) as depicted in our Geotechnical Cross Section A-A' on Plate 2.

2.7.1 Soil Strength Parameters

The shear strength parameters used in the stability analyses were based on laboratory test results of relatively undisturbed soil samples obtained from the onsite material. The following table summarizes the parameters used in the stability analysis.

Analysis Type	Material	Strength Parameter	Friction Angle (°)	Cohesion (psf)	Unit Weight (pcf)
Surficial/Global	Alluvium	Ultimate Strength	$\phi = 34.1$	C = 184	$\gamma = 120$

2.7.2 Surficial Stability

Surficial stability of the slope was analyzed for the onsite slope assuming an infinite 2H:1V slope with seepage parallel to the slope surface and consistent subsoil profile. The failure plane for this case is parallel to the surface of slope and the limit equilibrium method can be applied readily. The following factor of safety is derived from a homogeneous c-ϕ soil based on effective stress analysis. The results of the analyses indicate that the existing slopes have a minimum factor of safety of 1.78 for surficial stability under static condition.

$$\text{Factor of Safety} = \frac{C+H*\gamma_b*cos^2(\beta)\tan(\varphi)}{\gamma_{sat}*H*\sin(\beta)\cos(\beta)}$$

Where:

$H =$	3 feet	(saturation zone)
$\gamma_b =$	58 pcf	(buoyant soil unit weight)
$\gamma_{sat} =$	130 pcf	(saturated soil unit weight)
$\beta =$	26.6 °	(slope angle)

Considering the shear strength of soil and the slope inclination, seasonal local surficial sloughing cannot be entirely precluded and should be considered by the project design team. Permanent devices should be designed by the project civil engineer such as but not limited to wall free board, "V" ditches, benches, etc., to minimize and contain any remote pop-outs. In addition, to minimize the potential for surficial sloughing the slope should be maintained with appropriate deep root vegetation and ground cover.

2.7.3 Global Stability Analysis

Global stability analysis was performed to evaluate the probable static and dynamic gross stability of the existing slope configuration. The analyses utilize the simplified method of slices by Bishop through the software program GEOSTASE and the upper boundary theorem of plasticity through the software program LimitState:GEO. The results of the slope stability analyses are provided in Appendix E of this report.

The seismic stability of the site was calculated in conformance with the Southern California Earthquake Center (SCEC), 2002, "Recommended Procedures for Implementation of DMG Special Publication 117, Guidelines for Analyzing and Mitigating Landslide Hazards in California," and the California Geological Survey (CGS), Special Publication 117A, 2008 "Guidelines for Evaluating and Mitigating Seismic Hazards in California." A seismic coefficient (K_{eq}) of 0.473 was utilized in our analysis and was derived based on a maximum allowable displacement of 5 cm, a computed PGA_M of 1.266g, a moment magnitude of 7.9, and a distance to the ground motion source of 1.3 km.

Our analyses indicate that the existing slopes have a minimum factor of safety of 3.08 and 1.28 under static and pseudo-static conditions, respectively. Based on our field observation and slope stability analyses, the existing slopes are considered stable.

Continuing stability of the slope will greatly depend on controlling the water, proper planting and maintaining the drainage for proper functioning. Drainage control measures recommended in this report and the project civil engineer should be implemented during site development.

3.0 TENTATIVE RECOMMENDATIONS

3.1 EARTHWORK RECOMMENDATIONS

The following recommendations are provided regarding aspects of the anticipated earthwork construction. These recommendations should be considered subject to revision based on additional geotechnical evaluation of the conditions observed by the Geotechnical Engineer during site development.

3.1.1 Site Clearing, Grubbing and Fill Removal

All debris, undocumented fill, abandoned utility lines, roots, irrigation appurtenances, underground structures, deleterious materials, etc., should be removed and hauled offsite. Cavities created during site clearance should be backfilled in a controlled manner.

3.1.2 Slab-on-Grade Preparation

The slab subgrade should be scarified to a depth of at least 8-inches below proposed subgrade soil elevation, moisture conditioned, and recompacted to at least 90 percent relative compaction.

3.1.3 Footing Preparation

The footing excavations should be observed by the soil engineer. The footings should be excavated into competent native soil that is determined to be firm and unyielding. If loose soil is encountered in the bottom of the footing excavations, we recommend deepening the footing excavation into competent native material. The bottom of the excavation should be void from slough.

3.1.4 Trench Backfill

All utility trenches and retaining wall backfills should be mechanically compacted to the minimum requirements of at least 90 percent relative compaction. Onsite soils derived from trench excavations can be used as trench backfill except for deleterious materials. Soils with sand equivalent greater than 30 may be utilized for pipe bedding and shading. Pipe bedding should be required to provide uniform support for piping. Excavated material from footing trenches should not be placed in slab-on-grade areas unless properly compacted and tested.

3.1.5 Compacted Fills/Imported Soils

Any soil to be placed as fill, whether presently onsite or import, should be approved by the soil engineer or his representative prior to their placement. All onsite soils to be used as fill should be cleansed of any roots, or other deleterious materials. Rocks larger than 8-inches in diameter should be removed from soil to be used as compacted fill.

All fills should be placed in 6- to 8-inch loose lifts, thoroughly watered, or aerated to near optimum moisture content, mixed and compacted to at least 90 or 95 percent relative compaction depending on the material (subgrade soil or aggregate base) and application (pavement subgrade, building pad, etc.). This is relative to the maximum dry density determined by ASTM D1557 Test Method. Any imported soils should be sandy (preferably USCS "SM" or "SW", and very low in expansion potential) and approved by the soil engineer. The soil engineer or his representative should observe the placement of all fill and take sufficient tests to verify the moisture content and the uniformity and degree of compaction obtained.

3.2 TEMPORARY EXCAVATIONS

All excavation slopes and shoring systems should meet the minimum requirements of the Occupational Safety and Health (OSHA) Standards. Maintaining safe and stable slopes on excavations is the responsibility of the contractor and will depend on the nature of the soils and groundwater conditions encountered and his method of excavation. Excavations during construction should be carried out in such a manner that failure or ground movement will not occur. The contractor should perform any additional studies deemed necessary to supplement the information contained in this report for the purpose of planning and executing his excavation plan.

3.2.1 Cal/OSHA Soil Type

The subsurface soil expected to be encountered during site development may be classified as “Soil Type B” per the California Occupational Safety and Health Administration (Cal/OSHA).

3.2.2 Excavation Characteristics

The upper soil onsite is generally composed of medium dense silty sand with gravel which is not expected to exhibit difficult excavation resistance for typical excavating equipment in good working condition.

3.2.3 Safe Vertical Cuts

Temporary un-surcharged excavations of 4 feet high may be made at a vertical gradient for short periods of time. Temporary un-surcharged excavations greater than 4 feet may be trimmed back at 1H:1V gradients to a maximum height of 10 feet. Exposed conditions during construction should be verified by the project geotechnical engineer. No excavations should take place without the direct supervision of the project geotechnical engineer. If potentially unstable soil conditions are encountered, modifications of slope ratios for temporary cuts may be required.

3.2.4 Excavation Setbacks

No excavations should be conducted, without special considerations, along property lines, public right-of-ways, or existing foundations, where the excavation depth will encroach within the “zone of influence”. The “zone of influence” of the existing footings, property lines, or public right-of-way may be assumed to be below a 45-degree line projected down from the bottom edge of the footing, property line, or right-of-way.

3.3 FOUNDATION RECOMMENDATIONS

The proposed ramp may be supported on conventional shallow foundation systems deriving support in competent native soil (see Section 3.1.3 Footing Preparation). Foundations should be deepened as necessary to penetrate through soft or disturbed soil at the discretion of the Geotechnical Engineer. All foundation excavations must be observed and approved by the Geotechnical Engineer’s representative, prior to placing steel reinforcement or concrete.

3.3.1 Bearing Capacity

Spread, continuous, or pad-type foundations carried at least 36-inches below the lowest adjacent grade may be designed to impose a net dead-plus-live load pressure of 2000 psf. The bearing capacity may be increased 15 percent for every additional foot of embedment, to a maximum allowable bearing pressure of 2500 psf. A one-third increase may be used for wind or seismic loads.

3.3.2 Lateral Resistance

Resistance to lateral footing will be provided by passive earth pressure and base friction. For footings bearing against firm native material, passive earth pressure may be considered to be developed at a rate of 280 psf per foot of depth to a maximum of 2000 psf. Base friction may be computed at 0.40 times the normal load. If passive earth pressure and friction are combined to provide required resistance to lateral forces, the value of the passive pressure should be reduced to two-thirds the value.

3.3.3 Settlement

The onsite soils below the foundation depth have relatively high strengths and will not be subject to significant stress increases from foundations of the new structure. Therefore, estimated total long-term static and seismic settlement between similarly loaded adjacent foundation systems should not exceed 1-inch. The structures should be designed to tolerate a differential settlement on the order of 1/2-inch over a 30-foot span.

3.3.4 Reinforcement

Footing reinforcement should be determined by the structural engineer; however, minimum reinforcement should be at least two No. 4 reinforcing bars, top and bottom. Reinforcement and size recommendations presented in this report are considered the minimum necessary for the soil conditions present at the foundation level and are not intended to supersede the design of the project structural engineer or criteria of the governing agencies for the project.

3.4 SLABS-ON-GRADE

Slabs-on-grade should be at least 4-inches thick and reinforced with at least No. 4 bars at 16-inches on-center both ways, properly centered in mid thickness of slabs. The structural engineer should design the actual slab thickness and reinforcement based on structural load requirements.

3.4.1 Modulus of Subgrade Reaction

A coefficient of vertical subgrade reaction (K_V) of 130 psi/in may be assumed for the building pad compacted fill soils. The modulus of subgrade reaction was estimated based on the NAVFAC 7.1 design charts. This value is for a small loaded area (1 sq. ft or less) such as for wheel loads or point loads and should be adjusted for larger loaded areas, as necessary.

3.4.2 Capillary Break & Vapor Membrane

If vinyl or other moisture-sensitive floor coverings are planned, we recommend that the floor slab in those areas be underlain by a vapor membrane and capillary break consisting of a minimum 10-mil vapor-retarding membrane over a 4-inch thick layer of clean sand. The 4-inch thick layer of sand should be placed between the subgrade soil and the membrane to decrease the possibility of damage to the membrane.

3.4.3 Slab Curling Precautions

A low-slump concrete should be used to minimize possible curling of the slab. Additionally, a layer of sand may be placed over the vapor retarding membrane to reduce slab curling. If this sand bedding is used, care should be taken during the placement of the concrete to prevent displacement of the sand. However, the need for sand and/or the thickness of sand above the moisture vapor barrier should be specified by the structural engineer or concrete contractor. The selection of sand above the barrier is not a geotechnical engineering issue and hence outside our purview.

3.4.4 Subgrade Exposure

Construction activities and exposure to the environment can cause deterioration of the prepared subgrade. Therefore, we recommend that our field representative observe the condition of the final subgrade soils immediately prior to slab-on-grade construction, and, if necessary, perform further density and moisture content tests to determine the suitability of the final prepared subgrade.

Additionally, the slab subgrade should be moisture conditioned to 2 to 4 percent above the optimum moisture content, to a depth of 12 inches. The moisture content of the floor slab subgrade soils should be verified by the geotechnical engineer within 24 hours prior to placing the vapor retarding membrane.

3.5 RETAINING WALLS

The following lateral earth pressures, in conjunction with the lateral resistance parameters provided in the Foundation Recommendations section of this report, may be used for the design of retaining walls with free draining compacted backfills. If passive earth pressure and friction are combined to provide required resistance to lateral forces, the value of the passive pressure should be reduced to two-thirds the following recommendations.

Lateral Earth Pressure Condition	Soil Backfill Condition	Equivalent Fluid Pressure (pcf)	Earth Pressure Coefficient
Active Case (Drained)*	Level	34	$K_a = 0.28$
At-Rest Case (Drained)	Level	53	$K_o = 0.44$
Total Unit Weight of Soil	120 pcf		

All retaining walls and block walls footings should be founded in compacted fill or firm native soils. We recommend drainage for retaining walls to be provided in accordance with Plate 3 of this report. Maximum precautions should be taken when placing drainage materials and during backfilling. All wall backfills should be properly compacted to at least 90 percent relative compaction.

3.6 SITE DRAINAGE

Positive drainage should be provided and maintained for the life of the project around the perimeter of all structures (including slopes and retaining walls) and all foundations toward streets or approved drainage devices to minimize water infiltrating into the underlying natural and engineered fill soils. In addition, finish subgrade adjacent to exterior footings should be sloped down (at least 2%) and away to facilitate surface drainage. Perimeter water collection devices may be installed around the structure to collect roof/irrigation/natural drainage. Roof drainage should be collected and directed away from foundations via nonerosive devices. Over the slope drainage must not be permitted.

Water, either natural or by irrigation, should not be permitted to pond or saturate the foundation soils. Planter areas and large trees adjacent to the foundations are not recommended. All planters and terraces should be provided with drainage devices. Internal drainage should be directed to approved drainage collection devices.

Location of drainage device should be in accordance with the design civil engineer’s drainage and erosion control recommendations. The owner should be made aware of the potential problems, which may develop when drainage is altered through construction of retaining walls, patios and other devices. Ponded water, leaking irrigation systems, over watering or other conditions which could lead to ground saturation should be avoided. Surface and subsurface runoff from adjacent properties should be controlled. Area drainage collection should be directed through approved drainage devices. All drainage devices should be properly maintained.

4.0 ADDITIONAL SERVICES

Plan Reviews

The recommendations provided in this report are based on preliminary information and subsurface conditions as interpreted from limited exploratory boreholes at the site. We should be retained to review the final grading and foundation plans to revise our conclusions and recommendations, as necessary. Professional fees will apply for each review.

Our conclusions and recommendations should also be reviewed and verified during site grading and revised accordingly if exposed geotechnical conditions vary from our preliminary findings and interpretations.

Additional Observation and/or Testing

GeoMat Testing Laboratories, Inc. should observe and/or test at the following stages of construction.

- During slab-on-grade scarification and compaction.
- Following footing excavation and prior to placement of footing materials.
- During wetting of slab subgrade and prior to placement of slab materials.
- During all trench backfill.
- When any unusual conditions are encountered.

Final Report of Compaction During Grading

A final report of compaction control should be prepared subsequent to the completion of grading. The report should include a summary of work performed, laboratory test results, and the results and locations of field density tests performed during grading.

5.0 GEOTECHNICAL RISK

The concept of risk is an important aspect of the geotechnical evaluation. The primary reason for this is that the analytical methods used to develop geotechnical recommendations do not comprise an exact science. The analytical tools which geotechnical engineers use are generally empirical and must be used in conjunction with engineering judgment and experience. Therefore, the solutions and recommendations presented in the geotechnical evaluation should not be considered risk-free and, more importantly, are not a guarantee that the interaction between the soils and the proposed structure will perform as planned.

The engineering recommendations presented in the preceding sections constitute GeoMat Testing Laboratories professional estimate of those measures that are necessary for the proposed development to perform according to the proposed design based on the information generated and referenced during this evaluation, and GeoMat Testing Laboratories experience in working with these conditions.

6.0 LIMITATION OF INVESTIGATION

This report was prepared for the exclusive use on the new construction. The use by others, or for the purposes other than intended, is at the user's sole risk.

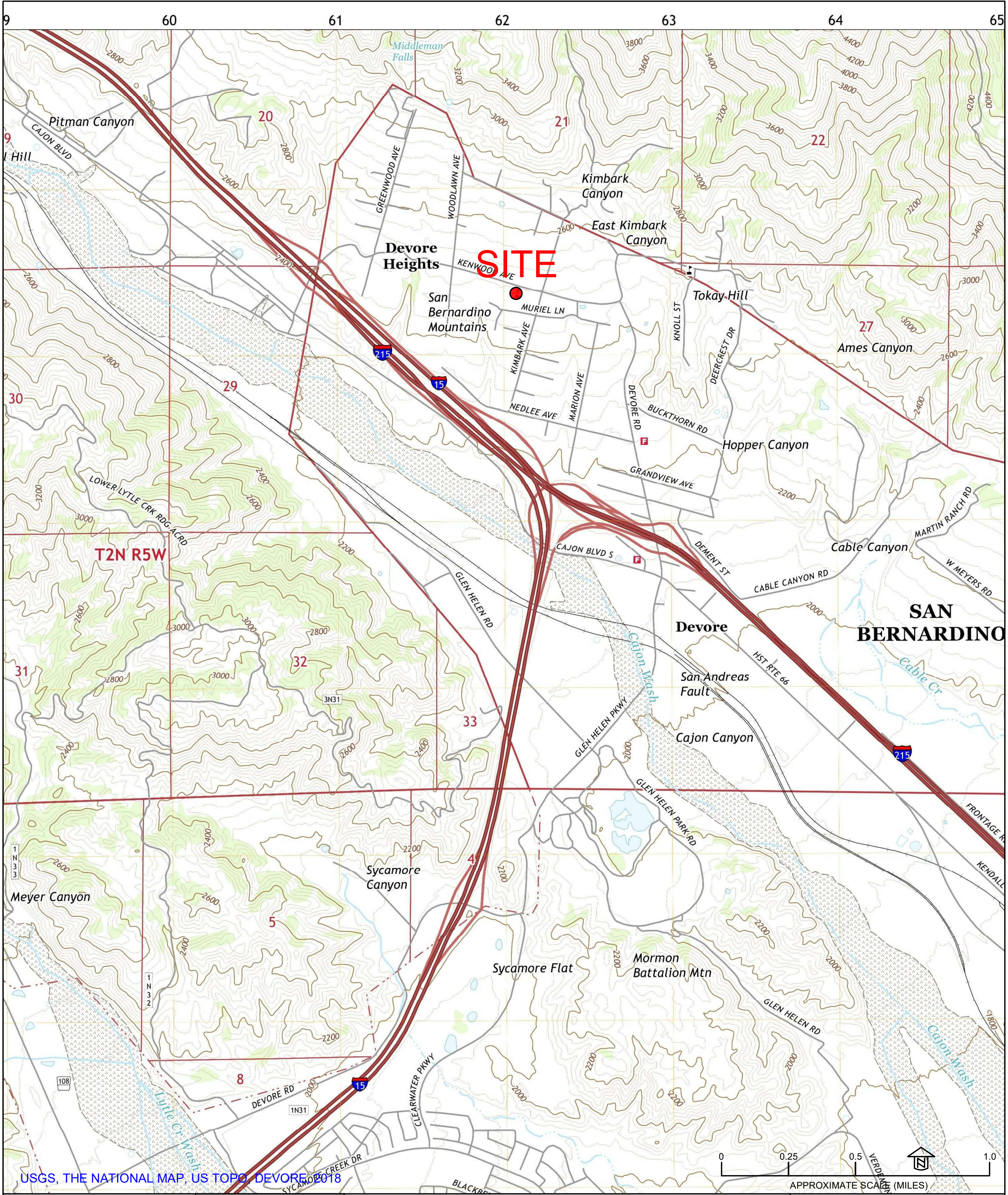
Our investigation was performed using the degree of care and skill ordinarily exercised, under similar circumstances, by reputable Geotechnical Engineers practicing in this or similar locations within the limitations of scope, schedule, and budget. No other warranty, expressed or implied, is made as to the conclusions and professional advice included in this report.

The field and laboratory test data are believed representative of the site; however, soil conditions can vary significantly. As in most projects, conditions revealed during construction may be at variance with preliminary findings. If this condition occurs, the possible variations must be evaluated by the Project Geotechnical Engineer and adjusted as required or alternate design recommended.

This report is issued with the understanding that it is the responsibility of the owner, or his representative, to ensure that the information and recommendations contained herein are brought to the attention of the engineer for the development and incorporated into the plans, and the necessary steps are taken to see that the contractor and subcontractor carry out such recommendations in the field.

This firm does not practice or consult in the field of safety engineering. We do not direct the contractor's operations, and we cannot be responsible for other than our own personnel on the site; therefore, the safety of others is the responsibility of the contractor. The contractor should notify the owner if he considers any of the recommended actions presented herein to be unsafe.

The findings, conclusions, and recommendations presented herein are based on our understanding of the proposed development and on subsurface conditions observed during our site work, and are valid as of the present date. However, changes in the conditions of a property can occur with the passage of time, whether they be due to natural processes or the works of man on this or adjacent properties. In addition, changes in applicable or appropriate standards may occur, whether they result from legislation or the broadening of knowledge.



USGS, THE NATIONAL MAP, US TOPO, DEVORE 2018

geomat

GeoMat Testing Laboratories, Inc.
9980 Indiana Avenue, Suite 14,
Riverside, California

DWN BY:	AM
CHK'D BY:	MN
DATUM:	--
PROJECTION:	--
SCALE:	1" = 1/2 MILE
REV. NO.:	--

PROJECT: PRELIMINARY SOIL INVESTIGATION REPORT
18021 KENWOOD AVENUE
SAN BERNARDINO, CALIFORNIA

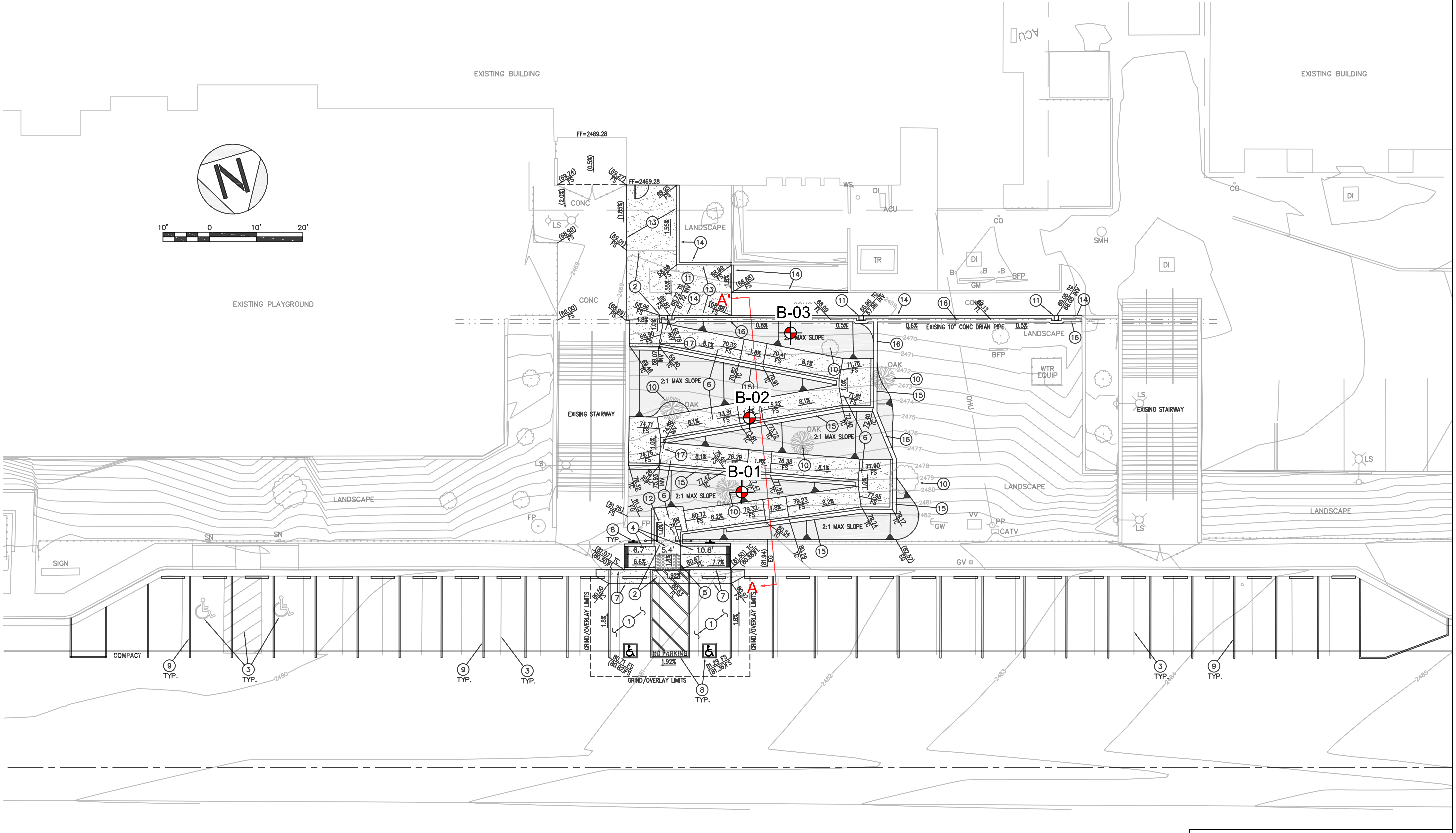
TITLE:

