PL-85-2037

Chen Northern, Inc.

Consulting Engineers and Scientists

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GEOTECHNICAL INVESTIGATION
CONDOMINIUM DEVELOPMENT
LOCATED AT 1100 EAST AND 4800 SOUTH
SALT LAKE COUNTY, UTAH

PREPARED FOR:

EDINBURGH OF HOLLADAY
1521 East 3900 South
Suite 200
Salt Lake City, Utah

ATTENTION: KELLY SHEPPARD

JOB NO. 519985 DATE: JUNE 19, 1985

CONCLUSIONS

(1) The proposed condominium buildings may be founded on spread footings bearing on the natural soils designed for a maximum soil bearing pressure of 1,500 pounds per square foot.

(2) The natural soils may be excavated using conventional excavation equipment.

(3) Construction precautions outlined in this report should be considered during planning and design.

(4) Ground water was encountered at depths from 7 1/2 to 22 feet below existing grade.

SCOPE

This report presents the results of a geotechnical investigation for a proposed condominium development to be constructed north of Murray Holladay Road (4800 South) at approximately 1100 East in Holladay, Utah. The report presents the foundation type, allowable soil pressures, free water conditions and other soil-related design and construction details.

PROPOSED CONSTRUCTION

We understand that approximately 42 units are planned for the development. The buildings will be up to three stories. The facility will also include a swimming pool and several retaining wall structures.

Should actual construction be different from that presented, we should be notified so that a re-evaluation of the recommendations given within this report, may be made.

SITE CONDITIONS

At the time of our investigation, the site consisted of hilly topography, with approximately 30 feet of relief across the site. Several homes were present on the site in the southwest portion and northeast corner. The houses are generally single-story on a shallow foundation. The north boundary of the site forms a ridge which overlooks the Hidden Lake condominium development.

Several areas of fill were observed on the site. Trash consisting of wood, barrels, metal and tanks were observed on site. The area where fill was observed on the ground surface, is shown approximately on Figure 1. Vegetation at the site is generally grass with a number of large trees.

SUBSOIL CONDITIONS

Subsoil conditions at the site were investigated by drilling nine exploratory borings at the locations shown on Figure 1. The borings were advanced using a truck mounted rotary drill equipped with 7-inch diameter hollow stem augers.

The subsurface soils encountered in the borings were somewhat variable across the site. The subsoils were generally a mixture of silt and clay. Silty sand was encountered at depths of 11, 6, 3, and 16 feet in Borings B-3, B-6, B-8, and B-9, respectively. Silty gravels were encountered at depths of 14 and 14 1/2 feet in Boring B-1 and B-4, respectively. One to 2 1/2 feet of fill was encountered in Borings B-3, B-5 and B-6.

The fill was quite variable between the 4 borings and consisted of clay, to clayey to silty sands and gravels. The fill contained a small to moderate amount of cobbles. The fill was generally moist to wet and brown to black in color.

The clay soils were generally slightly sandy to very sandy with occasional gravelly layers and occasional

cobbles. Consistency of the clay ranged from very soft to hard. Moisture content ranged from moist to wet. Color of the clay soils ranged from brown to green to black, with iron oxide staining.

The interlayered clays and silts contained a small to moderate number of silty sand layers. The silts and clays were generally in a loose to medium dense or stiff to very stiff condition. The silts and clays were generally moist to wet, brown to green-brown in color, with iron oxide staining.

The silty sands contained thin clay layers. Densities of the silty sands range from loose to dense. The silty sands were slightly moist to moist, brown to gray in color.

A laboratory investigation was conducted to determine the engineering charcteristics of the material obtained in the exploratory borings. Laboratory testing included standard property tests such as natural moisture content, dry unit weight, Atterberg limits and gradation. Swell consolidation tests were also conducted on selected samples of the soil to determine their consolidation characteristic and behavior under constant pressure upon wetting. Test results indicate that the clay and silt soils will have slight to moderate compression under light to moderate loads. A summary of the test results are shown on Figures 2 and 3, and on Table I. Results of the consolidation tests are shown on Figures 4 and 5. Gradation test results are shown on Figure 6.

Free water was encountered in Borings 1 and 7, at depths of 7 1/2 to 22 feet respectively.

FOUNDATION RECOMMENDATIONS

Based on the proposed construction, subsoil conditions encountered at the site and laboratory test results, the proposed buildings should be founded on spread footings placed on the natural soils below the existing topsoil and any existing fill. With the extent of surface fill on the site and the potential for fill in other areas, care should be taken to remove all fill from building areas. Footings may also be placed on compacted structural fill.

The following design and construction details should be observed:

(1) Footings placed on the natural soils or compacted structural fill, may be designed for a maximum soil bearing pressure of 1,500 pounds per square foot. Under this pressure, settlement is estimated to be on the order of 1 inch.

(2) All existing fill materials and disturbed soils should be removed from below footing areas. Higher bearing pressures may be considered if footings are placed on compacted structural fill.

(3) In areas where existing fill or disturbed soils have been removed from below the desired bearing elevation, the excavated area may be replaced with

compacted structural fill.

(4) Structural fill should be granular soils with less than 30 percent passing the No. 200 sieve and a maximum size less than 6 inches.

(5) Structural fill should be compacted to at least 95 percent modified Proctor density (ASTM D-1557) within 2 percent of optimum moisture content.

(6) Structural fill should extend beyond the footings a distance equal to the depth of fill beneath the footings.

(7) Footings should have a minimum width of at least 18 inches, and a minimum embedment of at least 18 inches. Lower bearing pressures should be used if these minimums cannot be maintained. Wider footings may have less embedment an deeper footings may be narrower than the values given above.

(8) Continuous foundation walls should be reinforced top and bottom to span an unsupported length of at least 10 feet.

(9) Exterior footings should be provided with at least 30 inches of soil cover above their bearing elevation for frost protection.

(10) We recommend that a representative of the soils engineer observe footing excavations and observe placement and frequently test compaction of structural fill.

