GEOSCIENCE ENGINEERING AND TESTING, INC.

GEOTECHNICAL & MATERIALS ENGINEERS

October 6, 2006

BM Design, L.L.C.
1463 Highway 6 South, Suite 200
Houston, Texas 77077

Attention: Mr. M.A. Majid

Reference: Geotechnical Investigation
Proposed Building
2600 Block of West Tidwell
Houston, Texas
GETI NO.: 06G15191

Dear Mr. Majid:

GEOSCIENCE ENGINEERING & TESTING, INC. is pleased to submit this report for the above referenced project. This study was authorized by you on October 02, 2006. This report briefly describes the procedures employed in our investigation and presents the conclusions and recommendations of our studies.

We appreciate the opportunity to work with you on this phase of the project. If you have any question concerning this report or require additional information, please contact us.

Very Truly Yours,

Alam Noor, MSCE, E.I.T.
Graduate Engineer

Jim A. Palavan, MSCE, P.E.
Chief Engineer

Copies Submitted: (2)

JIM A. PALAVAN
51001
REGISTERED
PROFESSIONAL ENGINEER

APPROVED
FOR BUILDING PERMIT ONLY
CITY OF HOUSTON
CODE ENFORCEMENT DIVISION
The owner is responsible for compliance with the Building Code. Such approved plans and specifications shall not be changed, modified or altered without authorizations from the building official, and all work shall be done in accordance with the approved plans
NO. 371

I. INTRODUCTION

Geoscience Engineering and Testing, Inc. hereby submits this report of Geotechnical Investigation of subsurface conditions at the site of the proposed Building located at 2600 Block of West Tidwell Road in Houston, Texas. GETI's investigation was authorized by Mr. M.A. Majid with BM Design, L.L.C. on October 02, 2006.

II. PURPOSE

The purpose of the Geotechnical Investigation was to determine the subsurface soil conditions at the site of the proposed Building with particular reference to the recommendations for the design of the foundation for the structure.

III. SUBSURFACE EXPLORATION

1. General

This report presents the results of our soil exploration and foundation analysis for the proposed Building located at 2600 Block of West Tidwell Road in Houston, Texas.

Scope of this investigation included a reconnaissance of the immediate site, the subsurface exploration, field and laboratory testing, an engineering analysis and evaluation of the subsurface materials. The purpose of this subsurface exploration and analysis was to determine soil profile components, the engineering characteristics of the subsurface materials and to provide criteria for use by design engineers and architects in preparing the foundation design and pavement.

The exploration and analysis of the subsurface conditions reported herein are considered in sufficient detail and scope to form a reasonable basis for the recommendations. The recommendations submitted are based on the available soil information and the preliminary design details furnished by Mr. M.A. Majid with BM Design, L.L.C. Any revision in plans for the proposed Building from those enumerated in this report should be brought to the attention of the soil engineer, so that he may determine, if changes in the recommendations are required. If deviations from the noted subsurface conditions are encountered during construction, they should also be brought to the attention of the soil engineer.

2. Description of the Site:

The site of the proposed Building upon which this subsurface exploration has been made, is located at 2600 Block of West Tidwell Road in Houston, Texas. The site soil is relatively level and cleared. The surface soils were wet and soft at the time of drilling operation.

3. Field Investigation:

The field investigation, which was completed on October 03, 2006, was to determine the engineering characteristics of the subsurface materials included a reconnaissance of the project site, drilling the exploratory borings and recovering the representative soil samples.

The subsurface soil conditions were explored by advancing and sampling two (2) soil borings. The soil borings B-1 and B-2 were drilled to a depth of fifteen (15) feet below existing ground surface. The approximate soil boring locations are shown on the attached soil Boring Plan, Plate No. 1.

Sample depth and description of soil classification (based on the Unified Soil Classification System) are presented on the Soil Boring Logs, Plate Nos. 2 and 3. Keys to terms and symbols used on the soil boring logs are shown on Plate No. 4.

