KAHEHAME RIDGE "500" RESERVOIR - SOIL EXPLORATION REPORT

MAUNALUA, OAHU, HAWAII
TAX MAP KEY:  3-9-10: 7

FOR REFERENCE
not to be taken from this room

To:
KAISER-AETNA

WALTER LUM ASSOCIATES, INC.
CIVIL, STRUCTURAL, SOILS ENGINEERS
JANUARY 14, 1972

MUNICIPAL REFERENCE & RECORDS CENTER
City & County of Honolulu
City Hall Annex - 558 S. King Street
Honolulu, Hawaii 96813
January 14, 1972

KAISER-AETNA
P. O. Box 2997
Honolulu, Hawaii 96802

Gentlemen:

Subject: Kamehame Ridge "500" Reservoir
Soil Exploration Report
(for foundation design purposes)
Maunalua, Oahu, Hawaii
Tax Map Key: 3-9-10: 7

Transmitted herewith is our soil exploration report for the Kamehame Ridge "500" Reservoir at Maunalua, Oahu, Hawaii.

The borings generally indicated a surface layer of about 5 to 9 ft of a mixture of decomposed rock, clinkers and silty clay. Below that was lava rock (puka puka rock with decomposed rock and clinker pockets) to about 35 to 41 ft, the depths drilled.

The proposed reservoir structure should be placed in a cut section. Continuous footing or slab foundations may be considered. Bearing values of 5000 p.s.f. may be used for footings on lava rock.

This report includes a Boring Location Plan, boring logs, laboratory test results, recommendations and limitations.

Respectfully submitted,

WALTER LUM ASSOCIATES, INC.

Ezra Koike
Professional Engineer
Hawaii No. 1450
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### APPENDICES:

- A. LOGS OF BORINGS - Boring Nos. 1 thru 3
- B. LIMITATIONS
- C. BORING LOCATION PLAN
SCOPE OF EXPLORATION

The purpose of this exploration was to determine general soil conditions at the proposed site of the 1.5 M.G. Kamehame Ridge "500" Reservoir for foundation design.

This report includes preliminary field exploration, laboratory tests and recommendations for the tank foundation design.

FIELD EXPLORATION

Three exploratory borings were made at the site as shown on the Boring Location Plan. Borings were made with 3 and 4-in. diameter augers using carbide bits and "BXM" core barrel using diamond coring bits.

Soil samples were recovered with a 2-in. standard split spoon sampler driven with a 140-lb hammer falling 30 inches. Rock samples were recovered with a "BXM" core barrel.

LABORATORY TESTS

Laboratory tests included: natural water content. Because of the rocky nature of the surface soils, no Atterberg limit tests were performed.
SOIL CLASSIFICATION SYSTEM

Soil samples were visually observed and subjected to appropriate tests in the laboratory. Based on visual observations and laboratory tests, the soil descriptions given on the boring logs are generally made in accordance with the "Unified Soil Classification System."

GENERAL SITE CONDITIONS

The project site is located about 2,800 ft north of the existing Kamiloiki 2.0 M.G. reservoir on Kamehame Ridge between Kamiloiki and Kalama Valleys. The sides of the ridge slope down toward the valleys at about 10 to 20% or more gradients.

A paved access road is located about 300 ft east of the site. The existing ground surface appears to be weathered and eroded volcanic rock sparsely covered with brush. Several lava rock outcrops were noted in the area.

INTERPRETATION OF SOIL CONDITIONS

From the field exploration, the soils at the site may be described as follows:

A surface layer about 5 to 9 ft of a mixture of decomposed rock, clinker and silty clay underlain by lava rock (puka puka rock with decomposed rock and clinker pockets) to about 35 to 41 ft, the depths drilled.
Water was not noted in the borings during the field explorations.

For more detailed descriptions of soils encountered in the drill holes, refer to the boring logs.

DISCUSSION AND RECOMMENDATIONS

A 120-ft diameter 1.5 M.G. tank is proposed at the site. The proposed site grading indicates cuts up to about 25 ft in height and possibly some shallow fills for a perimeter road around the tank.

Foundations

The plans indicate a bottom of tank elevation of about 480 ft. On the high side of the site, the grading would involve cuts up to about 25 ft, and on the low side, cuts of about 5 ft or more for the tank.

For tank foundations, a level platform is usually made by excavating down to about the approximate subgrade below the finish floor of the tank.

The excavation should preferably be made to such depths to generally comply with the following conditions:

1. The excavation should extend 10 ft beyond the outside perimeter of the tank.
2. The depth of excavation to the finish floor at any point around the perimeter of the tank should be about 1/2 the height of the tank.

By making the tank excavation approximately equal to 1/2 the height of the tank, the weight of a full water tank will be approximately equal to the weight of the materials removed. This will minimize differential settlements because little, if any, additional stresses are added to the underlying soft spots and clinker pockets of lava tubes that may go undetected.

