December 14, 1971
W. O. 310-40

T. K. Lalakea, Ltd.
745 Fort Street, Suite 201
Honolulu, Hawaii 96813

Grading Permit No. 5379

Attention: Mr. Thomas K. Lalakea

Subject: Supplemental Recommendation to Foundation Investigation Report Proposed Apartment Complex Corner of Kuakini and Bachelot Streets Honolulu, Hawaii T.M.K. 1-7-15:6,15,21

Gentlemen:

At a conference recently held at your office regarding the subject project with the architect and structural engineer, it is desired to use a higher design bearing value for the proposed apartment buildings. The tolerable differential settlement is set at 1/4" with uniform total settlement of 1" per 15-foot span between bays.

The total settlement based on 200 kip column load and the various bearing value to be used are presented on Plate 1, Bearing Value Versus Settlement. This will enable the design consultants to
choose the bearing value desired with total settlement factor taken into consideration.

The following analyses are presented based on 1/4\" differential settlement and 1\" total uniform settlement per 15-foot span between bays. Our analysis shows that differential settlement between bays will not exceed 0.15 inch. The total settlement becomes the controlling factor which, in this case is limited to 1\" and are based on the proposed final grade.

**SPREAD FOOTINGS**

**Scheme 1**

A. Allowable net bearing value = 2000 psf

B. Footing shall be embedded at least 4 feet below natural ground surface.

**Scheme 2**

A. Allowable net bearing value = 2500 psf

B. Footings shall be embedded at least 5 feet below natural ground surface.

c. Except for Building No. 1, the given net bearing value shall apply. For Building No. 1, the allowable net bearing value
shall be 3000 psf for footings embedded at least 5 feet.

**Scheme 3**

A. Allowable net bearing value = 5000 psf

B. Footings shall be embedded at least 10 feet below natural ground surface.

All the other recommendations and precautions concerning expansive soil contained in our report remain applicable and unchanged.

Alternately, the following foundation type may be considered and may prove to be more economical.

**DRILLED CAST-IN-PLACE CONCRETE PILES**

1. For a 12-inch diameter drilled cast-in-place concrete piles carried 6 inches into the underlying basalt, a downward capacity of 100 kips per pile may be developed. This assumes both frictional resistance and point-bearing value for a 15-foot pile.

2. For a depth of embedment less than 15-foot length, the pile capacity will be reduced by a value of 4 kips per foot of pile length. Conversely, an increase of 4 kips per foot of pile length installed may be allowed.
3. The above values shall be used in considering total dead plus live loads; a 50% increase may be used when considering wind or seismic loads.

4. Piles in groups shall be spaced a minimum of 2½ diameters on centers and shall be drilled and filled alternately with concrete permitted to set at least 8 hours before drilling an adjacent hole.

5. The above values are based on the strength of the soils; the actual pile capacity may be limited to lower values by the strength of the piles.

6. Tip of piles shall bear on Basalt.

7. Upward pile capacity shall be equal to one-half the computed downward pile capacity.

8. Lateral loads may be resisted by the piles, by soil friction on the floor slabs, and by the passive resistance of the soils. For computing lateral resistance of drilled piles, any accepted pole formula may be used. When using the pole formula, an allowable lateral bearing value of 500 pounds per square foot per foot of depth, up to a maximum of 10,000 pounds per square foot may be used. A one-third increase may be used for wind or seismic
loads. The lateral capacity is based on the assumption that required backfill adjacent to pile caps and grade beams will be properly compacted.

9. The maximum ultimate settlement of the proposed structures, supported on drilled piling, will be about 1/4-inch.

10. To minimize the lateral flow of water from planters which are planned adjacent to concrete walkways and slabs, we suggest that planter walls extend 2½ feet below the adjacent grade (bottom of walkway or slab). With this depth of planter walls, we believe that impermeable bottoms within the planters may be omitted.

We trust the above satisfies your other requirements. Please do not hesitate to call if you have any questions.

Very truly yours,

GEOLABS-HAWAII, INC.

Stanley N. Mitchell, P.E.

Peter S. C. Chan
Vice President

Encl: Plate 1, Bearing Value Versus Settlement

xc. (4) Addressee
(1) ECOL Architects and Planners
  Attn: Mr. Frank Wynkoop
(1) Dimitrios Bratakos, Structural Engineer
  Attn: Mr. Jim Adams

GEOLABS-HAWAII, INC.
Max. Column Load = 200 k

5' x 5' FG.

6.5' x 6.5' FG.

10' x 10' FG.