SITE LOCATION MAP

DATE: OCTOBER 2020

PROJECT NO.: 20229-01

FIGURE NO.: Figure 1



LEGEND:

B-03 EXPLORATORY BORING

A A' CROSS SECTION

ALL LOCATIONS ARE APPROXIMATE

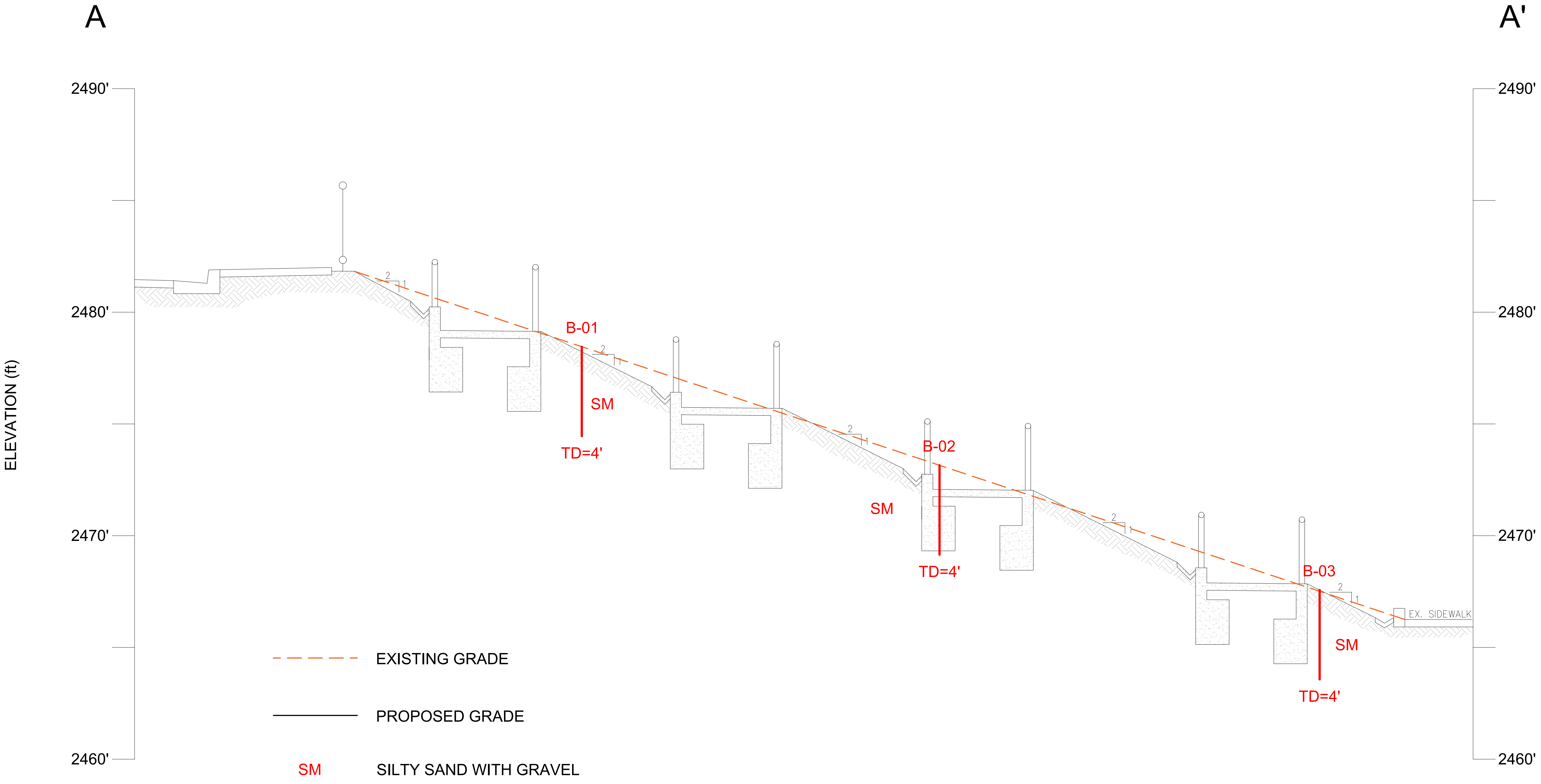
EXPLORATORY BOREHOLE LOCATION MAP

18021 KENWOOD AVENUE
SAN BERNARDINO, CALIFORNIA

PREPARED BY:
geomat
GeoMat Testing Laboratories, Inc.
9980 Indiana Avenue, Suite 14,
Riverside, California

DATE:	OCTOBER 2020
DRAWN BY:	AM
CHECKED BY:	HMN
PROJECT NO.:	20229-01
SCALE:	1" = 20' (11"x17")

PLATE
1



GEOTECHNICAL CROSS SECTION A-A'

18021 KENWOOD AVENUE
SAN BERNARDINO, CALIFORNIA

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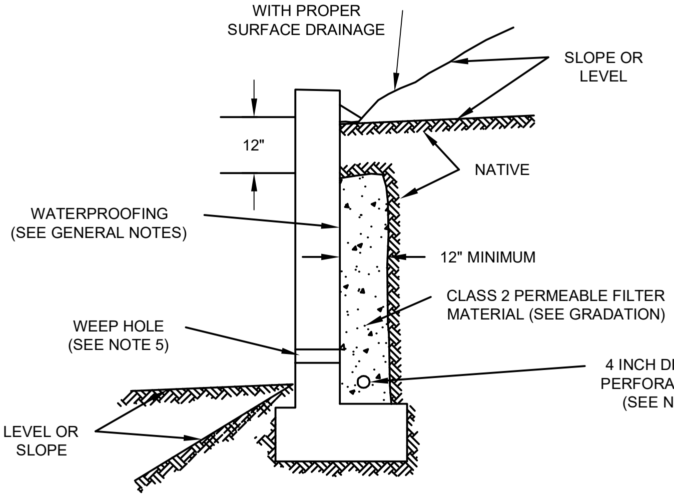
Riverside, California

DATE:	OCTOBER 2020
DRAWN BY:	AM
CHECKED BY:	HMN
PROJECT NO.:	20229-01
SCALE:	1" = 5' (11"x17")

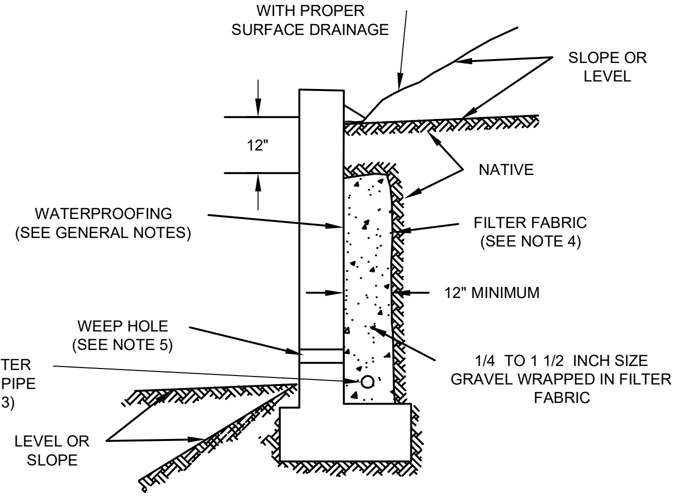
PLATE
2

SUBDRAIN OPTIONS AND BACKFILL WHEN NATIVE MATERIAL HAS EXPANSION INDEX ≤ 50

OPTION 1: PIPE SURROUNDED WITH CLASS 2 PERMEABLE MATERIAL



OPTION 2: GRAVEL WRAPPED IN FILTER FABRIC



Class 2 Filter Permeable Material Gradation
Per Caltrans Specifications

Sieve Size	Percent 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

GENERAL NOTES:

*Waterproofing should be provided where moisture nuisance problem through the wall is undesireable.
*Water proofing of the walls is not under the purview of the geotechnical engineer.
*All drains should have a gradient of 1 percent minimum.
*Outlet portion of the subdrain should have a 4-inch diamater solid pipe discharged into a suitable disposal area designed by the project engineer. The subdrain pipe should be accessible for maintenance (rodding).
*Other subdrain backfill options are subject to the review by the geotechnical engineer and modification of design parameters.

Notes:

1) Sand should have a sand equivalent of 30 or greater and may be densified by water jetting.
2) 1 Cu. ft. per ft. of 1/4 - to 1 1/2 -inch size gravel wrapped in filter fabric
3) Pipe type should be ASTM D1527 Acrylonitrile Butadiene Styrene (ABS) SDR35 or ASTM D1785 Polyvinyl Chlorise plastic (PVC), Schedule 40, Armco A2000 PVC, or approved equivalent. Pipe should be installed with perforations down. Perforations should be 3/8 -inch in diameter placed at the ends of a 120-degree arc in two rows at 3-inch on center (staggered).
4) Filter Fabric should be Mirafi 140NC or approved equivalent.
5) Weephole should be 3-inch minimum diameter and provided at 10-foot maximum intervals. if exposure is permitted, weepholes should be located 12-inches above finished grade. If exposure is not permitted, such as for a wall adjacent to a sidewalk/curb, a pipe under the sidewalk to be discharged through the curb face or equivalent should be provided. For a basement-type wall, a proper subdrain outlet system should be provided.
6) Retaining wall plans should be reviewed and approved by the geotechnical engineer.
7) Walls over six feet in height are subject to a special review by the geotechnical engineer and modifications to the above requirements.

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RETAINING WALL BACKFILL AND SUBDRAIN DETAIL

PLATE
3

APPENDIX A

SELECTED REFERENCES

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San Bernardino County Land Use Plan, Geologic Hazard Overlays, Sheet FH21C

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Department of Water Resources, Water Data Library

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Department of the Navy, Design Manual 7.02, Foundation and Earth Structures, September 1986.

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Robert Day, Geotechnical Engineer’s Portable Handbook.

Robert Day, Geotechnical Foundation Handbook.

APPENDIX B

SOIL CLASSIFICATION CHART

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

NOTE: Dual symbols are used to indicate gravels or sand with 5-12% fines and soils with fines classifying as CL-ML. Symbols separated by a slash

RELATIVE DENSITY		**CONSISTENCY**		UNCONFINED COMPRESSIVE
SANDS AND GRAVELS	SPT, N	SILTS AND CLAYS	SPT, N	STRENGTH, tsf
VERY LOOSE	0 - 4	VERY SOFT	0 - 2	0 - 0.25
LOOSE	4 -10	SOFT	2 - 4	0.25 - 0.50
MEDIUM DENSE	10 - 30	MEDIUM FIRM	4 - 8	0.50 - 1.00
DENSE	30 - 50	FIRM	8 - 15	1.00 - 2.00
VERY DENSE	50+	VERY FIRM	15 - 30	2.00 - 4.00
		HARD	30+	>4.00

MOISTURE CONDITION

DESCRIPTION	CRITERIA
DRY	Absence of moisture, dusty, dry to the touch
MOIST	Damp but no visible water
WET	Visible free water, usually soil is below water table

CONSTITUENT DESCRIPTIONS

DESCRIPTION	CRITERIA	DESCRIPTION	CRITERIA
TRACE	Less than 5%	SOME	30% to 45%
FEW	5% to 10%	MOSTLY	50% to 100%
LITTLE	15% to 25%		

Sampler and Symbol Descriptions

B	▦	Bulk "grab" sample taken from the auger cuttings or excavated soil
S	■	1.4" I.D./2" O.D. Standard Penetration Test (ASTM D1586) sampler (SPT)
R	☒	2.5" I.D./3" O.D. Modified California Ring Sampler (Ring)
D	⬚	2.5" I.D./3" O.D. Dames and Moore Manual Ring Sampler

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KEY TO BORING LOGS

APPENDIX B

PROJECT:	18021 West Kenwood Avenue San Bernardino, California	**Log of Boring**	**B-1**	PAGE 1 of 1

Project No.	**20229-01**	Boring Location:	**See Plate 1**	Logged by:	**AM**
Drill Company/Rig	**GeoMat/Manual**	Date Started:	**10/4/2020**	Notes:	No Groundwater
Drilling Method:	**Dames and Moore**	Date Finished:	**10/4/2020**		Total Depth 4 feet
Hammer Weight/Drop:	**35 lbs./24-inches**	Hammer Type:	**--**		

Sampler(s): Dames & Moore Sample (D), Bulk Sample (B), Nuclear Gauge Test per ASTM 3017 (N)

DEPTH (FT)	SAMPLES				Graphic Log	Classification (USCS)	MATERIAL DESCRIPTION	LABORATORY TEST DATA					
	Type	Sample	Blows / 6"	SPT "N" Value				Moisture Content (%)	Dry Density (pcf)	Fines (%)	Liquid Limit	Plastic Limit	Plast. Index
	B				▨	SM	**SILTY SAND WITH GRAVEL** medium brown silty sand dry to slightly moist 1" gravel noted loose in upper ~18-inches						
1					▨								
2					▨								
3	D			21	▨		medium dense dry to slightly moist	4	104	13			
4							TD = 4'						
5													
6													
7													
8													
9													
10													
11													
12													
13													

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PROJECT NO. 20229-01

APPENDIX B

PROJECT: **18021 West Kenwood Avenue**
San Bernardino, California

Log of Boring B-2

PAGE 1 of 1

Project No.	**20229-01**	Boring Location:	**See Plate 1**
Drill Company/Rig	**GeoMat/Manual**	Date Started:	**10/4/2020**
Drilling Method:	**Dames and Moore**	Date Finished:	**10/4/2020**
Hammer Weight/Drop:	**35 lbs./24-inches**	Hammer Type:	**--**

Sampler(s): Dames & Moore Sample (D), Bulk Sample (B), Nuclear Gauge Test per ASTM 3017 (N)

Logged by: **AM**

Notes: No Groundwater
Total Depth 4 feet

LABORATORY TEST DATA

DEPTH (FT)	SAMPLES Type	Sample	Blows / 6"	SPT "N" Value	Graphic Log	Classification (USCS)	MATERIAL DESCRIPTION	Moisture Content (%)	Dry Density (pcf)	Fines (%)	Liquid Limit	Plastic Limit	Plast. Index
	B				🟧	SM	**SILTY SAND WITH GRAVEL** medium brown silty sand dry to slightly moist 1" gravel noted loose in upper ~18-inches						
1					🟧								
2					🟧								
3	D			10	🟧		medium dense dry to slightly moist	5	106				
4							TD = 4'						
5													
6													
7													
8													
9													
10													
11													
12													
13													

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This log is part of the report prepared by GeoMat for this project and should be read together with the report. This summary applies only at the location of the exploration and at the time of drilling or excavation. Subsurface conditions may differ at other locations and may change at this location with tiume. Data presented are a simplification of actual conditions encountered.

PROJECT:	**18021 West Kenwood Avenue** **San Bernardino, California**

Log of Boring B-3

Project No.	**20229-01**	Boring Location:	**See Plate 1**
Drill Company/Rig	**GeoMat/Manual**	Date Started:	**10/4/2020**
Drilling Method:	**Dames and Moore**	Date Finished:	**10/4/2020**
Hammer Weight/Drop:	**35 lbs./24-inches**	Hammer Type:	**--**

Sampler(s): Dames & Moore Sample (D), Bulk Sample (B), Nuclear Gauge Test per ASTM 3017 (N)

Logged by: **AM**

Notes: No Groundwater

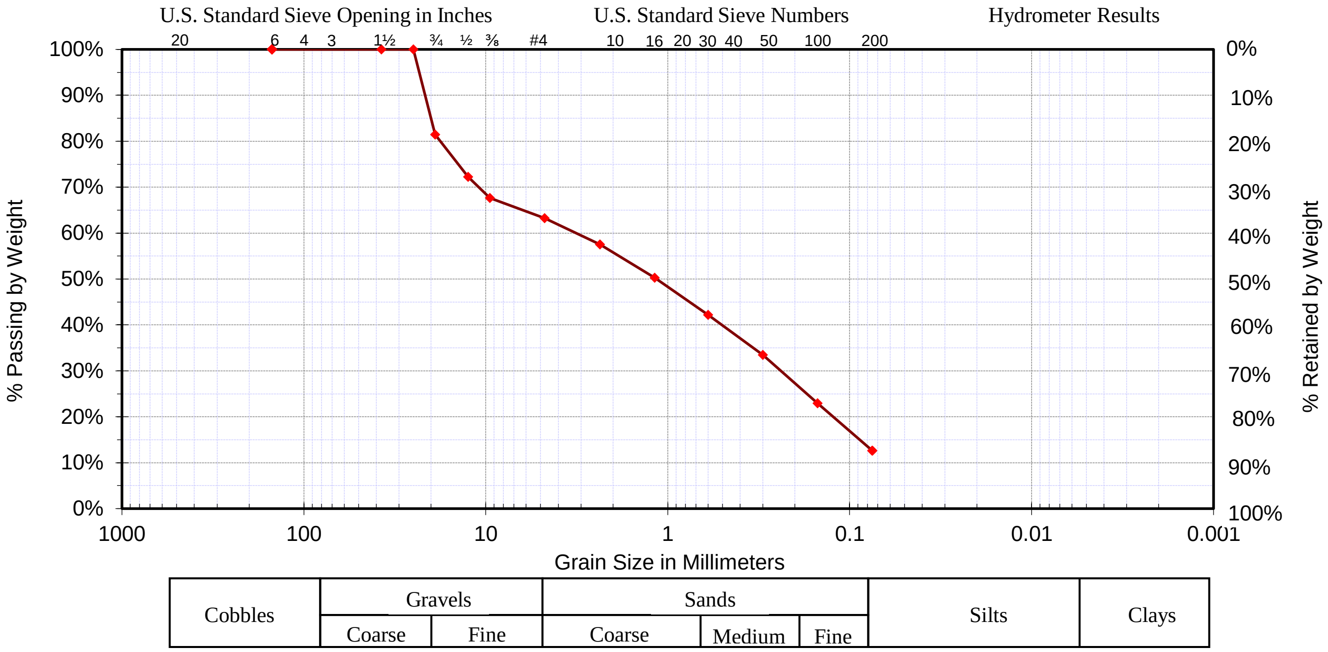
Total Depth 4 feet

LABORATORY TEST DATA

DEPTH (FT)	SAMPLES Type	SAMPLES Sample	SAMPLES Blows / 6"	SAMPLES SPT "N" Value	Graphic Log	Classification (USCS)	MATERIAL DESCRIPTION	Moisture Content (%)	Dry Density (pcf)	Fines (%)	Liquid Limit	Plastic Limit	Plast. Index
	B	▒			🟧	SM	**SILTY SAND WITH GRAVEL** medium brown silty sand dry to slightly moist 1" gravel noted loose in upper ~12-inches						
1													
2													
3	D	▮		12			medium dense dry to slightly moist	4	103				
4							TD = 4'						
5													
6													
7													
8													
9													
10													
11													
12													
13													

APPENDIX C

LABORATORY TEST RESULTS



Date : 10/04/20
Sample #:
Sample ID: B-1 @ 3'
Source: Ring
Project: 18021 West Kenwood Avenue
Location: San Bernardino, California
Boring #: B-1
Depth: 3'

D_{10} = 0.06
D_{30} = 0.25
D_{60} = 3.40
C_C = 0.31
C_U = 57.14
Liquid Limit= n/a
Plastic Limit= n/a
Plasticity Index= n/a

Classification
SM, Silty Sand with Gravel

Specifications
custom specs 1

Fineness Modulus
3.81

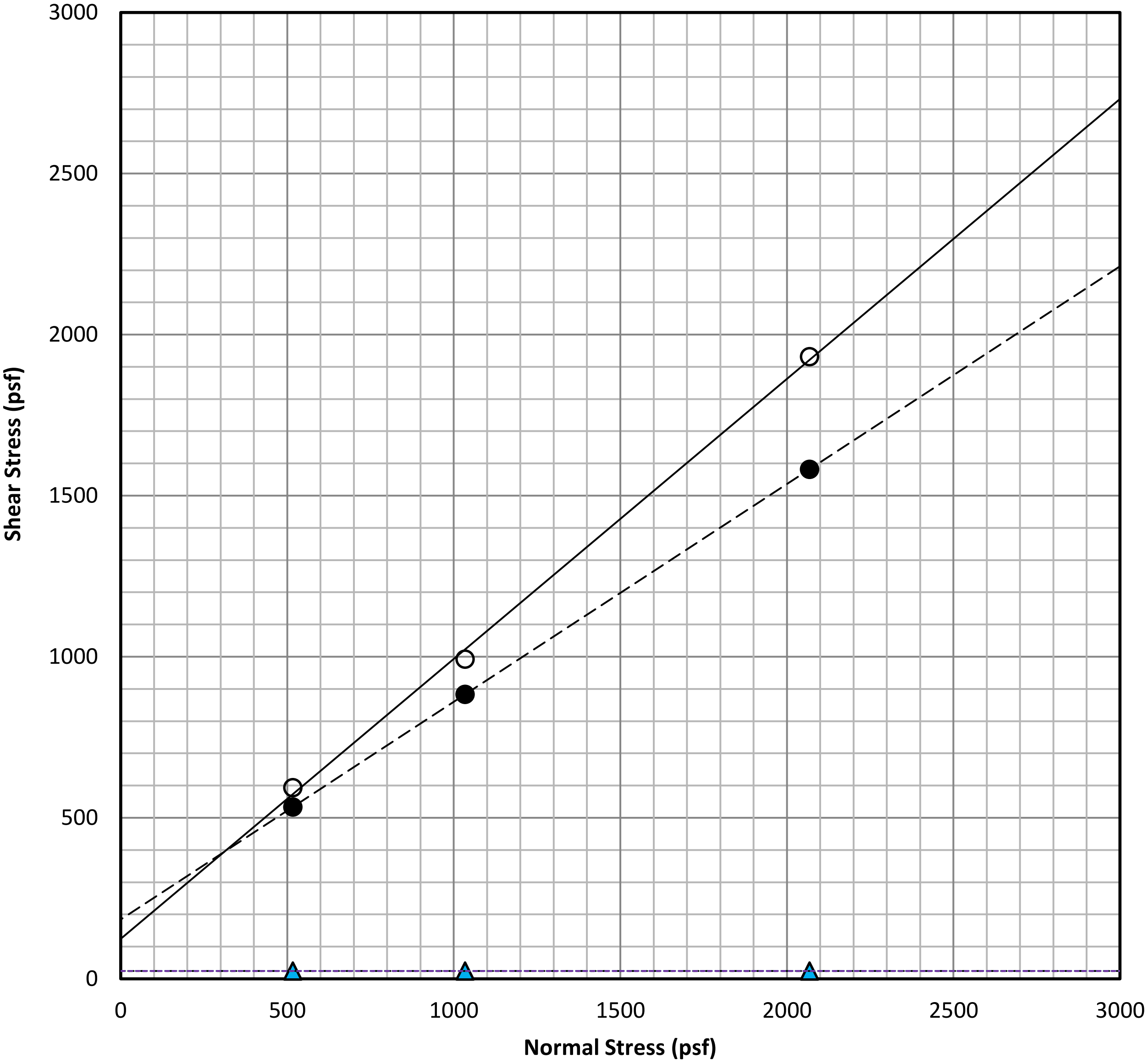
% Gravel
36.77%
% Sand
50.62%
% Silt & Clay
12.61%

Sample Moisture
3.8%

Coarse Section Sieve Size US	Metric	Actual Cumulative Percent Passing	Interpolated Cumulative Percent Passing	Specs Max	Specs Min
6.00"	150.00		100.0%		
4.00"	100.00		100.0%		
3.00"	75.00		100.0%		
2.50"	63.00		100.0%		
2.00"	50.00		100.0%		
1.75"	45.00		100.0%		
1.50"	37.50	100.0%	100.0%		
1.25"	31.50		100.0%		
1.00"	25.00	100.0%	100.0%		
7/8"	22.40		92.0%		
3/4"	19.00	81.5%	81.5%		
5/8"	16.00		77.2%		
1/2"	12.50	72.2%	72.2%		
3/8"	9.50	67.6%	67.6%		
1/4"	6.30		64.7%		
#4	4.75	63.2%	63.2%		

Fines Section Sieve Size US	Metric	Actual Cumulative Percent Passing	Interpolated Cumulative Percent Passing	Specs Max	Specs Min
#4	4.750	63.2%	63.2%		
#8	2.360	57.5%	57.5%		
#10	2.000		55.3%		
#16	1.180	50.3%	50.3%		
#20	0.850		45.7%		
#30	0.600	42.2%	42.2%		
#40	0.425		37.1%		
#50	0.300	33.5%	33.5%		
#60	0.250		30.0%		
#80	0.180		25.1%		
#100	0.150	22.9%	22.9%		
#140	0.106		16.9%		
#170	0.090		14.7%		
#200	0.075	12.6%	12.6%		
#270	0.053				

