FIELD OBSERVATION & FOUNDATION RECOMMENDATIONS
MOMILANI VILLA, UNIT I
LOTS 1-2, 3-4, 5-6, 7-8, 9-10,
25-26, 27-28, 47-48 & 67-68
FOR
CIVIC DEVELOPMENT

WITHDRAWN

GEOLABS-HAWAII
1553 COLBURN STREET, SUITE 202
HONOLULU, HAWAII 96817
June 5, 1978
W.O. 738-00(C)

Civic Development
Room A, 1305 South King Street
Honolulu, Hawaii 96814

Attention: Mr. George H. Sakoda

Subject: Field Observation and
Foundation Recommendations
Momilani Villa, Unit I
Lots 1-2, 3-4, 5-6, 7-8, 9-10,
25-26, 27-28, 47-48 & 67-68

Gentlemen:

As requested, the site conditions at the above referenced
lots were evaluated for foundation design purposes. As
stated in our proposal, it is not the purpose of this
investigation to check the compaction quality of the
already completed grading work.

Our findings and recommendations are presented in this
letter.

The soil report and site grading observations for the above
project were made by others. The site grading plan by
Park Engineering Inc. dated September 13, 1976 was used
to determine the grading that had taken place at the site.
FIELD EXPLORATION AND LABORATORY TESTING

Eight borings were drilled at the above referenced lots to evaluate the subsurface conditions for the design of the foundation for the proposed housing structure. Detailed description of the soils encountered are presented on the logs. The approximate locations of the boring are shown on the attached Site Plan, Plate 1.

2.4-inch diameter ring samples of the top 1.5 feet below the existing building pads were obtained for visual inspection and laboratory testing to evaluate the expansive properties of the existing surface materials. Water contents and swell tests on 1 inch thick undisturbed ring samples with 55 p.s.f. surcharge loads were utilized in the evaluation of the soil properties.

The results of the laboratory tests are summarized in Table 1.

Based on the field exploration and laboratory test results, our recommendations for the remaining lots at Unit I are as follows:

Lots 1-2
The laboratory swell tests indicated that critically expansive soils were encountered in these lots.
For the proposed slab-on-grade, deep perimeter footings around the house slab should be used to reduce the shrink-swell effects of the soils.

The perimeter footings should extend a minimum of 3 feet below the outside ground elevation and have a minimum thickness of 9 inches. A #5 bar should be placed at the top and bottom of this cut-off wall footing.

The 6-inch base course layer should be compacted wet of optimum moisture content to a minimum of 90% maximum density. Prior to pouring the slab, the subgrade and base course layer should be kept continuously moist by flooding or sprinkling. The soils engineer should inspect the subgrade preparation, check the moisture contents of the underlying soils, and test compaction of the cushion layer prior to pouring of the slab and perimeter footing.

The bottom of the footing excavation should be neat and free of loose soils.

The concreting of footing and slab should be coordinated in such a way that the time period between the initial excavation and final concrete placement at each lot should be kept to a minimum.
Continual flooding and wetting by sprinkler of the exposed subgrade are required to saturate the underlying expansive soils.

The finish grade outside the slab should be shaped to shed water away from the perimeter footing and to avoid ponding condition near the slab area. Also, gutter water should be diverted far away from the perimeter footings and walkways.

It is our opinion that the existing slope above the proposed building area at its present undisturbed conditions is stable. Therefore, in order to keep the slope in its stable condition, future grading development and vegetation removal are not recommended for this upper slope area.

Lots 3-4

The recent laboratory tests and field observations indicated that slightly expansive soils encountered in these lots. The recommendations for expansive soil conditions given above should be used, except that the deep perimeter footing may be reduced to
only 12 inches below the outside finish grade around the slab-on-grade area.

The rear portion of these units is located on slope area. For footings on sloping area, post and pier footing foundations are recommended except for the unit common and partition tile wall where step wall footing can be utilized.

The footing foundation above the garage retaining wall should extend through the fill and bear on the stiff natural soils.

The bottom of all post and wall footings should have a minimum embedment of 24 inches below the finish grade and that the outer edge of the foundation should have a minimum horizontal set-back distance of 5 feet away from the outer slope surface.

For the retaining walls planned at the rear portion of the garage unit, the following design recommendations may be used:
1. Well-graded granular material, such as base course rock, should be used as backfill material behind the walls.