The soil borings were of three-inch nominal diameter. Undisturbed soil samples were obtained at two (2) foot intervals continuously to a depth of ten (10) feet and at five (5) foot intervals thereafter. The soil borings were performed with a drilling rig equipped with rotary head. Conventional solid-stem augers were used to advance the holes. Representative disturbed or undisturbed soil samples were obtained employing thin-walled sampling procedures in accordance with ASTM D-1587. The obtained soil samples were extruded from the tube and visually classified in the field. Soil samples were identified according to the boring number and depth and wrapped in aluminum foil and polyethylene plastic wrapping bags to prevent moisture loss and disturbance. All of the samples were transported to our geotechnical laboratory for examination, testing and analysis. All borings were backfilled after final water reading were obtained with the soil cuttings accumulated during the drilling operation unless noted otherwise on the soil boring logs.

3.1 Field Strength Tests:

During the field boring operation, samples of the cohesive soil from the thin-walled tube were frequently tested in compression by use of a calibrated soil penetrometer to aid in determining the strength of the soil.

3.2 Water Level Measurement:

The information in this report summarizes condition as found on the date the borings were drilled. Free groundwater was not encountered during the drilling operation. Long-term monitoring of the groundwater level was beyond the scope of this study. It should be noted that the groundwater table may be expected to fluctuate with environmental variations such as frequency and magnitude of rainfall and the time of the year when construction begins.

4. Surface Fault:

A surface fault investigation is beyond the scope of this investigation. It should be noted that the coastal plains in this region has a complex geology, which included active surface faulting.

5. Laboratory Testing:

In addition to the field investigation, a supplemental laboratory investigation was conducted to ascertain additional pertinent engineering characteristics of the subsurface materials necessary in analyzing their behavior under the proposed loading conditions. During the laboratory investigation all field soil samples from the boring were examined and classified by a soil engineer. Laboratory tests were then performed on selected soil samples in order to evaluate and determine the physical and engineering properties of the soils in accordance with the prescribed ASTM procedures. Strength properties of the soils were determined by means of unconfined compression tests performed on undisturbed samples.

The type and number of the laboratory tests performed for this investigation are:

Descriptions	No. of Test
Hand Penetrometer Test	9
Moisture Content Test	12
Atterberg Limits	4
Dry Density Test	2
Unconfined Compression Test	2

The tests noted above were performed to establish the index properties and to aid in the proper classification of the subsurface soils. The test results are shown on the soil boring logs and are presented on Plate Nos. 2 and 3.

IV. GENERAL DESCRIPTION OF SUBSURFACE MATERIALS

The specific subsurface stratigraphy as determined by the field exploration is shown in detail on the soil boring logs herein. However, the stratigraphy can be generalized as follow:

Depth (FT.)	Description
0'-2'	Possible Fill: Dark gray very SANDY CLAY to CLAYEY SAND with roots
2'-15'	Soft to very stiff light gray and tan SANDY CLAY with ferrous nodules (CL) *

*Classification is in accordance with the Unified Soil Classification System

Swell Potential:

The Atterberg Limit tests indicate that the Liquid Limits of soil in the upper eight (8) feet is in the order of 32 to 40 and the plasticity index (P. I.) is in the order of 16 to 24. The subsoil would then be described as sandy clays having a low to moderate shrink/swell potential.

V. FOUNDATION RECOMMENDATION

1. Foundations and Risks:

Many lightly loaded foundations are designed and constructed on the basis of economics, risks, soil type, foundation shape and structural loading. Many times, due to economic considerations, higher risks are accepted in foundation design. It should be noted that some levels of risk are associated with all types of foundations. All of these foundations must be stiffened in the areas where expansive soils are present and trees should be removed prior to construction.

2. Foundation Discussion:

In general, the foundation for the structures must satisfy two independent criteria. First, the maximum design pressure exerted at foundation levels should not exceed the allowable net bearing pressure based on an adequate factor of safety with respect to soil shear strength.

Second, the magnitude of total and differential settlements or heave under sustained foundation loads must be such that the structure movement is within tolerable limits.