DIRECT SHEAR TEST RESULTS



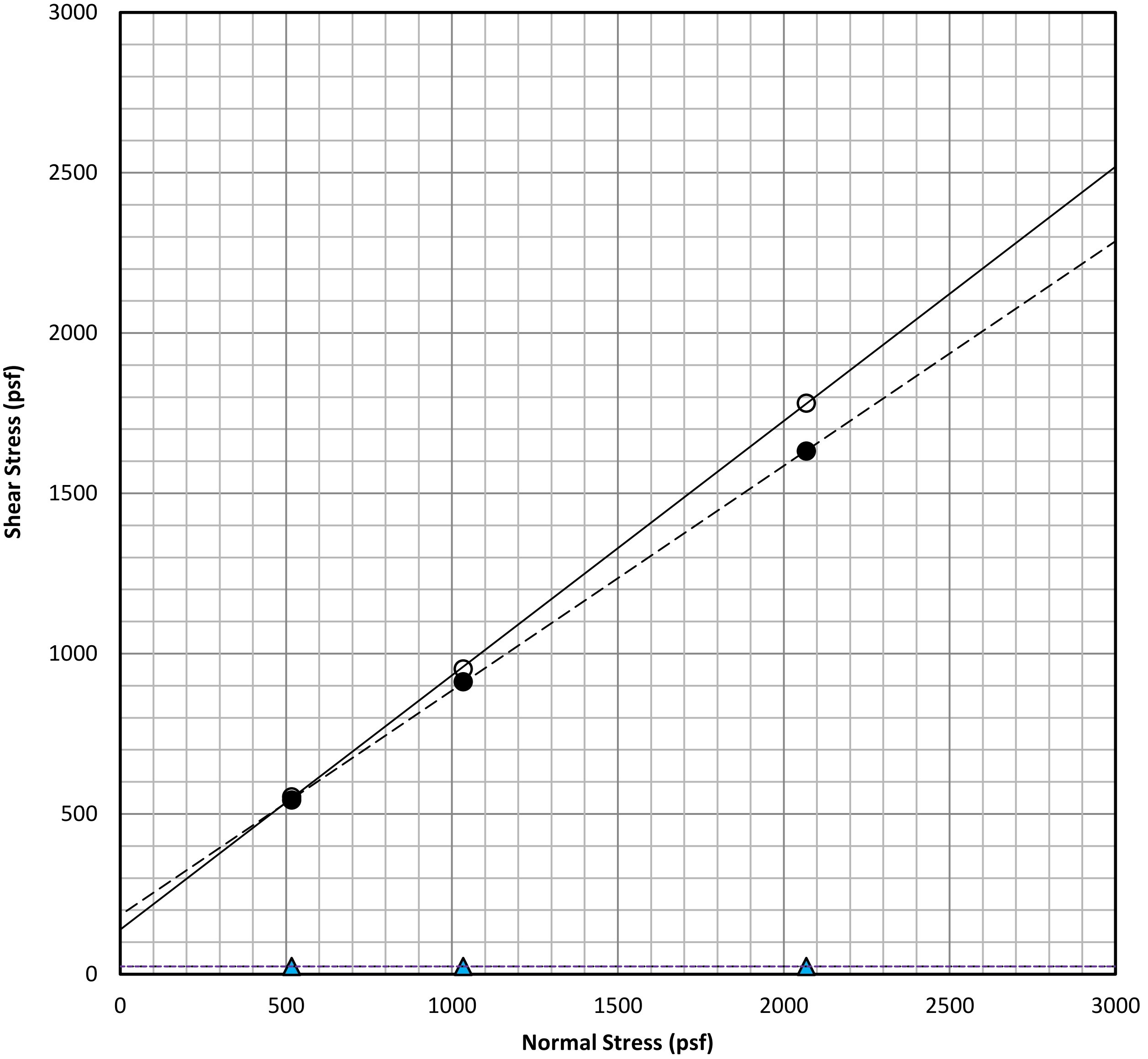
Sample	Symbol	Description	Soil Type [USCS]	Shear Strength	Friction Angle, ϕ [degrees]	Cohesion, c [psf]
B-1 @ 3'	—○—	Silty Sand w/Gravel	SM	Peak	41.0	124
B-1 @ 3'	– –●– –	Silty Sand w/Gravel	SM	Ultimate	34.1	184
B-1 @ 3'	- -▲- - -	Silty Sand w/Gravel	SM	*Residual	N/A	N/A

Sample Moisture [%]	Saturated Moisture [%]	Dry Unit Weight [pcf]
9.1	20.9	103.5

ASTM D-3080

*Residual results were determined from the lowest re-shear values obtained after 5 re-shears

DIRECT SHEAR TEST RESULTS



Sample	Symbol	Description	Soil Type [USCS]	Shear Strength	Friction Angle, ϕ [degrees]	Cohesion, c [psf]
B-3 @ 3'	—○—	Silty Sand w/Gravel	SM	Peak	38.4	139
B-3 @ 3'	— —●— —	Silty Sand w/Gravel	SM	Ultimate	35.0	184
B-3 @ 3'	- - ▲- - -	Silty Sand w/Gravel	SM	*Residual	N/A	N/A

Sample Moisture [%]	Saturated Moisture [%]	Dry Unit Weight [pcf]
6.8	25.6	100.1

ASTM D-3080

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*Residual results were determined from the lowest re-shear values obtained after 5 re-shears

GeoMat Testing Laboratories, Inc.
Soil Engineering, Environmental Engineering, Materials Testing, Geology

SOLUBLE SULFATE AND CHLORIDE TEST RESULTS

Project Name	18021 W. Kenwood Avenue, San Bernardino, CA	**Test Date**	10/05/2020
Project No.	20229-01	**Date Sampled**	10/04/2020
Project Location	18021 W. Kenwood Avenue, San Bernardino, CA	**Sampled By**	AM
Location in Structure	B-1 @ 0-3’	**Sample Type**	Bulk
Sampled Classification	SM	**Tested By**	AM

TESTING INFORMATION

Sample weight before drying	173.6 g
Sample weight after drying	164.4 g
Sample Weight Passing No. 10 Sieve	100.0 g
Moisture	5.6 %

Location	**Mixing Ratio**	**Dilution Factor**	**Sulfate Reading (ppm)**	**Sulfate Content**	
				(ppm)	**(%)**
B-1	3	1	<50	<150	<0.015
			Average		

Chloride Reading (ppm)	**Chloride Content**	
	(ppm)	**(%)**
Average		

pH	
Average	

ACI 318-19 Table 19.3.2.1 - Requirements for Concrete by Exposure Class

Exposure Class		**Water-Soluble Sulfate (%)**	**Maximum *w/cm***	**Minimum f’*c* (psi)**	**Cementitous Material (Types)**			**Calcium Chloride Admixture**
					ASTM C150-	**ASTM C595**	**ASTM C1157**	
S0		<0.10	N/A	2500	No Type Restriction	No Type Restriction	No Type Restriction	No Restriction
S1		0.10 to 0.20	0.50	4000	II	Type IP, IS, or IT with (MS) Designation	MS	No Restriction
S2		0.20 to 2.00	0.45	4500	V	Type IP, IS, or IT with (HS) Designation	HS	Not Permitted
S3	Option 1	>2.00	0.45	4500	V + Pozzolan or Slag Cement	Type IP, IS, or IT with (HS) Designation + Pozzolan or Slag Cement	HS + Pozzolan or Slag Cement	Not Permitted
	Option 2	>2.00	0.40	5000	V	Types with (HS) designation	HS	Not Permitted

Exposure Class	**Maximum *w/cm***	**Minimum f’*c* (psi)**	**Maximum Water-Soluble Chloride ion (Cl^-) Content in Concrete, Percent by Wight of Cement**		**Additional Provisions**
			Nonprestressed Concrete	**Prestressed Concrete**	
C0	N/A	2500	1.00	0.06	None
C1	N/A	2500	0.30	0.06	None
C2	0.40	5000	0.15	0.06	Concrete Cover

Caltrans classifies a site as corrosive to structural concrete as an area where soil and/or water contains >500pp chloride, >2000ppm sulfate, or has a pH <5.5. A minimum resistivity of less than 1000 ohm-cm indicates the potential for corrosive environment requiring testing for the above criteria.

The information in this form is not intended for corrosion engineering design. If corrosion is critical, a corrosion specialist should be contacted to provide further recommendations.

APPENDIX D

Latitude, Longitude: 34.236011, -117.411911

Date	10/2/2020, 10:01:16 AM
Design Code Reference Document	ASCE7-16
Risk Category	II
Site Class	D - Default (See Section 11.4.3)

Type	**Value**	**Description**
S_S	2.454	MCE_R ground motion. (for 0.2 second period)
S_1	1.045	MCE_R ground motion. (for 1.0s period)
S_{MS}	2.945	Site-modified spectral acceleration value
S_{M1}	null -See Section 11.4.8	Site-modified spectral acceleration value
S_{DS}	1.964	Numeric seismic design value at 0.2 second SA
S_{D1}	null -See Section 11.4.8	Numeric seismic design value at 1.0 second SA

Type	**Value**	**Description**
SDC	null -See Section 11.4.8	Seismic design category
F_a	1.2	Site amplification factor at 0.2 second
F_v	null -See Section 11.4.8	Site amplification factor at 1.0 second
PGA	1.055	MCE_G peak ground acceleration
F_{PGA}	1.2	Site amplification factor at PGA
PGA_M	1.266	Site modified peak ground acceleration
T_L	12	Long-period transition period in seconds
SsRT	3.217	Probabilistic risk-targeted ground motion. (0.2 second)
SsUH	3.59	Factored uniform-hazard (2% probability of exceedance in 50 years) spectral acceleration
SsD	2.454	Factored deterministic acceleration value. (0.2 second)
S1RT	1.328	Probabilistic risk-targeted ground motion. (1.0 second)
S1UH	1.506	Factored uniform-hazard (2% probability of exceedance in 50 years) spectral acceleration.
S1D	1.045	Factored deterministic acceleration value. (1.0 second)
PGAd	1.055	Factored deterministic acceleration value. (Peak Ground Acceleration)
C_{RS}	0.896	Mapped value of the risk coefficient at short periods
C_{R1}	0.882	Mapped value of the risk coefficient at a period of 1 s

DISCLAIMER

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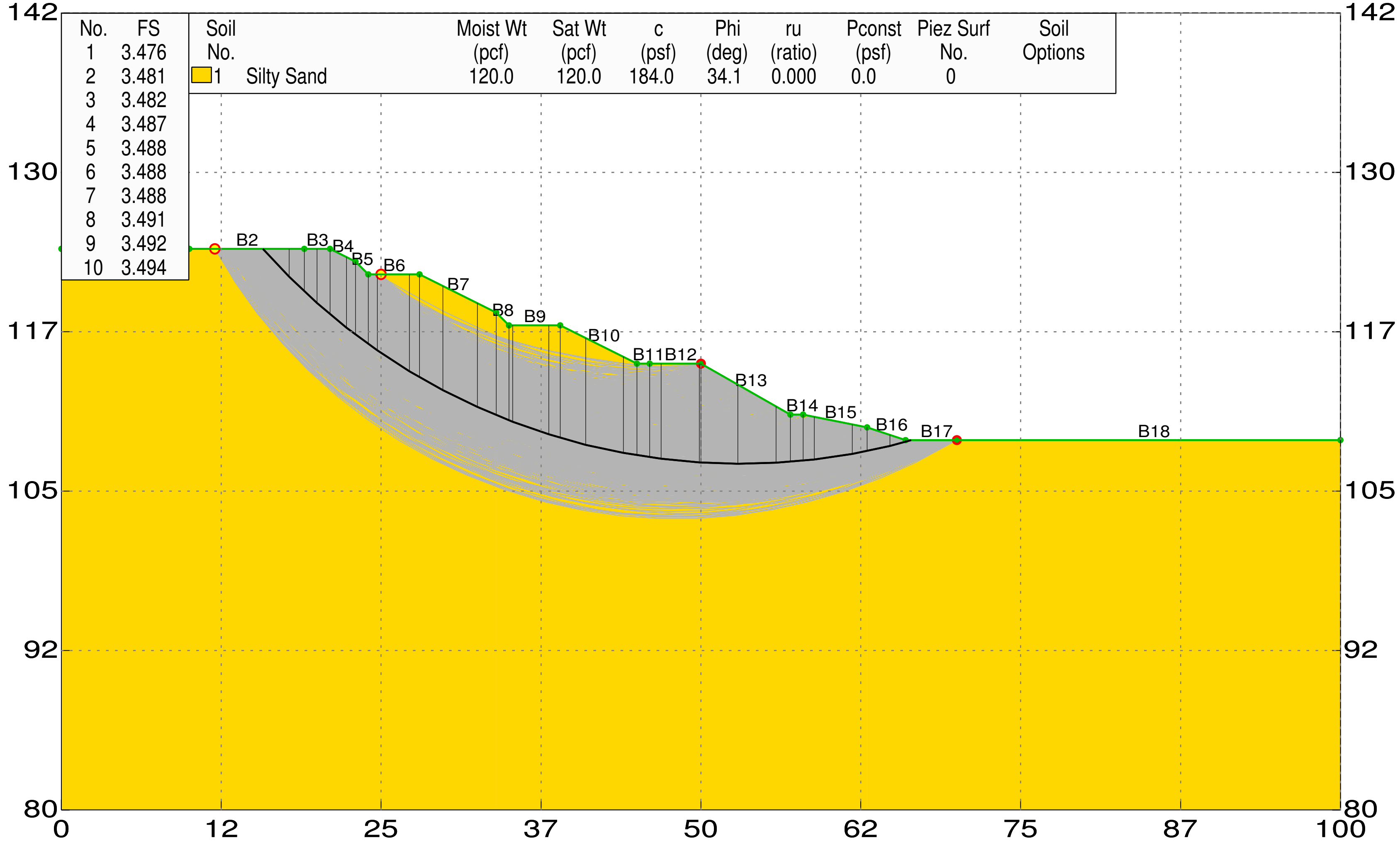
APPENDIX E

18021 West Kenwood Ave, San Bernardino, Ca.
Project No. 20229-01

GeoMat C:\Users\Abdullah\OneDrive - Geomat Testing Laboratories\GeoMat Reports\ANNUAL REPORTS\2020 REPORTS\20229.San Bernardino Kimbark Elementary School\Geostatse 2\Proposed.gsd



No.	FS
1	3.476
2	3.481
3	3.482
4	3.487
5	3.488
6	3.488
7	3.488
8	3.491
9	3.492
10	3.494

Soil No.		Moist Wt (pcf)	Sat Wt (pcf)	c (psf)	Phi (deg)	ru (ratio)	Pconst (psf)	Piez Surf No.	Soil Options
🟨 1	Silty Sand	120.0	120.0	184.0	34.1	0.000	0.0	0	

GEOSTASE FS = 3.476

Spencer Method

GEOSTASE
Slope Stability
Analysis

GREGORY
GEOTECHNICAL

GEOSTASE® by GREGORY GEOTECHNICAL SOFTWARE

PLATE C.2

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                              ***  GEOSTASE(R)  ***

               ** GEOSTASE(R) (c)Copyright by Garry H. Gregory, Ph.D., P.E.,D.GE **

                  ** Current Version 4.30.31-Double Precision, August 2019 **
                       (All Rights Reserved-Unauthorized Use Prohibited)



*********************************************************************************
                             SLOPE STABILITY ANALYSIS SOFTWARE
              Simplified Bishop, Simplified Janbu, or General Equilibrium (GE)
Options.
                 (Spencer, Morgenstern-Price, USACE, and Lowe & Karafiath)
                 Including Pier/Pile, Planar Reinf,  Nail, Tieback, Line Loads
                 Applied Forces, Fiber-Reinforced Soil (FRS), Distributed Loads
                 Nonlinear Undrained Shear Strength, Curved Strength Envelope,
                 Anisotropic Strengths, Water Surfaces, 3-Stage Rapid Drawdown
                 2- or 3-Stage Pseudo-Static & Simplified Newmark Seismic Analyses.

*********************************************************************************


          Analysis Date:            10/  6/ 2020
          Analysis Time:
          Analysis By:              GeoMat



          Input File Name:          C:\Users\Abdullah\OneDrive - Geomat Testing
Laboratories\GeoMat Reports\ANNUAL REPORTS\2020 REPORTS\20229.San Bernardino Kimbark
Elementary School\Geostatse 2\Proposed.gsd

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Laboratories\GeoMat Reports\ANNUAL REPORTS\2020 REPORTS\20229.San Bernardino Kimbark
Elementary School\Geostatse 2\Proposed.OUT

          Unit System:              English


          PROJECT: 18021 West Kenwood Ave, San Bernardino, Ca.


          DESCRIPTION: Project No. 20229-01



          BOUNDARY DATA

             18 Surface Boundaries
```

```
             18 Total   Boundaries

          Boundary      X - 1       Y - 1       X - 2       Y - 2      Soil Type
             No.        (ft)        (ft)        (ft)        (ft)       Below Bnd

              1          0.000     124.000      10.000     124.000        1
              2         10.000     124.000      19.000     124.000        1
              3         19.000     124.000      21.000     124.000        1
              4         21.000     124.000      23.000     123.000        1
              5         23.000     123.000      24.000     122.000        1
              6         24.000     122.000      28.000     122.000        1
              7         28.000     122.000      34.000     119.000        1
              8         34.000     119.000      35.000     118.000        1
              9         35.000     118.000      39.000     118.000        1
             10         39.000     118.000      45.000     115.000        1
             11         45.000     115.000      46.000     115.000        1
             12         46.000     115.000      50.000     115.000        1
             13         50.000     115.000      57.000     111.000        1
             14         57.000     111.000      58.000     111.000        1
             15         58.000     111.000      63.000     110.000        1
             16         63.000     110.000      66.000     109.000        1
             17         66.000     109.000      70.000     109.000        1
             18         70.000     109.000     100.000     109.000        1

          User Specified X-Origin =         0.000(ft)

          User Specified Y-Origin =        80.000(ft)


         MOHR-COULOMB SOIL PARAMETERS

           1 Type(s) of Soil Defined

       Soil Number           Moist  Saturated  Cohesion Friction   Pore   Pressure
Water   Water
           and              Unit Wt. Unit Wt. Intercept   Angle  Pressure Constant
Surface  Option
       Description           (pcf)    (pcf)     (psf)     (deg)  Ratio(ru) (psf)
 No.

  1 Silty Sand               120.0    120.0     184.00    34.10    0.000      0.0
  0       0

          Drained Shear Strength Reduction Factor applied after first stage = 1.0000


          TRIAL FAILURE SURFACE DATA

          Circular Trial Failure Surfaces Have Been Generated Using A Random
```

```
Procedure.

            1000 Trial Surfaces Have Been Generated.

            1000 Surfaces Generated at Increments of 0.1562(in) Equally Spaced
Within the Start Range

          Along The Specified Surface Between  X =  12.00(ft)
                                          and  X =  25.00(ft)

          Each Surface Enters within a Range Between   X =  50.00(ft)
                                                 and   X =  70.00(ft)

          Unless XCLUDE Lines Were Specified, The Minimum Elevation
          To Which A Surface Extends Is  Y =      80.00(ft)


          Specified Maximum Radius = 10000.000(ft)

          3.000(ft) Line Segments Were Used For Each Trial Failure Surface.


          Restrictions Have Been Imposed Upon The Angle Of Initiation.
          The Angle Has Been Restricted Between The Angles Of -60.0
          And -30.0 deg.

          The Spencer Method Was Selected for FS Analysis.

          Selected fx function = Constant (1.0)

          SELECTED CONVERGENCE PARAMETERS FOR SPENCER METHOD:
          Initial estimate of FS =  1.500
          FS tolerance =  0.000001000
          Initial estimate of theta(deg) = 15.00
          Theta tolerance(radians) =  0.0001000
          Minimum theta(deg) = -45.00 ; Maximum theta(deg) =  45.00
          Theta convergence Step Factor = 5000.00
          Maximum number of iterations = 50
          Allowable negative side force = -1000.0(lbs)
          Maximum force imbalance  = 100.000000(lbs)
          Maximum moment imbalance = 100.000000 (ft/lbs)

          Selected Lambda Coefficient =  1.00

          Specified Tension Crack Water Depth Factor =   0.000

          Total Number of Trial Surfaces Attempted = 1000

          WARNING! The Factor of Safety Calculation for one or More Trial Surfaces
          Did Not Converge in 50 Iterations.
```

```
          Number of Trial Surfaces with Non-Converged FS = 7

          Number of Trial Surfaces With Valid FS = 993


          Percentage of Trial Surfaces With Non-Converged and/or
          Non-Valid FS Solutions of the Total Attempted =   0.7 %

          Statistical Data On All Valid FS Values:
             FS Max =   5.926   FS Min =   3.476   FS Ave =   3.865
             Standard Deviation =    0.327   Coefficient of Variation =    8.47 %


          Critical Surface is Sequence Number     287 of Those Analyzed.


          *****BEGINNING OF DETAILED GEOSTASE OUTPUT FOR CRITICAL SURFACE FROM A
SEARCH*****

          BACK-CALCULATED CIRCULAR SURFACE PARAMETERS:

          Circle Center At X =     53.074129(ft) ; Y =    156.875345(ft); and Radius
=     49.730029(ft)

          Circular Trial Failure Surface Generated With 20 Coordinate Points

            Point      X-Coord.      Y-Coord.
             No.        (ft)          (ft)

              1         15.761      124.000
              2         17.811      121.810
              3         19.990      119.747
              4         22.288      117.820
              5         24.699      116.035
              6         27.214      114.398
              7         29.822      112.916
              8         32.515      111.594
              9         35.283      110.437
             10         38.115      109.448
             11         41.002      108.633
             12         43.933      107.993
             13         46.897      107.530
             14         49.884      107.248
             15         52.882      107.146
             16         55.881      107.225
             17         58.870      107.484
             18         61.838      107.924
             19         64.774      108.541
```

```
   20         66.447      109.000


  Iter.     Theta         FS         FS
   No.      (deg)      (Moment)   (Force)
           (fx=1.0)                           Lambda        Delta FS

    1       -15.0000    3.423701   3.482344    -0.268      0.5864285E-01
    2       -19.9500    3.089097   3.561677    -0.363      0.4725792E+00
    3       -14.2999    3.511576   3.471689    -0.255      0.3988678E-01
    4       -14.7395    3.454409   3.478366    -0.263      0.2395652E-01
    5       -14.5745    3.475038   3.475854    -0.260      0.8163818E-03
    6       -14.5687    3.475783   3.475766    -0.260      0.1728608E-04
    7       -14.5688    3.475767   3.475767    -0.260      0.2830594E-07


Factor Of Safety For The Preceding Specified Surface =  3.476
Theta (fx = 1.0) = -14.57 Deg    Lambda =  -0.260


The Spencer Method Has Been Selected For Analysis.

Selected fx function = Constant (1.0)

SELECTED CONVERGENCE PARAMETERS FOR ANALYSIS METHOD:
Initial estimate of FS =  1.500
FS tolerance =  0.000001000
Initial estimate of theta(deg) = 15.00
Theta tolerance(radians) =  0.0001000
Minimum theta(deg) = -45.00 ; Maximum theta(deg) =  45.00
Theta convergence Step Factor = 5000.00
Maximum number of iterations = 50
Maximum force imbalance = 100.000000(lbs)
Maximum moment imbalance(if Applicable) = 100.000000 (ft/lbs)


Selected Lambda Coefficient =  1.00

Tension Crack Water Force =        0.00(lbs)

Specified Tension Crack Water Depth Factor =  0.000

Depth of Tension Crack (zo) at Side of First Slice =   0.000(ft)

Depth of Water in Tension Crack =   0.000(ft)

Theoretical Tension Crack Depth =   5.780(ft)

NOTE: In Table 1 following, when a tension crack with water is present on
the
```

```
          first slice (right facing slope) or on the last slice (left facing slope),
the
          "side force" in the tension crack is set equal to the water pressure
resultant.


