Interparking Corporation c/o Carl Walker, Inc.

2198 Gladstone Court, Suite D Glendale Heights, IL 60139

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Subsurface Exploration and Geotechnical Engineering Evaluation

Interparking Corporation c/o Carl Walker, Inc.

Proposed LaSalle/Hubbard Site Development Chicago, IL

30852

February 4, 2001 Updated January 25, 2001





February 4, 2000 Updated January 25, 2001

Mr. Larry Standlee **Interparking Corporation** c/o Mr. Thomas J. Delaney, P.E., S.E. Carl Walker, Inc. 2198 Gladstone Court Suite D Glendale Heights, IL 60139

Subsurface Exploration and Geotechnical Engineering Evaluation for the Proposed RE: LaSalle/Hubbard Site Development in Chicago, Illinois - STS Project No. 30852

Dear Mr. Delaney:

We have finalized subsurface exploration and geotechnical engineering evaluation for the proposed LaSalle/Hubbard development in Chicago, Illinois. This work is based on our proposal to you dated November 8, 1999. This report presents the results of our field and laboratory testing programs and provides recommendations concerning soil and groundwater characteristics as they relate to the proposed construction. Three vane shear test holes were performed in January, 2001 and our original report has been updated with these test results as well as the addition of basement construction and earth retention recommendations.

If there are any questions regarding the information contained in this report or if we may be of further service to you, please do not hesitate to contact us.

Respectfully,

STS CONSULTANTS, LTD.

Andrew J. Ptak, P.E.

**Project Engineer** 

Clyde N. Baker, P.E., S.E. Senior Principal Engineer

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### Attachments

Mr. P. Danos; Chris P. Stefanos Assoc., Inc.; 4532 W. 103<sup>rd</sup> Street; Oak Lawn, IL 60453 cc:

Mr. T. Humes; Solomon Cordwell Buenz and Assoc. Inc.; 625 N. Michigan Av.; Chicago, IL 60611

Mr. T. Black; The Habitat Company; 350 W. Hubbard Street; Chicago, IL 60610

# **TABLE OF CONTENTS**

	PAGE
	<u>NO.</u>
1.0 PROJECT OVERVIEW	1
1.1 Project Description	1
1.2 Scope of Work	1
2.0 EXPLORATION PROCEDURES	2
2.1 Subsurface Exploration	2
2.2 Laboratory Testing Procedures	3
2.3. Special Testing	3
3.0 EXPLORATION RESULTS	5
3.1 Site Conditions	5
3.2 Soil Conditions	5
3.3 Groundwater Conditions	7
4.0 ANALYSIS AND RECOMMENDATIONS	8
4.1 Caisson Foundations	8
4.2 Lateral Load Design	10
4.3 Excavation Support System	11
4.4 Basement Construction	
4.5 Slab-on-Grade and Pavement Areas	
4.6 Excavation of Existing Foundations	
4.7 Construction Considerations	
4.8 Ceneral Qualifications	

**APPENDIX** 

# SUBSURFACE EXPLORATION AND GEOTECHNICAL ENGINEERING EVALUATION PROPOSED LASALLE & HUBBARD SITE DEVELOPMENT CHICAGO, ILLINOIS

### 1.0 PROJECT OVERVIEW

## 1.1 Project Description

We understand that the existing parking lot located on the southwest corner of LaSalle Street and Hubbard Street in Chicago, Illinois is being considered for development. The proposed development will consist of 50-story residential structure with no basement and a nine to ten story parking garage having a ground level at-grade. Column loads ranging from 1,200 to 2,400 kips are anticipated for the parking garage and 2,200 to 4,000 for the high-rise.

# 1.2 Scope of Work

The scope of work for this project consisted of performing eleven (11) soil borings over the site. These borings were performed to depths of 100 to 126 below the existing grade. Insitu pressuremeter testing was also performed at three (3) soil boring locations. Laboratory tests were conducted to determine engineering characteristics of the soils encountered at the boring locations, and the geotechnical evaluation of the site was performed based on the data gathered. This report describes the results of our current field exploration and laboratory testing program and contains geotechnical recommendations related to the design and construction of the foundations for the proposed construction.

### 2.0 EXPLORATION PROCEDURES

### 2.1 Subsurface Exploration

Eleven (11) soil borings, ranging in depth from 100 to 126 feet below the existing grade, were performed. The soil boring locations were provided by the design team and located in the field by STS and are indicated on the attached boring location diagram. Boring B-3 was located by STS approximately 5 feet outside the proposed building footprint. We consider the location adequate to encompass the soils in this north east area of the proposed high rise. The ground surface elevations at the boring locations were referenced from the top of curb at the southwest corner of LaSalle and Hubbard (reference elevation +13.6 feet City of Chicago Datum (CCD)). The locations of the borings are displayed on Figure 2.

The drilling program was performed on site between January 6<sup>th</sup> to January 25<sup>th</sup>. The soil borings were performed by augering methods through the existing fill and then continued with rotary methods. Representative soil samples were obtained in the borings using split-spoon and Shelby tube sampling procedures performed in general conformance with ASTM Standards D-1586 and D-1587. In addition, pressuremeter testing was conducted at three (3) of the boring locations. A summary of this data can be found in the Attachments along copies of the applicable ASTM Standards.

A field log, recording observed soil conditions, groundwater conditions, and drilling procedures was maintained by the drill crew. All soil samples obtained from the drilling operations were sealed immediately in the field and taken to our laboratory for further examination and testing. Observations of water levels encountered in the boring both during and upon completion of the drilling and sampling operations are noted on the representative soil boring logs. The boreholes were backfilled with tremied cement grout after completion of the drilling operations.

### 2.2 <u>Laboratory Testing Procedures</u>

The laboratory testing program for this project consisted of visual classification and water content testing of all samples and hand penetrometer testing on cohesive samples. In the hand penetrometer test, the unconfined compressive strength of the soil, to a maximum value of 7.0 tons per square foot (tsf) is estimated by measuring the resistance of the soil sample to penetration of a small, spring calibrated cylinder. The results of the laboratory tests are noted on the soil boring logs in the Attachments.

In conjunction with the laboratory testing, the soil samples were examined and visually classified by a geotechnical engineer on the basis of texture and plasticity in accordance with the Unified Soil Classification System. Soil descriptions on the boring logs are in general conformance with this system, and the estimated group symbols according to the system are included in parentheses following the soil descriptions on the boring logs. A brief explanation of the Unified Soil Classification System is included in the Attachments.

The procedures used in preparing the final boring logs from field logs and laboratory test data are described on the sheets entitled "STS Field and Laboratory Procedures", which are included in the Attachments. All soil samples recovered in the borings will be retained at our Vernon Hill, Illinois laboratory for a period of 60 days, after which they will be discarded unless other specific instructions as to their disposition are received.

### 2.3 Special Testing

In addition to the routine sampling and testing, Menard Pressuremeter tests was performed at Borings B-1, B-5 and B-10.

Pressuremeter results in this hard, very silty clay to clayey silt stratum indicated that the limit pressures,  $P_{\nu}$  ranged from 27.5 to 35.9 tons per square foot (tsf) and the elastic modulus, Ed, ranged from 194 to 1161 tsf. The creep pressures,  $P_{\nu}$  ranged from 14.0 to 37.0 tsf. A summary of the pressuremeter tests is presented in the Appendix.

In addition, three (3) vane shear test borings (VS#1, VS#2, and VS#3) were performed in January of 2001 from depths ranging from 24 to 49 feet below existing grade. Peak undrained shear strengths ranged from 500 to 1,675 pounds per square foot (psf). A summary of the vane shear testing results is presented in the Appendix.

### 3.0 EXPLORATION RESULTS

### 3.1 Site Conditions

The site is located on the southwest corner of the intersection of LaSalle and Hubbard Streets in Chicago, Illinois. The site is currently an at-grade asphalt parking lot.

### 3.2 Soil Conditions

Based on results of the eleven (11) soil borings completed for this project, the following subsurface profile is presented. A description of each general soil unit has been identified and is described below.

Miscellaneous Fill - Urban fill was encountered at the boring locations to depths ranging from 9.5 to 15 feet at the boring locations. The fill consists of urban fill consisted of sand, gravel, cinders, brick, concrete, and miscellaneous fill containing some organic material. The relative density of the fill was generally loose to medium dense. A strong petroleum odor was noted near the bottom of the fill at boring B-10.

<u>Very Stiff to Stiff Clay</u> - Below the urban fill to a depth of approximately 15 to 20 feet, brown and gray to brown silty clay (CL) with trace amounts of shale was encountered at the boring locations. The consistency of the silty clay was generally from very stiff to stiff.

<u>Soft to Stiff Silty Clay</u> -Below the very stiff clay to a depth of approximately 55 to 60 feet, gray silty clay (CL) with trace amounts of shale was encountered at the boring locations. The consistency of the silty clay was generally from soft to stiff. Peak, undrained shear strengths in this stratum, as measured by insitu vane shear testing, ranged from 500 to 1675

pounds per square foot. A summary of these vane shear results can be found in the Appendix.

Stiff to Very Stiff Silty Clay - Underlying the soft to stiff silty clay, to a depth of approximately 82 to 85 feet, gray silty clay (CL) with trace amounts of shale was encountered at the boring locations. The consistency of the silty clay was generally from stiff to very stiff. Note that a water bearing, granular layer was encountered at the bottom of this layer at borings B-5, B-6 and B-7.

Hard Silty Clay to Clayey Silt with Occasional Waterbearing Sand and Silt Seams - Underlying the very stiff silty clay, to depths of approximately 102 feet, gray silty clay (CL) to clayey silt (CL-ML) with trace amounts of shale was encountered at all boring locations. The consistency of this stratum was very stiff to very hard. Experience in the downtown area and the measured water contents indicate the soil stratum typically considered "hardpan" in the downtown Chicago area. Occasional waterbearing sand and silt seams, cobbles and boulders are usually present in this stratum. Note that at borings B-3, B-10 and B-11, a water bearing silt (ML) stratum was encountered in this stratum at a depth of approximately 88 feet.

Pressuremeter results in this hard, very silty clay to clayey silt stratum indicated that the limit pressures,  $P_{i}$ , ranged from 27.5 to 35.9 tons per square foot (tsf) and the elastic modulus, Ed, ranged from 194 to 1161 tsf. The creep pressures,  $P_{i}$ , ranged from 14.0 to 37.0 tsf. A summary of the pressuremeter tests is presented in the Appendix.

Extremely Dense Silt with Occasional Waterbearing Sand Seams - Underlying the hardpan, to the top of bedrock at an approximate depth of approximately 124 feet, gray, water bearing silt (ML) to clayey silt (CL-ML) with trace amounts of shale was encountered at all boring locations. The consistency of this stratum was extremely dense.

The geologic profile described above generally represents the conditions encountered in the soil borings performed. Some variations in the descriptions should be expected. A geotechnical engineer grouped the various soil types in the major zones noted on the boring logs. The stratification lines designating the interfaces between earth materials shown on the boring logs and profiles are approximate; in-situ, the transition may be gradual. Results of the borings are in general agreement with previous explorations completed by STS Consultants, Ltd. in the immediate vicinity. However, variations from the above general conditions may occur.

### 3.3 Groundwater Conditions

Groundwater was encountered during our drilling exploration at a depth of approximately 12 to 14 feet during drilling. For foundation design purposes, that water table can be assumed to be at +3 feet (CCD). The nearby Chicago river level typically is at elevations between +0 to +3 feet (CCD).

### 4.0 ANALYSIS AND RECOMMENDATIONS

### 4.1 Caisson Foundations

For the proposed fifty story building and nine to ten story parking garage, we recommend that the proposed structures be supported on drilled caisson foundations based on the available soil and structural information. For caissons supported on the hard, very silty clay to clayey silt hardpan at approximately 83 feet below existing grade (approximate elevation -67 feet CCD), we recommend a maximum net allowable soil bearing pressure not to exceed 30,000 pounds per square foot (psf). The maximum net allowable soil bearing pressure is that pressure which may be transmitted to the foundation soil in excess of the final minimum surrounding overburden pressure. The bases of the foundations should be enlarged by belling to achieve the required bearing area. Belling should be feasible in the very stiff silty clay soils which overlie the recommended soil bearing layer.

We caution against excavating below a depth of 88 feet (approximate elevation -72 feet CCD) in the areas near Borings B-3, B-10 and B-11 because of potential water blow-in problems due to underlying occasional saturated silt and silty sand strata.

Also note that at Boring B-5, B-6 and B-7, a thin, saturated granular stratum was encountered immediately above the hardpan stratum. The contractor should be prepared with enough casing to penetrate and case through this saturated granular material (if necessary) and bell below the casing. Alternatively, the grout bell technique could be utilized to seal off this layer and permit excavation the next day partially through the grout bell and partially below.

Based on our borings, it appears that these saturated strata are not interconnected and are only expected in isolated caisson excavation instances during excavation.

Based on the estimated bearing pressures, the consistency of the soils encountered and the magnitude of the loads expected, we estimate a maximum settlement in the range of 0.9 to 1.1 inches for belled caisson foundations supported on the hard silty clay or clayey silt hardpan layer described above for a maximum estimated loading of 2,400 to 4,000 kips for the parking garage and high rise, respectively. Differential settlements would be dependent on the adjacent loads but is typically 1/2 to 2/3 of the total settlement. It should be noted that these settlement values are for soil compression only and that elastic compression of the caisson concrete should be added to these values.

To prevent the surface soils from sloughing into the caisson shaft and water inflow from the shallow water table, we recommend that a temporary steel casing be employed at the surface during construction. The top temporary casing should be extended to a minimum of 2 feet into the underlying clay to effect a seal against groundwater.

We recommend that caisson construction begin in the interior of the site to determine if caisson shaft squeeze may be a problem. Soft silty clay deposits having significant moisture contents (>25%) are present from 15 to 30 feet below grade; however, unconfined strengths at these depths indicate a moderate strength of the clay. Based on the results of our insitu vane shear testing, the potential for squeeze of these deposits into the caisson shaft during construction considered low and extended temporary steel casing is not considered necessary.

A minimum caisson shaft diameter of 2 1/2 feet is recommended. The caisson bell should have a base angle of at least 60 degrees (from horizontal) and the bell diameter should not exceed 3 times the shaft diameter. Caisson concrete may be placed by the free fall method into the clean and dry shaft excavations as long as concrete does not hit the sides of the

shaft or the rebar cage during placement. Concrete slump should be in the range of 5 to 7 inches.

Because the caisson technician will likely not be lowered into the excavation to observe the base of the caisson excavation directly due to safety concerns, it will be necessary to oversize the bell area by 15% or 1 foot, whichever is smaller. Alternatively, if it proves more economical, a camera could be lowered into the bell after final cleanup to verify that the bell is suitably free of loose material and the oversize eliminated.

We strongly recommend that an experienced soil engineer be present during all phases of caisson construction to observe that the excavations have reached a suitable bearing stratum as recommended in the design.

The caisson design and construction procedures should be reviewed with the contractor selected for this work prior to the start of construction. If you wish, we would be pleased to review the plans and specifications for the foundation work once they are prepared so that we may have the opportunity to comment on the effects of the soil and groundwater conditions on the site.

### 4.2 <u>Lateral Load Design</u>

For lateral load analysis on the caissons, the following horizontal subgrade resistance profile may be utilized for design.

Lateral Modulus of Subgrade Reaction Profile (K<sub>s</sub>)

Depth (ft)	$K_{\underline{s}} (tsf/ft)^*$
0 to -12	15
-12 to -15	40
-15 to -55	15
-60 to -82	60
-82 to -102	150

<sup>\*</sup>Assuming a 4 foot diameter caisson shaft is used.

Assuming that the backfill behind the foundation walls and grade beams is comprised of a well-graded sand and gravel (IDOT CA-6 or equivalent), compacted in 9" maximum loose lifts to a minimum of 90 percent of the maximum dry density (modified) as per ASTM D-1557, a friction factor (tan  $\delta$ ) of 0.35 can be utilized along the exterior formed concrete/backfill interface. This assumes a friction angle of 35° and an at-rest earth pressure coefficient ( $K_o$ ) of 0.5.

The long-term passive pressure coefficient (Kp) recommended for design is 2.0 behind grade beams and foundation walls against compacted granular backfill. Note that these passive pressures have a factor of safety of 1.5 to limit movements to less than 1/2 inch.

# 4.3 Excavation Support System

We anticipate that an excavation support system will be required to facilitate basement excavation along Hubbard and LaSalle Streets. Interlocking sheetpile walls are typically used downtown for earth retention for one to two level basement excavations. Interlocking sheet piles will minimize groundwater infiltration into the excavation. The excavation support system should be designed for lateral earth pressures, hydrostatic pressures, traffic

loads, and surcharge loads within a 1:1 (H:V) zone from the base of the excavation. In order to minimize lateral movements of the system, we recommend that the system be adequately braced and streets be underpinned as needed. The retention system should be designed by an Illinois Registered Structural Engineer. For permanent wall design, we recommend an atrest lateral earth pressure of 45 psf per foot of wall depth and 85 psf per foot of wall depth to be used for calculations above and below the water table, respectively.

To minimize groundwater infiltration into the excavation and to help prevent groundwater from entering the basement area, we recommend that the sheeting be socketed at least two feet into the underlying silty clay below. This should cut off the majority of any perched groundwater infiltration and therefore should provide relatively dry working conditions and a relatively dry basement. However, deeper embedment depths may be required based on the structural design.

For areas where open-cut excavation are used, we recommend that cut slopes be no steeper than 1.5 Horizontal to 1.0 Vertical above the water table.

### 4.4 Basement Construction

The basement floor slab subgrade will be situated on the natural, gray, soft to stiff, silty clay (CL) observed at depths of 11 to 14 feet below existing grade. The slab subgrade should be undercut by a minimum of 18 inches to permit placement of a 10 inch working mat of crushed concrete or CA-6 crushed stone compacted to a minimum of 90% of the maximum dry density obtained in accordance with ASTM D-1557 modified Proctor method. An 8 inch drainage layer of CA-7 grade stone should be placed over the working mat and drain lines placed on 50 foot centers connected to a sump pit and pump system to carry off any small seepage coming through the clay. We recommend that an STS geotechnical engineer

or qualified representative observe the basement slab excavation of subgrade soils and compaction of structural fill.

For the drained case, there are two approaches to the basement wall design consisting of either waterproofing and designing for maximum exterior water table pressure, or external perimeter drainage and only damp-proofing of the wall.

A perimeter drainage system should be used which would consist of a perforated or porous wall drain tile installed outside the basement. The drain tile should be surrounded with a minimum of 6 inches of granular filter material which is compatible with the size of the openings in the drain lines and surrounding soils. The drain tile should outlet into a sump pit equipped with an automatic pump to remove collected water.

The zone adjacent to the basement walls should be backfilled with a minimum 2 feet wide zone of free draining granular material (less than 3% by weight passing the No. 200 sieve) to prevent the buildup of hydrostatic pressure behind the wall. Above this free-draining material, a 2 feet thick clay fill should be compacted at the surface to prevent surface water infiltration. The clay fill should be compacted to a minimum of 90% of the maximum dry density obtained in accordance with ASTM D-1557 modified Proctor method.

Assuming that a perimeter drainage system has been utilized, we recommend that basement walls be designed for a lateral earth pressure of 45 psf per foot depth of wall.

If the proposed perimeter basement walls will be constructed directly against the excavation support system so that an external perimeter drainage is not practical, the walls should be designed to resist the full lateral earth pressures, external water pressure traffic loads, and surcharge loads lying within a 1:1 (H:V) zone from the base of the foundation

wall. Basement walls should be damp proofed above the maximum assumed water table and waterproofed below.

The proposed elevator pit slab that is well below the drainage system should be waterproofed and designed to resist the maximum hydrostatic uplift pressure up to the level of the slab drainage layer.

Slab reinforcement and joint spacing should be carefully considered to control random cracking due to slab shrinkage. Slabs should be isolated from the foundations to allow differential movements to take place between the slab and walls.

### 4.5 Slab-on-Grade and New Pavement Areas

For slab-on-grade and pavement areas of the site, after removal of any surficial vegetation and topsoil or pavement surface, we recommend that the subgrade be proof-rolled with a loaded semi-trailer or a heavy piece of construction equipment to delineate an soft, yielding areas. These soft, yielding areas (if any) should be removed and replaced with structural fill to the depth encountered or a maximum additional depth of 1.5 feet.

New fill for slab-on-grade should be an approved, inorganic material. This material should be free of organic matter, topsoil, high moisture content clay and debris. New fill should be placed in maximum 9-inch-thick loose lifts and compacted to a minimum of 90 percent of maximum dry density as determined by ASTM Specification D1557, Modified Proctor method. Where pavement areas are to be utilized by truck traffic or in slab-on-grade areas which will support loads in excess of 500 psf, heavy concentrated loads or masonry partition walls, the fill should be compacted to a minimum of 95% of the dry density referenced above. Periodic density testing should be performed on any fill in order to document that density requirements have been met.

Floor slabs should be isolated from foundations to permit relative displacement without cracking. Slabs should also be provided with adequate reinforcing and jointing to control minor slab cracking.

## 4.6 Excavation of Existing Foundations

We recommend that an attempt be made to obtain drawings of any existing structures previously onsite to determine conflicts that may occur between existing buried foundations and new proposed foundations and caisson excavations.

### 4.7 Construction Considerations

All excavation sides should be constructed such that they provide a safe, stable excavation. OSHA regulations regarding excavations should be followed. Care should be exercised when excavating adjacent to existing structures to prevent loss of support.

All soils which become softened or loosened at the base of subgrade areas should be carefully recompacted or removed prior to placement fill material. No structural fill should be placed in areas of ponded water or frozen soil.

It is recommended that all foundation subgrade soils be observed by an experienced geotechnical engineer or his field representative prior to placement of concrete n order to confirm that the soil conditions are consistent with the design assumptions and recommendations contained in this report. Periodic density testing should be performed on any fill in order to document that density requirements have been met.

# 4.8 **General Qualifications**

General Qualifications applicable to subsurface exploration, earthwork, construction, and the recommendations contained in this report are a part of this report and are attached.

### **APPENDIX**

- 1. General Qualifications
- 2. Changed Conditions
- 3. Site Location Map
- 4. Boring Location Diagram
- 5. Boring Logs
- 6. Vane Shear Testing Results
- 7. Pressuremeter Test Results
- 8. General Notes
- 9. Unified Soil Classification System
- 10. Field and Laboratory Procedures
- 11. Standard Boring Log Procedures
- 12. Sampling Procedures

ASTM D-1586-83 ASTM D-1587-84 ASTM D-2573-94



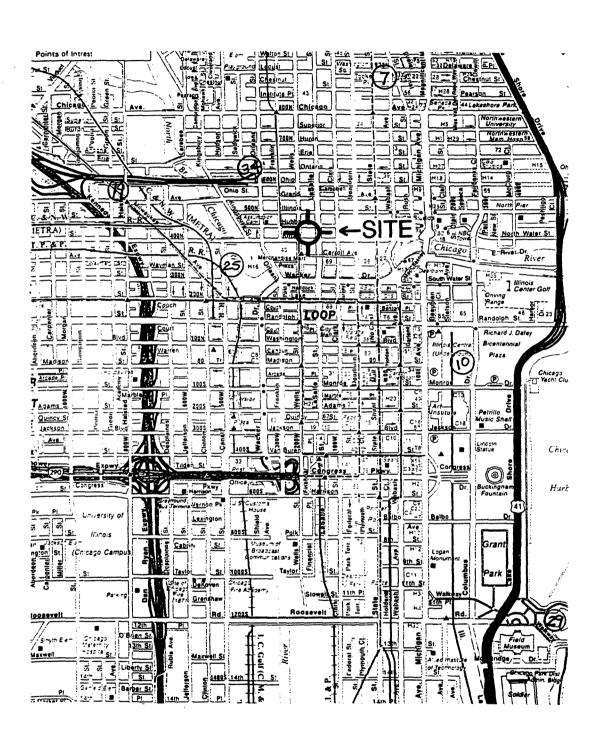
### STS CONSULTANTS, LTD.

# The following is a suggested standard clause for unanticipated subsurface conditions:

"The owner has had a subsurface exploration performed by a foundation consultant, the results of which are contained in the consultant's report. The consultant's report presents his conclusions on the subsurface conditions based on his interpretation of the data obtained in the exploration. The contractor acknowledges that he has reviewed the consultant's report and any addenda thereto, and that his bid for earthwork operations is based on the subsurface conditions, as described in that report. It is recognized that a subsurface exploration may not disclose all conditions as they actually exist and further, conditions may change, particularly groundwater conditions, between the time of subsurface exploration and the time of earthwork operations. In recognition of these facts, this clause is entered in the contract to provide a means of equitable additional compensation for the contractor if adverse unanticipated conditions are encountered and to provide a means of rebate to the owner if the conditions are more favorable than anticipated.

At any time during earthwork, paving and foundation construction operations that the contractor encounters conditions that are different than those anticipated by the foundation consultant's report, he shall immediately (within 24 hours) bring this fact to the owner's attention. If the owner's representative on the construction site observes subsurface conditions which are different than those anticipated by the foundation consultant's report, he shall immediately (within 24 hours) bring this fact to the contractor's attention. Once a fact of unanticipated conditions has been brought to the attention of either the owner or the contractor, and the consultant has concurred, immediate negotiations will be undertaken between the owner and the contractor to arrive at a change in contract price for additional work or reduction in work because of the unanticipated conditions. The contractor agrees that the following unit prices would apply for additional or reduced work under the contract. For changed conditions for which unit prices are not provided, the additional work shall be paid for on a time and material basis."