BEARING VALUE (KSF)

0  5  10  15

SETTLEMENT (inches)
FOUNDATION INVESTIGATION
PROPOSED APARTMENT COMPLEX
CORNER OF KUAKINI AND BACHELOT STREETS
HONOLULU, HAWAII
W. O. 310-40 - NOVEMBER 24, 1971

GEOLABS-HAWAII, INC.
1553 COLBURN STREET, SUITE 203
HONOLULU, HAWAII 96817

MUNICIPAL REFERENCE & RECORDS CENTER
City & County of Honolulu
City Hall Annex, 558 S. King Street
Honolulu, Hawaii 96813
T. K. Lalakea, Ltd.
745 Fort Street, Suite 201
Honolulu, Hawaii 96813

Attention: Mr. Thomas K. Lalakea

Subject: Transmittal of Foundation Investigation Report
Proposed Apartment Complex
Corner of Kuakini and Bachelot Streets
Honolulu, Hawaii

Gentlemen:

Six copies of our report "Foundation Investigation Report, Proposed Apartment Complex, Corner of Kuakini and Bachelot Streets, Honolulu, Hawaii" are enclosed.

The investigation was requested by and coordinated with Mr. Thomas K. Lalakea of T. K. Lalakea, Ltd. This report presents the results of our field exploration, laboratory testing, and conclusions and recommendations pertaining to development of the proposed apartment complex.

Based upon our investigation, the site may be developed for the intended use, provided the recommendations contained in the attached report are included in the design and construction stages of development.

We sincerely appreciate the opportunity to be of service, and if you have any questions pertaining to the report, please call.

Very truly yours,
GEOLABS-HAWAII, INC.

Peter S. C. Chan
Vice President
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<tr>
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<td>11</td>
</tr>
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GEOLABS-HAWAII, INC.
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REPORT ON FOUNDATION INVESTIGATION
PROPOSED APARTMENT COMPLEX
CORNER OF KUAKINI AND BACHELOT STREETS
HONOLULU, HAWAII
FOR T. K. LALAKEA LTD.
W. O. 310-40
NOVEMBER 24, 1971

INTRODUCTION

This report presents the results of a subsurface investigation conducted at the site of the proposed apartment complex located at the corner of Kuakini and Bachelot Streets in Oahu, Hawaii. This was conducted to determine the soils underlying the site, to ascertain their engineering properties, and to provide recommendations for the design and construction of the sub-structural elements of the proposed structures and other related facilities.

This investigation consisted of conducting five exploratory test borings and one shallow test pit, laboratory tests, engineering analyses and evaluation of both field and laboratory test results. Location of borings and test pit are shown on Plate 1, Site Plan.

STRUCTURAL CONSIDERATIONS

The apartment complex will consist of four individual buildings as shown on Plate 1, Site Plan. Information regarding the proposed apartment complex and the existing site conditions was furnished
by ECOL, Architects and by Dimitrios Bratakos, Structural Engineer. Column loads will be on the order of 200 kips and wall loads are on the order of 12 kips per lineal foot.

The planned final grades of various buildings range from Elevation 72 to 77. Based on the existing topography, cuts up to 3 feet and fill ranging from 1 to 4 feet will be made in order to obtain the desired final grades. The floor elevations of the various buildings are shown on Plates 1 through 3.

**SITE CONDITIONS**

The subject property covers an area of about 34,000 square feet. The natural ground surface slopes gradually to the south. Most areas not occupied by the existing residential houses are covered by grass or weeds. Some trees and shrubs are interspersed between the houses. Several piles of trash were noted. Contours showing the topography of the site are shown on Plate 1, Site Plan.

**FIELD EXPLORATION**

The site was explored on October 29 and November 2, 1971 by drilling five exploratory test borings and one shallow test pit. The test borings included conducting the standard penetration
test which allow recovery of soil samples, undisturbed sampling, and rotary core drilling. The standard penetration test was performed at five-foot intervals using a standard split-barrel sampler driven by a 140-lb. hammer freely falling from a height of 30 inches. At depths where less firm and cohesive layer was encountered, undisturbed samples were extracted using a 2.4" I.D. Sampler with 1-inch brass liners and driven with a 300-lb. hammer. Where rock was encountered, continuous cores were taken using a NX diamond core barrel. Logs of the test borings are shown on Plates 4 through 9.

Samples recovered from the test borings and shallow test pit were brought to the laboratory for testing to determine pertinent engineering properties. Testing consisted of performing natural moisture content tests, Atterberg limit tests, direct shear test, proctor, CBR tests, and consolidation tests. Field visual identifications were verified in the laboratory by plotting the results of the Atterberg limit tests in the plasticity chart. Final soil classification is based on the Unified Soil Classification System. Results of laboratory tests are found appended to this report.
SOIL CONDITIONS

The test borings reveal the presence of three distinct strata. The upper 6 to 14 feet consists of light brown, stiff to very stiff clay. Below this stratum, the clay is interlayered with lenses of hard basalt and its color becomes grayish with depth. This layer is about 10 feet thick. It is residual soil derived from its parent rock which is dark gray, relatively impervious, hard basalt. The bedrock gently slopes in the same direction as the natural ground surface. The clay soils are expansive.