                  *** Table 1 - Line of Thrust(if applicable) and Slice Force Data
***

          Slice      X         Y               Side Force     fx    Force Angle
Vert. Shear
           No.     Coord.    Coord.    h/H        (lbs)                 (Deg)
Force(lbs)

            1      15.76    124.00    0.000         0.00     1.000        0.00
  0.0
            2      17.81    122.90    0.500         2.11     1.000      -14.57
 -0.5
            3      19.00    121.12    0.130       133.90     1.000      -14.57
-33.7
            4      19.99    120.42    0.158       312.52     1.000      -14.57
-78.6
            5      21.00    119.77    0.170       525.16     1.000      -14.57
-132.1
            6      22.29    118.96    0.206       845.88     1.000      -14.57
-212.8
            7      23.00    118.56    0.223      1009.43     1.000      -14.57
-253.9
            8      24.00    118.03    0.270      1236.98     1.000      -14.57
-311.2
            9      24.70    117.65    0.271      1400.90     1.000      -14.57
-352.4
           10      27.21    116.35    0.257      2018.25     1.000      -14.57
-507.7
           11      28.00    115.97    0.251      2207.00     1.000      -14.57
-555.2
           12      29.82    115.10    0.268      2664.35     1.000      -14.57
-670.2
           13      32.52    113.99    0.294      3196.61     1.000      -14.57
-804.1
           14      34.00    113.45    0.308      3404.71     1.000      -14.57
-856.4
           15      35.00    113.09    0.341      3536.31     1.000      -14.57
-889.5
           16      35.28    112.99    0.338      3571.94     1.000      -14.57
-898.5
           17      38.12    112.09    0.309      3808.67     1.000      -14.57
-958.0
           18      39.00    111.84    0.300      3837.67     1.000      -14.57
-965.3
```

```
           19      41.00    111.28    0.316     3901.44     1.000       -14.57
-981.4
           20      43.93    110.58    0.343     3806.36     1.000       -14.57
-957.5
           21      45.00    110.37    0.354     3710.73     1.000       -14.57
-933.4
           22      46.00    110.17    0.341     3621.57     1.000       -14.57
-911.0
           23      46.90    109.99    0.330     3540.94     1.000       -14.57
-890.7
           24      49.88    109.54    0.295     3090.42     1.000       -14.57
-777.4
           25      50.00    109.53    0.294     3065.29     1.000       -14.57
-771.0
           26      52.88    109.23    0.336     2485.98     1.000       -14.57
-625.3
           27      55.88    109.03    0.409     1845.08     1.000       -14.57
-464.1
           28      57.00    108.98    0.452     1603.59     1.000       -14.57
-403.4
           29      58.00    108.93    0.425     1403.52     1.000       -14.57
-353.0
           30      58.87    108.90    0.423     1235.06     1.000       -14.57
-310.7
           31      61.84    108.87    0.409      642.93     1.000       -14.57
-161.7
           32      63.00    108.91    0.407      423.60     1.000       -14.57
-106.6
           33      64.77    108.97    0.497      164.09     1.000       -14.57
-41.3
           34      66.00    109.05    1.000+      33.80     1.000       -14.57
 -8.5

          NOTE: A value of 0.000- for h/H indicates that the line of thrust is at or
below
          the lower boundary of the sliding mass. A value of 1.000+ for h/H
indicates that
          the line of thrust is at or above the upper boundary of the sliding mass.


               ***Table 2 - Geometry Data on the   34 Slices***


 Slice   Width   Height   X-Cntr    Y-Cntr-Base  Y-Cntr-Top    Alpha   Beta    Base
Length
  No.     (ft)    (ft)     (ft)        (ft)         (ft)        (deg)   (deg)
(ft)

   1      2.05     1.10     16.79      122.90       124.00      -46.89    0.00
3.00
```

```
   2       1.19      2.75      18.41       121.25       124.00       -43.43    0.00
1.64
   3       0.99      3.78      19.49       120.22       124.00       -43.43    0.00
1.36
   4       1.01      4.68      20.49       119.32       124.00       -39.98    0.00
1.32
   5       1.29      5.32      21.64       118.36       123.68       -39.98  -26.57
1.68
   6       0.71      5.62      22.64       117.56       123.18       -36.52  -26.57
0.89
   7       1.00      5.58      23.50       116.92       122.50       -36.52  -45.00
1.24
   8       0.70      5.71      24.35       116.29       122.00       -36.52    0.00
0.87
   9       2.51      6.78      25.96       115.22       122.00       -33.06    0.00
3.00
  10       0.79      7.83      27.61       114.17       122.00       -29.60    0.00
0.90
  11       1.82      8.11      28.91       113.43       121.54       -29.60  -26.57
2.10
  12       2.69      8.16      31.17       112.26       120.42       -26.15  -26.57
3.00
  13       1.48      8.09      33.26       111.28       119.37       -22.69  -26.57
1.61
  14       1.00      7.74      34.50       110.76       118.50       -22.69  -45.00
1.08
  15       0.28      7.50      35.14       110.50       118.00       -22.69    0.00
0.31
  16       2.83      8.06      36.70       109.94       118.00       -19.23    0.00
3.00
  17       0.88      8.68      38.56       109.32       118.00       -15.78    0.00
0.92
  18       2.00      8.58      40.00       108.92       117.50       -15.78  -26.57
2.08
  19       2.93      7.95      42.47       108.31       116.27       -12.32  -26.57
3.00
  20       1.07      7.36      44.47       107.91       115.27        -8.86  -26.57
1.08
  21       1.00      7.25      45.50       107.75       115.00        -8.86    0.00
1.01
  22       0.90      7.40      46.45       107.60       115.00        -8.86    0.00
0.91
  23       2.99      7.61      48.39       107.39       115.00        -5.41    0.00
3.00
  24       0.12      7.75      49.94       107.25       115.00        -1.95    0.00
0.12
  25       2.88      6.98      51.44       107.19       114.18        -1.95  -29.74
2.88
  26       3.00      5.31      54.38       107.19       112.50         1.51  -29.74
3.00
```

```
  27    1.12     4.05     56.44      107.27      111.32       4.96  -29.74
1.12
  28    1.00     3.63     57.50      107.37      111.00       4.96    0.00
1.00
  29    0.87     3.47     58.44      107.45      110.91       4.96  -11.31
0.87
  30    2.97     2.83     60.35      107.70      110.53       8.42  -11.31
3.00
  31    1.16     2.07     62.42      108.05      110.12      11.88  -11.31
1.19
  32    1.77     1.35     63.89      108.35      109.70      11.88  -18.43
1.81
  33    1.23     0.50     65.39      108.71      109.20      15.34  -18.43
1.27
  34    0.45     0.06     66.22      108.94      109.00      15.34    0.00
0.46


 ***Table 2A - Coordinates of Slice Points Defining the Slip Surface***


 Point           X-Pt            Y-Pt
  No.            (ft)            (ft)

   1           15.760761        124.000000
   2           17.810983        121.809888
   3           19.000000        120.684209
   4           19.989534        119.747386
   5           21.000000        118.900236
   6           22.288486        117.820000
   7           23.000000        117.293148
   8           24.000000        116.552681
   9           24.699474        116.034744
  10           27.213722        114.398114
  11           28.000000        113.951358
  12           29.822081        112.916068
  13           32.515059        111.593998
  14           34.000000        110.973108
  15           35.000000        110.554984
  16           35.282856        110.436715
  17           38.115398        109.448431
  18           39.000000        109.198496
  19           41.002378        108.632743
  20           43.933289        107.992620
  21           45.000000        107.826278
  22           46.000000        107.670339
  23           46.897466        107.530390
  24           49.884121        107.247735
  25           50.000000        107.243791
  26           52.882385        107.145686
```

```
  27           55.881346        107.224612
  28           57.000000        107.321783
  29           58.000000        107.408647
  30           58.870092        107.484226
  31           61.837745        107.923585
  32           63.000000        108.168052
  33           64.773505        108.541088
  34           66.000000        108.877431
  35           66.446955        109.000000


  ***Table 3 - Force and Pore Pressure Data On The   34 Slices (Excluding
Reinforcement)***


                       Ubeta   Ubeta      Ualpha              Earthquake
                       Force   Stress     Force      Pore        Force
Distributed
 Slice      Weight      Top     Top        Bot      Pressure   Hor    Ver        Load
   No.      (lbs)      (lbs)   (psf)      (lbs)      (psf)     (lbs)  (lbs)
(lbs)
   1         269.4       0.0     0.0        0.0       0.0     0.0       0.0
0.00
   2         392.8       0.0     0.0        0.0       0.0     0.0       0.0
0.00
   3         449.4       0.0     0.0        0.0       0.0     0.0       0.0
0.00
   4         567.0       0.0     0.0        0.0       0.0     0.0       0.0
0.00
   5         822.2       0.0     0.0        0.0       0.0     0.0       0.0
0.00
   6         480.0       0.0     0.0        0.0       0.0     0.0       0.0
0.00
   7         669.3       0.0     0.0        0.0       0.0     0.0       0.0
0.00
   8         479.0       0.0     0.0        0.0       0.0     0.0       0.0
0.00
   9        2046.7       0.0     0.0        0.0       0.0     0.0       0.0
0.00
  10         738.3       0.0     0.0        0.0       0.0     0.0       0.0
0.00
  11        1773.4       0.0     0.0        0.0       0.0     0.0       0.0
0.00
  12        2637.2       0.0     0.0        0.0       0.0     0.0       0.0
0.00
  13        1441.2       0.0     0.0        0.0       0.0     0.0       0.0
0.00
  14         928.3       0.0     0.0        0.0       0.0     0.0       0.0
0.00
  15         254.7       0.0     0.0        0.0       0.0     0.0       0.0
```

```
0.00
  16        2738.8       0.0     0.0        0.0       0.0     0.0       0.0
0.00
  17         921.0       0.0     0.0        0.0       0.0     0.0       0.0
0.00
  18        2062.6       0.0     0.0        0.0       0.0     0.0       0.0
0.00
  19        2797.3       0.0     0.0        0.0       0.0     0.0       0.0
0.00
  20         941.8       0.0     0.0        0.0       0.0     0.0       0.0
0.00
  21         870.2       0.0     0.0        0.0       0.0     0.0       0.0
0.00
  22         796.9       0.0     0.0        0.0       0.0     0.0       0.0
0.00
  23        2727.7       0.0     0.0        0.0       0.0     0.0       0.0
0.00
  24         107.8       0.0     0.0        0.0       0.0     0.0       0.0
0.00
  25        2414.9       0.0     0.0        0.0       0.0     0.0       0.0
0.00
  26        1911.3       0.0     0.0        0.0       0.0     0.0       0.0
0.00
  27         543.2       0.0     0.0        0.0       0.0     0.0       0.0
0.00
  28         436.2       0.0     0.0        0.0       0.0     0.0       0.0
0.00
  29         361.9       0.0     0.0        0.0       0.0     0.0       0.0
0.00
  30        1006.1       0.0     0.0        0.0       0.0     0.0       0.0
0.00
  31         288.8       0.0     0.0        0.0       0.0     0.0       0.0
0.00
  32         287.3       0.0     0.0        0.0       0.0     0.0       0.0
0.00
  33          72.9       0.0     0.0        0.0       0.0     0.0       0.0
0.00
  34           3.3       0.0     0.0        0.0       0.0     0.0       0.0
0.00

          TOTAL WEIGHT OF SLIDING MASS =   35238.67(lbs)

          EFFECTIVE WEIGHT OF SLIDING MASS =   35238.67(lbs)

          TOTAL AREA OF SLIDING MASS =   293.66(ft2)


 ***TABLE 4 - SOIL STRENGTH & SOIL OPTIONS DATA ON THE   34 SLICES***

 Slice  Soil   Cohesion   Phi(Deg)   Options
```

```
No.   Type     (psf)
 1      1     184.00     34.10
 2      1     184.00     34.10
 3      1     184.00     34.10
 4      1     184.00     34.10
 5      1     184.00     34.10
 6      1     184.00     34.10
 7      1     184.00     34.10
 8      1     184.00     34.10
 9      1     184.00     34.10
10      1     184.00     34.10
11      1     184.00     34.10
12      1     184.00     34.10
13      1     184.00     34.10
14      1     184.00     34.10
15      1     184.00     34.10
16      1     184.00     34.10
17      1     184.00     34.10
18      1     184.00     34.10
19      1     184.00     34.10
20      1     184.00     34.10
21      1     184.00     34.10
22      1     184.00     34.10
23      1     184.00     34.10
24      1     184.00     34.10
25      1     184.00     34.10
26      1     184.00     34.10
27      1     184.00     34.10
28      1     184.00     34.10
29      1     184.00     34.10
30      1     184.00     34.10
31      1     184.00     34.10
32      1     184.00     34.10
33      1     184.00     34.10
34      1     184.00     34.10

SOIL OPTIONS:
A = ANISOTROPIC SHEAR STRENGTH
C = CURVED STRENGTH ENVELOPE (TANGENT PHI & C)
F = FIBER-REINFORCED SOIL (FRS)
M = INDEPENDENT MULTI-STAGE SHEAR STRENGTH
N = NONLINEAR UNDRAINED SHEAR STRENGTH
R = RAPID DRAWDOWN OR RAPID LOADING (SEISMIC) SHEAR STRENGTH
NOTE: Phi and C in Table 4 are modified values based on specified
Soil Options (if any).


       ***TABLE 5 - Total Base Stress Data on the   34 Slices***
```

```
 Slice   Alpha     X-Coord.      Base         Total             Total           Total
  No.    (deg)    Slice Cntr     Leng.     Normal Stress     Vert. Stress
Normal/Vert.
   *                 (ft)        (ft)          (psf)            (psf)        Stress
Ratio

   1    -46.89      16.79        3.00           61.75           131.41
0.470
   2    -43.43      18.41        1.64          213.06           330.35
0.645
   3    -43.43      19.49        1.36          302.75           454.10
0.667
   4    -39.98      20.49        1.32          398.71           561.14
0.711
   5    -39.98      21.64        1.68          456.58           638.13
0.715
   6    -36.52      22.64        0.89          504.73           674.56
0.748
   7    -36.52      23.50        1.24          500.61           669.25
0.748
   8    -36.52      24.35        0.87          512.66           684.75
0.749
   9    -33.06      25.96        3.00          637.03           814.03
0.783
  10    -29.60      27.61        0.90          764.01           939.03
0.814
  11    -29.60      28.91        2.10          792.38           973.29
0.814
  12    -26.15      31.17        3.00          824.71           979.28
0.842
  13    -22.69      33.26        1.61          844.36           970.52
0.870
  14    -22.69      34.50        1.08          807.32           928.31
0.870
  15    -22.69      35.14        0.31          782.91           900.50
0.869
  16    -19.23      36.70        3.00          868.38           966.89
0.898
  17    -15.78      38.56        0.92          964.88          1041.18
0.927
  18    -15.78      40.00        2.08          954.55          1030.05
0.927
  19    -12.32      42.47        3.00          912.20           954.41
0.956
  20     -8.86      44.47        1.08          870.71           882.87
0.986
  21     -8.86      45.50        1.01          858.30           870.20
0.986
  22     -8.86      46.45        0.91          875.70           887.96
0.986
```

```
  23     -5.41       48.39         3.00          929.12          913.31
1.017
  24     -1.95       49.94         0.12          976.80          930.51
1.050
  25     -1.95       51.44         2.88          880.72          837.81
1.051
  26      1.51       54.38         3.00          696.03          637.31
1.092
  27      4.96       56.44         1.12          553.84          485.57
1.141
  28      4.96       57.50         1.00          499.55          436.17
1.145
  29      4.96       58.44         0.87          477.36          415.99
1.148
  30      8.42       60.35         3.00          408.85          339.04
1.206
  31     11.88       62.42         1.19          320.17          248.45
1.289
  32     11.88       63.89         1.81          218.89          161.98
1.351
  33     15.34       65.39         1.27          106.34           59.42
1.790
  34     15.34       66.22         0.46           43.20            7.35
5.875


         ***TABLE 5A - Total Base Force Data on the   34 Slices***

 Slice   Alpha     X-Coord.      Base         Total            Total            Total
  No.    (deg)    Slice Cntr     Leng.     Normal Force     Vert. Force
Normal/Vert.
   *                 (ft)        (ft)          (lbs)            (lbs)         Force
Ratio

   1    -46.89       16.79         3.00          185.25          269.41
0.688
   2    -43.43       18.41         1.64          348.86          392.80
0.888
   3    -43.43       19.49         1.36          412.54          449.35
0.918
   4    -39.98       20.49         1.32          525.74          567.02
0.927
   5    -39.98       21.64         1.68          767.69          822.22
0.934
   6    -36.52       22.64         0.89          446.86          479.96
0.931
   7    -36.52       23.50         1.24          622.91          669.25
0.931
   8    -36.52       24.35         0.87          446.20          478.97
0.932
```

```
   9    -33.06      25.96        3.00         1911.09         2046.67
0.934
  10    -29.60      27.61        0.90          690.92          738.34
0.936
  11    -29.60      28.91        2.10         1660.55         1773.42
0.936
  12    -26.15      31.17        3.00         2474.13         2637.18
0.938
  13    -22.69      33.26        1.61         1359.02         1441.17
0.943
  14    -22.69      34.50        1.08          875.05          928.31
0.943
  15    -22.69      35.14        0.31          240.03          254.71
0.942
  16    -19.23      36.70        3.00         2605.14         2738.76
0.951
  17    -15.78      38.56        0.92          886.95          921.03
0.963
  18    -15.78      40.00        2.08         1986.20         2062.56
0.963
  19    -12.32      42.47        3.00         2736.60         2797.29
0.978
  20     -8.86      44.47        1.08          940.03          941.76
0.998
  21     -8.86      45.50        1.01          868.67          870.20
0.998
  22     -8.86      46.45        0.91          795.41          796.91
0.998
  23     -5.41      48.39        3.00         2787.35         2727.75
1.022
  24     -1.95      49.94        0.12          113.26          107.83
1.050
  25     -1.95      51.44        2.88         2540.05         2414.88
1.052
  26      1.51      54.38        3.00         2088.09         1911.27
1.093
  27      4.96      56.44        1.12          621.89          543.18
1.145
  28      4.96      57.50        1.00          501.43          436.17
1.150
  29      4.96      58.44        0.87          416.92          361.95
1.152
  30      8.42      60.35        3.00         1226.56         1006.15
1.219
  31     11.88      62.42        1.19          380.26          288.76
1.317
  32     11.88      63.89        1.81          396.70          287.28
1.381
  33     15.34      65.39        1.27          135.24           72.88
1.856
```

```
  34     15.34      66.22        0.46           20.02            3.29
6.092


         ***TABLE 6 - Effective and Base Shear Stress Data on the   34 Slices***

 Slice    Alpha     X-Coord.     Base       Effective       Available
Mobilized
  No.     (deg)   Slice Cntr     Leng.    Normal Stress   Shear Strength    Shear
Stress
   *                 (ft)         (ft)        (psf)           (psf)            (psf)

   1     -46.89      16.79       3.00           61.75          225.81
64.97
   2     -43.43      18.41       1.64          213.06          328.26
94.44
   3     -43.43      19.49       1.36          302.75          388.98
111.91
   4     -39.98      20.49       1.32          398.71          453.95
130.60
   5     -39.98      21.64       1.68          456.58          493.12
141.88
   6     -36.52      22.64       0.89          504.73          525.73
151.26
   7     -36.52      23.50       1.24          500.61          522.94
150.45
   8     -36.52      24.35       0.87          512.66          531.10
152.80
   9     -33.06      25.96       3.00          637.03          615.30
177.03
  10     -29.60      27.61       0.90          764.01          701.27
201.76
  11     -29.60      28.91       2.10          792.38          720.48
207.29
  12     -26.15      31.17       3.00          824.71          742.37
213.58
  13     -22.69      33.26       1.61          844.36          755.68
217.41
  14     -22.69      34.50       1.08          807.32          730.60
210.20
  15     -22.69      35.14       0.31          782.91          714.07
205.44
  16     -19.23      36.70       3.00          868.38          771.94
222.09
  17     -15.78      38.56       0.92          964.88          837.27
240.89
  18     -15.78      40.00       2.08          954.55          830.28
238.88
  19     -12.32      42.47       3.00          912.20          801.60
230.63
```

```
  20      -8.86      44.47      1.08          870.71          773.52
222.55
  21      -8.86      45.50      1.01          858.30          765.11
220.13
  22      -8.86      46.45      0.91          875.70          776.90
223.52
  23      -5.41      48.39      3.00          929.12          813.06
233.92
  24      -1.95      49.94      0.12          976.80          845.34
243.21
  25      -1.95      51.44      2.88          880.72          780.29
224.50
  26       1.51      54.38      3.00          696.03          655.25
188.52
  27       4.96      56.44      1.12          553.84          558.98
160.82
  28       4.96      57.50      1.00          499.55          522.22
150.25
  29       4.96      58.44      0.87          477.36          507.20
145.92
  30       8.42      60.35      3.00          408.85          460.82
132.58
  31      11.88      62.42      1.19          320.17          400.77
115.30
  32      11.88      63.89      1.81          218.89          332.20
95.58
  33      15.34      65.39      1.27          106.34          256.00
73.65
  34      15.34      66.22      0.46           43.20          213.25
61.35


         ***TABLE 6A - Effective and Base Shear Force Data on the   34 Slices***

 Slice    Alpha     X-Coord.    Base       Effective       Available
Mobilized
  No.     (deg)   Slice Cntr    Leng.     Normal Force    Shear Force       Shear
Force
   *                 (ft)        (ft)       (lbs)           (lbs)
(lbs)

   1     -46.89      16.79      3.00          185.25          677.42
194.90
   2     -43.43      18.41      1.64          348.86          537.47
154.63
   3     -43.43      19.49      1.36          412.54          530.04
152.50
   4     -39.98      20.49      1.32          525.74          598.58
172.21
   5     -39.98      21.64      1.68          767.69          829.14
```

```
238.55
   6     -36.52      22.64       0.89          446.86          465.45
133.91
   7     -36.52      23.50       1.24          622.91          650.69
187.21
   8     -36.52      24.35       0.87          446.20          462.25
132.99
   9     -33.06      25.96       3.00         1911.09         1845.91
531.08
  10     -29.60      27.61       0.90          690.92          634.19
182.46
  11     -29.60      28.91       2.10         1660.55         1509.88
434.40
  12     -26.15      31.17       3.00         2474.13         2227.11
640.75
  13     -22.69      33.26       1.61         1359.02         1216.28
349.93
  14     -22.69      34.50       1.08          875.05          791.89
227.83
  15     -22.69      35.14       0.31          240.03          218.92
62.99
  16     -19.23      36.70       3.00         2605.14         2315.81
666.27
  17     -15.78      38.56       0.92          886.95          769.65
221.43
  18     -15.78      40.00       2.08         1986.20         1727.62
497.05
  19     -12.32      42.47       3.00         2736.60         2404.81
691.88
  20      -8.86      44.47       1.08          940.03          835.09
240.26
  21      -8.86      45.50       1.01          868.67          774.36
222.79
  22      -8.86      46.45       0.91          795.41          705.66
203.02
  23      -5.41      48.39       3.00         2787.35         2439.18
701.77
  24      -1.95      49.94       0.12          113.26           98.01
28.20
  25      -1.95      51.44       2.88         2540.05         2250.41
647.46
  26       1.51      54.38       3.00         2088.09         1965.74
565.56
  27       4.96      56.44       1.12          621.89          627.66
180.58
  28       4.96      57.50       1.00          501.43          524.19
150.81
  29       4.96      58.44       0.87          416.92          442.97
127.45
  30       8.42      60.35       3.00         1226.56         1382.45
```

```
397.74
  31      11.88      62.42      1.19          380.26          475.99
136.95
  32      11.88      63.89      1.81          396.70          602.05
173.21
  33      15.34      65.39      1.27          135.24          325.57
93.67
  34      15.34      66.22      0.46           20.02           98.83
28.43

     Average Effective Normal Stress = 628.2132(psf)
     Average Available Shear Strength = 609.3323(psf)
     Total Length of Failure Surface = 55.7352(ft)


     SUM OF MOMENTS =  -0.563805E-04 (ft/lbs);Imbalance (Fraction of Total Weight) =
 -0.1599960E-08
     SUM OF FORCES = -.314786E-04 (lbs);Imbalance (Fraction of Total Weight) =
-0.8932980E-09

     Sum of Available Shear Forces =   33961.28(lbs)

     Sum of Mobilized Shear Forces =    9770.87(lbs)