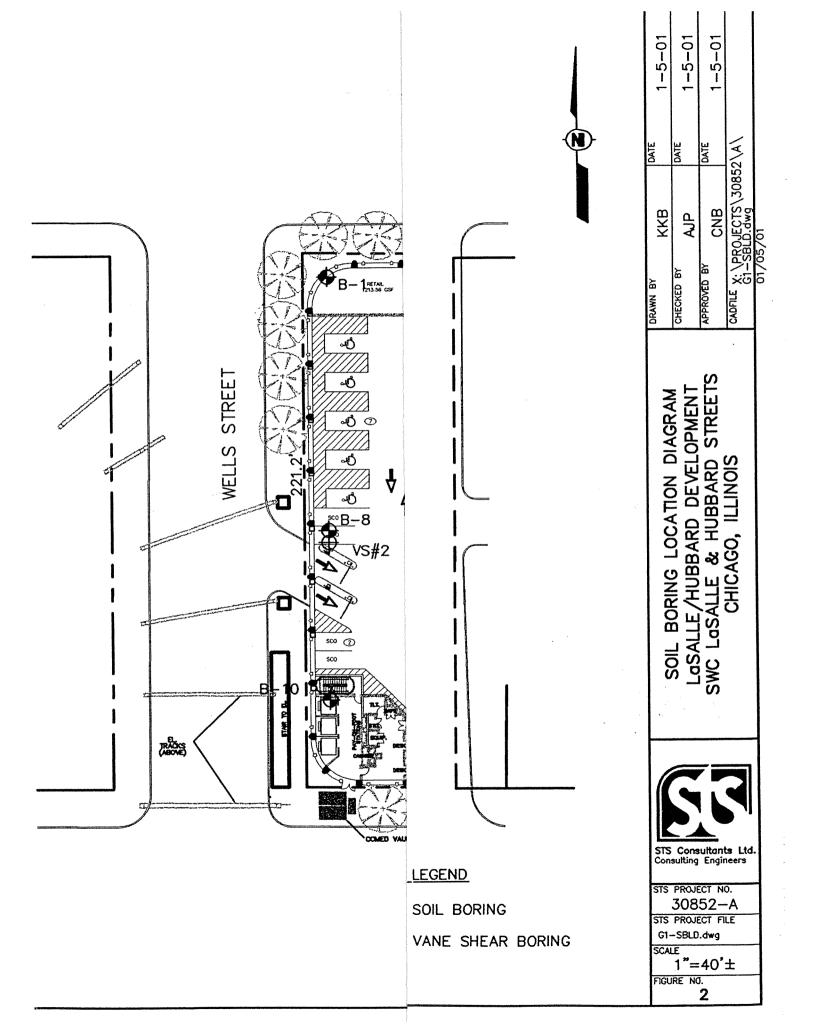
Another example of a changed conditions clause can be found in paper No. 4035 by Robert F. Borg, published in ASCE Construction Division Journal, No. CO2, September 1964, page 37.





SITE LOCATION MAP
LaSALLE/HUBBARD DEVELOPMENT
SWC LaSALLE & HUBBARD STREETS
CHICAGO, ILLINOIS

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	& Hubbard Streets; Chicago, IL	UNCONFINED COMPRESSIVE STREET TONS/FT. <sup>2</sup> 3 4 5	
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SAMPLE DIS	SURFACE ELEVATION +15.3 CCD	(Continued) STANDARD  STANDARD  PENETRATION BLOWS/F1  10 20 30 40 50	
7 ST	Silty clay, trace gravel, sand and shale - gray - stiff to sof	(Continued) 5 3 10 20 30 40 50	
45.0 RB ST S5.0 RB			
9 ST	Silty clay, trace gravel, sand and shale - gray - very stiff to	to stiff (CL)	
5.0 RB			
10 ST			
70.0 RB			
11 ST			
75.0 RB		123	
12 ST			
	Continued Continued	* Calibrated Penetrometer  * Calibrated Penetrometer  * STS JOB NO. 30852 SHEET NO. OF 2	

	7 -	3		OWNER		LOG OF B	ORING NUM	MBER B-1			
	4	7		Interparking		ABOUTE	T FNONE				ļ
				PROJECT NAME  LaSalle/Hubbard Dev	valonment	AHCHITEC	CT-ENGINE	:H			
SITE	CONSU		Ltd.	LaSalle/Hubbaru Dev	reiopineiit			-O UNCONFINE	D COMPRESSI	VE STRENGTH	
			alle	& Hubbard Streets; Cl	nicago, IL			TONS/FT.2	3 4	5	
	ELEVATION(FT)		NCE	T	RIPTION OF MATERIAL		UNIT DRY WT.	10 20	WATER CONTENT %	LIQUID LIMIT % — 🛆	
1°		A A	AMP	OURS A CE SUSTION	15.0.000	(01-	TIN S	Ø ₽	TANDARD ENETRATION &	BLOWS/FT.	
M	10	1 8		SURFACE ELEVATION	-15.3 CCD and and shale - gray - very sti	(Continue	ed)   5 🖫	10 20	30 4	0 50	1
		3 S1		4	and and shale - gray - very st	in to sun (CL	-)			,90.	
	7			Very silty clay, trace gra	vel, sand and shale - gray - ha	rd (CL)			*	V	1
85.0		RE	#	Pressuremeter Test at 8	2.5-85 ft.			•			₹6 *
90.0		RE		Pressuremeter Test at 8	7.5-90 ft.			•			7+ O * 7+_ 100/5*
		RE I SS			2 5-95 ft.						7+ 100/5" * 7+ 100/6"
	$\exists$	RB		Tressuremeter rest at 5	L.5 55 K.						l
95.0	19	SS	$\pm$								7+ 100/6"
	$\exists$							l 1/ I			*
100.	7 20	RB									7+ •
100.9	55			End of Boring Borehole grouted upon c Casing used: 20 ft. of 4 i	n. er used for Standard Penetra	tion Tests.	*Cal	brated Penetron	neter		*
<u></u>	<u></u>	<u></u>	<u> </u>								
3	Th	e stra	tifica	tion lines represent the appr	oximate boundary lines between	en soil type	s: in situ,	the transition r	nay be grad	ual.	
WL	21.0 ft	BCR	21.0	ft. ACR	BORING STARTED 1/13/00		STS OFFICE	Chicag	go Area - 01		
WL					BORING COMPLETED		ENTERED BY	SHEET	TNO. OF		
WL					1/13/00 RIG/FOREMAN		KKI APP'D BY		3 08 NO.	3	
31					Mobile B-61/Baker		AJF		30852	<u>!</u>	

		1		1	OWNER	LOG OF BOR	NG NU	<b>ABER</b>	B-	-2			
	7				Interparking								
	_			,	ROJECT NAME	ARCHITECT-E	NGINE	ER					
SITE LO	CATI	ON!	td.	Ц	LaSalle/Hubbard Development		<del></del>		INCONFI	NED CO	MPDESS	IVE STE	ENGTH
			lle	&	Hubbard Streets; Chicago, IL			O;	ONS/FT.	2	MPRESS	4	5
	Ť	Π	П	7			1		<del></del>	-	<del></del>	<del>-</del>	
E			삥	1	DESCRIPTION OF MATERIAL SURFACE ELEVATION +14.1 CCD				ISTIC		TER TENT %		UID IT %
DEPTH(FT) ELEVATION(FT)	١.	w	M		DESCRIPTION OF MATERIAL		į.		ж <del>-</del> –				Δ
DEPTH(FT)	2	Σ	ă	ᆲ			Α ≿		10 2	90	30 4	10 5	i0
8 3	SAMPLE NO.	SAMPLE TYPE	F F	힝			UNIT DRY WT. LBS./FT.ª		8	STAND			_
XI_	ď	ď	8	삐	SURFACE ELEVATION +14.1 CCD		3 9				RATION 30 4		0
	1_	PA	$\Box$	4	Asphalt (3") and base course (9")						ļ		
	1	SS	$\Pi$	Ц	Miscellaneous urban fill: Brick, cinders, and, gravel, woo concrete and slag.	a, crusnea		•	[. /	20	1	1	
	2	50	Ш	I	•			84	•				1
	Ľ	SS	Ш					)	1				
5.0	+	PA	$\mathbf{H}$	ᆸ				⊗4				1	
<u></u>	3	SS						\ .		1			
	=	PA	#	$\exists$					1	١.			1
	4	ss		丩				99	7	,	1		
10.0		PA	Щ	╁	Sandy silt to silty sand, trace clay - brownish gray - loose	) •		<del>- :</del>	<del>                                     </del>	-/-	<del> </del>		<del>                                     </del>
	5	ss		Ш	saturated (ML to SM)			⊗₄		•			
	1	-	Щ	1									
	]	RB								l			
	]	nø											
15.0	$\vdash$	<del> </del>	H	+	Silty clay, trace gravel, sand and shale - gray - soft to me	edium (CL)	<del>                                     </del>		<del>                                     </del>	<del> </del>	<del> </del>		<del> </del>
	1 .	ST											
		RB	#	H						L			
	6	ST		Ц			*	$\circ$	∮ '	7	1		
20.0		RB	#	1									
	1.	ST											
	1_	RB	4	-									
	7	ST	$\prod$	П				g	þ. •				
25.0	Ľ	1 1	Щ	7				*/	~				
25.0	1	RB		Ц				$\bot$		`	1_		
	8	ST					*	4			•		
				7				1		/			
	1	RB								/			
30.0			$\prod$	$\prod$						1			
	9	ST						ф					
	}		4	7									
	}	RB						1					
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35.0	-		$\dagger \dagger$	П			83	4					
	10	ST	11	Ц			03	*4	*				
:===				7						1			
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40.0			$\bot$	1			_		_	1		Ll	
					continued		* Cai	brated	Penetr	meter			
300													
40.0													
<b> </b>			<u>_</u>	<u></u>				OP ***		Ta			
The str	atificat	ion line	es rep	ores	sent the approximate boundary lines between soil types: in situ, the transition m	ay be gradual.	STSJ	OB NO.	30852	S	HEET NO	). C	)F

A						LOG OF BORI	NG NUN	BER B	-2	-		
7	5	·			Interparking PROJECT NAME	ARCHITECT-E	NGINEF	R		·		
STS Con	- - -	nde i	td		LaSalle/Hubbard Development							
SITE LO	CATIO	NC						O UNCONI	INED COM	APRESSI\	/E STRE	NGTI
SW	CL	aSa	lle	. &	Hubbard Streets; Chicago, IL	T		1	2 3	4	5	i
F			پر					PLASTIC	WA"		LIQI	
DEF I H(F I)  ELEVATION(FT)		w w	SAMPLE DISTANCE		DESCRIPTION OF MATERIAL		ı.	LIMIT %	_ CONTI		- Ł	
ELEVATION	Š	1	Sia	ĒΑ			<u>}</u>	10	20 3	0 40	50	0
7 3	SAMPLE NO.	SAMPLE TYPE	MPL	RECOVERY			UNIT DRY WT. LBS./FT.ª	8	STANDA	ATION B	LOWS/F	т.
	क	ŝ	8	Ĕ	SURFACE ELEVATION +14.1 CCD  Silty clay, trace gravel, sand and shale - gray - soft to me	(Continued)	5 5	10	20 3			
	11	ѕτ		Щ	Silly clay, trace graver, sand and share - gray - son to me	didili (OL)		*9P*			1	
		_	۲	Н			[				1	
		RB										
45.0				Ш					1!		1	
	12	ST	$\prod$	П				.ф.				
	<u> </u>	Ľ	$\mu$	片				_    _				
		pn										
		RB										
50.0		-	T	Ш				6			1	
	13	ST		Щ				*4	Ī			
				П				V				
		RB						1				
55.0			-	$  \cdot  $	Silty clay, trace gravel, sand and shale - gray - stiff to ven	v stiff (CL)		1	1			
	14	ST		Ш	Only day, trace graver, said and shale - gray - still to ver	, Jun (OL)		*100°	•			-
			μ-	Н				\				
		RB							1			
60.0												
	15	ST	$\prod$						$\phi$			
			Щ	口					,1" }		1	
		RB							<b>'</b>			
		UR						/		\		
65.0			П	T	Silty clay, trace gravel, sand and shale - gray - hard to ve	ry stiff	128	- 6	1	k	<b>े</b>	
	16	ST		H	(CL)					1	/     †	
		RB						١		$V \mid$		
70.0			-	H				1	6			
	17	ST		Н		:		1	<b>1</b> 111		[	
	-		╨	Н								
		RB				1			11		1	
75.0											. 1	
	18	ST	$\prod$	$\prod$							]	
	"	J,	Щ	出					* *			
		-							',		- 1	
		RB							',		ł	
80.0			H	Н	continued		* Call	brated Pene	rometer	<del></del>		
					Saluriues		Jui				J	
											l	
The stra	atifical	ion lin	es r	epre	sent the approximate boundary lines between soil types: in situ, the transition ma	y be gradual.	STS	JOB NO. 3085	, Si	HEET NO.	2	)F
1110 3111	2011001				0011 til 000 000 000 000 000 000 000 000 000 0	, ,		3085	2			

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7		ij.			Interparking PROJECT NAME		ARCHITE	CT F	NONE					
	•			1.	LaSalle/Hubbard Dev	reionment	Anchire	EU 1-E	NGINE	=rt				
STS Cons			<u>.1d.</u>		Laballer Hubbard Dev	Ciopincia				<b>⊕</b> UNC	ONFINED CO	MPRES:	SIVE STE	RENGTH
SWC	L	Sa	ile	&	<b>Hubbard Streets; Ch</b>	nicago, IL				TON	S/FT. <sup>2</sup>	3	4	5
			Γ							~			•	
DEPTH(FT) ELEVATION(FT)			Š	RECOVERY						PLAST LIMIT	% CON	ATER TENT %		QUID VIT %
DEPTH(FT) ELEVATION	ó	PE	STA		DESC	RIPTION OF MATERIAL			¥	×		• -		△
	Ž Ų	H.	9	(ER	,				T.	10	20	-	40	50
	SAMPLE NO.	SAMPLE TYPE	Ę	S					UNIT DRY WT.	8	STAND	ARD RATION	BLOWS	VFT.
			100	Œ	SURFACE ELEVATION +	14.1 CCD d shale - gray - medium (CH)	(Contin	ued)	5 =	10	20			50
	19	ST	₩	Н	• •	ravel and sand - gray - hard				.00	-	+	4_	+
	19A	ST	╨	Щ	(CL-ML to ML)	lavel and salle - gray - nate	1110151						+-	*
	20 20A	RB ST	H	H	Very silty clay, trace gray	vel, sand and shale - gray - h	ard (CL to				•0	+	-	<del></del>
		RB	1		CL-ML)	on, come and analog gray				·  T				*
85.0	21	ST	,	Н						•				77
		RB						- 1						*
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	22	SS	Ш	Щ						•	•			7
90.0		RB								[/				7
	23	SS'	I	田						<b> </b>				7-
		RB						ļ						
$\equiv 1$	24	SS*		Н										7
		RB		П										*
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	25	SS	Н	Н						•				*
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00.0	26	ST		+				1		1				17
00.5					End of Boring		.,,		* Cal	brated Pe	enetromete	r	1	<b>†</b>
					Borehole grouted upon co Casing used: 20 ft. of 4 in	ገ.		-						1 1
					Automatic-Mobile Hammi	er used for Standard Penetra	ation Tests.	1						
					SS* = SPT value based of	m urst o in.		ł						
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Т	he :	strat	ific	atio	on lines represent the appr	oximate boundary lines betw	een soil typ	es: i	n situ,	the trans	sition may	be gra	dual.	
7.0 ft	w	n				BORING STARTED 1/10/00		STS	OFFICE		Chicago A	rea - 01		
						BORING COMPLETED		ENTE	RED BY	, 1	SHEET NO.	Of	=	
	nt. E	CR;	22	.0 ft	t. ACR	1/10/00 RIG/FOREMAN		APP	KKE	5	STS JOB N	3	3	——
L 						Mobile B-61/Bake	r	LAFFI	AJF	•	J. J. J. J. D. NI	3085	2	1

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	7	N .			Interparking PROJECT NAME ARC	CHITECT-E	WGINET.	D					
	_	_ <b>_</b> - ^			LaSalle/Hubbard Development	ンロロビレーと	AGINEE						
SITE LO			<u>.td.</u>		Lasaile Hubbard Development			٠٠٠	NCONFI	NED CO	MPRESSI	VE STR	ENGTH
			lle	8	Hubbard Streets; Chicago, IL			T	ONS/FT.	•	3 4		5
			Τ	Π			ſ	······································	•	<b>+</b>	+		•
E			빙				1		STIC IT %		TER ENT %	LIQ	
DEPTH(FT) ELEVATION(FT)		<b>w</b>	I A		DESCRIPTION OF MATERIAL		<u>.</u>		<del>~</del> –	(	<b>D</b>		Δ
DEPTH(FT) ELEVATION	Ş	Σ	ă	E			<u>≯</u>	1	0 2	0 :	30 4	0 5	0
<u> </u>	SAMPLE NO.	SAMPLE TYPE	SAMPLE DISTANCE	RECOVERY			UNIT DRY WT. LBS./FT.*			STANDA			
$\boxtimes$	SA	SA	NS.	12	SURFACE ELEVATION +14.2 CCD		3 9	1			RATION E		F1. 0
		PA	1		Asphalt (3") and base course (9")								
	1	ss	Ш	μ.	Miscellaneous urban fill: Brick, cinders, sand, gravel, wood, crushed concrete and slag.		1		•	27			
	<del> </del>	00	Ħ	T	organico constato ano siag.		1	11	<b>8</b> •	-			
	2	SS	Ш				1	,	1				
5.0		PA	+	<b> </b>				5 . ⊗	\				
	3	ss	$\ $	十				w.					
		PA	μ	$\vdash$						1			
			T	口					\$	19	•		
	4	SS							/	,	1		
10.0		PA	F	H	Fill: Silty clay, little brick and organics - brownish gray and bl	ack		~	-	-			<u> </u>
	5	SS	11	Н	(CL)			*~	) ⊗ */15	<b>T</b>			
			╀	Н							]		
		PA							$  \cdot  $	1			
		, ^							<u>'</u>	1			
15.0	_		T	T	Silty clay, trace gravel and sand - grayish brown - very stiff (0	CL)		88		7	-		
	6	SS	Ш	出	2 , 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	•		80		*	Y*		
		RB		H	Silty clay, trace gravel, sand and shale - gray - medium to sti	iff (CL)			/				
20.0													
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The stra	tificati	on lin	es re	epre	sent the approximate boundary lines between soil types: in situ, the transition may be	e gradual.	13127	OB NO.	20252	اعا	HEET NO	. , 0	F ,

/				1	1	OG OF BORIN	IG NUN	DEN	<b>B-</b> 3			
2	7	1			nterparking							
	_	-		1		RCHITECT-EI	VGINEE	H				
ITE LOC			d.		_aSalle/Hubbard Development			O IIN	CONFINED	COMPRE	SSIVE ST	PENGTH
			le	&	Hubbard Streets; Chicago, IL			O TO	NS/FT.2	3	4	5
				$\tilde{\Box}$			j	<u>;</u>		<del></del>		<del>-</del>
E			핒					PLAS" LIMIT		WATER		QUID
ELEVATION(FT)		w	LANC		DESCRIPTION OF MATERIAL		ا ن	X		ONTENT 9		vit % ≥∆
×	Š	ځ	DIS	¥			<b>≯</b> .	10	20	30	40	50
ELEVATION	SAMPLE NO.	SAMPLE TYPE	PLE	RECOVERY			UNIT DRY WT. LBS./FT.*	_	STA	NDARD		
1	SAN	SAM	SAM	REC	SURFACE ELEVATION +14.2 CCD (0	Continued)	LBS	<b>⊗</b>	PEN 20	IETRATIO		VFT. 50
		1 1	T	П	Silty clay, trace gravel, sand and shale - gray - medium to s	stiff (CL)		<u>Ж</u>	241	Ť	Ť	Ť
	11	ST		Н		1		* 1	*\	1		
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		RB		1				- 1	l	İ	1	
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	40	2	T	$\prod$				$\mathcal{A}$	17			
<b>=</b>	12	ST					110	<b>.</b> ф	*			
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		RB							$\chi$			
0.0			_	_						$\overline{}$		
	15	ST			Silty clay, trace gravel, sand and shale - gray - stiff to very	stiff (CL)			• .	, OC		
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		RB							1y			
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		RB							H'	1		
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	17	ST		7			- 1	1	*			
			Ч	$\dashv$				1	ıl			
		RB						- 1	il	İ		.
		no							!]			
5.0		-	┪		Silty clay, trace gravel, sand and shale - gray - hard (CL)			$\dashv$		$\dashv$	+	+
	18	ST							\]			
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	7			1	OWNER		LOG OF B	ORIN	IG NUM	BER	B-	3			
	-				Interparking PROJECT NAME		ARCHITEC	~T.E.	ICINEE						
					LaSalle/Hubbard Deve	Nonment	Anomited	J1-E1	4GH4EE	n					
TS Consult			d.	Ľ	Lasalle/Nubbard Deve	nopment		Т		○ UN	CONFIN	NED CO	<b>IPRESSI</b>	VE STRE	NGTH
			le	&	<b>Hubbard Streets; Chi</b>	cago. IL			l	TO	NS/FT.		3 4	5	1
	T	T	 T	一				$\neg$	Ì	-			+		
E			삥							PLAS			TER ENT %	LIQI	
ELEVATION(FT)	١,	.	ž	RECOVERY	DESCE	RIPTION OF MATERIAL		- 1	<u>.</u>	×			<u> </u>	- £	
٤٤		=	띪	≿	5250.	11 11014 01 11011 E1101E		- 1	<b>}</b>	10	2	0 3	10 4	0 5	0
ELEVATION		ا ۲	۳	S					E F	•		STAND/	ARD		
ELEVATI SAMPLE NO.		SAMPLE I YPE	Ž	ŭ	SURFACE ELEVATION +1	4.2 CCD	(Continu	ed)	UNIT DRY WT. LBS./FT.*	8			RATION E		
<u> </u>	+	$\H +$	Ť	T		stiff - wet (CL-ML to ML)				Ť		<u> </u>	Ĩď	K	
19	9	Т	П	Щ				- 1				ر آ		~*	
	╁	В	Н					- 1		1					
20	H	$\blacksquare$	Ц	Ц	Silty clay trace gravel sa	nd and shale - gray - hard (C	L)			+4		-	<b>X</b>		
		В			Only clay, hace graver, sa	na ana onaio gia) naia (e	-,	- 1	1	- 1	1	*	* ]		_ l,
3 <b>5.0</b> 21	+	T	┰	$\neg$				1		Į.	•				148
	Т	7	+					1		1	1				*
		В	١					1			1				7+
22	15	T	Ц	耳							•	<u> </u>			7† *
	F	В	7		Sandy silt, trace gravel - g	gray - extremely dense - satu	rated (ML)				/				
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					Borehole grouted upon co	mpletion.									
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					SS* = SPT value based o			- 1							
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12.0 ft.	. w	D				1/6/00		5,3	J. 1 10E		Chic	ago Ai	rea - 01		
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The 12.0 ft.						Mobile B-61/Baker			AJ	P			3085	2	

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	1	ss		Ш	Urban fill: Cinders, brick, sand, gravel, crushed concrete a	and slag			•	⊗			
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5	SITE LO					Highbord Chronics Chicago II				CONFIN NS/FT. <sup>2</sup>	IED CO	MPRESSIVE		
L	SW	CL	aSa	lle	- &	Hubbard Streets; Chicago, IL			1	2	!	3 4	5	
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F	<u> </u>			T	Ш	Silty clay, trace gravel, sand and shale - gray - stiff to very	stiff (CL)		K	3				
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5	The str	atificat	tion lin	es r	epre	sent the approximate boundary lines between soil types: in situ, the transition ma	y be gradual.	1515.	JOB NO.	20852	IS	HEET NO.	, Of	۶ ء

	OWNER	LOG OF BORING NUMBER B-4									
	Interparking PROJECT NAME		T-ENGINEE	ENGINEER							
STS Consultants Ltd.	LaSalle/Hubbard Dev										
SITE LOCATION					-O-UNCON	FINED COM	APRESSIV	E STREN	<b>IGTH</b>		
SWC LaSalle	& Hubbard Streets; Cl	nicago, IL			TONS/F	2 :	3 4	5			
SAMPLE TYPE SAMPLE TYPE SAMPLE DISTANCE	DESC	RIPTION OF MATERIAL		UNIT DRY WT.	PLASTIC LIMIT % X-	CONTI	TER ENT % 0 40	LIQUI LIMIT — &			
WP I EI DE	S	- F 8	⊗	STANDARD PENETRATION BLOWS/FT.							
19 ST I	W SURFACE ELEVATION	and and shale - gray - stiff to	(Continue	) 5 g	10		0 40	60			
19 ST	Sample 19 - disturbed s		very suit (OL	"   ]	œ <del>.</del>	•	<del>,e</del> ÿ	*	•		
RB				]		+			]		
20 ST							78		7+		
20A ST   85.0 RB	Very silty clay - gray - h	ard (CL)									
21 ST	I				•				7+ 5+ -0		
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RB		ountered 91-91.5' and 96.5-97	•		(,				7+_ 6		
24 SS' I	T								7 <u>+</u> 0€		
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95.0   25   SS'   I	ゴ				<b>þ</b>				7+ <b>.</b> 4		
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100.0					1				7.0		
100.5 26 ST 1	End of Boring  Borehole grouted upon c Casing used: 16 ft. of 4 i	n. er used for Standard Penetra	tion Tests.	*Call	brated Pene	trometer			*		
The stratific	ation lines represent the appr	oximate boundary lines between	en soil type	s: in situ.	the transiti	on may b	e gradu	al.			
L.		BORING STARTED		STS OFFICE		icago An					
13.0 ft. WD		1/18/00 BORING COMPLETED		ENTERED BY	' Si	HEET NO.	OF		$\dashv$		
20.0 ft. BCR; 20	.0 ft. ACR	1/19/00 RIG/FOREMAN		KKE APP'D BY	3		3	3			
VL .		Mobile B-61/Baker		APPUBI		O JUD NU.	30852		1		

