NANAKULI ELEMENTARY SCHOOL - FIRST INCREMENT
PRELIMINARY SOIL REPORT

D.A.G.S. JOB NO. 02-16-6321.2
NANAKULI, OAHU, HAWAII
TAX MAP KEY: 8-9-07: POR. 3

RECEIVED
SEP 24 1975
WILSON, OKAMOTO & ASSOCIATES

To:
DIVISION OF PUBLIC WORKS
DEPARTMENT OF ACCOUNTING AND GENERAL SERVICES
STATE OF HAWAII

WALTER LUM ASSOCIATES, INC.
CIVIL, STRUCTURAL, SOILS ENGINEERS
SEPTEMBER 20, 1975

MUNICIPAL REFERENCE RECORDS CENTER
City & County of Honolulu
City Hall Annex, 658 S. King Street
Honolulu, Hawaii 96813

WITHDRAWN
March 31, 1976

DIVISION OF PUBLIC WORKS
Department of Accounting and General Services
State of Hawaii
P. O. Box 119
Honolulu, Hawaii 96810

Gentlemen:

Subject: Addendum #1 to Nanakuli Elementary School - First Increment Preliminary Soil Report Dated February 3, 1976 D.A.G.S. Job No. 02-16-6809.2 Nanakuli, Oahu, Hawaii Tax Map Key: 8-9-07: Por. 3

As requested by Wilson, Okamoto & Associates, Structural Engineers for the project, additional guidelines for retaining wall design are being submitted as follows:

1. Lateral earth pressures for sloping backfill may be according to earth pressure charts by Terzaghi & Peck or other similar accepted theory.

2. Estimated allowable bearing values of 3,000 p.s.f. may be used for wall foundations resting on dense or hard natural ground or on compacted select fill that extends thru the surface clay (CH-CL) soils. Toe pressures may be increased about 1/3 where a triangular pressure diagram is used along the base of the wall and a lesser increase for a trapezoidal pressure diagram.

3. For sliding resistance between the base and subgrade, a coefficient of friction of 0.40 plus an ultimate cohesion of 400 p.s.f. may be used where the subgrade is sandy-silty material and the base of the wall is well drained.

Respectfully submitted,

WALTER LUM ASSOCIATES, INC.

Edward K. Watanabe

cc: Wilson, Okamoto & Associates
DIVISION OF PUBLIC WORKS
Department of Accounting and General Services
State of Hawaii
P. O. Box 119
Honolulu, Hawaii 96810

Gentlemen:

Subject: Nanakuli Elementary School - First Increment
Preliminary Soil Report
(for site grading and master planning purposes)
D.A.G.S. Job No. 02-16-6321.2
Nanakuli, Oahu, Hawaii
Tax Map Key: 8-9-07: Por. 3

Transmitted herewith is our soil exploration report for site grading and master planning considerations for the proposed Nanakuli Elementary School - First Increment at Nanakuli, Oahu, Hawaii.

This report includes a Boring Location Sketch, boring logs, laboratory test results, general site grading and master planning design guidelines and limitations.

Respectfully submitted,

WALTER LUM ASSOCIATES, INC.

By

Ezra Koike

CM/EK:vl
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C. Plasticity Chart
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F. Boring Location Sketch
H. Suggested Slope for Cuts & fills in Adobe - Figure 1
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SCOPE OF EXPLORATION

The purpose of this exploration was to evaluate general soil conditions for site grading and master planning considerations for the proposed Nanakuli Elementary School - First Increment at Nanakuli, Oahu, Hawaii.

This report includes field exploration, laboratory tests, general design guidelines for site grading and master planning and limitations.

FIELD EXPLORATION

Seven borings were made at the site. The approximate locations of these borings are shown on the Boring Location Sketch.

The borings were made by MAS Drilling Co. and logged by Walter Lum Associates, Inc.

The borings were made with 4-in. diameter augers using a carbide drag bit. Soil samples were recovered with a 2-in. standard split spoon sampler driven with a 140-lb hammer falling 30 inches.
LABORATORY TESTS

Laboratory tests included: natural water content, Atterberg limit, grain-size analysis, specific gravity, ASTM D-1557-70 density and CBR.

A summary of the laboratory test results is given in Tables IA thru IC.

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."

GEOLOGIC AND SOIL DESCRIPTIONS BY OTHERS

From a review of geologic literature and the U. S. Soil Conservation Service maps of the area, the soils are generally described by others as follows:

Stearns, H. T. and U. S. Geological Survey, "Geologic and Topographic Map of Island of Oahu," 1938:

Pa - Consolidated noncalcareous material, chiefly older alluvium


LPE - Lualualei extremely stony clay (3 to 35% slopes)

High shrink-swell potential

Unified Soil Classification - CH
GENERAL SITE CONDITIONS

The proposed site is located near the end of Haleakala Avenue about 3,000 ft northeasterly of Farrington Highway.