SLAB ON GRADE CONSTRUCTION

The undisturbed natural soils exclusive of the topsoil, organics, or any uncompacted, untested fill, are suitable to support slab-on-grade construction. With the fill material observed on site, care should be taken to remove all existing fill from beneath building areas. Slabs may also be supported on compacted structural fill. A 4-inch layer of free draining gravel should be provided beneath the floor slabs. In areas where fill is required beneath the floor slabs to achieve the desired finished grade, the natural ground surface should be scarified to a depth of 6 inches, adjusted to near optimum moisture content and compacted to 90 percent modified proctor density. Fill should be nonexpansive granular soils.

SURFACE DRAINAGE

The following drainage precautions should be observed during construction and maintained at all times after the condominiums have been completed:

(1) Excessive wetting or drying of foundation excavations should be avoided during construction.

(2) Backfill around the buildings should be moistened and compacted to at least 85 percent modified Proctor density. Backfill supporting concrete or asphalt pavement should be compacted to 90 percent modified Proctor density.

(3) The ground surface surrounding the exterior of the buildings should be sloped to drain away from the buildings in all directions.

(4) Roof downspouts and drains should discharge well beyond the limits of all backfill.

WATER SOLUBLE SULFATES

Two samples of the subsoils were tested for their water soluble sulfate content. Results of these tests indicate that the samples contain less than 0.1 percent water soluble sulfate. Based on these results and published literature, the natural soils possess negligible sulfate attack potential on concrete placed adjacent to the soils. Therefore, sulfate resistant cement is not warranted. Other conditions may dictate the type of cement to be used in concrete placed adjacent to the natural soils.

PAVEMENT

The upper subgrade soils at the site consist of silts and clay soils. These soils are generally considered poor subgrade soils for pavement.

Based on an average daily traffic of 300 vehicles per day of which 100 are pickup trucks, and 2 garbage trucks per week, calculations indicate a pavement section consisting of 2 inches of asphaltic concrete overlying 9 inches of compacted, high quality base course. An alternative to this section, would be 2½ inches of asphaltic concrete overlying 7 inches of base course, the thicker asphalt section should be considered in areas of heavy traffic. Consideration may also be given to using Portland cement concrete pavement in dumpster loading areas. In each case of the cases listed above, the base course material was assumed to have a CBR value of at least 50. Other alternatives may be calculated based on subgrade preparation, the base course used and traffic loadings.

Prior to placing the pavement section, the upper organic topsoil and other deleterious material should be removed. Subgrade soils should be scarified to a depth of 8 inches, moisture content adjusted to near optimum and compacted to 90 percent modified Proctor density. After compaction, the area should be proof rolled with heavily loaded pneumatic-tired equipment and any soft areas deforming excessively under wheel loads, should be removed and replaced with granular fill compacted to at least 90 percent modified Proctor density. Fill required to bring the site to grade, should be compacted to 90 percent modified Proctor density. The on-site soils should be suitable as fill under pavement.

The collection and diversion of drainage away from the pavement surface is extremely important to the satisfactory performance of the pavement section.

RETAINING WALL STRUCTURES

Several retaining wall structures are planned for the development.

The following design and construction details should be observed:

(1) The retaining walls may be founded on natural soils or on compacted structural fill below existing topsoil, disturbed soil, or any existing fill material, and designed for a maximum allowable bearing pressure of

1500 pounds per square foot. This bearing elevation may be increased to 2000 pounds per square foot for temporary loading conditions.

(2) Backfill behind the retaining structure should be granular soils and/or the natural silt and clay soils, compacted to at least 90 percent modified Proctor density, near optimum moisture content.

(3) Based on fill material compaction requirements as listed above, the proposed retaining wall should be designed to resist a lateral pressure resulting from an equivalent fluid weight of 40 pounds per cubic foot for the granular backfill, and 50 pounds per cubic foot for the natural clay and silt soils. The equivalent fluid weight should be increased by 20 pounds per cubic foot to account for seismic design considerations. Lateral resistance should also include loads from traffic loadings.

(4) A sliding factor at the base of retaining walls is calculated to be on the order of 0.35.

SWIMMING POOL

Excavation for the swimming pool may be accomplished with conventional excavation equipment. The free water level will not likely be encountered within the excavation for the swimming pool. However, should the water rise above the bottom of the excavation, dewatering will be required to

facilitate construction of the swimming pool.

SEISMIC CONSIDERATIONS

The Uniform Building Code Seismic Zone Map of the United States places this site within Seismic Zone 3. The Seismic Safety Advisory Council of Utah places this site within Seismic Zone U-4, Based on these designations and the location of the site, the condominiums should be constructed conforming to the regulations and standards presented with the additional recommendations suggested by the Seismic Safety Advisory Council of Utah.