Various types of foundation such as Slab-on-Grade, Spread Footings, Underreamed Drilled Footings, Straight Shaft Footings etc. have been discussed for the support of the proposed structure. Based on the field investigation and laboratory test results, the soils are sandy clays having a low to moderate shrink/swell potential. Details of soil strata are given in soil boring logs, Plate Nos. 2 and 3. In our opinion, for this type of soil strata both Underreamed Drilled Footings (Drilled Piers) and Slab-on-grade (Shallow Foundation) are considered suitable foundation systems. Details are given in the following section VI "Recommended Foundation System".

VI. RECOMMENDED FOUNDATION SYSTEM

1. Underreamed Footings (Drilled Piers):

Based on the soil condition revealed by the field soil test borings and laboratory tests, it is our understanding that the structure at the site can be supported on a foundation system comprised of drilled underreamed footing bearing at a depth of six (6) to seven (7) feet below existing grade in the layer of very stiff light gray and tan sandy clays with ferrous nodules. The footing on these sites may be sized for a net allowable bearing pressure of 3,500 psf for dead load plus sustained live load. The bearing pressure contains a factor of safety of 2 and may be increased 25 percent for total load conditions, whichever is critical. Spacing between the centers of the two adjacent footings should be at least 3 times of the bell diameter.

The plinths of underreamed footing should be reinforced with sufficient reinforcing (tension) steel to resist the potential tension force caused by uplift loads due to expansive soils between the depth of seasonal moisture changes nine (9) feet and the final ground surface elevation. An adhesion value of 0.5 tsf should be applied to the straight shaft portion of the drilled footings for computation of uplift loads.

Caving of soils around the footings may occur during construction of the drilled piers. In case the bell on the drilled footings cannot be constructed due to the occurrence of caving, it is recommended that the construction contractor should use **cased piers** or convert this Underreamed footings to **Straight shaft footings** immediately. The bottom of the piers should be dry and clean. If water encounters during installation, it should be pumped out prior to concrete placement. We recommend that the drilling be performed under the supervision of a Geotechnical Engineer.

Experience indicates that underreams can be successfully installed and based on local practice for performing underreamed drill pier is to utilize 3.0 to 1.0 for underream to shaft ratio. Should caving occur during belling operation, the shaft diameter may have to be increased, thereby changing the bell to shaft ratio. If the soil conditions warrant the changing of the shaft diameter, the structural engineer of record should be informed about any changes, because they may require a change in reinforcing steel or bell diameter. Another alternative, would be to change the typical 45 degree angle of the underreamed to 60 degree. The concrete should be placed in a timely manner after drilling to minimize the potential for caving of the foundation soils.

No footing should be poured without the prior approval of the project engineer, architect or owner's representative. Since the exact and locations of the footings are not know at this time, a detailed settlement analysis was not authorized, nor performed. It is anticipated that the footing designed using the recommended allowable bearing capacity will experience small settlement that will be within the tolerable limits for the proposed structure.

Inspection during Construction of Drilled Piers:

The recommendations are based on the subsoil data in the field exploration and laboratory testing. Due to the geological deposition of the Pleistocene soils in the Gulf Coastal area, variances may occur between boring locations.

Therefore, the footing excavations should be inspected under the supervision of a geotechnical engineer to confirm that the bearing soils are similar to those encountered in our field exploration and that the footing area have been properly prepared. The geotechnical engineer should be immediately notified if any subsoil condition be uncovered that will alter the conclusions and recommendations contained in this report. Further investigation and supplemental recommendations may be required, if such a condition is encountered. Prior to placement of concrete, the footings should be inspected to monitor that:

1. The footing bears in the proper bearing strata at the depth recommended in this report.

2. The footing shafts are of the proper dimensions and reinforcing steel is placed as shown on the structural drawings.

3. The footings are concentric with the shaft and the shaft has been drilled plumb within specified tolerances.

4. Excessive cutting, build up of cutting, and any other soft compressible materials have been removed from the bottom of the excavations.