The site is bordered by Nanakuli High School on the east, an existing paved playcourt on the south and residences on the west. The area to the north is presently vacant.

A stockpile of soil is located in the northern portion of the site.

A drainageway about 5 to 15 ft deep crosses the northerly third of the site in an east-west direction. The upper or eastern end of the site was filled over when Nanakuli High School was constructed. Except for a wet spot near the eastern boundary of the site, the drainageway was generally dry during the field exploration.

In general, the site is about 10 to 20 ft lower than the Nanakuli High School grounds along the easterly boundary and about 5 to 15 ft higher than the paved playcourt along the southerly boundary.

Except for the drainageway, the rest of the site is on a gradual slope with gradients of about 5 to 10% down toward the west. The elevation at the site generally varies from about 88 to 126 ft.

The site is generally covered with grass, with a good growth in the drainageway. Some trees and boulders were noted in the drainageway.
INTERPRETATION OF SOIL CONDITIONS

From the field explorations and laboratory test results, the soils encountered in the borings may be generally approximated as follows:

A surface layer about 1 to 5 ft of stiff clay (CH and CL soils) over stiff sandy silts (ML soil) and dense silty sand and gravel with cobbles and boulders (SM, GM soils) to 15 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.

Variations to the above soil and water conditions are to be expected between borings and in localized areas.

DISCUSSION AND RECOMMENDATIONS

The proposed plan is to grade the site by filling the gully and leveling the site for buildings for an elementary school.

Cuts and fills and retaining walls are contemplated.

Since the surface soils are expansive, the ideal solution would be to strip and waste the expansive soils that are on the site.

Since stripping and wasting the expansive soils may not be economically practicable, an alternative solution would be to strip the expansive soils from the higher areas and use the material to fill the bottom of the
gully. The expansive soils should be capped with 3 ft of non-expansive material. Also, the outer slopes of expansive soils should be capped with non-expansive soils.

The existing drainageway will most likely be covered by the filling operations. After clearing and grubbing, subdrains should be provided at the bottom of the drainageway and daylighted. The fill should be placed as soon as practicable to allow the fill soils to settle and lessen future settlements.

For planning or siting of the buildings, if practicable, the proposed buildings should not be located over the existing drainageway where the fill soils tend to consolidate and settle.

If cesspools are encountered during grubbing work, they should be backfilled as recommended under "Cesspools."

Site Grading
In general, the borings indicated a surface layer of clay (CH) soils of about 1 to 2 ft except at the eastern portion of the drainageway where the clay was about 5 ft.

The southerly portion of the site will probably be mostly in cut, and most of the surface clay (CH) soils can be removed. The northwesterly third of the site may be mostly filled. As much as practicable, the surface clay (CH) soils should be stripped and placed near the bottom layers of the fills in the gully.
Grading work should be done in accordance with the Revised Ordinances of Honolulu, 1969 As Amended and as recommended below:

1. The area should be cleared and grubbed.

2. Surface vegetation and miscellaneous debris, boulder stockpiles and rubbish should be cleared and removed prior to site filling.

3. Topsoil should be stripped to stiff natural ground and stockpiled for finish grading.

4. Soft pockets and clay (CH) soils encountered during site preparations should be excavated and replaced with select soils compacted in thin lifts.

5. Hard surfaces such as along existing unpaved roads should be scarified down to stiff soils and recompacted to match the density of the surrounding soil.

6. Where fills are proposed on sidehill areas, gullies and natural drainageways, soft soils and loose material at the bottoms and sides should be stripped down to firm soils before the placement of fills.
Subdrains should be placed along the bottoms of natural drainageways with laterals in a herringbone pattern along the sides of the drainageways. Subdrains should be daylighted.

7. The materials used for filling the site should be controlled. In general, expansive clay soils and cobbles larger than 3 in. but less than 6 in. should be kept below 3 ft of finish grade.

Non-expansive soils (P.I. less than 20) should be used to finish the top 3 ft of fill. Gravel size materials in the fill should not be greater than 3 inches.

The on-site cobbles and boulders larger than 6 in. should be used to construct the outer slopes of fills at the westerly corner of the site.

8. Where clay (CH) soils are used for fills, the following guidelines may be considered:

   a. Where fills are to be placed over clay (CH) soils, the existing surface should be scarified and recompacted on the wet side of optimum.
b. Fills should be constructed in thin lifts on the wet side of optimum to lessen the swell potential of the clay.

c. Fills should be compacted to 90% of ASTM D-1557-70.

d. The clay soils should not be allowed to dry out before placing the next lift.

e. Use of clay (CH) soils in fills on sloping areas or the construction of slopes should be avoided.

On-site clay soils should generally be placed in the deeper portions of fills in flat areas and away from the faces of slopes.