LIMITATIONS

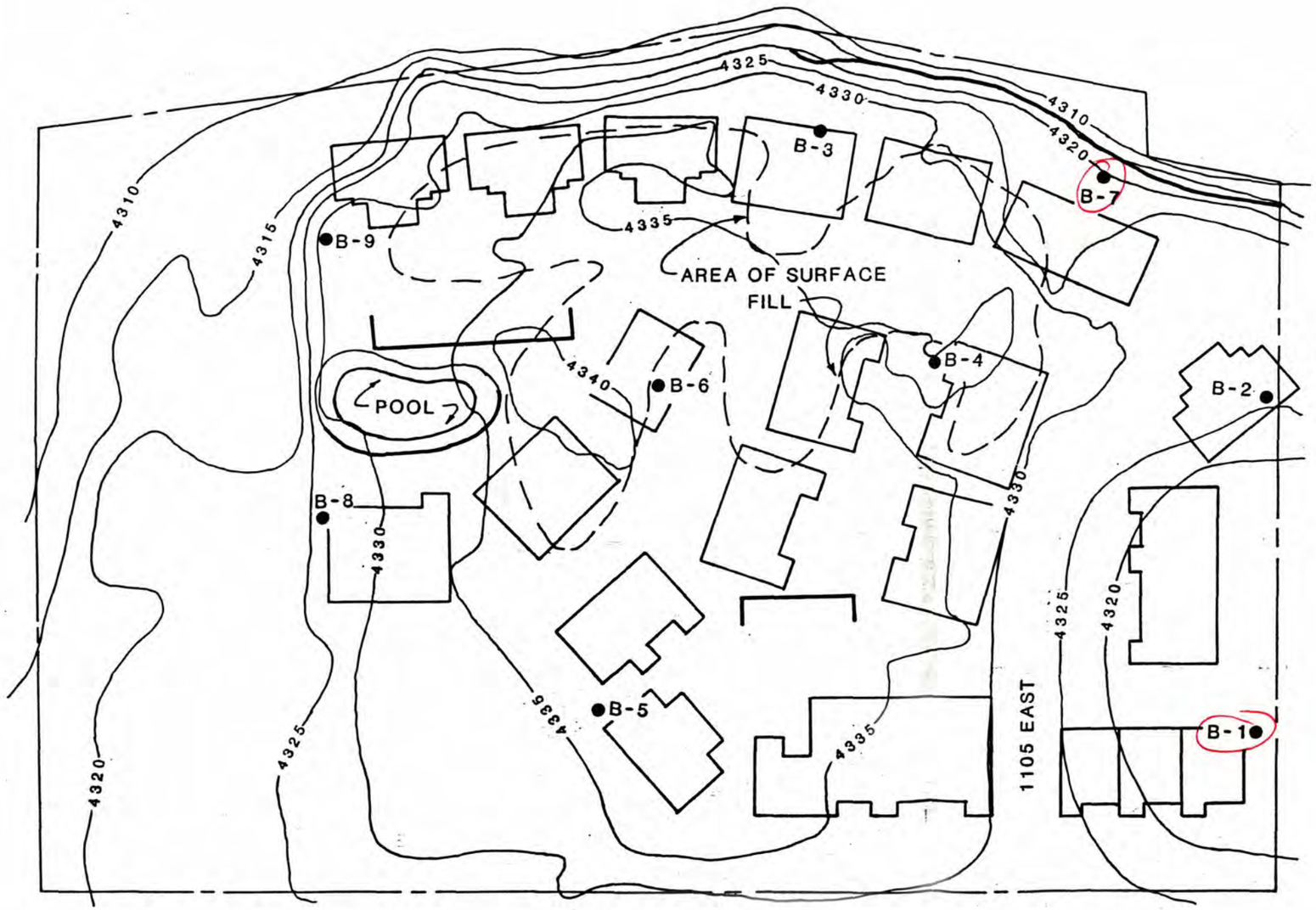
This report has been prepared in accordance with generally accepted soil and foundation engineering practices in this area for the use of the client for design purposes. The conclusions and recommendations submitted in this report are based upon the data obtained from the exploratory borings drilled at the locations indicated on the exploratory boring plan. The nature and extent of variations between exploratory borings may not become evident until excavation is performed. If during construction, soil and groundwater conditions appear to be different from those described herein, this office should be advised at once so that re-evaluation of the recommendations may be made. We recommend on-site observation of excavations and foundation bearing strata and frequent testing of fill placement by a representative of the soils engineer.

CHEN AND ASSOCIATES, INC.

Douglas R. Hawkes

Reviewed by James E. Nordquist, P.E.

DRH/irp



123'

2 Story

Phase II

NORTH

APPROXIMATE SCALE 1"=30'