2. The bottoms of footings should be a minimum of 18 inches below the finish grades.

3. Allowable bearing values of 3000 p.s.f. may be used for footings resting on stiff soil.

4. For lateral earth pressure, the following can be used:
   a) Walls unrestrained at the top - 45 p.c.f. equivalent fluid pressure.
   b) Walls restrained at the top - 60 p.c.f. equivalent fluid pressure.

   Additional load due to sloping surcharge should be included where applicable.

5. A friction factor of 0.40 can be utilized to determine the sliding resistance of the wall foundation.

6. A subsurface drainage system should be used to prevent the build-up of hydrostatic pressure behind the walls.
Lot 5-6
The plot plan for these lots was not available at the time of writing this soils report. It is our understanding that the proposed building construction scheme at these lots will be similar to the structures being planned for Lots 3-4. The recommendations given for Lots 3-4 may be used for Lots 5-6. Due to expansive soil encountered, a 2-foot deep perimeter footing along with saturating the subgrade soil are recommended for slab-on-grade construction.

Lots 7-8, 9-10, 25-26 & 27-28
These lots are located on the existing clay slope. The 'adobe' clay soil was exposed on the face of the existing retaining wall vertical cut made at the toe of the existing slope at Lot 27.

Based on the results of our field study and laboratory testing, the existing moisture contents of the underlying 'adobe' clay soil are generally on the dry side. When these clayey soils are subjected to wetting by water infiltration through surface cracks,
they could lose substantial portion of shear strength and therefore the clayey surface soil layer would tend to creep or move down-hill. Because of that, special construction methods would be required in the design against potential down-hill movement. The following methods had been discussed with the Project Consultants and the owner during the course of the investigation. The following are the detailed recommendations for the two alternate special construction methods:

Alternate 1 - Stabilization Key

In the slope area, stabilization keyways should be constructed along and up-hill of the building area in Lots 25-26 and 27-28, and down-hill of building area in Lots 7-8 and 9-10 to stabilize down-hill slope creep. The stabilization key should penetrate through the 'adobe' clay layers and into the competent decomposed rock formation. It is estimated that the depth of the 'adobe' excavation would be about 10 feet. However, the more exact depth of removal and backfill
will have to be determined during the grading operations.

A generalized cross-section of the stabilization fill is presented on Plate 2. The over-excavation of the stabilization fill area should extend a minimum of 2 feet into the underlying firm decomposed basalt or competent materials that are found beneath the creep zone.

Due to the highly expansive soils encountered at this area, the foundation outside the stabilization backfill area should be designed for the expansive soil conditions. Both post and wall footing foundation should be a minimum of 3 feet below the finish grade.

The retaining wall for the garage should be designed per our recommendations given for Lots 2-3.

Alternate 2 - Caisson Foundation

For footings on the slope area, caisson foundation could be utilized to replace the upper stabilization keyway construction.
The caisson foundations should extend through the clayey material and with a minimum penetration of 2 feet into the underlying decomposed rock or rock layer. A bearing value of 8000 p.s.f. may be used for the caisson foundation.

Although the caisson foundation can extend through the creep zone, the retaining wall for the lower garage should be designed to resist the down-hill movement. It is estimated that the retaining wall should resist a lateral force of 13 kips per lineal foot for Lots 25-26 and 27-28, and a lateral force of 7 kips per lineal foot for Lots 7-8 and 9-10.

Rock out-crop was noted at the upper portion of Lot 7. If possible, the building for Lot 7 should be located over the rocky area and bypass the lower slope area which has down-hill creep potential.
Lots 47-48 and 67-68

The laboratory tests indicated critically expansive soils encountered in these lots. For the proposed slab-on-grade construction, the 3-foot deep perimeter footing recommendation given for Lot 1-2 should also be used in these lots.

For footing next to the slope area, the outer edge of the footing foundation should have a minimum horizontal set-back distance of 5 feet from the outer slope face. An allowable bearing pressure of 2000 p.s.f. may be used on stiff in-situ materials.

Should you have any questions concerning the contents of this report, please feel free to call us.

Respectfully submitted,

C.W. ASSOCIATES, INC.
dba GEOLABS-HAWAII

By Bob Y.K. Wong, P.E.