9. Fills should be constructed in approximately level layers starting at the lower end and working upward. Where fills are made on sloping areas steeper than about 5 horizontal to 1 vertical, the ground at the toe of the fill should be benched to a generally level
condition. As the fill is brought up, it should continually be keyed into the stiff natural ground by cutting steps into the slopes and compacting the fill into these steps.

10. For construction of the toe of the fill slope at the lower end of the gully at the westerly end of the site, the adobe soils should be stripped 3 ft below the natural ground level and replaced with select soils before the construction of the fill.

Boulders may be placed along the toe sections of the fill slope and outside of probable building sites. Before placing any fill or boulders, the subgrade should be stripped to stiff natural ground and shaped to drain. A layer of select granular material should be placed on the subgrade and the fill or boulders placed on the select material. The void spaces between boulders should be filled with smaller granular material. A blanket of filter material should be placed against the boulders before any earth fills are placed against the boulders. See attached sketch, Figure 1.
11. Fills should be laid in 6-in. compacted layers to 90% of the maximum density determined by the ASTM D-1557-70 test method. In roadway areas, the top 2 ft of fill should be compacted to 95% of the maximum density.

12. Provisions to drain the site should be included during and after the completion of filling operations.

Slopes

In silty and sandy soils, cut and fill slopes of 2 horizontal to 1 vertical or flatter may generally be considered.

Other general guidelines for slope design are as follows:

1. In general, 8-ft wide benches should be placed at height intervals of about 15 ft for the higher slopes. Where adobe soils are used as fill materials, the height of the slopes or fill should be less than 15 ft.

2. To lessen erosion, the runoff from rainstorms should be diverted by berms or ditches away from slopes whenever practicable.

3. The surface of fill slopes should be compacted by cat-tracking or with a sheepsfoot roller.
4. Slope planting is recommended on cut and fill slopes to lessen erosion.

5. Slope adjustments or other precautions may be necessary if seepage zones or expansive clay pockets are encountered in localized areas.

Sitting of Buildings

Buildings and retaining walls should not be located directly over the drainageway, if practicable, to lessen the possible differential settlement effects resulting from the consolidation of the fill over the gully.

To reduce the effects of slope creep, buildings and retaining walls should be kept 15 ft or more away from the tops of slopes.

Parking areas and other facilities that can tolerate settlements may be located over the drainageway.

Foundations

For preliminary planning purposes, the following guidelines may be considered:

1. Any "CH" clay soils within 3 ft of the surface and within 5 ft of the perimeter of buildings or structures should be removed and replaced with non-expansive soils.
2. Spread or continuous beam type foundations may be considered on stiff natural silty-sandy materials or compacted fills for light one or two-story, short-span small classroom buildings. Buildings that will be over fills over the drainageway should be designed with continuous beam type footings to lessen the effects of differential settlements.

Allowable bearing values of about 2500 p.s.f. may be considered on stiff silty and sandy soils.

3. Soft spots or pockets of loose material encountered in footing excavations or below the building area should be excavated and replaced with well-graded granular material.

4. Concrete slabs on ground should be placed over a base course of 4 in. of gravel less than 3/4-in. and greater than 1/4-in. in size or some other form of capillary break should be provided. The subgrade should be compacted and shaped to a level surface or to drain, if practicable, and generally should be kept slightly higher than the finish grade on the outside of buildings.
5. Construction of retaining walls on slopes should generally be avoided.

6. Good surface drainage away from the foundations of structures should be maintained and the site should be graded to prevent the ponding of water.

7. Additional explorations and soil tests may be required as plans develop, particularly for long-span or multi-story structures.

Roadway and Parking Areas

The surface clay (CH) soils within 3 ft of the finish grades should be removed.

For light automobile traffic and drained subgrade conditions, the roadway pavement section for the general soil conditions may be as follows:

2. Base course - 6-in. base course.
3. Subbase course - 6-in. subbase course over a prepared subgrade.

Provisions should be made in the contract documents to allow for local adjustments regarding select borrow subbase and borrow requirements in the field in accordance with the design standards of the City and County of Honolulu. In
fill areas, the use of select soils within the top 2 to 3 ft of the subgrade may reduce the thickness of or eliminate the need for the select borrow subbase or borrow courses.

The subgrade should be compacted and shaped to drain. To lessen the ponding of water and softening of the subgrade, weep holes should be placed at subgrade levels thru the walls of the catch basins.

Cesspools

Cesspools may be encountered during the site preparation work. When encountered, cesspools should be flagged and located on the plans. Sludge should be removed from the bottom and the cesspool backfilled with fairly well-graded granular materials. The materials should be placed in thin layers and rammed into place or compacted with vibratory equipment. The top 4 ft of fill should be compacted in 6-in. compacted layers.

Building foundations should be designed to bridge the cesspool or extended to the bottoms of the cesspools.