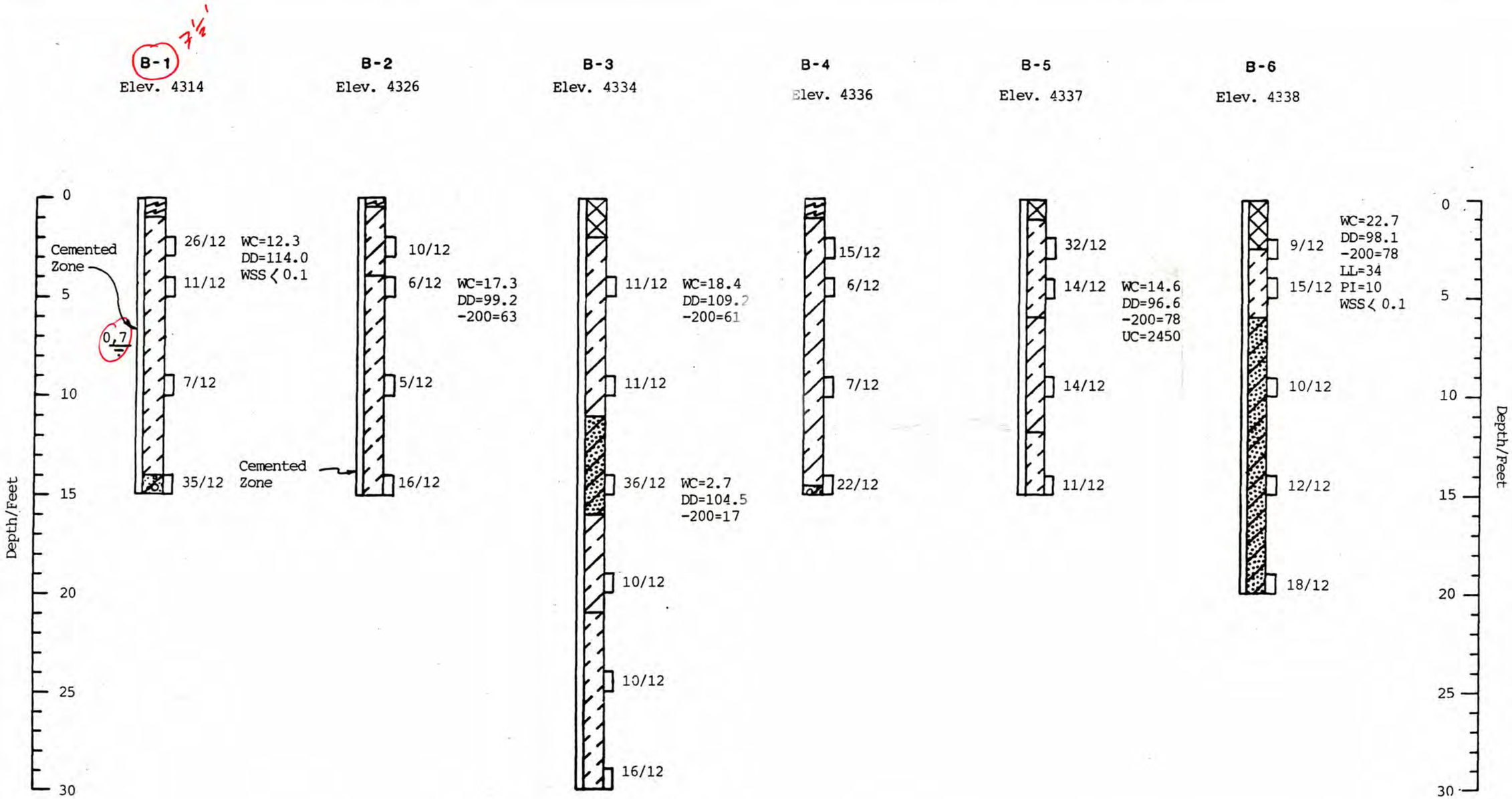
CONDOMINIUM DEVELOPMENT

1100 E. 4800 S.

HOLLADAY, UTAH

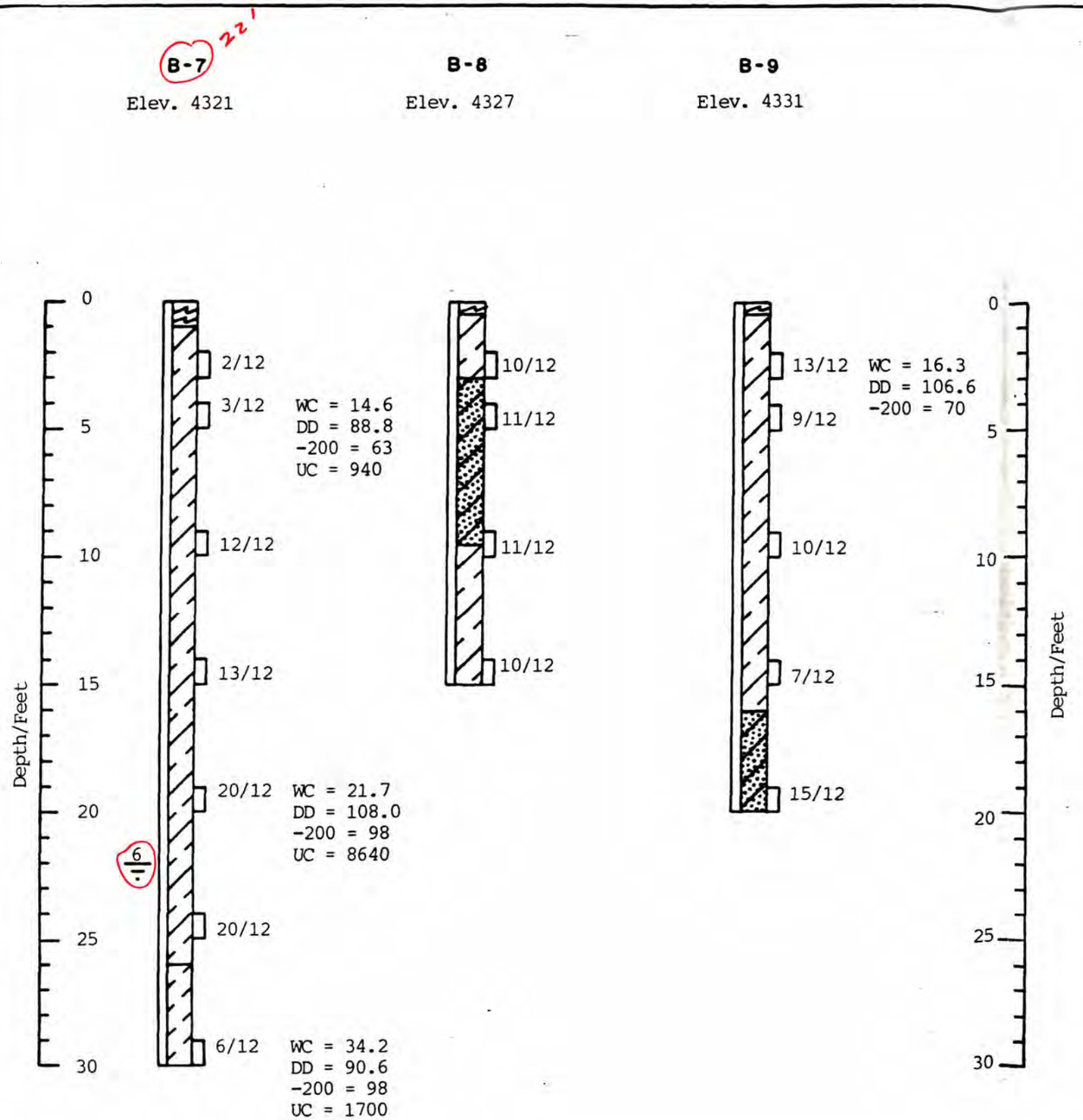
— RETAINING WALLS

#519985	chen and associates, inc.	LOCATION OF EXPLORATORY BORINGS AND PROPOSED CONDOMINIUM BUILDINGS	Figure 1



See Figure 3 for Legend and Notes

#519985	chen and associates, inc.	LOGS OF EXPLORATORY BORINGS	Figure 2



LEGEND

Fill - Clay with sand and gravel, cobbles, slightly moist to wet, brown.

Topsoil - Gravelly clay, moist, dark brown to black.