Because the surface of lava formations has dips and high spots and underlying clinker pockets, the footings may be designed at a fixed depth and soft pockets excavated and replaced with low grade concrete up to the bottom of the footing. Hard ridges should be excavated to about a foot below the bottom of the footing and replaced with low grade concrete.

After the excavation is made for the perimeter and column footings, the ground should be probed for several feet below the excavation to check for soft spots or void spaces. If
soft spots or voids are encountered below the excavation, they should be removed and the excavation backfilled with compacted crusher run rock (3/4" to 0") or with low grade concrete.

The bottoms of all footing excavations should be well compacted before placing any concrete.

The contract documents should include items of work for over-excavations below bottoms of footings, extra drill holes and grouting under footings.

Continuous footing or slab foundations may be used. The footings around the perimeter of the tank should extend to at least 3 ft below the finish grade, or designed with a cut-off wall that extends below the invert of the perimeter subdrain that is placed around the tank.

Bearing values of about 5000 p.s.f. may be used for foundations resting on lava rock.

**Site Grading**

Provisions should be made to drain the excavations.

Grading should be done in general conformance with the requirements of Chapter 23, Revised Ordinances of Honolulu, 1961 As Amended.
Guide lines regarding site grading are as follows:

1. Surface vegetation and miscellaneous debris should be cleared and removed prior to site filling.

2. The contractor should be made aware that removal of boulders from the site should be done with care. Boulders and excavation materials should be kept away from the side slopes of the ridge that overlooks Kamiloiki Subdivision.

3. Localized soft pockets encountered during site preparations should be excavated and replaced with compacted select material or low grade concrete.

**Slopes**

Cut slopes of 2 horizontal to 1 vertical may be used for the upper 5 to 10 ft and about 1-1/2 to 1 or flatter in the mixed lava rock layers.

Slope adjustments or other precautions may be necessary if seepage zones or soft spots are encountered in localized areas.
If slope heights greater than 20 ft are considered, 8-ft-wide benches should be placed at height intervals of about 20 ft in both cuts and fills.

Erosion may be a problem in the soils. Runoff should be diverted away from the slopes.

Slope planting is recommended to minimize erosion in fills and exposed soil sections.

**Roadway Pavement Around Tank**

A rough estimate of the roadway pavement thickness for the light automobile traffic anticipated is as follows:

1. Wearing course - 2-in. asphallic concrete.
2. Base course - 6-in. base course over a prepared subgrade.

The subgrade should be compacted and shaped to drain. To avoid the ponding of water and softening of the subgrade at low points, weep holes should be placed at subgrade level thru the walls of the catch basin.

**Unforeseen Conditions**

Unforeseen or undetected conditions such as soft spots or seepage water may occur in localized areas and will have to be adjusted and corrected in the field as they are detected.
BORING LOGS

The stratification lines shown on each of the boring logs represent the approximate boundary between soil types and the transition may be gradual.

Symbols

Symbols used generally are in accordance with the Unified Soil Classification System.

Where a parenthesis "(MH)" is used, the soil sample was classified by visual observation of the sample recovered.

Where no parenthesis "MH" is used, the soil sample was classified from either the Atterberg limit or sieve analysis test results.
<table>
<thead>
<tr>
<th>Depth (ft)</th>
<th>Description</th>
<th>Sample No.</th>
<th>Plastic Limit</th>
<th>Water Cont.</th>
<th>Liquid Limit</th>
<th>Unconf. Comp.</th>
<th>Penetration Test</th>
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<tr>
<td>ELEV. = 498' 2&quot; K 7</td>
<td>MOTTLED BROWN BORING NO. 1</td>
<td>5-A</td>
<td>11</td>
<td>0</td>
<td>10</td>
<td>ROLLER ROCK, DIAMOND CORING</td>
<td>PENETRATION DATA</td>
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<td>PENETRATION DATA</td>
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<td>10</td>
<td>REDDISH-GRAY, PARTIALLY DECOMPOSED PUKA PUKA BASALT ROCK WELL FRACTURED</td>
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<td>ROLLER ROCK, DIAMOND CORING</td>
<td>PENETRATION DATA</td>
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<td>ROLLER ROCK, DIAMOND CORING</td>
<td>PENETRATION DATA</td>
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<tr>
<td>35</td>
<td>GRAY, PUKA PUKA BASALT ROCK END OF BORING @ 35'</td>
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<td>0</td>
<td>10</td>
<td>ROLLER ROCK, DIAMOND CORING</td>
<td>PENETRATION DATA</td>
</tr>
</tbody>
</table>

* Elevation estimated from topographic map by Park Eng. Dated 11-30-71
**Boring Log**

**PROJECT**  
Kanemah Ridge "550" Reservoir

**LOCATION**  
Maunulua, Oahu, Hawaii

**Tax Map Key:** 3-9-10:7

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**HAMMER:**

- **Weight:** 140 ft-
- **Drop:** 2'-5" - 2" Standard Split Spoon  
- **Sampler:** "BX" - 15x Double Tube Core Barrel