Utilities

Utilities should be placed after the fills are constructed. Utility lines should be designed with flexible joints, particularly where lines are connected to structures.

Utility line trenches should be daylighted with rock drains to drain water.
Unforeseen Conditions

Because of the variability of soil deposits, site improvements, designs and construction techniques, existing or changed conditions may be encountered that cannot be foreseen with even the most exhaustive studies of site and project conditions. These unforeseen conditions should be recognized when encountered and then evaluated so that the designs or the construction methods may be modified accordingly, if necessary.

Unforeseen or changed or undetected conditions such as soft spots, existing utility trenches, underground structures, pipes, voids or cavities, boulders, expansive soil pockets, seepage water or water level changes with weather, etc., may occur in localized areas and will have to be adjusted and corrected in the field as they are detected.

Site Regrading

After mass grading work is done and cuts and fills are made according to the grading plans, regrading at some future date should be avoided unless done under the guidance of a soils engineer.
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 grain-size analysis test results.
Boring Log

NANAKULI ELEMENTARY SCHOOL

FIRST INCREMENT

LOCATION: Nanakuli, Oahu, Hawaii

Tax Map Key: 8-9-07: Por. 3

HAMMER:
- Weight: 140 lbs
- Drop: 30'

SAMPLER: 2" STANDARD SPLIT SPOON

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ELEV. = 10G'-12'

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<th>UNITED CLASSIFICATION</th>
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<td>C H</td>
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<td>STIFF, BROWN, CLAY</td>
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( SM )

DENSE, BROWN
Silty Sand
W/DECOMPOSED ROCK
GRAVEL

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NOTE:
ENCOUNTERED COBBLES, BOULDERS BETWEEN 6'-15'

END OF BORING = 15.4'
8.25.75

*Elevation estimated from Topo Map
**Boring Log**

**NANAKULI ELEMENTARY SCHOOL**

**PROJECT** FIRST INCREMENT

**LOCATION** Nanakuli, Oahu, Hawaii

**Tax Map Key:** 8-9-07: Por. 3

**HAMMER:**

- **Weight:** 140#
- **Drop:** 30" 

**SAMPLER:** 2" STANDARD SPLIT SPOON

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<th>Depth (ft)</th>
<th>Sample</th>
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<th>Unit Comp.</th>
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**NOTE:**

- Encountered cobbles & boulders between 0'-15'.
- **END OF BORING** @ 15.2' 8-25-75

**Elevation estimated from Topo Map**

---

**HAMMER BOUNCES**

**ENGAGED IN COBBLES & BOULDERS BETWEEN 0'-15'**

---

*Elevation estimated from Topo Map*
Boring Log

NANAKULI ELEMENTARY SCHOOL
FIRST INCREMENT

LOCATION: Nanakuli, Oahu, Hawaii

Hammer:
- Weight: 140 lbs
- Drop: 30".

Sampler: 2" STANDARD SPLIT SPOON

Tax Map Key: 8-9-07: Por. 3

Boring No. 3

Driller: MAS DRILLING CO.
Date: Aug. 25, 1975
Field Party: ASATO (W. LUM ASSOC., INC.)

Type of Boring: AUGER (B-40) Diam.: 4" 128' +

Elev.:

Drill Bit: T.C. DRAG

Time:

Date: 8-25-75

Penetration Data

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*Elevation estimated from Topo Map

Note: Encountered cobbles; boulders between 0' - 19'
End of boring @ 15.7' 8-25-75

*Elevations estimated from Topo Map
**Boring Log**

**NANAKULI ELEMENTARY SCHOOL**

**PROJECT**
FIRST INCREMENT

**LOCATION**
Nanakuli, Oahu, Hawaii

**Tax Map Key:** 8-9-07; Por. 3

**HAMMER:**
- Weight: 140 lb
- Drop: 30"

**SAMPLER:**
2" STANDARD SPLIT SPOON

---

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<td><strong>CH</strong></td>
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<td>0</td>
<td>STIFF BROWN CLAY w/ TRACES OF GRAVEL</td>
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<td>GRAY, PUKA PUKA ROCK w/ MOTTLED BROWN SILTY SAND</td>
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<tr>
<td>10</td>
<td>DENSE, MOTTLED BROWN SILTY SAND w/ TRACES OF GRAVEL</td>
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<td>15</td>
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<td>20</td>
<td>STIFF, BROWN SANDY SILT</td>
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**NOTE:**
- Encountered cobbles 1 foot between 0'-15'
- End of boring @ 16.3' 8-25-75

*Elevation estimated from Topo Map*
**Boring Log**

**NANAKULI ELEMENTARY SCHOOL**

**PROJECT** FIRST INCREMENT

**LOCATION** Nanakuli, Oahu, Hawaii

Tax Map Key: 8-9-07: Por. 3

**HAMMER:**
- **Weight:** 140 lbs
- **Drop:** 30".

**SAMPLER:** 2" STANDARD SPLIT SPONG

---

**UNIFIED SOIL CLASSIFICATION**

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<th>Depth (ft)</th>
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<td>5-B</td>
<td>5-C</td>
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**ELEV. = 122' + 0"**