Clay (CL) - Slightly sandy to very sandy, silt and sand layers, occasional gravelly zones, very soft to hard, slightly moist to wet, brown to black,occasional cemented layers, iron oxide stained.

Clay to Silt (CL-ML) - Interlayered, silty sand layers, occasional gravelly layers, medium to very stiff, loose to medium dense, slightly moist to wet, brown to green to gray, iron oxide stained.

Sand - Slightly silty to silty, occasional thin clay and silt layers, loose, dense, slightly moist to moist, brown.

Gravel - Silty sandy, medium dense to dense, moist to wet, brown.

Indicates PVC pipe installed in hole to depth shown.

California Drive sample - The symbol 10/12 indicates that 10 blows of a 140-pound hammer falling 30 inches were required to drive the sampler 12 inches.

$\frac{6}{\nabla}$ Indicates depth to free water and number of days after drilling measurement was taken.

NOTES

1. Exploratory borings were drilled on May 16, 1985 with a 7-inch diameter continuous flight hollow stem power auger.
2. Locations on the site plan were measured approximately by pacing from features shown on the site plan provided.
3. Elevations of exploratory borings were obtained by interpolating between contours shown on the site plan provided.
4. The exploratory boring locations and elevations should be considered accurate only to the degree implied by the method used.
5. The lines between the materials shown on the boring logs, represent the approximate boundaries between material types and the transitions may be gradual.
6. Water level readings shown on the logs were made at the time and under the conditions indicated. Fluctuations in the water level may occur with time.
7. WC = Water Content (%); DD = Dry Density (pcf); -200 = Percent Passing No. 200 Sieve; UC = Unconfined Compressive Strenght (psf); WSS = Water Soluble Sulfate (%).

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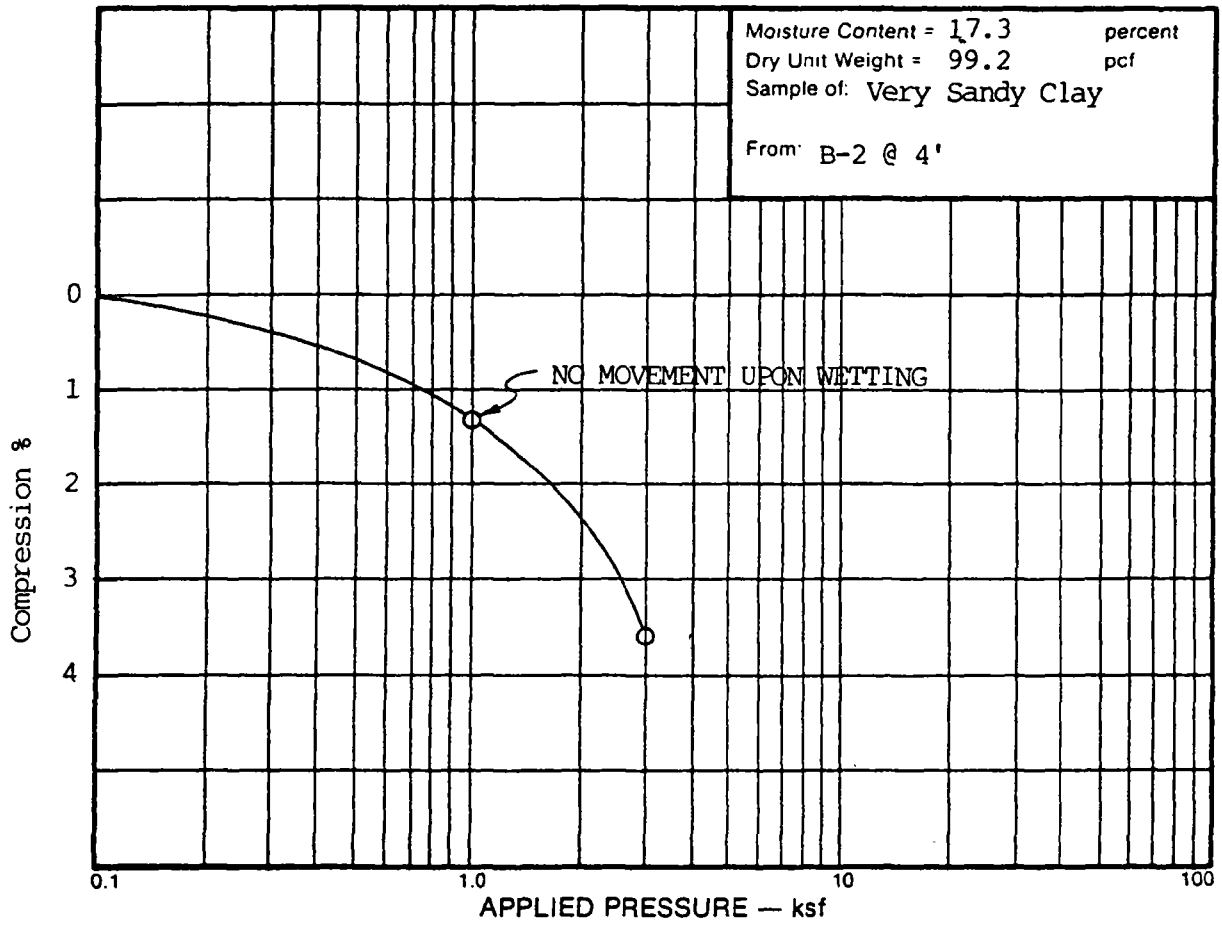