Subsurface soil profiles are shown on Plates 2 and 3.

DISCUSSION

Laboratory tests performed on samples extracted from both clay strata indicate that the clay has adequate strength to support the proposed structures; however the upper clay soils exhibit undesirable swelling and shrinking properties. This fact is confirmed by the presence of wide and deep shrinkage cracks at the ground surface. The upper clay soils will require special treatment for foundation and slab support.

Ground water was not encountered in any of the borings.
The information obtained during our investigation indicates that the subject site is suited to the proposed construction insofar as the following recommendations are incorporated in the design considerations, project plans and job specifications.

Treatment of Existing Ground

1. Debris, vegetation, disturbed, uncompacted and soft soil and other deleterious materials should be removed from the proposed construction site. The soft soils are localized conditions along Kuakini Street under portion of Buildings 1 and 2.

2. Prior to placement of compacted fill in the building and paved areas, the existing soils should be scarified to a depth of six inches, watered as necessary, and be compacted to a minimum relative compaction of 90 percent of the laboratory maximum density.

3. The processed areas should be inspected and approved by the soils engineer prior to placing controlled compacted fill.
Fill Placement

1. Fill materials, consisting of soils approved by the soils engineer, shall be placed in controlled compacted layers with approved compaction equipment. The excavated onsite soils are considered satisfactory for reuse in the controlled fills.

2. All imported fill shall be examined and approved by the soils engineer prior to use in controlled fill areas.

3. All fill shall be compacted to a minimum relative compaction of 90 percent of the laboratory maximum density as determined by test ASTM D-1557-70.

4. Backfill behind retaining walls should be clean sand flooded into place if the space between the backcut and the wall is less than 18 inches. It should be compacted to 90% if the space is greater than 18 inches.

5. Inspection and field tests shall be carried on during grading by the soils engineer to assist the contractor in obtaining the required degree of compaction and the proper moisture content. Where compaction is less than required, additional compactive effort shall be made with adjustment of the moisture content.
as necessary until 90 percent compaction is obtained.

6. Our Standard Grading Specifications are attached in the Appendix and should be used during grading operations.

Excavation Stability

For Buildings 2 and 3, it will be necessary to excavate up to a depth of about 4 feet below existing grade to construct the walls. The borings indicate that the upper soils are sufficiently firm so that the temporary cuts may be made nearly vertical.

Care should be exercised such that water is not allowed to flow over the top of the cuts or that material stockpiles and equipment is allowed near the top of the slopes.

Foundations

1. Footings: Continuous wall footings and column spread footings should be founded at a minimum depth of 36 inches below the lowest adjacent grade or at least 1 foot into the medium to stiff clay, whichever is lower. The properly compacted fill may be considered as medium to stiff clay. All footings should be reinforced with two No. 4 reinforcing bars placed at the top and bottom of the footings.
2. **Floor Slabs:** Floor slabs should be reinforced with a minimum of 6 inch by 6 inch, No. 6 by No. 6 welded wire mesh over 4 inches of crushed rock. Slabs, other than the subterranean garage floor, which will be provided with a floor covering should be protected by a polyethylene plastic vapor barrier to minimize floor dampness. The moisture barrier should be covered with one inch of sand to prevent punctures and aid in concrete curing.

3. **Bearing Value:** An allowable net bearing value of 2500 lbs./sq. ft. may be used for design of continuous footings a minimum of 12 inches wide and 2000 lbs./sq.ft. for column spread footings a minimum of 12 inches square. These bearing values may be increased by 225 lbs./sq. ft. for each additional 12 inches of width, to a maximum of 3000 lbs./sq. ft.

The total bearing value may be increased by one-third when designing for short duration loadings such as seismic or wind.

4. **Settlement:** Most of the settlement of the foundation system is expected to occur during the construction phase and the maximum settlement is anticipated to be 1½ inch. Differential settlement is expected to be less than 3/4 inch.

5. **Lateral Pressure:** The active earth pressure to be utilized
for retaining wall design may be computed as an equivalent fluid having a density of 30 pounds per cubic foot when the slope of the backfill behind the wall is level. Weep holes should be provided behind the walls to prevent build up of hydrostatic pressure.

Passive earth pressure may be computed as an equivalent fluid having a density of 250 pounds per cubic foot, with a maximum earth pressure of 2000 pounds per square foot.