**DESCRIPTION**

- **CH.** STIFF, BROWN CLAY w/ GRAVEL
- **(SM).** DENSE, BROWN SILTY SAND
- **(ML).** STIFF, BROWN SANDY SILT
- **(GM).** DENSE, BROWN SILTY GRAVEL w/SAND
- **(SM).** DENSE, BROWN SILTY SAND

**NOTE:**
- ENCOUNTERED COBBLES, BOULDERS BETWEEN 0'-15'
- END OF BORING @ 16.5' 8-25-75

**Elevation estimated from Topo Map.**
## Boring Log

**Location:** Nanakuli, Oahu, Hawaii  
**Tax Map Key:** 8-9-07: Por. 3  
**Boring No.:** G  
**Sheet No.:**  
**Type of Boring:** AUGER (B:40)  
**Diam.:** 4"  
**Weight:** 140#  
**Drop:** 30"  
**Hammer:**  
**Sampler:** 2" STANDARD SPLIT SPOON  
**Driller:** MAS DRILLING CO.  
**Date:** AUG 25, 1975  
**Field Party:** ASATO (W. LUM ASSOC, INC.)  
**Drill Bit:** T.C.DRAG  
**Water Level:** Not Noticed  
**Date:** 8-25-75  

### PENETRATION DATA

<table>
<thead>
<tr>
<th>Depth (ft)</th>
<th>Sample No.</th>
<th>Plastic Limit</th>
<th>Liquid Limit</th>
<th>Unconf. Comp.</th>
<th>Vane Shear</th>
<th>N (Blows per foot)</th>
<th>Standard Penetration Test</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>G-A</td>
<td>16</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>22/0.2</td>
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</tr>
<tr>
<td>5</td>
<td>G-B</td>
<td>24</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>47/0.6</td>
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</tr>
<tr>
<td>10</td>
<td>G-C</td>
<td>9</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>52/0.4</td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>G-D</td>
<td>29</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>62</td>
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<td>G-E</td>
<td>16</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>30/0.5</td>
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</table>

*Elevation estimated from Topo Map*
**Boring Log**

**NANAKULI ELEMENTARY SCHOOL**

**PROJECT:** FIRST INCREMENT

**LOCATION:** Nanakuli, Oahu, Hawaii

**Tax Map Key:** 8-9-07; Por. 3

**HAMMER:**
- Weight: 140#
- Drop: 30"

**SAMPLER:** 2" STANDARD SPLIT SPOON

<table>
<thead>
<tr>
<th>Unit of Classification</th>
<th>Description</th>
<th>Depth (ft)</th>
<th>Sampler</th>
<th>Sample No.</th>
<th>Plastic Limit</th>
<th>Liquid Limit</th>
<th>Uplift Comp.</th>
<th>Shear Mod.</th>
<th>Standard Penetration Test</th>
</tr>
</thead>
<tbody>
<tr>
<td>(GM)</td>
<td>Dense, Brown Silty Sand 1 Decomposed Rock</td>
<td>0</td>
<td>7-A</td>
<td>16</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>90</td>
</tr>
<tr>
<td></td>
<td>Dense, Gray Brown Cinder w/ Puka Puka Rock</td>
<td>5</td>
<td>7-B</td>
<td>12</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>50% 5'</td>
</tr>
<tr>
<td>(ML)</td>
<td>Stiff, Brown Clayey Silt</td>
<td>10</td>
<td>7-C</td>
<td>25</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>58</td>
</tr>
<tr>
<td>(SM)</td>
<td>Dense, Brown Silty Sand</td>
<td>15</td>
<td>7-D</td>
<td>60</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>50% 2'</td>
</tr>
</tbody>
</table>