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**ELEVATION:** 503' ± 70

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<table>
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<th>Depth (ft)</th>
<th>Sampler</th>
<th>Sample No.</th>
<th>Water Cont. %</th>
<th>Liquid Limit</th>
<th>Unconf. Comp.</th>
<th>Penetration Test</th>
<th>N (Blows per foot)</th>
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<td>0</td>
<td>&quot;BX&quot;</td>
<td>2A</td>
<td>35</td>
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<td></td>
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<tr>
<td>5</td>
<td>&quot;BX&quot;</td>
<td>Run #1</td>
<td>Cored: 5'0'</td>
<td>Recovered: 4'5&quot;</td>
<td></td>
<td></td>
<td></td>
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<td>10</td>
<td>&quot;BX&quot;</td>
<td>Run #2</td>
<td>Cored: 5'0'</td>
<td>Recovered: 4'5&quot;</td>
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<tr>
<td>15</td>
<td>&quot;BX&quot;</td>
<td>Run #3</td>
<td>Cored: 5'0'</td>
<td>Recovered: 4'5&quot;</td>
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<td>20</td>
<td>&quot;BX&quot;</td>
<td>Run #4</td>
<td>Cored: 9'0'</td>
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<td>Run #5</td>
<td>Cored: 5'0'</td>
<td>Recovered: 4'2&quot;</td>
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<td>Run #6</td>
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<td>Recovered: 4'3&quot;</td>
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<td>Run #7</td>
<td>Cored: 5'0'</td>
<td>Recovered: 4'8&quot;</td>
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<td>40</td>
<td>&quot;BX&quot;</td>
<td>Run #8</td>
<td>Cored: 3'0'</td>
<td>Recovered: 2'6&quot;</td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>

**END OF BORING @ 41'**

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* *Elevation estimated from Topographic Map by Park Engr. Dated 11-30-71*
**BORING LOG**

**PROJECT**
KAMEHAME RIDGE "550" RESERVOIR

**LOCATION**
Mauna Lua, Oahu, Hawaii

**Tax Map Key:** 3-9-10: 7

**HARNESS:**

- **Weight:** 140 #
- **Drop:** 30'
- **Sampler:** 2" S. - 2" O.D. THIN WALL TUBE

**SPECIMEN:**

- **2" S. - 2" S. STANDARD SPLIT SPOON

**CORE SAMPLER:**

- **DIAMOND CORING

**LOCATION:**

- **Hammer:** 7/16" SLEDGE HAMMER
- **Hammer:** 10" SLEDGE HAMMER

**EVENT:**

- **End of Boring @ 39'

**ELEVATION ESTIMATED FROM TOPOGRAPHIC MAP BY PARK ENGR. DATED 11-30-71**

**Table:**

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<tr>
<th>Depth (Ft)</th>
<th>Scanner</th>
<th>Sample No.</th>
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<th>Plastic Unit</th>
<th>Voided Unit</th>
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<td>3-A</td>
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<td>100</td>
<td>70</td>
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<td>2.59</td>
<td>3-B</td>
<td>17</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>RUN #1</td>
<td>CORED: 5.0' RECOVER: 2&quot;</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>RUN #2</td>
<td>CORED: 5.0' RECOVER: 2&quot;</td>
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<td></td>
<td></td>
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<tr>
<td>20</td>
<td>RUN #3</td>
<td>CORED: 5.0' RECOVER: 4.5'</td>
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<td>25</td>
<td>RUN #4</td>
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<td>RUN #5</td>
<td>CORED: 5.0' RECOVER: 4.3'</td>
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<td>RUN #6</td>
<td>CORED: 5.0' RECOVER: 4.6'</td>
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</tbody>
</table>

**ELEVATION:**

- **ELEV. = 493.2 ± 7**

**PENETRATION DATA:**

- **N (Blows per foot):**
  - 0
  - 10
  - 20
  - 30
  - 40

**2.0" O.D. THIN WALL TUBE SAMPLER**

- **Hammer:** 7/16" SLEDGE HAMMER
- **Hammer:** 10" SLEDGE HAMMER

**KEY:**

- **RUN:**
  - 20/2
  - 10/8 SLEDGE HAMMER

**NOTES:**

- **End of Boring @ 39'**
LIMITATIONS

In general, soil formations are commonly erratic and rarely uniform or regular. The boring logs indicate the approximate subsurface soil conditions encountered only at the drill holes where the borings were made at the times designated on the logs and may not represent conditions at other locations or at other dates. Soil conditions and water levels may change with the passage of time and construction methods or improvements at the site.

During construction, should subsurface conditions much different from those in the borings be observed, encountered, or otherwise indicated, we should be advised immediately to review or reconsider our recommendations in light of the new developments.

Our professional services were performed, findings obtained and recommendations prepared in accordance with generally accepted engineering practices. This warranty is in lieu of all other warranties expressed or implied.