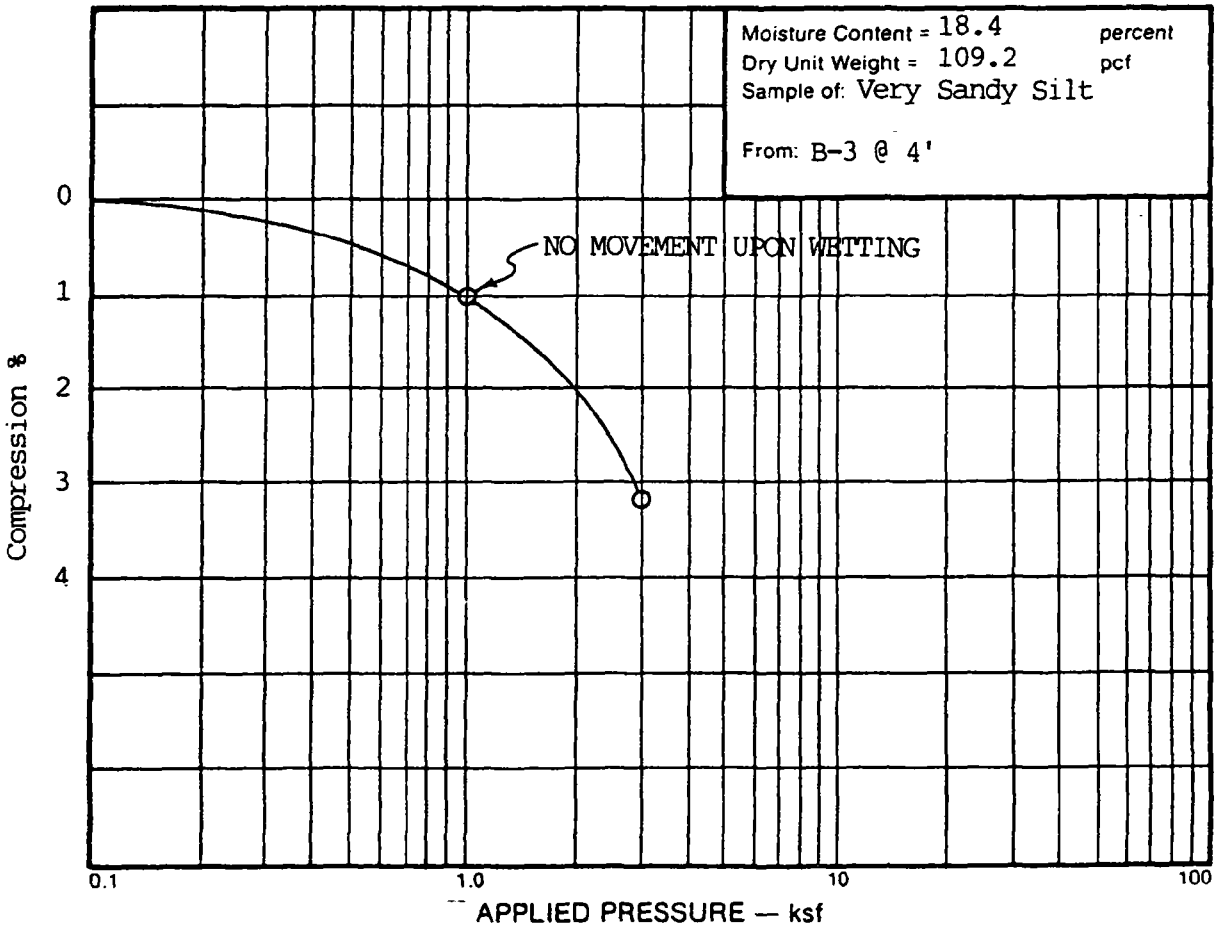

Job No. 519985 SWELL-CONSOLIDATION TEST RESULTS Fig. 4

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