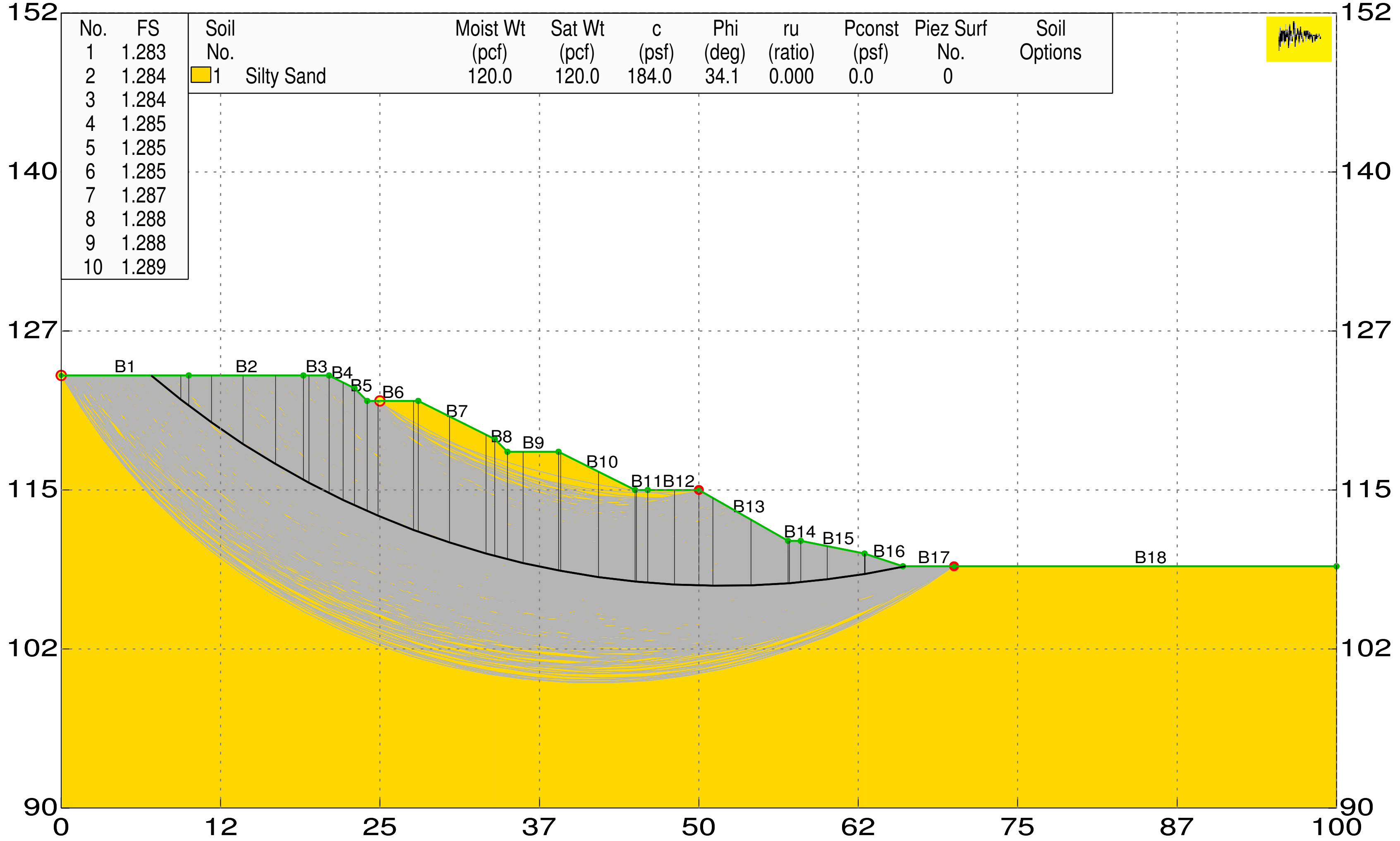
     FS Balance Check: FS =  3.475767

                         **** END OF GEOSTASE OUTPUT ****
```

18021 West Kenwood Ave, San Bernardino, Ca.
Project No. 20229-01

GeoMat

\Proposed Seismic.gsd



No.	FS
1	1.283
2	1.284
3	1.284
4	1.285
5	1.285
6	1.285
7	1.287
8	1.288
9	1.288
10	1.289

Soil No.		Moist Wt (pcf)	Sat Wt (pcf)	c (psf)	Phi (deg)	ru (ratio)	Pconst (psf)	Piez Surf No.	Soil Options
🟨1	Silty Sand	120.0	120.0	184.0	34.1	0.000	0.0	0	

GEOSTASE FS = 1.283

Spencer Method

kh = 0.47300

GEOSTASE® by GREGORY GEOTECHNICAL SOFTWARE

GEOSTASE
Slope Stability
Analysis

GREGORY
GEOTECHNICAL

PLATE C.2

```
                              ***  GEOSTASE(R)  ***

               ** GEOSTASE(R) (c)Copyright by Garry H. Gregory, Ph.D., P.E.,D.GE **

                  ** Current Version 4.30.31-Double Precision, August 2019 **
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*********************************************************************************
                             SLOPE STABILITY ANALYSIS SOFTWARE
              Simplified Bishop, Simplified Janbu, or General Equilibrium (GE)
Options.
                 (Spencer, Morgenstern-Price, USACE, and Lowe & Karafiath)
                 Including Pier/Pile, Planar Reinf,  Nail, Tieback, Line Loads
                 Applied Forces, Fiber-Reinforced Soil (FRS), Distributed Loads
                 Nonlinear Undrained Shear Strength, Curved Strength Envelope,
                 Anisotropic Strengths, Water Surfaces, 3-Stage Rapid Drawdown
                 2- or 3-Stage Pseudo-Static & Simplified Newmark Seismic Analyses.

*********************************************************************************


          Analysis Date:            10/  6/ 2020
          Analysis Time:
          Analysis By:              GeoMat



          Input File Name:          C:\Users\Abdullah\OneDrive - Geomat Testing
Laboratories\GeoMat Reports\ANNUAL REPORTS\2020 REPORTS\20229.San Bernardino Kimbark
Elementary School\Geostatse 2\Proposed Seismic.gsd

          Output File Name:         C:\Users\Abdullah\OneDrive - Geomat Testing
Laboratories\GeoMat Reports\ANNUAL REPORTS\2020 REPORTS\20229.San Bernardino Kimbark
Elementary School\Geostatse 2\Proposed Seismic.OUT

          Unit System:              English


          PROJECT: 18021 West Kenwood Ave, San Bernardino, Ca.


          DESCRIPTION: Project No. 20229-01



          BOUNDARY DATA

             18 Surface Boundaries
```

```
             18 Total   Boundaries


          Boundary      X - 1       Y - 1       X - 2       Y - 2      Soil Type
             No.        (ft)        (ft)        (ft)        (ft)       Below Bnd

              1          0.000     124.000      10.000     124.000        1
              2         10.000     124.000      19.000     124.000        1
              3         19.000     124.000      21.000     124.000        1
              4         21.000     124.000      23.000     123.000        1
              5         23.000     123.000      24.000     122.000        1
              6         24.000     122.000      28.000     122.000        1
              7         28.000     122.000      34.000     119.000        1
              8         34.000     119.000      35.000     118.000        1
              9         35.000     118.000      39.000     118.000        1
             10         39.000     118.000      45.000     115.000        1
             11         45.000     115.000      46.000     115.000        1
             12         46.000     115.000      50.000     115.000        1
             13         50.000     115.000      57.000     111.000        1
             14         57.000     111.000      58.000     111.000        1
             15         58.000     111.000      63.000     110.000        1
             16         63.000     110.000      66.000     109.000        1
             17         66.000     109.000      70.000     109.000        1
             18         70.000     109.000     100.000     109.000        1

          User Specified X-Origin =         0.000(ft)

          User Specified Y-Origin =        90.000(ft)


         MOHR-COULOMB SOIL PARAMETERS

           1 Type(s) of Soil Defined

       Soil Number           Moist  Saturated  Cohesion Friction   Pore   Pressure
Water   Water
           and              Unit Wt. Unit Wt. Intercept   Angle  Pressure Constant
Surface  Option
       Description           (pcf)    (pcf)     (psf)     (deg)  Ratio(ru) (psf)
 No.

  1 Silty Sand               120.0    120.0     184.00    34.10    0.000      0.0
  0       0

          Drained Shear Strength Reduction Factor applied after first stage = 1.0000

         SEISMIC (EARTHQUAKE) DATA

          Specified Peak Ground Acceleration Coefficient (PGA) =   0.000(g)
          Default Velocity =   0.000(ft) per second
```

```
          Specified Horizontal Earthquake Coefficient (kh) =  -.47300(g)
          Specified Vertical Earthquake Coefficient (kv) =   0.000(g)
          (NOTE:Input Velocity = 0.0 will result in default Peak
          Velocity = 2 times(PGA) times 2.5 fps or 0.762 mps)
          Specified Seismic Pore-Pressure Factor =   0.000
          Horizontal Seismic Force is Applied at Center of Gravity of Slices


          TRIAL FAILURE SURFACE DATA

          Circular Trial Failure Surfaces Have Been Generated Using A Random
Procedure.

            1000 Trial Surfaces Have Been Generated.

            1000 Surfaces Generated at Increments of 0.3003(in) Equally Spaced
Within the Start Range

          Along The Specified Surface Between  X =   0.00(ft)
                                          and  X =  25.00(ft)

          Each Surface Enters within a Range Between   X =  50.00(ft)
                                                 and   X =  70.00(ft)

          Unless XCLUDE Lines Were Specified, The Minimum Elevation
          To Which A Surface Extends Is  Y =      90.00(ft)


          Specified Maximum Radius = 10000.000(ft)

          3.000(ft) Line Segments Were Used For Each Trial Failure Surface.


          Restrictions Have Been Imposed Upon The Angle Of Initiation.
          The Angle Has Been Restricted Between The Angles Of -60.0
          And -30.0 deg.

          The Spencer Method Was Selected for FS Analysis.

          Selected fx function = Constant (1.0)

          SELECTED CONVERGENCE PARAMETERS FOR SPENCER METHOD:
          Initial estimate of FS =  1.500
          FS tolerance =  0.000001000
          Initial estimate of theta(deg) = 15.00
          Theta tolerance(radians) =  0.0001000
          Minimum theta(deg) = -45.00 ; Maximum theta(deg) =  45.00
          Theta convergence Step Factor = 5000.00
          Maximum number of iterations = 50
          Allowable negative side force = -1000.0(lbs)
```

```
          Maximum force imbalance  = 100.000000(lbs)
          Maximum moment imbalance = 100.000000 (ft/lbs)

          Selected Lambda Coefficient =  1.00

          Specified Tension Crack Water Depth Factor =   0.000

          Total Number of Trial Surfaces Attempted = 1000

          Number of Trial Surfaces With Valid FS = 1000


          Statistical Data On All Valid FS Values:
             FS Max =   2.695   FS Min =   1.283   FS Ave =   1.465
             Standard Deviation =    0.129   Coefficient of Variation =    8.83 %


          Critical Surface is Sequence Number     282 of Those Analyzed.


          *****BEGINNING OF DETAILED GEOSTASE OUTPUT FOR CRITICAL SURFACE FROM A
SEARCH*****

          BACK-CALCULATED CIRCULAR SURFACE PARAMETERS:

          Circle Center At X =     51.794006(ft) ; Y =    176.274798(ft); and Radius
=     68.804426(ft)

          Circular Trial Failure Surface Generated With 23 Coordinate Points

            Point      X-Coord.      Y-Coord.
             No.        (ft)          (ft)

              1          7.057      124.000
              2          9.378      122.100
              3         11.780      120.302
              4         14.258      118.611
              5         16.808      117.030
              6         19.423      115.561
              7         22.101      114.207
              8         24.835      112.972
              9         27.620      111.857
             10         30.451      110.864
             11         33.322      109.996
             12         36.229      109.254
             13         39.165      108.639
             14         42.126      108.153
             15         45.104      107.796
             16         48.096      107.570
             17         51.094      107.474
```

```
   18         54.094      107.509
   19         57.090      107.674
   20         60.075      107.971
   21         63.045      108.396
   22         65.993      108.951
   23         66.201      109.000


  Iter.     Theta         FS         FS
   No.      (deg)      (Moment)   (Force)
           (fx=1.0)                            Lambda        Delta FS

    1       -15.0000    1.933293   1.228820    -0.268      0.7044728E+00
    2       -19.9500    1.516537   1.243255    -0.363      0.2732826E+00
    3       -23.0856    1.405285   1.253790    -0.426      0.1514950E+00
    4       -26.9847    1.323050   1.268902    -0.509      0.5414817E-01
    5       -29.1523    1.292366   1.278528    -0.558      0.1383761E-01
    6       -29.8958    1.283569   1.282072    -0.575      0.1496761E-02
    7       -29.9858    1.282557   1.282511    -0.577      0.4605246E-04
    8       -29.9887    1.282525   1.282525    -0.577      0.2395647E-06


Factor Of Safety For The Preceding Specified Surface =  1.283
Theta (fx = 1.0) = -29.99 Deg    Lambda =  -0.577



The Spencer Method Has Been Selected For Analysis.

Selected fx function = Constant (1.0)

SELECTED CONVERGENCE PARAMETERS FOR ANALYSIS METHOD:
Initial estimate of FS =  1.500
FS tolerance =  0.000001000
Initial estimate of theta(deg) = 15.00
Theta tolerance(radians) =  0.0001000
Minimum theta(deg) = -45.00 ; Maximum theta(deg) =  45.00
Theta convergence Step Factor = 5000.00
Maximum number of iterations = 50
Maximum force imbalance = 100.000000(lbs)
Maximum moment imbalance(if Applicable) = 100.000000 (ft/lbs)


Selected Lambda Coefficient =  1.00

Tension Crack Water Force =        0.00(lbs)

Specified Tension Crack Water Depth Factor =  0.000

Depth of Tension Crack (zo) at Side of First Slice =   0.000(ft)
```

```
          Depth of Water in Tension Crack =   0.000(ft)

          Theoretical Tension Crack Depth =   5.780(ft)

          NOTE: In Table 1 following, when a tension crack with water is present on
the
          first slice (right facing slope) or on the last slice (left facing slope),
the
          "side force" in the tension crack is set equal to the water pressure
resultant.


                  *** Table 1 - Line of Thrust(if applicable) and Slice Force Data
***

          Slice      X         Y              Side Force     fx    Force Angle
Vert. Shear
           No.     Coord.    Coord.    h/H        (lbs)                (Deg)
Force(lbs)

            1        7.06    124.00    0.000        0.00     1.000        0.00
  0.0
            2        9.38    123.05    0.500     -216.45     1.000      -29.99
108.2
            3       10.00    122.26    0.266     -215.74     1.000      -29.99
107.8
            4       11.78    116.16    0.000-     -85.50     1.000      -29.99
 42.7
            5       14.26    124.38    1.000+    358.15     1.000      -29.99
-179.0
            6       16.81    122.00    0.713     1073.29     1.000      -29.99
-536.5
            7       19.00    120.91    0.623     1843.00     1.000      -29.99
-921.2
            8       19.42    120.71    0.610     2012.80     1.000      -29.99
-1006.1
            9       21.00    120.12    0.580     2639.34     1.000      -29.99
-1319.2
           10       22.10    119.68    0.592     3104.93     1.000      -29.99
-1551.9
           11       23.00    119.35    0.604     3445.02     1.000      -29.99
-1721.9
           12       24.00    118.94    0.646     3805.73     1.000      -29.99
-1902.2
           13       24.83    118.58    0.621     4102.55     1.000      -29.99
-2050.6
           14       27.62    117.59    0.565     5080.12     1.000      -29.99
-2539.2
           15       28.00    117.48    0.561     5205.20     1.000      -29.99
-2601.7
```

```
          16      30.45     116.71     0.590     5997.20     1.000       -29.99
-2997.6
          17      33.32     115.79     0.620     6694.34     1.000       -29.99
-3346.0
          18      34.00     115.58     0.628     6807.00     1.000       -29.99
-3402.3
          19      35.00     115.25     0.674     6956.18     1.000       -29.99
-3476.9
          20      36.23     114.82     0.637     7129.63     1.000       -29.99
-3563.6
          21      39.00     114.05     0.577     7386.58     1.000       -29.99
-3692.0
          22      39.17     114.01     0.579     7403.27     1.000       -29.99
-3700.4
          23      42.13     113.28     0.619     7446.49     1.000       -29.99
-3722.0
          24      45.00     112.54     0.658     7215.74     1.000       -29.99
-3606.6
          25      45.10     112.51     0.655     7206.46     1.000       -29.99
-3602.0
          26      46.00     112.31     0.630     7060.74     1.000       -29.99
-3529.2
          27      48.10     111.85     0.577     6721.39     1.000       -29.99
-3359.5
          28      50.00     111.60     0.546     6249.07     1.000       -29.99
-3123.5
          29      51.09     111.45     0.576     5978.43     1.000       -29.99
-2988.2
          30      54.09     111.04     0.685     4995.43     1.000       -29.99
-2496.9
          31      57.00     110.53     0.860     3900.38     1.000       -29.99
-1949.5
          32      57.09     110.51     0.853     3868.84     1.000       -29.99
-1933.8
          33      58.00     110.36     0.802     3482.54     1.000       -29.99
-1740.7
          34      60.07     109.99     0.774     2633.32     1.000       -29.99
-1316.2
          35      63.00     109.56     0.728     1338.96     1.000       -29.99
-669.3
          36      63.04     109.56     0.730     1320.63     1.000       -29.99
-660.1
          37      65.99     109.09     1.000+      83.71     1.000       -29.99
-41.8
          38      66.00     109.09     1.000+      80.79     1.000       -29.99
-40.4

          NOTE: A value of 0.000- for h/H indicates that the line of thrust is at or
below
          the lower boundary of the sliding mass. A value of 1.000+ for h/H
```

```
indicates that
          the line of thrust is at or above the upper boundary of the sliding mass.


               ***Table 2 - Geometry Data on the   38 Slices***


 Slice   Width   Height   X-Cntr    Y-Cntr-Base  Y-Cntr-Top    Alpha   Beta    Base
Length
  No.     (ft)    (ft)     (ft)        (ft)         (ft)        (deg)   (deg)
(ft)

   1      2.32     0.95      8.22       123.05       124.00      -39.31    0.00
3.00
   2      0.62     2.13      9.69       121.87       124.00      -36.81    0.00
0.78
   3      1.78     3.03     10.89       120.97       124.00      -36.81    0.00
2.22
   4      2.48     4.54     13.02       119.46       124.00      -34.31    0.00
3.00
   5      2.55     6.18     15.53       117.82       124.00      -31.81    0.00
3.00
   6      2.19     7.59     17.90       116.41       124.00      -29.31    0.00
2.51
   7      0.42     8.32     19.21       115.68       124.00      -29.31    0.00
0.49
   8      1.58     8.84     20.21       115.16       124.00      -26.82    0.00
1.77
   9      1.10     9.24     21.55       114.49       123.72      -26.82  -26.57
1.23
  10      0.90     9.22     22.55       114.00       123.22      -24.32  -26.57
0.99
  11      1.00     8.92     23.50       113.58       122.50      -24.32  -45.00
1.10
  12      0.83     8.84     24.42       113.16       122.00      -24.32    0.00
0.92
  13      2.79     9.59     26.23       112.41       122.00      -21.82    0.00
3.00
  14      0.38    10.21     27.81       111.79       122.00      -19.32    0.00
0.40
  15      2.45    10.09     29.23       111.29       121.39      -19.32  -26.57
2.60
  16      2.87     9.63     31.89       110.43       120.06      -16.82  -26.57
3.00
  17      0.68     9.26     33.66       109.91       119.17      -14.32  -26.57
0.70
  18      1.00     8.80     34.50       109.70       118.50      -14.32  -45.00
1.03
  19      1.23     8.59     35.61       109.41       118.00      -14.32    0.00
1.27
```

```
  20      2.77     9.04     37.61      108.96      118.00     -11.83    0.00
2.83
  21      0.17     9.30     39.08      108.66      117.96     -11.83  -26.57
0.17
  22      2.96     8.78     40.65      108.40      117.18      -9.33  -26.57
3.00
  23      2.87     7.74     43.56      107.98      115.72      -6.83  -26.57
2.89
  24      0.10     7.20     45.05      107.80      115.00      -6.83    0.00
0.11
  25      0.90     7.24     45.55      107.76      115.00      -4.33    0.00
0.90
  26      2.10     7.35     47.05      107.65      115.00      -4.33    0.00
2.10
  27      1.90     7.46     49.05      107.54      115.00      -1.83    0.00
1.91
  28      1.09     7.20     50.55      107.49      114.69      -1.83  -29.74
1.09
  29      3.00     6.03     52.59      107.49      113.52       0.67  -29.74
3.00
  30      2.91     4.24     55.55      107.59      111.83       3.16  -29.74
2.91
  31      0.09     3.33     57.04      107.67      111.00       3.16    0.00
0.09
  32      0.91     3.28     57.54      107.72      111.00       5.66    0.00
0.91
  33      2.07     2.92     59.04      107.87      110.79       5.66  -11.31
2.09
  34      2.93     2.11     61.54      108.18      110.29       8.16  -11.31
2.95
  35      0.04     1.60     63.02      108.39      109.99       8.16  -18.43
0.05
  36      2.95     0.82     64.52      108.67      109.49      10.66  -18.43
3.00
  37      0.01     0.05     66.00      108.95      109.00      13.16  -18.43
0.01
  38      0.20     0.02     66.10      108.98      109.00      13.16    0.00
0.21


 ***Table 2A - Coordinates of Slice Points Defining the Slip Surface***


 Point           X-Pt          Y-Pt
  No.            (ft)          (ft)

   1           7.057057       124.000000
   2           9.378318       122.099540
   3          10.000000       121.634303
   4          11.780217       120.302075
```

```
   5           14.258186        118.611020
   6           16.807516        117.029590
   7           19.000000        115.798510
   8           19.423359        115.560794
   9           21.000000        114.763828
  10           22.100743        114.207421
  11           23.000000        113.801062
  12           24.000000        113.349178
  13           24.834577        112.972047
  14           27.619665        111.857018
  15           28.000000        111.723673
  16           30.450710        110.864456
  17           33.322332        109.996247
  18           34.000000        109.823211
  19           35.000000        109.567871
  20           36.229071        109.254041
  21           39.000000        108.673880
  22           39.165401        108.639249
  23           42.125739        108.153041
  24           45.000000        107.808850
  25           45.104457        107.796341
  26           46.000000        107.728530
  27           48.095894        107.569827
  28           50.000000        107.508929
  29           51.094361        107.473929
  30           54.094158        107.508830
  31           57.000000        107.669509
  32           57.089582        107.674463
  33           58.000000        107.764747
  34           60.074938        107.970513
  35           63.000000        108.390029
  36           63.044552        108.396419
  37           65.992777        108.951369
  38           66.000000        108.953058
  39           66.200791        109.000000


  ***Table 3 - Force and Pore Pressure Data On The   38 Slices (Excluding
Reinforcement)***


                       Ubeta   Ubeta      Ualpha              Earthquake
                       Force   Stress     Force      Pore        Force
Distributed
 Slice      Weight      Top     Top        Bot     Pressure   Hor    Ver        Load
   No.      (lbs)      (lbs)   (psf)      (lbs)      (psf)    (lbs)  (lbs)
(lbs)
   1         264.7       0.0     0.0        0.0       0.0  -125.2       0.0
0.00
   2         159.1       0.0     0.0        0.0       0.0   -75.3       0.0
```

```
0.00
   3         647.7       0.0     0.0        0.0       0.0  -306.3       0.0
0.00
   4        1351.0       0.0     0.0        0.0       0.0  -639.0       0.0
0.00
   5        1890.5       0.0     0.0        0.0       0.0  -894.2       0.0
0.00
   6        1995.8       0.0     0.0        0.0       0.0  -944.0       0.0
0.00
   7         422.7       0.0     0.0        0.0       0.0  -199.9       0.0
0.00
   8        1672.1       0.0     0.0        0.0       0.0  -790.9       0.0
0.00
   9        1220.4       0.0     0.0        0.0       0.0  -577.2       0.0
0.00
  10         995.0       0.0     0.0        0.0       0.0  -470.6       0.0
0.00
  11        1071.0       0.0     0.0        0.0       0.0  -506.6       0.0
0.00
  12         885.3       0.0     0.0        0.0       0.0  -418.7       0.0
0.00
  13        3203.6       0.0     0.0        0.0       0.0 -1515.3       0.0
0.00
  14         466.0       0.0     0.0        0.0       0.0  -220.4       0.0
0.00
  15        2968.3       0.0     0.0        0.0       0.0 -1404.0       0.0
0.00
  16        3317.2       0.0     0.0        0.0       0.0 -1569.0       0.0
0.00
  17         753.0       0.0     0.0        0.0       0.0  -356.2       0.0
0.00
  18        1056.5       0.0     0.0        0.0       0.0  -499.7       0.0
0.00
  19        1266.8       0.0     0.0        0.0       0.0  -599.2       0.0
0.00
  20        3004.6       0.0     0.0        0.0       0.0 -1421.2       0.0
0.00
  21         184.6       0.0     0.0        0.0       0.0   -87.3       0.0
0.00
  22        3119.4       0.0     0.0        0.0       0.0 -1475.5       0.0
0.00
  23        2668.8       0.0     0.0        0.0       0.0 -1262.3       0.0
0.00
  24          90.2       0.0     0.0        0.0       0.0   -42.7       0.0
0.00
  25         777.8       0.0     0.0        0.0       0.0  -367.9       0.0
0.00
  26        1848.8       0.0     0.0        0.0       0.0  -874.5       0.0
0.00
  27        1704.7       0.0     0.0        0.0       0.0  -806.3       0.0
```