An allowable coefficient of friction between soil and concrete of 0.4 may be used with the dead load forces.

When combining passive pressure and frictional resistance, the passive pressure component should be reduced by one-third. For design of isolated poles, the allowable passive earth pressure may be increased by one hundred percent.

6. Paving: The following pavement sections are recommended:

<table>
<thead>
<tr>
<th>Traffic Loading</th>
<th>Pavement Thickness (inches)</th>
<th>Base Course Thickness (inches)</th>
<th>Sub-base Thickness (inches)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Light for Passenger Cars</td>
<td>2</td>
<td>4</td>
<td>12</td>
</tr>
<tr>
<td>Heavy for Truck Driveways (storage, etc.)</td>
<td>4</td>
<td>8</td>
<td>12</td>
</tr>
</tbody>
</table>
Positive drainage should be provided to increase the life of the paving. Due to the expansive nature of the soil, it is recommended a seal coat be applied to the paving.

7. **Inspection:** It is recommended that all footings and slab areas be inspected by the soils engineer prior to placing forms, concrete or steel. The excavations should be trimmed neat, level, and square and be free of sloughed soils at the time of inspection. Footing excavations should be kept moist and not allowed to dry and crack before placing concrete or steel.

**Expansive Soil**

The onsite natural soils are expansive and become highly expansive when recompacted. Special care and sufficient reinforcing steel should be provided to counteract the differential movement.

The following should be observed in the planning and construction stages of the development:

1. Garage slabs should be cast independently of the stem wall and a positive separation maintained with expansion joint material.

2. Planter bottoms should be provided in landscape areas to prevent infiltration of moisture. Positive drainage away from the buildings should be provided to prevent ponding of water.
adjacent to footings.

3. It is recommended all compacted fill be compacted at above optimum moisture content to reduce expansive potential of the compacted fill. The exposed surface should be kept moist, and watered as necessary so as not to allow the soils to dry up and crack before placing fill.

**Design Review**

The foundation plans for the structures (with footing loads indicated) should be forwarded to the soils engineer for review and comments prior to finalizing the design.

Additional analysis and/or subsurface investigation should be made where conditions different from the basic assumptions indicated herein are used or are encountered.

**INVESTIGATION LIMITATIONS**

The materials encountered on the project site are considered representative of the total area; however, soil materials may vary in characteristics between borings. Since our investigation is based on a fraction of the site materials, selective laboratory testing and analyses, the conclusions and recommendations are professional opinions. These opinions have been
derived in accordance with current standards of practice and a warranty is not expressed nor implied.

Respectfully submitted,
GEOLABS-HAWAII, INC.

Stanley N. Mitchell, P.E.

Peter S. C. Chan
Vice President

xc: (6) Addressee
APPENDIX A

SITE PLAN
Legend:
- B-1 Boring location and No.
- TP-1 Test Pit location and No.
- F.F.E. Finished Floor Elevation

References:
Plans (undated) by
ECOL Architecture, Planning
and Survey (dated 8-24-77)
by John Cline Mann.

SITE PLAN

PLATE 1
APPENDIX B

SUBSURFACE SOIL PROFILES
Elev. 80

**BLDG. 3**

**F.F.E. = 75**

Medium CLAY

**Stiff to very stiff, light brown CLAY**

**Very stiff, light gray CLAY with decomposed basalt**

**Hard, gray BASALT**

**SECTION A-A**

*Hor. scale: 1" = 40'*

---

Elev. 80

**BLDG. 2**

**F.F.E. = 72**

**Soft CLAY**

**Stiff to very stiff, light brown CLAY**

**Very stiff, light gray CLAY with decomposed basalt**

**Hard, gray BASALT**

**SECTION B-B**

*Hor. scale: 1" = 40'*
Stiff to very stiff, light brown CLAY

Very stiff, light gray CLAY
with decomposed basalt

Slight Boulders

SECTION C-C
Hor. scale: 1" = 40'