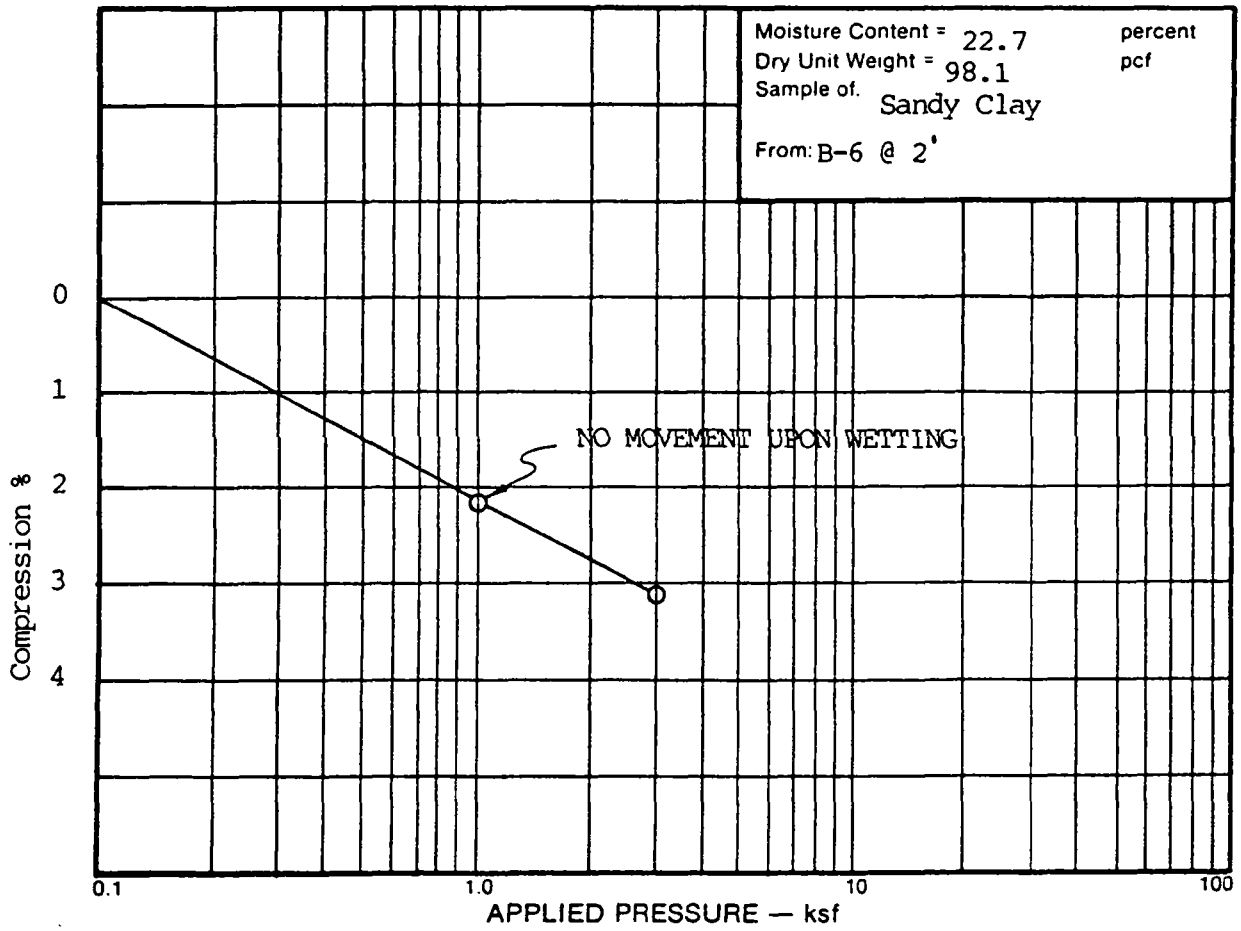
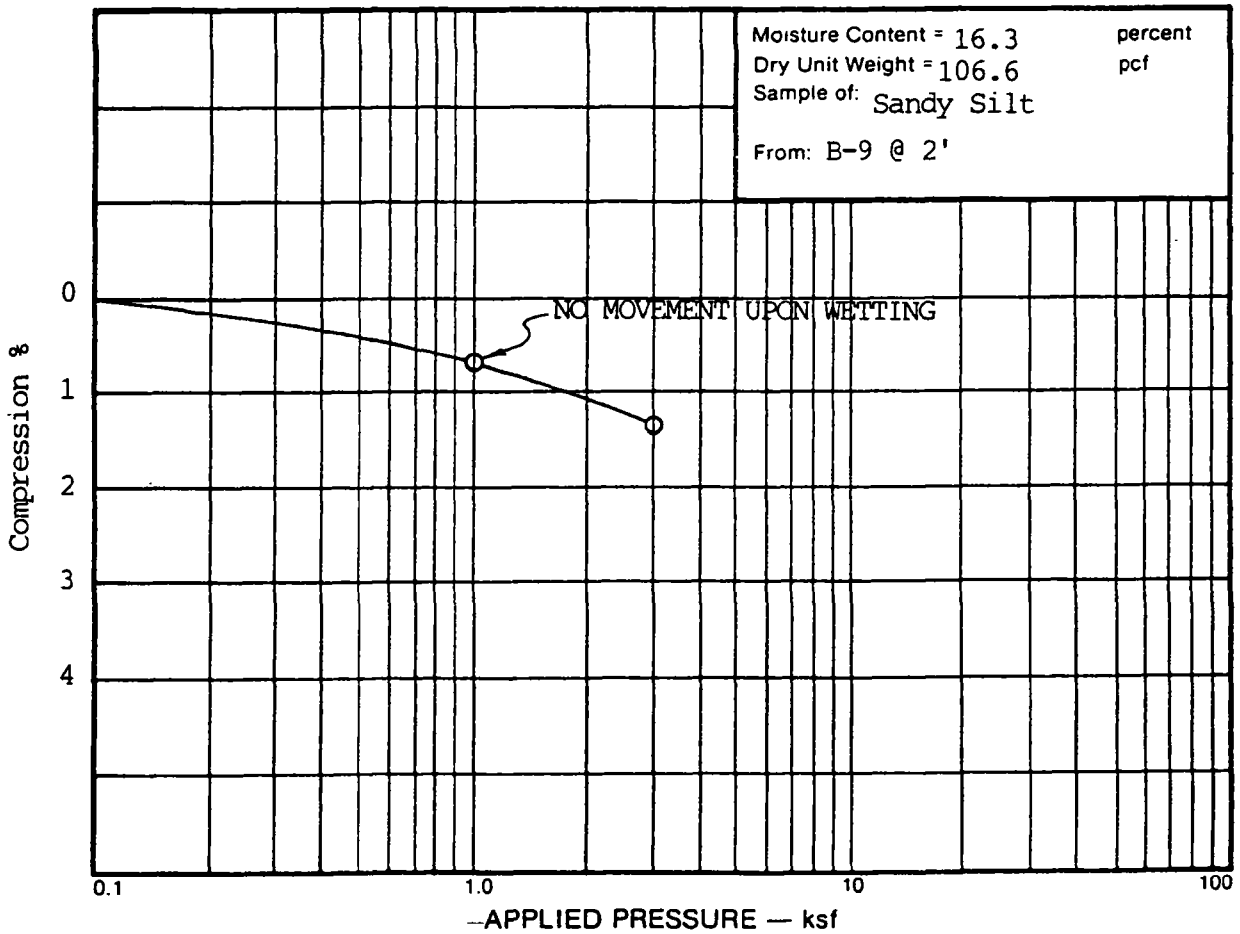
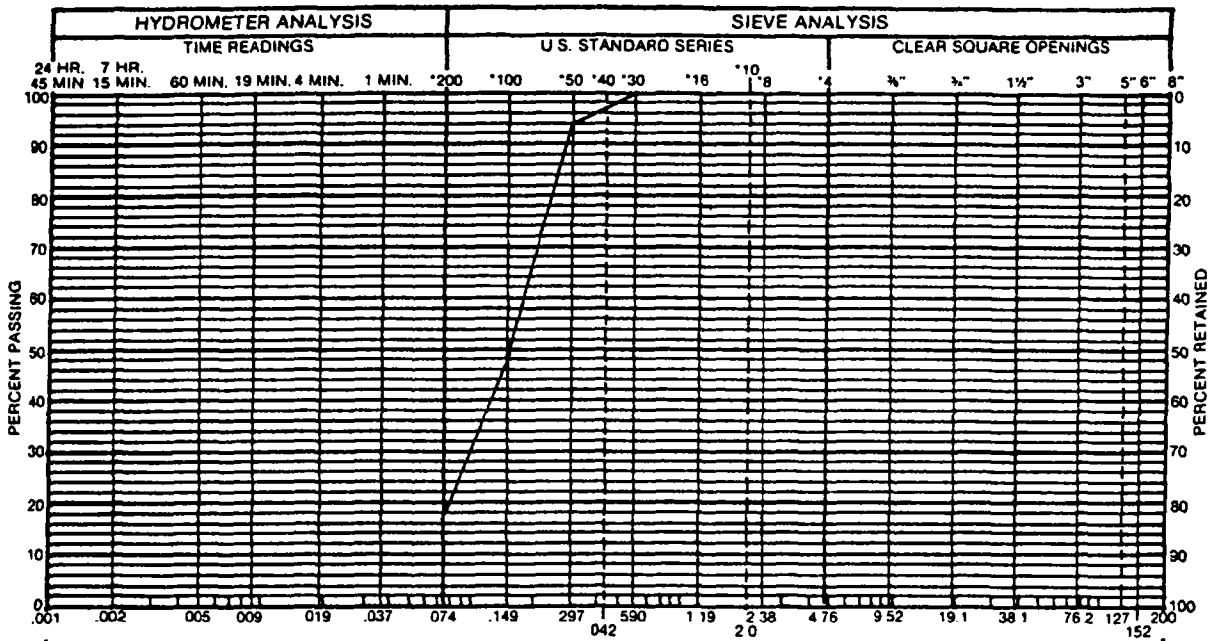