		1		1	OWNER	LOG OF BORI	NG NUM	BER	B-	5			
19	74	l			nterparking								
		7		•	1 " 1	ARCHITECT-E	NGINEE	R					
STS Cor	= reultr	ints L	td.	ı	LaSalle/Hubbard Development								
SITE LO								O <sup>™</sup>	CONFINENS/FT.	IED CON	IPRESSI	VE STR	ENGTH
SWC LaSalle & Hubbard Streets; Chicago, IL										2 3	3 4		5
_								PLAS	TIC.	WA	ren	LIQ	1110
DEPTH(FT) ELEVATION(FT)			SAMPLE DISTANCE	1				LIMIT	T %	CONT		LIM	T %
F 5	ان	Ę.	IŽ.	DESCRIPTION OF MATERIAL					<del>-</del>	_	<b>)</b>	£	7
DEPTH(FT) ELEVATION	Ž	E	٥	١٩			£	10	2	0 3	0 4	5	0
2 4	SAMPLE NO.	SAMPLE TYPE	3	81			UNIT DRY WT. LBS./FT.ª	8		STANDA	RD ATION E	n OWER	==
$\times$	Š	Š	S	2	SURFACE ELEVATION +14.1 CCD		5 9	10	2				
		PA			Asphalt (3 in.) and base course (9 in.)				15				
	1	ss		П	Miscellaneous urban fill: Brick, cinders, sand, gravel, clay	, wood,		l	⊗ ,	<b>D-O</b>			
	_		╫	H	crushed concrete and slag.			1	10-	`			
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		33	╀	4			[	ĺ		⊗ 14/9"			
								1					
		PA	$\vdash$	+	Silty clay, trace gravel and sand - brownish gray - very sti	iff (CL)							<b></b>
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15.0			+	Н			113	1	4	\cdot			
	6	ST	11-	Ц			' '	]	*	$\mathcal{O}_{\star}$			
			4	$\dashv$						`\			
		22		1				ſ		\			
		RB		-				ł	/	\			
20.0				┥	Silty clay, trace gravel, sand and shale - gray - medium to	stiff (CL)		-/		<u> </u>			
	7	ST		11	Sity day, trace graver, said and shale - gray - medium to	3 Still (OE)		٠¢		•			
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The stra	atificat	ion line	es rep	ores	sent the approximate boundary lines between soil types: in situ, the transition ma	ay be gradual.	STS J	OB NO.	30852	SH	HEET NO	. 1	)F
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		1			DWNER	LOG OF BORI	NG NUN	(BER	B-	5				
	6	1			Interparking ROJECT NAME	ARCHITECT-E	NGINE	R	<del></del>					
STS Con		inde l	tel		LaSalle/Hubbard Development									
SITE LOC	CATIC	NC						<b>₩</b>	NCONFII	NED COM	APRESSIV	E STRE	NGTH	
SW	CL	aSa	lle	&	Hubbard Streets; Chicago, IL					2 3	3 4	5		
_								PLA:		WA.	TER	LIQ	OIL	
L X		l	ANC		DESCRIPTION OF MATERIAL			LIMI	π% ← —	CONT	ENT %	LIMIT		
DEPTH(FT) ELEVATION(FT)	õ	SAMPLE TYPE	SAMPLE DISTANCE	<b>}</b>	DESCRIPTION OF MATERIAL		UNIT DRY WT. LBS./FT.			0 3	0 40			
DEP	SAMPLE NO.	P.E.	PLE	RECOVERY			AO F			STANDA		•		
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	9	ST	П	П	Silty clay, trace gravel, sand and shale - gray - medium	to stiff (CL)		.d	5	•				
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	11	ST	Π	$\prod$	Silty clay, trace gravel, sand and shale - gray - very stiff (CL)	to hard			,(	Q				
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The str	atifica	tion lin	es r	epre	sent the approximate boundary lines between soil types: in situ, the transition	may be gradual.	STS	JOB NO.	20852	s	HEET NO	. پ	)F	1

		9		1	WNER	LOG OF BORI	NG NU	MBER B-	5		
7	7				nterparking ROJECT NAME	ARCHITECT-E	NGINE	- a			
		4 1			_aSalle/Hubbard Development	Anonitectie	HONVE	<b>-</b> n			1
STS Con			<u>td.</u>	1.	Lacand Habbara Dorotophion.			-O UNCONFIN	ED COMPRE	SSIVE STRENGT	ъ́н
SW	C L	aSa	lle	&	Hubbard Streets; Chicago, IL			TONS/FT.2	3	4 5	
								PLASTIC	WATER	LIQUID	
DEPTH(FT) ELEVATION(FT)			SAMPLE DISTANCE					LIMIT %	CONTENT	% LIMIT %	
DEPTH(FT) ELEVATION	ø	YPE	ISTA	_	DESCRIPTION OF MATERIAL		¥.	X		<u> </u>	.
EV.	LE N	LE LE	E	VER			P. F.	10 20		40 50	-
	SAMPLE NO.	SAMPLE TYPE	AMP	S	SURFACE ELEVATION +14.1 CCD	(Continued)	UNIT DRY WT. LBS./FT.*	⊗ F		N BLOWS/FT.	
7			Ϋ́	Ť	Silty clay to clayey silt, trace gravel, sand and shale -			10 20	30	40 50	<b>1</b> %
	15		Ш	4	(CL to CL-ML)	-			7		1.0
	-	RB	Н	-	Silty fine to coarse sand, trace clay and gravel - gray -	veny dence -			<del>-   -</del>		32/€
	16	SS	Щ	Щ	saturated	very delise -		}	•		&
85.0		RB			Very silty clay, trace gravel, sand and shale - gray - ha	rd (CL to		/			7. 4
	17	SS	Ш	Ш	Pressuremeter Test at 82.5-85 ft.			•			7+04
		RB									7.
	18	ST	Щ	_	Pressuremeter Test at 87.5-90 ft.			•			70
		RB			ressurement rest at or.3-30 it.						
90.0	19	SS*		T					1		7+ 8 O8
		RB						\	l		*
	- 88										7+0₹
	20	SS*	Н	ᅦ	Pressuremeter Test at 92.5-95 ft.			T			* OS
95.0		RB									7+ 5
	21	SS*	П	耳					1		7 <b>-</b> 0\$
					·				ļ		
		RB							l		
0.00	70	SI		$\dashv$					ł		70
	~			٦	Pressuremeter Test at 100-102.5 ft.				ļ		1.0
		RB				•		\			
	23	ST	Ш	Щ	Silt, trace fine to medium sand - gray - extremely dens (ML)	e - saturated		9			
05.0					(WL)				ł		
05.0		PA						\			
								ï			1
	24	SS*							•		8
								/			
10.0				$\dashv$	Character and and about			<i> </i> '			
		RB		١	Clayey silt, trace gravel, sand and shale - gray - extrem saturated (CL-ML to ML)	nery dense -		/			
					,			,'			1 1
	25	SS'	Щ	П				•	- 1		⊗ 3
								\			
15.0		RB						\	1		
								\			
	26	SS*	H	$\forall$				7	l		7+ 1 O8
			П	7							1*
20.0				$\perp$			L _		l	<u> </u>	_
				T	continue	d	* Cal	brated Penetro	meter		7
1											1
									1		1
				$\perp$							
					ent the approximate boundary lines between soil types: in situ, the transition		STS	JOB NO.	SHEET	NO OF	

				- 1	OWNER		LOG OF B	BORIN	G NUN	IBER	B-	5				
	7	V			Interparking PROJECT NAME		ARCHITE	CT-EN	GINE	:D						
					LaSalle/Hubbard Dev	elopment		02.1		-1.						
SITE LO	CATIC	ON	<u>.1d.</u>		Lacanor noboli d' Ber		<u> </u>	Т		-()·U	CONFI	NED CON	APRESSI	VE STR	ENGTH	
SW	C L	aSa	ille	<b>&amp;</b>	<b>Hubbard Streets; Ch</b>	nicago, IL				) 70	ONS/FT.	2 :			5	
DEPTH(FT) ELEVATION(FT)	ō.	SAMPLE TYPE	ISTANCE	<b>\</b>	DESC SURFACE ELEVATION 4	RIPTION OF MATERIAL			UNIT DRY WT. LBS./FT.*	PLAS LIMI	τ <b>%</b> ← −	CONT	TER ENT %	Z	OUID IT %	
LEV.	LEN	LE	E	VER					F S					0 5	<del>50</del>	
<del>\</del>	SAMPLE NO.	¥ ₽	A P	ECO	CUREACE ELEVATION	14.1 CCD	(Continu	od)	BS./	6	•		ATION I			
$\Delta$	S .	HB	100	14	Clavey silt, trace gravel.	sand and shale - gray - extreme		-		10	0 2	0 3	0 4	0 5	50	
	27	551			saturated (CL-ML to ML)		•				١					7÷.11
	27	33	T					1								*
125.0		RB	+	Н	Probable weathered lime	estone hedrock		$\dashv$						<b> </b> -		
		"			. IODADIO WEALIICIEU IIIII	JULIUTO MOGROUN.										
126.5		}—	+	H	End of Boring			$\dashv$	* Call	brated	Penetr	ometer		<del> </del>	<del>  </del>	
					Borehole grouted upon of Casing used: 20 ft. of 4 i	n. er used for Standard Penetration	on Tests.									
													!			
	The	stra	tific	cati	on lines represent the appr	oximate boundary lines between	n soil type				Insition	may t	e grac	Jual.		
VL 14.1	0 ft. '	WD				BORING STARTED 1/6/00 BORING COMPLETED 1/7/00			RED B			ago Ar	oF	· · · · · · · · · · · · · · · · · · ·		
14.1 VL 20.1 VL	0 ft. l	BCR	; 20	).0 f	t. ACR	RIG/FOREMAN		APP'0	RED BY			JOB NO	4	4		
						Mobile B-61/Baker			AJI				30007	<u> </u>		

			_	- 1		OG OF BORING	NUME	BER	B-	·6			
7		1			Interparking PROJECT NAME	RCHITECT-ENG	SILICE			····			
				•	LaSalle/Hubbard Development	MONITECT-ENG	SINCE	٦.					
TS Cor			<u>M</u> .		La Salle Nubbard Development		—т	<b>⊕</b> ′	NCONFI	NED CO	MPRESSI	VE STRE	NGTH
			lle	<b>&amp;</b>	Hubbard Streets; Chicago, IL			<b>₩</b>	ONS/FT.	2	3 4	5	
	Τ	Ī	Т	П			r		<b></b>	+			
E			W				- 1	PLA: LIM	STIC		TER ENT %	LIQU	
ELEVATION(FT)		Ĭ,	3		DESCRIPTION OF MATERIAL		<u>.</u>		<del>-</del> -		<b>D</b> —	- A	
ELEVATION	S S	3	Sig	Æ		3	\$	1	0 2	20 :	0 4	0 50	,
3	SAMPLE NO.	SAMPLE TYPE	FE	Š			UBS./FT.			STAND		•	
	8	SA	S	RECOVERY	SURFACE ELEVATION +15.2 CCD	170	5 9	1			ration e 10 4	3LOWS/F7 0 50	
		PA			Asphalt (3") and base course (9")								
	$\vdash$		$\overline{\mathbf{H}}$	Н	Miscellaneous urban fill: Brick, cinders, sand, gravel, wood crushed concrete and slag.	,			14				
	1	SS	Ш	世	Crusheu concrete and slag.		1		M		1 1		
	2	ss	Ш	Щ			- 1		158				
5.0	二	PA	片	H			1	۵	, '		1 1		
	3	ss	Ш	Щ			- 1	96			<del> </del>		
	1	PA	Щ	$\sqcup$			1		ļ.	1		- 1	_
			T	Ш			1	11	<b>3</b>			1	7
	4	SS		H				*			] ]	_ +	-
0.0		PA	F		Clayey silt, trace sand - gray - medium - saturated (CL-ML	<del>,</del>		-1			$\vdash = \mid$	$\longrightarrow$	
	5	ss		H	Stay of Sitt, hace Said - gray - mediani - Saturated (OL-ME	'		*6		Ĭ			
			μ.	Н			1	١ "		1			
		RB	-	H	Silty clay - brownish gray - stiff (CL)				ackslash	<del>                                     </del>	$\vdash$		
		ייי			2, 1, 2					1 \			
5.0	-		T	Н					7	1 7			
	6	ST	Ш	Ш			}		$\varphi_{\star}$	7			
			╫	H					\	1			
		RB							,	1			
0.0										N			
			T	Ш	Clayey, sandy silt - gray - very stiff - moist (CL-ML)				•	Ø,			
	7	ST							,	Y *			
				П						[\			İ
		RB								\		-	
5.0										1			
	8	ST	П		Silty clay, trace gravel, sand and shale - gray - soft to med	um (CL)	k	3		•			
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	9	ST					,k	<b>Þ</b> . 1					
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		RB				1		1		li -			[
5.0			<del>                                      </del>	H			1	7					1
	10	ST		Щ			1	<b>*</b> Ψ		1		1	
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		RB					1					1	l
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0.0			Н	H	continued	+;	Call	- 1	Penetr	ometer	— †	-	
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		]		- 1		OG OF BORIT	NG NUN	IBER	<b>B-6</b>			
	74	U			Interparking							
		ч				ARCHITECT-E	NGINEE	R				
STS Co			td.		LaSalle/Hubbard Development			-				
SITE LO								-O UNCO	NFINED CO	MPRESSI	VE STA	ENGTH
SW	<u>C</u> L	aSa	lle	8	Hubbard Streets; Chicago, IL			10113	2	3 4		5
								D. 4070				
DEPTH(FT) ELEVATION(FT)			팋					PLASTIC LIMIT %		ATER TENT %	LIQ	
E Š	١.	W	Ž		DESCRIPTION OF MATERIAL		E	<b>X</b> -		•	4	
¥ ×	Ž	Σ	S	¥			<u>\$</u>	10	20	30 40	5	0
DEPTH(FT) ELEVATION	1 2	1 2	12	8	·		E F.		STAND	ARD		<b>,</b>
X	SAMPLE NO.	SAMPLE TYPE	SAMPLE DISTANCE	RECOVERY	SURFACE ELEVATION +15.2 CCD	(Continued)	UNIT DAY WT. LBS./FT.ª	<b>⊗</b> 10	PENET 20	RATION E		
	<del>                                     </del>	<del>                                     </del>	T	Ť	Silty clay, trace gravel, sand and shale - gray - soft to med			नाँ	TI-	<u>ו</u>	, ,	ř
	11	ST	П	$\coprod$		` '		*44	<b>T</b>	1 1		· ·
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	1	RB	l						1	1 1		
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	12	ST	П	4			*	4 1	•	1 1		
	Ľ	Ľ	Ш					1 1		1 1		
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	}	RB						\ \	1 :	1 1		
50.0	1						1			1 1		
20.0	<del>                                     </del>	<del>                                     </del>	T	T			[	11		1		
	13	ST					107	Ι Φ.	•			
			μ.	Н				-	1 !	1 1		
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		RB						11	11	1 1		[
55.0			Ļ	Н				11	1 ;	1 1		
	14	ST						db .		1 1		
	'	3,	Ш	Ш				**	17	1 1		
								1	11			
		RB						<b>\</b>	1;			
50.0								1\	1/			
60.0	<del>                                     </del>		П	$\mathbf{H}$	Silty clay, trace gravel, sand and shale - gray - stiff to very	stiff (CL)		H	<u> </u>	†		
	15	ST		Ш		, ,		₩	<b>₹</b>	1 1		
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		RB					. [	- 1	11		j	
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	16	ST	П						• O	ΦП		
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			_	П		[		1	1	V 1		
		RB							1	1	1	
70.0						l		1			1	
10.0	_		Т	М			120		1	A 1		
	17	ST		Щ			120		7 .	44. I		
	<del>                                     </del>		1	Н			1		1		]	
	}								- 1	1 }		
	1	RB							11	1		
75.0			-	H	Oith, alon, to				<del>-1 </del>	1	$ \lambda$	
8	18	ST		Щ	Silty clay, trace gravel, sand and shale - gray - hard to ver (CL)	y stiff		1	7	1 1	<b>.</b> g	$\infty$
<u> </u>			Ш	Ш	( <del>-</del> )		1	l	'	1 1		-
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5		RB				}	1	1	N	1 1	/	
80.0							1		ľ	1 1	1	
2 00.0			Н	H	continued		**	brated Per		-1 /+		
80.0 The str.					continued		Call	biated Fer	reti prijete	1 1	1	
8								•	`		1	
3										1 1	l	
5												
F	atition	ion lin	ac .	enra	sent the approximate boundary lines between soil types: in situ, the transition ma	v he gradual	STS	OB NO.		HEET NO.	-	F
ine str	a on Cal	ווווויייייייייייייייייייייייייייייייייי	ا دن	€ ایون	The second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second secon	, ve gracual.		30	852		2	4

C	7			1	DWNER Interparking	LOG OF BOR	ING NUI	MBER E	3-6			
		li .			PROJECT NAME	ARCHITECT-E	NGINE	ER				
STS Consu	ulta	nts L	td.		LaSalle/Hubbard Development							
SITE LOCA SWC			lle	&	Hubbard Streets; Chicago, IL			-O-UNCON TONS/F	т.•	MPRESS		ENGTH 5
FT) ION(FT)	SAMPLE NO.			RECOVERY			UNIT DRY WT. LBS./FT.	PLASTIC LIMIT % X—	CONT	ATER FENT %	LIQ LIM	2010 117 % 20
য়	SAM	SAM	SAM	REC	SURFACE ELEVATION +15.2 CCD	(Continued)	LBS/	<b>⊗</b>	PENETI	RATION I		FT.
	19	ST			Silty clay, trace gravel, sand and shale - gray - hard to v (CL)	ery stiff			<b>)</b> .	φ <u>.</u>		
3	20. 0A	HB SSS SSS	Ŧ	$\mathbb{H}$	Silt and fine to medium sand - gray - dense - saturated	(ML)	<del>                                     </del>		1. 15/6	×0.0	19/6*	<sub>7</sub>
85.0	- 1	SS RB ST			Very silty clay, trace gravel, sand and shale - gray - hard CL-ML)	d (CL to		7			<sup>3</sup> 20/6°	7
	1	RB										1 1
2	- 1	ST RB	I	피				÷				7
90.0	- 1	SS'										7.
	- 1	RB		7								1 1
2	ख	ss.	1	山				•				7
95.0		RB										*
	5	ss	$\prod$	口				•				7.
			-									
		RB										
100.0	6	SI	1						,			7-
	$\downarrow$		4	7	Clayey silt to silt, trace limestone gravel - gray - extreme	ly dense		<u> </u>	<u> </u>			*`
		RB			saturated (ML)	ny uense -		\ \				
105.0									\			
2	7	ss.	4	H								
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110.0	8	ss.	1	$\downarrow$								7,
	T								1			1*
		RB						/				
4450												
115.0	9	ss•	#	디				4				173
								\				X
	-	RB						١				
120.0	$\downarrow$	_	1	1				_   \			_ [	
					continued		* Cal	brated Pener	trometer			
The stratifi	catio	n line	s re	pres	sent the approximate boundary lines between soil types: in situ, the transition r	nay be gradual.	STS	OB NO. 3085	SI	HEET NO.	3 0	F 4

ſ					1	OWNER		LOG OF B	BORIN	IG NUN	MBER	B-	6			
	7					Interparking PROJECT NAME		ADOUTE	CT EN	IONE	-					······································
						LaSalle/Hubbard Dev	relonment	ARCHITE	C1-En	AGINE	:H					
h	SITE LO	CATIO	nts L	td.	1	La Saller Hubbard Dev	elopinent		T		<b>∠</b> U	NCONFI	NED COA	PRESS	VE STRE	NGTH
				lle	&	<b>Hubbard Streets; Ch</b>	nicago, IL				O 10	ONS/FT.	NED CON	3 4		5
											P: 4	0710	****			
1	DEPTH(FT) ELEVATION(FT)	l		Š							LIM		CONT	TER ENT %	LIM	T %
1	E OF	o	YPE	STA	_	DESC	RIPTION OF MATERIAL			Ę.		<b>←</b> –			£	
1	DEPTH(FT) ELEVATION	LE N	LET	9	VER				1	P. E.	1	0 2	STANDA		0 5	<u> </u>
k	<u>ה</u>	SAMPLE NO.	SAMPLE TYPE	AMP	RECOVERY	SURFACE ELEVATION 4	-15.2 CCD	(Continu	ed)	UNIT DRY WT. LBS./FT.*	Q.		PENETR	ATTON I		ਜ.
K			SS	Ï	立	Clayey silt to silt, trace li	mestone gravel - gray - extreme				-	•	90 3 		ڔٞڞؙ	<u> </u>
F		1				saturated (ML)			1				i	•	*	
F		1	RB						1							
E		1_							$\bot$							
E	125.0	1	RB			Probable weathered lime	estone bedrock.									
F	126.0	1_				End of Boring	······································		_	+ Col	5a	Dan-11	ometer			
ı						Borehole grouted upon o	completion.			- Cai	brated	Penetr	ometer			
						Casing used: 15 ft. of 4 i	n. er used for Standard Penetratio	n Taete								
1						Adjoinatic-Mobile Harrin	ier uses for Standard Fenetialio	1 16313.								
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3		Th -	<u></u>	<u> </u>		on lines represent the same	ovimate houndary lines hoteres	n soil turn	<u></u>	n eiter	the *	neitia	L marrie		<u> </u>	
25		ıne	strat	ITIC	atio	on lines represent the appr	oximate boundary lines between	ii soli type			trie tra	uisillof	ı may E	e grac	iual.	
۱ او	VL 10.	.0 ft. '	NS				BORING STARTED 1/11/00		STS	OFFICE		Chic	ago Ar	ea - 01		
S   S   S   S   S   S   S   S   S   S	VL.			19	.5 f	t. ACR	BORING COMPLETED 1/11/00		ENTE	RED BY	, 3	SHE	ET NO.	4 OF	4	
Ž v	VL			, ,			RIG/FOREMAN		APPE	DBY		STS	JOB NO			
бL							Mobile B-61/Baker			AJF	-			30852	<u> </u>	

e<sup>122/6</sup>″

		1		7	DWNER	LOG OF BORI	NG NU	MBER	В	-7			
91	74				Interparking								
		•		1	PROJECT NAME	ARCHITECT-E	ENGINE	ER					
STS Con			td.		LaSalle/Hubbard Development								
ITE LOC				_				<b>주</b>	INCONF ONS/FT	INED CO	MPRESS	IVE STR	ENGTH
SWC		aSa	lle	&	Hubbard Streets; Chicago, IL		]		1	2	3	4	5
DEFIN(FI)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DISTANCE	OVERY	DESCRIPTION OF MATERIAL		UNIT DRY WT. LBS./FT.ª	LiM	+	20 3	ARD .	LIM 2	101D 17 % 2
বা	SA.	A W	X	EC	SURFACE ELEVATION +14.7 CCD		E SI		<b>⊗</b> 10			BLOWS/	
		PA	+	F	Asphalt (3") and base course (9")		+	<b>-</b>	Ϊ	<del>~</del>	<u>~                                     </u>	60 5 T	$^{\circ}$
		-	╁	-	Miscellaneous urban fill: Brick, cinders, sand, gravel, wo	od	<del> </del>	<del> </del>	160		-	<del> </del>	<del>  </del>
	1	ss ss	#	H	crushed concrete and slag	<b></b>		6 <sub>⊗</sub>	166				
5.0	2	PA	$\prod_{i=1}^{n}$	Т	Concrete obstructions encountered at 4.5-5 ', 6.5-7' and	8-13'.			1.	. 26			
	3	SS	$\mu$		Boring offset 6' west and boring continued.							<b>.</b> .	<b>-</b> .
	4	SS	1	囯					•				
10.0		PA							\				/
								<u></u>	<u>L</u> .	<u>,                                    </u>		L	<u> </u>
	5	SS SS	IT	Д	Clayey silt, trace gravel and sand - brownish gray - stiff -	wet			000	9/6	1		
,	5A		井	四	Possible steel beam encountered at 13 ft. Silty clay, trace gravel and sand - brownish gray - stiff (C	/		] .	<b>)</b>				
5.0		RB	ļ.	$\sqcup$				ļ	6/6*	1	<u> </u>	<u> </u>	$oxed{oxed}$
	6	ST		$\ \ $	Silty clay, trace gravel, sand and shale - gray - medium	(CL)			Ф.				
	-	J'		H				1 * 7	*				
								1 /				1	
		RB											
0.0													
V.V.			T	H				1					
	7	ST	Ш				101	Ι.Φ			Ì		
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		110								1			
25.0			+	+						'	j		
	8	ST					\ .	p.		•			1
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	9	ST						1.9	₽.	•		] ]	
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5.0				$ \parallel $						1'	1		
	10	ST						ΙΦ	1			1 1	
$= \pm$		- '	Ш	4				*					1
										11			
		RB								ľ			ı
10.0										11			- 1
			П	7	continued		* Cal	brated	Penet	rometer			- 1
							<u> </u>		<u></u>				
The strat	tificat	ion lin	es r	epre	sent the approximate boundary lines between soil types: in situ, the transition n	nay be gradual.	STS	JOB NO.	3085	2 S	HEET NO	). <b>1</b>	)F 3

		1		1	OWNER	LOG OF BORI	NG NU	ABER	B-7				
2	1	•			Interparking								
	_	•		1	PROJECT NAME	ARCHITECT-E	NGINE	ER					
STS Cor	neuit	ents i	ᆏ.	$\perp$	LaSalle/Hubbard Development				.covenie				
SITE LO			مالد	Q.	Hubbard Streets; Chicago, IL				NCONFINE DNS/FT.2	D COM	PHESSIV	/E STRE	NGTH
311		T	T	- CX	nubbalu Streets, Chicago, IL				2	3			
F			ļ,					PLA!		WAT		LIQ	
DEPTH(FT) ELEVATION(FT)		1	SAMPLE DISTANCE		DESCRIPTION OF MATERIAL			LIMI	T% -	CONTE	NT %	LIMI	
DEPTH(FT) ELEVATION	ġ	I Z	TSIC	≿	DESCRIPTION OF MATERIAL		¥	1		30	, ) 40		
LEV.	Ę	Ä.	E	VEF			ě E			ANDAF			
ਕਾਂ ਹੈ	SAMPLE NO.	SAMPLE TYPE	X	ECC	SURFACE ELEVATION +14.7 CCD	(Continued)	UNIT DRY WT. LBS./FT. <sup>3</sup>	6	) PE	NETR/	ATION B		
$\simeq$	<del>  "</del>	100	╫	H	Silty clay, trace gravel, sand and shale - gray - medium		123	1		30	40	) 5	<u>-</u>
	11	ST	$\ $	Ш	Only day, had grave, said and shall gray modeling	(-1)		<b>.</b> 9		•	ı		l
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	13	ST						Ι.Ф		•	1		
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		110							/	1		7	_
65.0	-		Н		Very silty clay, trace gravel, sand and shale - gray - hard	l to very	<del> </del>		6	-			$\dashv$
	16	ST		П	stiff (CL-ML to CL)	•			\	- [			l,
	-	$\vdash$	Н	H			]		\ \	- [	1		/
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The stre	atifica	tion lin	es r	epre	sent the approximate boundary lines between soil types: in situ, the transition n	nay be gradual.	STS	JOB NO.	30852	SH	EET NO.	2 0	<sup>F</sup> 3