```
0.00
  28         945.0       0.0     0.0        0.0       0.0  -447.0       0.0
0.00
  29        2169.3       0.0     0.0        0.0       0.0 -1026.1       0.0
0.00
  30        1478.9       0.0     0.0        0.0       0.0  -699.5       0.0
0.00
  31          35.8       0.0     0.0        0.0       0.0   -16.9       0.0
0.00
  32         358.4       0.0     0.0        0.0       0.0  -169.5       0.0
0.00
  33         728.3       0.0     0.0        0.0       0.0  -344.5       0.0
0.00
  34         741.4       0.0     0.0        0.0       0.0  -350.7       0.0
0.00
  35           8.6       0.0     0.0        0.0       0.0    -4.0       0.0
0.00
  36         290.1       0.0     0.0        0.0       0.0  -137.2       0.0
0.00
  37           0.0       0.0     0.0        0.0       0.0    -0.0       0.0
0.00
  38           0.6       0.0     0.0        0.0       0.0    -0.3       0.0
0.00

          TOTAL WEIGHT OF SLIDING MASS =   45761.68(lbs)

          EFFECTIVE WEIGHT OF SLIDING MASS =   45761.68(lbs)

          TOTAL AREA OF SLIDING MASS =   381.35(ft2)


 ***TABLE 4 - SOIL STRENGTH & SOIL OPTIONS DATA ON THE   38 SLICES***

 Slice  Soil   Cohesion   Phi(Deg)   Options
  No.   Type     (psf)
   1      1     184.00     34.10
   2      1     184.00     34.10
   3      1     184.00     34.10
   4      1     184.00     34.10
   5      1     184.00     34.10
   6      1     184.00     34.10
   7      1     184.00     34.10
   8      1     184.00     34.10
   9      1     184.00     34.10
  10      1     184.00     34.10
  11      1     184.00     34.10
  12      1     184.00     34.10
  13      1     184.00     34.10
  14      1     184.00     34.10
  15      1     184.00     34.10
```

```
  16      1     184.00     34.10
  17      1     184.00     34.10
  18      1     184.00     34.10
  19      1     184.00     34.10
  20      1     184.00     34.10
  21      1     184.00     34.10
  22      1     184.00     34.10
  23      1     184.00     34.10
  24      1     184.00     34.10
  25      1     184.00     34.10
  26      1     184.00     34.10
  27      1     184.00     34.10
  28      1     184.00     34.10
  29      1     184.00     34.10
  30      1     184.00     34.10
  31      1     184.00     34.10
  32      1     184.00     34.10
  33      1     184.00     34.10
  34      1     184.00     34.10
  35      1     184.00     34.10
  36      1     184.00     34.10
  37      1     184.00     34.10
  38      1     184.00     34.10

  SOIL OPTIONS:
  A = ANISOTROPIC SHEAR STRENGTH
  C = CURVED STRENGTH ENVELOPE (TANGENT PHI & C)
  F = FIBER-REINFORCED SOIL (FRS)
  M = INDEPENDENT MULTI-STAGE SHEAR STRENGTH
  N = NONLINEAR UNDRAINED SHEAR STRENGTH
  R = RAPID DRAWDOWN OR RAPID LOADING (SEISMIC) SHEAR STRENGTH
  NOTE: Phi and C in Table 4 are modified values based on specified
  Soil Options (if any).



         ***TABLE 5 - Total Base Stress Data on the   38 Slices***

 Slice   Alpha     X-Coord.      Base         Total            Total           Total
  No.    (deg)    Slice Cntr     Leng.     Normal Stress    Vert. Stress
Normal/Vert.
   *                 (ft)        (ft)          (psf)           (psf)        Stress
Ratio

   1    -39.31       8.22        3.00           30.15          114.03
0.264
   2    -36.81       9.69        0.78          106.11          255.97
0.415
   3    -36.81      10.89        2.22          157.62          363.82
0.433
```

```
   4    -34.31      13.02        3.00          263.05          545.21
0.482
   5    -31.81      15.53        3.00          385.96          741.56
0.520
   6    -29.31      17.90        2.51          504.69          910.31
0.554
   7    -29.31      19.21        0.49          553.38          998.44
0.554
   8    -26.82      20.21        1.77          623.10         1060.52
0.588
   9    -26.82      21.55        1.23          651.04         1108.70
0.587
  10    -24.32      22.55        0.99          688.39         1106.47
0.622
  11    -24.32      23.50        1.10          666.80         1070.99
0.623
  12    -24.32      24.42        0.92          660.55         1060.73
0.623
  13    -21.82      26.23        3.00          757.32         1150.26
0.658
  14    -19.32      27.81        0.40          852.66         1225.16
0.696
  15    -19.32      29.23        2.60          843.28         1211.19
0.696
  16    -16.82      31.89        3.00          854.12         1155.17
0.739
  17    -14.32      33.66        0.70          873.67         1111.16
0.786
  18    -14.32      34.50        1.03          833.04         1056.54
0.788
  19    -14.32      35.61        1.27          813.82         1030.69
0.790
  20    -11.83      37.61        2.83          907.62         1084.32
0.837
  21    -11.83      39.08        0.17          932.67         1116.25
0.836
  22     -9.33      40.65        3.00          941.26         1053.73
0.893
  23     -6.83      43.56        2.89          894.89          928.51
0.964
  24     -6.83      45.05        0.11          837.95          863.69
0.970
  25     -4.33      45.55        0.90          902.88          868.51
1.040
  26     -4.33      47.05        2.10          915.57          882.10
1.038
  27     -1.83      49.05        1.91          997.82          895.27
1.115
  28     -1.83      50.55        1.09          966.22          863.51
1.119
```

```
  29      0.67      52.59        3.00          894.09          723.14
1.236
  30      3.16      55.55        2.91          726.42          508.93
1.427
  31      3.16      57.04        0.09          600.83          399.36
1.504
  32      5.66      57.54        0.91          654.21          393.65
1.662
  33      5.66      59.04        2.09          601.26          350.99
1.713
  34      8.16      61.54        2.95          535.79          253.47
2.114
  35      8.16      63.02        0.05          452.44          191.92
2.357
  36     10.66      64.52        3.00          372.06           98.39
3.782
  37     13.16      66.00        0.01          275.98            5.88
46.944
  38     13.16      66.10        0.21          270.88            2.82
96.176


         ***TABLE 5A - Total Base Force Data on the   38 Slices***

 Slice   Alpha     X-Coord.       Base         Total           Total            Total
  No.    (deg)    Slice Cntr      Leng.     Normal Force    Vert. Force
Normal/Vert.
   *                 (ft)         (ft)          (lbs)           (lbs)        Force
Ratio

   1    -39.31       8.22        3.00           90.44          264.69
0.342
   2    -36.81       9.69        0.78           82.39          159.13
0.518
   3    -36.81      10.89        2.22          350.47          647.67
0.541
   4    -34.31      13.02        3.00          789.16         1351.02
0.584
   5    -31.81      15.53        3.00         1157.88         1890.49
0.612
   6    -29.31      17.90        2.51         1269.02         1995.85
0.636
   7    -29.31      19.21        0.49          268.68          422.70
0.636
   8    -26.82      20.21        1.77         1100.79         1672.06
0.658
   9    -26.82      21.55        1.23          802.98         1220.40
0.658
  10    -24.32      22.55        0.99          679.31          995.00
0.683
```

```
  11    -24.32       23.50         1.10           731.72          1070.99
0.683
  12    -24.32       24.42         0.92           604.96           885.26
0.683
  13    -21.82       26.23         3.00          2271.96          3203.56
0.709
  14    -19.32       27.81         0.40           343.65           465.97
0.737
  15    -19.32       29.23         2.60          2189.98          2968.28
0.738
  16    -16.82       31.89         3.00          2562.37          3317.20
0.772
  17    -14.32       33.66         0.70           611.06           753.00
0.811
  18    -14.32       34.50         1.03           859.77          1056.54
0.814
  19    -14.32       35.61         1.27          1032.33          1266.79
0.815
  20    -11.83       37.61         2.83          2569.48          3004.59
0.855
  21    -11.83       39.08         0.17           157.61           184.63
0.854
  22     -9.33       40.65         3.00          2823.77          3119.39
0.905
  23     -6.83       43.56         2.89          2590.52          2668.79
0.971
  24     -6.83       45.05         0.11            88.15            90.22
0.977
  25     -4.33       45.55         0.90           810.88           777.79
1.043
  26     -4.33       47.05         2.10          1924.42          1848.78
1.041
  27     -1.83       49.05         1.91          1900.93          1704.70
1.115
  28     -1.83       50.55         1.09          1057.93           944.99
1.120
  29      0.67       52.59         3.00          2682.27          2169.28
1.236
  30      3.16       55.55         2.91          2114.10          1478.87
1.430
  31      3.16       57.04         0.09            53.91            35.78
1.507
  32      5.66       57.54         0.91           598.52           358.38
1.670
  33      5.66       59.04         2.09          1253.69           728.27
1.721
  34      8.16       61.54         2.95          1583.25           741.41
2.135
  35      8.16       63.02         0.05            20.36             8.55
2.382
```

```
  36     10.66      64.52        3.00          1116.19          290.06
3.848
  37     13.16      66.00        0.01             2.05            0.04
48.210
  38     13.16      66.10        0.21            55.86            0.57
98.769


         ***TABLE 6 - Effective and Base Shear Stress Data on the   38 Slices***

 Slice    Alpha     X-Coord.     Base       Effective       Available
Mobilized
  No.     (deg)   Slice Cntr     Leng.    Normal Stress   Shear Strength    Shear
Stress
   *                 (ft)         (ft)         (psf)           (psf)            (psf)

   1     -39.31        8.22       3.00           30.15          204.41
159.38
   2     -36.81        9.69       0.78          106.11          255.84
199.48
   3     -36.81       10.89       2.22          157.62          290.72
226.67
   4     -34.31       13.02       3.00          263.05          362.10
282.33
   5     -31.81       15.53       3.00          385.96          445.32
347.22
   6     -29.31       17.90       2.51          504.69          525.70
409.89
   7     -29.31       19.21       0.49          553.38          558.67
435.60
   8     -26.82       20.21       1.77          623.10          605.87
472.41
   9     -26.82       21.55       1.23          651.04          624.79
487.15
  10     -24.32       22.55       0.99          688.39          650.08
506.87
  11     -24.32       23.50       1.10          666.80          635.46
495.47
  12     -24.32       24.42       0.92          660.55          631.23
492.18
  13     -21.82       26.23       3.00          757.32          696.74
543.26
  14     -19.32       27.81       0.40          852.66          761.30
593.59
  15     -19.32       29.23       2.60          843.28          754.95
588.64
  16     -16.82       31.89       3.00          854.12          762.29
594.36
  17     -14.32       33.66       0.70          873.67          775.52
604.68
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```
  18     -14.32      34.50       1.03          833.04          748.01
583.23
  19     -14.32      35.61       1.27          813.82          735.00
573.08
  20     -11.83      37.61       2.83          907.62          798.50
622.60
  21     -11.83      39.08       0.17          932.67          815.46
635.83
  22      -9.33      40.65       3.00          941.26          821.28
640.36
  23      -6.83      43.56       2.89          894.89          789.89
615.88
  24      -6.83      45.05       0.11          837.95          751.33
585.82
  25      -4.33      45.55       0.90          902.88          795.30
620.10
  26      -4.33      47.05       2.10          915.57          803.89
626.80
  27      -1.83      49.05       1.91          997.82          859.58
670.22
  28      -1.83      50.55       1.09          966.22          838.18
653.54
  29       0.67      52.59       3.00          894.09          789.34
615.46
  30       3.16      55.55       2.91          726.42          675.83
526.95
  31       3.16      57.04       0.09          600.83          590.79
460.65
  32       5.66      57.54       0.91          654.21          626.93
488.83
  33       5.66      59.04       2.09          601.26          591.08
460.87
  34       8.16      61.54       2.95          535.79          546.76
426.31
  35       8.16      63.02       0.05          452.44          490.33
382.31
  36      10.66      64.52       3.00          372.06          435.91
339.88
  37      13.16      66.00       0.01          275.98          370.85
289.16
  38      13.16      66.10       0.21          270.88          367.40
286.47


         ***TABLE 6A - Effective and Base Shear Force Data on the   38 Slices***

 Slice    Alpha     X-Coord.     Base        Effective       Available
Mobilized
  No.     (deg)   Slice Cntr     Leng.     Normal Force    Shear Force       Shear
Force
```

```
   *                 (ft)         (ft)        (lbs)           (lbs)
(lbs)

   1     -39.31       8.22       3.00           90.44          613.23
478.15
   2     -36.81       9.69       0.78           82.39          198.66
154.90
   3     -36.81      10.89       2.22          350.47          646.41
504.01
   4     -34.31      13.02       3.00          789.16         1086.30
847.00
   5     -31.81      15.53       3.00         1157.88         1335.95
1041.65
   6     -29.31      17.90       2.51         1269.02         1321.85
1030.66
   7     -29.31      19.21       0.49          268.68          271.25
211.50
   8     -26.82      20.21       1.77         1100.79         1070.35
834.56
   9     -26.82      21.55       1.23          802.98          770.60
600.84
  10     -24.32      22.55       0.99          679.31          641.50
500.19
  11     -24.32      23.50       1.10          731.72          697.32
543.71
  12     -24.32      24.42       0.92          604.96          578.10
450.75
  13     -21.82      26.23       3.00         2271.96         2090.23
1629.78
  14     -19.32      27.81       0.40          343.65          306.83
239.24
  15     -19.32      29.23       2.60         2189.98         1960.57
1528.68
  16     -16.82      31.89       3.00         2562.37         2286.86
1783.09
  17     -14.32      33.66       0.70          611.06          542.41
422.92
  18     -14.32      34.50       1.03          859.77          772.01
601.95
  19     -14.32      35.61       1.27         1032.33          932.35
726.96
  20     -11.83      37.61       2.83         2569.48         2260.58
1762.60
  21     -11.83      39.08       0.17          157.61          137.80
107.45
  22      -9.33      40.65       3.00         2823.77         2463.84
1921.08
  23      -6.83      43.56       2.89         2590.52         2286.56
1782.86
  24      -6.83      45.05       0.11           88.15           79.04
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61.63
  25      -4.33      45.55       0.90          810.88          714.26
556.92
  26      -4.33      47.05       2.10         1924.42         1689.68
1317.46
  27      -1.83      49.05       1.91         1900.93         1637.56
1276.83
  28      -1.83      50.55       1.09         1057.93          917.74
715.57
  29       0.67      52.59       3.00         2682.27         2368.03
1846.38
  30       3.16      55.55       2.91         2114.10         1966.84
1533.57
  31       3.16      57.04       0.09           53.91           53.00
41.33
  32       5.66      57.54       0.91          598.52          573.57
447.22
  33       5.66      59.04       2.09         1253.69         1232.47
960.97
  34       8.16      61.54       2.95         1583.25         1615.66
1259.75
  35       8.16      63.02       0.05           20.36           22.07
17.21
  36      10.66      64.52       3.00         1116.19         1307.72
1019.64
  37      13.16      66.00       0.01            2.05            2.75
2.14
  38      13.16      66.10       0.21           55.86           75.76
59.07

     Average Effective Normal Stress = 651.8026(psf)
     Average Available Shear Strength = 625.3035(psf)
     Total Length of Failure Surface = 63.2136(ft)


     SUM OF MOMENTS =  -0.987489E-01 (ft/lbs);Imbalance (Fraction of Total Weight) =
 -0.2157894E-05
     SUM OF FORCES = -.140345E-02 (lbs);Imbalance (Fraction of Total Weight) =
-0.3066871E-07

     Sum of Available Shear Forces =   39527.70(lbs)

     Sum of Mobilized Shear Forces =   30820.23(lbs)

     FS Balance Check: FS =  1.282525

                  *** SEISMIC SLOPE DISPLACEMENT DATA ***
           (Note: kv is set = zero for displacement calculations)
           Seismic Yield Coefficient (ky) =  0.66809(g)
           Calculated Newmark Seismic Displacement =    0.000(ft)
```

```
           Average Elevation of Point of Application of kh on Sliding Mass =
114.584(ft)

           Non-Symmetrical Sliding Resistance Has Been Specified
           for Downhill Sliding.