**NOTE:**
- Encountered cobbles 4, boulders between 0'-15
- End of Boring at 15.7' 8-25-75

*Elevation estimated from Topo Map*
NANAKULI ELEMENTARY SCHOOL - 1ST INCREMENT

**TABLE I A** - SUMMARY OF LABORATORY TEST RESULTS

<table>
<thead>
<tr>
<th>BORING NO.</th>
<th>SAMPLE NO.</th>
<th>DEPTH BELOW SURFACE</th>
<th>DESCRIPTION</th>
<th>GRAIN-SIZE ANALYSIS (%) Passing</th>
<th>ATTERBERG LIMITS</th>
<th>UNIFIED SOIL CLASSIFICATION</th>
<th>APPARENT SPECIFIC GRAVITY</th>
<th>CBR TEST</th>
<th>MOISTURE-DENSITY RELATIONS OF SOILS</th>
<th>REMARKS:</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>A</td>
<td>0'-0.5</td>
<td>BROWN CLAY WITH traces OF ROOTS</td>
<td>1-1/2&quot;, 1&quot;, 1/2&quot;, #4, #10, #20, #40, #100, #200</td>
<td>Liquid Limit: 58</td>
<td>CH</td>
<td>2.91</td>
<td>20.4</td>
<td>Dry to Wet or Wet to Dry</td>
<td>9-18-75</td>
</tr>
<tr>
<td>1</td>
<td>B</td>
<td>2.5'-4'</td>
<td>BROWN CLAY WITH traces OF ROOTS</td>
<td></td>
<td>Plasticity Index: 34</td>
<td></td>
<td></td>
<td>101.9</td>
<td>Max. Dry Density (P.C.F.)</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>7.0</td>
<td>Optimum Moisture (%)</td>
<td></td>
</tr>
</tbody>
</table>

WALTER LUM ASSOCIATES, INC.
CIVIL, STRUCTURAL, SOILS ENGINEERS
TABLE I (3) - SUMMARY OF LABORATORY TEST RESULTS

<table>
<thead>
<tr>
<th>BORING NO.</th>
<th>SAMPLE NO.</th>
<th>DEPTH BELOW SURFACE</th>
<th>DESCRIPTION</th>
<th>GRAIN-SIZE ANALYSIS</th>
<th>ATTERBERG LIMITS</th>
<th>UNIFIED SOIL CLASSIFICATION</th>
<th>APPARENT SPECIFIC GRAVITY</th>
<th>CBR TEST</th>
<th>MOISTURE-DENSITY RELATIONS OF SOILS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>SURFACE 0'-1.5'</td>
<td>REDDISH-BROWN CLAY</td>
<td>...% Passing</td>
<td>NATURAL</td>
<td>CL</td>
<td>2.95</td>
<td>...</td>
<td>A</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0'-1.5'</td>
<td>REDDISH-BROWN CLAY</td>
<td>...% Passing</td>
<td>NATURAL</td>
<td>CL</td>
<td>2.95</td>
<td>...</td>
<td>A</td>
</tr>
<tr>
<td></td>
<td></td>
<td>BROWN CLAY</td>
<td>WITNESS OF CLAY</td>
<td>...% Passing</td>
<td>NATURAL</td>
<td>CH</td>
<td>2.95</td>
<td>...</td>
<td>A</td>
</tr>
</tbody>
</table>

MOISTURE-DENSITY RELATIONS OF SOILS (AASHO T-180-73I, Method_____
- Dry to Wet or Wet to Dry
- Max. Dry Density (P.C.F.)
- Optimum Moisture (%)

REMARKS:

Date 9-13-75 By
## TABLE 10 - SUMMARY OF LABORATORY TEST RESULTS

<table>
<thead>
<tr>
<th>BORING NO.</th>
<th>5</th>
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</thead>
<tbody>
<tr>
<td>SAMPLE NO.</td>
<td>SURFACE</td>
<td>0-15'</td>
</tr>
<tr>
<td>DEPTH BELOW SURFACE</td>
<td>BROWN CLAY</td>
<td>BROWN CLAY W/GRANUL</td>
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### DESCRIPTION

#### GRAIN-SIZE ANALYSIS

<table>
<thead>
<tr>
<th>Sieve</th>
<th>1-1/2&quot;</th>
<th>1&quot;</th>
<th>1/2&quot;</th>
<th>#4</th>
<th>#10</th>
<th>#20</th>
<th>#40</th>
<th>#100</th>
<th>#200</th>
</tr>
</thead>
<tbody>
<tr>
<td>% Passing</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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#### ATTERBERG LIMITS

<table>
<thead>
<tr>
<th>Air Dried or Natural</th>
<th>Natural</th>
<th>Liquid Limit</th>
<th>Plastic Limit</th>
<th>Plasticity Index</th>
<th>Dilatancy</th>
<th>Toughness</th>
<th>Dry Strength</th>
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<tbody>
<tr>
<td></td>
<td></td>
<td>52</td>
<td>#2</td>
<td>31</td>
<td>NONE</td>
<td>VERY STIFF</td>
<td>VERY HIGH</td>
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#### UNIFIED SOIL CLASSIFICATION

<table>
<thead>
<tr>
<th>CH</th>
<th>CI1</th>
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</table>

#### APPARENT SPECIFIC GRAVITY

<table>
<thead>
<tr>
<th>2.90</th>
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</thead>
</table>

#### CBR TEST

<table>
<thead>
<tr>
<th>(Surcharge - 51 P.S.F.)</th>
<th>19.7</th>
</tr>
</thead>
<tbody>
<tr>
<td>Molding Moisture, %</td>
<td>10.1</td>
</tr>
<tr>
<td>Molding Dry Density, P.C.F.</td>
<td>9.7</td>
</tr>
<tr>
<td>Swell upon saturation, %</td>
<td>2.3</td>
</tr>
<tr>
<td>CBR at 0.1&quot; Penetration</td>
<td></td>
</tr>
</tbody>
</table>