Hard, gray BASALT
APPENDIX C

UNIFIED SOIL CLASSIFICATION SYSTEM

LOGS OF BORINGS
## UNIFIED SOIL CLASSIFICATION SYSTEM

### MAJOR DIVISIONS

<table>
<thead>
<tr>
<th>MAJOR DIVISIONS</th>
<th>GROUP SYMBOLS</th>
<th>TYPICAL NAMES</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>COARSE GRAINED SOILS</strong> (More than 50% of coarse fraction is larger than No. 200 sieve size)</td>
<td><strong>GW</strong></td>
<td>Well graded gravels, gravel-sand mixtures, little or no fines</td>
</tr>
<tr>
<td></td>
<td><strong>GP</strong></td>
<td>Poorly graded gravels, gravel-sand mixtures, little or no fines</td>
</tr>
<tr>
<td></td>
<td><strong>GW</strong></td>
<td>Silty gravels, gravel-sand-silt mixtures</td>
</tr>
<tr>
<td></td>
<td><strong>GG</strong></td>
<td>Clayey gravels, gravel-sand-clay mixtures</td>
</tr>
<tr>
<td></td>
<td><strong>SM</strong></td>
<td>Silty sands, sand-silt mixtures</td>
</tr>
<tr>
<td></td>
<td><strong>SC</strong></td>
<td>Clayey sands, sand-clay mixtures</td>
</tr>
<tr>
<td><strong>SANDS</strong> (More than 50% of coarse fraction is smaller than No. 4 sieve size)</td>
<td><strong>SV</strong></td>
<td>Well graded sands, gravelly sands, little or no fines</td>
</tr>
<tr>
<td></td>
<td><strong>SP</strong></td>
<td>Poorly graded sands, gravelly sands, little or no fines</td>
</tr>
<tr>
<td></td>
<td><strong>SM</strong></td>
<td>Silty sands, sand-silt mixtures</td>
</tr>
<tr>
<td></td>
<td><strong>SC</strong></td>
<td>Clayey sands, sand-clay mixtures</td>
</tr>
<tr>
<td><strong>SILTS AND CLAYS</strong> (Liquid limit less than 50%)</td>
<td><strong>ML</strong></td>
<td>Inorganic silts &amp; very fine sands, not plasticity, fine silt or silty fine sands, clayey silts with slight plasticity</td>
</tr>
<tr>
<td></td>
<td><strong>CL</strong></td>
<td>Inorganic clays of low to medium plasticity, gravelly clays, silty clays, lean clays</td>
</tr>
<tr>
<td></td>
<td><strong>OL</strong></td>
<td>Organic silts &amp; organic silt-clays of low plasticity</td>
</tr>
<tr>
<td><strong>FINE GRAINED SOILS</strong> (More than 50% passing No. 200 sieve size)</td>
<td><strong>ML</strong></td>
<td>Inorganic silts,cursorial and diatomaceous fine sandy silty clays, silty clays</td>
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<tr>
<td></td>
<td><strong>CH</strong></td>
<td>Inorganic clay of high plasticity, fast clays</td>
</tr>
<tr>
<td></td>
<td><strong>P1</strong></td>
<td>Organic clays of medium to high plasticity, organic silts</td>
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### HIGHLY ORGANIC SOILS

### PARTICLE SIZE LIMITS

<table>
<thead>
<tr>
<th>PARTICLE SIZE LIMITS</th>
<th>GRAVEL</th>
<th>SAND</th>
<th>SILT</th>
<th>CLAY</th>
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<tr>
<td>Coarse Fine Grits Medium Fine</td>
<td>3/4 in.</td>
<td>No. 200</td>
<td>No. 200</td>
<td>.005 mm</td>
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**U.S. STANDARD SIEVE SIZE**

### GEOLABS-HAWAII, INC.

1553 COLBURN ST., HONOLULU, H.I. TEL. 815-064
**GEOLABS—HAWAII, INC.**

**BORING LOG**

**Drilling Date:** 10-29-71  \( \text{Driving Wt.} \) 140 lbs \( \text{Elevation} \) 77.6' *

**Job:** Apartment Complex \( \text{Drop} \) 30" \( \text{Work Order} \) 310-40

<table>
<thead>
<tr>
<th>Sample Depth ft</th>
<th>Blows per ft</th>
<th>Moisture Content %</th>
<th>Dry Unit Weightpcf</th>
<th>Depth in Feet</th>
<th>Graphic Log</th>
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</thead>
<tbody>
<tr>
<td>0</td>
<td></td>
<td>CH</td>
<td>Medium, dark brown, Silty CLAY with some rock fragments. Moist</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.0</td>
<td>6 18.8</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.0</td>
<td>14 58.8</td>
<td></td>
<td></td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>7.0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10.0</td>
<td>7** 53.0</td>
<td></td>
<td>Medium, mottled, gray and brown CLAY. Moist</td>
<td></td>
<td></td>
</tr>
<tr>
<td>12.0</td>
<td></td>
<td></td>
<td></td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>15.0</td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>16.5</td>
<td>22 28.3</td>
<td></td>
<td>Very stiff, gray, Silty CLAY with some decomposed, angular, basalt fragments. (Weathered Basalt)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>20.0</td>
<td></td>
<td></td>
<td></td>
<td>15</td>
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</tr>
<tr>
<td>20.1</td>
<td>50/1</td>
<td></td>
<td>Dark gray, Basalt.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Water not encountered. Bottom of Hole 20.5 Feet

*Elevations taken from map prepared by J.C. Mann.