                         **** END OF GEOSTASE OUTPUT ****
```

This report was generated by LimitState:GEO3.5.g.24265 - limitstate.com

About this Report

This report has been generated using LimitState:GEO, a software application capable of directly identifying the critical collapse mechanism for a wide variety of geotechnical stability problems, including those involving slopes, retaining walls, footings etc.

The software utilizes the Discontinuity Layout Optimization (DLO) procedure to obtain a solution (Smith and Gilbert 2007). The main steps involved are: (i) distribution of nodes across the problem domain; (ii) connection of every node to every other node with potential discontinuities (e.g. slip-lines); (iii) application of rigorous optimization techniques to identify the critical subset of potential discontinuities, and hence also the critical failure mechanism and margin of safety.

The accuracy of the DLO solution is controlled by the specified nodal density. Within the set of all possible discontinuities linking pairs of nodes, all potential translational failure mechanisms are considered, whether anticipated or not by the engineer. Failure mechanisms involving rotations along the edges of solid bodies in the problem can also be identified. Thus in this case the solution identified by the DLO procedure is guaranteed to be the most critical solution for the problem posed. This means that there is no need to prescribe any aspect of the collapse mechanism prior to an analysis, or to separately consider different failure modes. The critical mechanism and collapse load factor are determined according to the well established upper bound theorem of plasticity.

LimitState:GEO reports the solution to a problem both visually as a collapse mechanism and numerically in terms of an Adequacy Factor, which is defined as the factor by which specified loads must be increased, or material strengths decreased, in order for the system under consideration to reach a collapse state.

REFERENCE

Smith, C.C. and Gilbert, M. (2007) Application of discontinuity layout optimization to plane plasticity problems, Proceedings of the Royal Society A: Mathematical, Physical and Engineering Sciences, Vol. 463, 2086, pp 2461-2484.

Summary

Name	Date of Analysis	Name of Engineer	Organization
Access Ramp Stability Analysis	Mon Oct 5 2020	HMN	GeoMat Testing Laboratories, Inc.

Reference #	Location	Map Reference	Tags
Project No. 20229-01	Kimbark Elementary School, San Bernardino, CA	Access Ramp	

Comments
Static Condition

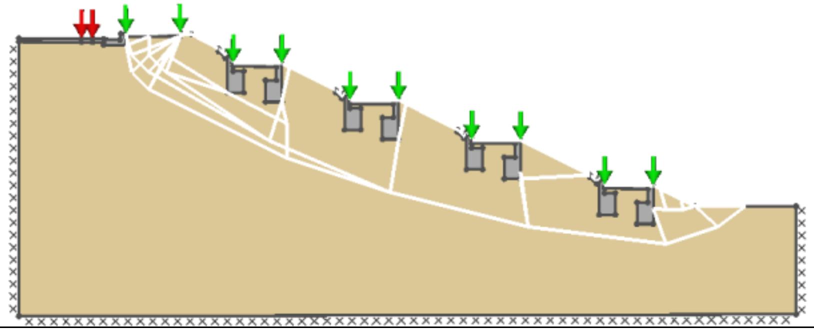
Target Nodal Density	Nodal Spacing Scale Factor	Water	Model Translational Failures?	Model Rotational Failures?	Seismic Accelerations: Horiz. / Vert. (g)
Fine (1000 nodes)	2.06269	Enabled	True	Along edges	None

Scenario	Partial Factor Set	Short / Long Term?**	Analysis Type	Adequacy Factor
1*	**User**	**Long Term**	**Factor Strength(s)**	**3.075**

**This report provides details of this scenario, which has been identified as the most critical.*

***For Mohr Coulomb materials with Drainage Behaviour specified as 'drained/undrained', undrained properties are used in a short term analysis, and drained properties are used in a long term analysis.*

Failure Mechanism (Scenario 1)



Analysis Options

Factor Strength(s)

Solution Tolerance (%)	Automatic Adequacy on Load(s)	Factor on Load(s)	Artificial Cohesion (kN/m² (kPa))
1	True	1	0.1

Geometry

(all distances in ft)

All Geometrical Objects

No. of Vertices (V)	No. of Boundaries (B)	No. of Solids (S)
101	114	14

Boundary Objects

ID	Start Vertex ID (x, y)	End Vertex ID (x, y)	Baseline Nodal Spacing	Support Type	Material(s)
B1	V1 (14.1076, 124.672)	V2 (14.1076, 124.672)	1.64042	Free	Frictionless
B2	V2 (14.1076, 124.672)	V3 (19.0289, 124.672)	1.64042	Free	-
B3	V3 (19.0289, 124.672)	V4 (19.0289, 124.672)	1.64042	Free	-
B4	V4 (19.0289, 124.672)	V6 (19.0289, 124.672)	1.64042	Free	-
B6*	V1 (14.1076, 124.672)	V6 (19.0289, 124.672)	1.64042	Free	-
B15	V12 (65.6168, 108.268)	V15 (75.4593, 108.268)	1.64042	Free	-
B23	V21 (62.336, 108.268)	V22 (62.336, 108.268)	1.64042	Free	-
B24	V22 (62.336, 108.268)	V23 (62.336, 111.549)	1.64042	Free	-
B25*	V23 (62.336, 111.549)	V24 (59.0551, 111.549)	1.64042	Free	-

B26	V24 (59.0551, 111.549)	V25 (59.0551, 111.549)	1.64042	Free	-
B27	V25 (59.0551, 111.549)	V26 (59.0551, 111.549)	1.64042	Free	-
B28	V26 (59.0551, 111.549)	V27 (59.0551, 111.549)	1.64042	Free	-
B29	V27 (59.0551, 111.549)	V28 (55.7743, 111.549)	1.64042	Free	-
B30	V28 (55.7743, 111.549)	V29 (55.7743, 111.549)	1.64042	Free	-
B31	V29 (55.7743, 111.549)	V30 (59.0551, 111.549)	1.64042	Free	-
B32	V30 (59.0551, 111.549)	V31 (59.0551, 111.549)	1.64042	Free	-
B33	V31 (59.0551, 111.549)	V32 (59.0551, 108.268)	1.64042	Free	-
B34	V32 (59.0551, 108.268)	V33 (59.0551, 108.268)	1.64042	Free	-
B35	V33 (59.0551, 108.268)	V34 (59.0551, 108.268)	1.64042	Free	-
B36	V34 (59.0551, 108.268)	V35 (59.0551, 108.268)	1.64042	Free	-
B37	V35 (59.0551, 108.268)	V36 (59.0551, 111.549)	1.64042	Free	-
B38	V36 (59.0551, 111.549)	V37 (62.336, 111.549)	1.64042	Free	-
B39	V37 (62.336, 111.549)	V38 (62.336, 108.268)	1.64042	Free	-
B40	V38 (62.336, 108.268)	V39 (62.336, 108.268)	1.64042	Free	-
B41	V21 (62.336, 108.268)	V39 (62.336, 108.268)	1.64042	Free	-
B42	V40 (49.2126, 111.549)	V41 (49.2126, 111.549)	1.64042	Free	-
B43	V41 (49.2126, 111.549)	V42 (49.2126, 114.829)	1.64042	Free	-
B44*	V42 (49.2126, 114.829)	V43 (45.9318, 114.829)	1.64042	Free	-
B45	V43 (45.9318, 114.829)	V44 (45.9318, 114.829)	1.64042	Free	-
B46	V44 (45.9318, 114.829)	V45 (45.9318, 114.829)	1.64042	Free	-
B47	V45 (45.9318, 114.829)	V46 (45.9318, 114.829)	1.64042	Free	-
B48	V46 (45.9318, 114.829)	V47 (45.9318, 114.829)	1.64042	Free	-
B49	V47 (45.9318, 114.829)	V48 (45.9318, 111.549)	1.64042	Free	-
B50	V48 (45.9318, 111.549)	V49 (45.9318, 111.549)	1.64042	Free	-
B51	V49 (45.9318, 111.549)	V50 (45.9318, 114.829)	1.64042	Free	-
B52	V50 (45.9318, 114.829)	V51 (45.9318, 114.829)	1.64042	Free	-
B53	V51 (45.9318, 114.829)	V52 (45.9318, 114.829)	1.64042	Free	-
B54	V52 (45.9318, 114.829)	V53 (49.2126, 114.829)	1.64042	Free	-
B55	V53 (49.2126, 114.829)	V54 (49.2126, 111.549)	1.64042	Free	-
B56	V54 (49.2126, 111.549)	V55 (49.2126, 111.549)	1.64042	Free	-
B57	V40 (49.2126, 111.549)	V55 (49.2126, 111.549)	1.64042	Free	-
B58	V56 (45.9318, 114.829)	V47 (45.9318, 114.829)	1.64042	Free	-

B59	V46 (45.9318, 114.829)	V57 (45.9318, 114.829)	1.64042	Free	-
B60	V57 (45.9318, 114.829)	V58 (45.9318, 114.829)	1.64042	Free	-
B61	V58 (45.9318, 114.829)	V59 (45.9318, 114.829)	1.64042	Free	-
B62	V56 (45.9318, 114.829)	V59 (45.9318, 114.829)	1.64042	Free	-
B63	V60 (39.3701, 114.829)	V61 (39.3701, 114.829)	1.64042	Free	-
B64	V61 (39.3701, 114.829)	V62 (39.3701, 118.11)	1.64042	Free	-
B65*	V62 (39.3701, 118.11)	V63 (36.0892, 118.11)	1.64042	Free	-
B66	V63 (36.0892, 118.11)	V64 (36.0892, 118.11)	1.64042	Free	-
B67	V64 (36.0892, 118.11)	V65 (32.8084, 118.11)	1.64042	Free	-
B68	V65 (32.8084, 118.11)	V66 (32.8084, 118.11)	1.64042	Free	-
B69	V66 (32.8084, 118.11)	V67 (32.8084, 118.11)	1.64042	Free	-
B70	V67 (32.8084, 118.11)	V68 (32.8084, 114.829)	1.64042	Free	-
B71	V68 (32.8084, 114.829)	V69 (36.0892, 114.829)	1.64042	Free	-
B72	V69 (36.0892, 114.829)	V70 (36.0892, 118.11)	1.64042	Free	-
B73	V70 (36.0892, 118.11)	V71 (36.0892, 118.11)	1.64042	Free	-
B74	V71 (36.0892, 118.11)	V72 (36.0892, 118.11)	1.64042	Free	-
B75	V72 (36.0892, 118.11)	V73 (39.3701, 118.11)	1.64042	Free	-
B76	V73 (39.3701, 118.11)	V74 (39.3701, 118.11)	1.64042	Free	-
B77	V74 (39.3701, 118.11)	V75 (39.3701, 118.11)	1.64042	Free	-
B78	V60 (39.3701, 114.829)	V75 (39.3701, 118.11)	1.64042	Free	-
B79	V76 (32.8084, 118.11)	V67 (32.8084, 118.11)	1.64042	Free	-
B80	V66 (32.8084, 118.11)	V77 (32.8084, 118.11)	1.64042	Free	-
B81	V77 (32.8084, 118.11)	V78 (32.8084, 118.11)	1.64042	Free	-
B82	V78 (32.8084, 118.11)	V79 (32.8084, 118.11)	1.64042	Free	-
B83	V76 (32.8084, 118.11)	V79 (32.8084, 118.11)	1.64042	Free	-
B84	V80 (26.9029, 118.11)	V81 (28.5433, 118.11)	1.64042	Free	-
B85	V81 (28.5433, 118.11)	V82 (28.5433, 121.391)	1.64042	Free	-
B86*	V82 (28.5433, 121.391)	V83 (23.9501, 121.391)	1.64042	Free	-
B87	V83 (23.9501, 121.391)	V84 (23.9501, 121.391)	1.64042	Free	-
B88	V84 (23.9501, 121.391)	V85 (23.622, 121.391)	1.64042	Free	-
B89	V85 (23.622, 121.391)	V86 (23.622, 121.391)	1.64042	Free	-
B90	V86 (23.622, 121.391)	V110 (23.622, 121.391)	1.64042	Free	-
B91	V87 (23.622, 118.11)	V88 (24.9344, 118.11)	1.64042	Free	-
B92	V88 (24.9344, 118.11)	V89 (24.9344, 121.391)	1.64042	Free	-
B93	V89 (24.9344, 121.391)	V90 (23.9501, 121.391)	1.64042	Free	-

B94	V90 (23.9501, 121.391)	V91 (23.9501, 121.391)	1.64042	Free	-
B95	V91 (23.9501, 121.391)	V92 (27.8871, 121.391)	1.64042	Free	-
B96	V92 (27.8871, 121.391)	V93 (27.8871, 121.391)	1.64042	Free	-
B97	V93 (27.8871, 121.391)	V94 (26.9029, 121.391)	1.64042	Free	-
B98	V80 (26.9029, 118.11)	V94 (26.9029, 121.391)	1.64042	Free	-
B99	V95 (12.1391, 124.672)	V96 (12.1391, 124.672)	1.64042	Free	Frictionless
B100	V96 (12.1391, 124.672)	V112 (11.1549, 124.672)	1.64042	Free	-
B101	V97 (4.26509, 124.672)	V98 (4.26509, 124.672)	1.64042	Fixed	-
B102	V95 (12.1391, 124.672)	V114 (11.1549, 124.672)	1.64042	Free	-
B103	V99 (4.26509, 98.4252)	V100 (75.4593, 98.4252)	1.64042	Fixed	-
B104	V100 (75.4593, 98.4252)	V15 (75.4593, 108.268)	1.64042	Fixed	-
B105	V12 (65.6168, 108.268)	V23 (62.336, 111.549)	1.64042	Free	-
B106	V28 (55.7743, 111.549)	V42 (49.2126, 114.829)	1.64042	Free	-
B107	V58 (45.9318, 114.829)	V62 (39.3701, 118.11)	1.64042	Free	-
B108	V78 (32.8084, 118.11)	V82 (28.5433, 121.391)	1.64042	Free	-
B109	V86 (23.622, 121.391)	V101 (23.294, 121.391)	1.64042	Free	-
B110	V101 (23.294, 121.391)	V102 (22.6378, 124.672)	1.64042	Free	-
B111	V102 (22.6378, 124.672)	V103 (20.0131, 124.672)	1.64042	Free	-
B112	V103 (20.0131, 124.672)	V4 (19.0289, 124.672)	1.64042	Free	-
B113	V2 (14.1076, 124.672)	V104 (14.1076, 124.672)	1.64042	Free	-
B114	V104 (14.1076, 124.672)	V105 (12.1391, 124.672)	1.64042	Free	-
B115	V105 (12.1391, 124.672)	V95 (12.1391, 124.672)	1.64042	Free	-
B116	V99 (4.26509, 98.4252)	V98 (4.26509, 124.672)	1.64042	Fixed	-
B117	V1 (14.1076, 124.672)	V106 (13.7795, 124.672)	1.64042	Free	-
B118	V106 (13.7795, 124.672)	V107 (13.4514, 124.672)	1.64042	Free	-
B119	V107 (13.4514, 124.672)	V96 (12.1391, 124.672)	1.64042	Free	-
B120	V31 (59.0551, 111.549)	V26 (59.0551, 111.549)	1.64042	Free	-
B121	V102 (22.6378, 124.672)	V108 (22.6378, 121.391)	1.64042	Free	-
B122	V108 (22.6378, 121.391)	V109 (23.294, 121.391)	1.64042	Free	-
B123	V109 (23.294, 121.391)	V110 (23.622, 121.391)	1.64042	Free	-
B125	V110 (23.622, 121.391)	V87 (23.622, 118.11)	1.64042	Free	-
B126	V111 (9.84252, 124.672)	V97 (4.26509, 124.672)	1.64042	Free	-

B127*	V112 (11.1549, 124.672)	V111 (9.84252, 124.672)	1.64042	Free	-
B128	V111 (9.84252, 124.672)	V113 (9.84252, 124.672)	1.64042	Free	Frictionless
B129	V113 (9.84252, 124.672)	V98 (4.26509, 124.672)	1.64042	Free	-
B130	V112 (11.1549, 124.672)	V114 (11.1549, 124.672)	1.64042	Free	Frictionless
B131	V114 (11.1549, 124.672)	V113 (9.84252, 124.672)	1.64042	Free	-

** Loaded boundary.*

Solid Objects

ID	Vertex IDs (x, y)	Boundary IDs	Baseline Nodal Spacing (x / y)	Material(s)/Water Regime(s)
S1*	V1 (14.1076,124.672) V2 (14.1076,124.672) V3 (19.0289,124.672) V4 (19.0289,124.672) V6 (19.0289,124.672)	B1 B2 B3 B4 B6	3.28084 / 3.28084	Concrete
S6*	V40 (49.2126,111.549) V41 (49.2126,111.549) V42 (49.2126,114.829) V43 (45.9318,114.829) V44 (45.9318,114.829) V45 (45.9318,114.829) V46 (45.9318,114.829) V47 (45.9318,114.829) V48 (45.9318,111.549) V49 (45.9318,111.549) V50 (45.9318,114.829) V51 (45.9318,114.829) V52 (45.9318,114.829) V53 (49.2126,114.829) V54 (49.2126,111.549) V55 (49.2126,111.549)	B42 B43 B44 B45 B46 B47 B48 B49 B50 B51 B52 B53 B54 B55 B56 B57	3.28084 / 3.28084	Concrete
S7*	V56 (45.9318,114.829) V47 (45.9318,114.829) V46 (45.9318,114.829) V57 (45.9318,114.829) V58 (45.9318,114.829) V59 (45.9318,114.829)	B58 B48 B59 B60 B61 B62	3.28084 / 3.28084	Concrete
S8*	V60 (39.3701,114.829) V61 (39.3701,114.829) V62 (39.3701,118.11) V63 (36.0892,118.11) V64 (36.0892,118.11) V65 (32.8084,118.11) V66 (32.8084,118.11) V67 (32.8084,118.11) V68 (32.8084,114.829) V69 (36.0892,114.829) V70 (36.0892,118.11) V71 (36.0892,118.11) V72 (36.0892,118.11) V73 (39.3701,118.11) V74 (39.3701,118.11) V75 (39.3701,118.11)	B63 B64 B65 B66 B67 B68 B69 B70 B71 B72 B73 B74 B75 B76 B77 B78	3.28084 / 3.28084	Concrete
S9*	V76 (32.8084,118.11) V67 (32.8084,118.11) V66 (32.8084,118.11) V77 (32.8084,118.11) V78 (32.8084,118.11)	B79 B69 B80 B81 B82	3.28084 / 3.28084	Concrete

	V79 (32.8084,118.11)	B83		
S10*	V80 (26.9029,118.11)	B84	3.28084 / 3.28084	Concrete
	V81 (28.5433,118.11)	B85		
	V82 (28.5433,121.391)	B86		
	V83 (23.9501,121.391)	B87		
	V84 (23.9501,121.391)	B88		
	V85 (23.622,121.391)	B89		
	V86 (23.622,121.391)	B90		
	V110 (23.622,121.391)	B125		
	V87 (23.622,118.11)	B91		
	V88 (24.9344,118.11)	B92		
	V89 (24.9344,121.391)	B93		
	V90 (23.9501,121.391)	B94		
	V91 (23.9501,121.391)	B95		
	V92 (27.8871,121.391)	B96		
	V93 (27.8871,121.391)	B97		
	V94 (26.9029,121.391)	B98		
S13*	V105 (12.1391,124.672)	B114	3.28084 / 3.28084	Concrete
	V104 (14.1076,124.672)	B113		
	V2 (14.1076,124.672)	B1		
	V1 (14.1076,124.672)	B117		
	V106 (13.7795,124.672)	B118		
	V107 (13.4514,124.672)	B119		
	V96 (12.1391,124.672)	B99		
	V95 (12.1391,124.672)	B115		
S14*	V26 (59.0551,111.549)	B28	3.28084 / 3.28084	Concrete
	V27 (59.0551,111.549)	B29		
	V28 (55.7743,111.549)	B30		
	V29 (55.7743,111.549)	B31		
	V30 (59.0551,111.549)	B32		
	V31 (59.0551,111.549)	B120		
S15*	V31 (59.0551,111.549)	B33	3.28084 / 3.28084	Concrete
	V32 (59.0551,108.268)	B34		
	V33 (59.0551,108.268)	B35		
	V34 (59.0551,108.268)	B36		
	V35 (59.0551,108.268)	B37		
	V36 (59.0551,111.549)	B38		
	V37 (62.336,111.549)	B39		
	V38 (62.336,108.268)	B40		
	V39 (62.336,108.268)	B41		
	V21 (62.336,108.268)	B23		
	V22 (62.336,108.268)	B24		
	V23 (62.336,111.549)	B25		
	V24 (59.0551,111.549)	B26		
	V25 (59.0551,111.549)	B27		
	V26 (59.0551,111.549)	B120		
S17*	V110 (23.622,121.391)	B90	3.28084 / 3.28084	Concrete
	V86 (23.622,121.391)	B109		
	V101 (23.294,121.391)	B110		
	V102 (22.6378,124.672)	B121		
	V108 (22.6378,121.391)	B122		
	V109 (23.294,121.391)	B123		
S18*	V110 (23.622,121.391)	B125	3.28084 / 3.28084	Silty Sand with Gravel
	V87 (23.622,118.11)	B91		
	V88 (24.9344,118.11)	B92		
	V89 (24.9344,121.391)	B93		
	V90 (23.9501,121.391)	B94		
	V91 (23.9501,121.391)	B95		
	V92 (27.8871,121.391)	B96		
	V93 (27.8871,121.391)	B97		
	V94 (26.9029,121.391)	B98		
	V80 (26.9029,118.11)	B84		
	V81 (28.5433,118.11)	B85		
	V82 (28.5433,121.391)	B108		
	V78 (32.8084,118.11)	B82		

	V79 (32.8084,118.11)	B83		
	V76 (32.8084,118.11)	B79		
	V67 (32.8084,118.11)	B70		
	V68 (32.8084,114.829)	B71		
	V69 (36.0892,114.829)	B72		
	V70 (36.0892,118.11)	B73		
	V71 (36.0892,118.11)	B74		
	V72 (36.0892,118.11)	B75		
	V73 (39.3701,118.11)	B76		
	V74 (39.3701,118.11)	B77		
	V75 (39.3701,118.11)	B78		
	V60 (39.3701,114.829)	B63		
	V61 (39.3701,114.829)	B64		
	V62 (39.3701,118.11)	B107		
	V58 (45.9318,114.829)	B61		
	V59 (45.9318,114.829)	B62		
	V56 (45.9318,114.829)	B58		
	V47 (45.9318,114.829)	B49		
	V48 (45.9318,111.549)	B50		
	V49 (45.9318,111.549)	B51		
	V50 (45.9318,114.829)	B52		
	V51 (45.9318,114.829)	B53		
	V52 (45.9318,114.829)	B54		
	V53 (49.2126,114.829)	B55		
	V54 (49.2126,111.549)	B56		
	V55 (49.2126,111.549)	B57		
	V40 (49.2126,111.549)	B42		
	V41 (49.2126,111.549)	B43		
	V42 (49.2126,114.829)	B106		
	V28 (55.7743,111.549)	B30		
	V29 (55.7743,111.549)	B31		
	V30 (59.0551,111.549)	B32		
	V31 (59.0551,111.549)	B33		
	V32 (59.0551,108.268)	B34		
	V33 (59.0551,108.268)	B35		
	V34 (59.0551,108.268)	B36		
	V35 (59.0551,108.268)	B37		
	V36 (59.0551,111.549)	B38		
	V37 (62.336,111.549)	B39		
	V38 (62.336,108.268)	B40		
	V39 (62.336,108.268)	B41		
	V21 (62.336,108.268)	B23		
	V22 (62.336,108.268)	B24		
	V23 (62.336,111.549)	B105		
	V12 (65.6168,108.268)	B15		
	V15 (75.4593,108.268)	B104		
	V100 (75.4593,98.4252)	B103		
	V99 (4.26509,98.4252)	B116		
	V98 (4.26509,124.672)	B129		
	V113 (9.84252,124.672)	B131		
	V114 (11.1549,124.672)	B102		
	V95 (12.1391,124.672)	B115		
	V105 (12.1391,124.672)	B114		
	V104 (14.1076,124.672)	B113		
	V2 (14.1076,124.672)	B2		
	V3 (19.0289,124.672)	B3		
	V4 (19.0289,124.672)	B112		
	V103 (20.0131,124.672)	B111		
	V102 (22.6378,124.672)	B121		
	V108 (22.6378,121.391)	B122		
	V109 (23.294,121.391)	B123		
S112*	V111 (9.84252,124.672)	B126	3.28084 / 3.28084	Concrete
	V97 (4.26509,124.672)	B101		
	V98 (4.26509,124.672)	B129		
	V113 (9.84252,124.672)	B128		
S114*	V114 (11.1549,124.672)	B102	3.28084 / 3.28084	Concrete

	V95 (12.1391,124.672) V96 (12.1391,124.672) V112 (11.1549,124.672)	B99 B100 B130		
S115*	V112 (11.1549,124.672) V111 (9.84252,124.672) V113 (9.84252,124.672) V114 (11.1549,124.672)	B127 B128 B131 B130	3.28084 / 3.28084	Concrete

** Loaded solid (self weight).*

Water Table

(all distances in ft)

Water Table Status	Vertices (x, y)
Enabled	(No water table points defined)

Water Regimes

(potentials in ft, pressures in psf (lb/ft²))

(No water regime defined)

Materials

(unit weights (weight densities) in pcf (lb/ft³), strengths in psf (lb/ft²), angles in degrees, datum level in ft, undrained strength gradient in psf (lb/ft²)/ft)

Mohr-Coulomb Material(s)

Key	Name	Unit Weight (Saturated Unit Weight)	Drainage Behaviour	c' (ϕ')	c_u (datum) (gradient) (grid)
●	Concrete	146.415 (146.415)	Always undrained	0 (0)	208854* (0*) (0*) (-)
●	Frictionless	0 (0)	Always drained	0* (0*)	0 (0) (0) (-)
●	Silty Sand with Gravel	120 (130)	Drained/undrained	184* (34.1*)	0 (0) (0) (-)

**Property used in Scenario 1 (described in this report).*

Partial Factors

Factor	User*			
Unfavourable: permanent	1			
Unfavourable: variable	1			
Unfavourable: accidental	1			
Favourable: permanent	1			
Favourable: variable	1			
Favourable: accidental	1			

c'	1			
tanϕ'	1			
c_u	1			

**These partial factors were used in Scenario 1 (described in this report).*

Loads

(normal and shear loads in psf (lb/ft^2))

Boundary Objects

Loaded Object	Type	Loading Type	Adequacy?	Normal	Shear
B6	Permanent Load	neutral	false	499.999	0
B25	Permanent Load	neutral	false	499.999	0
B44	Permanent Load	neutral	false	499.999	0
B65	Permanent Load	neutral	false	499.999	0
B86	Permanent Load	neutral	false	499.999	0
B127	Variable Load	neutral	true	2000	0

Solid Objects

Loaded Object	Type	Loading Type	Adequacy?
S1	Permanent (unfactored self weight: 146.415 pcf (lb/ft^3))	neutral	true
S6	Permanent (unfactored self weight: 146.415 pcf (lb/ft^3))	neutral	true
S7	Permanent (unfactored self weight: 146.415 pcf (lb/ft^3))	neutral	true
S8	Permanent (unfactored self weight: 146.415 pcf (lb/ft^3))	neutral	true
S9	Permanent (unfactored self weight: 146.415 pcf (lb/ft^3))	neutral	true
S10	Permanent (unfactored self weight: 146.415 pcf (lb/ft^3))	neutral	true
S13	Permanent (unfactored self weight: 146.415 pcf (lb/ft^3))	neutral	true
S14	Permanent (unfactored self weight: 146.415 pcf (lb/ft^3))	neutral	true
S15	Permanent (unfactored self weight: 146.415 pcf (lb/ft^3))	neutral	true
S17	Permanent (unfactored self weight: 146.415 pcf (lb/ft^3))	neutral	true
S18	Permanent (unfactored self weight: 120 pcf (lb/ft^3))	neutral	true
S112	Permanent (unfactored self weight: 146.415 pcf (lb/ft^3))	neutral	true
S114	Permanent (unfactored self weight: 146.415 pcf (lb/ft^3))	neutral	true
S115	Permanent (unfactored self weight: 146.415 pcf (lb/ft^3))	neutral	true