BYKW:RS: cw

(6 copies submitted)
INVESTIGATION LIMITATIONS

Our services consist of professional opinions and recommendations made in accordance with generally accepted soil and foundation engineering principles and practices. This warranty is in lieu of all other warranties either expressed or implied.

The analyses and recommendations submitted in this report are based on our site reconnaissance, soil information from boring data and laboratory tests obtained from this study.

Unanticipated soil conditions are commonly encountered and cannot be fully determined by taking borings alone. These unforeseen conditions such as seepage, soft spots and expansive soil pockets may occur in localized areas.

This report has been prepared in order to assist the engineer in the foundation design of this project.
NOTE: 1. SIDE SLOPES OF KEY EXCAVATION WILL BE CUT TO STEEPEST STABLE CONDITION.

2. KEY SHOULD EXTEND A MINIMUM OF 2 FT. INTO COMPETENT MATERIAL.

3. KEY MATERIAL SHOULD BE NON-EXPANSIVE GRANULAR MATERIAL AND COMPACTED TO A MINIMUM OF 90% OF MAXIMUM DENSITY.
BOURING 9

Sample

Dry density (pcf)

Blows per foot

50 40 30 20 10 0

Depth (feet)  Surface elevation 187.5'

(ESTIMATED FROM GRADING PLAN)

Graph

SOIL DESCRIPTION

MOTTLED BROWN CLAY; VERY STIFF TO STIFF

usc

MH/CH

BORING TERMINATED AT
11.5 FEET ON 3-13-78

NO GROUNDWATER ENCOUNTERED

MOISTURE CONTENT

LEGEND

1 2.0" O.D. split-spoon sample

II Undisturbed ring sample

X Disturbed ring sample

I Core sample

P Sampler pushed

Driving energy: 140 lb. wt., 70 lb. HAM W.O. 738-00(C) MAY 1978

MOMILANI VILLA, UNIT I

LOG OF BORING

CIVIC DEVELOPMENT

GEOLABS-HAWAII

FOUNDATION ENGINEERING • ENVIRONMENTAL ENGINEERING • GEOTECHNICAL
BORING 10

Sample
Dry density (pcf)

Blows per foot

Depth (feet)

Surface elevation 154.01
(ESTIMATED FROM GRADING PLAN)

Graph

SOIL DESCRIPTION

BORING CLAY; VERY STIFF

CH

GRADED TO MOTTLED BROWN CLAY; HARD

GRADED TO GRAY BROWN CLAY (ADOBE) WITH SOME DECOMPOSED GRAVEL

BORING TERMINATED AT
10.7 FEET ON 3-13-78

NO GROUNDWATER ENCOUNTERED

Moisture content

LEGEND

1 2.0" O.D. split-spoon sample

II Undisturbed ring sample

III Disturbed ring sample

IV Core sample

P Sampler pushed

Driving energy: 140 lb. wt., 30" drop

W.O. 738-00(C) MAY 1978

MOMILANI VILLA, UNIT I
CIVIC DEVELOPMENT

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Foundation Engineering • PIP Engineering • Geology
BORING 11

Sample
Dry density (pcf)

Blows per foot
50 40 30 20 10 0

Depth (feet)

Graph

Surface elevation 160.5 ± (ESTIMATED FROM GRADING PLAN)

SOIL DESCRIPTION

BROWN CLAY; STIFF

BOULDERLY BELOW 2.3 FEET

BORING TERMINATED AT
3.0 FEET ON 3-14-78

NO GROUNDWATER ENCOUNTERED

MOMILANI VILLA, UNIT I
LOG OF BORING
CIVIC DEVELOPMENT

MOISTURE CONTENT

LEGEND

I 2.0" O.D. split-spoon sample
II Undisturbed ring sample
K Disturbed ring sample
X Core sample
P Sampler pushed

PLASTIC LIMIT

LIQUID LIMIT

NATURAL WATER CONTENT

DRIVING ENERGY 140 lb wt.
### Boring 12

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<th>Surface elevation 151.0'</th>
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<th>(Estimated from Grading Plan)</th>
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#### Soil Description
- **Dark Gray Clay (Adobe); Stiff CH**
- **Mottled Brown Clay; Very Stiff CH**
- **Light Brownish Gray Clay; Stiff CH**
- **Dark Gray Clay (Adobe); Stiff CH**
- **Mottled Greenish & Grayish Brown Clayey Silt with Some Decomposed Rock**