**2.4" I.D. sampler driven with 300-lb hammer.**
# Boring Log

**Drilling Date:** 10-29-71  
**Driving Wt.:** 140 lbs  
**Elevation:** 75.7'  
**Job:** Apartment Complex  
**Drop:** 30''  
**Work Order:** 310-40

<table>
<thead>
<tr>
<th>Sample Depth</th>
<th>Blows per ft.</th>
<th>Moisture Content %</th>
<th>Dry Unit Weight (p.s.f.)</th>
<th>Depth in Feet</th>
<th>Graphic Log</th>
<th>Description</th>
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</thead>
<tbody>
<tr>
<td>2.0</td>
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<td></td>
<td></td>
<td>0</td>
<td></td>
<td>CH Stiff, dark brown CLAY.</td>
</tr>
<tr>
<td>4.0</td>
<td>6</td>
<td>47.3</td>
<td></td>
<td></td>
<td></td>
<td>CH Medium, light brown CLAY.</td>
</tr>
<tr>
<td>5.0</td>
<td></td>
<td></td>
<td></td>
<td>5</td>
<td></td>
<td>CH Stiff, mottled gray and brown CLAY.</td>
</tr>
<tr>
<td>6.0</td>
<td>14</td>
<td>46.5</td>
<td>77.6</td>
<td></td>
<td></td>
<td>CH Very stiff, light gray, CLAY with some angular, partially decomposed basalt.</td>
</tr>
<tr>
<td>10.0</td>
<td></td>
<td></td>
<td></td>
<td>10</td>
<td></td>
<td></td>
</tr>
<tr>
<td>11.5</td>
<td>42</td>
<td>34.3</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>15.0</td>
<td></td>
<td></td>
<td></td>
<td>15</td>
<td></td>
<td></td>
</tr>
<tr>
<td>16.5</td>
<td>30</td>
<td>37.6</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
**GEOLABS—HAWAII, INC.**

**BORING LOG 2 (cont.)**

**Drilling Date** 10-29-71  **Driving Wt.** 140 lbs  **Elevation** 75.7' *

**Job** Apartment Complex  **Drop** 30''  **Work Order** 310-40

<table>
<thead>
<tr>
<th>Sample Depth ft.</th>
<th>Blows per ft.</th>
<th>Moisture Content%</th>
<th>Dry Unit Weight per ft.</th>
<th>Depth in feet</th>
<th>Graphic Log</th>
</tr>
</thead>
<tbody>
<tr>
<td>20.0</td>
<td>30/0.0</td>
<td></td>
<td></td>
<td>20</td>
<td></td>
</tr>
</tbody>
</table>

**Description**

Hard, dark gray, BASALT with small pukas.

| 25               |               |                   |                         |               |             |

**Description**

Bottom of Hole 29.0 Feet
Water not encountered.

| 30               |               |                   |                         |               |             |
GEOLABS—HAWAII, INC.
BORING LOG 3

Drilling Date 11-2-71  Driving Wt. 140 lbs  Elevation 71.0' *

Job Apartment Complex  Drop 30''  Work Order 310-40

<table>
<thead>
<tr>
<th>Sample Depth ft.</th>
<th>Blows per ft.</th>
<th>Moisture Content %</th>
<th>Dry Unit Weight p.c.f.</th>
<th>Depth in feet</th>
<th>Graphic Log</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.0</td>
<td>13</td>
<td>46.8</td>
<td></td>
<td>0</td>
<td></td>
<td>CH Medium, brown Silty CLAY with rock fragments.</td>
</tr>
<tr>
<td>4.0</td>
<td></td>
<td></td>
<td></td>
<td>5</td>
<td></td>
<td>CH Stiff, light brown CLAY. Moist</td>
</tr>
<tr>
<td>5.0</td>
<td></td>
<td>48.5</td>
<td>77.8</td>
<td></td>
<td></td>
<td>CH Very stiff, brown, CLAY with decomposed basalt fragments.</td>
</tr>
<tr>
<td>10.0</td>
<td>44</td>
<td></td>
<td></td>
<td>10</td>
<td></td>
<td>GP Hard, dark gray, fragments of decomposed BASALT.</td>
</tr>
<tr>
<td>11.5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Hard, dark gray, BASALT.</td>
</tr>
<tr>
<td>15.0</td>
<td>51.5</td>
<td></td>
<td></td>
<td>15</td>
<td></td>
<td>Bottom of Hole 19.5 Feet</td>
</tr>
<tr>
<td>16.5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Water not encountered</td>
</tr>
</tbody>
</table>