			1	owner Interparking		LOG OF BO	DRING NU	MBER	B-7		
	6	4	ŀ	PROJECT NAME		ARCHITEC	T-ENGINE	ER	· · · · · · · · · · · · · · · · · · ·		-
STS Con	- neultz	ents L	td.	LaSalle/Hubbard Dev	/elopment						- 1
SITE LO	CATI	NC		Mark hand Changes Of	-:			-O-UNC	Wri.	RESSIVE STRENGT	H
SW	CL	a5a	lie d	k Hubbard Streets; Ch	nicago, iL		_	1	2 3	4 5	_
F			w l					PLASTI			
DEPTH(FT) ELEVATION(FT)			SAMPLE DISTANCE	nesc	CRIPTION OF MATERIAL		1	LIMIT 9	CONTEN	T% LIMIT%	
H. K	ò	ξ	DIST S	DESC	OTHER TON OF WATERIAL		\ <u>\\</u>	10	20 30	40 50	
DEPTH(FT) ELEVATION	SAMPLE NO.	SAMPLE TYPE	PE				UNIT DRY WT.		STANDARD	<del>}</del>	
M	SA S	SAN	SAN	SURFACE ELEVATION		(Continue	(b) \$ 8	10	PENETRAT 20 30	10N BLOWS/FT. 40 50	
	19		Ш	Very silty clay, trace gra-	vel, sand and shale - gray - ha	rd to very	132	•		.06.	
	<u> </u>		Щ	stiff (CL-ML to CL)						"   "	_,
	20	RB SS	h	Silty sand to sandy silt, t	race gravel - gray - very dense	e - saturated		<del>                                     </del>	4 +		-   &°
	20	↓	Щ.	(SM to ML)					/		
85.0	21	RB		Very silty clay trace gray	vel, sand and shale - gray - ha	rd (CL to	<del></del>	<del>    </del>		<del></del>	- <b>7</b> 5
		RB	П	CL-ML)	vei, salid alid stiale - gray - lie	iid (OL io		1	1 1		1.
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	22	SI	┟╀	1							1.0
90.0	1	RB						1 11			1_
	23	ss	$ \uparrow\uparrow $						,		7-06
		RB	M							1 1	*
	24	SS*	Ш	}						1 1	7+05
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95.0	<u> </u>		Щ,				l			1 1	7+ 4
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	1						1	1 1			1
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	}			į			ĺ				_
100.0	26	SI	Ш			··		•			70
100.5				End of Boring Borehole grouted upon o	completion.		*Ca	Ibrated Pe	netrometer		*
				Casing used: 16 ft. of 4 i	in.	A' <b></b> 4 -	}	1 1			1
				SS* = SPT value based	ner used for Standard Penetra on first 6 in.	tion lests.					1
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	The	stra	tifica	ion lines represent the appl	roximate boundary lines between	een soil type	s: in situ	, the trans	sition may be	gradual.	7
WL					BORING STARTED		STS OFFIC				=
12	.5 ft.				1/12/00				Chicago Area		4
WL 18.	.0 ft.	BCR:	18.0	ft. ACR	BORING COMPLETED 1/12/00		ENTERED E	B	SHEET NO.	OF 3	
WL					RIG/FOREMAN Mobile 8-61/Baker		APP'D BY	IP	STS JOB NO.	30852	7

		3			OWNER	LOG OF BOR	ING NU	ABER E	3-8				1
17	1				Interparking PROJECT NAME	ARCHITECT-	ENGINE	= D				·	l
				ł	LaSalle/Hubbard Development	ANUNIEUIS	CINCINE	m17					
STS CO	CATI	ents L	td.		La Salle Mubbard Development		7	-O-UNCON	FINED COM	PRESSIV	E STRE	NGTH	
			lle	&	Hubbard Streets; Chicago, IL			TONS/F	T. <sup>2</sup> 3		5		
	Π	Τ	Γ			······································	1			······································		·	1
E			빙	RECOVERY				PLASTIC LIMIT %	CONTI		LIQ		
DEPTH(FT) ELEVATION(FT)		<u> </u>	Ž		DESCRIPTION OF MATERIAL		ايا	<b>X</b> - ·	(	_	- £		
DEPTH(FT) ELEVATION	S	ξ.	ă	ERY			≽	10	20 3	0 40	50	0	
	SAMPLE NO.	SAMPLE TYPE	3	Š		·	UNIT DRY WT. LBS./FT.ª		STANDA				
imes	S.	SA	Š	Ä	SURFACE ELEVATION +16.2 CCD		3 9	<b>⊗</b> 10	20 3	ATION BI			
	1	PA	L	Ш	Asphalt (2-3") and base course (10")								
	1	SS		Щ	Urban fill: Brick, cinders, sand, gravel and slag			13 🛇			- 1		
	2	SS	H	Ш				•	<b>8</b> 22		1		
	1-		μ	H				, '	1		ļ		
5.0	1	PA	-	Н				8.			-		
	3	SS		Щ				-89	<b>"</b> .]				
		PA	上	Н					<b>Y</b>		]		1
	4	ss	$ \Gamma $	Ш				98			J		
100	1	<del>                                     </del>	1	H				'	1				
10.0	1										- 1		
	1	PA								\ \ .	. [		
	1										- 1		l
	1			Ш	Concrete obstruction encountered at 13-13.5' and 15-1	6'.						\	١.
15.0	5	SS		Ш					•		- 1		-
		PA				2 (OL)			1	<u></u>			l
	6	ss		Щ	Silty clay, trace gravel, sand and shale - very stiff to still	T (CL)		⊗ 15	100				l
			L	Н				, ,	$X \mid I$				
	1	RB						/	/				
20.0	-	-	Т	Н	Silty clay, trace gravel and shale - gray - stiff to soft (CL	.)		46					l
	7	ST	1	Н	, , , ,	•		*Y*			1		
	<del>                                     </del>		1	H				/	1 1				
		RB									l		
25.0	1										l		
	۵	ST					103	6					
	8	SI	$\perp$	Щ			*	*			1		
	1	RB									J		
30.0	}—		Т	H					1/ ]		l		
	9	ST		Ш				φ		]	]		
	<del>                                     </del>	$\vdash$	1	H					]		1		
	1	RB							Ji l				
35.0	1								$\mathbf{I}_{i}$		1		
	1.		T	П				9			- 1		
	10	ST		Щ				*			- 1		
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	1	RB									1		
40.0				Ц		<del></del>	↓ _	∟Ц_	4				
					continued	<b>t</b>	* Cal	brated Pene	trometer		- 1		
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	<u></u>		ل	$\perp$			<u> </u>		<u></u>	L	1		
	atifical	ion line	95 F	epre	sent the approximate boundary lines between soil types: in situ, the transition	may be gradual.	STS.	JOB NO. 308	SF	EET NO.	1 0	F 3	

		1		70	OWNER	·	LOG OF	BORIN	NG NUN	BER	B-	8				]
	1	1			nterparking											
	~	•			ROJECT NAME	_	ARCHITE	CT-E	NGINE	R						]
	onsult		Jd.	卫	LaSalle/Hubbard Dev	elopment										]
SITEL			dia	Q.	Hubbard Streets; Ch	nicago II				O TOP	CONFIN NS/FT. <sup>2</sup> 2	NED COM				
<u>-</u>		<b>43</b> a	T	- <b>a</b>	ngubaru Streets, Or	iioago, it				1		3		l :	5	ł
DEPTH(FT)	O	SAMPLE TYPE	SAMPLE DISTANCE	}÷	DESC	RIPTION OF MATERIAL			UNIT DRY WT. LBS./FT.³	PLAST LIMIT X	%	WAT CONTE	NT %	LIM	NUID 17 % 2	
	٦	٣	E	XE.					E F			STANDA			-	1
X	SAMPLE NO.	N N	NA.	RECOVERY	SURFACE ELEVATION +	16.2 CCD	(Continu	ued)	JNIT.	<b>⊗</b>		PENETR	ATION E		FT. i0	ĺ
	コー	1	İΪ	Ħ		and and shale - gray - very stiff	7			1,4	20	j	<del>) 4</del>	<u> </u>	Ĩ	1
	<b>-</b> 19	ST	$\ $	Н	(CL)						7		* 1	N.		
	4	BB			Venucilty clay trace gray	vel, sand and shale - gray - hard	L(CL)									弦
	20	ST	#	Ħ	very sitty clay, trace grav	rei, sailu ailu silale - giay - ilalu	i (OL)			Ţ			1			<b>1.</b> C
85.0	Ι	RB		Ш						1	1	1	1			7.
	<b>=</b> 21	ST		Ш						ė	•					7 <u>+</u> 0
	+	RB	+	Н									- 1			7.
	22	SI	丁	口				J		•	- 1					<sup>7</sup> 0
	7	RB														
90.0	23	SS*	$\perp$	Н	Boulder obstruction enco	ountered at 89.5-90 ft.		l			,					7+ 50/6
	コ	RB								1	1					*
		<u> </u>		Ш							`					7+_ 37/6
	24	ss	Щ	Щ							•					7+037/6
95.0	7	RB	(							1/						7+ 45/6
	25	SS*	T	Щ						P	' <u>[</u>					7+ 45/6°
	_															
	$\exists$	RB								ļ						
																1
100.0	7 26	ST	+	H												<sup>7</sup> 0
100.5					End of Boring Borehole grouted upon co	ompletion.			* Cal	brated P	enetr	meter				1*
					Casing used: 20 ft. of 4 in	n. er used for Standard Penetratio	n Taete				1					
					SS* = SPT value based of		11 16313.				1					
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2	<u></u>	<u> </u>	Ш	Ц												
25.5	The	stra	tific	atio	on lines represent the appre	oximate boundary lines betwee	n soil type	es: i	n situ,	the tran	sition	may b	e grad	ual.		
00/15/1 1GD S15 C4D 7690 DO 15/1 1GD S15 C4D 7690 DO 15/1 1GD S15 C4D 7690 DO 15/1 1GD S15 C4D 7690 DO 15/1 1GD S15 C4D 7690 DO 15/1 1GD S15 C4D 7690 DO 15/1 1GD S15 C4D 7690 DO 15/1 1GD S15 C4D 7690 DO 15/1 1GD S15 C4D 7690 DO 15/1 1GD S15 C4D 7690 DO 15/1 1GD S15 C4D 7690 DO 15/1 1GD S15 C4D 7690 DO 15/1 1GD S15 C4D 7690 DO 15/1 1GD S15 C4D 7690 DO 15/1 1GD S15 C4D 7690 DO 15/1 1GD S15 C4D 7690 DO 15/1 1GD S15 C4D 7690 DO 15/1 1GD S15 C4D 7690 DO 15/1 1GD S15 C4D 7690 DO 15/1 1GD S15 C4D 7690 DO 15/1 1GD S15 C4D 7690 DO 15/1 1GD S15 C4D 7690 DO 15/1 1GD S15 C4D 7690 DO 15/1 1GD S15 C4D 7690 DO 15/1 1GD S15 C4D 7690 DO 15/1 1GD S15 C4D 7690 DO 15/1 1GD S15 C4D 7690 DO 15/1 1GD S15 C4D 7690 DO 15/1 1GD S15 C4D 7690 DO 15/1 1GD S15 C4D 7690 DO 15/1 1GD S15 C4D 7690 DO 15/1 1GD S15 C4D 7690 DO 15/1 1GD S15 C4D 7690 DO 15/1 1GD S15 C4D 7690 DO 15/1 1GD S15 C4D 7690 DO 15/1 1GD S15 C4D 7690 DO 15/1 1GD S15 C4D 7690 DO 15/1 1GD S15 C4D 7690 DO 15/1 1GD S15 C4D 7690 DO 15/1 1GD S15 C4D 7690 DO 15/1 1GD S15 C4D 7690 DO 15/1 1GD S15 C4D 7690 DO 15/1 1GD S15 C4D 7690 DO 15/1 1GD S15 C4D 7690 DO 15/1 1GD S15 C4D 7690 DO 15/1 1GD S15 C4D 7690 DO 15/1 1GD S15 C4D 7690 DO 15/1 1GD S15 C4D 7690 DO 15/1 1GD S15 C4D 7690 DO 15/1 1GD S15 C4D 7690 DO 15/1 1GD S15 C4D 7690 DO 15/1 1GD S15 C4D 7690 DO 15/1 1GD S15 C4D 7690 DO 15/1 1GD S15 C4D 7690 DO 15/1 1GD S15 C4D 7690 DO 15/1 1GD S15 C4D 7690 DO 15/1 1GD S15 C4D 7690 DO 15/1 1GD S15 C4D 7690 DO 15/1 1GD S15 C4D S15 C4D 7690 DO 15/1 1GD S15 C4D 7690 DO 15/1 1GD S15 C4D 7690 DO 15/1 1GD S15 C4D 7690 DO 15/1 1GD S15 C4D 7690 DO 15/1 1GD S15 C4D 7690 DO 15/1 1GD S15 C4D 7690 DO 15/1 1GD S15 C4D 7690 DO 15/1 1GD S15 C4D 7690 DO 15/1 1GD S15 C4D 7690 DO 15/1 1GD S15 C4D 7690 DO 15/1 1GD S15 C4D 7690 DO 15/1 1GD S15 C4D 7690 DO 15/1 1GD S15 C4D T5/1 1GD S15 C4D T5/1 1GD S15 C4D T5/1 1GD S15 C4D T5/1 1GD S15 C4D T5/1 1GD S15 C4D T5/1 1GD S15 C4D T5/1 1GD S15 C4D T5/1 1GD S15 C4D T5/1 1GD S15 C4D T5/1 1GD S15 C4D T5/1 1GD S15 C4D T5/1 1GD S15 C4D T5/1 1GD S15 C4D T5/1 1GD S15 C4D T5/1		W/C				BORING STARTED 1/17/00		STS	OFFICE		Chica	ago Are	a - 01			
S WL	6.0 ft.					BORING COMPLETED		ENTE	RED BY	·		ET NO.	OF	·····		
2	7.0 ft.	BCR	; 27	.0 f	t. ACR	1/18/00			KKI	3	<u> </u>		3	3		
Ž WL						RIG/FOREMAN  Mobile B-61/Baker		APP'I	AJF	•	315.	JOB NO.	30852			

C		3			owner Interparking	LOG OF BORI	NG NUI	MBER	B-	9				l
7	6	1			PROJECT NAME	ARCHITECT-E	NGINE	ER						1
					LaSalle/Hubbard Development									
TS CO	CATI	ON	10.	Т.		l	T	الم	NCONFIN	IED CO	MPRESSI	VE STR	ENGTH	1
			lle	&	Hubbard Streets; Chicago, IL			7	ONS/FT.	· !	3 4		- 1	
	T		T	П			1			<del></del>	•	<del> </del>		
E			W						STIC IT %		TER ENT %		UID IT %	l
Š	1	<u></u>	Ž		DESCRIPTION OF MATERIAL		ا ا		<del>-</del> -	(	- ~	£		l
Ę	ġ	Ž	Sis	ا≾ا	DESCRIPTION OF WATERIAL		<b>\\ \\</b>		0 2	0 3	- 30 4	-	0	l
ELEVATION(FT)	<u> </u>	9	3	١١			E F	<u> </u>	·	STANDA				l
<u>,                                     </u>	SAMPLE NO.	SAMPLE TYPE	SAMPLE DISTANCE	RECOVERY	SURFACE ELEVATION +15.6 CCD		UNIT DRY WT. LBS./FT. <sup>3</sup>	6	<b>3</b>	PENETF	I MOITAF			l
7	<u>0</u>		Ś	Ξ	Asphalt (2-3") and 10" base course		2 2	1	0 2	0 3	0 4	0 5	٩	ļ
	1_	PA	ļ.	$\Box$	· · · · · · · · · · · · · · · · · · ·									l
	11	SS		Н	Fill: Sandy clay, little crushed concrete, slag and cinders very stiff to stiff (CL)	s - gray -							- 1	1-
	+	PA	╁	Н	Very Still to Still (OL)			10		~~				l
	2	SS	П	Щ					9	$\infty_{\star}$				
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	3	ss	Ш	Ш			•	1	<b>*</b> ]			1		1
	<u>1</u>	PA	L				l			١				
	4	ss	П	П				5⊗	1					
	1-	<u> </u>	μ.	H			}		*/	Γ*				
0.0	1	PA	-	Ш			<u> </u>	<u> </u>	$\perp \perp$	/	<u> </u>	<b></b>		1
	5	ss			Silty clay to clayey silt, little roots - gray (CL-ML)			68	<b>X</b> 2. •					
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	$f^{-}$						1			1				1
	7	RB					]			N				
5.0	1									1				
J.U	1	$\vdash$	T	Ш	Silty clay, trace gravel and sand - brownish gray - very s	tiff (CL)	<del>                                     </del>	<del>                                     </del>		0	0	<b> </b>	$\vdash \vdash \vdash$	1
	6	ST								<b>*</b> 17	*			1
	}	<del>                                     </del>	-	$\vdash$										
	-									Vi				
	1	RB								[				
0.0	1	<u> </u>	_		City star Associated and all the second	# (CL)	ļ	<u> </u>	-/-		<del> </del>	<b> </b>		
	7	ST	Ш		Silty clay, trace gravel, sand and shale - gray - stiff to so	nt (CL)			$ \infty $	•	1			
	1_	<u> </u>	Ш				1	<b>*</b>	/ *		1.			
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	7		C	OWNER	LOG OF BORI	NG NUN	MBER	B-9	·····		
	4			Interparking							
	"			PROJECT NAME	ARCHITECT-E	NGINE	ER				
STS Consul	Itants	Ltd.		LaSalle/Hubbard Development							
SITE LOCAT	TION						O TONS	NFINED C	OMPRESS	IVE STREE	NGTH
SWC	LaS	alle	8	Hubbard Streets; Chicago, IL			1	2	3 4	5	
		1.	П				PLASTIC		VATER	LIQU	
DEPTH(FT) ELEVATION(FT)		Š	RECOVERY				LIMIT %		NTENT %	LIMIT	*
DEPTH(FT) ELEVATION	.   #	STA		DESCRIPTION OF MATERIAL		UNIT DRY WT. LBS./FT. <sup>3</sup>	<b>X</b> -		• —	- 4	٠ ]
EV. EV.		9	EP			£ 7.	10	20	30 4	50	
SAMPI F NO	SAMPLE TYPE	₹	8			S.F	- ⊗	STAN		BLOWS/FT	.
X	5 8	S	E	SURFACE ELEVATION +15.6 CCD	(Continued)	5 9	10	20		0 50	
=== 1-	1 S	- 11	Ш	Silty clay, trace gravel, sand and shale - gray - stiff to so	oft (CL)	1	6				
	$T_{\tilde{a}}$	Ш	Щ				1 1	П		!!	
		T	П				l V	l,		1 1	
	RI	3						- 1',		1 1	- 1
45.0		1					<b>I</b>			1 1	- 1
		T	Ш				ab.	17		1 1	1
12	2 S		Щ				1 * 41 *				
	+	廾	H					1 '	1		1
	RI	3							1		1
	- '"								1		]
50.0	+-	╁	₩					1	1		1
13	3 S						Φ.	•			]
	+	#	Щ				*	1			
								.1			]
	R	3						/			]
55.0		4	$\coprod$				کیا ا		1		J
	4 S	-	Н	Sample 14 - disturbed sample.			*OP,		1		
	$\perp$	Ш	Ш				<i> \</i> /,		1		1
	T	T	П				\		1		1
	R	3					\	// ]			1
0.0								//]		] [	1
		$\prod$	Ш	Silty clay, trace gravel, sand and shale - hard to stiff (CL	.)			de	1		
15	5   S		Щ				*	-	7		1
	1	十	П								
	R	3						4			
55.0								1	1	1 1	\
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70.0	+	+	H			]			1		1
<b>=</b> 17	7   S1	-	Ш					) , (	AP.		[
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	-					}		1			İ
	R	3					1 1		1	1 1	\
75.0	_	4	H				<u>L</u> '		1		7
18	3 S1	$\ \cdot\ $	Щ								1
		Ш	Ш				\	.	)	1 <i>I</i>	
	1	1					] ]	\	1 -		[
	1	. 1						1	1	] [	- 1
	RE	' (								1 1	- 1
80.0	RE										
30.0	RE	+	H	manining	<del></del>	*Call	brated Per	etromet	er	<del> </del>	- 1
80.0	RE	-		continued	·	* Cal	brated Per	netromet	er -	<u> </u>	-
30.0	RE			continued		* Cal	brated Per	netromet	er	-	- 1
30.0	RE			continued		* Cal	brated Per	netromet	er		
BO.0	RE			continued		* Cal	brated Per	netromet	er		

				1	1	LOG OF BORI	NG NUM	IBER	B-	10			
					Interparking						<del> </del>		
		•		1		ARCHITECT-E	NGINEE	R					
STS Co			td.	$\perp$	LaSalle/Hubbard Development								
SITE LO			••		II delicated Observation Observation III			$\mathcal{O}_{\mathbf{r}}^{u}$	NCONFII ONS/FT. <sup>2</sup>	NED COM			
SW	CL	<b>a</b> Sa	11e	Č	Hubbard Streets; Chicago, IL		١.		1 1	2 3			<u> </u>
_								Pi A	STIC	WAT	TR.	LIQ	I II O
DEPTH(FT) ELEVATION(FT)	1		ž					LIM	IT %	CONTE		LIMI	T %
DEPTH(FT) ELEVATION		2	STA		DESCRIPTION OF MATERIAL		5	>	<del>-</del> -		<b>-</b>	£	7
F X	Ž	7	ā	ERY			<u>}</u>	1	0 2	0 30	40	5	0
2 7	SAMPLE NO.	SAMPLE TYPE	SAMPLE DISTANCE	RECOVERY			UNIT DRY WT. LBS./FT.³		2	STANDA			
$\bowtie$	S	SAI	SA	RE	SURFACE ELEVATION +16.3 CCD		3 9	1		PENETRA 0 30			
	一	PA			Asphalt (2")				47				
	1	SS	П	П	Urban fill: Cinders, brick, crushed concrete, sand and gra	vei		•	17 Ø		1		
	<del>  '</del> -	33	Щ	井				11			l		
	2	SS	Ш	Н				• • •	7		]		
	╁─╴	PA	-	Н				,	1.		ļ		
5.0	_	<del>  ^</del>	T	Н				12	⊗ •		1		
	3	SS	П	П			]		Π,				
	}—	PA	H	$\vdash$					<u>'</u> '	[			
	1		П	П				(	<b>8</b> 10		[		
	4	SS	П	M							1		
10.0	+		1	H									
	1	PA						i		[	1		
	<u> </u>	` ^									- 1		
	┼		-	Н				7 ⊗		1			
	5	ss		М	Driller's observation: Strong petroleum odor noted in Sam	nple 5.		~	١.	$\lceil \setminus \rceil$			
15.0	1	PΔ	Ш	Н					12/6*	\ \ \			
120	6	PA SS*	T	П	Silty sand - brown - medium dense - saturated (SP to SM	1)				80			
	6A	SS	Ш	Щ	Silty clay, trace gravel, sand and shale - brownish gray -	very stiff			*		`⊗ 34		
	┧				(CL)				/		34		
	1	RB							/	1			
	-								//	' '			
20.0	1-		-	H	Silty clay, trace shale - gray - medium (CL)				<del>/</del>				
	7	ST			Sity clay, trace shale - gray - medium (OL)			·9	$\mathbb{P}_{\star}$	•			
	1		Ш	H									
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25.0	1									1			
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35.0	1												
§	7	RB							1				
\$	7							1	1				
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TS.C	1												
₩ 40.0	1_		Ш	Ц				_ L	<b> </b>	ᄔᆜ			
BOHING LOG 30852.GPJ STS.GDT 1/31/00  The st					continued		* Cal	brated	Penetr	pmeter			
082													
9									1				
9]													
¥	1						l ete	IOB NO.	<u> </u>	<u> </u>	HEET NO		\E
m The st	ratifica	ion lin	es r	epre	sent the approximate boundary lines between soil types: in situ, the transition m	ay be gradual.	3133	JOB NO.	30852	2 3"	ILE I NO	1	)F 4

				1		OG OF BORIN	NG NUN	ABER	B-10			
	7	Ų			Interparking PROJECT NAME AF	RCHITECT-EI	MOINE					,
				1	LaSalle/Hubbard Development	TORITEC 1-EI	NOINE	-n				
SITE LOC			td.		Lasalle/ Nubbalu Developillent			O UNC	CONFINED CO	MPRESSI	/E STRE	ENGTH
			lle	&	Hubbard Streets; Chicago, IL			O TON	IS/FT."	3 4	5	
										+		<del> </del>
DEPTH(FT) ELEVATION(FT)			Š					PLAST LIMIT		TER ENT %	LIQ	
Ē Ş	Ċ.	ų.	STA		DESCRIPTION OF MATERIAL		Ë	×	(	<b>)</b>	- 1	7
DEPTH(FT) ELEVATION	N N	E T	ō	/ER			۲. م ۲. م	10	20 :	40	5	0
	SAMPLE NO.	SAMPLE TYPE	SAMPLE DISTANCE	RECOVERY			UNIT DRY WT. LBS./FT.*	8	STANDA	ARD RATION B	LOWS/F	FT.
$\bowtie$	ŝ	8	3	æ	SURFACE ELEVATION +16.3 CCD (C Silty clay, trace shale - gray - medium (CL)	Continued)		10		30 40		
	9	ST	Ш		Sity clay, trace shale gray - medium (OL)			ф,	•	1 1		
		├	╨	Н				11				
									[ ]			
								11				
45.0								- 11	11			
		RB										
50.0												
	10	ST	П	П	Silty clay, trace gravel, sand and shale - gray - stiff (CL)			6				
		J,	Ш	Щ				*4	IT			
								<b>\</b>	li i			
55.0								[]	ľ			
		RB						- 11	- [,			
								11	1.			
60.0			П	П					1_			
	11	ST					117	*	P.•			
			Н	٦					\			
		RB		1		ļ			\			
65.0						l			\			
	12	ST				ļ				1 1		
	٠-	5	Ш	4				*	V			
									1/		. ]	
		RB				j			1] \	]		
70.0			$  \mathbf{H}  $	┰┤	Silty clay, trace gravel, sand and shale - gray - very stiff to h	nard		$-\!\!\!\!\!+$	11 3			
	13	ST		Ц	(CL)				$\bullet$	P. [		
			씸	$\dashv$		1				$  \setminus  $	1	
		RB				1			1	$  \setminus  $	1	
75.0						1				1	l	
			П	П		[				1 k	100	
	14	ST		ᅱ		1			V	1	7~*	
						l			<b>\</b>	/	ł	
		RB		- 1		l	Ì		١\	/		
80.0			Ц	$\perp$					_ Li _	1/1		
	1				continued		* Cal	brated Pe	enetrometer			
											1	
80.0	l					į					1	
				1			<u> </u>					
The stra	itificat	ion fin	es re	epre	sent the approximate boundary lines between soil types: in situ, the transition may t	be gradual.	STS.	10B NO.	0852 S	HEET NO.	2 0	F 4