**Momilani Villa, Unit I**

**Log of Boring**

Civic Development

**Legend**
- 2" O.D. split-spoon sample
- Undisturbed ring sample
- Disturbed ring sample
- Core sample
- Sample pushed

**Driving energy:** 140 lb wt., 30" drop  
W.O. 738-00(C) May 1978
BORING 15

Sample
Dry density (pcf)

Depth (feet) Surface elevation 194.0’
(ESTIMATED FROM GRADING PLAN)

Graph

SOIL DESCRIPTION

BROWN CLAY; STIFF

Moisture content

LEGEND

Moisture content

I 2.0” O.D. split-spoon sample
II Undisturbed ring sample
III Disturbed ring sample
IV Core sample
P Spt. required

Plastic limit
Liquid limit
Natural water content

BORING TERMINATED AT
8.5 FEET ON 3-24-78

NO GROUNDWATER ENCOUNTERED

MOMILANI VILLA, UNIT I
LOG OF BORING
CIVIC DEVELOPMENT

GEOLABS-HAWAII
Foundation Engineering • Mill Engineering • Derby

Driving energy 140 lb wt. 30” drop
W.O. 738-00(C) MAY 1978
**BORING 16**

<table>
<thead>
<tr>
<th>Sample</th>
<th>Depth (feet)</th>
<th>Surface elevation 194.0 ft (ESTIMATED FROM GRADING PLAN)</th>
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<td>Dry density (pcf)</td>
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**SOIL DESCRIPTION**

- REDDISH BROWN SILTY CLAY; MH STIFF
- GRADED TO BROWN CLAY; STIFF CH
- BASALT ROCK

**BORING TERMINATED AT 3.5 FEET ON 3-24-78**

**NO GROUNDWATER ENCOUNTERED**

**LOG OF BORING**

**CIVIC DEVELOPMENT**

**MOMILANI VILLA, UNIT I**

**GEOLESS-HAWAII**

Foundation Engineering + Site Engineering + Design
BORING 17

Sample
Dry density (pcf)

Blows per foot
50 40 30 20 10 0

Depth (feet)

Surface elevation 248.0' ±
(ESTIMATED FROM GRADING PLAN)

Graph

SOIL DESCRIPTION

REDDISH BROWN SILTY CLAY
WITH SOME GRAVEL; MEDIUM
STIFF TO STIFF

GRADED TO VERY STIFF
(BELOW 8 FEET)

BORING TERMINATED AT
12.0 FEET ON 3-24-78
NO GROUNDWATER ENCOUNTERED

MOISTURE CONTENT

LEGEND

I 2.0" O.D. split-spoon sample
II Undisturbed ring sample
K Disturbed ring sample
I Core sample
P Sampler pushed

MOMILANI VILLA, UNIT I
CIVIC DEVELOPMENT

LOG OF BORING

Driving energy: 140 lb wt. 30" drop W.O. 738-00(C) MAY 1978
BORING 18

Sample
Dry density (pcf)

Depth (feet)  Surface elevation 263.0' (ESTIMATED FROM GRADING PLAN)

Graph

SOIL DESCRIPTION  u s c

MOTTLED REDDISH BROWN SILTY CLAY WITH SOME GRAVEL; STIFF TO MEDIUM STIFF

GRAY SILTY SAND AND GRAVEL; DENSE

BORING TERMINATED AT 10.8 FEET ON 3-24-78
NO GROUNDWATER ENCOUNTERED

Moisture content LEGEND

- 2.0" O.D. split-spoon sample
- Undisturbed ring sample
- Disturbed ring sample
- Core sample
- Sampler pushed

Driving energy: 140 lb. wt., 30" drop

MOMILANI VILLA, UNIT I
LOG OF BORING
CIVIC DEVELOPMENT

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MOMILANI VILLA, UNIT I
LOG OF BORING
CIVIC DEVELOPMENT

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MOMILANI VILLA, UNIT I
LOG OF BORING
CIVIC DEVELOPMENT

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TABLE 1
SUMMARY OF RING SWELL & MOISTURE CONTENT TESTS

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<tr>
<th>Lot No.</th>
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