* Water not encountered.
**GEOLABS - HAWAII, INC.**

BORING LOG **4**

Drilling Date **11-2-71**  
Driving Wt. **140 lbs**  
Elevation **74.5'**

**Job** Apartment Complex  
**Drop** **30''**  
**Work Order** **310-40**

<table>
<thead>
<tr>
<th>Sample Depth</th>
<th>Blows per ft.</th>
<th>Moisture Content %</th>
<th>Dry Unit Weight p.c.f.</th>
<th>Depth in feet</th>
<th>Graphic Log</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>2.0</strong></td>
<td>8</td>
<td>53.0</td>
<td></td>
<td>0</td>
<td></td>
<td>CH Medium, brown Silty CLAY with rock fragments.</td>
</tr>
<tr>
<td><strong>4.0</strong></td>
<td>5</td>
<td>55.0</td>
<td>74.7</td>
<td>5</td>
<td></td>
<td>CH Stiff, light brown, CLAY. Moist</td>
</tr>
<tr>
<td><strong>5.0</strong></td>
<td>11**</td>
<td>50.5</td>
<td>74.7</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>6.5</strong></td>
<td>13</td>
<td>50.2</td>
<td></td>
<td></td>
<td></td>
<td>CH Stiff, mottled, gray and brown CLAY. Moist</td>
</tr>
<tr>
<td><strong>10.0</strong></td>
<td>14</td>
<td>50.2</td>
<td></td>
<td>10</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>16.5</strong></td>
<td>24</td>
<td>45.5</td>
<td></td>
<td>15</td>
<td></td>
<td>CH Very stiff, gray and brown CLAY with decomposed basalt fragments.</td>
</tr>
</tbody>
</table>

*Hard Basalt.*

**Bottom of Hole 19.5 Feet**

**Water not encountered**
**GEOLABS—HAWAII, INC.**

**BORING LOG**

<table>
<thead>
<tr>
<th>Drilling Date</th>
<th>Driving Wt.</th>
<th>Elevation</th>
</tr>
</thead>
<tbody>
<tr>
<td>11-2-71</td>
<td>140 lbs</td>
<td>71.5'*</td>
</tr>
</tbody>
</table>

**Job** Apartment Complex

**Drop** 30"

**Work Order** 310-40

<table>
<thead>
<tr>
<th>Sample Depth</th>
<th>Blows per ft</th>
<th>Moisture Content %</th>
<th>Dry Unit Weight (lbs)</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.0</td>
<td>44.7</td>
<td>75.7</td>
<td></td>
<td>CH Soft, gray CLAY with rock fragments.</td>
</tr>
<tr>
<td>3.5</td>
<td>3**</td>
<td></td>
<td></td>
<td>CH Soft, dark brown, CLAY. Very moist</td>
</tr>
<tr>
<td>5.0</td>
<td>51.5</td>
<td>68.4</td>
<td></td>
<td>CH Stiff, light brown, CLAY with partially decomposed basalt fragments. Moist</td>
</tr>
<tr>
<td>6.5</td>
<td>15**</td>
<td></td>
<td></td>
<td>Boulders with CLAY. (very slow drilling)</td>
</tr>
<tr>
<td>10.1</td>
<td>50/1</td>
<td></td>
<td></td>
<td>Decomposed Basalt.</td>
</tr>
<tr>
<td>15.0</td>
<td>36</td>
<td>34.8</td>
<td></td>
<td>CH Very stiff, brown CLAY with decomposed basalt fragments.</td>
</tr>
<tr>
<td>20.0</td>
<td></td>
<td></td>
<td></td>
<td>Hard, dark gray BASALT.</td>
</tr>
</tbody>
</table>

Bottom of Hole 20.0 Feet

Water not encountered
APPENDIX D

LABORATORY DATA

GEOLABS - HAWAII, INC.
DIRECT SHEAR TEST

DH-2
Depth: 5.0' - 5.5'
c=3800 PSF
\( \phi = 23.4^{\circ} \)
Description: Light brown CLAY

DH-4
Depth: 5.0' - 5.5'
c=1860 PSF
\( \phi = 23.4^{\circ} \)
Description: Light brown CLAY

Shear Stress (PSF)

0 1000 2000 3000 4000 5000

NORMAL STRESS (PSF)

GEOLABS, INC.
GEOL OGY AND SOIL ENGINEERING

DATE 11-12-71 BY A.B.C.
SCALE WO. 310-40

PLATE 10
CONsolidation - Pressure Curve

% Swell

% Consolidation

Normal pressure, kips per square ft

Soil type: CH
Dry unit wt: 75pcf
Liquid limit: 148.0%
Plastic limit: 30.0%
Plastic index: 118%

Plate 12
Date: 11-12-71

Job: Proposed Apartment Complex

Boring No.: 2

Depth: 5'-6'

Consolidation Pressure Curve

Normal Pressure, Kips per Sq. Ft.