Floor Slab Options:

There may be two options for floor slab:

a) Slab supported by piers only: In this option slab is supported by only grade beams, which are supported by piers. In this case loads are applied on only piers. The slab should be tied and stiffened with grade beams.

b) Slab supported by grade beams and sub-grade: Another option is that the slab may be supported by the grade beams and the sub-grade (soil beneath the slab). For this option the surficial soil containing roots, organic and unsuitable materials should be stripped off and replaced by non-active type Structural select fill materials having a P. I. between 10 and 20 to minimize any possibility of vertical displacement. The structural select fill materials should be filled according to the procedures prescribed in the section "Structural Fill and Subgrade Preparation".

2. Post-Tension Slab Design Parameters:

Based on the soil conditions revealed by the field soil test borings and referring the guide from "Design and Construction of Post-Tensioned Slabs on Ground", published by Post-Tensioning Institute (PTI), the structure can be supported on a foundation system comprised of post-tensioned slab. The soil parameters to be utilized for design are as follows:

1.	Minimum Grade Beam Depth: (Below final Grade)	24 inches
2.	Minimum Grade Beam Width:	12 inches
3.	Effective Plasticity Index (PI):	20
4.	Depth to Constant Soil Suction:	Approximately 9-ft
5.	Principal Clay Mineral:	Montmorillonite
6.	Constant Suction Value:	pF = 3.6
7.	Thornthwaite Moisture Index:	18
8.	Estimated Total Settlement:	Less than 1-in.
9.	Estimated Moisture Velocity:	0.7 in/month
10.	Edge Moisture Variation Distance:	
	Center Lift:	7.2 ft
	Edge Lift:	4.9 ft
11.	Differential Swell:	
	Center Lift:	0.75 inch
	Edge Lift:	0.96 inch
12.	Allowable bearing capacity:	
	Dead Load:	1,000 psf
	Total Load:	1,500 psf
13.	Slab subgrade coefficient	
	Slab-on-sand bedding:	1.00
	Slab-on-polyethylene over sand:	0.75

The PTI and BRAB design parameters, presented above, are based upon our interpretation of the on-site soil conditions found at the time of our field investigation and the empirical data presented in the BRAB and design manual.

The PTI differential soil movements estimates do not account for site preparation and vegetative influences, such as prior trees and residential landscaping, which can greatly influence foundation performance. The actual performance of slab-on-grade foundations will largely depend on actual soil moisture conditions, construction techniques, site preparation and landscaping. The construction of post-tensioned slabs requires close attention to detail during construction.

The surficial soil containing roots, organic and unsuitable materials should be removed and replaced with structural select fill and compacted as per recommendations for select fill. A bedding layer of leveling sand, two (2) inches thick should be placed immediately beneath the floor slab. A vapor barrier consisting of six mil plastic sheeting should be placed over the sand cushion to prevent water migration through the concrete slab. The excavations for the grade beams should be clean and free of any loose materials prior to concrete placement.

Information was not available on whether fill will be used to raise site grade prior to foundation construction. In the event fill is placed on the site, specifications should require a uniform thickness throughout the slab area and placement in accordance with our recommendations given in the section "Structural Fill and Subgrade Preparation". Lack of proper consideration of these factors will result in additional stresses and inferior slab performance.

In general, site preparation should consist of removing any existing foundations, paved areas and undesirable materials. The exposed subgrade should be proof-rolled to detect local weak areas which should be excavated, processed, and recompacted in loose lifts of approximately eight-inch thickness.

VIII. GENERAL CONSTRUCTION CONSIDERATIONS

1. Site Preparation:

Our recommendations for site preparations in the floor slab are summarized below:

1.1 In general, remove all vegetation, tree roots, organic topsoil and any undesirable materials from the construction area. Tree trunks and roots under the floor slabs should be removed to a root size of less than 0.5-inch. We recommend that the stripping depth be evaluated at the time of construction by a soil technician.

1.2 Any on-site fill soils, encountered in the structure areas during construction, must have records of successful compaction tests signed by a registered professional engineer that confirms the use of the fill and record of construction and earthwork testing. These tests must have been performed on all the lifts for the entire thickness of the fill. In the event that no compaction test results are available, the fill soil must be removed, processed and recompacted in accordance with our recommendations of "Structural Fill and Subgrade Preparation". Excavation should extend at least two feet beyond the structure area. Alternatively, the existing fill soils should be tested comprehensively to evaluate the degree of compaction in the fill soils.

1.3 The subgrade areas should then be proofrolled with a loaded dump truck, scraper, or similar pneumatic-tired equipment. The proofrolling serves to compact surficial soils and to detect any soft or loose zones. Any soils deflecting excessively under moving loads should be undercut to firm soils and recompacted. The proofrolling operations should be observed by an experienced geotechnician.

1.4 In the areas where expansive soils are present, rough grade the site with structural fill soils to insure positive drainage. Due to their high permeability of sands, sands should not be used for site grading where expansive soils are present.

1.5 We recommend that the site and soil conditions used in the structural design of the foundation be verified by the engineer's site visit after all of the earthwork and site preparation has been completed prior to the concrete placement.

2. Structural Fill and Subgrade Preparation:

It is recommended that the subgrade and fill be prepared as follow:

2.1 The site should be stripped to suitable depth to remove any top soil and miscellaneous fill material. The exposed subgrade surface then should be proof-rolled. All soft or loose soils should be removed and replaced with select fill materials.

2.2 The natural subgrade should be scarified to a minimum depth of six (6) inches. The scarified soils should then be recompacted to a minimum of 95 percent of the maximum dry density as determined by the Standard Proctor Density Test (ASTM-D 698). The moisture content should range -1% to +3% of optimum moisture.

2.3 Structural Select fill used to elevate the grade should consist of a clean Sandy Clay with Liquid Limit less than 35 and a Plasticity Index (P.I.) between 10 and 20.

2.4 The Structural Select fill material should be placed in maximum of eight (8) inch loose lift and compacted to a minimum of 95 percent of the maximum dry density as per ASTM D-698. The moisture content should be with -1% to +3% of optimum moisture.

2.5 A bedding layer of leveling sand, a maximum of two (2) inches thick may be placed immediately beneath the floor slab. A vapor barrier consisting of six (6) mil plastic sheeting should be placed over the sand cushion to prevent water migration through the concrete slab. The excavations for the grade beams should be clear and free of any loose materials prior to concrete placement.

2.6 In cut areas, the soils should be excavated to grade and the surface soils proofrolled and scarified to a minimum depth of six inches and recompacted to the previously mentioned density tests at the time of construction.

3. Surface Drainage:

It is recommended that the site drainage be well developed. Surface water should be directed away from the foundation soils (use a minimum of 2% with 10 feet away of foundation). No ponding of surface water should be allowed near the structure. The following drainage precaution should be observed during construction and at all times after the structure has been completed.

1) Backfill around the structure should be a cohesive soil material which should be moistened and compacted to at lease ninety (90) percent of standard proctor density. Any cohesionless soil material accumulated around the perimeter of the structure during construction should be removed and not allowed to be mixed with or covered by the backfill material.

2) Where landscaping is to be installed next to the perimeter of grade beam, a moisture barrier or other suitable means should be installed to prevent moisture from entering the underlying clay soils.

3) Roof downspouts and drains should discharge well away from the limits of the foundation or grade beams.

4. Vegetation Control:

We recommend trees not to be closer than half the canopy diameter of the mature tree from the grade beams, typically a minimum of 20 feet. This will minimize possible foundation settlement caused by the tree root systems.

VIII. DISCLAIMER

The information and recommendation contained in the report summarized condition found at the site specified and on the date the field exploration was completed. The attached soil boring logs are a true representation of the soils encountered at the stratigraphy as found during the field exploration and drilling of the subject site.

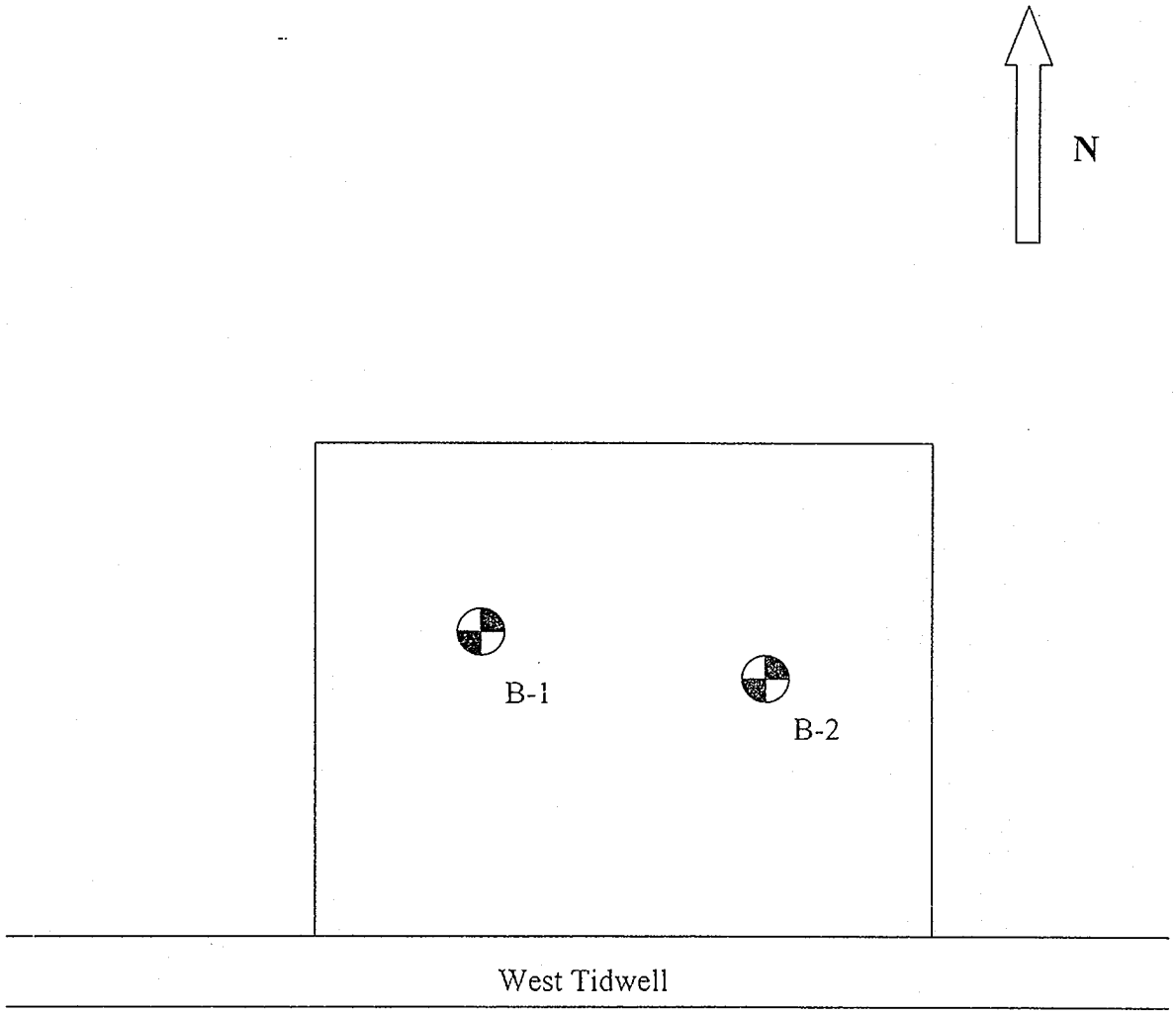
Reasonable variations from the subsurface information presented in this report are assumed. If condition encountered during construction are significantly different than those presented in this report, GETI should be notified immediately.

The report was prepared for the sole and exclusive use by our client, based on specific and limited objectives. All reports, boring logs, field data, laboratory test results, and other documents prepared by GETI as instruments of service shall remain the property of GETI. Reuse of these documents is not permitted without written approval by GETI. GETI assumes no responsibility or obligation for the unauthorized use of this report by other parties and for purposes beyond the stated project objectives and work limitations.

In addition, the construction process may itself alter site soil conditions. Therefore, experienced geotechnical personnel should observe and document the construction procedures and all conditions encountered. We recommend that the owner retain Geoscience Engineering and Testing, Inc. to provide this service as well as the construction material and testing and inspection required during the construction phase of the project. We would welcome the opportunity to discuss our recommendation with you and hope we may have the opportunity to provide any additional studies or service to complete this project.

The following illustrations are attached and complete this report:

	Plate
Boring Location Plan	1
Boring Logs	2 and 3
Symbols and Terms used on Boring Logs	4
ASTM Procedures	5



Approximate Boring Locations

LOCATION
Proposed Building
2600 Block of West Tidwell
Houston, Texas
GETI NO.: 06G15191

NOT TO SCALE

PLATE NO. 1

LOG OF BORING

PROJECT: Proposed Building
2600 Block of West Tidwell
Houston, Texas

CLIENT:

BORING NO. B-1
PROJECT NO. 06G15191
DATE 10-3-06
SURFACE ELEVATION

FIELD DATA				LABORATORY DATA							
DEPTH (FT)	SOIL SYMBOL	SAMPLES	N: BLOWS/FT T: INCHES/100 BLOWS P: TONS/SQ FT R: PERCENT RQD: PERCENT	MOISTURE CONTENT (%)	DRY DENSITY POUNDS/CU.FT	ATTERBERG LIMITS (%)			MINUS NO. 200 SIEVE (%)	SHEAR STRENGTH (TONS/SQ FT)	DESCRIPTION OF STRATUM
						LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI			
				10							Possible Fill: Dark gray very SANDY CLAY to CLAYEY SAND with roots
											2.0
			P=2.5	11		40	16	24			Very stiff light gray and tan SANDY CLAY
5			P=3.5	11							- ferrous nodules below 6'
			P=4.5	10	123	34	16	18		2.10	
10			P=2.5	12							
											- soft below 13'
			P=0.25	13							
15											15.0
20											
25											
30											

DRILLING METHOD(S):
Dry Auger

GROUNDWATER INFORMATION:
Groundwater was not encountered during drilling operation

N - STANDARD PENETRATION TEST RESISTANCE
T - TXDOT CONE PENETRATION RESISTANCE
P - POCKET PENETROMETER RESISTANCE
R - PERCENTAGE OF ROCK CORE RECOVERY
RQD - ROCK QUALITY DESIGNATION

GEOSCIENCE ENGINEERING AND TESTING, INC.

PLATE NO. 2

LOG OF BORING

PROJECT: Proposed Building
2600 Block of West Tidwell
Houston, Texas

CLIENT:

BORING NO. B-2
PROJECT NO. 06G15191
DATE 10-3-06
SURFACE ELEVATION

DRILLING METHOD(S):
Dry Auger

GROUNDWATER INFORMATION:
Groundwater was not encountered during drilling operation

FIELD DATA				LABORATORY DATA							
DEPTH (FT)	SOIL SYMBOL	SAMPLES	N: BLOWS/FT T: INCHES/100 BLOWS P: TONS/SQ FT R: PERCENT ROD: PERCENT	MOISTURE CONTENT (%)	DRY DENSITY POUNDS/CU.FT	ATTERBERG LIMITS (%) LIQUID LIMIT LL	ATTERBERG LIMITS (%) PLASTIC LIMIT PL	ATTERBERG LIMITS (%) PLASTICITY INDEX PI	MINUS NO. 200 SIEVE (%)	SHEAR STRENGTH (TONS/SQ FT)	DESCRIPTION OF STRATUM
				9							Possible Fill: Dark gray very SANDY CLAY to CLAYEY SAND with roots
											2.0
			P=2.5	12		32	16	16			Very stiff light gray and tan SANDY CLAY
5			P=3.0	10		39	15	24			
			P=4.0	12							
											- ferrous nodules below 8'
10			P=4.5	11	121					1.50	
											- soft below 13'
15			P=0.25	13							15.0
20											
25											
30											

N - STANDARD PENETRATION TEST RESISTANCE
T - TXDOT CONE PENETRATION RESISTANCE
P - POCKET PENETROMETER RESISTANCE
R - PERCENTAGE OF ROCK CORE RECOVERY
RQD - ROCK QUALITY DESIGNATION

GEOSCIENCE ENGINEERING AND TESTING, INC.

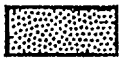
KEY TO SOIL CLASSIFICATION AND SYMBOLS

SOIL TYPES

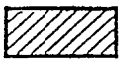

Gravel (GW, GP, GM, GC)


Clayey Sand (SC)


Sandy Silt (ML)


Sand (SW, SP)


Clayey Silt (ML)


Silty or Sandy Clay (CL)


Silty Sand (SM)


Silt (ML)


Clay (CH)

CONSISTENCY OF COHESIVE SOILS

Description	Shear Strength-KSF	Penetration Resistance Blows / Ft
Very Soft	Less than 0.25	0 - 2
Soft	0.25 - 0.50	2 - 4
Firm	0.50 - 1.00	4 - 8
Stiff	1.00 - 2.00	8 - 15
VeryStiff	2.00 - 4.00	15 - 30
Hard	Greater than 4.00	> 30

RELATIVE DENSITY OF COHESIONLESS SOIL

Description	Penetration Resistance Blows / Ft	Relative Density , %
Very Loose	0 - 4	0 - 15
Loose	4 - 10	15 - 35
Medium Dense	10 - 30	35 - 65
Dense	30 - 50	65 - 85
Very Dense	> 50	85 -100

SOIL STRUCTURE

CALCAREOUS NODULES	- Nodules of Calcium Carbonate
FERROUS NODULES	- Nodules of Ferrous Material
SLICKENSIDED	- Having inclined planes of weakness that are slick and glossy
BLOCKY	- Having inclined planes of weakness that are frequent and rectangular in pattern
LAMINATED	- Composed of thin layers of varying soil type and texture
FISSURED	- Containing shrinkage cracks frequently filled with fine sand
INTERBEDDED	- Composed of alternate layers of different soil types

SAMPLE SYMBOLS


Shelby Tube Sample


Standard Penetration Test


Auger or Wash Sample


No Recovery

GROUNDWATER


(24 hr) - Water level after drilling (time increment after drilling)

- Free water observed during drilling

FAILURE DESCRIPTION (COMPRESSION TEST)

B - Bulge	SLS - Failure surface occuring along slickensided plane
S - Shear	SAS - Failure surface occuring along or in sand seam
M/S - Multiple Shear	SS - Failure surface occuring in or along other secondary structure such as calcareous pockets

PLATE NO: 4

Soil samples are tested in the laboratory as specified by the following ASTM test procedures:

Designation	Short Title
ASTM D421	Dry Preparation of the Soil Sample for Practice Size Analysis Determination of Soil Constants
ASTM D422	Particle Size Analysis of Soils
ASTM D698	Moisture-Density Relation (Standard Proctor)
ASTM D854	Specific Gravity of Soils
ASTM D1140	Amount of Material in Soils finer than No. 200 Sieve
ASTM D1557	Moisture-Density Relations (Modified Proctor)
ASTM D2166	Unconfined Compressive Strength of Cohesive Soil
ASTM D2216	Water Contest of Soil, Rock & Soil-Aggregate Mixtures
ASTM D2217	Wet Preparation of Soil Samples for Practical Size Analysis and Determination of Soil Constants
ASTM D2435	One-Dimensional Consolidation Properties of Soils
ASTM D2487	Classification of Soils for Engineering Purposes
ASTM D2850	Undrained, Unconsolidated Strength in Trixail Compression Trixial (CU and CD)
ASTM D4318	Liquid Limit, Plastic Limits & Plasticity Index of Soils
ASTM D4546	One-Dimensional Swell/Settlement Potential of Cohesive Soils

Plate No.: 5