Job No. 519985 SWELL-CONSOLIDATION TEST RESULTS Fig. 5

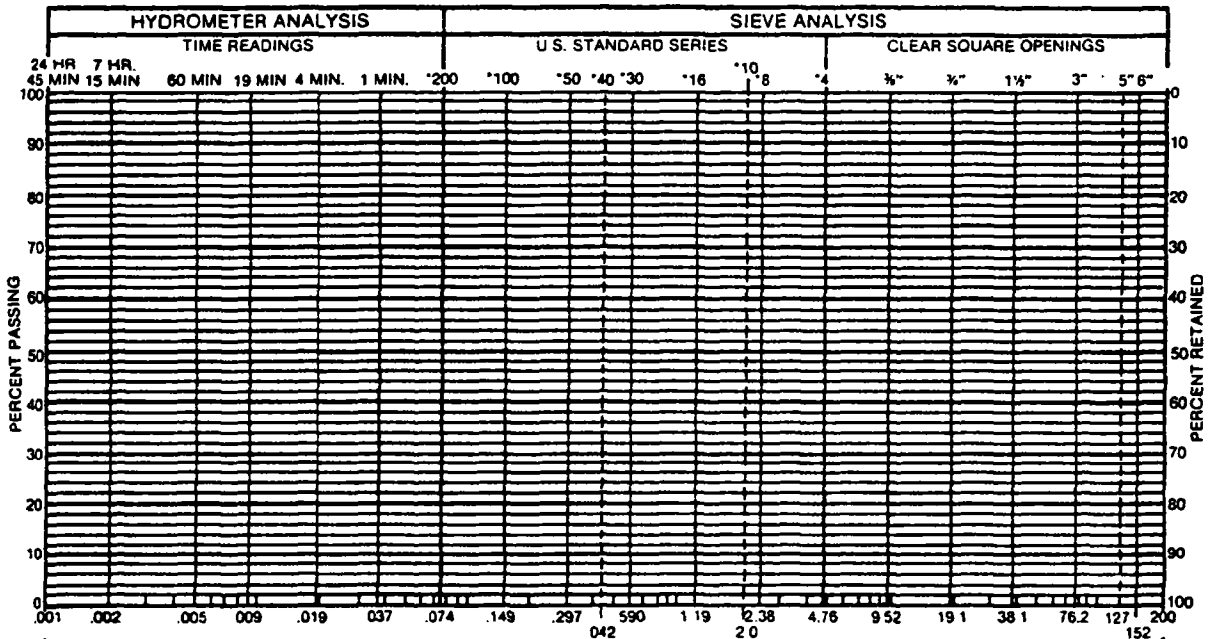
chen and associates, inc.



GRAVEL 0 % SAND 83 % SILT AND CLAY 17 %

LIQUID LIMIT % PLASTICITY INDEX %

SAMPLE OF Silty Sand FROM B-3 @ 14'



GRAVEL % SAND % SILT AND CLAY %

LIQUID LIMIT % PLASTICITY INDEX %

SAMPLE OF FROM

Job No. 519985 GRADATION TEST RESULTS Fig. 6

CHEN AND ASSOCIATES Job No. 519985

TABLE I

SUMMARY OF LABORATORY TEST RESULTS

SAMPLE LOCATION		NATURAL MOISTURE CONTENT (%)	NATURAL DRY DENSITY (PCF)	GRADATION		PERCENT PASSING NO. 200 SIEVE	ATTERBERG LIMITS		UNCONFINED COMPRESSIVE STRENGTH (PSF)	WATER SOLUBLE SULFATE (%)	SOIL OR BEDROCK TYPE
HOLE	DEPTH (FEET)			GRAVEL (%)	SAND (%)		LIQUID LIMIT (%)	PLASTICITY INDEX (%)			
1	2	12.3	114.0							<0.1	Very Sandy Clay
2	4	17.3	99.2			63					Very Sandy Clay
3	4	18.4	109.2			61					Very Sandy Silt
	14	2.7	104.5		83	17					Silty Sand
5	4	14.6	96.6			78			2450		Sandy Clay
6	2	22.7	98.1			78	34	10		<0.1	Sandy Clay
7	4	14.6	88.8			63			940		Very Sandy Silt
	19	21.7	108.0			98			8640		Clay
	29	34.2	90.6			98			1700		Clay
9	2	16.3	106.6			70					Sandy Silt