% Swell

% Consolidation

Soil Type: CH
Dry Unit Weight: 72.6 PCF
Liquid Limit: 115.5%
Plastic Limit: 30.9%
Plastic Index: 84.8%

Plate: 13
APPENDIX E

FIELD AND LABORATORY SPECIFICATIONS

GEOLABS - HAWAII, INC.
FIELD AND LABORATORY SPECIFICATIONS

EXPLORATORY DRILLING AND SAMPLING

Method for soil investigation and sampling by auger borings (Tentative)

Method for penetration test and split barrel sampling of soils (Tentative)

LABORATORY TESTING

Grain Size Analysis

Grain size analysis of soil ±200

ASTM Designation: D 422-63

ATTERBERG LIMITS

Determining the liquid limit of soils. Tests conducted from natural moisture content unless otherwise noted.

Determining the plastic limit and plasticity index of soils.

Direct Shear (Q Test) Consolidation Tests

"Soil Testing for Engineers" by T. William Lambe

SPECIFIC GRAVITY

Specific gravity of soils Modified as follows: Le Chatelier Flask

ASTM Designation: D 854-58

CBR TESTS

Expansion test and California Bearing Ratio (CBR)

ASTM Designation: D 1883-61T
ASTM Designation: D 1557-64T

PROCTOR TEST

Moisture-Density relations of soils using a 10# hammer and an 18" drop.

AASHO Designation: T 180-57
ASTM Designation: D 1557-64T

Suggested Method by A. A. Wagner - ASTM Committee D-18

UNIFIED SOIL CLASSIFICATION
APPENDIX F

STANDARD GRADING SPECIFICATIONS
STANDARD GRADING SPECIFICATIONS
PROPOSED APARTMENT COMPLEX
CORNER OF KUAKINI AND BACHELOT STREETS
HONOLULU, HAWAII

The work under this section includes:

1. Clearing and grubbing of site
2. Preparation of natural ground
3. Preparation of fill areas
4. Placement and control of fill operations
5. Compaction equipment
6. Removal and backfill of underground structures
7. Supervision of earthwork
8. Seasonal requirements

1. Clearing

All areas within contract limit lines shall be cleared of trash, debris and organic matter, and such material shall be burned and removed from the site.

2. Preparation of Natural Ground

In areas where the bottom of footings are designed on or below existing natural ground, the soils shall be scarified to a depth as determined by the soils engineer until the material is free of all uneven features and shall be precompacted as outlined in the following Section #4b.
3. **Preparation of Fill Areas**

All areas upon which fill is to be placed after clearing, as outlined in Section #1 of these specifications, shall be scarified until free of uneven features to a depth as determined by the soils engineer, and watered and compacted according to Section #4 of these specifications.

4. **Placement of Fill**

a. Material for fill shall consist of onsite soils. Fill material shall be free of all organic matter and other deleterious material, and shall not contain rocks or lumps in excess of four inches (4") in diameter.

b. **Compaction of Fill**

After the base for the fill has been prepared as described above, it shall be brought to the proper moisture content and compacted to not less than 90% of maximum density in accordance with Test ASTM D-1557-70.

c. **Depth of Fill**

Fill shall be placed in horizontal layers which,
when compacted, will not exceed six inches (6"").

5. **Compaction Equipment**

The soils engineer shall determine the type of compacting equipment which will attain the specified results in the most efficient manner. Sheepsfoot, vibratory, or pneumatic tire rollers may be used in the test section and the equipment which produces the specified results in the most expedient manner as determined by the soils engineer shall be employed by the contractor. The equipment used in rolling shall be in good working condition, fully ballasted, and self cleaning. Fill material placed in an unsatisfactory condition and not within the enclosed specifications shall be rejected by the soils engineer and the contractor shall rework the fill placed such that the specifications are followed.

6. **Removal and Backfill of Underground Structures**

Any underground structures such as cesspools, cisterns, septic tanks, wells, pipe lines, etc. shall be removed under the direction of the soils engineer. Backfill of the excavation shall be in accordance with these specifications.
7. **Supervision of Earthwork**

Field density tests shall be made by the soils engineer during the earthwork operation such that he may certify that the fill was placed according to accepted specifications. In the event that field density tests of a layer or any portion thereof is less than the required density, the particular layer or portion shall be reworked until the required density is obtained.

8. **Seasonal Requirements**

No fill shall be placed during unfavorable weather conditions as determined by the soils engineer. After interruption of work due to heavy rain, the soils engineer shall approve previously placed fill before resumption of earth-moving operations.