		1		1	WNER	LOG OF BORI	NG NUN	ABER	B-10				}
	7				nterparking								}
	_			1	ROJECT NAME	ARCHITECT-E	NGINE	ER					
STS Co			td.		aSalle/Hubbard Development	L		- UNIC	NEWED C	OMPRESSI	ur cro	FNOTU	
SITE LO			ماا	æ	Hubbard Streets; Chicago, IL			TONS		3 4		5	
		1		Ĩ	indubate officers, officego, re		-	<u> </u>			-	<del></del>	
E			삤					PLASTI		VATER		UID	
DEPTH(FT) ELEVATION(FT)		w	SAMPLE DISTANCE	-	DESCRIPTION OF MATERIAL		ایا	X-		NTENT %		π % Δ	
DEPTH(FT)	ğ	2	DIS	≥	DESCRIPTION OF MATERIAL		\$	10	20	30 4	iO 5	iO	
E.E.	٣	2	핗	3			E E		STAN	DARD	<del></del>	<del></del>	
	SAMPLE NO.	SAMPLE TYPE	NA.	RECOVERY	SURFACE ELEVATION +16.3 CCD	(Continued)	UNIT DRY WT. LBS./FT.	<b>⊗</b>	PENE	TRATION I			
	+	۳	T	Ħ	Silty clay, trace gravel, sand and shale - gray - very stiff		+==	T T	20   ] ]	30 4 17		ю Г	j
	15	ST			(CL)				•	$\mathcal{P}_{\bullet}$			
	$\vdash$	RB	Ш										
	16	ST		П					ak	` <b>`</b>		]	
	1"			Ц				1	·	<b>→</b>			
85.0	17	BB ST	H	7	Very silty clay to clayey silt, trace gravel, sand and shale	a - oray -	-			1-		-	
	17	<del> </del>	Щ	ᅬ	hard (CL to CL-ML)	- 9/			7				<b>&gt;</b> 0,
	1	RB			Caturated all commo noted in Commis 40				1			/	1
	18	ST	П	口	Saturated silt seams noted in Sample 18.						کہ ا	<b>X</b>	1
	<del> </del>		Щ	4	Pressuremeter Test at 85-87.5 ft.		<del>  </del>	<del>  -</del>		+-		<u> </u>	ł
90.0	1_	RB		$\dashv$	Driller's observation: Sand and gravel (likely saturated).				11				
	19	ST	Ш	닉	Drilling fluid loss=60% from 90-93'.				<b>1</b>	<b>Σ</b> Φ.*			
	1	RB			Note: Borehole was caving in when trying to run pressur	remeter			1				
	1	no			test. No PMT could be performed at 90-92.5 ft.						Į		
	100	00	П	T	Silty clay to clayey silt, trace gravel, sand and shale - gr	ay - hard				<b>—</b>	$\lambda_{\hat{\alpha}}$	<del>                                     </del>	1
95.0	20	SS	Щ	Ц	(CL to CL-ML)	•				36 ★	$\sim$		
	<u> </u>	RB	Ц	$ \bot $	Pressuremeter Test at 93.5-96 ft.			<u> </u>					7±
	21	ST	Щ	Ц				9			Ì		0
	22	RB	Н	H					į				7+ 38/6
	122	<del> </del>	14	Ч	Pressuremeter Test at 97.5-100 ft.				- 1				*08
100.0	1	RB							-				7+
	23	ST		П				•					<sup>7</sup> 0
	}	20			Boulder obstruction encountered from 102-102.75'.								
	1	RB											
105.0	1												7+ 45/6"
	24	SS.	Щ	П				•					7+ 45/6°
	1		H	+	Clayey silt to silt, trace gravel, sand and shale - gray - h	ard - wot	<del> </del>	<del>                                     </del>		-	<b> </b>	<u> </u>	"
	1	RB		1	(CL-ML to ML)	aiu - WCl						1	ł
	1	1"6							1				l
110.0	1			1	Drilling fluid loss=20% from 107.5 to EOB. Boulder obstruction encountered from 107-107.5', 111-1	11.5'		,1,					7+ 01/6
	25	ss.	耳	口	114-115', 116.5-117' and 122-122.5'.			•					7+ 81/6* O⊗
	1								1				[
	1								ĺ				
	1	RB											
1150	1								1			l	
115.0		000	$\sqcup$	$\downarrow$									7+ 125/6
	26	SS.	╁┼	ᅥ				T					*O80
	1												
3	1	RB											
GB-SIS	1												
			+	+			<del>  -  </del>	<u> </u>	_ + -	-	-		
920					continued		* Cal	brated Pe	netromete	er			
S.									1	( i			
3				1									
The str			$\perp$	$\perp$			<u> </u>	<u> </u>					
The str	atificat	ion lin	es re	pre	sent the approximate boundary lines between soil types: in situ, the transition is	may be gradual.	STS.	JOB NO.	2852	SHEET NO	). <b>3</b>	DF A	
Ď L Ď					, , , , , , , , , , , , , , , , , , ,			3(	852		J	4	

		7	1		1	wnen nterparking		LOG OF B	ORIN	G NUN	<b>ABER</b>	B-	10				
		6	4		_	ROJECT NAME		ARCHITE	CT-EN	GINE	R	<del></del>			<del>-</del> ,,		1
	Con			id.	旦	aSalle/Hubbard Dev	elopment										
SITE				ماا	£.	Hubbard Streets; Ch	icago II				<b>₩</b>	NCONFI DNS/FT.	NED CON				
-				T	$\Box$	Trubbara Otrects, On	iioago, iL		-				-			5	
	E			쀵								STIC	CONTI			WID IT %	
E	ELEVATION(FT)	<u></u>	W.	TAN	RECOVERY	DESC	RIPTION OF MATERIAL	-		Ë		<del>(</del> –		<u> </u>		Δ	
DEPTH(FT)	EVA	N N	7	Ö	ERY					≨ ≿ •.	1	0 2	0 3	0 4	0 5	50	l
L <sub>2</sub>	피	SAMPLE NO.	SAMPLE TYPE	MP	Š					UNIT DRY WT. LBS./FT.ª	6		STANDA		BLOWS/	FT.	]
X	$\dashv$	ις 27	35	13	Ē	SURFACE ELEVATION +	16.3 CCD ravel, sand and shale - gray -	(Continu	ed)	5 5	1		0 3				7+ 140/ *
	$\exists$					(CL-ML to ML)	raver, sand and snale - gray -	Halu - Wet									. <sup>©</sup>
						Drilling fluid loss=20% fro	om 107.5 to EOB.										1
	ᆿ		RB			Boulder obstruction enco	untered from 107-107.5', 111	-111.5',	1								1
125						114-115', 116.5-117' and	122-122.5'.		1								<b>&amp;</b> 100/
		_	55.	H	Ħ				1							1	⊗
	$\exists$															<u></u>	
	$\exists$		RB	П	T	Driller's observation: Prol	bable weathered limestone be	edrock.									
129	.0			Ц					_								1
						End of Boring Borehole grouted upon o	ompletion.			* Cal	brated	Penetr	ometer				
1						Casing used: 20 ft. of 4 in		4: <b>T</b> 4-	- 1								
1						SS* = SPT value based of		tion lests.	- 1								
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	7	The	stra	tific	atio	on lines represent the appr	oximate boundary lines betwe	en soil type	es: in	situ.	the tra	ansition	n may t	e grad	lual.		
WI							BORING STARTED	,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,		FFICE							
	14.5	ft. V	NS				1/14/00					<del></del>	ago An				
WL	22.0	ft. E	3CR:	22	.0 f	. ACR	BORING COMPLETED 1/17/00	ł	ENTE	RED B	Y B	SHE	ET NO.	4 OF	4		
WL WL							RIG/FOREMAN		APP'D	BY		STS	JOB NO				
i <b></b>							Mobile B-61/Baker			AJ				30852	<u> </u>		İ

				1		G OF BORIN	IG NUM	BER	B-	11			
	7				Interparking								
P		•			1	CHITECT-E	NGINEE	R					
STS Cor			td.	$\perp$	LaSalle/Hubbard Development								
SITE LO					Highband Christin Chicago II			<b>₩</b>	NCONFI ONS/FT. 1	NED CON			
SW	<b>لا</b> ت	<b>858</b>	11e	Č	Hubbard Streets; Chicago, IL		1			2 3	4		5
F			u u		·		1		STIC	WAT		LIQ	
ارا الا			Š		DECORIDE OF 114 TEDIA				π% ← –	CONT	ENT %	LIM	
F F	ġ	Ž	JST,	≥	DESCRIPTION OF MATERIAL		ξ			on 3	0 40		7
DEPTH(FT) ELEVATION(FT)	Ē	LE I	E	VER		1	¥ +	1	<del></del>	20 3			0
<b>"</b>	SAMPLE NO.	SAMPLE TYPE	A P	RECOVERY	CURRACE ELEVATION 145 8 CCD		UNIT DRY WT. LBS./FT.*		<b>3</b>	STANDA PENETR	ATION B		
$\sim$	Š	Š	S	Œ	SURFACE ELEVATION +15.8 CCD Asphalt (2-3") and base course (10")		25			20 3	40	5	0
	<u> </u>	PA	<u> </u>	Н	Urban fill: Cinders, brick, sand, gravel, crushed concrete, cla	214 and							
		'^			Slag	ay anu	1				[		
	1	ss	П	П			1	10	<b>30</b>				
	Ľ	L	$\coprod$	Н			ł		1		l		
5.0	<u> </u>	PA	-	H			1	8⊗					
	2	ss		М			l	۳					
		PA		H			}		14				
	3	ss	П	田		]	1		<b>6</b>				
	3	33	μ.	Ц		l			',				
10.0					Driller's observation: Concrete slab encountered at 10-10.5'.		l		[	]			
		PA		$\vdash \vdash$	Fill: Silty clay, little brick - brownish gray - very stiff (CL)				IT				
			_				ĺ		⊗ <sup>12</sup>	7-			
	4	ss		Щ			1		⊗ ,				
		RB							ļ,	<u> </u>			
15.0		nb	_		Silty clay, trace gravel and sand - brownish gray - stiff (CL)		1		/	<b>\</b> \			
	5	ST							6	7			
			Щ	Щ			1	*	7*	1			
								,	<b>Y</b>	1			
		RB						/		1			
20.0													
	6	SS			Silty clay - gray - soft to medium (CL)		k	$\infty$					
			Щ	Щ			*	*		/			
							]						
		RB					1	-		1			
25.0				Ш		(		1		,			
	7	ST					k	οю.		•			
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		RB					Į						
30.0			$\Box$	H			}	1	1				
	8	ST					k	ф					
			Щ	Щ			*	1 *			{		
								1		[/			
		RB					1	1		/			
35.0			Щ	Ш		l		1					
	9	ST						<b>*</b> Ф					
			Ш	出				*					
			Ц	Ц					ļ				
		RB			Silty fine to coarse sand, trace clay and gravel - gray - media dense - saturated (SM)	um							
40.0							[			L _			
					continued		* Cal	orated	Penetr	ometer			
							1						
									1			1	
				-			ļ						
							STS	OB NO.	<u> </u>	T <sub>SI</sub>	HEET NO	· ·	)F
The stra	atricat	ion lini	es re	epre	sent the approximate boundary lines between soil types: in situ, the transition may be	e gradual.	1		30852	2 1 3		1	<b>"</b> з

				1	WNER	LOG OF BORI	NG NU	ABER	B-	11			
					nterparking					·			
	_			1	ROJECT NAME	ARCHITECT-E	NGINE	ER					
STS Cons			td.	L	_aSalle/Hubbard Development		<del></del>						
SITE LOC				۰	U.bhard Streets, Chiange II			(구 다	NCONFII ONS/FT.	NED CO	MPRESSI	VE STR	ENGT
SWC	<u>, L</u>	128	iie	œ	Hubbard Streets; Chicago, IL		1 1		1	5	3 4	<u> </u>	5
اء			[[	- (				DI A	STIC	w	TER		DIUK
DEPTH(FT) ELEVATION(FT)			SAMPLE DISTANCE	1				LIM	IT %		ENT %		IT %
DEPTH(FT)	٠.	W L	ZY.		DESCRIPTION OF MATERIAL		ايا	2	<del>×-</del> -		<b>-</b>	_ 1	Δ
¥ ×	ž	≿	ă				≥ -	•	0 2	0	30 4	0 5	50
8 8	7	3	립	اة			[ E F			STAND	ARD		
বা	SAMPLE NO.	SAMPLE TYPE	SAN	RECOVERY	SURFACE ELEVATION +15.8 CCD	(Continued)	UNIT DRY WT. LBS./FT.³				RATION E		FT. 50
	10	SS		H	Silty fine to coarse sand, trace clay and gravel - gray - m				2		Ĩ		$\tilde{\sqsubseteq}$
	10A	SS	Ш	Ш	dense - saturated (SM)	/	1	5/6*	OCE	•			
			П		20% drilling fluid loss at 38-48'.			•	16*	1			1
		RB		- [	Silty clay, trace gravel, sand and shale - gray - stiff (CL)				/				1
		ND	Ц	1						$\Delta$			<u>L</u>
15.0					Sandy clay to clayey sand, little gravel - gray (CL to SC)				,	,	00		
	11	ss	П	Π						i	29		
		-55	井	$\exists$					1	<b>'</b>			
				1					1		1		
		RB					]		'.		]		
		-							\				
0.0			4	4					1			<u> </u>	
	12	ST	11	Ш	Silty clay, trace gravel, sand and shale - gray - stiff to ver	y stiff			.0		1		
	_	٠,	$\prod$	_]			]			<u> </u>			
				7									
		RB		-					1 1			1	
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5.0	$\dashv$		+	H							}		
	13	ST							<b>d</b>				
二			4	Ц					1*				
	- 1	RB					] ]						
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	14	ST	$\Pi$				1 1		φ.				
$=$ $\downarrow$	_		4				] ]	_	1 \ \ \ \ \				
									l \.'				
	1	RB							\/				
5.0		- 1					1 1		<b> </b>				1
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	15	ST	11	4					**	<b>*</b>			l
		-	+	$\dashv$			[ [						l
			- 1										
	1	RB							!!	\			1
0.0			$\downarrow$	$\perp$						`			L
	16	ST		Ш	Silty clay, trace gravel, sand and shale - gray - very stiff to	o stiff (CL)			•		80		
	, °	31	11	4						•	1-1-1		1
	$\neg$		$\top$	7									ĺ
		RB									\		ĺ
	-	-							,		l V		l
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二.	17	ST	11	Ц					◀	•	1	$\infty$	l
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	1	- 1						1		`,			
		RB								١			İ
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44	+		+	+			<u> </u>				1 — 🕂		
					continued		* Cali	orated	Penetre	meter	[		
[	- [											1	r
				1							1 1	- 1	
-		1									] ]	ļ	
							<del></del>			<del></del>	<u> </u>		
	ficati	on line	s rec	res	ent the approximate boundary lines between soil types: in situ, the transition may	ay be gradual.	STS J	OB NO.	30852	S	HEET NO	2 0	)F

	~			1	nterparking		Logore	יווחטפ	IG NON	IDEN	B-	.11				
	6	ll .			ROJECT NAME		ARCHITE	CT-EN	VGINEE	R						
STS Con		-4-14		1	aSalle/Hubbard Deve	elopment			•							
ITE LOC	ATIC	N		<u> </u>	Hubbard Streets; Ch		<u> </u>			O TO	ICONFI INS/FT.	2	MPRESSI	VE STR		
DEPTH(FT) ELEVATION(FT)	SAMPLE NO.		SAMPLE DISTANCE	٦		RIPTION OF MATERIAL			UNIT DRY WT. LBS./FT.³	10	τ% ( ) :	CONT		<del></del>	0 2	
₹ T	SAN	SAR	SAR	Æ	SURFACE ELEVATION +		(Continu		ž š	8 10			RATION I		-1. 0	j
	22 18	SS		$\prod_{i=1}^{n}$	Silty clay, trace gravel, sa	and and shale - gray - very	stiff to stiff (C	L)				1	~	<b>⊗</b> 46		
		ST RB ST	П	$\frac{1}{4}$	Clayey silt, trace gravel, s (CL-ML)	sand and shale - gray - stiff	to very stiff		109		,0					
85.0	20	BB ST			Wet silt seams noted. Clayey silt, trace gravel, s to ML)	sand and shale - gray - har	d - wet (CL-M					•		,0	Q.	
	21	RB ST			Silt little clay trace sand	and shale - gray - dense -	saturated (Mi					•				6.2
90.0		RB RB			om, mue dray, trace sand	and ondio gray conse-		-, 								
	23	SS	T	$\mathbb{I}$									39			
95.0		RB									_/	<u> </u>			_	
	24	ss	$\prod$	$\prod_{i=1}^{n}$	Very silty clay, trace grav	el, sand and shale - gray -	hard (CL)				•					<b>6</b> 3
100.0		RB														7÷
100.5					End of Boring Borehole grouted upon or Casing used: 20 ft. of 4 ir Automatic-Mobile Hamme SS* = SPT value based of	n. er used for Standard Penet	tration Tests.		*Cal	brated	Peneti	remete				*
	The	stra	tific	ati	on lines represent the appr	oximate boundary lines be	tween soil typ				Insitio	n may	be grad	l dual.	L	
VL 13.	5 ft.	ws				BORING STARTED 1/25/00		STS	OFFICE		Chi	cago A	rea - 01			
VI			21	.0	H. ACR	BORING COMPLETED 1/25/00 RIG/FOREMAN		ENTERED BY						-		
						Mobile B-61/Ba	ker	<u> </u>	AJ	Р			3085	2		J

PROJECT:

400 N. LaSalle

\*VANE SIZE

STS JOB NUMBER:

30852-A

 $2.0 = SMALL (11CM \times 5CM) VANE$ 

OPERATOR:

Knight

 $1.0 = MEDIUM (13CM \times 6.5 CM) VANE$ 

DATE OF TEST:

01/04/01

 $0.5 = LARGE (17.2CM \times 8CM) VANE$ 

SURFACE ELEVATION:

15 Feet CCD +/-

VANE CONSTANT, K=1.0071

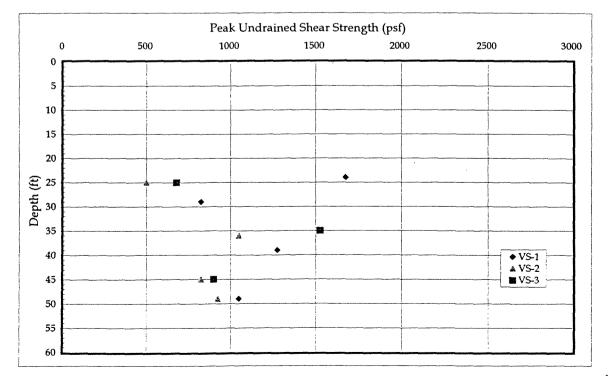
DATA REDUCTION:

Knight

#### **VANE SHEAR RESULTS**

BORING	VANE TIP DEPTH	VANE	a	PEA	KS <sub>u</sub>	a	REMOL	DED S.	SENSITIVITY	APPROX. VANE TIP ELEVATION
NO.	(ft)		(in)	(tsf)	(psf)	(in)	(tsf)	(psf)	PEAK/REM.	(CCD)
VS-1	24.0	1.0	3.21	0.84	1675	-	-	-	-	-9.0
	29.0	1.0	1.59	0.42	825	0.86	0.22	450	1.8	-14.0
	39.0	1.0	2.43	0.63	1275	1.46	0.38	750	1.7	-24.0
	49.0	1.0	2.00	0.52	1050	1.27	0.33	675	1.6	-34.0
VS-2	25.0	1.0	0.94	0.25	500	0.50	0.13	250	2.0	-10.0
	36.0	1.0	2.03	0.53	1050	1.05	0.27	550	1.9	-21.0
	45.0	1.0	1.60	0.42	825	0.80	0.21	425	1.9	-30.0
	49.0	1.0	1.77	0.46	925	0.93	0.24	475	1.9	-34.0
VS-3	25.0	1.0	1.28	0.33	675	0.52	0.14	275	2.5	-10.0
	35.0	1.0	2.91	0.76	1525	1.25	0.33	650	2.3	-20.0
	45.0	1.0	1.74	0.45	900	0.91	0.24	475	1.9	-30.0

Comments: VS-1 (24') test maxed out vane testing limits



PROJECT NAME: Walker Parking STS JOB NUMBER: 30852 OPERATOR: Seiler

DATE: 1/15/00

#### PRESSUREMETER TEST RESULTS

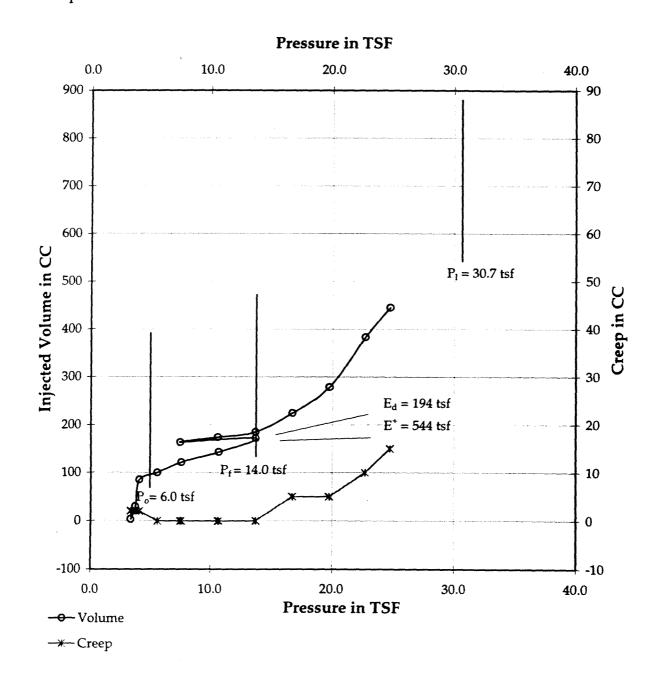
BORING	DEPTH	$P_o$	$\mathbf{P}_{\!f}$	$\mathbf{P}_l$	$\mathbf{E}_d$	E <sup>+</sup>			
NUMBER	(ft)	(tsf)	(tsf)	(tsf)	(tsf)	(tsf)	$E_d/E^+$	$E_d/P_l$	$P_l/P_f$
1	82.5-85.0	6.0	14.0	30.7	194	544	0.36	6.3	2.2
	87.5-90.0	7.0	34.0	-	697	1597	0.44	-	-
	92.5-95.0	7.0	29.0	-	662	1441	0.46	-	-
5	82.5-85.0	6.0	18.0	35.9	313	481	0.65	8.7	2.0
	87.5-90.0	7.0	37.0	_	1161	3431	0.34	-	-
	92.5-95.0	7.0	26.0	_	677	1134	0.60	-	-
	100.0-102.5	7.0	18.0	34.7	478	798	0.60	13.8	1.9
10	85.0-87.5	6.0	15.0	27.5	240	742	0.32	8.7	1.8
	93.5-96.0	6.0	15.0	30.6	201	434	0.46	6.6	2.0
	97.5-100.0	7.0	18.0	40.3	310	349	0.89	7.7	2.2
					AVERAGE		0.51	8.6	2.0

STS Job Number: 30852

Date: 1-13-00

Boring No. 1

Test Depth: 82.5-85.0 Feet



STS Consultants, Ltd. STS Job Number: 30852

Boring No.: 1

Test Depth: 82.5-85.0 Feet

Water Correction:

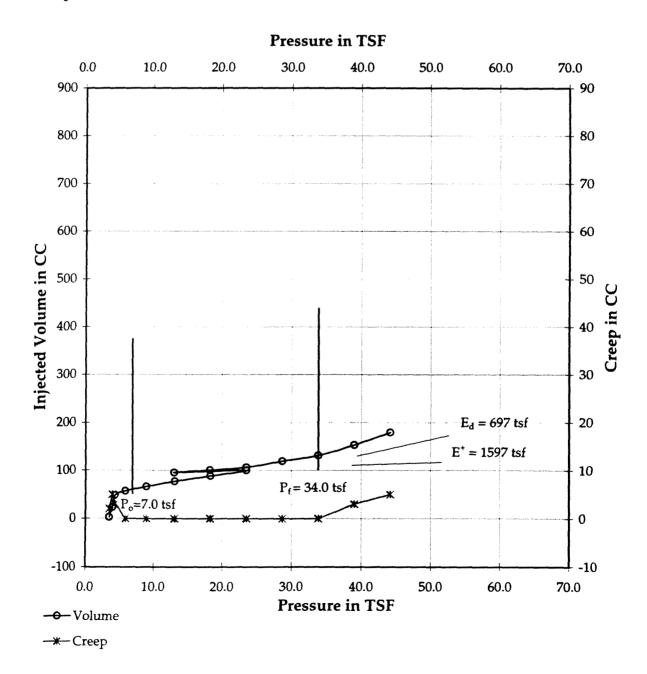
No.	Pressure Readings (bars)	Inertia Correction (bars)	Corrected Pressure (tsf)	30 Sec. Volume (cc)	60 Sec. Volume (cc)	Creep (cc)	Corrected 30 Sec. Volume (cc)	Corrected 60 Sec. Volume (cc)	Incremental Modulus (tsf)
1	0.50	0.02	3.4	3	5	2	1.0	3.0	
2	1.00	0.13	3.8	30	32	2	27.8	29.8	22
3	1.50	0.32	4.1	85	87	2	82.7	84.7	9
4	3.00	0.37	5.6	103	103	0	100.1	100.1	164
5	5.00	0.43	7.6	125	125	0	121.5	121.5	162
6	8.00	0.49	10.7	147	147	0	142.8	142.8	257
7	11.00	0.57	13.8	177	177	0	172.1	172.1	191
8	5.00	0.54	7.5	167	167	0	163.5	163.5	1358
9	8.00	0.57	10.6	178	178	0	173.8	173.8	568
10	11.00	0.60	13.7	190	190	0	185.1	185.1	519
11	14.00	0.69	16.8	225	230	5	219.6	224.6	152
12	17.00	0.80	19.8	280	285	5	274.0	279.0	116
13	20.00	0.98	22.7	380	390	10	373.5	383.5	65
14	22.00	1.08	24.7	437	452	15	430.1	445.1	81
	$E_d =$	194	TSF	$\mathbf{E}^{+} =$	544	TSF	$P_{l}=$	30.7	TSF