#### MOISTURE-DENSITY RELATIONS OF SOILS

<table>
<thead>
<tr>
<th>DRY TO WET</th>
</tr>
</thead>
<tbody>
<tr>
<td>109</td>
</tr>
<tr>
<td>20</td>
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### REMARKS:

Date 9-18-75  By YDT
PLASTICITY CHART

PROJECT: NANAKULI ELEMENTARY SCHOOL - 1ST INCREMENT
LOCATION: NANAKULI, OAHU, HAWAII

DATE 9-18-75  BY PCT

WALTER LUM ASSOCIATES, INC.
CIVIL, STRUCTURAL, SOILS ENGINEERS
MOISTURE-DENSITY CURVE (ASTM D-1557-70, METHOD A)

PROJECT: NANAKULI ELEMENTARY SCHOOL
LOCATION: NANAKULI, OAHU, HAWAII
SAMPLE NO.: 1 SURFACE
SAMPLE DESCRIPTION: BROWN CLAY

MOISTURE-DENSITY CURVE

ZERO AIR VOIDS CURVE
SPECIFIC GRAVITY = 2.91

WATER CONTENT (%)

DENSITY (P.C.F.)

OPT. MOIST. = 12%
95% w = 22.4%
90% w = 25.7%
85% w = 28.7%

AGGREGATE: 1/4 MINUS
MOLD SIZE: 4" X 4.5 X 4.1 HIGH
HAMMER: 10 LBS, 18 DROP
LAYERS: 5
BLOWS: 25/LAYER
MOISTURE-DENSITY CURVE (ASTM D-1557-70, METHOD A)

PROJECT: NANAKULI ELEMENTARY SCHOOL
LOCATION: NANAKULI, OAHU, HAWAII
SAMPLE NO.: 3 SURFACE
SAMPLE DESCRIPTION: REDDISH-BROWN CLAY

AGGREGATE: 1/4" MINUS
MOLD SIZE: 16" x 9" x 6" HIGH
HAMMER: 100 LBS. 13 DROP
LAYERS: 5
BLOWS: 25 / LAYER

WATER CONTENT (%)

DENSITY (P.C.F.)

ZERO AIR VOIDS CURVE
SPECIFIC GRAVITY - 2.93

OPTIMUM MOIST. CONTENT = 20%
65% W = 20%
60% W = 29%
55% W = 34%
90% W = 9%
100% W = 3%
105% W = 10%
110% W = 20%
130% W = 100%

DATE 8-28-75 BY R.N.
MOISTURE-DENSITY CURVE (ASTM D-1557-79 METHOD A)

PROJECT: NANAKULI ELEMENTARY SCHOOL
LOCATION: NANAKULI, OAHU, HAWAII
SAMPLE NO.: 5 SURFACE
SAMPLE DESCRIPTION: BROWN CLAY

AGGREGATE: 1/4" MINUS
MOLD SIZE: 4"X4X5 1/2" HIGH
HAMMER: 10 LBS 18" DROP
LAYERS: 5
BLOWS: 25/LAYER

DATE 9-4-75  BY  RII

WALTER LUM ASSOCIATES, INC.
CIVIL, STRUCTURAL, SOILS ENGINEERS
CBR TEST

PROJECT: NANAKULI ELEMENTARY SCHOOL - 1ST INCREMENT

LOCATION: NANAKULI, OAHU, HAWAII

SAMPLE NO: 1 SURFACE

SAMPLE DESCRIPTION: PROVIN CLAY

TEST RESULTS:

MOLDING MOISTURE, %: 20.4
MOLDING DRY DENSITY, P.C.F.: 107.9
CBR @ 0.1" PENETRATION: 2.2
DAYS SOAKED: 5

CBR PENETRATION DATA

<table>
<thead>
<tr>
<th>PENETRATION (INCHES)</th>
<th>LOAD (LBS)</th>
<th>LOAD (PSI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.025</td>
<td>23</td>
<td>8</td>
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<tr>
<td>0.050</td>
<td>39</td>
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<td>0.075</td>
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<td>0.125</td>
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<td>0.150</td>
<td>92</td>
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<td>0.175</td>
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<td>39</td>
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<td>0.300</td>
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<td>139</td>
<td>46</td>
</tr>
<tr>
<td>0.500</td>
<td>148</td>
<td>49</td>
</tr>
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</table>