This report was generated by LimitState:GEO3.5.g.24265 - limitstate.com

About this Report

This report has been generated using LimitState:GEO, a software application capable of directly identifying the critical collapse mechanism for a wide variety of geotechnical stability problems, including those involving slopes, retaining walls, footings etc.

The software utilizes the Discontinuity Layout Optimization (DLO) procedure to obtain a solution (Smith and Gilbert 2007). The main steps involved are: (i) distribution of nodes across the problem domain; (ii) connection of every node to every other node with potential discontinuities (e.g. slip-lines); (iii) application of rigorous optimization techniques to identify the critical subset of potential discontinuities, and hence also the critical failure mechanism and margin of safety.

The accuracy of the DLO solution is controlled by the specified nodal density. Within the set of all possible discontinuities linking pairs of nodes, all potential translational failure mechanisms are considered, whether anticipated or not by the engineer. Failure mechanisms involving rotations along the edges of solid bodies in the problem can also be identified. Thus in this case the solution identified by the DLO procedure is guaranteed to be the most critical solution for the problem posed. This means that there is no need to prescribe any aspect of the collapse mechanism prior to an analysis, or to separately consider different failure modes. The critical mechanism and collapse load factor are determined according to the well established upper bound theorem of plasticity.

LimitState:GEO reports the solution to a problem both visually as a collapse mechanism and numerically in terms of an Adequacy Factor, which is defined as the factor by which specified loads must be increased, or material strengths decreased, in order for the system under consideration to reach a collapse state.

REFERENCE

Smith, C.C. and Gilbert, M. (2007) Application of discontinuity layout optimization to plane plasticity problems, Proceedings of the Royal Society A: Mathematical, Physical and Engineering Sciences, Vol. 463, 2086, pp 2461-2484.

Summary

Name	Date of Analysis	Name of Engineer	Organization
Access Ramp Stability Analysis	Mon Oct 5 2020	HMN	GeoMat Testing Laboratories, Inc.

Reference #	Location	Map Reference	Tags
Project No. 20229-01	Kimbark Elementary School, San Bernardino, CA	Access Ramp	

Comments
Seismic Condition

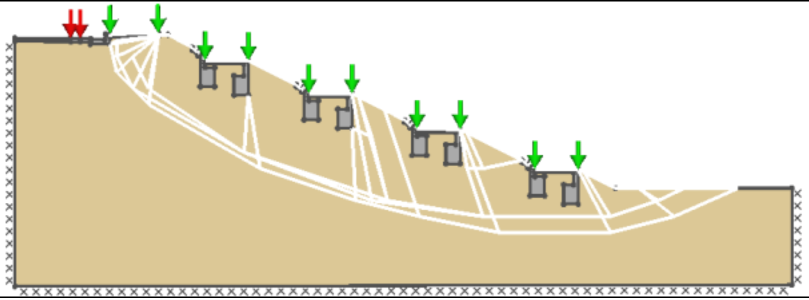
Target Nodal Density	Nodal Spacing Scale Factor	Water	Model Translational Failures?	Model Rotational Failures?	Seismic Accelerations: Horiz. / Vert. (g)
Fine (1000 nodes)	1.98166	Enabled	True	Along edges	-0.473* / 0*

**Adequacy factor applied to seismic acceleration component.*

Scenario	Partial Factor Set	Short / Long Term?**	Analysis Type	Adequacy Factor
1*	**User**	**Long Term**	**Factor Strength(s)**	**1.387**

**This report provides details of this scenario, which has been identified as the most critical.*

***For Mohr Coulomb materials with Drainage Behaviour specified as 'drained/undrained', undrained properties are used in a short term analysis, and drained properties are used in a long term analysis.*

Failure Mechanism (Scenario 1)


Analysis Options

Factor Strength(s)

Solution Tolerance (%)	Automatic Adequacy on Load(s)	Factor on Load(s)	Artificial Cohesion (kN/m² (kPa))
1	True	1	0.1

Geometry

(all distances in ft)

All Geometrical Objects

No. of Vertices (V)	No. of Boundaries (B)	No. of Solids (S)
101	114	14

Boundary Objects

ID	Start Vertex ID (x, y)	End Vertex ID (x, y)	Baseline Nodal Spacing	Support Type	Material(s)
B1	V1 (14.1076, 124.672)	V2 (14.1076, 124.672)	1.64042	Free	Frictionless
B2	V2 (14.1076, 124.672)	V3 (19.0289, 124.672)	1.64042	Free	-
B3	V3 (19.0289, 124.672)	V4 (19.0289, 124.672)	1.64042	Free	-
B4	V4 (19.0289, 124.672)	V6 (19.0289, 124.672)	1.64042	Free	-
B6*	V1 (14.1076, 124.672)	V6 (19.0289, 124.672)	1.64042	Free	-
B15	V12 (65.6168, 108.268)	V15 (85.3018, 108.268)	1.64042	Free	-
B23	V21 (62.336, 108.268)	V22 (62.336, 108.268)	1.64042	Free	-
B24	V22 (62.336, 108.268)	V23 (62.336, 111.549)	1.64042	Free	-
B25*	V23 (62.336, 111.549)	V24 (59.0551, 111.549)	1.64042	Free	-

B26	V24 (59.0551, 111.549)	V25 (59.0551, 111.549)	1.64042	Free	-
B27	V25 (59.0551, 111.549)	V26 (59.0551, 111.549)	1.64042	Free	-
B28	V26 (59.0551, 111.549)	V27 (59.0551, 111.549)	1.64042	Free	-
B29	V27 (59.0551, 111.549)	V28 (55.7743, 111.549)	1.64042	Free	-
B30	V28 (55.7743, 111.549)	V29 (55.7743, 111.549)	1.64042	Free	-
B31	V29 (55.7743, 111.549)	V30 (59.0551, 111.549)	1.64042	Free	-
B32	V30 (59.0551, 111.549)	V31 (59.0551, 111.549)	1.64042	Free	-
B33	V31 (59.0551, 111.549)	V32 (59.0551, 108.268)	1.64042	Free	-
B34	V32 (59.0551, 108.268)	V33 (59.0551, 108.268)	1.64042	Free	-
B35	V33 (59.0551, 108.268)	V34 (59.0551, 108.268)	1.64042	Free	-
B36	V34 (59.0551, 108.268)	V35 (59.0551, 108.268)	1.64042	Free	-
B37	V35 (59.0551, 108.268)	V36 (59.0551, 111.549)	1.64042	Free	-
B38	V36 (59.0551, 111.549)	V37 (62.336, 111.549)	1.64042	Free	-
B39	V37 (62.336, 111.549)	V38 (62.336, 108.268)	1.64042	Free	-
B40	V38 (62.336, 108.268)	V39 (62.336, 108.268)	1.64042	Free	-
B41	V21 (62.336, 108.268)	V39 (62.336, 108.268)	1.64042	Free	-
B42	V40 (49.2126, 111.549)	V41 (49.2126, 111.549)	1.64042	Free	-
B43	V41 (49.2126, 111.549)	V42 (49.2126, 114.829)	1.64042	Free	-
B44*	V42 (49.2126, 114.829)	V43 (45.9318, 114.829)	1.64042	Free	-
B45	V43 (45.9318, 114.829)	V44 (45.9318, 114.829)	1.64042	Free	-
B46	V44 (45.9318, 114.829)	V45 (45.9318, 114.829)	1.64042	Free	-
B47	V45 (45.9318, 114.829)	V46 (45.9318, 114.829)	1.64042	Free	-
B48	V46 (45.9318, 114.829)	V47 (45.9318, 114.829)	1.64042	Free	-
B49	V47 (45.9318, 114.829)	V48 (45.9318, 111.549)	1.64042	Free	-
B50	V48 (45.9318, 111.549)	V49 (45.9318, 111.549)	1.64042	Free	-
B51	V49 (45.9318, 111.549)	V50 (45.9318, 114.829)	1.64042	Free	-
B52	V50 (45.9318, 114.829)	V51 (45.9318, 114.829)	1.64042	Free	-
B53	V51 (45.9318, 114.829)	V52 (45.9318, 114.829)	1.64042	Free	-
B54	V52 (45.9318, 114.829)	V53 (49.2126, 114.829)	1.64042	Free	-
B55	V53 (49.2126, 114.829)	V54 (49.2126, 111.549)	1.64042	Free	-
B56	V54 (49.2126, 111.549)	V55 (49.2126, 111.549)	1.64042	Free	-
B57	V40 (49.2126, 111.549)	V55 (49.2126, 111.549)	1.64042	Free	-
B58	V56 (45.9318, 114.829)	V47 (45.9318, 114.829)	1.64042	Free	-

B59	V46 (45.9318, 114.829)	V57 (45.9318, 114.829)	1.64042	Free	-
B60	V57 (45.9318, 114.829)	V58 (45.9318, 114.829)	1.64042	Free	-
B61	V58 (45.9318, 114.829)	V59 (45.9318, 114.829)	1.64042	Free	-
B62	V56 (45.9318, 114.829)	V59 (45.9318, 114.829)	1.64042	Free	-
B63	V60 (39.3701, 114.829)	V61 (39.3701, 114.829)	1.64042	Free	-
B64	V61 (39.3701, 114.829)	V62 (39.3701, 118.11)	1.64042	Free	-
B65*	V62 (39.3701, 118.11)	V63 (36.0892, 118.11)	1.64042	Free	-
B66	V63 (36.0892, 118.11)	V64 (36.0892, 118.11)	1.64042	Free	-
B67	V64 (36.0892, 118.11)	V65 (32.8084, 118.11)	1.64042	Free	-
B68	V65 (32.8084, 118.11)	V66 (32.8084, 118.11)	1.64042	Free	-
B69	V66 (32.8084, 118.11)	V67 (32.8084, 118.11)	1.64042	Free	-
B70	V67 (32.8084, 118.11)	V68 (32.8084, 114.829)	1.64042	Free	-
B71	V68 (32.8084, 114.829)	V69 (36.0892, 114.829)	1.64042	Free	-
B72	V69 (36.0892, 114.829)	V70 (36.0892, 118.11)	1.64042	Free	-
B73	V70 (36.0892, 118.11)	V71 (36.0892, 118.11)	1.64042	Free	-
B74	V71 (36.0892, 118.11)	V72 (36.0892, 118.11)	1.64042	Free	-
B75	V72 (36.0892, 118.11)	V73 (39.3701, 118.11)	1.64042	Free	-
B76	V73 (39.3701, 118.11)	V74 (39.3701, 118.11)	1.64042	Free	-
B77	V74 (39.3701, 118.11)	V75 (39.3701, 118.11)	1.64042	Free	-
B78	V60 (39.3701, 114.829)	V75 (39.3701, 118.11)	1.64042	Free	-
B79	V76 (32.8084, 118.11)	V67 (32.8084, 118.11)	1.64042	Free	-
B80	V66 (32.8084, 118.11)	V77 (32.8084, 118.11)	1.64042	Free	-
B81	V77 (32.8084, 118.11)	V78 (32.8084, 118.11)	1.64042	Free	-
B82	V78 (32.8084, 118.11)	V79 (32.8084, 118.11)	1.64042	Free	-
B83	V76 (32.8084, 118.11)	V79 (32.8084, 118.11)	1.64042	Free	-
B84	V80 (26.9029, 118.11)	V81 (28.5433, 118.11)	1.64042	Free	-
B85	V81 (28.5433, 118.11)	V82 (28.5433, 121.391)	1.64042	Free	-
B86*	V82 (28.5433, 121.391)	V83 (23.9501, 121.391)	1.64042	Free	-
B87	V83 (23.9501, 121.391)	V84 (23.9501, 121.391)	1.64042	Free	-
B88	V84 (23.9501, 121.391)	V85 (23.622, 121.391)	1.64042	Free	-
B89	V85 (23.622, 121.391)	V86 (23.622, 121.391)	1.64042	Free	-
B90	V86 (23.622, 121.391)	V110 (23.622, 121.391)	1.64042	Free	-
B91	V87 (23.622, 118.11)	V88 (24.9344, 118.11)	1.64042	Free	-
B92	V88 (24.9344, 118.11)	V89 (24.9344, 121.391)	1.64042	Free	-
B93	V89 (24.9344, 121.391)	V90 (23.9501, 121.391)	1.64042	Free	-

B94	V90 (23.9501, 121.391)	V91 (23.9501, 121.391)	1.64042	Free	-
B95	V91 (23.9501, 121.391)	V92 (27.8871, 121.391)	1.64042	Free	-
B96	V92 (27.8871, 121.391)	V93 (27.8871, 121.391)	1.64042	Free	-
B97	V93 (27.8871, 121.391)	V94 (26.9029, 121.391)	1.64042	Free	-
B98	V80 (26.9029, 118.11)	V94 (26.9029, 121.391)	1.64042	Free	-
B99	V95 (12.1391, 124.672)	V96 (12.1391, 124.672)	1.64042	Free	Frictionless
B100	V96 (12.1391, 124.672)	V112 (11.1549, 124.672)	1.64042	Free	-
B101	V97 (4.26509, 124.672)	V98 (4.26509, 124.672)	1.64042	Fixed	-
B102	V95 (12.1391, 124.672)	V114 (11.1549, 124.672)	1.64042	Free	-
B103	V99 (4.26509, 98.4252)	V100 (85.3018, 98.4252)	1.64042	Fixed	-
B104	V100 (85.3018, 98.4252)	V15 (85.3018, 108.268)	1.64042	Fixed	-
B105	V12 (65.6168, 108.268)	V23 (62.336, 111.549)	1.64042	Free	-
B106	V28 (55.7743, 111.549)	V42 (49.2126, 114.829)	1.64042	Free	-
B107	V58 (45.9318, 114.829)	V62 (39.3701, 118.11)	1.64042	Free	-
B108	V78 (32.8084, 118.11)	V82 (28.5433, 121.391)	1.64042	Free	-
B109	V86 (23.622, 121.391)	V101 (23.294, 121.391)	1.64042	Free	-
B110	V101 (23.294, 121.391)	V102 (22.6378, 124.672)	1.64042	Free	-
B111	V102 (22.6378, 124.672)	V103 (20.0131, 124.672)	1.64042	Free	-
B112	V103 (20.0131, 124.672)	V4 (19.0289, 124.672)	1.64042	Free	-
B113	V2 (14.1076, 124.672)	V104 (14.1076, 124.672)	1.64042	Free	-
B114	V104 (14.1076, 124.672)	V105 (12.1391, 124.672)	1.64042	Free	-
B115	V105 (12.1391, 124.672)	V95 (12.1391, 124.672)	1.64042	Free	-
B116	V99 (4.26509, 98.4252)	V98 (4.26509, 124.672)	1.64042	Fixed	-
B117	V1 (14.1076, 124.672)	V106 (13.7795, 124.672)	1.64042	Free	-
B118	V106 (13.7795, 124.672)	V107 (13.4514, 124.672)	1.64042	Free	-
B119	V107 (13.4514, 124.672)	V96 (12.1391, 124.672)	1.64042	Free	-
B120	V31 (59.0551, 111.549)	V26 (59.0551, 111.549)	1.64042	Free	-
B121	V102 (22.6378, 124.672)	V108 (22.6378, 121.391)	1.64042	Free	-
B122	V108 (22.6378, 121.391)	V109 (23.294, 121.391)	1.64042	Free	-
B123	V109 (23.294, 121.391)	V110 (23.622, 121.391)	1.64042	Free	-
B125	V110 (23.622, 121.391)	V87 (23.622, 118.11)	1.64042	Free	-
B126	V111 (9.84252, 124.672)	V97 (4.26509, 124.672)	1.64042	Free	-

B127*	V112 (11.1549, 124.672)	V111 (9.84252, 124.672)	1.64042	Free	-
B128	V111 (9.84252, 124.672)	V113 (9.84252, 124.672)	1.64042	Free	Frictionless
B129	V113 (9.84252, 124.672)	V98 (4.26509, 124.672)	1.64042	Free	-
B130	V112 (11.1549, 124.672)	V114 (11.1549, 124.672)	1.64042	Free	Frictionless
B131	V114 (11.1549, 124.672)	V113 (9.84252, 124.672)	1.64042	Free	-

** Loaded boundary.*

Solid Objects

ID	Vertex IDs (x, y)	Boundary IDs	Baseline Nodal Spacing (x / y)	Material(s)/Water Regime(s)
S1*	V1 (14.1076,124.672) V2 (14.1076,124.672) V3 (19.0289,124.672) V4 (19.0289,124.672) V6 (19.0289,124.672)	B1 B2 B3 B4 B6	3.28084 / 3.28084	Concrete
S6*	V40 (49.2126,111.549) V41 (49.2126,111.549) V42 (49.2126,114.829) V43 (45.9318,114.829) V44 (45.9318,114.829) V45 (45.9318,114.829) V46 (45.9318,114.829) V47 (45.9318,114.829) V48 (45.9318,111.549) V49 (45.9318,111.549) V50 (45.9318,114.829) V51 (45.9318,114.829) V52 (45.9318,114.829) V53 (49.2126,114.829) V54 (49.2126,111.549) V55 (49.2126,111.549)	B42 B43 B44 B45 B46 B47 B48 B49 B50 B51 B52 B53 B54 B55 B56 B57	3.28084 / 3.28084	Concrete
S7*	V56 (45.9318,114.829) V47 (45.9318,114.829) V46 (45.9318,114.829) V57 (45.9318,114.829) V58 (45.9318,114.829) V59 (45.9318,114.829)	B58 B48 B59 B60 B61 B62	3.28084 / 3.28084	Concrete
S8*	V60 (39.3701,114.829) V61 (39.3701,114.829) V62 (39.3701,118.11) V63 (36.0892,118.11) V64 (36.0892,118.11) V65 (32.8084,118.11) V66 (32.8084,118.11) V67 (32.8084,118.11) V68 (32.8084,114.829) V69 (36.0892,114.829) V70 (36.0892,118.11) V71 (36.0892,118.11) V72 (36.0892,118.11) V73 (39.3701,118.11) V74 (39.3701,118.11) V75 (39.3701,118.11)	B63 B64 B65 B66 B67 B68 B69 B70 B71 B72 B73 B74 B75 B76 B77 B78	3.28084 / 3.28084	Concrete
S9*	V76 (32.8084,118.11) V67 (32.8084,118.11) V66 (32.8084,118.11) V77 (32.8084,118.11) V78 (32.8084,118.11)	B79 B69 B80 B81 B82	3.28084 / 3.28084	Concrete

	V79 (32.8084,118.11)	B83		
S10*	V80 (26.9029,118.11)	B84	3.28084 / 3.28084	Concrete
	V81 (28.5433,118.11)	B85		
	V82 (28.5433,121.391)	B86		
	V83 (23.9501,121.391)	B87		
	V84 (23.9501,121.391)	B88		
	V85 (23.622,121.391)	B89		
	V86 (23.622,121.391)	B90		
	V110 (23.622,121.391)	B125		
	V87 (23.622,118.11)	B91		
	V88 (24.9344,118.11)	B92		
	V89 (24.9344,121.391)	B93		
	V90 (23.9501,121.391)	B94		
	V91 (23.9501,121.391)	B95		
	V92 (27.8871,121.391)	B96		
	V93 (27.8871,121.391)	B97		
	V94 (26.9029,121.391)	B98		
S13*	V105 (12.1391,124.672)	B114	3.28084 / 3.28084	Concrete
	V104 (14.1076,124.672)	B113		
	V2 (14.1076,124.672)	B1		
	V1 (14.1076,124.672)	B117		
	V106 (13.7795,124.672)	B118		
	V107 (13.4514,124.672)	B119		
	V96 (12.1391,124.672)	B99		
	V95 (12.1391,124.672)	B115		
S14*	V26 (59.0551,111.549)	B28	3.28084 / 3.28084	Concrete
	V27 (59.0551,111.549)	B29		
	V28 (55.7743,111.549)	B30		
	V29 (55.7743,111.549)	B31		
	V30 (59.0551,111.549)	B32		
	V31 (59.0551,111.549)	B120		
S15*	V31 (59.0551,111.549)	B33	3.28084 / 3.28084	Concrete
	V32 (59.0551,108.268)	B34		
	V33 (59.0551,108.268)	B35		
	V34 (59.0551,108.268)	B36		
	V35 (59.0551,108.268)	B37		
	V36 (59.0551,111.549)	B38		
	V37 (62.336,111.549)	B39		
	V38 (62.336,108.268)	B40		
	V39 (62.336,108.268)	B41		
	V21 (62.336,108.268)	B23		
	V22 (62.336,108.268)	B24		
	V23 (62.336,111.549)	B25		
	V24 (59.0551,111.549)	B26		
	V25 (59.0551,111.549)	B27		
	V26 (59.0551,111.549)	B120		
S17*	V110 (23.622,121.391)	B90	3.28084 / 3.28084	Concrete
	V86 (23.622,121.391)	B109		
	V101 (23.294,121.391)	B110		
	V102 (22.6378,124.672)	B121		
	V108 (22.6378,121.391)	B122		
	V109 (23.294,121.391)	B123		
S18*	V110 (23.622,121.391)	B125	3.28084 / 3.28084	Silty Sand with Gravel
	V87 (23.622,118.11)	B91		
	V88 (24.9344,118.11)	B92		
	V89 (24.9344,121.391)	B93		
	V90 (23.9501,121.391)	B94		
	V91 (23.9501,121.391)	B95		
	V92 (27.8871,121.391)	B96		
	V93 (27.8871,121.391)	B97		
	V94 (26.9029,121.391)	B98		
	V80 (26.9029,118.11)	B84		
	V81 (28.5433,118.11)	B85		
	V82 (28.5433,121.391)	B108		
	V78 (32.8084,118.11)	B82		

	V79 (32.8084,118.11)	B83		
	V76 (32.8084,118.11)	B79		
	V67 (32.8084,118.11)	B70		
	V68 (32.8084,114.829)	B71		
	V69 (36.0892,114.829)	B72		
	V70 (36.0892,118.11)	B73		
	V71 (36.0892,118.11)	B74		
	V72 (36.0892,118.11)	B75		
	V73 (39.3701,118.11)	B76		
	V74 (39.3701,118.11)	B77		
	V75 (39.3701,118.11)	B78		
	V60 (39.3701,114.829)	B63		
	V61 (39.3701,114.829)	B64		
	V62 (39.3701,118.11)	B107		
	V58 (45.9318,114.829)	B61		
	V59 (45.9318,114.829)	B62		
	V56 (45.9318,114.829)	B58		
	V47 (45.9318,114.829)	B49		
	V48 (45.9318,111.549)	B50		
	V49 (45.9318,111.549)	B51		
	V50 (45.9318,114.829)	B52		
	V51 (45.9318,114.829)	B53		
	V52 (45.9318,114.829)	B54		
	V53 (49.2126,114.829)	B55		
	V54 (49.2126,111.549)	B56		
	V55 (49.2126,111.549)	B57		
	V40 (49.2126,111.549)	B42		
	V41 (49.2126,111.549)	B43		
	V42 (49.2126,114.829)	B106		
	V28 (55.7743,111.549)	B30		
	V29 (55.7743,111.549)	B31		
	V30 (59.0551,111.549)	B32		
	V31 (59.0551,111.549)	B33		
	V32 (59.0551,108.268)	B34		
	V33 (59.0551,108.268)	B35		
	V34 (59.0551,108.268)	B36		
	V35 (59.0551,108.268)	B37		
	V36 (59.0551,111.549)	B38		
	V37 (62.336,111.549)	B39		
	V38 (62.336,108.268)	B40		
	V39 (62.336,108.268)	B41		
	V21 (62.336,108.268)	B23		
	V22 (62.336,108.268)	B24		
	V23 (62.336,111.549)	B105		
	V12 (65.6168,108.268)	B15		
	V15 (85.3018,108.268)	B104		
	V100 (85.3018,98.4252)	B103		
	V99 (4.26509,98.4252)	B116		
	V98 (4.26509,124.672)	B129		
	V113 (9.84252,124.672)	B131		
	V114 (11.1549,124.672)	B102		
	V95 (12.1391,124.672)	B115		
	V105 (12.1391,124.672)	B114		
	V104 (14.1076,124.672)	B113		
	V2 (14.1076,124.672)	B2		
	V3 (19.0289,124.672)	B3		
	V4 (19.0289,124.672)	B112		
	V103 (20.0131,124.672)	B111		
	V102 (22.6378,124.672)	B121		
	V108 (22.6378,121.391)	B122		
	V109 (23.294,121.391)	B123		
S112*	V111 (9.84252,124.672)	B126	3.28084 / 3.28084	Concrete
	V97 (4.26509,124.672)	B101		
	V98 (4.26509,124.672)	B129		
	V113 (9.84252,124.672)	B128		
S114*	V114 (11.1549,124.672)	B102	3.28084 / 3.28084	Concrete

	V95 (12.1391,124.672) V96 (12.1391,124.672) V112 (11.1549,124.672)	B99 B100 B130		
S115*	V112 (11.1549,124.672) V111 (9.84252,124.672) V113 (9.84252,124.672) V114 (11.1549,124.672)	B127 B128 B131 B130	3.28084 / 3.28084	Concrete

** Loaded solid (self weight).*

Water Table

(all distances in ft)

Water Table Status	Vertices (x, y)
Enabled	(No water table points defined)

Water Regimes

(potentials in ft, pressures in psf (lb/ft²))

(No water regime defined)

Materials

(unit weights (weight densities) in pcf (lb/ft³), strengths in psf (lb/ft²), angles in degrees, datum level in ft, undrained strength gradient in psf (lb/ft²)/ft)

Mohr-Coulomb Material(s)

Key	Name	Unit Weight (Saturated Unit Weight)	Drainage Behaviour	c' (ϕ')	c_u (datum) (gradient) (grid)
●	Concrete	146.415 (146.415)	Always undrained	0 (0)	208854* (0*) (0*) (-)
●	Frictionless	0 (0)	Always drained	0* (0*)	0 (0) (0) (-)
●	Silty Sand with Gravel	120 (130)	Drained/undrained	184* (34.1*)	0 (0) (0) (-)

**Property used in Scenario 1 (described in this report).*

Partial Factors

Factor	User*			
Unfavourable: permanent	1			
Unfavourable: variable	1			
Unfavourable: accidental	1			
Favourable: permanent	1			
Favourable: variable	1			
Favourable: accidental	1			

c'	1			
tanϕ'	1			
c_u	1			

**These partial factors were used in Scenario 1 (described in this report).*

Loads

(normal and shear loads in psf (lb/ft²))

Boundary Objects

Loaded Object	Type	Loading Type	Adequacy?	Normal	Shear
B6	Permanent Load	neutral	false	499.999	0
B25	Permanent Load	neutral	false	499.999	0
B44	Permanent Load	neutral	false	499.999	0
B65	Permanent Load	neutral	false	499.999	0
B86	Permanent Load	neutral	false	499.999	0
B127	Variable Load	neutral	true	2000	0

Solid Objects

Loaded Object	Type	Loading Type	Adequacy?
S1	Permanent (unfactored self weight: 146.415 pcf (lb/ft³))	neutral	true
S6	Permanent (unfactored self weight: 146.415 pcf (lb/ft³))	neutral	true
S7	Permanent (unfactored self weight: 146.415 pcf (lb/ft³))	neutral	true
S8	Permanent (unfactored self weight: 146.415 pcf (lb/ft³))	neutral	true
S9	Permanent (unfactored self weight: 146.415 pcf (lb/ft³))	neutral	true
S10	Permanent (unfactored self weight: 146.415 pcf (lb/ft³))	neutral	true
S13	Permanent (unfactored self weight: 146.415 pcf (lb/ft³))	neutral	true
S14	Permanent (unfactored self weight: 146.415 pcf (lb/ft³))	neutral	true
S15	Permanent (unfactored self weight: 146.415 pcf (lb/ft³))	neutral	true
S17	Permanent (unfactored self weight: 146.415 pcf (lb/ft³))	neutral	true
S18	Permanent (unfactored self weight: 120 pcf (lb/ft³))	neutral	true
S112	Permanent (unfactored self weight: 146.415 pcf (lb/ft³))	neutral	true
S114	Permanent (unfactored self weight: 146.415 pcf (lb/ft³))	neutral	true
S115	Permanent (unfactored self weight: 146.415 pcf (lb/ft³))	neutral	true