STS Job Number: 30852

Date: 1-13-00

Boring No. 1

Test Depth: 87.5-90.0 Feet



 $STS\ Consultants,\ Ltd.$ 

STS Job Number: 30852

Boring No.: 1

Test Depth: 87.5-90.0 Feet

Water Correction:

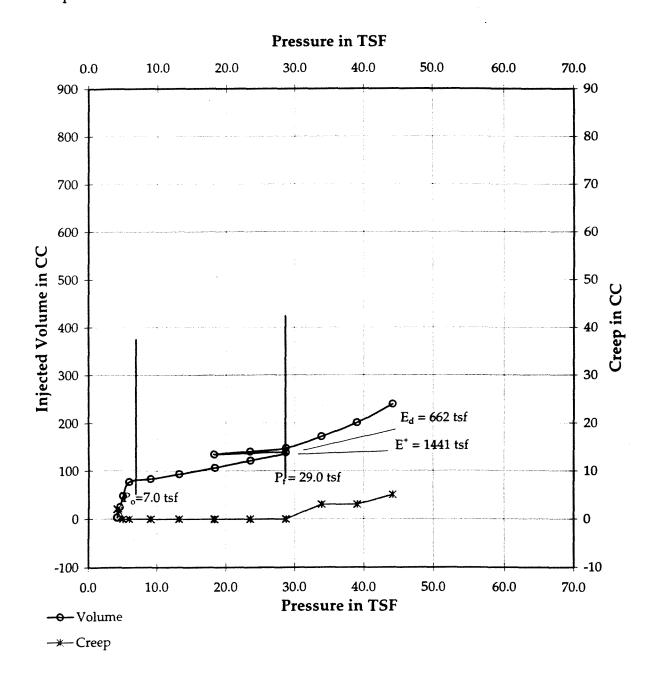
No.	Pressure Readings (bars)	Inertia Correction (bars)	Corrected Pressure (tsf)	30 Sec. Volume (cc)	60 Sec. Volume (cc)	Creep (cc)	Corrected 30 Sec. Volume (cc)	Corrected 60 Sec. Volume (cc)	Incremental Modulus (tsf)
1	0.50	0.02	3.5	3	5	2	0.9	2.9	
2	1.00	0.10	4.0	20	25	5	17.7	22.7	32
3	1.50	0.19	4.4	47	50	3	44.6	47.6	26
4	3.00	0.23	5.9	60	60	0	57.0	57.0	252
5	6.00	0.26	9.0	<b>7</b> 0	<i>7</i> 0	0	66.2	66.2	539
6	10.00	0.30	13.2	82	82	0	<i>7</i> 7.3	<i>7</i> 7.3	601
7	15.00	0.34	18.3	94	94	0	88.3	88.3	<i>7</i> 71
8	20.00	0.38	23.5	107	107	0	100.4	100.4	719
9	10.00	0.36	13.1	100	100	0	95.3	95.3	<b>344</b> 0
10	15.00	0.38	18.3	106	106	0	100.3	100.3	1736
11	20.00	0.40	23.5	113	113	0	106.4	106.4	1458
12	25.00	0.44	28.7	127	127	0	119.4	119.4	687
13	30.00	0.47	33.9	140	140	0	131.3	131.3	764
14	35.00	0.53	39.0	160	163	3	150.2	153.2	425
15	40.00	0.60	44.2	185	190	5	174.1	179.1	371
	$E_d =$	697	TSF	$\mathbf{E}^{+}=$	1597	TSF			

STS Job Number: 30852

Date: 1-13-00

Boring No. 1

Test Depth: 92.5-95.0 Feet



 $STS\ Consultants,\ Ltd.$ 

STS Job Number: 30852

Boring No.: 1

Test Depth: 92.5-95.0 Feet

Water Correction:

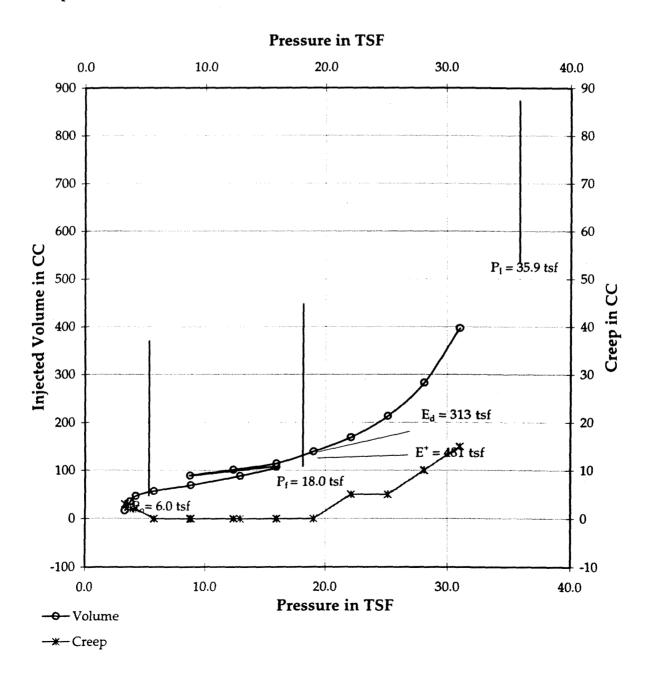
No.	Pressure Readings (bars)	Inertia Correction (bars)	Corrected Pressure (tsf)	30 Sec. Volume (cc)	60 Sec. Volume (cc)	Creep	Corrected 30 Sec. Volume (cc)	Corrected 60 Sec. Volume (cc)	Incremental Modulus (tsf)
1	1.00	0.02	4.2	3	5	2	0.6	2.6	
2	1.50	0.11	4.6	25	27	2	22.5	24.5	<b>2</b> 9
3	2.00	0.19	5.1	50	50	0	47.3	47.3	<b>2</b> 9
4	3.00	0.30	6.0	80	80	0	<i>7</i> 7.0	77.0	50
5	6.00	0.32	9.1	87	87	0	83.1	83.1	830
6	10.00	0.35	13.3	98	98	0	93.2	93.2	680
7	15.00	0.40	18.4	112	112	0	106.3	106.3	<i>67</i> 0
8	20.00	0.44	23.6	128	128	0	121.3	121.3	593
9	25.00	0.49	28.8	<b>14</b> 6	146	0	138.3	138.3	538
10	15.00	0.47	18.4	<b>14</b> 0	140	0	134.3	134.3	4615
11	20.00	0.49	23.6	147	147	0	140.4	140.4	1536
12	<b>25.</b> 00	0.51	28.8	155	155	0	147.3	147.3	1345
13	30.00	0.58	33.9	177	180	3	168.3	171.3	398
14	35.00	0.65	39.1	207	210	3	197.2	200.2	342
15	40.00	0.73	44.2	245	250	5	234.1	239.1	<b>2</b> 65
	$E_d =$	662	TSF	$\mathbf{E}^{+}=$	1441	TSF			

STS Job Number: 30852

Date: 1-7-00

Boring No. 5

Test Depth: 82.5-85.0 Feet



STS Consultants, Ltd. STS Job Number: 30852

Boring No.: 5

Test Depth: 82.5-85.0 Feet

Water Correction:

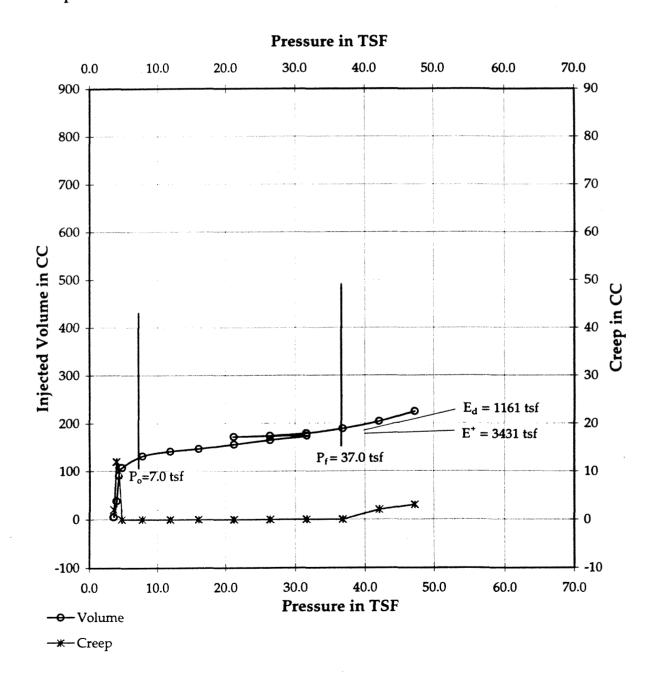
No.	Pressure Readings (bars)	Inertia Correction (bars)	Corrected Pressure (tsf)	30 Sec. Volume (cc)	60 Sec. Volume (cc)	Creep (cc)	Corrected 30 Sec. Volume (cc)	Corrected 60 Sec. Volume (cc)	Incremental Modulus (tsf)
1	0.50	0.07	3.3	15	18	3	13.0	16.0	
2	1.00	0.15	3.8	35	37	2	32.8	34.8	35
3	1.50	0.19	4.2	47	49	2	44.6	<b>4</b> 6.6	62
4	3.00	0.23	5.8	60	60	0	57.1	57.1	228
5	6.00	0.27	8.8	<b>7</b> 3	73	0	69.2	69.2	<b>4</b> 05
6	10.00	0.34	13.0	93	93	0	88.3	88.3	351
7	13.00	0.40	16.0	113	113	0	107.7	107.7	266
8	6.00	0.34	8.8	93	93	0	89.2	89.2	660
9	9.50	0.38	12.4	106	106	0	101.4	101.4	497
10	13.00	0.42	16.0	120	120	0	114.7	114.7	464
11	16.00	0.49	19.1	145	145	0	139.2	139.2	220
12	19.00	0.56	22.1	170	175	5	163.6	168.6	190
13	22.00	0.67	25.1	215	220	5	208.1	213.1	131
14	25.00	0.81	28.1	280	<b>29</b> 0	10	272.5	282.5	<b>9</b> 0
15	28.00	1.01	31.1	390	<b>4</b> 05	15	381.9	396.9	60
	$E_d =$	313	TSF	E <sup>+</sup> =	481	TSF	P <sub>l</sub> =	35.9	TSF

STS Job Number: 30852

Date: 1-7-00

Boring No. 5

Test Depth: 87.5-90.0 Feet



STS Consultants, Ltd.

STS Job Number: 30852

Boring No.: 5

Test Depth: 87.5-90.0 Feet

Water Correction:

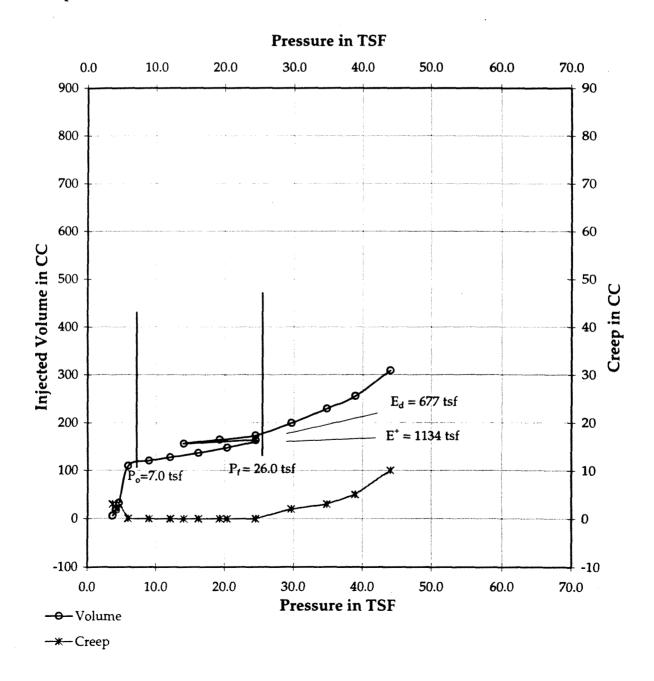
No.	Pressure Readings (bars)	Inertia Correction (bars)	Corrected Pressure (tsf)	30 Sec. Volume (cc)	60 Sec. Volume (cc)	Creep (cc)	Corrected 30 Sec. Volume (cc)	Corrected 60 Sec. Volume (cc)	Incremental Modulus (tsf)
1	0.50	0.03	3.5	5	7	2	2.9	4.9	
2	1.00	0.16	3.9	28	40	12	25.7	37.7	17
3	1.50	0.34	4.2	83	93	10	80.6	90.6	10
4	2.00	0.39	4.7	110	110	0	107.4	107.4	<b>4</b> 7
5	5.00	0.46	7.8	135	135	0	131.5	131.5	222
6	9.00	0.49	11.9	146	146	0	141.5	141.5	<b>7</b> 39
7	13.00	0.51	16.1	152	152	0	146.7	146.7	1444
8	18.00	0.53	21.3	162	162	0	155.8	155.8	1046
9	23.00	0.56	26.5	172	172	0	164.8	164.8	1065
10	28.00	0.58	31.7	182	182	0	173.7	173.7	1089
11	18.00	0.57	21.2	178	178	0	171.8	171.8	10053
12	23.00	0.58	26.4	181	181	0	173.8	173.8	<b>4</b> 867
13	28.00	0.59	31.7	187	187	0	178.7	178.7	1995
14	33.00	0.62	36.9	198	198	0	188.6	188.6	1004
15	38.00	0.65	42.0	212	214	2	201.5	203.5	<i>67</i> 7
16	43.00	0.70	47.2	233	236	3	221.4	224.4	<b>4</b> 92
	E <sub>d</sub> =	1161	TSF	$\mathbf{E}^{+}=$	3431	TSF			

STS Job Number: 30852

Date: 1-7-00

Boring No. 5

Test Depth: 92.5-95.0 Feet



 $STS\ Consultants,\ Ltd.$ 

STS Job Number: 30852

Boring No.: 5

Test Depth: 92.5-95.0 Feet

Water Correction:

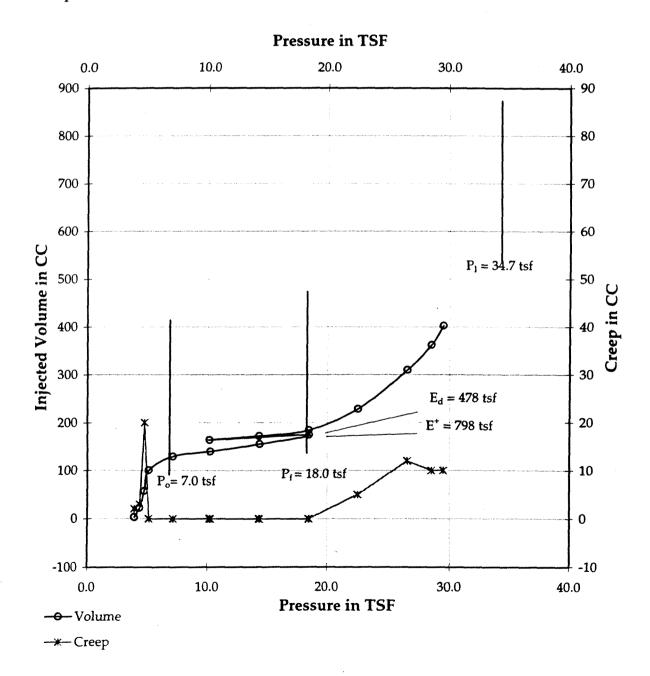
No.	Pressure Readings (bars)	Inertia Correction (bars)	Corrected Pressure (tsf)	30 Sec. Volume (cc)	60 Sec. Volume (cc)	Creep (cc)	Corrected 30 Sec. Volume (cc)	Corrected 60 Sec. Volume (cc)	Incremental Modulus (tsf)
1	0.50	0.03	3.7	5	8	3	2.8	5.8	
2	1.00	0.08	4.1	18	20	2	15.7	17.7	58
3	1.50	0.14	4.6	32	35	3	29.5	32.5	<b>4</b> 6
4	3.00	0.40	5.9	112	112	0	109.0	109.0	27
5	6.00	0.43	9.0	124	124	0	120.2	120.2	481
6	9.00	0.45	12.1	132	132	0	127.5	127.5	<b>74</b> 6
7	13.00	0.48	16.3	142	142	0	136.7	136.7	<b>79</b> 9
8	17.00	0.51	20.4	154	154	0	147.9	147.9	663
9	21.00	0.55	24.5	170	170	0	163.2	163.2	499
10	11.00	0.53	14.1	161	161	0	156.1	156.1	2711
11	16.00	0.55	19.3	170	170	0	164.1	164.1	1192
12	21.00	0.58	24.5	180	180	0	173.2	173.2	1075
13	26.00	0.64	29.7	205	207	2	197.2	199.2	381
14	31.00	0.71	34.8	235	238	3	226.1	229.1	343
15	35.00	0.76	38.9	<b>2</b> 60	265	5	250.2	255.2	326
16	40.00	0.86	44.1	310	320	10	299.1	309.1	206
	$E_d =$	677	TSF	E <sup>+</sup> =	1134	TSF	·		

STS Job Number: 30852

Date: 1-7-00

Boring No. 5

Test Depth: 100.0-102.5 Feet



STS Consultants, Ltd. STS Job Number: 30852

Boring No.: 5

Test Depth: 100.0-102.5 Feet

Water Correction:

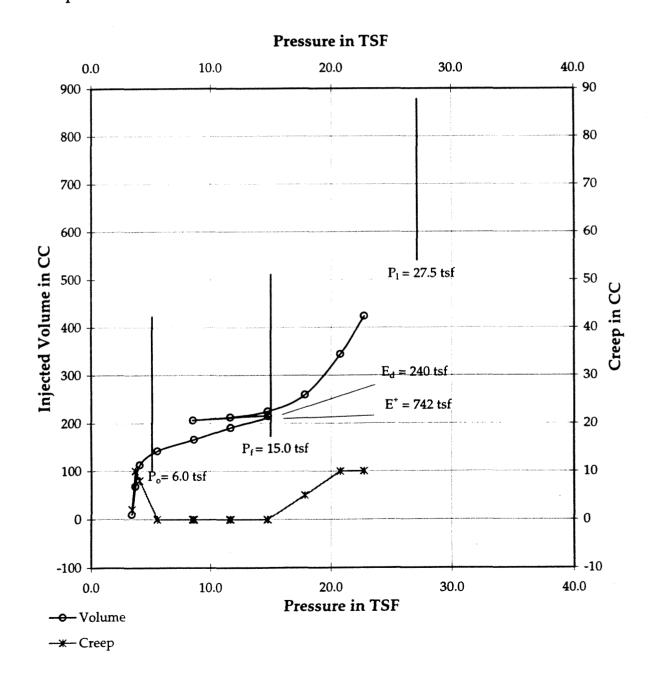
No.	Pressure Readings (bars)	Inertia Correction (bars)	Corrected Pressure (tsf)	30 Sec. Volume (cc)	60 Sec. Volume (cc)	Creep (cc)	Corrected 30 Sec. Volume (cc)	Corrected 60 Sec. Volume (cc)	Incremental Modulus (tsf)
1	0.50	0.02	3.9	3	5	2	0.7	2.7	
2	1.00	0.10	4.4	22	25	3	19.6	22.6	32
3	1.50	0.23	4.8	<b>4</b> 0	60	20	37.4	57.4	17
4	2.00	0.37	5.1	103	103	0	100.3	100.3	14
5	4.00	0.45	7.1	133	133	0	129.7	129.7	118
6	7.00	0.48	10.2	144	144	0	139.9	139.9	541
7	11.00	0.53	14.4	160	160	0	155.0	155.0	495
8	15.00	0.58	18.5	180	180	0	174.3	174.3	399
9	7.00	0.55	10.2	168	168	0	163.9	163.9	1500
10	11.00	0.57	14.3	177	177	0	172.0	172.0	953
11	15.00	0.60	18.5	190	190	0	184.3	184.3	642
12	19.00	0.70	22.5	230	235	5	223.5	228.5	181
13	23.00	0.86	26.6	305	317	12	297.8	309.8	106
14	25.00	0.95	28.5	360	370	10	352.4	362.4	88
15	26.00	1.02	29.5	<b>40</b> 0	<b>4</b> 10	10	392.2	402.2	60
	$E_d =$	<b>47</b> 8	TSF	$E^+=$	798	TSF	$P_{l}=$	34.7	TSF

STS Job Number: 30852

Date: 1-17-00

Boring No. 10

Test Depth: 85.0-87.5 Feet



STS Consultants, Ltd. STS Job Number: 30852

Boring No.: 10 Test Depth: 85.0-87.5 Feet

Water Correction:

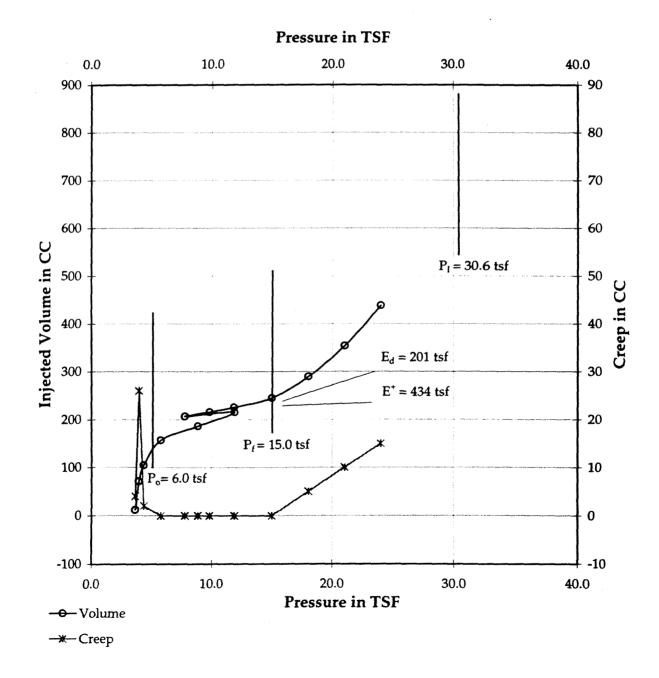
No.	Pressure Readings (bars)	Inertia Correction (bars)	Corrected Pressure (tsf)	30 Sec. Volume (cc)	60 Sec. Volume (cc)	Creep (cc)	Corrected 30 Sec. Volume (cc)	Corrected 60 Sec. Volume (cc)	Incremental Modulus (tsf)
1	0.50	0.05	3.4	10	12	2	7.9	9.9	
2	1.00	0.26	3.7	60	<b>7</b> 0	10	57.8	67.8	8
3	1.50	0.40	4.1	107	115	8	104.7	112.7	14
4	3.00	0.49	5.6	145	145	0	142.1	142.1	88
5	6.00	0.55	8.6	170	170	0	166.2	166.2	233
6	9.00	0.61	11.7	195	195	0	190.5	190.5	<b>24</b> 0
7	12.00	0.67	14.8	220	220	0	214.9	214.9	247
8	6.00	0.65	8.5	210	210	0	206.3	206.3	1428
9	9.00	0.66	11.7	217	217	0	212.6	212.6	983
10	12.00	0.69	14.8	230	230	0	224.9	224.9	502
11	15.00	0.76	17.8	260	265	5	254.4	259.4	184
12	18.00	0.92	20.8	<b>34</b> 0	350	10	333.9	343.9	78
13	20.00	1.05	22.7	420	<b>43</b> 0	10	413.5	423.5	60
	$E_d =$	240	TSF	$E^{+}=$	742	TSF	$P_{l}=$	27.5	TSF

STS Job Number: 30852

Boring No. 10

Test Depth: 93.5-96.0 Feet

Date: 1-17-00



STS Consultants, Ltd. STS Job Number: 30852

Boring No.: 10 Test Depth: 93.5-96.0 Feet

Water Correction:

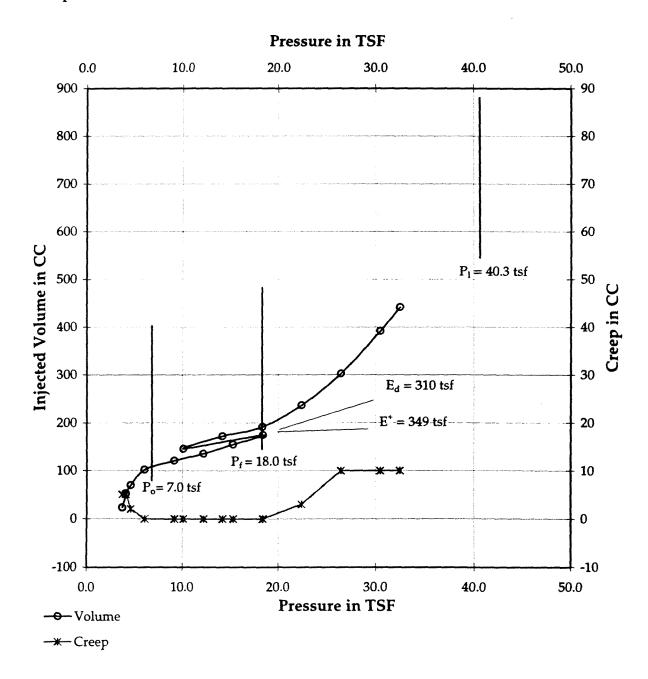
No.	Pressure Readings (bars)	Inertia Correction (bars)	Corrected Pressure (tsf)	30 Sec. Volume (cc)	60 Sec. Volume (cc)	Creep (cc)	Corrected 30 Sec. Volume (cc)	Corrected 60 Sec. Volume (cc)	Incremental Modulus (tsf)
1	0.50	0.06	3.7	10	14	4	7.8	11.8	
2	1.00	0.27	4.0	47	73	26	44.7	70.7	8
3	1.50	0.38	4.4	105	107	2	102.6	104.6	20
4	3.00	0.53	5.8	160	160	0	157.1	157.1	48
5	6.00	0.60	8.9	190	190	0	186.2	186.2	197
6	9.00	0.67	11.9	220	220	0	215.5	215.5	205
7	5.00	0.65	7.8	210	210	0	206.5	206.5	914
8	7.00	0.67	9.8	220	220	0	216.0	216.0	433
9	9.00	0.69	11.9	230	230	0	225.5	225.5	<b>43</b> 5
10	12.00	0.73	15.0	250	250	0	244.9	244.9	326
11	15.00	0.82	18.0	290	295	5	284.4	289.4	146
12	18.00	0.93	21.0	350	360	10	343.8	353.8	106
13	21.00	1.07	24.0	<b>4</b> 30	<b>44</b> 5	15	423.3	438.3	88
	$E_d =$	201	TSF	$E^+=$	434	TSF	$P_{l}=$	30.6	TSF

STS Job Number: 30852

Date: 1-17-00

Boring No. 10

Test Depth: 97.5-100.0 Feet



STS Consultants, Ltd. STS Job Number: 30852

Boring No.: 10

Test Depth: 97.5-100.0 Feet

Water Correction:

No.	Pressure Readings (bars)	Inertia Correction (bars)	Corrected Pressure (tsf)	30 Sec. Volume (cc)	60 Sec. Volume (cc)	Creep (cc)	Corrected 30 Sec. Volume (cc)	Corrected 60 Sec. Volume (cc)	Incremental Modulus (tsf)
1	0.50	0.10	3.8	20	25	5	17.8	22.8	
2	1.00	0.21	4.2	50	-55	5	47.6	52.6	21
3	1.50	0.27	4.6	70	72	2	67.5	69.5	43
4	3.00	0.37	6.1	105	105	0	102.0	102.0	74
5	6.00	0.43	9.2	125	125	0	121.1	121.1	276
6	9.00	0.47	12.2	140	140	0	135.4	135.4	381
7	12.00	0.53	15.3	160	160	0	154.8	154.8	287
8	15.00	0.58	18.4	180	180	0	174.3	174.3	<b>2</b> 95
9	7.00	0.50	10.1	150	150	0	145.9	145.9	539
10	11.00	0.57	14.2	177	177	0	172.0	172.0	290
11	15.00	0.62	18.4	197	197	0	191.3	191.3	<b>4</b> 09
12	19.00	0.72	22.4	240	243	3	233.6	236.6	<b>17</b> 9
13	23.00	0.85	26.5	300	310	10	292.8	302.8	131
14	27.00	1.00	30.5	390	<b>4</b> 00	10	382.0	392.0	106
15	29.00	1.08	32.5	<b>44</b> 0	<b>4</b> 50	10	431.6	441.6	103
	$E_d =$	310	TSF	$\mathbf{E}^{+} =$	349	TSF	$P_l$ =	40.3	TSF



### STS CONSULTANTS, LTD.

### DRILLING & SAMPLING SYMBOLS:

88 : 8plit 8poon-1 3/8" I.D., 2" O.D.