AGGREGATE: 1/4" MINUS
HAMMER WEIGHT: 10 LBS
HAMMER DROP: 18.1 INS
No. OF BLOWS: 56/LAYER
No. OF LAYERS: 5

WALTER LUM ASSOCIATES, INC.
CIVIL, STRUCTURAL, SOILS ENGINEERS
CBR TEST

PROJECT:  NANAKULI ELEMENTARY SCHOOL - 1ST INCREMENT

LOCATION:  NANAKULI, OAHU, HAWAII

SAMPLE NO:  3 SURFACE

SAMPLE DESCRIPTION:  REDDISH-BROWN CLAY

TEST RESULTS:

MOLDING MOISTURE, %  20.4

MOLDING DRY DENSITY, P.C.F.  110.7

CBR @ 0.1" PENETRATION  10.3

DAYS SOAKED  4

DATE  9-4-75  BY  TK

DATE  9-3-75  BY  RH

WALTER LUM ASSOCIATES, INC.
CIVIL, STRUCTURAL, SOILS ENGINEERS
CBR TEST

PROJECT: NANAUKI ELEMENTARY SCHOOL - 1ST INCREMENT

LOCATION: NANAUKI, OAHU, HAWAII

SAMPLE NO: 5 SURFACE

SAMPLE DESCRIPTION: BROWN CLAY

TEST RESULTS:

MOLDING MOISTURE, %: 19.7
MOLDING DRY DENSITY, P.C.F.: 110.1
CBR @ 0.1" PENETRATION: 2.3
DAYS SOAKED: 4

DATE 9-12-75 BY R.H.
DATE 9-15-75 BY R.H.

WALTER LUM ASSOCIATES, INC.
CIVIL, STRUCTURAL, SOILS ENGINEERS

CBR PENETRATION DATA

<table>
<thead>
<tr>
<th>PENETRATION (INCHES)</th>
<th>LOAD (LBS)</th>
<th>LOAD (PSI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.025</td>
<td>26</td>
<td>9</td>
</tr>
<tr>
<td>0.050</td>
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<td>0.150</td>
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<tr>
<td>0.450</td>
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<td>44</td>
</tr>
<tr>
<td>0.500</td>
<td>143</td>
<td>48</td>
</tr>
</tbody>
</table>

AGGREGATE 1/4" MINUS
HAMMER WEIGHT 10 LBS
HAMMER DROP 18 IN.
No. OF BLOWS 56/LAYER
No. OF LAYERS 5
SELECT FILL OR BOULDERS
FILL VOIDS BETWEEN
BOULDERS AS MUCH
AS PRACTICABLE.
3' ± MAXIMUM SIZE
BOULDERS

SELECT LESS
EXPANSIVE MATERIAL
FOR FILLS NEAR
FINISH GRADE

FILL HT:
< 15'

1

2

G" SOIL
COVER

TRANSITION FILTER (WELL GRADED
GRANULAR MATERIAL 6" MAXIMUM
TO DUST SIZES.)

SUBDRAIN W/ FILTER BLANKET
(DRAIN LIGHT TO DRAIN)

COMPACTED SELECT MATERIAL
PREFERABLY CORAL

SCARIFY & ROLL SUBGRADE
AT ABOVE OPTIMUM WATER
CONTENT PRIOR TO PLACING
SELECT MATERIAL

SECTION
NOT TO SCALE

FIGURE 1
SUGGESTED SLOPE FOR
CUTS & FILLS IN ADOBE
NANAKULI ELEMENTARY SCHOOL
FIRST INCREMENT
NANAKULI, OAHU, HAWAII

WALTER LUM ASSOCIATES, INC.
CIVIL, STRUCTURAL, SOILS ENGINEERS

SEPT. 1975
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 between borings, at other locations, or at other dates. Soil conditions and water levels may change with the passage of time, 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.

This report was prepared only for the indicated use of the site. If there is a substantial lapse of time between the submission of this report and the start of work at the site, or if conditions have changed due to natural causes, plan changes, or construction operations at or adjacent to the site, it is recommended that this report be reviewed to determine the applicability of the recommendations considering the time lapse, changed conditions, and changes in the state of the art of soil engineering.

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

Contract documents and specifications often prescribe supervision by the soil engineer. It should be understood by all parties that the soil engineer's actual scope of work is very limited. We as the soil engineer do not assume the day to day physical direction of the works, nor minute examination of the elements, nor do we assume the responsibility for the safety of the contractor's workmen. Supervision, inspection, control, etc., by the soil engineer generally mean taking of soil tests and making visual observations, sometimes on only an intermittent basis relating to earthwork or foundations for the project. The soil engineer does not guarantee the contractors' performance, but rather looks for general conformance to the intent of the plans and soil report. Any discrepancy noted by the soil engineer regarding earthwork or foundations will be referred to the project engineer or architect or contractor for action.

Although the soil report may comment or discuss construction techniques or procedures for the design engineer's guidance, the report should not be interpreted to prescribe or dictate construction procedures or to relieve the contractor in anyway of his responsibility for the construction.