Unless otherwise noted

ST : Shelby Tube-2" O.D.,

Unless otherwise noted

PA : Power Auger

DB: Diamond Bit-NX, BX, AX

AS: Auger Sample JS: Jar Sample

VS : Vane Shear

OS : Osterberg Sampler-3" Shelby Tube

HS: Hollow Stem Auger

W8: Wash Sample FT: Fish Tail

RB: Rock Bit BS: Bulk Sample

PM: Pressuremeter Test, In-Situ

G8: Giddings Sampler

Standard "N" Penetration:

Blows per foot of a 140 pound hammer falling 30 inches on a 2 inch 0.D. split spoon

sampler, except where otherwise noted.

#### WATER LEVEL MEASUREMENT SYMBOLS:

WL: Water Level WCI: Wet Cave In WS: While Sampling DCI: Dry Cave In

WD: While Drilling BCR: Before Casing Removal AB: After Boring ACR: After Casing Removal

Water levels indicated on the boring logs are the levels measured in the boring at the times indicated. In pervious soils, the indicated elevations are considered reliable groundwater levels. In impervious soils, the accurate determination of groundwater elevations may not be possible, even after several days of observations; additional evidence of groundwater elevations must be accurate.

### GRADATION DESCRIPTION & TERMINOLOGY:

Coarse Grained or Granular Soils have more than 50% of their dry weight retained on a #200 sieve; they are described as: boulders, cobbles, gravel or sand. Fine Grained soils have less than 50% of their dry weight retained on a #200 sieve; they are described as: clays or clayey silts if they are cohesive and silts if they are non-cohesive. In addition to gradation, granular soils are defined on the basis of their relative in-place density and fine grained soils on the basis of their strength or consistency and their plasticity.

Major Component Of Sample	Size Range	Description Of Components Also Present in Sample	Percent Of Dry Weight
Boulders	Over 8 in. (200 mm)	Trace	1-9
Cobbles	8 inches to 3 inches (200 mm to 75 mm)	Little	10-19
Gravel	3 inches to #4 sieve (76 mm to 4.76 mm)	8ome	20-34
Sand ·	#4 to #200 sieve (4.76 mm to 0.074 mm)	And	36-60
811t	Passing #200 sieve (0.074 mm to 0.005 mm)		
Clay	Smaller than 0.005 mm		

### CONSISTENCY OF COHESIVE SOILS:

### RELATIVE DENSITY OF GRANULAR SOILS:

Unconfined Compressive			
Strength, Qu, tsf	Consistency	N-Blows per ft.	Relative Density
0.25	Very Soft	0-3	Very Loose
0.25-0.49	Boft	4-9	Loose
0.50-0.99	Medium (Firm)	10- <b>2</b> 9	Medium Dense
1.00-1.99	8tiff	30-49	Dense
2.00-3.99	Very Stiff	<b>50-8</b> 0	Very Dense
4.00-8.00	Hard	>80	Extremely Dense
>8.00	Very Hard		



Ma	jor Divisi	ons	Group symbols	Typical names		Laboratory classification	criteria	
	noi	avels to fines)	GW	Well-grades gravels, gravel-sand mixtures, little or no fines	rained	$C_{ij} = \frac{D_{aa}}{D_{ia}}$ greater than 6; C <sub>ij</sub>	$c = \frac{(D_{10})^2}{D_{10} \times D_{10}}$ between 1 and 3	
size)	ize)  scarze fraction 4 sieve size)  Clean gravels (Little of no fines)		GP	Poorly graded gravels, gravel- sand mixtures, little or no fines	re), coarse-g P C requiring du	Not meeting all gradation requirements for GW		
o. 200 sieve	Gravels (More than half of coarse fraction larger than No. 4 sieve size)	th fines amount es)	GM d	Silty gravels, gravel-sand-silt mixtures	ize curve. n No. 200 sieve size), coarse-gra .GW, GP, SW, SP .GM, GC., SM, SC .Borderline cases requiring dual symbols	Atterberg limits below "A" line or P.I. less than 4	Above "A" line with P.I. between 4 and 7 are bor-	
ned soils arger than No	(More larg	Gravels with fines (Appreciable amount of fines)	СС	Clayey gravels, gravel-sand-clay mixtures	Determine percentages of sand and gravel from grain-size curve.  Depending on percentage of fines (fraction smaller than No. 200 sieve size), coarse-grained soils are classified as follows:  Less than 5 per cent	Atterberg limits above "A" line with P.I. greater than 7	derline cases requiring use of dual symbols	
Coarse-grained soils material is larger tha	tion ze)	Clean sands (Little or no fines)	sw	Well-graded sands, gravelly sands, little or no fines	gravel from fraction small	$C_u = \frac{D_{ob}}{D_{ob}}$ greater than 4; $C_C = \frac{(D_{ob})^2}{D_{ob} \times D_{ob}}$ between		
than half of	an half of r oarse fracti 4 sieve size		SP	Poorly graded sands, gravelly sands, little or no fines	of sand and of sand and of sand and sollows:	Not meeting all gradation requirements for SW		
(More	(More thi Sands than half of c	(More than half of is smaller than half of Sands with fines (Appreciable amount of fines)		Silty sands, sand-silt mixtures	Determine percentages of san Depending on percentage of 1 soils are classified as follows: Less than 5 per cent More than 12 per cent 5 to 12 per cent	Atterberg limits below "A" line or P.I. less than 4	Limits plotting in hatched zone with P.I. between 4 and 7 are borderline cases	
	(More is sr	Sands wi (Appreciab of fi	<b>S</b> C	Clayey sands, sand-clay mix- tures	Determine Depending Soils are of Less th More tl	Atterberg limits above "A" line with P.I. greater than 7	requiring use of dual symbols	
			ML	Inorganic silts and very fine sands, rock flour, silty or clayey fine sands or clayey silts with slight plasticity		ussification of fine-grained —		
:ve)	and clays	Silts and clays (Liquid limit less than 30)		Inorganic clays of low to me- dium plasticity, gravelly clays, sandy clays, silty clays, lean clays	50 grained Atterbe hatched ification	50 grained soils.  Atterberg Limits plotting in hatched area are borderline classifications requiring use of dual symbols.		
nn No. 200 si	Silts			Organic silts and organic silty clays of low plasticity		n of A-line:		
Fine-grained soils of material is smaller than No. 200 sieve)		ın 50)	мн	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts	ig 20	CL	OH and MH	
	Silts and clays	Silts and clays (Liquid limit greater than 50)		Inorganic clays of high plas- ticity, fat clays	10 7 CL.MI	ML and OL		
(More than half of	Silte	(Liquid lin	ОН	Organic clays of medium to high plasticity, organic silts	0 10	20 30 40 50 6	60 70 80 90 100	
(Mor	ighly	soils	Pt	Peat and other highly organic soils	1	Liquid Lin		

### SUBSURFACE EXPLORATION PROCEDURES

### Hand-Auger Drilling (HA)

In this procedure, a sampling device is driven into the soil by repeated blows of a sledge hammer. When the sampler is driven to the desired sample depth, the soil sample is retrieved. The hole is then advanced by manually turning the hand auger until the next sampling depth increment is reached. The hand auger drilling between sampling intervals also helps to clean and enlarge the bore hole in preparation for obtaining the next sample.

### Power Auger Drilling (PA)

In this type of drilling procedure, continuous flight augers are used to advance the bore holes. They are turned and hydraulically advanced by a truck or track-mounted unit as site accessibility dictates. In auger drilling, casing and drilling mud are not required to maintain open bore holes.

### Hollow Stem Auger Drilling (HS)

In this drilling procedure, continuous flight augers having open stems are used to advance the bore holes. The open stem allows the sampling tool to be used without removing the augers from the bore hole. Hollow stem augers thus provide support to the sides of the bore hole during the sampling operations.

### Rotary Drilling (RB)

In employing rotary drilling methods, various cutting bits are used to advance the bore holes. In this process, surface casing and/or drilling fluids are used to maintain open bore holes.

### Diamond Core Drilling (DB)

Diamond core drilling is used to sample cemented formations. In this procedure, a double tube (triple tube) core barrel with a diamond bit cuts an annular space around a cylindrical prism of the material sampled. The sample is retrieved by a catcher just above the bit. Samples recovered by this procedure are placed in sturdy containers in sequential order.



### SAMPLING PROCEDURES

### Auger Sampling (AS)

In this procedure, soil samples are collected from cuttings off of the auger flights as they are removed from the ground. Such samples provide a general indication of subsurface conditions; however, they do not provide undisturbed samples, nor do they provide samples from discrete depths.

### Split-Barrel Sampling (SS) — (ASTM Standard D-1586-84)

In the split-barrel sampling procedure, a 2 inch O.D., split barrel sampler is driven into the soil a distance of 18 inches by means of a 140 pound hammer falling 30 inches. The value of the Standard Penetration Resistance is obtained by counting the number of blows of the hammer over the final 12 inches of driving. This value provides a qualitative indication of the in-place relative density of cohesionless soils. The indication is qualitative only, however, since many factors can significantly affect the Standard Penetration Resistance Value, and direct correlation of results obtained by drill crews using different rigs, drilling procedures, and hammer-rod-spoon assemblies should not be made. A portion of the recovered sample is placed in a sample jar and returned to the laboratory for further analysis and testing.

### Shelby Tube Sampling Procedure (ST) — (ASTM Standard D-1587-85)

In the shelby tube sampling procedure, a thin-walled steel seamless tube with a sharp cutting edge is pushed hydraulically into the soil and a relatively undisturbed sample is obtained. This procedure is generally employed in cohesive soils. The tubes are carefully handled in the field to avoid excessive disturbance and are returned to the laboratory for extrusion and further analysis and testing.

### Giddings Sampler (GS)

This type of sampling device consists of 5-ft. sections of thin-wall tubing which are capable of retrieving continuous columns of soil in 5-ft. maximum increments. Because of a continuous slot in the sampling tubes, the sampler allows field determination of stratification boundaries and containerization of soil samples from any sampling depth within the 5-ft. interval.

### LABORATORY PROCEDURES

### Water Content (Wc)

The water content of a soil is the ratio of the weight of water in a given soil mass to the weight of the dry soil. Water content is generally expressed as a percentage.

### Hand Penetrometer (Qp)

In the hand penetrometer test, the unconfined compressive strength of a soil is determined, to a maximum value of 4.5 tons per square foot (tsf), by measuring the resistance of the soil sample to penetration by a small, spring-calibrated cylinder. The hand penetrometer test has been carefully correlated with unconfined compressive strength tests, and thereby provides a useful and a relatively simple testing procedure in which soil strength can be quickly and easily estimated.

### Unconfined Compression Tests (Qu)

In the unconfined compression strength test, an undisturbed prism of soil is loaded axially until failure or until 20% strain has been reached, whichever occurs first.

### Dry Density $(^{\delta}D)$

The dry density is the quantity used as a measure of the amount of solids in a unit volume of soil aggregate. Use of this value is often made when measuring the degree of compaction of a soil.

### Classification of Samples

In conjunction with the sample testing program, all soil samples are examined in our laboratory and classified on the basis of their texture and plasticity in accordance with United Soil Classification System (USCS). The soil descriptions on the boring logs are in conformance with this system and the estimated group symbols according to this system are included in parentheses following the soil descriptions on the boring logs. Included on a separate sheet entitled "General Notes" is a brief explanation of this system of soil classification.



### STS CONSULTANTS, LTD.

In the process of obtaining and testing samples and preparing this report, standard procedures are followed regarding field logs, laboratory data sheets and samples.

Field logs are prepared during performance of the drilling and sampling operations and are intended to essentially portray field occurrences, sampling locations and procedures.

Samples obtained in the field are frequently subjected to additional testing and reclassification in the laboratory by more experienced soil engineers, and differences between the field logs and the final logs may exist.

The engineer preparing the report reviews the field and laboratory logs, classifications and test data, and using judgment and experience in interpreting this data, may make further changes.

Samples taken in the field, some of which are later subjected to laboratory tests, are retained in our laboratory for sixty days and are then destroyed unless special disposition is requested by our client. Samples retained over a long period of time, even in sealed jars, are subject to moisture loss which changes the apparent strength of cohesive soil, generally increasing the strength from what was originally encountered in the field. Since they are then no longer representative of the moisture conditions initially encountered, observers of these samples should recognize this factor.

It is common practice in the geotechnical engineering profession that field logs and laboratory data sheets not included in engineering reports, because they do not represent the engineer's final opinions as to appropriate descriptions for conditions encountered in the exploration and testing work. On the other hand, we are aware that perhaps certain contractors and subcontractors submitting bids or proposals on work might have an interest in studying these documents before submitting a bid or proposal. For this reason, the field logs are retained in our office for review by all contractors submitting a bid or proposal. We would welcome the opportunity to explain any changes that have been and typically are made in the preparation of our final reports, to the contractor or subcontractors, before the firm submits its bid or proposal, and to describe how the information was obtained to the extent the contractor or subcontractor wishes. Results of laboratory tests are generally shown on the boring logs or are described in the text of the report, as appropriate.

The descriptive terms and symbols used on the logs are described on the attached sheet, entitled: "General Notes".





### AMERICAN SOCIETY FOR TESTING AND MATERIALS

### Standard Method for

### PENETRATION TEST AND SPLIT-BARREL SAMPLING OF SOILS1

This standard is issued under the fixed designation D 1886; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of the last revision. A number in parentheses indicates the year of last reapproval. A superscript spallon (6) indicates an editorial change since the last revision or reapproval.

This method has been approved for use by agencies of the Department of Defense and for listing in the DOD Index of Specifications and Standards.

#### 1. Scope

- 1.1 This method describes the procedure, generally known as the Standard Penetration Test (SPT), for driving a split-barrel sampler to obtain a representative soil sample and a measure of the resistance of the soil to penetration of the sampler.
- 1.2 This standard may involve hazardous materials, operations, and equipment. This standard does not purport to address all of the safety problems associated with its use. It is the responsibility of whoever uses this standard to consult and establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use. For a specific precautionary statement, see 5.4.1.
- 1.3 The values stated in inch-pound units are to be regarded as the standard.

#### 2. Applicable Documents

#### 2.1 ASTM Standards:

- D2487 Test Method for Classification of Soils for Engineering Purposes<sup>2</sup>
- D2488 Practice for Description and Identification of Soils (Visual-Manual Procedure)<sup>2</sup>
- D4220 Practice for Preserving and Transporting Soil Samples<sup>2</sup>

#### 5. Descriptions of Terms Specific to This Standard

3 1 anvil-that portion of the drive-

- strikes and through which the hammer energy passes into the drill rods.
- 3.2 cathead—the rotating drum or windiass in the rope-cathead lift system around which the operator wraps a rope to lift and drop the hammer by successively tightening and loosening the rope turns around the drum.
- 3.3 drill rods—rods used to transmit downward force and torque to the drill bit while drilling a borehole.
- 3.4 drive-weight assembly—a device consisting of the hammer, hammer fall guide, the anvil, and any hammer drop system.
- 3.8 hammer—that portion of the drive-weight assembly consisting of the  $140 \pm 2$  lb (63.5  $\pm 1$  kg) impact weight which is successively lifted and dropped to provide the energy that accomplishes the sampling and penetration.
- 3.6 hammer drop system—that portion of the drive-weight assembly by which the operator accomplishes the lifting and dropping of the hammer to produce the blow.
- 3.7 hammer fall guide—that part of the drive-weight assembly used to guide the fall of the hammer.
- 3.8 N-value—the blowcount representation of the penetration resistance of the soil. The N-value, reported in blows per foot, equals the sum of the number of blows required to drive the sampler over the depth interval of 6 to 18 in. (150 to 450 mm) (see 7.3).
- 3.9 AN-the number of blows ob-

- intervals of sampler penetration (see 7.3).
- 5.10 number of rope turns—the total contact angle between the rope and the cathead at the beginning of the operator's rope slackening to drop the hammer, divided by 560° (see Fig. 1).
- 3.11 sampling rods—rods that connect the drive-weight assembly to the sampler. Drill rods are often used for this purpose.
- 3.12 SPT—abbreviation for Standard Penetration Test, a term by which engineers commonly refer to this method.

### 4. Significance and Use

- 4.1 This method provides a soil sample for identification purposes and for laboratory tests appropriate for soil obtained from a sampler that may produce large shear strain disturbance in the sample.
- 4.2 This method is used extensively in a great variety of geotechnical exploration projects. Many local correlations and widely published correlations which relate SPT blowcount, or N-value, and the engineering behavior of earthworks and foundation are available.

Current edition approved Sept. 11, 1984. Published November 1984. Originally published as D1886—68T. Last previous edition D1886—67 (1974).

<sup>&</sup>lt;sup>1</sup>This method is under the jurisdiction of ASTM Committee D-18 on Soil and Rock and is the direct responsibility of subcommittee D18.02 on Sampling and Related Field Testing for Soil Investigations.

#### **ASTM Designation: D 1586**

#### 5. Apparatus

- 5.1 Drilling Equipment—Any drilling equipment that provides at the time of sampling a suitably clean open hole before insertion of the sampler and ensures that the penetration test is performed on undisturbed soil shall be acceptable. The following pieces of equipment have proven to be suitable for advancing a borehole in some subsurface conditions.
- 5.1.1 Drag, Chopping, and Fishtail Bits, less than 6.5 in. (162 mm) and greater than 2.2 in. (56 mm) in diameter may be used in conjunction with open-hole rotary drilling or casing-advancement drilling methods. To avoid disturbance of the underlying soil, bottom discharge bits are not permitted; only side discharging bits are permitted.
- 5.1.2 Roller-Cone Bits, less than 6.5 in. (162 mm) and greater than 2.2 in. (56 mm) in diameter may be used in conjunction with open-hole rotary drilling or casing-advancement drilling methods if the drilling fluid discharge is deflected.
- 5.1.3 Hollow-Stem Continuous Flight Augers, with or without a center bit assembly, may be used to drill the boring. The inside diameter of the hollow-stem augers shall be less than 6.5 in. (162 mm) and greater than 2.2 in. (56 mm).
- 5.1.4 Solid, Continuous Flight, Bucket and Hand Augers, less than 6.6 in. (162 mm) and greater than 2.2 in. (66 mm) in diameter may be used if the soil on the side of the boring does not cave onto the sampler or sampling rods during sampling.
- 5.2 Sampling Rods—Flush-joint steel drill rods shall be used to connect the split-barrel sampler to the drive-weight assembly. The sampling rod shall have a stiffness (moment of inertia) equal to or greater than that of parallel wall "A" rod (a steel rod which has an outside diameter of 1% in. (41.2 mm) and an inside diameter of 1% in. (28.5 mm).
- HOTE 1—Recent research and comparative testing indicates the type rod used, with stiffness ranging from "A" size rod to "H" size rod, will usually have a negligible effect on the H-values to depths of at least 100 ft (30 m).
- 5.3 Split-Barrel Sampler—The sampler shall be constructed with the dimensions indicated in Fig. 2. The driving shoe shall be of hardened steel and shall be replaced or repaired when it

becomes dented or distorted. The use of liners to produce a constant inside diameter of 1% in. (35 mm) is permitted, but shall be noted on the penetration record if used. The use of a sample retainer basket is permitted, and should also be noted on the penetration record if used.

NOTE 2—Both theory and available test data suggest that N-values may increase between 10 to 30% when liners are used.

#### 5.4 Drive-Weight Assembly:

6.4.1 Hammer and Anvil—The hammer shall weigh  $140 \pm 2$  lb  $(63.5 \pm 1)$  kg) and shall be a solid rigid metallic mass. The hammer shall strike the anvil and make steel on steel contact when it is dropped. A hammer fall guide permitting a free fall shall be used. Hammers used with the cathead and rope method shall have an unimpeded overlift capacity of at least 4 in. (100 mm). For safety reasons, the use of a hammer assembly with an internal anvil is encouraged.

NOTE 5—it is suggested that the hammer fall guide be permanently marked to enable the operator or inspector to judge the hammer drop height.

- 5.4.2 Hammer Drop System—Ropecathead, trip, semi-automatic, or automatic hammer drop systems may be used, providing the lifting apparatus will not cause penetration of the sampler while re-engaging and lifting the hammer.
- 5.5 Accessory Equipment—Accessories such as labels, sample containers, data sheets, and groundwater level measuring devices shall be provided in accordance with the requirements of the project and other ASTM standards.

#### 6. Drilling Procedure

- 6.1 The boring shall be advanced incrementally to permit intermittent or continuous sampling. Test intervals and locations are normally stipulated by the project engineer or geologist. Typically, the intervals selected are 5 ft (1.8 m) or less in homogeneous strata with test and sampling locations at every change of strata.
- 6.2 Any drilling procedure that provides a suitably clean and stable hole before insertion of the sampler and assures that the penetration test is performed on essentially undisturbed soil shall be acceptable. Each of the follow-

ing procedures have proven to be acceptable for some subsurface conditions. The subsurface conditions anticipated should be considered when selecting the drilling method to be used.

- 6.2.1 Open-hole rotary drilling method.
- 6.2.2 Continuous flight hollow-stem auger method.
  - 6.2.3 Wash boring method.
- 6.2.4 Continuous flight solid auger method.
- 6.3 Several drilling methods produce unacceptable borings. The process of jetting through an open tube sampler and then sampling when the desired depth is reached shall not be permitted. The continuous flight solid auger method shall not be used for advancing the boring below a water table or below the upper confining bed of a confined non-cohesive stratum that is under artesian pressure. Casing may not be advanced below the sampling elevation prior to sampling. Advancing a boring with bottom discharge bits is not permissible. It is not permissible to advance the boring for subsequent insertion of the sampler solely by means of previous sampling with the SPT sampler.
- 6.4 The drilling fluid level within the boring or hollow-stem augers shall be maintained at or above the in situ groundwater level at all times during drilling, removal of drill rods, and sampling.

### 7. Sampling and Testing Procedure

- 7.1 After the boring has been advanced to the desired sampling elevation and excessive cuttings have been removed, prepare for the test with the following sequence of operations.
- 7.1.1 Attach the split-barrel sampler to the sampling rods and lower into borehole. Do not allow the sampler to drop onto the soil to be sampled.
- 7.1.2 Position the hammer above and attach the anvil to the top of the sampling rods. This may be done before the sampling rods and sampler are lowered into the borehole.
- 7.1.5 Rest the dead weight of the sampler, rods, anvil, and drive weight on the bottom of the boring and apply a seating blow. If excessive cuttings are encountered at the bottom of the boring, remove the sampler and sampling rods from the boring and remove the cuttings.
- 7.1.4 Mark the drill rods in three successive 6-in. (0.15-m) increments

so that the advance of the sampler under the impact of the hammer can be easily observed for each 6-in. (0.15-m) increment.

- 7.2 Drive the sampler with blows from the 140-ib (63.5-kg) hammer and count the number of blows applied in each 6-in. (0.15-m) increment until one of the following occurs:
- 7.2.1 A total of 50 blows have been applied during any one of the three 6-in. (0.15-m) increments described in 7.1.4
- 7.2.2 A total of 100 blows have been applied.
- 7.2.3 There is no observed advance of the sampler during the application of 10 successive blows of the hammer.
- 7.2.4 The sampler is advanced the complete 18 in. (0.45 m) without the limiting blow counts occurring as described in 7.2.1, 7.2.2, or 7.2.3.
- 7.3 Record the number of blows required to effect each 6 in. (0.16m) of penetration or fraction thereof. The first 6 in. is considered to be a seating drive. The sum of the number of blows required for the second and third 6 in. of penetration is termed the "standard penetration resistance", or the "N-value". If the sampler is driven less than 18 in. (0.45 m), as permitted in 7.2.1, 7.2.2, or 7.2.3, the number of blows per each complete 6-in. (0.15-m) increment and per each partial increment shall be recorded on the boring log. For partial increments, the depth of penetration shall be reported to the nearest 1 in. (25 mm), in addition to the number of blows. If the sampler advances below the bottom of the boring under the static weight of the drill rods or the weight of the drill rods plus the static weight of the hammer, this information should be noted on the boring log.
- 7.4 The raising and dropping of the 140-lb (63.6-kg) hammer shall be accomplished using either of the following two methods:
- 7.4.1 By using a trip, automatic, or semi-automatic hammer drop system which lifts the 140-lb (63.8-kg) hammer and allows it to drop  $30 \pm 1.0$  in. (0.76 m  $\pm 25$  mm) unimpeded.
- 7.4.2 By using a cathead to pull a rope attached to the hammer. When the cathead and rope method is used the system and operation shall conform to the following:
- 7.4.2.1 The cathead shall be essentially free of rust, oil, or grease and have a diameter in the range of 6 to 10 to (150 to 250 mm).

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- 7.4.2.2 The cathead should be operated at a minimum speed of rotation of 100 RPM, or the approximate speed of rotation shall be reported on the boring log.
- 7.4.2.3 No more than 2% rope turns on the cathead may be used during the performance of the penetration test, as shown in Fig. 1.
- NOTE 4—The operator should generally use either 1% of 2% rope turns, depending upon whether or not the rope comes off the top (1% turns) or the bottom (2% turns) of the esthead. It is generally known and accepted that 2% or more rope turns considerably impedes the fall of the hammer and should not be used to perform the test. The esthead rope should be maintained in a relatively dry, clean, and unfrayed condition.
- 7.4.2.4 For each hammer blow, a 30-in. (0.76-m) lift and drop shall be employed by the operator. The operation of pulling and throwing the rope shall be performed rhythmically without holding the rope at the top of the stroke.
- 7.5 Bring the sampler to the surface and open. Record the percent recovery or length of sample recovered. Describe the soil samples recovered as to composition, color, stratification, and condition, then place one or more representative portions of the sample into sealable moisture-proof containers (jars) without ramming or distorting any apparent stratification. Seal each container to prevent evaporation of soil moisture. Affix labels to the containers bearing job designation, boring number, sample depth, and the blow count per 6-in. (0.15-m) increment. Protect the samples against extreme temperature changes. If there is a soil change within the sampler, make a jar for each stratum and note its location in the sampler barrel.

### 8. Report

- 8.1 Drilling information shall be recorded in the field and shall include the following:
  - 8.1.1 Name and location of job,
  - 8.1.2 Names of crew,
- 8.1.3 Type and make of drilling machine,
- 8.1.4 Weather conditions,
- 8.1.5 Date and time of start and finish of boring,
- 8.1.6 Boring number and location (station and coordinates, if available and applicable),
  - 8.1.7 Surface elevation, if available,
- 8.1.8 Method of advancing and cleaning the boring,

- 8.1.9 Method of keeping boring open,
- 8.1.10 Depth of water surface and drilling depth at the time of a noted loss of drilling fluid, and time and date when reading or notation was made,
- 8.1.11 Location of strata changes,
- 8.1.12 Size of casing, depth of cased portion of boring,
- 8.1.13 Equipment and method of driving sampler.
- 8.1.14 Type of sampler and length and inside diameter of barrel (note use of liners).
- 8.1.15 Size, type, and section length of the sampling rods, and
  - 8.1.16 Remarks.
- 8.2 Data obtained for each sample shall be recorded in the field and shall include the following:
- 8.2.1 Sample depth and, if utilized, the sample number,
  - 8.2.2 Description of soil,
  - 8.2.3 Strata changes within sample,
- 8.2.4 Sampler penetration and recovery lengths, and
- 8.2.6 Number of blows per 6-in. (0.16-m) or partial increment.

### 9. Precision and Bias

- 9.1 Variations in N-values of 100% or more have been observed when using different standard penetration test apparatus and drillers for adjacent borings in the same soil formation. Current opinion, based on field experience, indicates that when using the same apparatus and driller, N-values in the same soil can be reproduced with a coefficient of variation of about 10%.
- 9.2 The use of faulty equipment, such as an extremely massive or damaged anvil, a rusty cathead, a low speed cathead, an old, oily rope, or massive or poorly lubricated rope sheaves can significantly contribute to differences in N-values obtained between operator-drill rig systems.
- 9.3 The variability in N-values produced by different drill rigs and operators may be reduced by measuring that part of the hammer energy delivered into the drill rods from the sampler and adjusting N on the basis of comparative energies. A method for energy measurement and N-value adjustment is currently under development.

#### **ASTM Designation: D 1586**

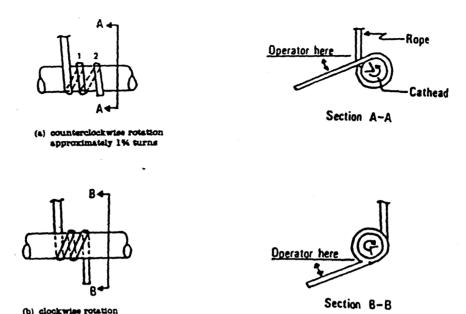
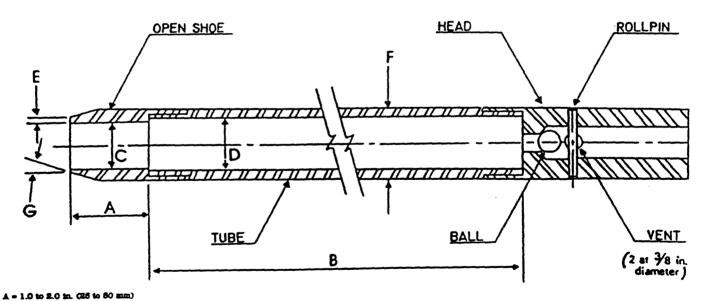


FIG. 1 Definitions of the Number of Rope Turns and the Angle for (a) Counterclockwise Rotation and (b) Clockwise Rotation of the Cathead

approximately 2% turns



B = 18.0 to 80.0 m. (0.457 to 0.762 m) C = 1.575 ± 0.006 in. (34.93 ± 0.13 mm)

 $D = 1.50 \pm 0.06 - 0.00 \text{ m.}$  (38.1 ± 1.5 - 0.0 mm)

E = 0.10 ± 0.02 in. (2.54 ± 0.25 mm)

 $P = 2.00 \pm 0.06 - 0.00 \text{ m.}$  (60.8 ± 1.5 - 0.0 mm)

G = 16.0° to 23.0°

The 1% in. (55 mm) inside diameter split barrel may be used with a 16-gage wall thickness split liner. The penetrating and of the drive shoe may be stightly rounded. Metal or plastic retainers may be used to retain soil samples.

#### FIG. 2 Split-Barrel Sampler

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This standard is subject to revision at any time by the responsible technical committee and must be reviewed every five years and if not revised, either responsible proved or withdrawn. Your comments are invited either for revision of this standard or for additional standards and should be addressed to ASTM Readquarters. Your comments will receive careful consideration at a meeting of the responsible technical committee, which you may attend. If you feel that your comments and a warm wiews known to the ASTM Committee on Standards, 1916 Race St., Philadelphia, Pa. 19103.





### AMERICAN SOCIETY FOR TESTING AND MATERIALS

### Standard Practice for

### THIN-WALLED TUBE SAMPLING OF SOILS1

This standard is issued under the fixed designation D 1687; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of the last revision. A number in parentheses indicates the year of last reapproval. A superscript spallon (6) indicates an editorial change since the last revision or reapproval.

This practice has been approved for use by agencies of the Department of Defense and for listing in the DOD Index os Specifications and Standards.

#### 1. Scope

1.1 This practice covers a procedure for using a thin-walled metal tube to recover relatively undisturbed soil samples suitable for laboratory tests of structural properties. Thin-walled tubes used in piston, plug, or rotary-type samplers, such as the Denison or Pitcher, must comply with the portions of this practice which describe the thin-walled tubes (6.3).

NOTE 1—This practice does not apply to liners

### 2. Applicable Documents

### 2.1 ASTM Standards:

D2488 Practice for Description and Identification of Boils (Visual-Manual Procedure)<sup>2</sup>

D3550 Practice for Ring-Lined Barrel Sampling of Soils<sup>2</sup>

D4220 Practice for Preserving and Transporting Soil Samples<sup>2</sup>

### 5. Summary of Practice

3.1 A relatively undisturbed sample is obtained by pressing a thin-walled metal tube into the in-situ soil, removing the soil-filled tube, and sealing the ends to prevent the soil from being disturbed or losing moisture.

### 4. Significance and Use

4.1 This practice, or Practice D3580, is used when it is necessary to obtain a relatively undisturbed specimen suitable for laboratory tests of structural properties or other tests that might be influenced by soil disturbance.

#### 5. Apparatus

5.1 Drilling Equipment—Any drilling equipment may be used that provides a reasonably clean hole; that does not disturb the soil to be sampled; and that does not hinder the penetration of the thin-walled sampler. Open

borehole diameter and the inside diameter of driven casing or hollow stem auger shall not exceed 3.6 times the outside diameter of the thin-walled tube.

5.2 Sampler Insertion Equipment, shall be adequate to provide a relatively rapid continuous penetration force. For hard formations it may be necessary, although not recommended, to drive the thin-walled tube sampler.

6.3 Thin-Walled Tubes, should be manufactured as shown in Fig. 1. They should have an outside diameter of 2 to 5 in. and be made of metal having adequate strength for use in the soil and formation intended. Tubes shall be clean and free of all surface irregularities including projecting weld

5.3.1 Length of Tubes—See Table 1 and 6.4.

5.3.2 Tolerances, shall be within the limits shown in Table 2.

5.3.3 Inside Clearance Ratio, should be 1% or as specified by the engineer or geologist for the soil and formation to be sampled. Generally, the inside clearance ratio used should increase with the increase in plasticity of the soil being sampled. See Fig. 1 for definition of inside clearance ratio.

5.3.4 Corrosion Protection-Corrosion, whether from galvanic or chemical reaction, can damage or destroy both the thin-walled tube and the sample. Severity of damage is a function of time as well as interaction between the sample and the tube. Thin-walled tubes should have some form of protective coating. Tubes which will contain samples for more than 72 h shall be coated. The type of coating to be used may vary depending upon the material to be sampled. Coatings may include a light coat of lubricating oil, lacquer, epoxy, Teflon, and others. Type of coating must be specified by the engineer or geologist if storage will exceed 72 h. Plating of the tubes or alternate base metals may be specified by the engineer or geologist.

5.4 Sampler Head, serves to couple the thin-walled tube to the insertion equipment and, together with the thin-walled tube, comprises the thin-walled tube sampler. The sampler head shall contain a suitable check valve and a venting area to the outside equal to or greater than the area through the check valve. Attachment of the head to the tube shall be concentric and coaxial to assure uniform application of force to the tube by the sampler insertion equipment.

### 6. Procedure

6.1 Clean out the borehole to sampling elevation using whatever method is preferred that will ensure the material to be sampled is not disturbed. If groundwater is encountered, maintain the liquid level in the borehole at or above ground water level during the sampling operation.

6.2 Bottom discharge bits are not permitted. Bide discharge bits may be used, with caution. Jetting through an open-tube sampler to clean out the borehole to sampling elevation is not permitted. Remove loose material from the center of a casing or hollow stem auger as carefully as possible to avoid disturbance of the material to be sampled.

<sup>&</sup>lt;sup>1</sup>This practice is under the jurisdiction of ASTM Committee D-16 on Soil and Rock and is the direct responsibility of Subcommittee D18.02 on Sampling and Related Field Testing for Soil Investigation.

Current edition approved Aug. 17, 1985. Published October 1985. Originally published as D 1887-86T. Last previous edition D 1887-74.

\*\*Annual Book of ASTM Standards. Vol 04.08.

NOTE 2-Roller bits are available in downvard-jetting and diffused-jet configurations. wnward-jetting configuration rock bits are not oceptable. Diffuse-jet configurations are generally acceptable.

- 6.3 Place the sample tube so that its bottom rests on the bottom of the hole. Advance the sampler without rotation by a continuous relatively rapid motion.
- 6.4 Determine the length of advance by the resistance and condition of the formation, but the length shall never exceed 5 to 10 diameters of the tube in sands and 10 to 15 diameters of the tube in clays.

HOTE 3-Weight of sample, laboratory handling capabilities, transportation problems, and commercial availability of tubes will generally limit maximum practical lengths to those shown in Table 1

- 6.5 When the formation is too hard for push-type insertion, the tube may be driven or Practice D3650 may be used. Other methods, as directed by the engineer or geologist, may be used. If driving methods are used, the data regarding weight and fall of the hammer and penetration achieved must be shown in the report. Additionally, that tube must be prominently labeled a "driven sample."
- 6.6 In no case shall a length of adance be greater than the sample-tube ingth minus an allowance for the sampler head and a minimum of 3 in. for sludge-end cuttings.

NOTE 4-The tube may be rotated to shear bottom of the sample after pressing is complete.

6.7 Withdraw the sampler from the formation as carefully as possible in order to minimize disturbance of the sample.

### 7. Preparation for Shipment

7.1 Upon removal of the tube, measure the length of sample in the tube. Remove the disturbed material in the upper end of the tube and measure the length again. Seal the upper end of the tube. Remove at least 1 in. of material from the lower end of the tube. Use this material for soil description in accordance with Practice D2488. Measure the overall sample length. Seal the lower end of the tube. Alternatively, after measurement, the tube may be sealed without removal of soil from the ends of the tube if so directed by the engineer or geologist.

NOTE 5-Field extrusion and packaging of extruded samples under the specific direction of a geotechnical angineer or geologist is permitted.

NOTE 6-Tubes sealed over the ends as opposed to those scaled with expanding packers should ntain end padding in end voids in order to prent drainage or movement of the sample within the tube.

7.2 Prepare and immediately affix labels or apply markings as necessary to identify the sample. Assure that the markings or labels are adequate to survive transportation and storage.

### **ASTM Designation: D 1587**

- 8.1 The appropriate information is required as follows:
- 8.1.1 Name and location of the pro-
- 8.1.2 Boring number and precise location on project.
- 8.1.3 Surface elevation or reference to a datum.
- 8.1.4 Date and time of boring—start and finish.
- 8.1.5 Depth to top of sample and number of samples,
- 8.1.6 Description of sampler: size, type of metal, type of coating,
- 8.1.7 Method of sampler insertion: push or drive,

- 8.1.8 Method of drilling, size of hole. casing, and drilling fluid used.
- 8.1.9 Depth to groundwater level: date and time measured.
- 8.1.10 Any possible current or tidal effect on water level.
- 8.1.11 Soil description in accordance with Practice D2488.
- 8.1.12 Length of sampler advance. and
- 8.1.13 Recovery: length of sample obtained

#### 9. Precision and Bias

9.1 This practice does not produce numerical data; therefore, a precision and bias statement is not applicable.

TABLE 1 Suitable Thin-Walled Steel Sample Tubes

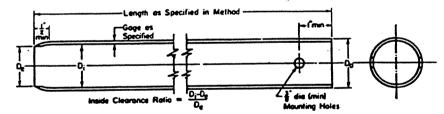
Outside diameter:			
in.	2	8	8
m.m	80.8	76.2	127
Wall thickness:			
BWE	18	16	11
in.	0.049	0.066	0.120
mm	1.24	1.66	8.06
Tube length:			
in.	36	36	84
m	0.91	0.91	1.45
Clearance ratio, %	1	1	1

AThe three diameters recommended in Table 1 are indicated for purposes of standardisation, and are not in-tended to indicate that sampling tubes of intermediate or larger diameters are not acceptable. Lengths of tubes shown are illustrative. Proper lengths to be determined as mitted to field conditions.

TARLE 2 Dimensional Toleranees for Thin-Walled Tubes

Nominal Tube Diameters from Table 1" Tolerances, in.							
Size Outside Diameter	2	3	8				
Outside diameter	+0.007	+0.010	+0.018				
	-0.000	-0.000	-0.000				
Inside diameter	+0.000	+0.000	+0.000				
	-0.007	-0.010	-0.015				
Wall thickness	±0.007	±0.010	±0.015				
Ovelity	0.018	0.020	0.030				
Straightness	0.030/fs	0.030/ft	0.030/ft				

AIntermediate or larger diameters should be p tional Tolerances shown are essentially standard commercial manufacturing tolerances for seamless steel mechanical tubing Specify only two of the first three tolerances; that is, O.D. and I.D., or O.D. or O.D. and Wall, or I.D. and Wall.



- NOTE 1—Minimum of two mounting holes on opposite sides for 2 to 3% in. sampler. NOTE 2—Minimum of four mounting holes spaced at 90° for samplers 4 in. and larger. NOTE 5—Tube held with hardened screws.

NOTE 4—Two-inch outside-diameter tubes are specified with an 15-gage wall thickness to comply with area of accepted for "undisturbed comples." Users are advised that such tubing is difficult to locate and can be extractive in small quantities. Sixteen-gage tubes are generally readily available.

Motrie 1	Equivalente
<b>L</b> .	
•/•	6.77
*	18.7
1	84.4
	80.8
8%	84.9
4	101.4

FIG. 1 Thin-Walled Tube for Sampling

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connection who any such patent rights, and the risk of infringement of such rights, are entirely their own responsibility.

This standard is subject to revision at any time by the responsible technical committee and must be reviewed every five years and if not revised, either reapproved or withdrawn. Your comments are invited either for revision of this standard or for additional standards and should be addressed to ASTM Headquarters. Your comments will receive careful considerstion at a meeting of the responsible technical committee, which you may attend. If you feel that your comments have n received a fair hearing you should make your views known to the ASTM Committee on Standards, 1916 Race St., Philadelphia, Pa. 19103.

AMERICAN SOCIETY FOR TESTING AND MATERIALS 1916 Race St. Philadelphia, Pa. 19103 Reprinted from the Annual Book of ASTM Standards. Copyright ASTM If not listed in the current combined index, will appear in the next edition

# Standard Test Method for Field Vane Shear Test in Cohesive Soil<sup>1</sup>

This standard is issued under the fixed designation D 2573, the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (c) indicates an editorial change since the last revision or reapproval.

This standard has been approved for use by agencies of the Department of Defense Consult the DoD Index of Specifications and Standards for the specific year of issue which has been adopted by the Department of Defense.

#### 1. Scope\*

1.1 This test method covers the field vane test in soft, saturated, cohesive soils. Knowledge of the nature of the soil in which each vane test is to be made is necessary for assessment of the applicability and interpretation of the test.

1.2 The values stated in inch-pound units are to be regarded as the standard. The SI units given in parentheses are for information only.

1.3 This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.

#### 2. Summary of Test Method

2.1 The vane shear test basically consists of placing a four-bladed vane in the undisturbed soil and rotating it from the surface to determine the torsional force required to cause a cylindrical surface to be sheared by the vane; this force is then converted to a unit shearing resistance of the cylindrical surface. It is of basic importance that the friction of the vane rod and instrument be accounted for, otherwise, the friction would be improperly recorded as soil strength. Friction measurements under no-load conditions (such as the use of a blank stem in place of the vanes, or a vane that allows some free rotation of the rod prior to loading) are satisfactory only provided that the torque is applied by a balanced moment that does not result in a side thrust. As torsional forces become greater during a test, a side thrust in the instrument will result in an increase in friction that is not accounted for by initial no-load readings. Instruments involving side thrust are not recommended. The vane rod may be of sufficient rigidity that it does not twist under full load conditions; otherwise a correction must be made for plotting torquerotation curves.

### 3. Significance and Use

- 3.1 This test method provides an indication of in-situ shear strength.
- 3.2 This test method is used extensively in a variety of geotechnical explorations, such as in cases where a sample

for laboratory testing cannot be obtained.

### 4. Apparatus

- 4.1 The vane shall consist of a four-bladed vane as illustrated in Fig. 1. The height of the vane shall be twice the diameter. Vane dimensions shall be as specified in Table 1. Sizes other than those specified in Table 1 shall be used only with the permission of the engineer in charge of the boring program. The ends of the vane may be tapered (see Fig. 1). The penetrating edge of the vane blade shall be sharpened having an included angle of 90°.
- 4.2 The vane shall be connected to the surface by means of steel torque rods. These rods shall have sufficient diameter such that their elastic limit is not exceeded when the vane is stressed to its capacity (Note 1). They shall be so coupled that the shoulders of the male and female ends shall meet to prevent any possibility of the coupling tightening when the torque is applied during the test. If a vane housing is used,

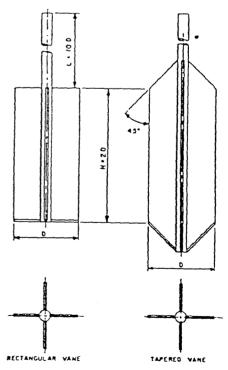


FIG. 1 Geometry of Field Vane

Current edition approved Sept. 15, 1994. Published November 1994. Originally published as D 2573 - 67 T. Last previous edition D 2573 - 72 (1978).

This test method is under the jurisdiction of ASTM Committee D-18 on Soil and Rock and is the direct responsibility of Subcommittee D18.02 on Sampling and Related Field Testing for Soil Investigations.

<sup>\*</sup> A Summary of Changes section appears at the end of this test method.

TABLE 1 Recommended Dimensions of Field Vanes<sup>A</sup>

Casing Size	Diameter, in. (mm)	Height, in. (mm)	Thickness of Blade, in. (mm)	Diameter of Vane Rod, in. (mm)
AX	11/2 (38.1)	3 (76.2)	Via (1.6)	1/2 (12.7)
₿X	2 (50.8)	4 (101.6)	Via (1.6)	92 (12.7)
NX	21/2 (63.5)	5 (127.0)	W (3.2)	Y2 (12.7)
4 in, (101.6 mm) <sup>8</sup>	354 (92.1)	7¼ (184.1)	W (3.2)	Vz (12.7)

A Selection of the vane size is directly related to the consistency of the soil being tested, that is, the softer the soil the larger the vane diameter.

A lesido diameter

the torque rods shall be equipped with well-lubricated bearings where they pass through the housing. These bearings shall be provided with seals to prevent soil from entering them. The torque rods shall be guided so as to prevent friction from developing between the torque rods and the walls of casing or boring.

NOTE 1—If torque versus rotation curves are to be determined, it is essential that the torque rods be calibrated (prior to use in the field). The amount of rod twist (if any) must be established in degrees per foot per unit torque. This correction becomes progressively more important as the depth of the test increases and the calibration must be made at least to the maximum depth of testing anticipated:

- 4.3 Torque shall be applied to the torque rods, thence to the vane. The accuracy of the torque reading should be such that it will produce a variation not to exceed  $\pm 25$  lb/ft<sup>2</sup> (1.20 kPa) shear strength.
- 4.4 It is preferable to apply torque to the vane with a geared drive. In the absence of a geared drive, it is acceptable to apply the torque directly by hand with a torque wrench or equivalent. The duration of the test should be controlled by the requirements of 5.3.

### 5. Procedure

- 5.1 In the case where a vane housing is used, advance the housing to a depth which is at least five vane housing diameters less than the desired depth of the vane tip. Where no vane housing is used, stop the hole in which the vane is lowered at a depth such that the vane tip may penetrate undisturbed soil for a depth of at least five times the diameter of the hole.
- 5.2 Advance the vane from the bottom of the hole or the vane housing in a single thrust to the depth at which the test is to be conducted. Take precautions to make sure no torque is applied to the torque rods during the thrust.
- 5.3 With the vane in position, apply the torque to the vane at a rate which should not exceed 0.1%. This generally requires a time to failure of from 2 to 5 min, except in very soft clays where the time to failure may be as much as 10 to 15 min. In stiffer materials, which reach failure at small deformations, it may be desirable to reduce the rate of angular displacement so that a reasonable determination of the stress-strain properties can be obtained. During the rotation of the vane, hold it at a fixed elevation. Record the maximum torque. With apparatus with geared drives, it is desirable to record intermediate values of torque at intervals of 15 s or at lesser frequency if conditions require.
- 5.4 Following the determination of the maximum torque, rotate the vane rapidly through a minimum of 10 revolutions; the determination of the remoulded strength should be started immediately after completion of rapid rotation and in all cases within 1 min after the remoulding process.
  - 5.5 In the case where soil is in contact with the torque

rods, determine the friction between the soil and the rod by means of torque tests conducted on similar rods at similar depths with no vane attached. Conduct the rod friction test at least once on each site; this shall consist of a series of torque tests at varying depths.

5.6 In apparatus in which the torque rod is completely isolated from the soil, conduct a friction test with a blank rod (Note 2) at least once on each site to determine the magnitude of the friction of the bearings. In a properly functioning vane apparatus, this friction should be negligible.

NOTE 2—In some cases it is not necessary to remove the vane for the friction test. As long as the vane is not in contact with the soil, that is, where it is retracted into a casing, the friction measurement is not affected.

5.7 Conduct undisturbed and remoulded vane tests at intervals of not less than 2½ ft (0.76 m) throughout the soil profile when conditions will permit vane testing (Note 3). Do not conduct the vane test in any soil that will permit drainage or dilates during the test period, such as sands or silts or in soils where stones or shells are encountered by the vane in such a manner as to influence the results.

NOTE 3—This spacing may be varied only by the engineer in charge of the boring program.

### 6. Calculation

6.1 Calculate the shear strength of the soil in the following manner. The turning moment required to shear the soil is as follows:

$$T = s \times K$$

where:

T = torque, lbf-ft (or N-m)

 $s = \text{shear strength of the clay, lbf/ft}^2 \text{ (or kPa), and}$ 

K = constant, depending on dimensions and shape of the vane, ft<sup>3</sup> (or m<sup>3</sup>).

6.2 Assuming the distribution of the shear strength is uniform across the ends of a cylinder and around the perimeter, calculate the value of K as follows:

Inch-Pound Units:

$$K = (\pi/1728) \times (D^2H/2) \times [1 + (D/3H)]$$

Metric Units:

$$K = (\pi/10^6) \times (D^2H/2) \times (1 + D/3H)$$

where:

D = measured diameter of the vane, in. (or cm), and

H = measured height of vane, in. (or cm).

It is important that these dimensions are checked periodically to ensure the vane is not distorted or worn.

6.3 As the ratio of length to breadth of the vane is 2:1, the value of K may be simplified in terms of the diameter so that it becomes the following: