REVISED

EXPANSIVE SOIL STUDY

Southwood Riviera Tract
Torrance, California

File No. 1987 — January 25, 1989
October 5, 1989

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SOIL, FOUNDATION AND GEOLOGIC STUDIES

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October 5, 1989 File No. 1987

Mr. Ralph Grippo
City of Torrance
Department of Building & Safety, Grading Section
3031 Torrance Boulevard
Torrance, California 90509-2970

SUBJECT: **EXPANSIVE SOIL STUDY**
Southwood Riviera Tract
Torrance, California

Dear Mr. Grippo:

Please find enclosed three revised copies of the third draft report for the Expansive Soil Study.

Please review the report, make any changes you feel necessary, and provide comments/ suggestions concerning the final report. I will call you soon to set up a meeting to discuss your ideas and prepare the final draft.

If you have any questions, please do not hesitate to call.

Respectfully submitted,
AMERICAN GEOTECHNICAL

Ron A. Hays
Project Engineer

RAH/GWA:jh

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1.0 INTRODUCTION

1.1 PURPOSE

The purpose of this investigation has been to define the limits of expansive soil in the Southwood Riviera section of Torrance; determine the potential expansivity of soils within the study area; provide recommendations for construction of additions to existing structures, and provide general remedial recommendations for existing structures presently undergoing geotechnically related distress due to expansive soil.

1.2 SCOPE OF SERVICES

The scope of work performed for this investigation included the following:

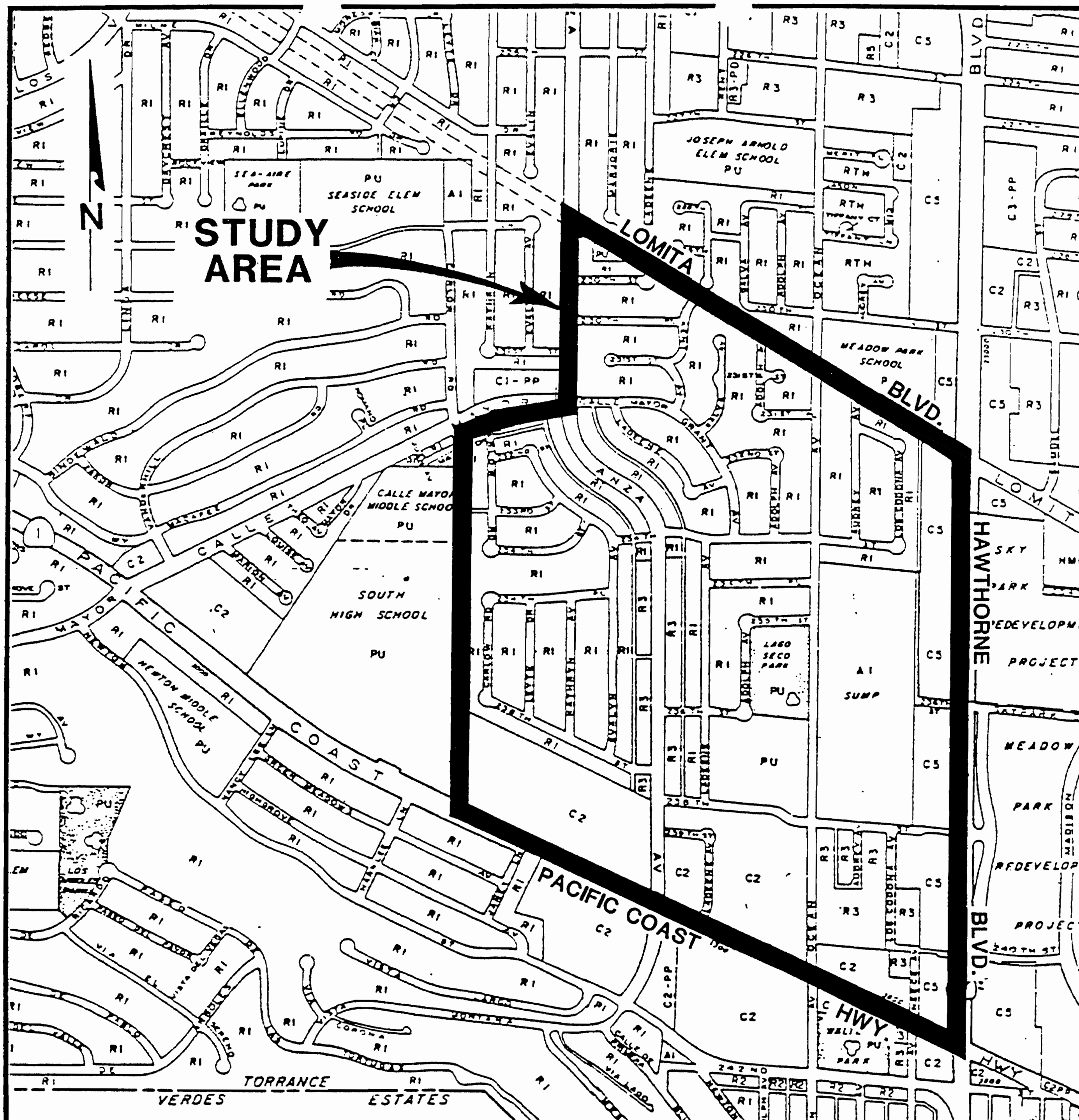
* Gathering and review of existing geotechnical engineering reports for the study area;
* Logging and sampling of 13 test borings including collection of representative soil samples for laboratory testing;
* Logging of 25 Cone Penetration Test locations;
* Laboratory testing of soil samples considered representative of those encountered during field exploration;
* Engineering analyses of field and laboratory data to provide a basis for the conclusions and recommendations presented herein;
* Preparation of this report which includes: description of the field and laboratory investigation and conclusions and recommendations based upon the investigations performed.

1.3 STUDY AREA DESCRIPTION

The study area is known locally as the Southwood Riviera section of the City of Torrance. The study area is bounded on the north by Lomita Boulevard and Calle Mayor, on the east by Hawthorne Boulevard, on the west by public school property (South High and Calle Mayor Middle Schools) and Anza Avenue, and south by Pacific Coast Highway. The study area is illustrated on the Location Map, Figure 1.

1.4 BACKGROUND

The Southwood Riviera section of Torrance was developed primarily during the 1960s and consists of portions of about 14 tracts. In 1978 the Building and Safety Department declared the Southwood Riviera section a problem area and began requiring soils investigations for new additions, pools and spas. This was



No Scale

LOCATION MAP			Figure 1
AMERICAN GEOTECHNICAL	F.N. 1987	JAN. 1989	

in response to approximately ten years of complaints from homeowners about expansive soil related damage.

In recent years a few homeowners and realtors selling property in the area alleged that property has been devalued because the City has labeled the area a "problem area" and placed expansive soil restrictions on construction within the area. Therefore, the Southwood Riviera Homeowners Association requested the City of Torrance for assistance in 1987 to have the City investigate the options available for removing the "special" condition for the area. This study is a result of that request.

2.0 FIELD INVESTIGATION AND LABORATORY TESTING

2.1 FIELD INVESTIGATION

Subsurface conditions throughout Southwood Riviera were explored by drilling 13 test borings and 25 Core Penetration Tests (CPT). Approximate locations of the borings and Cone Penetrometer tests are illustrated on the Expansive Soil Study Area, Plate 1 (in pocket).

2.1.1 Drilling

The borings were drilled with truck-mounted, hollow-stem auger drilling equipment. The borings were drilled to an approximate depth of 30 feet each. A geologist logged each boring, performed in-situ testing and obtained drive and bulk samples for visual examination and subsequent laboratory testing. Drive and bulk samples were obtained by the following methods:

1. A 2.5-inch inside diameter (3.0-inch outside diameter) split barrel sampler equipped with brass liner rings, driven by a 140-pound hammer falling 30 inches.

2. A Standard Penetration Test (SPT), split spoon sampler driven by a 140-pound hammer falling 30 inches.

The blow counts to drive the 2.5-inch split barrel sampler with the 140-pound hammer were noted on the logs only as indications of relative driving resistance in the various layers and are not Standard Penetration Test ("N") values. The Standard Penetration Test ("N") values were obtained with the Standard Split Spoon Sampler; these values are also shown on the logs. A description of the Unified Soil Classification system used to classify the soils is presented on Plate A1 in Appendix A. Boring logs are presented on Plates B-1 through B-13.

2.1.2 Cone Penetration Testing (CPT)

Cone Penetration Testing (CPT) was performed to verify the uniformity of soil conditions between borings. Cone Penetrometer Testing provides quick and economical means of verifying uniformity of soil conditions between widely spaced borings.

The Cone Penetrometer is an in-situ soil testing device. Testing is performed by hydraulically pushing a combination mechanical and electric cone (angle of 60 degrees) into the soil. A computer monitors tip resistance and sleeve friction as the cone is pushed. Information gathered during pushing is interpreted by computer and a soil profile log is generated. Cone penetration logs are presented in Appendix C, Plates C-1 through C-52.

2.2 LABORATORY TESTING

All soil samples obtained during drilling were re-examined in the laboratory to confirm field soil classifications and to select samples for testing. The testing program included the determination of moisture content, dry density, particle size analysis, strength (direct shear) and settlement characteristics, expansion and swell characteristics, chemical testing, and R-value testing. An explanation of the laboratory procedures is presented in Appendix D to this report. A summary of laboratory test results are presented in Appendix E, Tables E1 through E4. Illustrations of some of the test performed are presented in Appendix E, Plates E1 through E43.

3.0 GEOLOGY

To aid in understanding the Southwood Riviera section of Torrance, a brief look at the geology is important.

3.1 GEOLOGY OF SOUTHWOOD RIVIERA

The Southwood Riviera section is situated just north of the Palos Verdes Peninsula which, over the past approximately one to three million years, has lifted up out of the sea. Up until about one hundred thousand years ago the peninsula was an island, a member of the Channel Islands chain. Over a period of thousands of years, sedimentation within the Los Angeles basin from the Palos Verdes area and areas north, gradually closed the channel formerly separating the Palos Verdes area from the mainland.

Upon review of old maps and aerial photographs taken after the turn of the century, one finds that the Southwood Riviera area is situated at the westerly extension of a former wetlands area. The wetlands extended originally south-easterly from the study area to the Wilmington area. Some of the area has been described as the Bixby Slough or Walteria Lake. The wetlands area was the final link in the land bridge which joined the Los Angeles area to the Palos Verdes Peninsula. Typical of most wetlands is very slow moving water often described as swampy conditions. In those areas, soil is deposited very slowly. Only the finest soil particles can travel in the slow moving water. As such, considerable clay soil was deposited in a broad band through the Torrance Airport area and toward the harbor.

In virtually all of investigations conducted by this consultant in this area, highly plastic, silty clay material has been encountered. The material is typically dark gray to black in color with occasional traces of organics. Where the material is on the moist to dry side, it is quite stiff. Where the soil is wet, it is generally soft. At depth, soil conditions vary from clayey to silty and sandy. In areas west and north of the site, sandy conditions predominate. To the south is the Palos Verdes Peninsula. East of the study area similar clay soil conditions are typically encountered.

3.2 SOILS WITHIN THE STUDY AREA

Study of the Southwood Riviera section of Torrance reveals that the most significant aspect of the soil is the highly to critically expansive character. Tests performed for this study indicate this area has some of the most expansive soils encountered by this consultant in Southern California. To place the level of expansivity in perspective, reference is made to the Uniform Building Code (UBC) categorizations of expansive soil in Table 29-C and D. In that table, soil possessing an Expansion Index value (E.I. test per U.B.C. Standard 29-2) between 91-130 defines the category "High". An average soil in the study area has an index value about twice as high.

Soil with a significant clay fraction tends to possess expansive characteristics. Expansive soil heaves when water is introduced and shrinks as it dries. Pressures produced by heaving soil can be large enough to lift most buildings. Slabs over expansive soils are often said to "walk" as a result of expansive soil movement. This process generally tends to increase separation of slab joints and/or cause exterior improvements such as patios, originally abutting structures, to separate. Expansive soils can also cause cracking of slabs and foundations.

Expansive soil tends to be active near the ground surface. The actual depth varies with specific material type and environmental differences. To reduce the effect of expansive soil on surface structures, foundation systems are usually deepened. Slabs and foundations are usually reinforced to increase their resistance to differential movement. It is usually suggested in planning yard improvements and a landscape theme, that maintaining uniform moisture conditions around isolated individual structures is desirable. Preferably, soil should be kept on the moist side without allowing ponding. Since water tends to migrate under slab areas, saturation of the slab subgrade is usually recommended prior to placement of slab concrete. Placing trees within about ten feet of the structures is not desirable because they tend to extract water. Large trees or even small to medium size trees with invasive root systems should be kept at even greater distance.

4.0 EXPANSIVE SOIL

4.1 EXPANSIVE SOIL: A CLOSER LOOK

We know from the previous sections of this report that (a) the clay soils were deposited in slow moving water, and (b) the soils in the study area are critically expansive. To understand why clay soils shrink and expand, a closer look at clay particles should be taken.

4.1.1 Clay

Clay can be defined as a finely divided crystalline material. Clay particles usually exist as thin flakes but may be tube or fiber shaped depending upon molecular geometry and composition. Most commonly, clay crystals consist of atomic sheets of silica and aluminum stacked together to form plates. Hydrogen atoms hold the plates together. The various configurations of silica and aluminum stacked together produce three common clay types.

The three common clay types are Kaolinite, Illite, and Montmorillonite. Montmorillonites and blends of soil containing montmorillonites tend to be the most problematic of the three mineral types. The predominant clay mineral in the Southwood Riviera section of Torrance is Montmorillonites.

4.1.2 Forces Between Clay Particles

To understand why clay swells and shrinks, it must be realized that forces exist between clay particles. These forces tend to attract particles together and push particles apart. A clay particle could be compared to a common bar magnet. A clay soil could be represented by a large bin of bar magnets. Within the bin of magnets there would be a simultaneous attraction and repulsion between each individual magnet.

4.2 SOIL VOLUME CHANGE

As stated in the above paragraphs, expansive soils shrink when dry and expand when wet. Clay soils shrink and expand due to surface tension in the water between clay particles. As tension increases with drying due to evaporation, clay soils shrink. However, there is a point at which time shrinkage stops even with further reduction of moisture. The moisture content at which no further shrinkage occurs is known as the shrinkage limit.

Clay soil expands with the addition of moisture because additional moisture reduces surface tension between individual clay particles. The reduction of surface tension allows expansion of the distance between particles producing increase in volume.

It should be understood the above explanation for volume change in soil is greatly simplified. A detailed explanation of mechanisms for soil volume change would include a study in physics, chemistry, and mechanics.

5.0 DISTRESS DUE TO EXPANSIVE SOIL

The National Research Council has reported that the annual economic loss by swelling soils exceeds the total of all other losses from natural disasters, including landslides, permafrost, subsidence, frost action, rock deformation, earthquakes, and volcanos. In the United States alone, annual economic loss from swelling soil is estimated in the billions. Expansive soil losses, however, are generally less than dramatic compared to those of other natural disasters. The adverse impact of expansive soil is insidious. Expansive soil can produce direct adverse influence. Wetting and drying periods produce cyclic stresses which progressively deteriorate improvements over a period of years. Expansive soil action can directly influence foundations and slabs as well as earth pressures imposed on retaining structures. Expansive soil action can also significantly aggravate the tendency for slopes to yield and the tendency for surficial slope instability to develop.

Figures 2 through 6 illustrate some of the more common types of distress features observed. As will be seen from the illustrations, distress features can manifest in many different ways.

5.1 COMMONLY OBSERVED EXPANSIVE SOIL DISTRESS

This section presents some of the more commonly observed stress features produced by expansive soil.

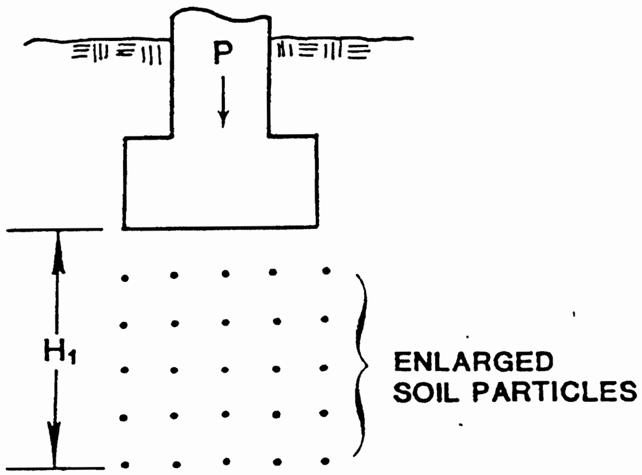
5.1.1 Expansive Soil Foundation Settlement

Even though swelling pressures can be easily high enough to lift most buildings, settlement is frequently the long term affect. The process sometimes referred to as progressive settlement is described in Figure 2. During wet cycles soil particles under a building move laterally since lateral confinement is lower than that vertical pressure produced by the footing. Since the concentration of soil particles under the footing is decreased, the dry cycle results in subsidence. This process can produce significant settlement but depends on significant moisture changes as the driving mechanism.

The progressive settlement process is more pronounced in raised wood floor construction than for slabs-on-grade since there is no soil confinement on either side of the foundation. Commonly, foundation rotation and pier rotation also result from the progressive settlement process. As illustrated in Figure 3, cracking may also develop in the stucco at the foundation/framing interface.

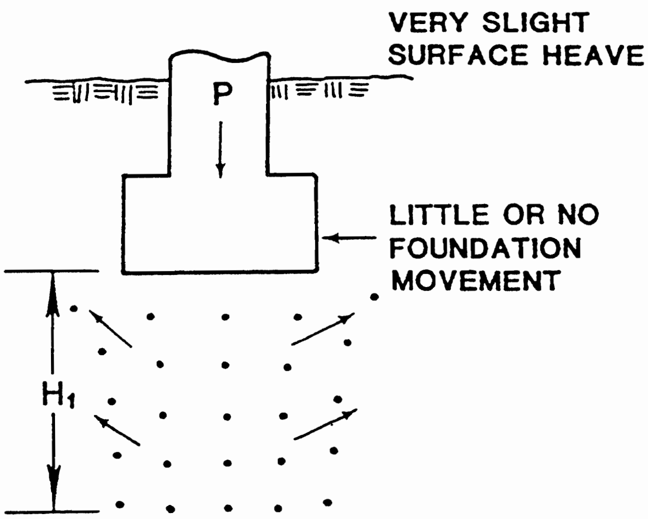
5.1.2 House on Expansive Soil

Figure 4 illustrates possible behavior of a structure on expansive soil when poor drainage and large trees are present. In this case, both settlement and expansion are affecting the structure. Figure 4 illustrates the importance of keeping trees as far as possible from structures.



A. ORIGINAL CONSTRUCTION

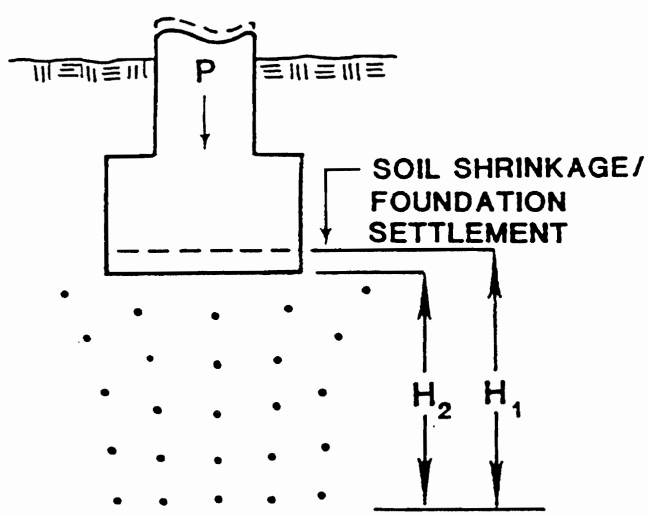
FOUNDATION WITH LOAD "P" EMBEDDED IN EXPANSIVE SOIL AT LOW TO MEDIUM MOISTURE CONTENT



B. "WET BEHAVIOR"

LATERAL SOIL MIGRATION

LATERAL MIGRATION OF SOIL PARTICLES OCCUR AS A RESULT OF LATERAL CONFINING PRESSURES BEING LOWER THAN VERTICAL CONFINING PRESSURE BY FOUNDATION

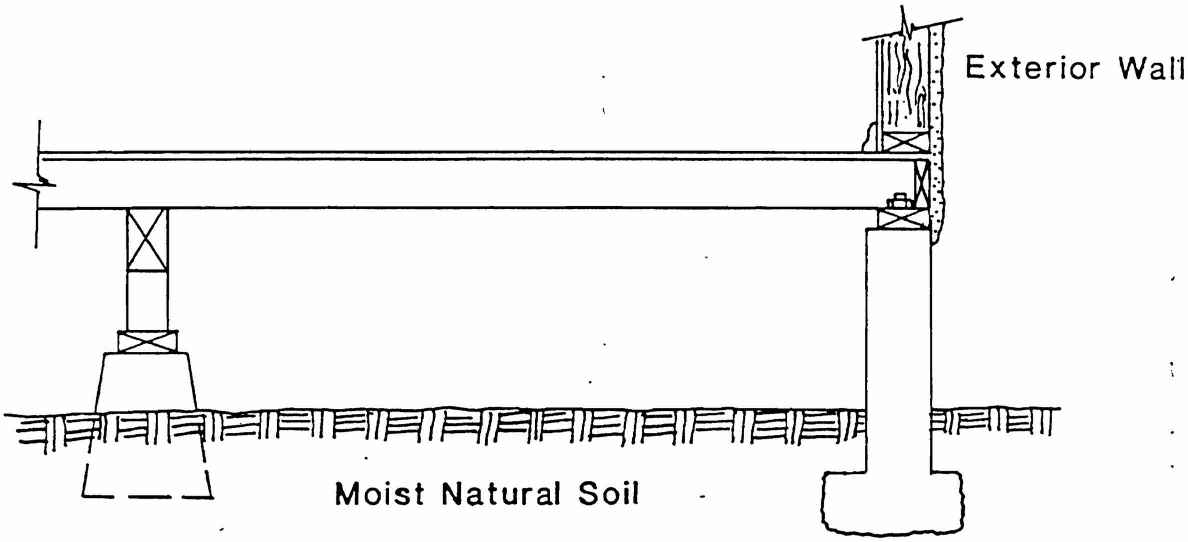


C. "DRY CYCLE BEHAVIOR"

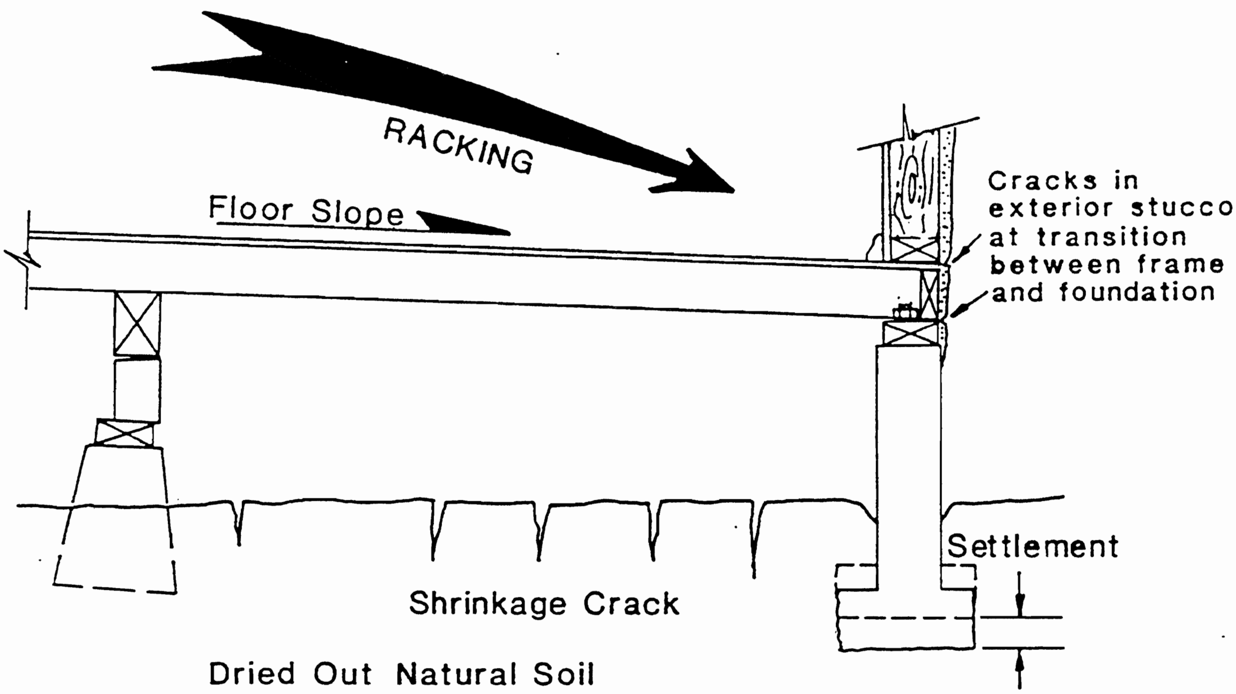
FOUNDATION SETTLEMENT

PROGRESSIVE SETTLEMENT OCCURS WITH SUCCESSIVE WET AND DRY CYCLES

EXPANSIVE SOIL FOUNDATION SETTLEMENT			Figure 2
AMERICAN GEOTECHNICAL	F.N. 1987	JAN. 1989	

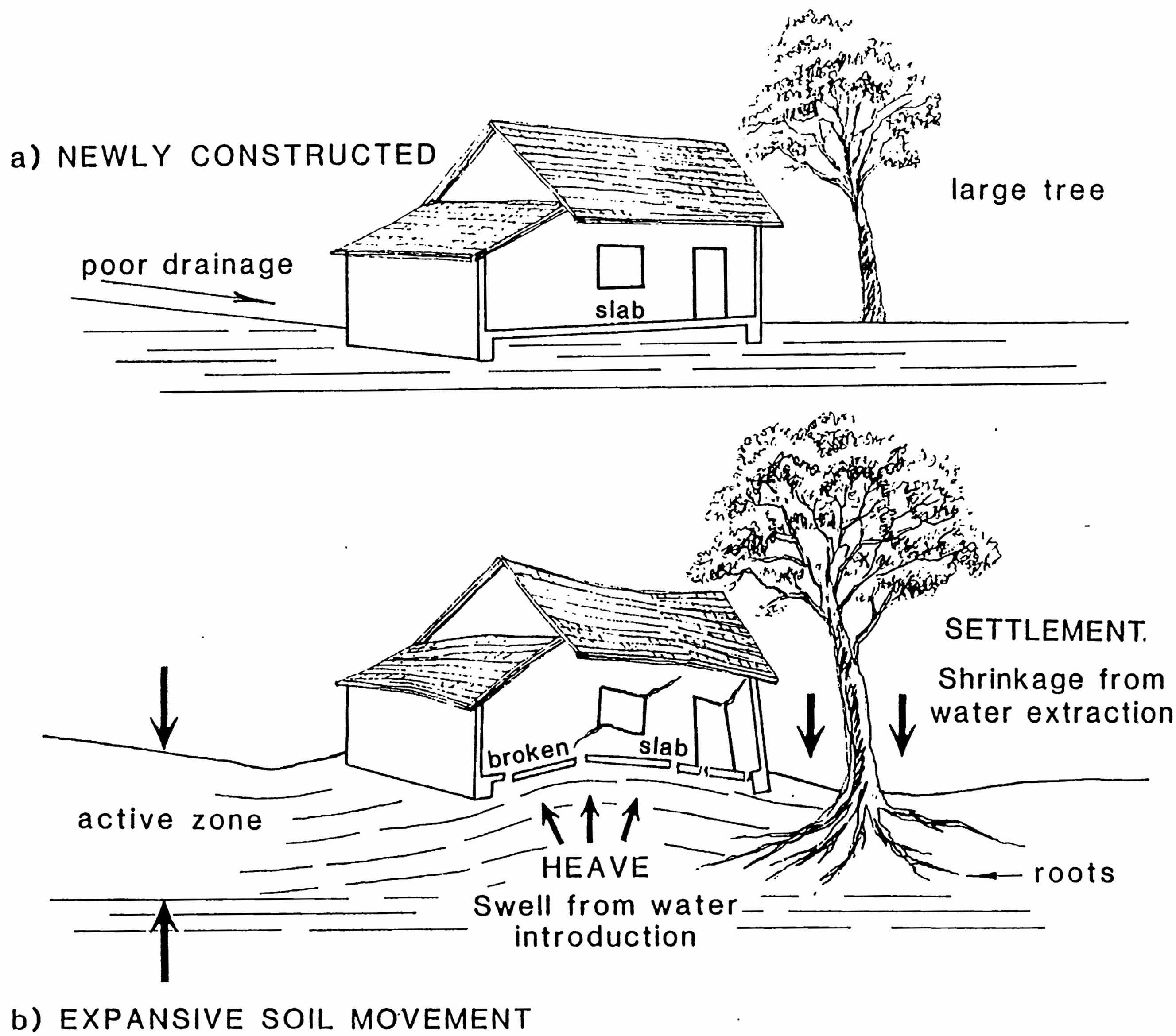


a) Newly Constructed



b) LONG-TERM PERFORMANCE OF POST AND PIER FOUNDATION

Post and Pier Foundation On Expansive Soils			Figure 3
AMERICAN GEOTECHNICAL	F.N. 1987	JAN. 1989	



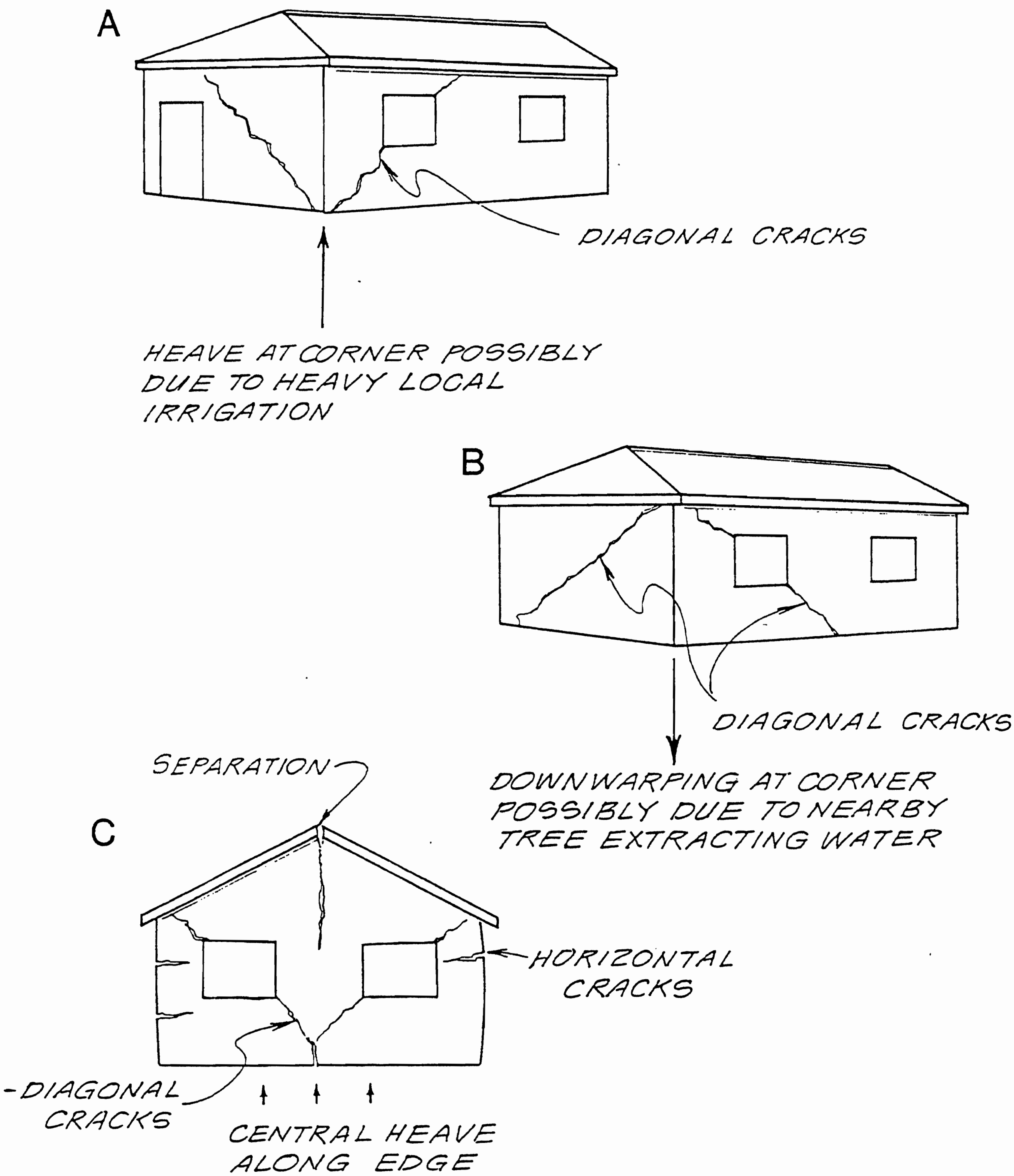
HOUSE ON EXPANSIVE SOIL			
AMERICAN GEOTECHNICAL	F.N. 1987	JAN. 1989	Figure 4

5.1.3 **Crack Patterns Due to Expansive Soil**

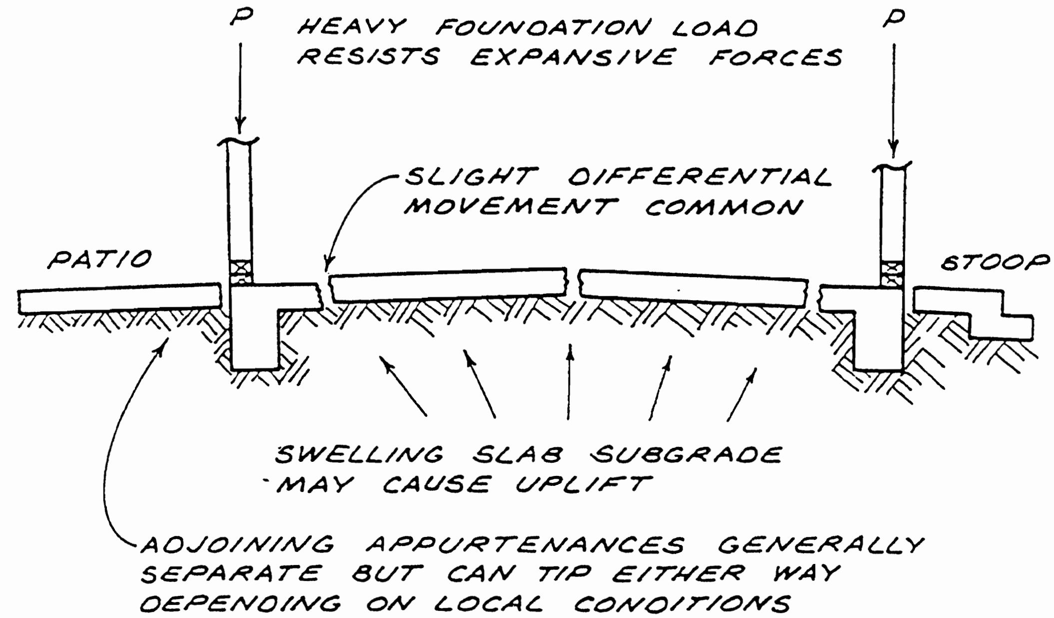
Expansive soil distress can sometimes be diagnosed by observation of commonly occurring crack patterns. Figure 5 illustrates some of the more common crack patterns which become apparent in stucco and masonry. The cracks occur where tensile stresses develop. Concrete, stucco, and masonry are quite strong in compression but weak in tension.

5.1.4 **Slab Cracking**

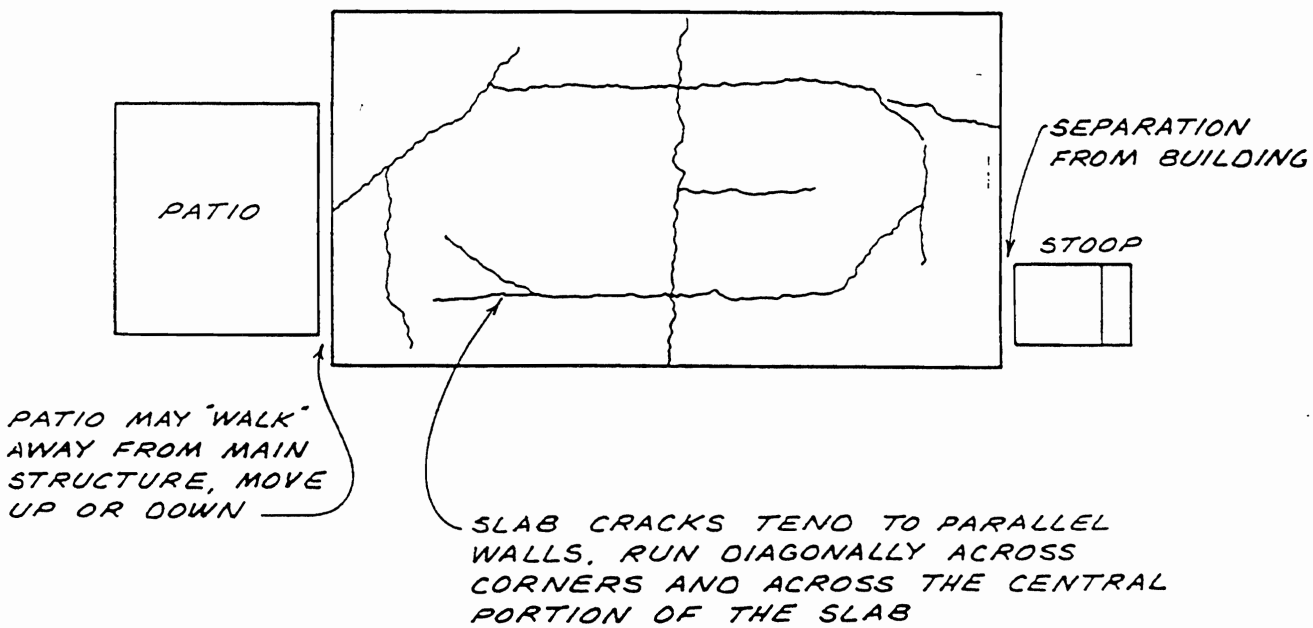
Along with common exterior wall cracking, cracks in patios and interior slabs display common patterns. Figure 6 illustrates these common crack patterns. Cracks commonly will occur across the central portions of large slab areas. Tension is induced in the slab by heave in the central portion of the slab. Parallel to the edges of the building, separations will develop as the foundations are pushed outward while the main slab area moves up in response to the subgrade heave.



CRACK PATTERNS DUE TO EXPANSIVE SOIL			Figure 5
AMERICAN GEOTECHNICAL	F.N. 1987	JAN. 1989	



a) SECTION VIEW



b) PLAN VIEW

EXPANSIVE SOIL SLAB CRACKING			Figure 6
AMERICAN GEOTECHNICAL	F.N. 1987	JAN. 1989	

6.0 CONCLUSIONS

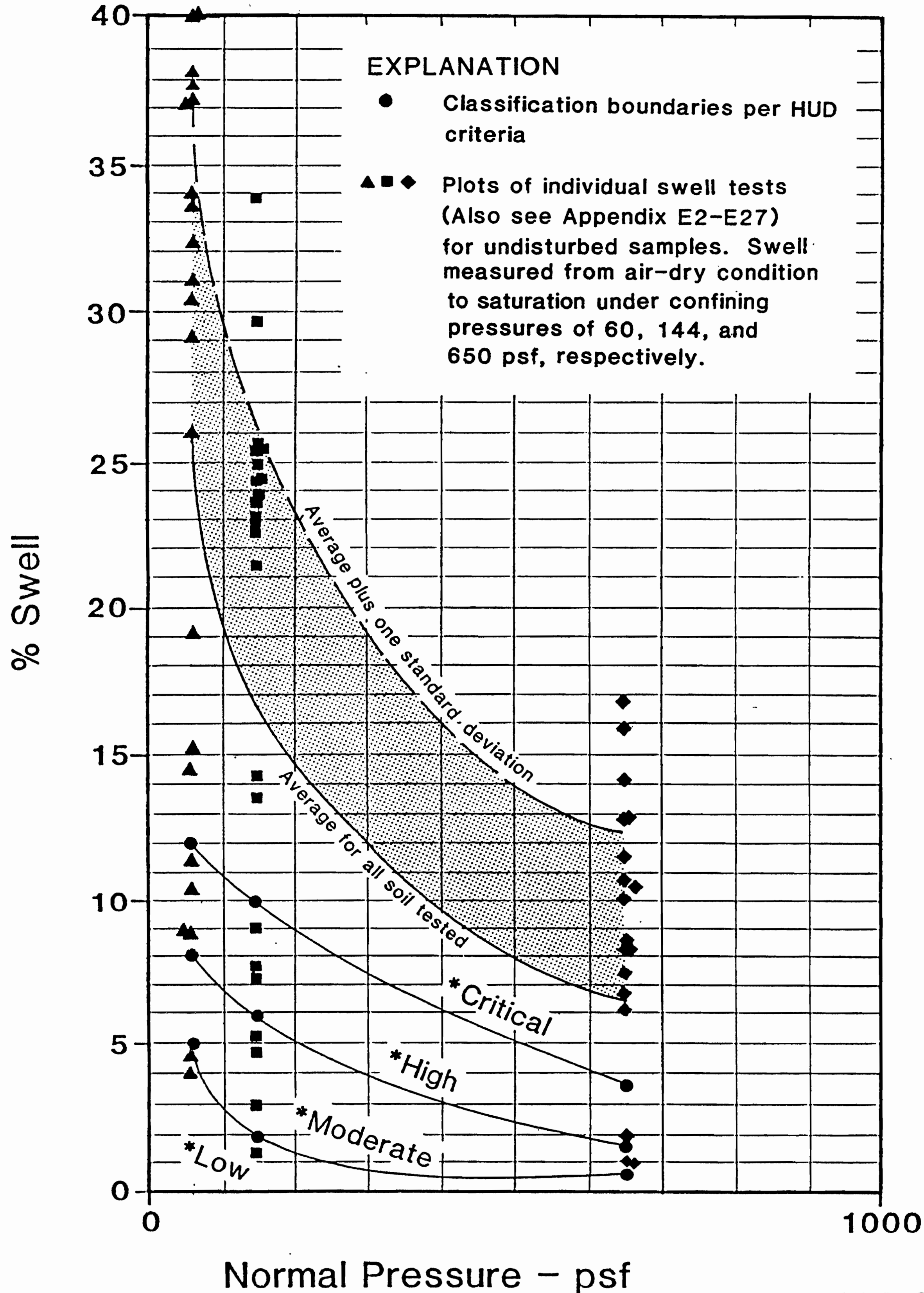
6.1 The conclusions in this report are based upon information provided, information gathered, field exploration, laboratory testing, geotechnical evaluation, experience and judgment.

Based upon our field and laboratory investigation, it is our conclusion the clay soils within the Southwood Riviera section of Torrance are very high[1] to extremely highly expansive. Nothing in this investigation, previous investigations by American Geotechnical, or investigations by other consultants reviewed by this consultant, indicate any other conclusion could be drawn. As can be seen by the Swell/Pressure Diagram, Figure 7; the Plasticity Summary, Figure 8, Summary of Laboratory Test Results, Tables E1 through E4; and individual Swell/Pressure Diagrams, Plates E2 through E27, the expansion potential for the soil within the Southwood Riviera tract are extremely high. The results of Expansion Index tests performed for this study are presented below. The results are followed by the Uniform Building code classification for expansive soil. The classification is based upon the soils Expansion Index.

TABLE 6A
Expansion Test Results
(UBC Test Standard 29-2)

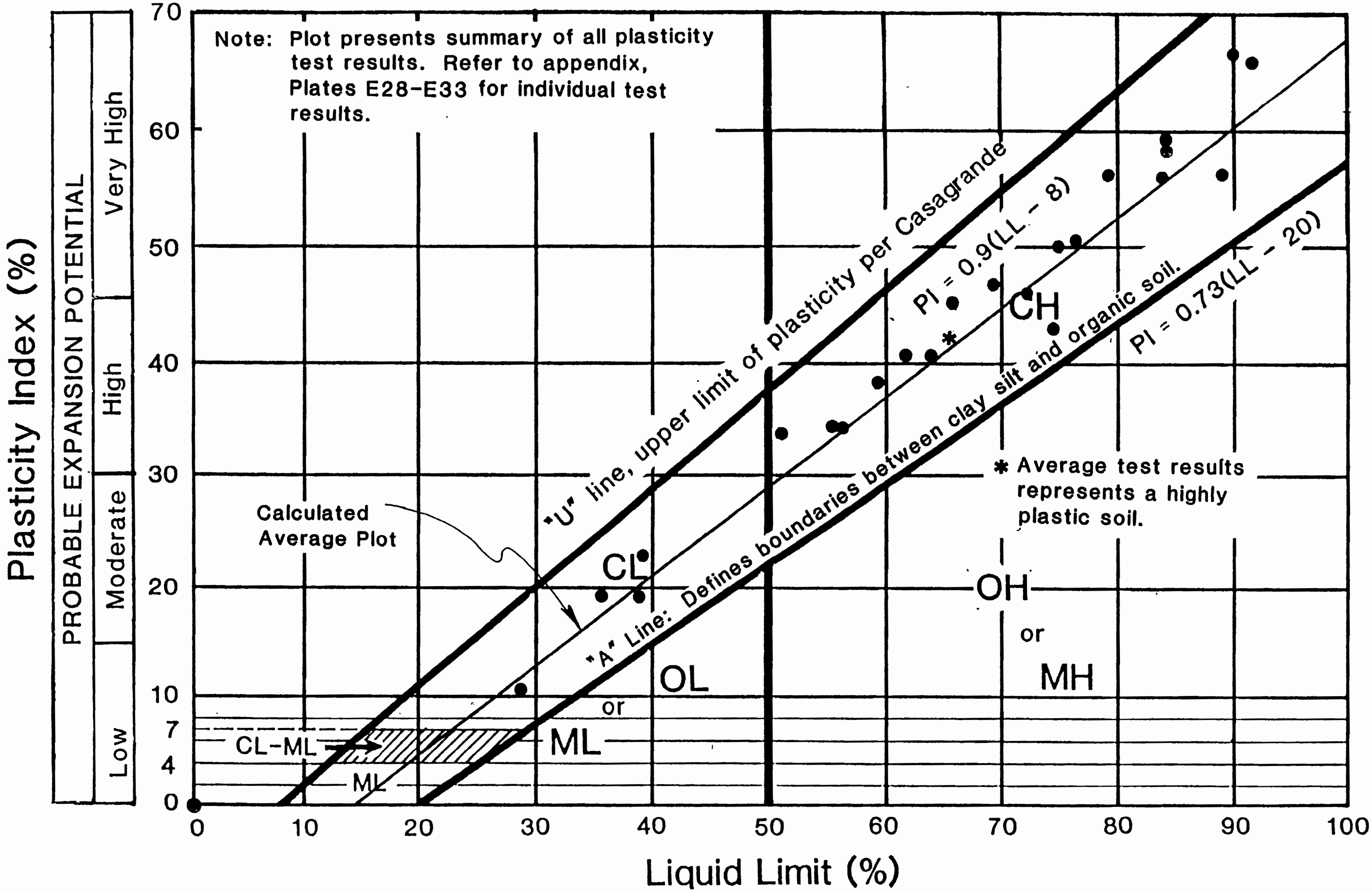
Boring No.	Expansion Index (EI)
B-2	132
B-4	168
B-5	222
B-6	244
B-7	313
B-9	204
B-10	82
B-11	211
B-11	247
B-12	237
Average E.I. =	206

1 "Very High" terminology per U.B.C., see Table 6B; "Critical" terminology per HUD, see Figure 7; "Extremely High" terminology represents conditions substantially above the boundaries of very high or critical per U.B.C. or HUD criteria, respectively.



* HUD Criteria

SWELL / PRESSURE DIAGRAM			Fig. 7
AMERICAN GEOTECHNICAL	F.N. 1987	JAN. 1989	



PLASTICITY SUMMARY

AMERICAN GEOTECHNICAL	F.N. 1987	JAN. 1989	FIGURE 8

TABLE 6B
Classification of Expansive Soil
(Uniform Building Code Table 29-C)

Expansion Index	Potential Expansion
0-20	Very low
21-50	Low
51-90	Medium
91-130	High
Above 130	Very high

As stated earlier, these values include some of the highest Expansion Indexes ever seen by this consultant. Our experience base extends over 16 years in the South Bay area but also includes other Southern California areas such as Ventura, Orange, and San Diego counties. On average, the results of these tests are about twice the value the Uniform Building Code would ordinarily categorize as high to very high. Accordingly, the City of Torrance is justified in their requirement of special soil investigation and controls on construction in this extremely high expansive soil area. Test data does indicate locally more favorable conditions as can be seen in Figure 8 test results. The frequency of occurrence of the extreme conditions, however, is sufficiently high to justify prescriptive foundation design criteria unless specific studies are conducted by property owners to justify lower criteria on any particular lot.

7.0 BUILDING ON EXPANSIVE SOIL

7.1 IDENTIFY THE PROBLEMS

The most desirable first step in mitigating against expansive soil problems is to, whenever possible, hire a geotechnical engineer experienced in the area. That engineer should conduct a soil engineering investigation to delineate the site soil and geologic environment. A site investigation should be conducted including subsurface investigation for the purpose of identifying the soil and geologic environment as well as to recover samples for subsequent laboratory use in conducting specific swell tests. This effort would be directed to determining the overall level of expansivity for the site.

In conjunction with site investigation, the development concept should be well understood by the geotechnical consultant. Whenever possible, plans, even though preliminary, should be forwarded to the geotechnical consultant for review and analysis. Along with preliminary plans, the soil engineer finds useful information regarding anticipated foundation and slab loading conditions. The approximate distribution and type of appurtenances should also be delineated along with a plan indicating the desired landscape environment for the project. With the information described above, the geotechnical consultant can conduct a risk assessment for the project with respect to expansive soil conditions. From that assessment, treatment options would be available for actual construction of foundation systems and other improvements. Along with the alternatives, the soil engineer will usually provide specific, minimum recommendations for foundation, slab, and/or soil treatment.

As a second best alternative to a site specific soil study, prescriptive standards can be developed for a given area which are based upon a general study of the area. Prescriptive standards are necessarily more restrictive on average than recommendations which are based upon site specific study. Prescriptive standards must address the above average conditions which might reasonably occur. For this project, prescriptive standards are presented in Section 9.0 of this report. In dealing with expansive soil, various soil and structural procedures are available. The more common procedures are described in the following report sections.

7.2 SOIL TREATMENT PROCEDURES

7.2.1 Removal

The most positive way to treat expansive soil is to simply excavate the soil and remove it from the site. The removed soil could then be replaced with nonexpansive soil or soil with low expansion potential. Depending on the level of expansivity, approximately four to six feet of soil would be required below finished grade. This treatment, although theoretically most desirable, as a practical matter is seldom adopted. Usually there are insufficient quantities of nonexpansive soil that can be obtained and transported at reasonable cost to a project. As such, expansive soil is ordinarily utilized on site, and other procedures are adopted to mitigate against damage.

7.2.2 **Compaction Control**

One construction procedure sometimes adopted is special compaction control. Ordinarily soil is compacted to the code minimum, 90% relative compaction. Expansive soil at this level of compaction has more damage potential in most cases than expansive soil placed at a lower level of compaction. For this reason, a lower compaction level is sometimes specified by the soils engineering in some cases and approved by the governing agencies' use in the upper three to five feet of an expansive soil site. A problem with this procedure is the fact that the desirable degree of compaction could be less than the code specified minimum. When compaction control is being considered for expansive soil treatment, a site specific soil study is essential. If the concept is approved by the City, careful field control of compaction and moisture is also essential.

7.2.3 **Prewetting**

A procedure which produces an effect somewhat similar to compaction control is prewetting. Since clay soil tends to heave when moisture is introduced, the objective of prewetting is to induce as much swell as practical prior to the completion of construction so that future swell potential is minimized. Associated with prewetting, there are usually other measures such as the placement of moisture membranes and deep perimeter footings to serve as cutoff walls which limit moisture variations.

7.2.4 **Chemical Stabilization**

Chemical stabilization is an approach which has been used primarily for compacted fill. By blending in lime or cement, the plasticity and expansivity of clay are reduced. Prior to adopting this method, the clay soil should be tested in the laboratory for the effectiveness of lime or cement stabilization. Different soil responds differently to these stabilization methods. The laboratory testing would be directed towards identifying the general acceptability of the procedure, and to aid in the development of specific project specifications. In utilizing chemical stabilization procedures, special control has to be exercised in the field in order to achieve desired chemical additive contents as well as thorough mixing and compaction.

In some cases, chemical stabilization procedures had been applied to in-place soil. These attempts generally involve drilling injection holes followed by actual injection of lime slurry into the clay mass. Since clay tends to be relatively impermeable, it can be quite difficult achieving successful results.

7.3 STRUCTURAL TREATMENT PROCEDURES

7.3.1 Heavy Conventional Foundation System

The most popular approach to treatment of expansive soil is the utilization of a heavy conventional slab and foundation system. Deeper and moderate to heavily reinforced continuous footings are provided to develop stiffness and resistance to differential movement resulting from expansive soil. Footings on the exterior of a structure also provide a cutoff wall which limits future moisture exchanges between the exterior and interior. Slabs are usually thicker than conventional slabs and contain moderate to heavy steel reinforcement. A rock subgrade is typically placed below the slab on top of which a plastic moisture barrier is added to limit interior moisture migration.

In tract developments, contractors or developers will commonly utilize some of the other structural treatments presented below since, on a large scale basis, economy can sometimes be achieved. On an individual lot, a heavy conventional slab and foundation system is usually adopted.

7.3.2 Rigid Reinforced Slab-on-Grade

A rigid reinforced slab-on-grade can be constructed either utilizing conventional reinforcement techniques or by utilizing post-tensioned designed systems. The slab usually is of a higher level of structural integrity than that described for the conventional construction process. Along with a perimeter grade beam, there are crisscrossing interior grade beams which serve as stiffeners rather than specific footings. When post-tensioned construction techniques are employed, high strength steel cables are placed through the slab and stiffener system. The cables, following initial curing of the concrete, are tightened which puts the entire foundation system in a state of compression. Since concrete is quite strong in compression, the result is a very stiff foundation. Because of the crisscrossing nature of the stiffeners under the structural slab, the system is sometimes referred to as a waffle-type rigid slab construction.

7.3.3 Mat Foundation

A mat foundation system is quite similar to a rigid reinforced slab on grade, but instead of utilizing a system of structural slab and grade beam stiffeners, a slab of generally uniform thickness is utilized. For example, the total slab thickness might range from 12 to 16 inches depending on site soil conditions and structural considerations. The thick slab would probably be reinforced with two mats of steel each containing about No. 7 bars at a relatively close spacing in both directions. Although more concrete and steel is utilized for mat construction in comparison to waffle-type slabs, cost savings associated with simple detailing often is greater than the additional material cost expenditures.

7.3.4 Drill Pier and Grade Beam Construction

Drill pier and grade beam construction is generally applied to the most severe cases of expansive soil. In this method the proposed structure is supported on a structural slab which transfers structural loads to a depth wherein expansive soil conditions are at equilibrium and are expected to stay at equilibrium by a system of drilled piers. These piers may extend 10, 15 or even 20 feet below the ground surface in areas of critical concern. Underneath both the grade beams and the structural slab, construction requires a relatively compressible material to be placed which would allow the subgrade to heave in the future without damaging the slab or grade beam system. Although various methods have been utilized in the past, one convenient method to produce this compressible layer is the use of corrugated cardboard built-up into a section of a few inches thick. At the time of construction, the cardboard has sufficient rigidity to allow for placement of the concrete without crushing. After the cardboard is in place for awhile, the natural introduction of moisture softens the cardboard which then allows subgrade heave without adverse structural influence.

7.4 OTHER CONSIDERATIONS

7.4.1 Construction Detailing of Appurtenances

Usually greatest attention with respect to expansive soil resistance is given to the main structure (i.e., the critical structure). Frequently upon assessing costs, benefits, and risks, substantially less attention is paid to appurtenant structures. The greater risk associated with the long term performance is offset by lower initial cost. Nonetheless, attention paid to appurtenant detailing can substantially reduce distress. Two structural concepts are available. The first, continuity/rigidity; and the second, separation/flexibility. As suggested, appurtenant facilities can be made structurally continuous and provided with rigidity similar to the main structure. This type of detailing is essential when relatively rigid veneers such as tile surfacing extend from the main structure to appurtenant areas. Providing continuity/rigidity is generally more expensive than the alternative, separation/flexibility. For a flexible system, a positive separation is usually provided between the main structure and appurtenances. Where it is architecturally feasible, a moderate to large separation is provided wherein differential movements between the independent structures is not readily apparent. Where relative closeness of the appurtenance to the main structure is desired, some continuity is generally provided by extending steel reinforcing dowels between the rigid structure and the appurtenance. To separate the appurtenance from the main structure, foam material or fiber joint material is added. This treatment, upon completion, will allow for some flexibility of the appurtenance without distress at the joint.

7.4.2 **Moisture Control**

In expansive soil it is desirable to maintain moisture conditions as uniform as possible. Generally, on top of structural considerations, it is recommended that drainage be maintained away from structures to approved disposal areas. Good drainage is generally recommended to prevent ponding. Although good structural design anticipates increase in moisture, ponding is an aggravating factor which should be avoided. Moisture barriers are also utilized in an attempt to maintain moisture conditions as uniform as practical. Moisture barriers are usually plastic membranes placed under slabs and at depth to isolate the soil conditions supporting the main structure or appurtenance. Under an appurtenance, moisture barriers are most effective when they extend several feet beyond the limits of the appurtenance. Generally, the moisture barrier is placed one to two inches below the slab-on-grade concrete. One or two inches of sand is placed as a protective barrier and to aid in concrete curing. Beyond the edges of the appurtenance, the moisture barrier would be deepened to allow landscape fill to be placed. The actual limit of moisture barrier extension beyond the flatwork would vary with site specific conditions, but on the order of six feet is desirable.

7.4.3 **Landscape Assessment**

Of significant consideration in an expansive soil environment is the landscape scheme. As indicated earlier in this report, moderate to large trees can be of significant adverse influence when placed too close to a structure founded in expansive soil. Some varieties of trees are more problematic than others. Trees with invasive root systems pose the greatest threat. Where trees are desirable in relatively close proximity to a structure, careful planning should be conducted by the landscape architect to identify the most desirable tree varieties that fit both the development concept and expansive soil conditions. In the event that a particularly problematic tree variety is selected, special construction techniques can be employed to minimize the influence of the tree on the foundation system. To a lesser extent, smaller shrubs and ground covers can also influence expansive soil behavior. Trees and shrubs can be evaluated by a landscape architect/nurseryman familiar with planting in an expansive soil environment.

7.5 RISK ASSESSMENT

7.5.1 **General**

For each project, site soil environment should be evaluated in relation to the proposed development. Risk associated with existing site soil conditions and/or anticipated soil conditions should be delineated. Generally, highest risk is associated with the highest level of soil expansivity. The nature of the development itself may tend to mitigate inherent risks, or increase risks. Consideration should be given to the level of acceptable risk associated with the primary structure and for the appurtenances. In essence, a cost, benefit, risk analysis would be conducted. Usually least risk is associated with the main structure, and more risk associated with the appurtenances. The higher risk for appurtenance damage is sometimes offset by lower initial cost.

7.5.2 **Primary Treatment**

Primary treatment can either be a soil treatment or structural treatment. Primary treatment is that treatment which offers the greatest resistance for expansive soil damage. A soil treatment might consist of removal and replacement with nonexpansive soil or chemical stabilization. Various structural treatments are also available as were previously discussed. Usually the primary treatment consists of a structural treatment such as a heavy conventional slab and foundation system.

7.5.3 **Secondary Treatment**

Secondary treatments are usually employed to provide limited protection against expansive soil damage. An example of a secondary treatment would be a suitably designed flexible joint between a main structure and appurtenance exterior slab. Another example of a secondary treatment would be the utilization of moisture barriers to modulate moisture changes and thereby reduce expansive soil damage.

7.5.4 **Tertiary Treatment**

Every plan for development should also include tertiary treatments. Although less benefit is associated with tertiary treatment, so is substantially reduced cost. Tertiary treatments include proper drainage, sometimes the provision of roof gutters and downspouts, and design of the landscape system.

7.6 TORRANCE PROJECT CONSIDERATIONS

Objectives for this study have included the development of recommendations for treatment of existing distressed buildings and provide suitable, general foundation recommendations for additions to existing residential structures. In both cases, a significant constraint is the prior existence of structures with foundation systems with varying levels of resistance to expansive soil problems. As such, practicality limits the available primary treatment alternatives. Structural mat foundations, rigid waffle foundations, and deep pier and grade beam foundation systems require special structural design on a case-by-case basis. Since an objective of this study is to provide general recommendations, the foregoing cannot reasonably be offered as treatments within the study area. For existing structures, it would similarly not be practical to recommend soil treatment such as removal and replacement of existing expansive soil. Accordingly, the general recommendations for treatment in the study area will include prescriptive construction standards and other specific details for use in design and construction of conventional foundation systems.

8.0 SUMMARY OF FINDINGS

8.1 GEOLOGY

The study area is just north of the Palos Verdes Peninsula and east of a gently sloping sand bluff along Redondo Beach and southwest Torrance. The site soil consists of very fine grained alluvial sediments. Until approximately the turn of the century, the study area was characterized by swamp or marshy conditions which represented the westerlymost extension of the Bixby slough. The only remaining wetland element of the Bixby slough is Harbor Lake located southeast of the intersection of Pacific Coast Highway and Vermont Avenue.

No active faults are known to extend through the study area, however, the Palos Verdes fault trending from southeast to northwest is projected to lie near the foot of the peninsula not far south of the study area. The Palos Verdes fault has historically produced relatively small earthquakes. The fault is not categorized as active by some since there is no surface ground rupture known to be associated with an earthquake in the past 10,000 years. State geologists categorize the Palos Verdes fault as "potentially active." Like most areas in Southern California, moderate to strong ground shaking can be expected during the remaining life of the residential development in the area. Moderate to strong ground shaking might occur along any number of regional faults such as the Newport-Inglewood fault zone, the San Andreas fault zone, or even the Palos Verdes fault. It should be kept in mind by homeowners that even if all applicable code criteria are incorporated into construction, the possibility of damage resulting from a strong earthquake cannot be ruled out. This possibility is the same for essentially all homesites in Southern California.

8.2 SOIL CONDITIONS

Soil conditions, within the study area, are characterized by relatively uniform deposits of dark brown to black, highly plastic clay. The depths of the clay deposits vary, but overall extend from about five to twenty feet below existing ground surface. With development in the area, and associated minor cutting and filling, surface conditions vary. In some cases, relatively thin layers of sand exist. Nonetheless, virtually without exception, highly plastic clays can be expected at shallow depths. At greater depth, sand and clay blends are encountered. The highly plastic clay is believed to be rich in montmorillonite clay minerals. This mineral is the most problematic of clay minerals. The clay soil in the study area exhibits critically expansive characteristics. Expansion potential is about twice as high as described for the "high" category presented in Uniform Building Code Table 29-C. Remolded samples compacted to 90% of the laboratory maximum density were found to exhibit, under low confinement, as much as about 40% increase in volume when measured from air dried to saturated conditions.

8.3 EXISTING CONSTRUCTION

Existing construction in the area consists of primarily residential dwellings constructed in the 1960's with both raised wood floor and slab-on-grade construction. In many cases, homes combine both foundation types. Although many homes in the area have performed well to date, numerous homes have also experienced moderate to severe distress resulting from the expansive soil conditions. Distress conditions are characterized by slab heave, slab and foundation cracks, and overall floor tilt. Corresponding to the foundation deformation is interior wall and stucco cracking. Appurtenant flatwork, patio, garden walls, property line walls, etc., have been moderately to severely affected by expansive soil action. In the absence of mitigating measures (as presented in Section 9.2, Part II), further damage can be expected in the area. Experience has demonstrated that homes without adequate foundation design will gradually lose their capacity to resist damage. In some cases, homes without much evidence of damage will, after several years, deteriorate in rapid fashion.

8.4 FUTURE CONSTRUCTION

Since the area is almost entirely developed, future construction in the area is expected to consist of primarily home additions, appurtenant flatwork reconstruction, and restoration for distressed conditions. Various other improvements could be proposed such as pools or spas.

8.5 FOUNDATION TREATMENTS

For building on expansive soil, various treatments are available such as have been described in Report Section 7.0. As discussed in that section, practical limitations exist when dealing with existing construction. As such, repair recommendations presented in the following section for use as prescriptive construction standards will be limited to conventional foundation construction. Other treatments are available but would require site specific geotechnical studies as well as structural engineering consulting. Generally, weighing costs, benefits, and risks, it is this consultant's opinion that providing heavy conventional slab and foundation detailing is the best approach as an alternative that the City of Torrance could accept in developing general prescriptive construction standards for the study area.

9.0 RECOMMENDATIONS FOR PRESCRIPTIVE CONSTRUCTION STANDARDS

Recommendations will be presented in three parts. Part I will consist of foundation recommendations for new additions. Part II will provide remedial recommendations for existing structures undergoing expansive soil related distress. Part III presents recommendations for various appurtenances. All recommendations provided herein are based upon the findings of the investigation, experience and judgment. The recommendations should be considered minimums to be generally applied throughout the study area without further site-specific investigation. The adoption of these recommendations should result in very low risk of future problems with "main structures" and low to ordinary risk for details associated with appurtenances. Lower risk can be attained if more rigorous criteria are adopted. Some risk would remain regardless of the criteria adopted which is always the case. If homeowners elect to retain geotechnical professionals to conduct site-specific investigations, it is possible that less rigorous recommendations could result.

9.1 PART I - NEW ADDITIONS

9.1.1 **Earthwork**: Although only minor grading is anticipated in conjunction with any new additions, adherence to code requirements and the following grading guidelines is recommended. Prior to the start of any grading operations, utility lines within the project area should be located and marked in the field so they can be rerouted or protected during site development. All debris and perishable material should be removed from the site. The area of site preparation should extend at least five feet beyond the limits of improvements. Where excavation and grading is conducted it should be done in accordance with good construction practice, minimum code requirements, and the geotechnical guidelines for grading projects which have been included in Appendix F of this report. Where excavations deeper than five feet are made, temporary construction slopes should be no steeper than 1:1 (horizontal to vertical). Temporary construction slopes, sheeting, and bracing should be provided by the contractor as necessary to protect workers in the excavation. Where excavations undermine existing improvements (i.e., 1.5:1 horizontal to vertical projection of the side of the existing improvement), temporary structural support should be considered to reduce risk of damage. Slot-cutting is another technique which can be employed to reduce the risk of damage resulting from undercutting. Permanent cut and fill slopes should not be constructed steeper than 2:1.

Prior to placement of any fill, existing fill and disturbed natural soil should be removed to expose firm natural ground. New fill should be placed in thin lifts and moisture content adjusted to above optimum by about two to four percent. Fill should be compacted to 90% of the laboratory maximum density unless otherwise recommended by a geotechnical consultant.

9.1.2 **Foundation Design**

Proposed additions within Southwood Riviera can be supported by conventional, continuous spread footings founded in natural silty clay or recompacted fill. Isolated pad foundations should not be used. Footings should be designed in accordance with the following criteria:

Minimum depth (measured from lowest adjacent compacted grade)	
a) exterior footings and interior footings under raised wood floors	5.0 feet
b) interior footings confined by slabs-on-grade	4.0 feet
Minimum width	1.5 feet
Allowable bearing pressure (net at minimum depths specified)	
a) sustained loads	1500 pounds per square foot (psf)
b) total loads (including wind or seismic)	2000 psf
Resistance to lateral loads	
a) passive soil resistance within firm natural or compacted fill confined by slab design per Section 9.1.3. For any other condition project the recommended distribution from the surface but ignore above a depth of three feet.)	200 pounds per cubic foot (pcf)
b. Coefficient of sliding friction	0.30

The allowable bearing pressures are for dead plus long term live loads and include a factor-of-safety of at least 3.0.

Footings can be designed to resist lateral loads by using a combination of sliding friction and passive resistance in properly compacted fill or natural soil. The coefficient of friction should be applied to dead load forces only.

Foundations constructed in accordance with the preceding recommendations are expected to settle approximately one inch. Between adjacent, similarly loaded footings, a maximum differential settlement of about 1/2-inch is anticipated.

9.1.3 Slab-On-Grade

If encountered, all existing fill or disturbed natural soil in slab areas should be removed and replaced as compacted fill as provided for in Section 9.1.1. Over the firm natural or compacted subgrade, provisions should be made for about 12 inches of clean, preferably crushed rock (e.g., one inch concrete aggregate or similar).

On the soil subgrade a continuous layer of "Mirafi-140, Supac 4P, Trevira 1114", or similar geofabric should be placed with at least one foot overlaps at splices. An approximately six inch layer of the above recommended rock should be placed over the fabric layer then compacted to an unyielding condition by light tamping with a vibrating sled or a drum roller.

Within the confinement of perimeter footings and after placement of the first six inches of rock, the soil subgrade should be thoroughly presaturated by flooding. The first layer of rock should be entirely inundated on a daily basis for a period of at least two weeks. The City inspector should verify the flooded condition on at least an alternating day basis. A wetting agent should be added once a day. Wetting agents facilitate deep penetration of moisture into clay soil and are available at good construction material suppliers. For most projects, one gallon over the course of the presaturation period would be sufficient. After presaturation, the additional rock should be placed as described above. The actual amount of rock used may vary depending upon the amount of subgrade heave induced by presaturation.

A vapor barrier over the crushed rock should be considered in areas where the migration of moisture through the floor slab would be detrimental. The vapor barrier should be at least 10-mil plastic and should be sealed at all splices, around plumbing, and at the perimeter of slab areas. Every effort should be made to provide a continuous barrier and care should be taken not to puncture the membrane. Some contractors exercising special care use heavier membranes (e.g., 20-mil) or double layers of 10-mil plastic with splices staggered and sealed. This thicker membrane or double layer alternative is recommended because plastic is relatively inexpensive and the risk of puncturing would be substantially reduced. Once the moisture barrier is in place, it should be covered with one to two inches of clean sand (i.e., washed concrete sand). The contractor should plan concrete placement in a manner that does not require puncturing the plastic membrane with form stakes.

The slab should be eight inches minimum thickness and contain not less than No. 5 bars at 12-inches on centers, both ways. Within six inches of all exterior edges there should be at least two No. 5 bars continuous reinforcement. At reentrant corners, two, three foot sections of No. 5 bars should be placed diagonally across the corners at distances of two inches and five inches from the edge of concrete.

Foundation and slab recommendations as presented above are summarized in Figure 9.

DEPTH OF FOOTING BELOW ADJACENT GRADE	Exterior 60" Interior 48"
FOOTING REINFORCEMENT	Exterior: 9 #5 bars 3-top, 3-bottom, and 3-middle Interior: 6 #5 bars 3-top and 3-bottom
SLAB THICKNESS/ REINFORCEMENT	8" nominal with #5 bars at 12" O/C, both ways.
PRESATURATION FOR SLABS	to about 36" below soil grade; provide 2 weeks of continuous flooding
GRAVEL BASE BELOW SLABS	12"

NOTES:

1) These recommendations are intended to substantially reduce risk of significant foundation and slab cracking. It should be recognized that adopting these recommendations may not prevent cracking in all cases. Criteria for special foundations with a lower risk potential can be developed upon request. Actual recommendations on individual sites may vary. Expansive soil recommendations should not be considered to preclude more restrictive structural or code requirements. Also, these recommendations should not be considered to preclude structural equivalents (e.g. 1 #6 bar in lieu of 2 #4 bars).

2) Unless cracking can be tolerated, these recommendations should also be considered applicable to exterior flatwork and foundations for other appurtenant improvements. Slabs and foundations for exterior improvements which abut the main structure should be structurally continuous with the main building or a distinct architectural separation should be provided. Simple abutting can result in separation. Unless vertical differential at the outer edge of flatwork can be tolerated, a minimum 8 inch wide cut-off wall should be constructed to the same depth as specified for exterior footings. Reinforcement should consist of at least 2 #4 bars per foot embedment plus slab ties as specified in Note 10.

3) Presaturation of footing areas may be omitted if footing excavations at the time of concrete placement are generally moist and free of desiccation cracks.

4) Gravel or approved alternative.

5) Vapor membrane such as "Visqueen" or equivalent for slab areas at grade where dampness is undesirable. "Visqueen", if adopted, should be installed to provide a continuous moisture barrier. The membrane should be sealed around pipes and be overlain by a minimum of 1 inch of clean sand.

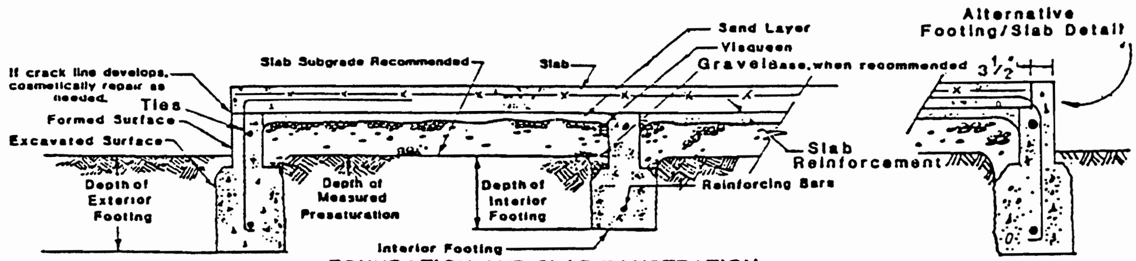
6) Unless otherwise specified, embedment near descending slopes should be increased to provide at least 20 feet horizontal distance to daylight. Horizontal reinforcement should consist of not less than 2 #4 bars per foot of embedment. Deepened footings near slopes will require design as retaining walls.

7) Grade beam recommended across garage entrances to similar depth and reinforcement as exterior footings.

8) Isolated piers not recommended.

9) Approved alternative: Post-tensioned slab construction or equivalent as designed by a structural engineer.

10) Except in garage, slabs should be structurally tied to perimeter footings by bar ties matching slab reinforcement which wrap around footing reinforcement and extend at least three feet into slabs.



FOUNDATION AND SLAB ILLUSTRATION

EXPANSIVE SOIL FOUNDATION RECOMMENDATIONS

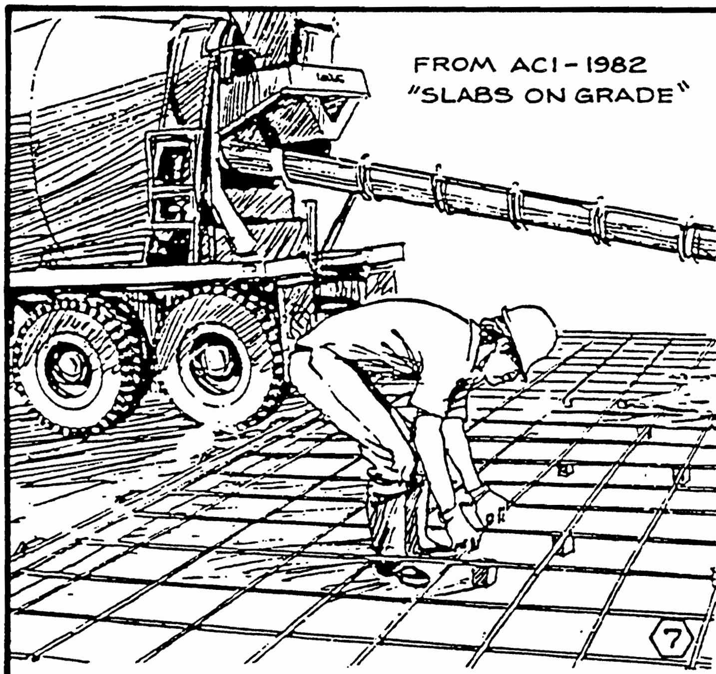
AMERICAN GEOTECHNICAL	F.N. 1987	JAN. 1989	FIGURE 9

9.1.4 **Foundation Details**

Reinforcement Placement: Care should be taken in the placement of foundation and slab reinforcement. Placement details should be in conformance with ACI specifications. Unless otherwise specified by the structural engineer, continuous footing reinforcement should be placed in the upper and lower one-third portions of the foundation sections. The bottom foundation steel should not be closer than three inches to the underlying excavation. Slab doweling matching slab steel (i.e., No. 5 bars at 12-inches on center) should be wrapped around continuous footing reinforcement and be of sufficient length to ultimately bend into the slab at least 36-inches and 60-inches on an alternating bar basis. Slab reinforcement should be placed in a positive fashion between the midpoint and upper one-third point of the slab section. "Lifting" slab steel into place following concrete placement is not recommended. It is recommended that the steel be blocked up and tied at three feet on centers both ways. Four-inch prefab concrete blocks should be used. Other suggestions for concrete and reinforcement detailing are presented in Figure 10. If the contractor produces a non-uniform grade or excavations, the inspector may recommend local addition of steel reinforcement. If forms are incomplete, yield under pressure or are otherwise poorly placed, the inspector may recommend improvement. The contractor should assume all risk of demolition and reconstruction arising out of improper forming and finish. Examples of improper forming and finishing include: improper dimension, out of square, out of plumb, ponding on finish, cracking, and non-uniform finish.

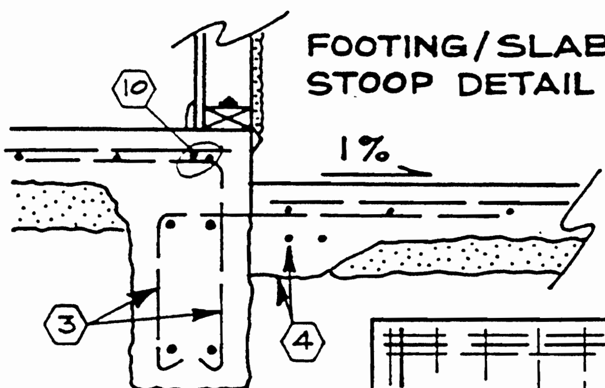
Foundation and Slab Concrete: The contractor should be responsible for supplying the owner with concrete mix designs for both slab and foundation concrete. The contractor should provide designs, place, finish, and cure concrete in accordance with all ACI recommended procedures. The contractor is referred to the ACI 1982 publication "Slabs on Grade." Special care should be taken to properly cure all concrete. If a chemical curing compound is utilized, it should be compatible with proposed floor coverings. As an alternative to a chemical curing compound, the slab area should be kept thoroughly moistened by misting until the initial concrete sets after which the concrete surface should be covered with plastic sheeting for at least two weeks. Three to four weeks is preferred. The owner should consider retaining a qualified materials testing laboratory to verify conformance with specifications.

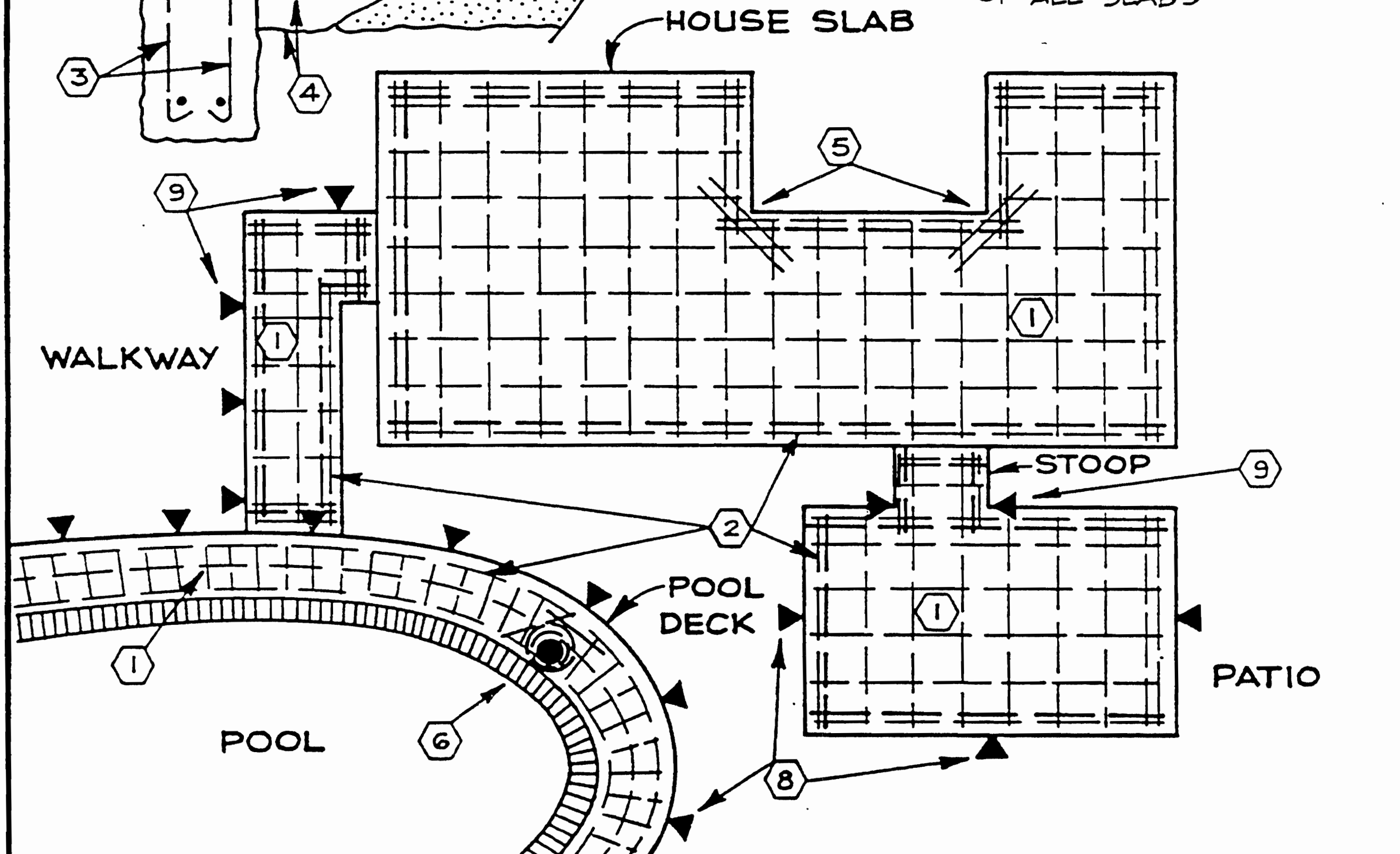
The project architect, structural engineer, and/or concrete engineer should provide actual concrete mix designs. The mixes should be designed for strength, workability and minimizing shrinkage cracking. With respect to shrinkage cracking, the use of pea gravel pump mixes is not recommended. The aggregate should preferably consist of a well graded crushed rock with one inch maximum aggregate size. The amount of cement specified should be just enough to meet or slightly exceed strength requirements. A low water:cement ratio, 0.55 maximum, is advised. The designer could consider



NOTES:

1. PATTERN STEEL
2. PERIMETER BAR CONTINUOUS AT 3-IN. FROM EDGE OF ALL SLABS
3. STRUCTURAL TIES
4. THICKENED EDGE AROUND ALL EXTERIOR SLABS, PLUS 2 EXTRA BARS
5. AT RE-ENTRANT CORNERS IN CONTINUOUS SLABS, ADD 2 3-FT. BARS AT 2-IN. AND 5-IN. FROM CORNER.
6. AROUND DISCONTINUITIES SUCH AS POOL SKIMMER ADD 2 BARS.
7. PROVIDE POSITIVE POSITIONING OF STEEL BETWEEN MID AND UPPER 1/3 POINTS.
8. FOR CONCRETE FINISH EXTERIOR SLABS AND GARAGE ADD CONTRACTION JOINTS. SPACE ABOUT WIDTH OF CONCRETE FOR WALKS, 10-FT. MAX. FOR LARGER SLABS.
9. ADD CONTRACTION JOINTS OPPOSITE EXTERIOR RE-ENTRANT CORNERS.
10. AT LEAST TWO BARS IN OUTER 6" OF ALL SLABS





SLAB STEEL PLACEMENT DETAIL			Figure 10
AMERICAN GEOTECHNICAL	F.N. 1987	JAN. 1989	

the use of plasticizers to increase workability in a low water:cement ratio mix. All concrete footings should be adequately vibrated to consolidate the mix without over-vibrating. Slab areas should be thoroughly tamped to consolidate the concrete.

A product relatively recently available for use in minimizing shrinkage cracking is fiber-mesh reinforcement. This product consists of short fiber-glass fibers blended into the concrete. The use of fiber-mesh reinforcement can be expected to add about ten dollars per cubic yard of concrete. A small disadvantage of fiber-mesh is slight fiber protrusion from the finished surface. This surface fiber can be expected to weather and wear off in about three to four months after which an ordinary surface condition would exist. The surface fiber protrusion, however, does not interfere with placement of surface veneers.

9.2 PART II - EXISTING STRUCTURES

9.2.1 Foundation Support

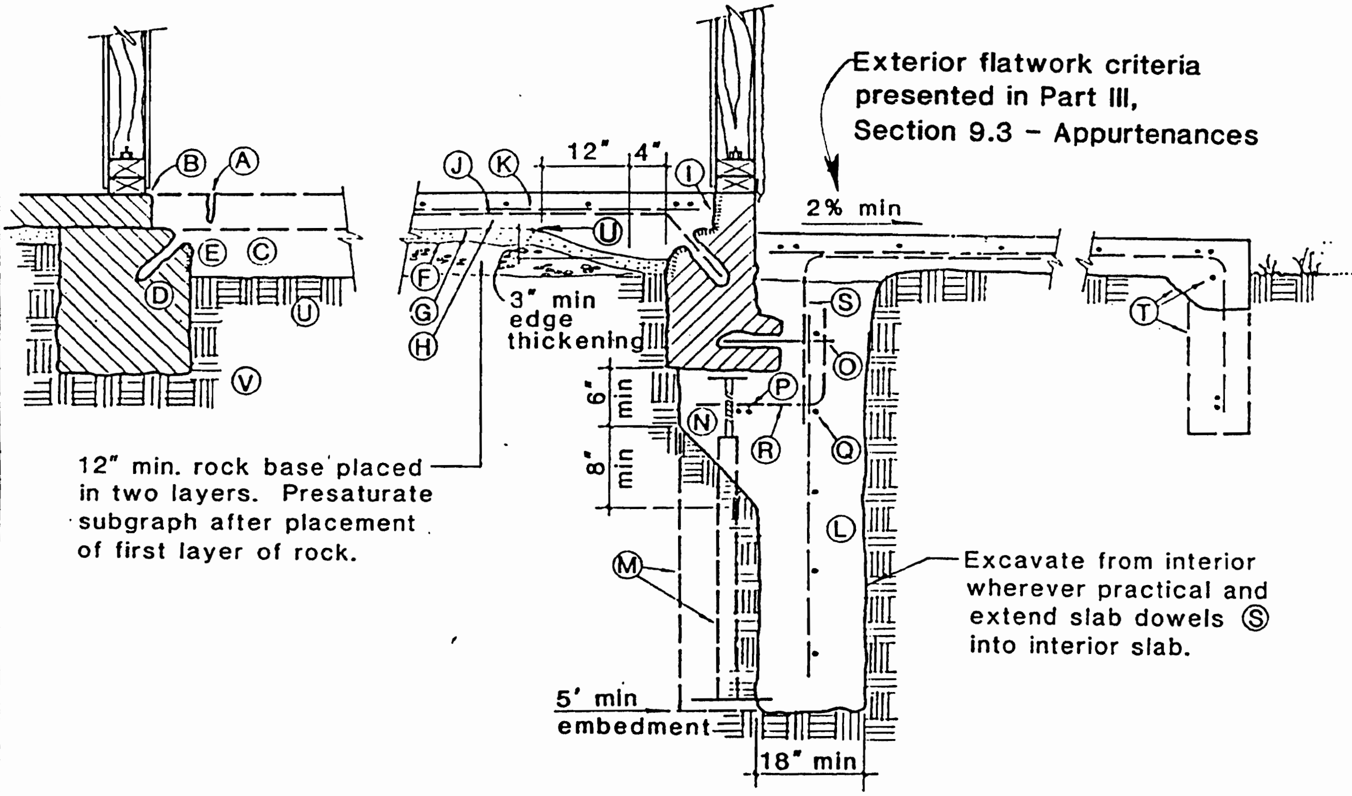
It is our opinion that underpinning of perimeter and interior footings below the depth of seasonal moisture change is the most appropriate treatment for structures undergoing distress due to expansive soil. A suitable underpinning system for residential construction has been illustrated in Figures 11 and 12.

9.2.2 Foundation Construction

It is not anticipated that construction difficulties will be encountered. However, prior to bidding any project, contractors should be allowed to visit the site to ensure that proper clearance is available for construction equipment. Soil removed for underpinning footings should be removed from the site.

9.2.3 Foundation and Slab Design and Detailing

Foundation and slab detailing should be as was previously recommended in report Sections 9.1.2, 9.1.3, and 9.1.4 and remains applicable to underpinning existing structures for the purposes of both treating distressed conditions and providing improved support for new additions. Beyond the limit of the proposed addition, underpinning and slab replacement is not a requirement but is highly desirable. This condition is illustrated in Figure 13. If a homeowner proposes to construct an addition without full underpinning and slab replacement in the existing structure, prior to issuance of a building permit a Form A-Awareness Statement, Covenant, and Agreement must be first signed by the homeowners, notarized, and approved by the City. A sample Form A has been included herein as Figure 14.



(A) Saw cut as near as possible to wall.

(B) Chip back flush with wall.

(C) Excavate for thickened edge, sand, moisture barrier and gravel base.

(D) Drill 8" minimum for dowels @ 12"o.c.

(E) Apply epoxy bonding compound* between dowel holes and grade. Seal moisture barrier to bonding agent but not closer than 2" to dowel holes. (*PRC Co., PR-940 or equal)

(F) Use 10-mil moisture barrier membrane sealed at all splices and around pipes.

(G) Use 2" clean sand protective cover.

(H) Use 8" minimum concrete slab; 11" minimum at thickened edges unless underpinning is excavated from the interior.

(I) At 1-2 hours prior to placement of concrete, apply bonding compound.*

(J) Use #5 dowels @ 12"o.c. Alternate 36" and 60" into slab. Anchor with bonding grout.

(K) Use #5 bars @ 12"o.c. both ways. Use two bars within 6" of slab edges. Add 2-#5 bars x 3' long @ 4" and 8" from reentrant corners.

(L) Primary excavation for underpinning. Excavate from interior where practical.

(M) At 48"o.c. maximum spacing, excavate 12" x 12" slots for support jacks and bearing plates.

(N) Excavate continuous haunch.

(O) Use #5 dowels @ 12"o.c.

(P) Use 2-#5 bars continuous.

(Q) Use #5 bars @ 12"o.c. both ways.

(R) Use #5 bars @ 18"o.c.

(S) Where exterior flatwork is planned, add dowels per note "J".

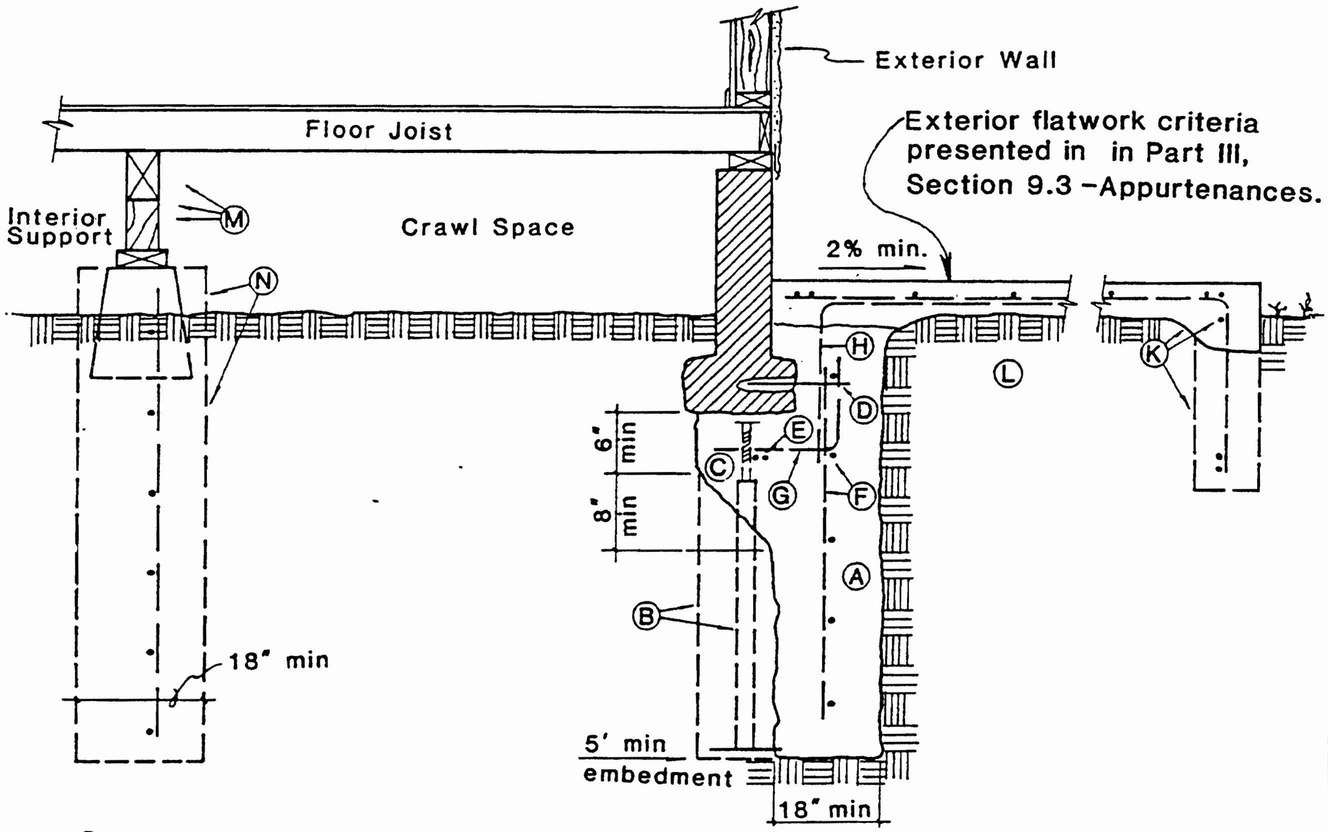
(T) At exterior edges, thicken to 8" minimum* and add 1-#4 bar continuous. (*10" wide by 36" minimum depth cut-off wall with 2-#4 bars as shown, preferred at exterior edges.)

(U) Slab subgrade should be presaturated for at least two weeks minimum prior to slab construction.

(V) Interior underpinning should be detailed as for exterior foundation.

(W) General Note: Concrete should consist of 5-sacks of cement per cubic yard minimum, Type II, 2000 psi minimum. For slab concrete, 4" maximum slump. Exterior flatwork should be jointed at 8' maximum spacing to minimize shrinkage cracks. Deputy inspection is recommended.

SLAB FOUNDATION REPAIR DETAIL			Figure 11
AMERICAN GEOTECHNICAL	F.N. 1987	JAN. 1989	



(A) Primary excavation for underpinning.

(B) At 48" maximum spacing, excavate 12" X 12" slots for support jacks and bearing plates. Level existing foundation as needed.

(C) Excavate continuous haunch.

(D) Use #4 dowels @ 18"o.c. with 8" minimum embedment and projection. To facilitate installation, dowels may be drilled on an angle and the projection bent horizontal. Anchor with bonding grout.

(E) Use 2-#5 bars continuous.

(F) Use #5 bars @ 12"o.c. for horizontal steel; #5 bars @ 16"o.c. for vertical steel.

(G) Use #5 bars @ 18"o.c.

(H) Where exterior flatwork is planned, add #4 dowels @ 16"o.c. Alternate 36" and 60" into slab. Anchor with bonding grout.

~~(I) Use #4 bars @ 16"o.c. both ways. Two bars within 6" of slab edges. Add 2-#4 bars X 3' long diagonally across and at 4" and 8" from reentrant corners.~~

~~(J) Use 5" minimum concrete slab, thickened to 8" minimum at edges.~~

~~(K) At exterior edges, thicken edges to 8" minimum and add 1-#4 bar continuous. A preferred option to a thickened edge is a cut-off wall at least 8" wide by 24" minimum depth as shown, with at least 2-#4 bars added to the bottom of the cut-off wall.~~

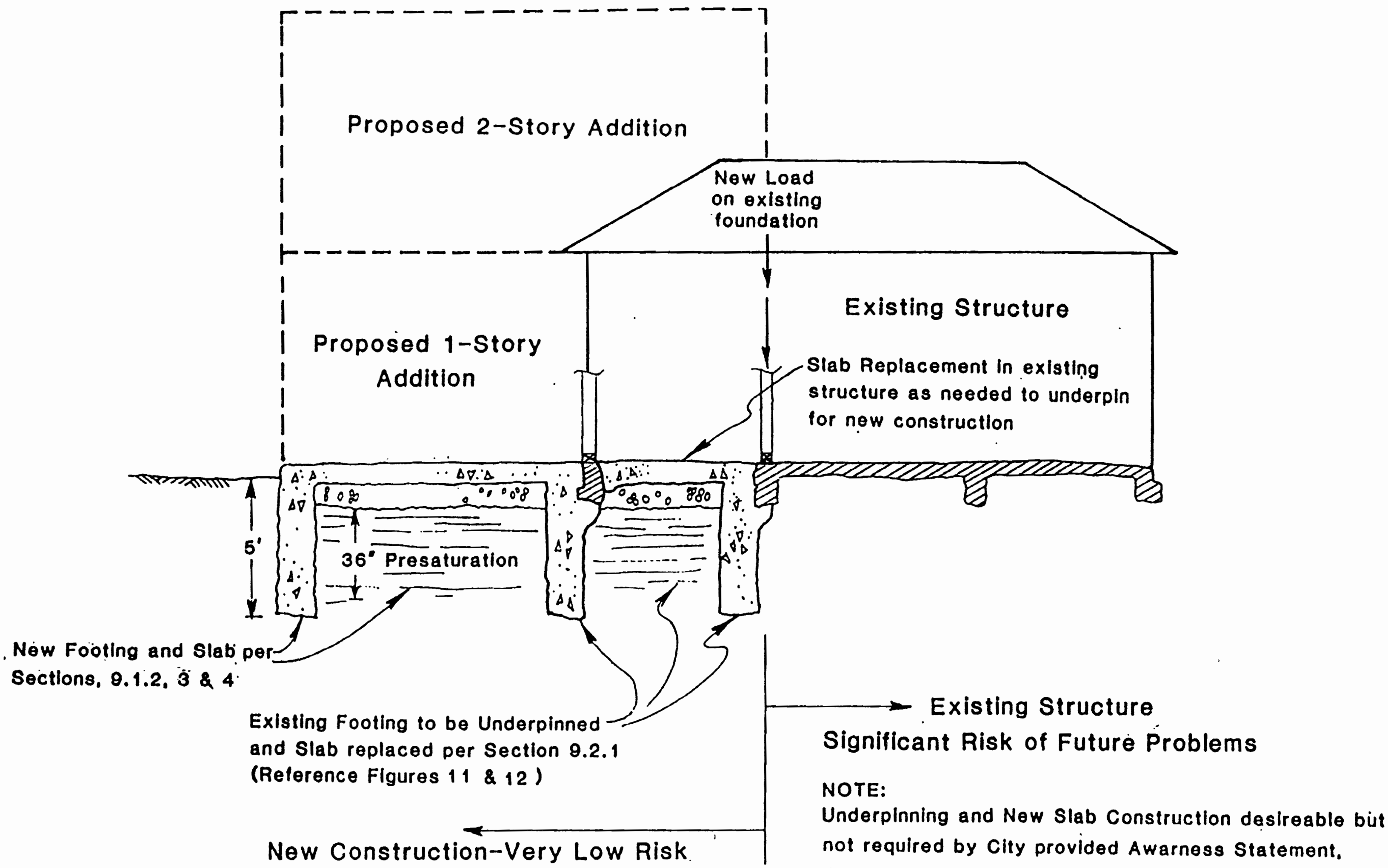
(L) Slab subgrade should be presaturated to a depth of 24" minimum, prior to placement of slab concrete.

(M) At completion of exterior foundation work, relevel interior using jacks for temporary support. Adjust post height as needed.

(N) Interior underpinning option as shown. Construct continuous foundation in alignment of existing isolated piers. Reinforce with #5 bars @ 12"o.c. for horizontal steel; #5 bars @ 16"o.c. for vertical steel. In order to maintain minimum crawl space through alignment of piers, block-out at suitable location(s) and keep concrete at or below existing grade.

(O) General Note: Concrete should be 5-sack minimum, Type II, 2000 psi minimum. For slab concrete, 4" maximum slump. Exterior flatwork should be jointed at 8' maximum spacing to minimize shrinkage cracks. Deputy inspection is recommended.

RAISED FOUNDATION REPAIR DETAIL			Figure 12
AMERICAN GEOTECHNICAL	F.N. 1987	JAN. 1989	



NOTE:
Underpinning and New Slab Construction desireable but not required by City provided Awarness Statement, Covenant and Agreement, Form A is signed by the Property Owner(s), notarized, and approved by the City prior to issuance of a building permit.

ILLUSTRATION OF HOUSE ADDITION

AMERICAN GEOTECHNICAL	F.N. 1987	JAN. 1989	FIGURE 13

WHEN RECORDED RETURN TO:

____

Space above this line for Recorder's use

AWARENESS STATEMENT,
COVENANT AND AGREEMENT

REGARDING THE ISSUANCE OF A BUILDING PERMIT IN AN AREA SUBJECT TO PHYSICAL HAZARDS OF AN EXPANSIVE SOIL NATURE.

The undersigned ____

____

(does) (do) hereby certify to be the owner(s) of the hereinafter legally described real property located in the County of Los Angeles, State or California:

____

____

____

____

as recorded in Book _______, page _______, Records of Los Angeles County, known as ____,

Street Address

____

Locally

(I) (We) hereby do acknowledge the fact that the property is within an expansive soil hazard zone identified by the City of Torrance and within the area of a special expansive soil by American Geotechnical as described by their soil and geologic report dated January 25, 1989. Furthermore, (I) (We) acknowledge that only the new construction (area of addition) will be provided with construction details consistent with Section Nine of the aforementioned American Geotechnical Report and the requirements of the City of Torrance, and (I) (We) accept all risk associated with foundation conditions as proposed. And, in consideration for the issuance of a building permit for ______________ ____, (I) (We) do hereby covenant and agree to and do hereby relieve the City of Torrance and all officers, employees, and agents thereof of any liability for any damage or loss which may result from the issuance of such permit.

This Covenant and Agreement shall run with the land and shall be binding upon the undersigned, any future owners, encumbrancers, their successors, heirs or assignees and shall continue in effect until such time as the County Engineer records in the office of the County Recorder's statement that he finds such expansive soil hazard no longer exists.

Owner: ______________________ Owner: ______________________
Signature Signature

Owner: ______________________ Owner: ______________________
Signature Signature

All signatures are to be acknowledged before a Notary Public.
If a corporation, the corporate form of acknowledgment shall be used.

Form A: January 1989

For Office Use Only

PERMIT #:	APPROVED BY:	DATE:

FORM A			Figure 14
AMERICAN GEOTECHNICAL	F.N. 1987	JAN. 1989	

9.3 PART III - APPURTENANCES

9.3.1 Risk Concept

In conjunction with improvement of distressed conditions, and for new construction, the main dwelling unit is generally given most consideration. Appurtenances are generally considered less critical. Each appurtenance must be considered separately but, in general, appurtenances rank behind the main structure. In light of cost savings, generally more risk is usually acceptable for less critical improvements. The recommendations in the following report sections provide moderately rigorous details but they are somewhat less rigorous than previously provided for more structures. Regardless of what approach is taken, however, some risk will remain, as is always the case. In general, the more rigorous criteria adopted for construction, the lower the risk of future problems. The attendant costs and benefits, as well as associated risks should be considered in the design of all improvements. The homeowner could decide to adopt the following criteria for appurtenances or the more rigorous criteria previously provided for main structures (reference Section 9.1).

9.3.2 Design and Detailing

General criteria for design and detailing of appurtenant structures (garden walls, screen walls, patios, walkways, etc.) is as follows:

1. Foundation Minimums;
   a) Depth below lowest adjacent grade: 36 inches
   b) Minimum width of footings: 15 inches
   c) Continuous footing reinforcement: No. 4 bars, 2 top, 2 bottom
   d) Vertical reinforcement ties to continuous reinforcement; vertical ties extend and bed into adjacent slabs as dowels: No. 4 bars @ 24" o.c.

2. Design criteria;
   a) Vertical bearing capacity: 1000 psf
   b) Lateral bearing: Ignore
   c) Coefficient of friction: 0.30

3. Slab minimums;
   a) Thickness net: 6"
   b) Reinforcement: No. 4 bars @ 12" o.c. both ways

4. Slab Subgrade:
   a) Presaturation requirement: Flooding for 1 week, min.
   b) Crushed rock base material thickness: 6"

c) Continuous plastic (i.e., sealed at all splices and at perimeter) subgrade moisture barrier (optional):	10-mil plastic
d) Protective clean sand cover over plastic:	1-2"

5. Ordinary concrete mix recommendations to be used unless otherwise superseded by the project structural engineer and/or architect;

a) Concrete minimum strength:	2000 psi
b) Concrete type:	Type II
c) Bags cement:	(5-sack/cu.yd min)
d) Maximum U.S. gallons water per cubic yard of concrete including free surface moisture or aggregates:	6.5
e) Concrete Aggregate:	3/4" min. (no pea gravel)
f) Maximum slump:	4"

Various details for appurtenant construction are presented in Figures 15 through 21. For concrete curing recommendations, the reader is referred to report Section 9.1.4, Foundation and Slab Concrete.

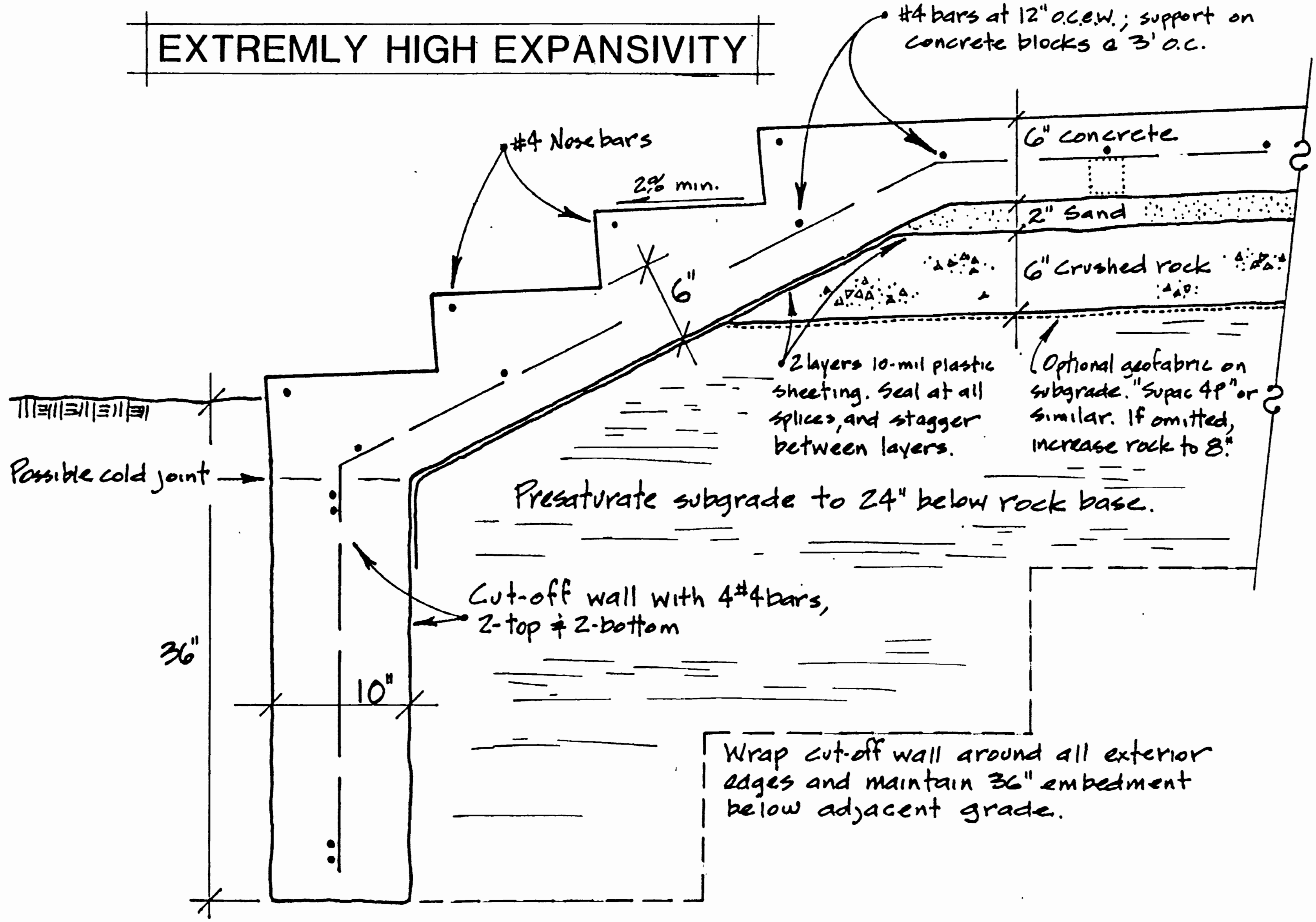
9.3.3 **Pool Design Criteria**

For design purposes it is recommended that the criteria presented in the accompanying Figure 22 should be incorporated into pool design. It is encouraged that the pool contractor utilize a licensed engineer (preferably a structural engineer experienced with expansive soil) to design the pool rather than attempt to identify a "standard pool sheet" that might fit the conditions. Experience with these standard sheets indicates they frequently do not address all necessary design criteria. Regardless of the recommendations by the licensed engineer, it is suggested that the minimum steel schedule consist of No. 4 bars placed at eight inches on center both directions for both pool walls and bottom. Bond beams should contain at least six No. 4 bars.

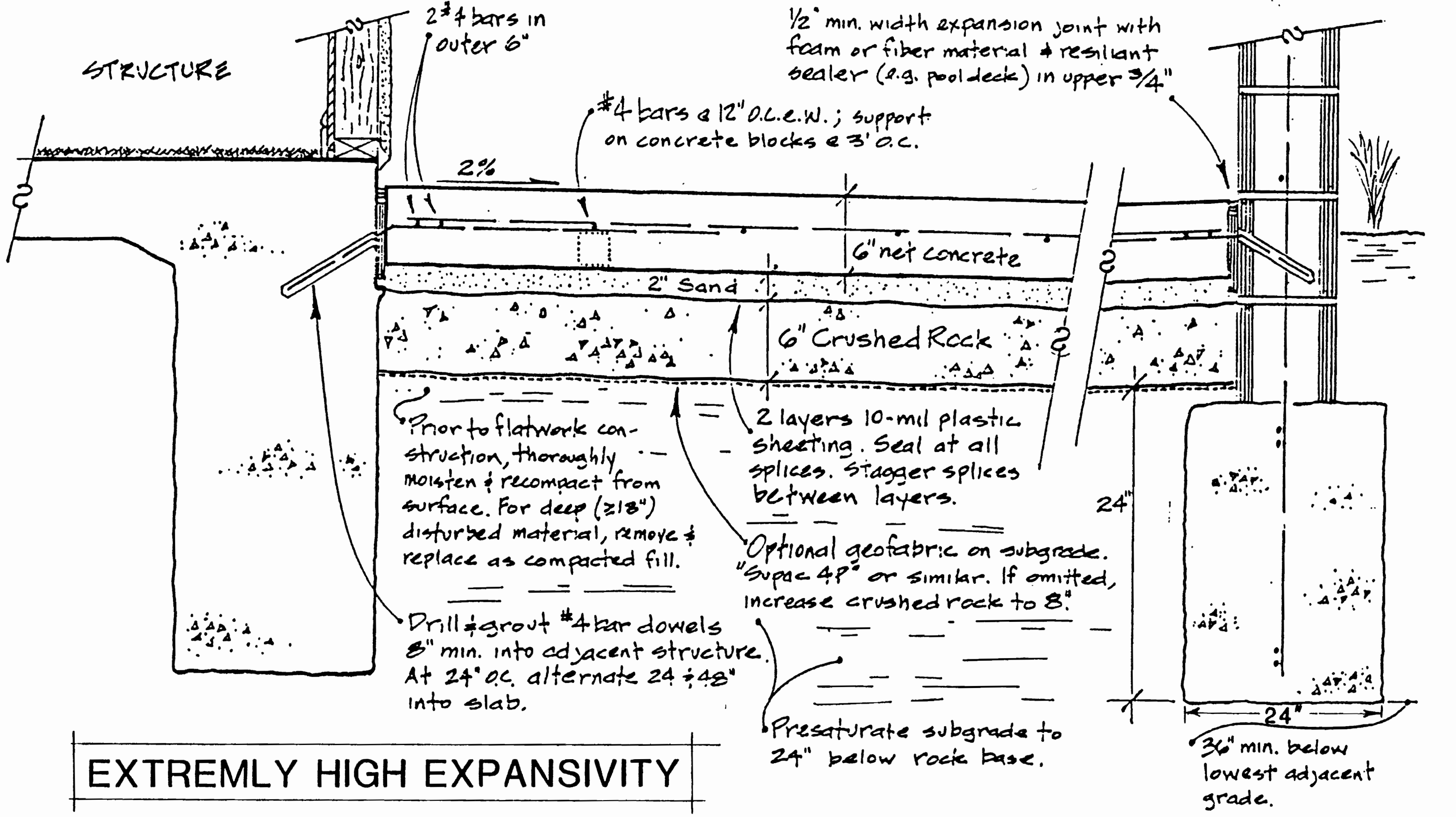
For pool deck construction the criteria presented in Section 9.3.2 should be adopted.

9.3.4 **Drainage**

Where possible, positive drainage should be planned for each site. Roof drainage should be directed away from structures via non-erodible conduits a minimum distance of five feet. Preferably roof drainage should be directed to suitable disposal areas such as yard drains. Five percent drainage is recommended directly away from structures. Two percent minimum is recommended for drainage over soil areas. In pipes or paved swales, one percent should be adopted as the minimum unless otherwise recommended by the project civil engineer. For yard drains, six inch minimum pipe diameter is recommended because experience has shown that three inch pipes tend to



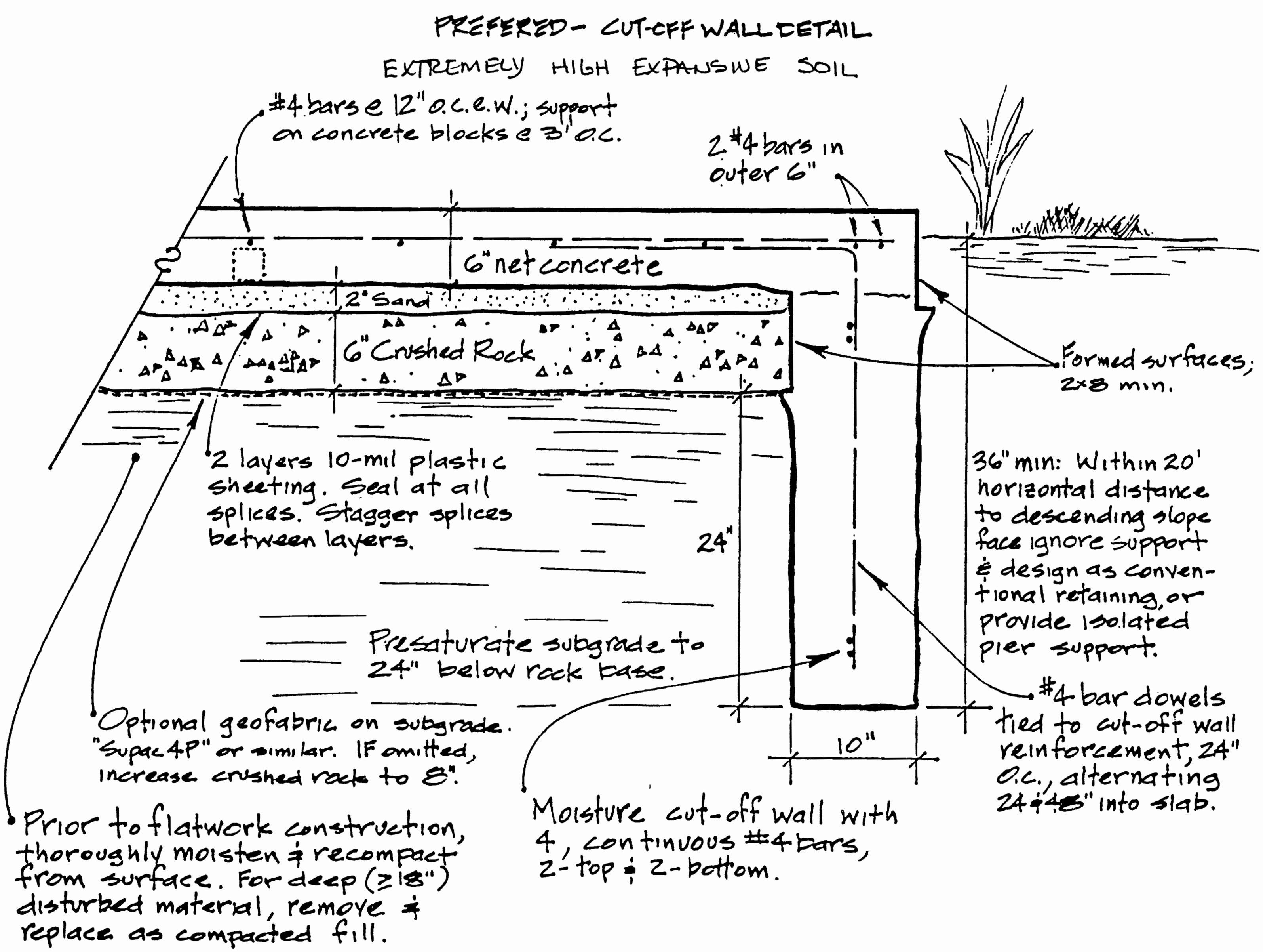
CONCRETE STEPS			
AMERICAN GEOTECHNICAL	F.N. 1987	JAN. 1989	FIGURE 15



EXTREMLY HIGH EXPANSIVITY

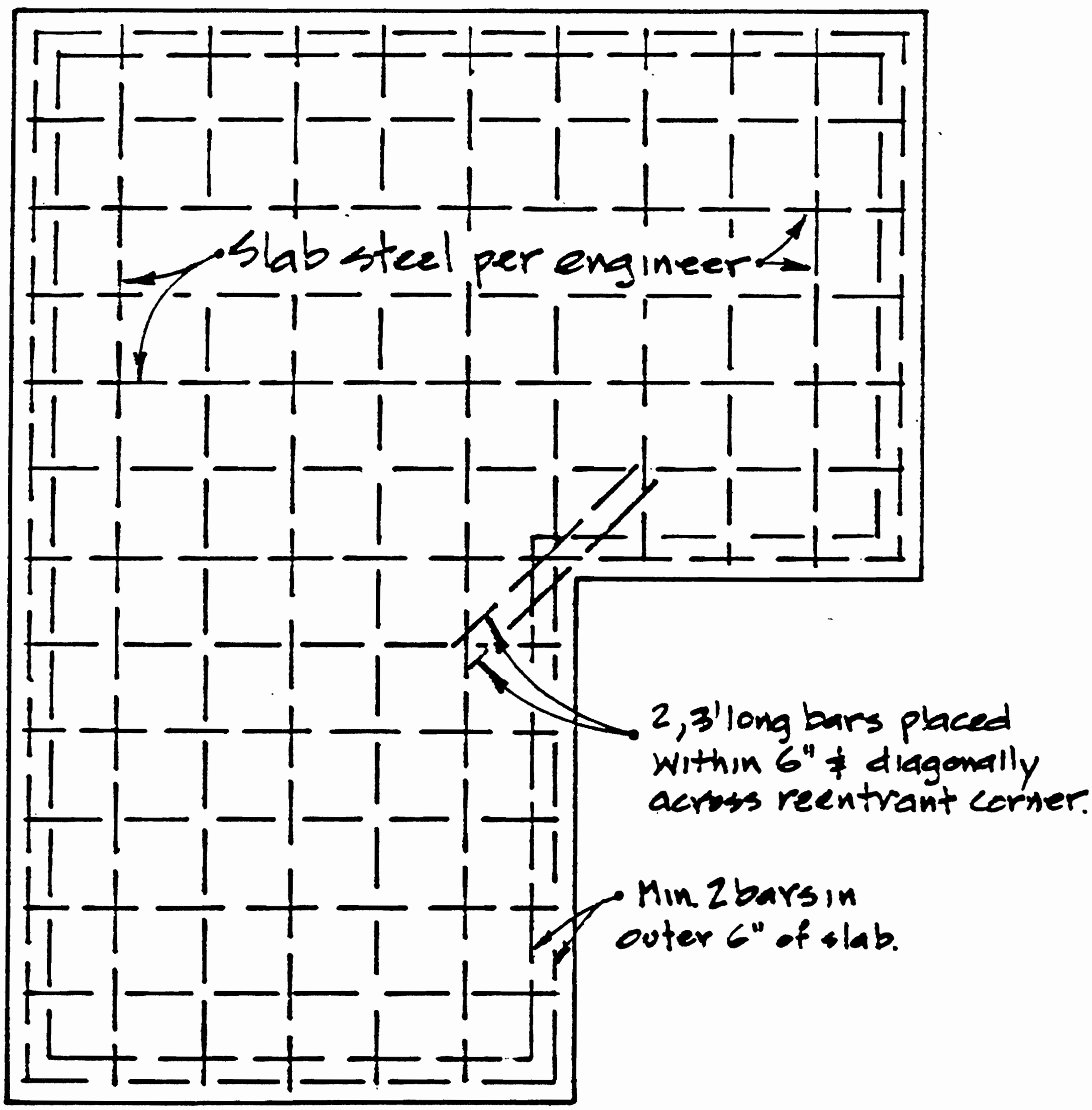
FLATWORK INTERIOR EDGE

AMERICAN GEOTECHNICAL	F.N. 1987	JAN. 1989	FIGURE 16



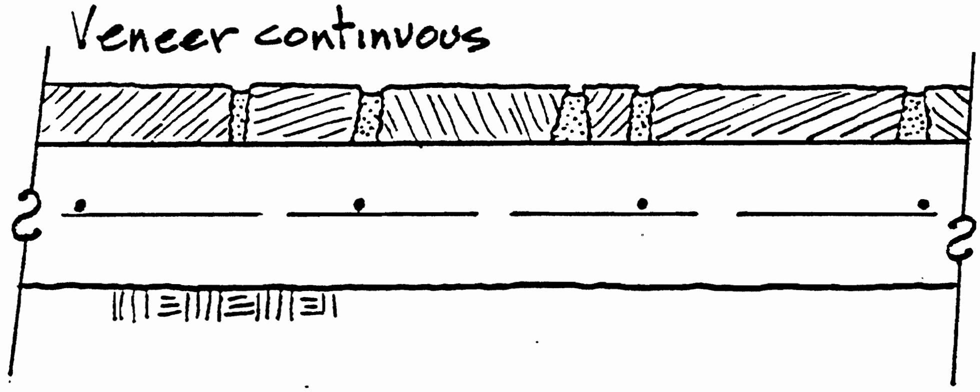
FLATWORK EXTERIOR EDGE

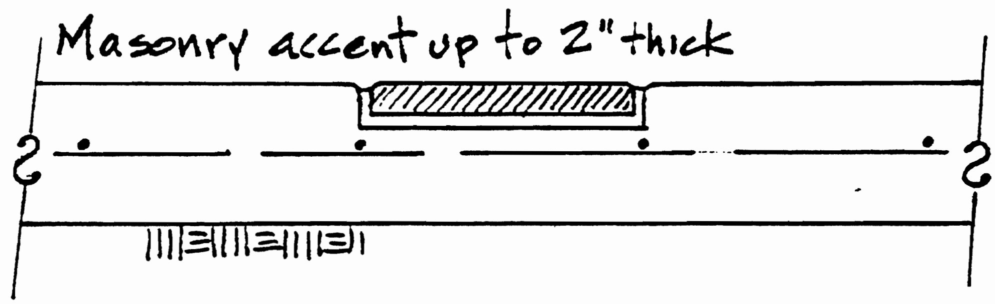
AMERICAN GEOTECHNICAL	F.N. 1987	JAN. 1989	FIGURE 17

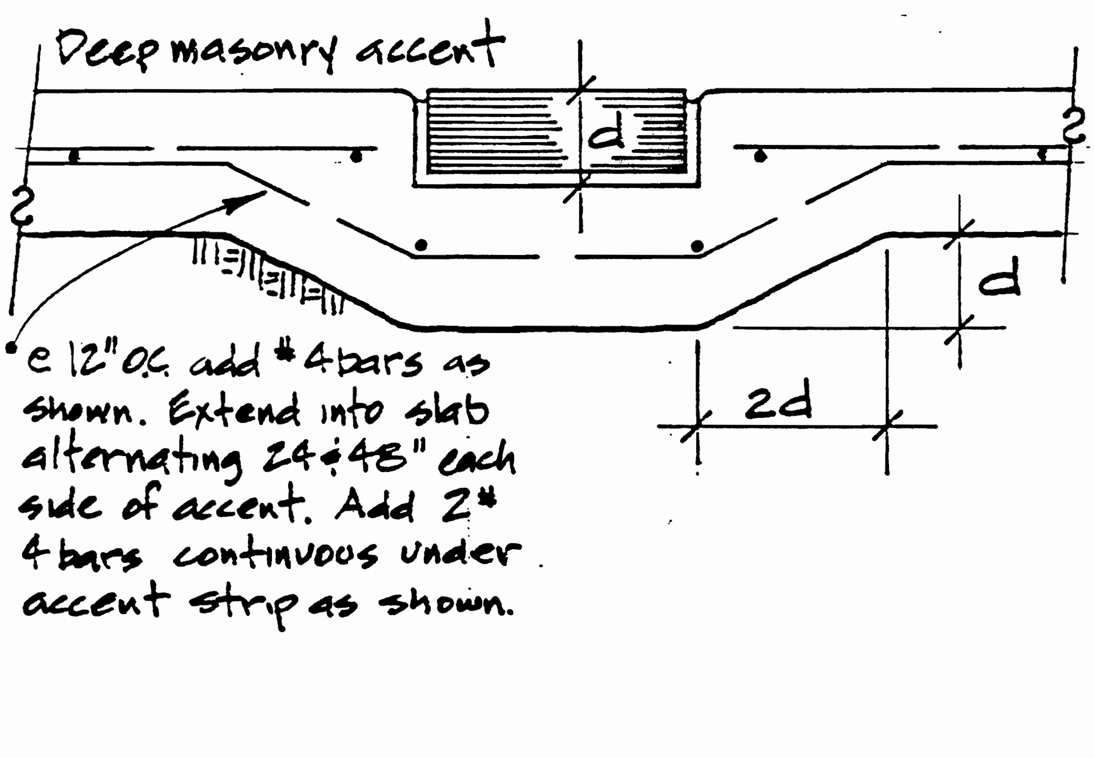


SLAB STEEL PLACEMENT

AMERICAN GEOTECHNICAL	F.N. 1987	JAN. 1989	Figure 18

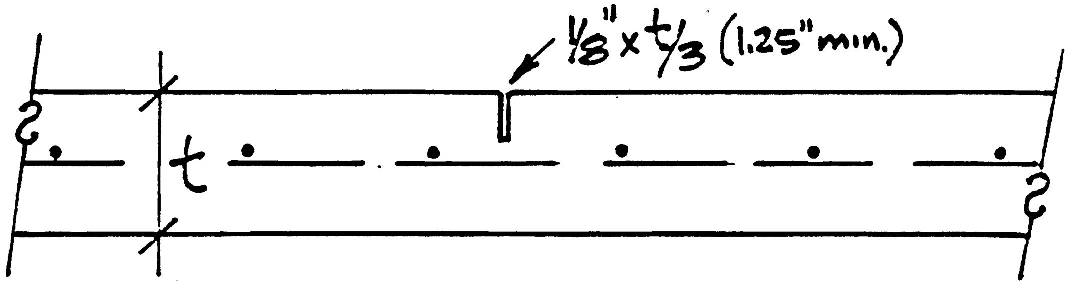






MASONRY VENEER			Figure 19
AMERICAN GEOTECHNICAL	F.N. 1987	JAN. 1989	

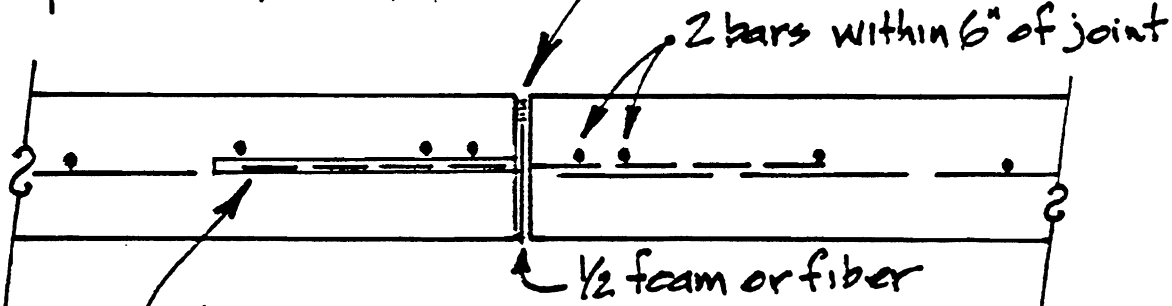
CONTROL JOINT - Space at 1.5 slab width, 12' max.



Sawcut control joint 24-48 hours following initial concrete set.

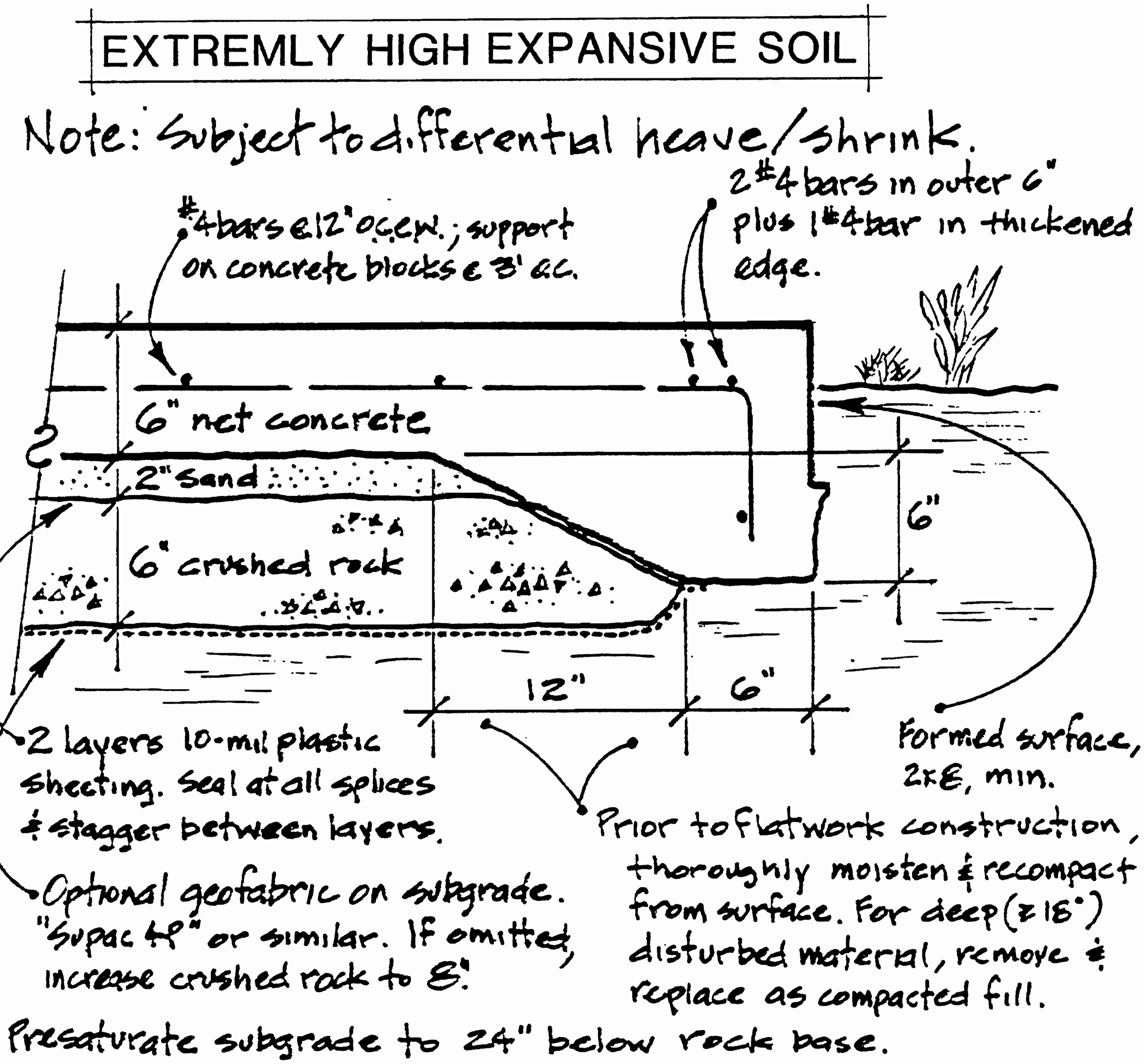
EXPANSION JOINT

Space at 40' max.



#4 bar, 18" each side of joint. On one side encase bar in 20" heavy vinyl sleeve (inexpensive garden hose or similar).

FLATWORK JOINTS			Figure 20
AMERICAN GEOTECHNICAL	F.N. 1987	JAN. 1989	



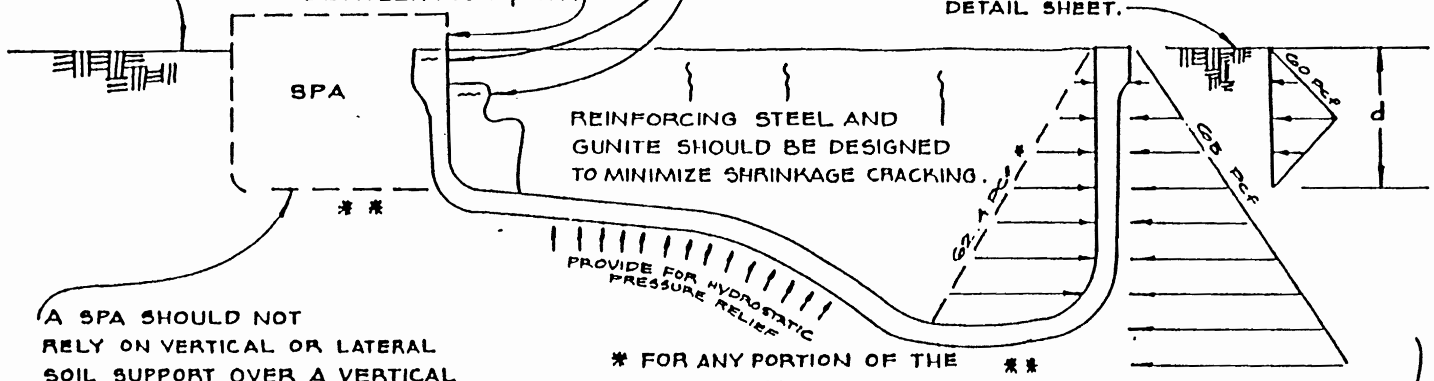
THICKENED EDGE			Figure 21
AMERICAN GEOTECHNICAL	F.N. 1987	JAN. 1989	

DECK DETAILS PER SEPARATE DETAIL SHEET

STRUCTURAL ENGINEER SHOULD DESIGN JOIN BETWEEN POOL & SPA

ADDING MORTAR TOPPING TO LEVEL OR ELEVATE THE POOL BOND BEAM OR STEPS CAN RESULT IN COLD JOINT CRACKS REFLECTING INTO THE PLASTER SURFACE.

DECK DETAIL PER SEPARATE DETAIL SHEET.



A SPA SHOULD NOT RELY ON VERTICAL OR LATERAL SOIL SUPPORT OVER A VERTICAL DISTANCE "d" (BUT NOT LESS THAN 2 FT.) FOR PROPOSED SHALLOWER DEPTHS SUPPORT SHOULD BE DEEPENED OR THE STRUCTURAL ENGINEER SHOULD DESIGN THE SPA TO BE SUPPORTED BY THE POOL SHELL.

* FOR ANY PORTION OF THE POOL SHELL WITHIN A 15 FT. HORIZONTAL DISTANCE TO A DESCENDING SLOPE, THE POOL SHELL DESIGN SHOULD IGNORE SUPPORT BY THE ADJACENT SOIL. FOR EXPANSIVE SOIL, DESIGN ENTIRE SHELL AS FREE STANDING.

** THE ENTIRE POOL BOTTOM AND SPA (WHERE SUPPORT IS RELIED UPON) SHOULD BE EMBEDDED IN THE SAME BEARING MATERIAL, SUCH AS ENTIRELY IN ENGINEERED COMPACTED FILL, FIRM NATURAL SOIL OR BEDROCK.

RECOMMENDED DESIGN CRITERIA FOR EARTH PRESSURE ON EMPTY POOL SHELL. EXPANSIVE SOIL SURCHARGE IS A FUNCTION OF DEPTH "d". *MINIMUM REINFOREMENT SHOULD BE #4 BARS @ 8 INCHES ON CENTER. SEE SECTION 9.3.3*

GUNITE NOTE : OBTAINING GOOD QUALITY GUNITE PLACEMENT IS AN ESSENTIAL COMPONENT OF THE POOL CONSTRUCTION PROCESS. IT IS *REQUIRED* THAT A LICENCED DEPUTY CONCRETE INSPECTOR BE RETAINED FOR THE PURPOSE OF REVIEWING STEEL AND GUNITE PLACEMENT AND APPROPRIATELY SAMPLE AND TEST THE GUNITE FOR CONFORMANCE WITH THE PROJECT SPECIFICATIONS.

POOL DESIGN CRITERIA

AMERICAN GEOTECHNICAL	FILE NO. 1987	JAN. 1989	FIGURE 22

clog. Four inches could be adopted as a minimum. All enclosed planters should be provided with a suitably located drain or drains and/or flooding protection in the form of weep holes or similar. Structures should have roof gutters and downspouts tied directly to the yard drainage system. Typical drainage systems can be designed using criteria in Figure 23, however, the depth of piping should be increased to three feet wherever possible.

9.3.5 **Utilities**

It is not recommended that utilities be planned below a 1:1 projection extending down from the outer edge of foundations. Footings should be deepened to satisfy the foregoing recommendation. Backfilling for all utilities should be placed by mechanical compaction methods. Flooding and/or jetting of utility or other trench backfill should not be undertaken. All utility conduits should be embedded at least three feet below grade unless covered by a concrete slab-on-grade designed in accordance with recommendations previously provided. For cases within slab cover the minimum embedment may be reduced to 12 inches.

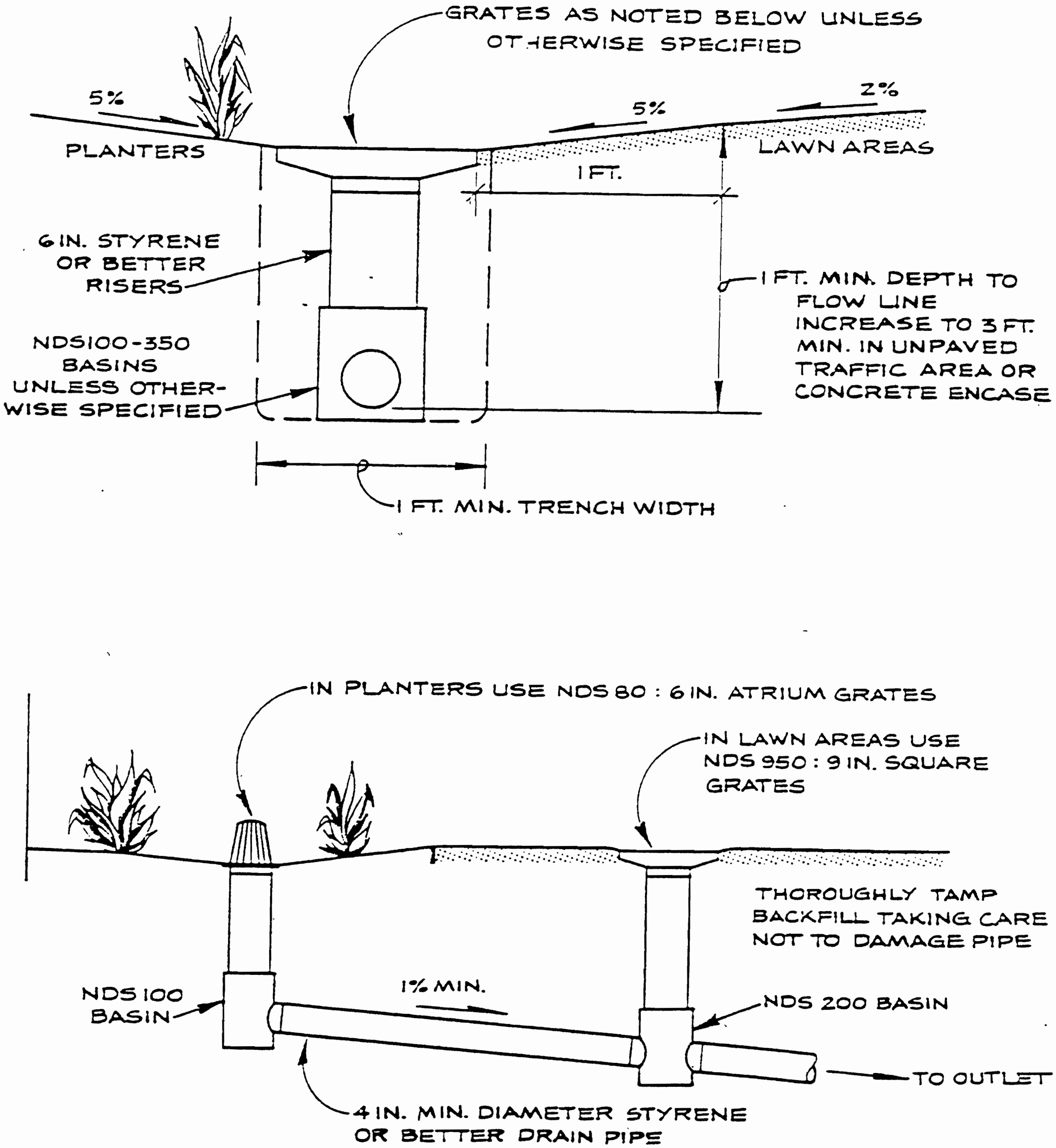
9.3.6 **Maintenance/Performance**

Structures in expansive soil areas tend to perform best when moisture conditions are maintained as close to uniform as possible. The amount of movement from heave to shrink can be reduced by limiting the variation in moisture around isolated individual structures. Since moisture naturally tends to migrate under slab areas, it is desirable to keep the perimeter of structures on the "moist side" without allowing ponding to occur.

Planting even small trees within about ten feet from the house is not recommended because trees usually extract water from the soil. Greater separation is appropriate for larger trees. The task of developing moisture equilibrium can be aided through the use of properly designed, installed, and adjusted automatic irrigation systems. Provisions should be made to interrupt and/or adjust irrigation in response to periods of rainfall.

Adopting the conventional foundation guidelines herein should reduce the risk of expansive soil related problems. Risk can be further lowered by adopting some of the maintenance items suggested herein. Risk could also be lowered through the use of special structurally designed foundation and slab systems.

American Geotechnical
A CALIFORNIA CORPORATION



DRAINAGE TRENCH DETAIL			Figure 23
AMERICAN GEOTECHNICAL	F.N. 1987	JAN. 1989	

10.0 REMARKS

Only a portion of subsurface conditions have been reviewed and evaluated. Conclusions and recommend-ations and other information contained in this report are based upon the assumption that subsurface conditions do not vary appreciably between and adjacent to observation points. Although no significant variation is anticipated, it must be recognized that variations can occur.

This report has been prepared for the sole use and benefit of our client. The intent of the report is to advise our client on geotechnical matters involving the proposed improvements. It should be understood that the geotechnical consulting provided and the contents of this report are not perfect. Any errors or omissions noted by any party reviewing this report, and/or any other geotechnical aspect of the project, should be reported to this office in a timely fashion. The client is the only party intended by this office to directly receive the advice. Subsequent use of this report can only be authorized by the client. Any transferring of information or other directed use by the client should be considered "advice by the client."

Geotechnical engineering is characterized by uncertainty. Geotechnical engineering is often described as an inexact science or art. Conclusions and recommendations presented herein are partly based upon the evaluations of technical information gathered, partly on experience, and partly on professional judgment. The conclusions and recommendations presented should be considered "advice." Other consultants could arrive at different conclusions and recommendations. Typically "minimum" recommendations have been presented. Although some risk will always remain, lower risk of future problems would usually result if more restrictive criteria were adopted. Final decisions on matters presented are the responsibility of the client and/or the governing agencies. No warranties in any respect are made as to the performance of the project.

Observation and testing services during construction only allow for specific evaluation of a small percentage of compacted fill placed at the site. Conditions will vary between points evaluated. Contractual arrangements made with a contractor should contain a provision that he is responsible for excavating, placing, and compacting fill in accordance with the project specifications. Observation and testing by the geotechnical consultant during construction should not relieve the grading contractor of his primary responsibility to perform work in accordance with the specifications.

11.0 CONCLUDING REMARKS

It is important to realize that most of the residences in this study area were constructed in the 1960's. The structures were built to standards in effect at the time of construction. Since that time, more has been learned about expansive soil and methods of construction in an expansive soil environment. If constructed today, foundation systems for these structures would be significantly different from existing foundation systems.

APPENDIX

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October 5, 1989 - REVISED

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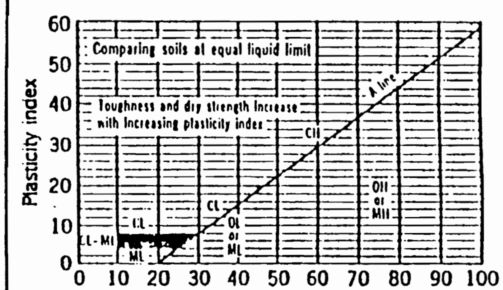
APPENDIX A

Classification and Sampling Techniques

Major divisions			Field Identification Procedures (Excluding particles larger than 3 in. and basing fractions on estimated weights)	Group Symbols a	Typical Names	Information Required for Describing Soils	Laboratory Classification Criteria
Coarse-grained soils More than half of material is *larger* than No. 200 sieve size b (The No. 200 sieve size is about the smallest particle visible to naked eye)	Gravels More than half of coarse fraction is larger than No. 4 sieve size (For visual classification, the ¼ in. size may be used as equivalent to the No. 4 sieve size)	Clean gravels (little or no fines)	Wide range in grain size and substantial amounts of all intermediate particle sizes	*GW*	Well graded gravels, gravel-sand mixtures, little or no fines	Give typical name; indicate approximate percentages of sand and gravel; maximum size; angularity, surface condition, and hardness of the coarse grains; local or geologic name and other pertinent descriptive information; and symbols in parentheses	Use grain size curve in identifying the fractions as given under field identification. Determine percentages of gravel and sand 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% *GW, GP, SW, SP*; More than 12% *GM, GC, SM, SC*; 5% to 12% *Borderline* cases requiring use of dual symbols. — $C_U = \frac{D_{60}}{D_{10}}$ Greater than 4; $C_C = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ Between 1 and 3
			Predominantly one size or a range of sizes with some intermediate sizes missing	*GP*	Poorly graded gravels, gravel-sand mixtures, little or no fines		Not meeting all gradation requirements for *GW*
		Gravels with fines (appreciable amount of fines)	Nonplastic fines (for identification procedures see *ML* below)	*GM*	Silty gravels, poorly graded gravel-sand-silt mixtures		Atterberg limits below "A" line, or *PI* less than 4 — Above "A" line with *PI* between 4 and 7 are *borderline* cases requiring use of dual symbols
			Plastic fines (for identification procedures, see *CL* below)	*GC*	Clayey gravels, poorly graded gravel-sand-clay mixtures	For undisturbed soils add information on stratification, degree of compactness, cementation, moisture conditions and drainage characteristics	Atterberg limits above "A" line, with *PI* greater than 7
	Sands More than half of coarse fraction is smaller than No. 4 sieve size	Clean sands (little or no fines)	Wide range in grain sizes and substantial amounts of all intermediate particle sizes	*SW*	Well graded sands, gravelly sands, little or no fines	Example: *Silty sand, gravelly;* about 20% hard, angular gravel particles ½-in. maximum size; rounded and subangular sand grains coarse to fine, about 15% non-plastic fines with low dry strength; well compacted and moist in place; alluvial sand; *(SM)*	$C_U = \frac{D_{60}}{D_{10}}$ Greater than 6; $C_C = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ Between 1 and 3
			Predominantly one size or a range of sizes with some intermediate sizes missing	*SP*	Poorly graded sands, gravelly sands, little or no fines		Not meeting all gradation requirements for *SW*
		Sands with fines (appreciable amount of fines)	Nonplastic fines (for identification procedures, see *ML* below)	*SM*	Silty sands, poorly graded sand-silt mixtures		Atterberg limits below "A" line or *PI* less than 5 — Above "A" line with *PI* between 4 and 7 are *borderline* cases requiring use of dual symbols
			Plastic fines (for identification procedures, see *CL* below)	*SC*	Clayey sands, poorly graded sand-clay mixtures		Atterberg limits below "A" line with *PI* greater than 7

Major divisions		Identification Procedures on Fraction Smaller than No. 40 Sieve Size: Dry Strength (crushing characteristics)	Dilatancy (reaction to shaking)	Toughness (consistency near plastic limit)	Group Symbols	Typical Names	Information Required for Describing Soils
Fine-grained soils More than half of material is *smaller* than No. 200 sieve size (The No. 200 sieve size is about the smallest particle visible to naked eye)	Silts and clays liquid limit less than 50	None to slight	Quick to slow	None	*ML*	Inorganic silts and very fine sands, rock flour, silty or clayey fine sands with slight plasticity	Give typical name; indicate degree and character of plasticity, amount and maximum size of coarse grains; colour in wet condition, odour if any, local or geologic name, and other pertinent descriptive information, and symbol in parentheses
		Medium to high	None to very slow	Medium	*CL*	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays	
		Slight to medium	Slow	Slight	*OL*	Organic silts and organic silt-clays of low plasticity	For undisturbed soils add information on structure, stratification, consistency in undisturbed and remoulded states, moisture and drainage conditions
	Silts and clays liquid limit greater than 50	Slight to medium	Slow to none	Slight to medium	*MH*	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts	
		High to very high	None	High	*CH*	Inorganic clays of high plasticity, fat clays	Example: *Clayey silt,* brown; slightly plastic; small percentage of fine sand; numerous vertical root holes; firm and dry in place; loess; *(ML)*
		Medium to high	None to very slow	Slight to medium	*OH*	Organic clays of medium to high plasticity	
Highly Organic Soils		Readily identified by colour, odour, spongy feel and frequently by fibrous texture			*Pt*	Peat and other highly organic soils	



Plasticity chart for laboratory classification of fine grained soils

KEY TO UNIFIED SOIL CLASSIFICATION SYSTEM ASTM D-2487

AMERICAN GEOTECHNICAL	F.N. 1987	JAN. 1989	TABLE A1

APPENDIX A: CLASSIFICATION AND SAMPLING TECHNIQUES

A.1 CLASSIFICATION

In the field, materials encountered are classified by visual and tactile methods. Typically textural classifications have been recorded followed by notations of colors, moisture, and tightness. Based on these field observations, Unified Soil Classification System symbols are assigned. A chart describing the U.S.C.S. method of classification is presented as Plate A1. Where appropriate, other comments have also been provided such as porosity, presence of gravel, cobbles, and/or boulders, vegetation, debris, etc. Where encountered, structural features such as bedrock bedding planes, fractures, joints, faults, and contacts are also mapped and recorded in the logs.

A.2 FIELD SAMPLING AND TESTING

During field exploration, various sampling and field testing techniques may be employed. The most frequently employed procedures are briefly described below.

A.2.1 Bulk Sampling

Bulk sampling is the simplest form of sampling ordinarily conducted. Bulk samples are typically recovered by careful hand selection and/or simple shoveling from the excavation cuttings. Specially selected samples are recovered and identified by test excavation number and depth, such as B-1 at two feet. Samples recovered by shoveling from the excavation cuttings are identified by test excavation number and depth range, such as B-1 at four to six feet. Bulk samples recovered are placed in heavy plastic bags which are tied off to minimize moisture loss during transport to the laboratory.

A.2.2 Relatively Undisturbed Samples

Relatively undisturbed samples are recovered by pushing and/or driving one of two types of ring-lined sampling barrels into materials in place below the test excavation. In relatively fine-grained soil which is essentially non-cemented and free of debris, a thin-walled sampling barrel is utilized. For other soil and soft rock types, a heavy-duty "California Barrel" is used. These samples are described in more detail below. Samples recovered in the fashions described below are sealed in moisture-resistant protective plastic containers in order to minimize moisture loss and disturbance during transport to the laboratory.

A.2.2a Thin-Wall Sampler ("T" Sample): The standard American Geotechnical thin-wall sampler is ring-lined and when assembled measures three inches, outside diameter (Do) 2.5 inches, inside diameter (Di). At the sampler tip, one percent relief is provided per ASTM Standard D1587 for acceptable clearance ratio. The rings which line the solid barrel sampler measure 2.50 inside diameter and 2.675 outside diameter. The rings are each one inch in height. The sampler is equipped at the driving head adaptor with a one inch diameter stainless steel ball-check pressure relief.

The thin-wall sampler can be advanced below the test excavation by either a hand-driven, approximately 40 pounds slide hammer or by driving using the drill rig equipment. For a bucket-auger type drill rig, the sampler is adapted to the drill rig "Kelly bar" by a device known as a driving jar. The sampler is advanced by pushing with the weight of the Kelly bar and/or by successive blows by dropping the Kelly bar over a distance of 12 inches. For most rotary wash and hollow-stem type drill rigs, the sampler is advanced by successive blows by an above-grade, 140 pound hammer falling 30 inches. Usually driving resistance is noted by recording the number of blows or by the driving energy which is the product of the driving weight, height of drop, and number of blows.

A.2.2b California Barrel ("R" Sample): The American Geotechnical, California-style sampling barrel, is a split-tube barrel lined with 2.50 inch inside diameter, 2.75 inch outside diameter brass rings, each one inch in height. The outside diameter of the barrel is 3.25 inches, but at the hardened, screw-on sampler tip the outside diameter increases to 3.50 inches. This sampling barrel is coupled with a driving jar and is advanced by pushing and/or driving with the drill rig Kelly bar. In the same fashion as was described for the thin-wall sampler, the sampler is driven a distance of 12 inches by successive drops of the Kelly bar falling 12 inches. Driving resistance is recorded in the fashion described for the thin-wall sampler.

A.2.3 Undisturbed Samples

Although it is technically not possible to recover absolutely undisturbed samples, American Geotechnical used two sampling techniques to recover the "most" undisturbed samples. These techniques are described below.

A.2.3a Shelby Tube Sampler ("U" Sample): The Shelby tube sampler is described by ASTM Standard Method D1587-74 for thin-walled tube sampling of soil. The standard specifies the acceptable range of clearance ratio, 100(Di-De)/De, of between 0.5 and 3 percent. The American Geotechnical Shelby tube clearance ratio is one percent. Actual dimensions of the American Geotechnical Shelby tube are: outside diameter, Do = 2.625 inches; inside diameter, Di = 2.500 inches, and tip cutting diameter, De = 2.475 inches. The area ratio, $100(Do^2-Di^2/Di^2)$, for the American Geotechnical sampler is ten percent, which is consistent with generally accepted criteria for undisturbed sampling.

The Shelby tube sampler is advanced below a test excavation in the same fashion as described for the thin-wall sampler (T-sample).

A.2.3b Chunk Samples ("C" Sample): Chunk samples are usually recovered in cases not suitable for the recovery of driven samples. Hard rock samples are commonly recovered as chunk samples from outcrops or from boring cuttings. Chunk samples are also hand-carved from soil possessing at least a trace of cohesion or cementation. Samples are paraffin covered and/or otherwise packaged and transported to the laboratory in a fashion which results in minimum disturbance.

A.3 FIELD DENSITY TESTING

During placement of compacted fill in a grading operation, dry unit weight of soil is determined in the field in order to ascertain whether the specified compaction is being achieved. American Geotechnical commonly uses two of these methods during other forms of investigation. These methods, the sand-cone method and the drive-cylinder method, are briefly described below.

A.3.1 Sand-Cone Method ("S" Test)

This method of test is described by ASTM Standard Method D1556. The procedure involves making a small circular excavation to remove soil and rock materials to a depth about equal to the diameter of the excavation. Although the standard test uses a six-inch diameter excavation, the actual test excavation size commonly varies from about four to 12 inches. The soil recovered is either weighed in the field and moisture content determined, or the sample is placed in a moisture-resistant, plastic bulk bag and transported to the laboratory. Clean, calibrated, silica sand is poured into the excavation through a calibrated, inverted funnel, the "sand-cone". The amount of soil actually filling the excavation is determined by sample before and after weighing. The volume of the excavation is then calculated based on the predetermined falling unit weight of the sand. Finally, dry unit weight of the in-place soil is calculated by dividing the weight of soil excavated by the sand volume.

A.3.2 Drive-Cylinder Method ("D" Test)

This test is described by ASTM Standard Method D2937. The test procedure involves driving an approximately 1/100 cubic foot, three-inch diameter, steel drive tube into the soil. A slide hammer weighing about ten pounds is used to drive the steel tube. After driving, the tube is excavated with "full" ends which are subsequently trimmed square in order to bring the soil sample down to the known volume. Finally, the soil is weighed and the dry unit weight calculated by dividing the soil weight by the tube volume.

File No. 1987
January 25, 1989
October 5, 1989 - REVISED

American Geotechnical
A CALIFORNIA CORPORATION

APPENDIX B

Test Excavation Logs

MAJOR DIVISIONS				TYPICAL NAMES
COARSE GRAINED SOILS MORE THAN HALF IS LARGER THAN NO 200 SIEVE	GRAVELS MORE THAN HALF COARSE FRACTION IS LARGER THAN No 4 SIEVE SIZE	CLEAN GRAVELS WITH LITTLE OR NO FINES	GW	WELL GRADED GRAVELS. GRAVEL-SAND MIXTURES
			GP	POORLY GRADED GRAVELS GRAVEL SAND MIXTURES
		GRAVELS WITH OVER 12% FINES	GM	SILTY GRAVELS. POORLY GRADED GRAVEL-SAND - SILT MIXTURES
			GC	CLAYEY GRAVELS POORLY GRADED GRAVEL SAND - CLAY MIXTURES
	SANDS MORE THAN HALF COARSE FRACTION IS SMALLER THAN NO 4 SIEVE SIZE	CLEAN SANDS WITH LITTLE OR NO FINES	SW	WELL GRADED SANDS. GRAVELLY SANDS
			SP	POORLY GRADED SANDS. GRAVELLY SANDS
		SANDS WITH OVER 12% FINES	SM	SILTY SANDS. POORLY GRADED SAND SILT MIXTURES
			SC	CLAYEY SANDS. POORLY GRADED SAND CLAY MIXTURES
FINE GRAINED SOILS MORE THAN HALF IS SMALLER THAN NO 200 SIEVE	SILTS AND CLAYS LIQUID LIMIT LESS THAN 50		ML	INORGANIC SILTS AND VERY FINE SANDS ROCK FLOUR SILTY OR CLAYEY FINE SANDS. OR CLAYEY SILTS WITH SLIGHT PLASTICITY
			CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY GRAVELLY CLAYS. SANDY CLAYS. SILTY CLAYS. LEAN CLAYS
			OL	ORGANIC CLAYS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY
	SILTS AND CLAYS LIQUID LIMIT GREATER THAN 50		MH	INORGANIC SILTS. MICACEOUS OR DIATOMACIOUS FINE SANDY OR SILTY SOILS. ELASTIC SILTS
			CH	INORGANIC CLAYS OF HIGH PLASTICITY FAT CLAYS
			OH	ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY ORGANIC SILTS
HIGHLY ORGANIC SOILS			Pt	PEAT AND OTHER HIGHLY ORGANIC SOILS

UNIFIED SOIL CLASSIFICATION SYSTEM

LL —— Liquid Limit (%)
PL —— Plastic Limit (%)
PI —— Plasticity Index
PP 200 —— Percent Passing # 200 Sieve

EI —— Expansion Index
Swell —— Saturated Swell
Shear —— Direct Shear
Consol —— Consolidation

KEY TO LABORATORY TEST

Note: Appencix C contains complete description of each test

SOIL CLASSIFICATION CHART & KEY TO LABORATORY TESTS			Table B1
AMERICAN GEOTECHNICAL	F.N. 1987	JAN. 1989	

TEST EXCAVATION LOG No. B-1

F.N. 1987

Project/Client: Expansive Soil Study/City of Torrance

Sheet: 1 of 2

Location: 23800 Block of Audrey, Torrance, California

Start: 1 SEP 88

Estimated Surface Elevation: '± Total Depth: 30.5' Rig Type: 8" Hollow Stem Auger

End: 1 SEP 88

Field Description By: TS

Surface Conditions: **Asphalt Concrete**

Subsurface Conditions: **FORMATION: Classification, color, moisture, tightness, etc.**

Depth-Feet	Sample Type (RING/BULK)	Blow Counts Blows/Foot	Dry Unit Weight Pcf	Moisture Content %	Laboratory Tests	USCS Symbol	Depth	Field Description
0							1.00	Asphalt Concrete 2 inches, Base 10 inches.
						CH		Silty Clay, Brown, moist, stiff, plastic.
	RING	58	101	15	Swell LL=38 PI=19 PP200 =49			
5								
	RING	44	92	29	Shear Swell		8.00	
						SC		Clayey Sand, brown, moist, dense, with subangular to rounded pebble to small cobble-size rock.
	RING	69	101	25	PP200 =14			
10								
15	RING	45	112	17	Consol			

NOTES: Total depth at 30.5 feet. No groundwater encountered during drilling. No caving during drilling.

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Plate B-1

TEST EXCAVATION LOG No. B-1

F.N. 1987

Project/Client: Expansive Soil Study/City of Torrance

Sheet: 2 of 2

Field Description

By: TS

Surface Conditions:

Asphalt Concrete

Subsurface Conditions: FORMATION: Classification, color, moisture, tightness, etc.

Depth-Feet	Sample Type: RING	Sample Type: BULK	Blow Counts Blows/Foot	Dry Unit Weight pcf	Moisture Content %	Laboratory Tests	USCS Symbol	Graphic Log	Description
20									
25									
29	■		49	96	27				
30									30.50
35									
40									

TEST EXCAVATION LOG No. B-2

F.N. 1987

Project/Client: Expansive Soil Study/City of Torrance

Sheet: 1 of 2

Location: Las Cadones near 238th Street, Torrance, California

Start: 1 SEP 88

Estimated Surface Elevation: '± Total Depth: 30.0' Rig Type: 8" Hollow Stem Auger

End: 1 SEP 88

Field Description

By: TS

Surface Conditions: Asphalt Concrete

Subsurface Conditions: **FORMATION: Classification, color, moisture, tightness, etc.**

Depth-Feet	Sample Type (RING / BULK)	Blow Counts Blows/Foot	Dry Unit Weight Pcf	Moisture Content %	Laboratory Tests	USCS Symbol	Description
0							Asphalt Concrete 2 inches, Base 10 inches.
1.00						CH	Silty Clay, dark gray, moist, stiff, plastic.
	RING	51	110	12	Swell Shear EI=132		Becomes brown with numerous 1/4" to 3" subangular to subrounded rock fragments to 6 feet.
5							
	RING	46	96	27	Swell LL=57 PI=34 PP200 =80		
9.00	RING	62	108	16	PP200 =23	SC	Clayey fine to medium sand, light brown, moist, dense.
10							
	RING	48	102	22			
15							
	RING	82	107	8	PP200 =37		

NOTES: Total depth at 30 feet. No groundwater encountered during drilling. No caving during drilling.

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Plate B-2

TEST EXCAVATION LOG No. B-2

F.N. 1987

Project/Client: Expansive Soil Study/City of Torrance

Sheet: 2 of 2

Depth-Feet	Sample Type: RING	Sample Type: BULK	Blow Counts Blows/Foot	Dry Unit Weight pcf	Moisture Content %	Laboratory Tests	USCS Symbol	Graphic Log	Field Description (By: TS)
									Surface Conditions: Asphalt Concrete
									Subsurface Conditions: FORMATION: Classification, color, moisture, tightness, etc.
20									
25									
	■		69	89	11				
30									30.00
35									
40									

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Plate B-2 (Cont.)

TEST EXCAVATION LOG No. B-3

F.N. 1987

Project/Client: Expansive Soil Study/City of Torrance

Sheet: 1 of 2

Location: Ocean Avenue at Pacific Coast Highway, Torrance, California

Start: 1 SEP 88

Estimated Surface Elevation: '± Total Depth: 30.5' Rig Type: 8" Hollow Stem Auger

End: 1 SEP 88

Field Description

By: TS

Surface Conditions: Asphalt Concrete

Subsurface Conditions: **FORMATION: Classification, color, moisture, tightness, etc.**

Depth-Feet	Sample Type (RING/BULK)	Blow Counts Blows/Foot	Dry Unit Weight Pcf	Moisture Content %	Laboratory Tests	USCS Symbol	Field Description
0							Asphalt Concrete 2 inches, Base 10 inches. (1.00)
	RING	36	108	16	Swell LL=39 PI=21	CH	Silty Clay, dark gray, moist, stiff.
							Becomes light brown.
5	RING	62	114	6	Swell PP200 =18		
							Becomes very sandy with numerous subangular to rounded rock fragments to 11 feet.
	RING	56	107	9	Shear PP200 =9		
10							
	RING	57	95	24			
15							
							Becomes very sandy to 19 feet.

NOTES: Total depth at 30.5 feet. No groundwater encountered during drilling. No caving during drilling.

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Plate B-3

TEST EXCAVATION LOG No. B-3

F.N. 1987

Project/Client: Expansive Soil Study/City of Torrance

Sheet: 2 of 2

Field Description By: TS

Surface Conditions: Asphalt Concrete

Subsurface Conditions: FORMATION: Classification, color, moisture, tightness, etc.

Depth-Feet	Sample Type (RING / BULK)	Blow Counts Blows/Foot	Dry Unit Weight pcf	Moisture Content %	Laboratory Tests	USCS Symbol	Graphic Log	Field Description
20	RING	20	85	36				
25								
	RING	77	98	7				29.50
30						SM		30.50 Becomes Silty Fine Sand, light brown, moist, dense.
35								
40								

TEST EXCAVATION LOG No. B-4

F.N. 1987

Project/Client: Expansive Soil Study/City of Torrance — Sheet: 1 of 2

Location: Off of Ocean Avenue near 238th Street, Torrance, California — Start: 2 SEP 88

Estimated Surface Elevation: '± Total Depth: 29.5' Rig Type: 8" Hollow Stem Auger — End: 2 SEP 88

Field Description By: TS

Surface Conditions: **Undeveloped Park Area**

Subsurface Conditions: **FORMATION: Classification, color, moisture, tightness, etc.**

Depth-Feet	Sample Type (RING/BULK)	Blow Counts Blows/Foot	Dry Unit Weight Pcf	Moisture Content %	Laboratory Tests	USCS Symbol	Field Description
0						CH	
1							Silty Clay, dark gray, dry, stiff.
2.5	RING	63	103	19	EI=168 Swell LL=56 PI=34 PP200 =68		
4							4 to 7 feet becomes gray-brown, sandy clay, moist, hard.
5	RING	86	111	13	Swell LL=28 PI=11 PP200 =28		
7							Color changes to gray.
8	RING	60	99	23	Shear LL=59 PI=37 PP200 =82		
14	RING	49	92	28			
18							Becomes very sandy to 23 feet.
19	RING	86	84	10	PP200 =34		

NOTES: Total depth at 29.5 feet. No groundwater encountered during drilling. No caving during drilling.

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Plate B-4

TEST EXCAVATION LOG No. B-4

F.N. 1987

Project/Client: Expansive Soil Study/City of Torrance

Sheet: 2 of 2

Field Description By: TS

Surface Conditions: Undeveloped Park Area

Subsurface Conditions: FORMATION: Classification, color, moisture, tightness, etc.

Depth-Feet	Sample Type (RING / BULK)	Blow Counts Blows/Foot	Dry Unit Weight pcf	Moisture Content %	Laboratory Tests	USCS Symbol	Graphic Log	Description
20	RING							
27.00						SC		Silty Sand, brown, moist, very stiff-hard.
29.50	RING	69	100	9				

Depth scale: 20, 25, 30, 35, 40

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Plate B-4 (Cont.)

TEST EXCAVATION LOG No. B-5

F.N. 1987

Project/Client: Expansive Soil Study/City of Torrance

Sheet: 1 of 2

Location: 23500 block of Adolph Avenue, Torrance, California

Start: 2 SEP 88

Estimated Surface Elevation: '± Total Depth: 30.5' Rig Type: 8" Hollow Stem Auger

End: 2 SEP 88

Field Description By: TS

Surface Conditions: Asphalt Concrete

Subsurface Conditions: **FORMATION: Classification, color, moisture, tightness, etc.**

Depth-Feet	Sample Type (RING/BULK)	Blow Counts Blows/Foot	Dry Unit Weight Pcf	Moisture Content %	Laboratory Tests	USCS Symbol	Field Description
0							Asphalt Concrete 2 inches, Base 10 inches.
1.00						CH	Silty Clay, dark gray, moist to very moist, firm.
	RING	20	81	39	EI=222 Swell LL=77 PI=51 PP200 =85		
5							
	RING	18	81	39	Shear Swell		
10	RING	22	65	38	LL=89 PI=57 PP200 =91		
	RING	44	86	33			
15							

NOTES: Total depth at 30.5 feet. No groundwater encountered during drilling. No caving during drilling.

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Plate B-5

TEST EXCAVATION LOG No. B-5

F.N. 1987

Project/Client: Expansive Soil Study/City of Torrance

Sheet: 2 of 2

Field Description By: TS

Surface Conditions: Asphalt Concrete

Subsurface Conditions: FORMATION: Classification, color, moisture, tightness, etc.

Depth-Feet	Sample Type RING	Sample Type BULK	Blow Counts Blows/Foot	Dry Unit Weight pcf	Moisture Content %	Laboratory Tests	USCS Symbol	Depth	Field Description
20	■		56	94	29	LL=66 PI=45 PP200 =77			
25									25 to 27 feet becomes very sandy.
	■		51	101	14		SC	29.00	Becomes Clayey Sand, orange brown, moist, firm.
30								30.50	
35									
40									

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Plate B-5 (Cont.)

TEST EXCAVATION LOG No. B-6

F.N. 1987

Project/Client: Expansive Soil Study/City of Torrance

Sheet: 1 of 2

Location: 4000 block of 232nd Street, Torrance, California

Start: 2 SEP 88

Estimated Surface Elevation: '± Total Depth: 30.5' Rig Type: 8" Hollow Stem Auger

End: 2 SEP 88

Field Description By: TS

Surface Conditions: **Asphalt Concrete**

Subsurface Conditions: **FORMATION: Classification, color, moisture, tightness, etc.**

Depth-Feet	Sample Type (Ring)	Blow Counts Blows/Foot	Dry Unit Weight Pcf	Moisture Content %	Laboratory Tests	USCS Symbol	Field Description
0							Asphalt Concrete 2 inches, Base 10 inches.
1.00						CH	Silty Clay, dark gray, moist, stiff.
2	Ring	34	82	36	EI=244 Swell LL=75 PI=50 PP200 =92		
5	Ring	26	83	35	Shear Swell		
9	Ring	63	95	26	Consol LL=72 PI-47 PP200 =79		
11.00						CH	Sandy Clay, orange brown, moist.
15	Ring	85	118	11			

NOTES: Total depth at 30.5 feet. No groundwater encountered during drilling. No caving during drilling.

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Plate B-6

TEST EXCAVATION LOG No. B-6

F.N. 1987

Project/Client: Expansive Soil Study/City of Torrance

Sheet: 2 of 2

Field Description By: TS

Surface Conditions: Asphalt Concrete

Subsurface Conditions: FORMATION: Classification, color, moisture, tightness, etc.

Depth-Feet	Sample Type: RING	Sample Type: BULK	Blow Counts Blows/Foot	Dry Unit Weight pcf	Moisture Content %	Laboratory Tests	USCS Symbol	Field Description
20	■		53	102	16			22.00
22.00–30.50							SC	Clayey Medium Sand, orange brown, moist, dense to very dense.
29	■		60					30.50

Depth scale: 20, 25, 30, 35, 40

TEST EXCAVATION LOG No. B-7

F.N. 1987

Project/Client: Expansive Soil Study/City of Torrance

Sheet: 1 of 2

Location: Alley south of 234th Street west of Anza, Torrance, California

Start: 2 SEP 88

Estimated Surface Elevation: '± Total Depth: 30.5' Rig Type: 8" Hollow Stem Auger

End: 2 SEP 88

Field Description

By: TS

Surface Conditions: Asphalt Alleyway

Subsurface Conditions: FORMATION: Classification, color, moisture, tightness, etc.

Depth-Feet	Sample Type (RING/BULK)	Blow Counts Blows/Foot	Dry Unit Weight Pcf	Moisture Content %	Laboratory Tests	USCS Symbol	Field Description
0.30						CH	Asphalt Concrete 3 inches, Base 1 inch.
							Silty Clay, dark gray, moist, firm to stiff.
	RING	18	83	36	EI=313 Swell LL=92 PI=67		Becomes light gray
	RING	25	82	38	Swell LL=90 PI=60 PP200 =85		
10	RING	46	91	32			
							Becomes gray-brown, hard, slightly plastic to plastic.
	RING	84	115	14			
15.00						SC	Clayey fine to medium Sand, orange-brown, moist, stiff.
	RING	46					

NOTES: Total depth at 30.5 feet. No groundwater encountered during drilling. No caving during drilling

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Plate B-7

TEST EXCAVATION LOG No. B-7

F.N. 1987

Project/Client: Expansive Soil Study/City of Torrance

Sheet: 2 of 2

Depth-Feet	Sample Type RING	Sample Type BULK	Blow Counts Blows/Foot	Dry Unit Weight pcf	Moisture Content %	Laboratory Tests	USCS Symbol	Graphic Log	Field Description By: TS
									Surface Conditions: Asphalt Alleyway
									Subsurface Conditions: FORMATION: Classification, color, moisture, tightness, etc.
20	■							▨	
25								▨	
								▨	Becomes more clayey.
	■		45					▨	
30	■							▨	30.50
35									
40									

TEST EXCAVATION LOG No. B-8

F.N. 1987

Project/Client: Expansive Soil Study/City of Torrance

Sheet: 1 of 2

Location: 23300 block of Carlow Road, Torrance, California

Start: 6 SEP 88

Estimated Surface Elevation: '± Total Depth: 30.5' Rig Type: 8" Hollow Stem Auger

End: 6 SEP 88

Field Description By: TS

Surface Conditions: **Asphalt Concrete**

Subsurface Conditions: **FORMATION: Classification, color, moisture, tightness, etc.**

Depth-Feet	Sample Type (RING/BULK)	Blow Counts Blows/Foot	Dry Unit Weight Pcf	Moisture Content %	Laboratory Tests	USCS Symbol	Description
0							Asphalt Concrete 2 inches, Base 10 inches.
1.00						CH	Silty Clay, dark gray, moist, stiff to very stiff.
	RING	23	84	36	Swell LL=79 PI=57 PP200 =83		
5							Becomes light gray.
	RING	28	82	34	Shear		
10	RING	38	87	34	Swell LL=84 PI=57 PP200 =82		
							Becomes sandier, color changes to orange-brown.
15	RING	71	111	13	PP200 =31		

NOTES: Total depth at 30.5 feet. No groundwater encountered during drilling. No caving during drilling.

TEST EXCAVATION LOG No. B-8

F.N. 1987

Project/Client: Expansive Soil Study/City of Torrance

Sheet: 2 of 2

Depth-Feet	Sample Type: RING	Sample Type: BULK	Blow Counts Blows/Foot	Dry Unit Weight pcf	Moisture Content %	Laboratory Tests	USCS Symbol	Graphic Log	Field Description (By: TS)
									Surface Conditions: Asphalt Concrete
									Subsurface Conditions: FORMATION: Classification, color, moisture, tightness, etc.
20	■		65	115	15				
25									Sand, light brown, moist, dense.
	■		38						
30									30.50
35									
40									

TEST EXCAVATION LOG No. B-9

F.N. 1987

Project/Client: Expansive Soil Study/City of Torrance

Sheet: 1 of 2

Location: 4400 block of 238th Street, Torrance, California

Start: 6 SEP 88

Estimated Surface Elevation: '± Total Depth: 30.5' Rig Type: 8" Hollow Stem Auger

End: 6 SEP 88

Field Description — By: TS

Surface Conditions: Asphalt Concrete

Subsurface Conditions: FORMATION: Classification, color, moisture, tightness, etc.

Depth-Feet	Sample Type (RING / BULK)	Blow Counts Blows/Foot	Dry Unit Weight Pcf	Moisture Content %	Laboratory Tests	USCS Symbol	Description
0–0.80							Asphalt Concrete 2 inches, Base 8 inches.
0.80–13.00						CH	Silty Clay, dark gray, moist, firm to stiff.
2	RING	34	91	27	LL=52 PI=34		
5	RING	30	90	31	EI=204 Swell LL=64 PI=41		
9	RING	97	112	17	Shear Swell		
13.00	RING	69	88	25	Consol	SC	Clayey fine sand, light brown to gray brown, moist, dense to very dense.
18	RING	75	105	14			

NOTES: Total depth at 30.5 feet. No groundwater encountered during drilling. No caving during drilling.

TEST EXCAVATION LOG No. B-9

F.N. 1987

Project/Client: Expansive Soil Study/City of Torrance

Sheet: 2 of 2

Depth-Feet	Sample Type (RING / BULK)	Blow Counts Blows/Foot	Dry Unit Weight pcf	Moisture Content %	Laboratory Tests	USCS Symbol	Graphic Log	Field Description By: TS
								Surface Conditions: Asphalt Concrete
								Subsurface Conditions: FORMATION: Classification, color, moisture, tightness, etc.
20								
25								
		45						
30								30.50
35								
40								

TEST EXCAVATION LOG No. B-10

F.N. 1987

Project/Client: Expansive Soil Study/City of Torrance

Sheet: 1 of 2

Location: Alley south of 238th Street west of Anza, Torrance, California

Start: 6 SEP 88

Estimated Surface Elevation: '± Total Depth: 30.5' Rig Type: 8" Hollow Stem Auger

End: 6 SEP 88

Field Description

By: TS

Surface Conditions:

Asphalt Concrete

Subsurface Conditions: **FORMATION: Classification, color, moisture, tightness, etc.**

Depth-Feet	Sample Type (RING / BULK)	Blow Counts Blows/Foot	Dry Unit Weight Pcf	Moisture Content %	Laboratory Tests	USCS Symbol	Field Description
0							0.85 Asphalt Concrete 1.5 inches, Base 7 inches.
						CH	Silty Clay, dark gray, moist, stiff to very stiff.
	RING	38	95	26	EI=82 Swell LL=62 PI=41 PP200 =60		
5							5 to 11 feet becomes sandy with scattered subangular to subrounded 1/4" to 1" rock fragments.
	RING	50	111	18	Swell LL=36 PI=19 PP200 =11		
	RING	86	110	18	Shear		
10							
15	RING	44	90	31	LL=74 PI=43 PP200 =75		

NOTES: Total depth at 30.5 feet. No groundwater encountered during drilling. No caving during drilling.

TEST EXCAVATION LOG No. B-10

F.N. 1987

Project/Client: Expansive Soil Study/City of Torrance

Sheet: 2 of 2

Field Description By: TS

Surface Conditions: Asphalt Concrete

Subsurface Conditions: FORMATION: Classification, color, moisture, tightness, etc.

Depth-Feet	Sample Type (RING / BULK)	Blow Counts Blows/Foot	Dry Unit Weight pcf	Moisture Content %	Laboratory Tests	USCS Symbol	Field Description
20	RING	78	94	28	LL=69 PI=47 PP200 =73		
23.00						SC	Clayey Sand, orange brown-gray brown, moist, firm, slightly plastic.
29	RING	30					
30.50							

Depth scale: 20, 25, 30, 35, 40

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Plate B-10 (Cont.)

TEST EXCAVATION LOG No. B-11

F.N. 1987

Project/Client: Expansive Soil Study/City of Torrance

Sheet: 1 of 2

Location: 3800 block of 234th Street, Torrance, California

Start: 7 SEP 88

Estimated Surface Elevation: '± Total Depth: 30.5' Rig Type: 8" Hollow Stem Auger

End: 7 SEP 88

Field Description By: TS

Surface Conditions: Asphalt Concrete

Subsurface Conditions: FORMATION: Classification, color, moisture, tightness, etc.

Depth-Feet	Sample Type (RING / BULK)	Blow Counts Blows/Foot	Dry Unit Weight Pcf	Moisture Content %	Laboratory Tests	USCS Symbol	Graphic Log	Field Description
0								Asphalt Concrete 2 inches, Base 10 inches.
1.00						CH		Silty Clay, mottled light and dark gray, moist.
	RING	23	83	37	EI=211 Swell			
5	RING	28	85	36	EI=247 LL=84 PI=59 PP200 =96			
	RING	34	81	37	Swell LL=90 PI=66 PP200 =91			
10								
	RING	39	83	37				
15								
17.00						SC		Clayey Fine Sand, brown, moist, very stiff to hard.
	RING	72	111	18				

NOTES: Total depth at 30.5 feet. No groundwater encountered during drilling. No caving during drilling.

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Plate B-11

TEST EXCAVATION LOG No. B-11

F.N. 1987

Project/Client: Expansive Soil Study/City of Torrance

Sheet: 2 of 2

Depth-Feet	Sample Type: RING	Sample Type: BULK	Blow Counts Blows/Foot	Dry Unit Weight pcf	Moisture Content %	Laboratory Tests	USCS Symbol	Graphic Log	Field Description (By: TS)
20									
25									
29–30.5		■	57						
30.50									30.50
35									
40									

Surface Conditions: Asphalt Concrete

Subsurface Conditions: FORMATION: Classification, color, moisture, tightness, etc.

TEST EXCAVATION LOG No. B-12

F.N. 1987

Project/Client: Expansive Soil Study/City of Torrance — Sheet: 1 of 2

Location: Alley west of 23400 block of Hawthorne, Torrance, California — Start: 7 SEP 88

Estimated Surface Elevation: '± Total Depth: 30.5' Rig Type: 8" Hollow Stem Auger — End: 7 SEP 88

Field Description By: TS

Surface Conditions: Asphalt Concrete

Subsurface Conditions: **FORMATION: Classification, color, moisture, tightness, etc.**

Depth-Feet	Sample Type (Ring/Bulk)	Blow Counts Blows/Foot	Dry Unit Weight Pcf	Moisture Content %	Laboratory Tests	USCS Symbol	Depth	Field Description
0							0.75	Asphalt Concrete 3 inches, Base 6 inches.
						SP		FILL Gravelly Sand, gray, numerous angular 1/2" to 2" rock fragments.
	Ring	43	93	28	EI=237 Swell Shear	CH	3.00	Silty Clay, dark gray, stiff.
5								
	Ring	44	92	30	Consol LL=84 PI=58 PP200 =80			Becomes light gray.
	Ring	42	83	31	Swell			
10								
15	Ring	64	100	24				
						SC	18.00	Clayey Sand, brown, moist, very dense.

NOTES: Total depth at 30.5 feet. No groundwater encountered during drilling. No caving during drilling.

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Plate B-12

TEST EXCAVATION LOG No. B-12

F.N. 1987

Project/Client: Expansive Soil Study/City of Torrance

Sheet: 2 of 2

Field Description By: TS

Surface Conditions: Asphalt Concrete

Subsurface Conditions: FORMATION: Classification, color, moisture, tightness, etc.

Depth-Feet	Sample Type (RING)	Sample Type (BULK)	Blow Counts Blows/Foot	Dry Unit Weight pcf	Moisture Content %	Laboratory Tests	USCS Symbol	Graphic Log	Field Description
20	■		87	100	8				
25									
29		■	84						
30									
30.50									30.50
35									
40									

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TEST EXCAVATION LOG No. B-13

F.N. 1987

Project/Client: Expansive Soil Study/City of Torrance

Sheet: 1 of 1

Location: 22900 block of Lomita Boulevard, Torrance, California

Start: 7 SEP 88

Estimated Surface Elevation: '± Total Depth: 7.5' Rig Type: 8" Hollow Stem Auger

End: 7 SEP 88

Field Description By: TS

Surface Conditions: Asphalt Concrete

Subsurface Conditions: FORMATION: Classification, color, moisture, tightness, etc.

Depth-Feet	Sample Type: RING	Sample Type: BULK	Blow Counts Blows/Foot	Dry Unit Weight Pcf	Moisture Content %	Laboratory Tests	USCS Symbol	Graphic Log	Field Description
0–1.50									Asphalt Concrete 4 inches, Base 12 inches.
1.50–3.00							CH		FILL Sandy Clay, dark gray, moist, firm.
3.00	■		12	110	19	Swell LL=39 PI-23 PP200 =53	CH		FILL Silty Clay, very dark gray, moist, firm.
6	■		17	106	19	Swell			
7.50									

NOTES: Total depth at 7.5 feet due to obstruction. No groundwater encountered during drilling. No caving during drilling.

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Plate B-13

File No. 1987
January 25, 1989
October 5, 1989 - REVISED

American Geotechnical
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APPENDIX C

Cone Penetration Testing

KEY TO CONE PENETROMETER TEST DATA

DEPTH (ft.)

Depth at which cone was read and interpolated. Depth can be specified in inches, millimeters, etc.

NORMALIZED CONE (tsf)

Normalization of the cone is necessary due to the fact soil strength will appear to increase with depth, even though the actual strength may remain the same or decrease.

FRICTION RATIO %

Generally, the higher this ratio the more cohesive (clayey) the soil tends to be. Obtained by dividing the sieve friction resistance by the cone tip resistance.

SOIL BEHAVIOR TYPE

An interpolation based upon comparison of data from many borings. This is not absolute and may vary from region to region.

EQUIVALENT RELATIVE DENSITY

Measures looseness of granular soil. Maximum is 100. The lower the number, the looser the material.

EQUIVALENT FRICTION ANGLE (degrees)

Interpolated friction angle (a strength parameter) based upon correlation with many borings. Like most correlations, this number may vary from region to region.

EQUIVALENT N1 (blows/foot)

Interpolated Standard Penetration Test blow count. Generally the higher the number the higher the strength of the soil.

EQUIVALENT N1'

Used in liquifaction analysis. Liquifaction can be a problem in very clean, fine sandy soil with high water table, during earthquake loading. The Southwood Riviera section of Torrance will never have to be concerned with liquifaction.

Su1

Undrained strength. This value can be used with Terzashi's bearing capacity equation to determine the soil bearing capacity at a site where no soil samples were obtained and tested.

Su2

Remolded soil strength. An interpolation of the strength of disturbed soil. Disturbed (remolded) soil has less strength than undisturbed soil.

CONE PENETROMETER TEST DATA

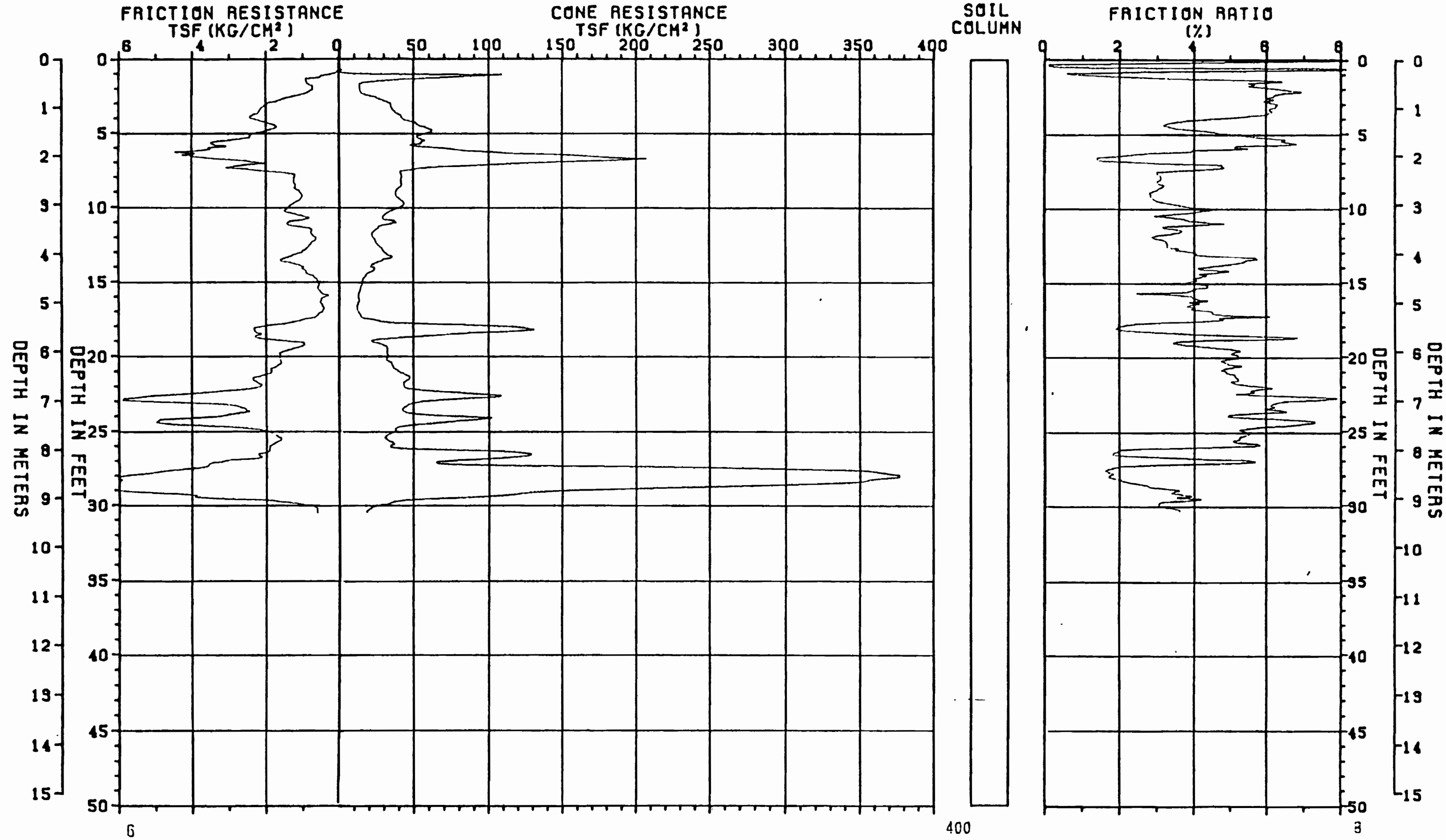
SOUNDING : CPT-1
PROJECT : CITY OF TORRANCE-AG FN 1987
PROJECT No: 89-230-3901
TEST DATE : 09-13-1988

LOCATION : TORRANCE CA
INSTRUMENT : F15CKE085
ELECTRONICS: T2
OPERATOR : MR/HA

Assumed Depth to Water (Feet)= 31 Soil Total Unit Weight (pcf) = 102

DEPTH (ft)	NORMALIZED CONE (tsf)	FRICTION RATIO (%)	SOIL BEHAVIOR TYPE	EQUIV RELATIVE DENSITY	EQUIV FRICTION ANGLE	EQUIV N1	EQUIV N1'	Su1= (C-T)/Nc (ksf)	Su2= Fs*A (ksf)
1.0	23.9	2.66	SANDY SILT-CLAYEY SILT	50-60	27-31	10-15	15-20		
2.0	26.9	5.36	*SANDY CLAY-SILTY CLAY			25-40	25-40	0.89	0.89
3.0	62.6	5.76	*SANDY CLAY-SILTY CLAY			80-100	80-100	2.29	2.29
4.0	71.3	5.37	*SANDY CLAY-SILTY CLAY			80-100	80-100	2.80	2.80
5.0	90.4	4.24	*CLAYEY SAND-SANDY CLAY			80-100	80-100		
6.0	105.1	5.03	*SANDY CLAY-SILTY CLAY			>100	>100	4.61	4.61
7.0	213.9	1.34	SAND TO SILTY SAND	70-80	40-42	>100	>100		
8.0	57.8	2.96	SANDY SILT-CLAYEY SILT	70-80	31-35	25-40	40-60		
9.0	50.0	2.86	SANDY SILT-CLAYEY SILT	70-80	31-35	25-40	25-40		
10.0	52.3	3.50	SANDY SILT-CLAYEY SILT	80-90	27-31	25-40	40-60		
11.0	47.5	3.73	SANDY SILT-CLAYEY SILT	90-100	27-31	25-40	40-60		
12.0	27.6	2.84	SANDY SILT-CLAYEY SILT	50-60	27-31	10-15	20-25		
13.0	35.8	3.37	SANDY SILT-CLAYEY SILT	70-80	27-31	20-25	25-40		
14.0	23.6	4.66	CLAYEY SILT-SILTY CLAY			15-20	25-40	2.65	1.92
15.0	16.7	3.96	CLAYEY SILT-SILTY CLAY			10-15	20-25	1.89	1.19
16.0	13.6	3.42	CLAYEY SILT-SILTY CLAY			5-10	15-20	1.56	0.86
17.0	13.2	3.78	CLAYEY SILT-SILTY CLAY			5-10	15-20	1.54	0.94
18.0	96.0	2.31	SILTY SAND-SANDY SILT	70-80	35-40	40-60	60-80		
19.0	21.1	6.53	SILTY CLAY TO CLAY			20-25	25-40	2.65	2.65
20.0	33.3	4.88	*SANDY CLAY-SILTY CLAY			25-40	40-60	2.17	2.17
21.0	38.2	4.69	*SANDY CLAY-SILTY CLAY			25-40	40-60	2.56	2.56
22.0	40.8	5.03	*SANDY CLAY-SILTY CLAY			40-60	40-60	2.79	2.79
23.0	62.1	7.78	*SANDY CLAY-SILTY CLAY			80-100	80-100	4.37	4.37
24.0	55.3	5.38	*SANDY CLAY-SILTY CLAY			60-80	60-80	3.96	3.96
25.0	33.9	5.29	*SANDY CLAY-SILTY CLAY			25-40	40-60	2.44	2.44
26.0	29.9	5.60	*SANDY CLAY-SILTY CLAY			25-40	40-60	2.19	2.19
27.0	68.8	3.97	*CLAYEY SAND-SANDY CLAY			60-80	60-80		
28.0	295.6	1.81	SAND TO SILTY SAND	90-100	40-42	>100	>100		
29.0	156.4	3.09	*SILTY SAND-CLAYEY SAND			>100	>100		

* - INDICATES OVERCONSOLIDATED OR CEMENTED MATERIAL



PROJECT: CITY OF TORRANCE-AG FN 1987
PROJECT NUMBER: 89-230-3901
INSTRUMENT NUMBER: F15CKE085
DATE: 09-13-1988

The Earth Technology Corporation

CONE PENETROMETER TEST
PROBE: CPT-1

Plate C4

CONE PENETROMETER TEST DATA

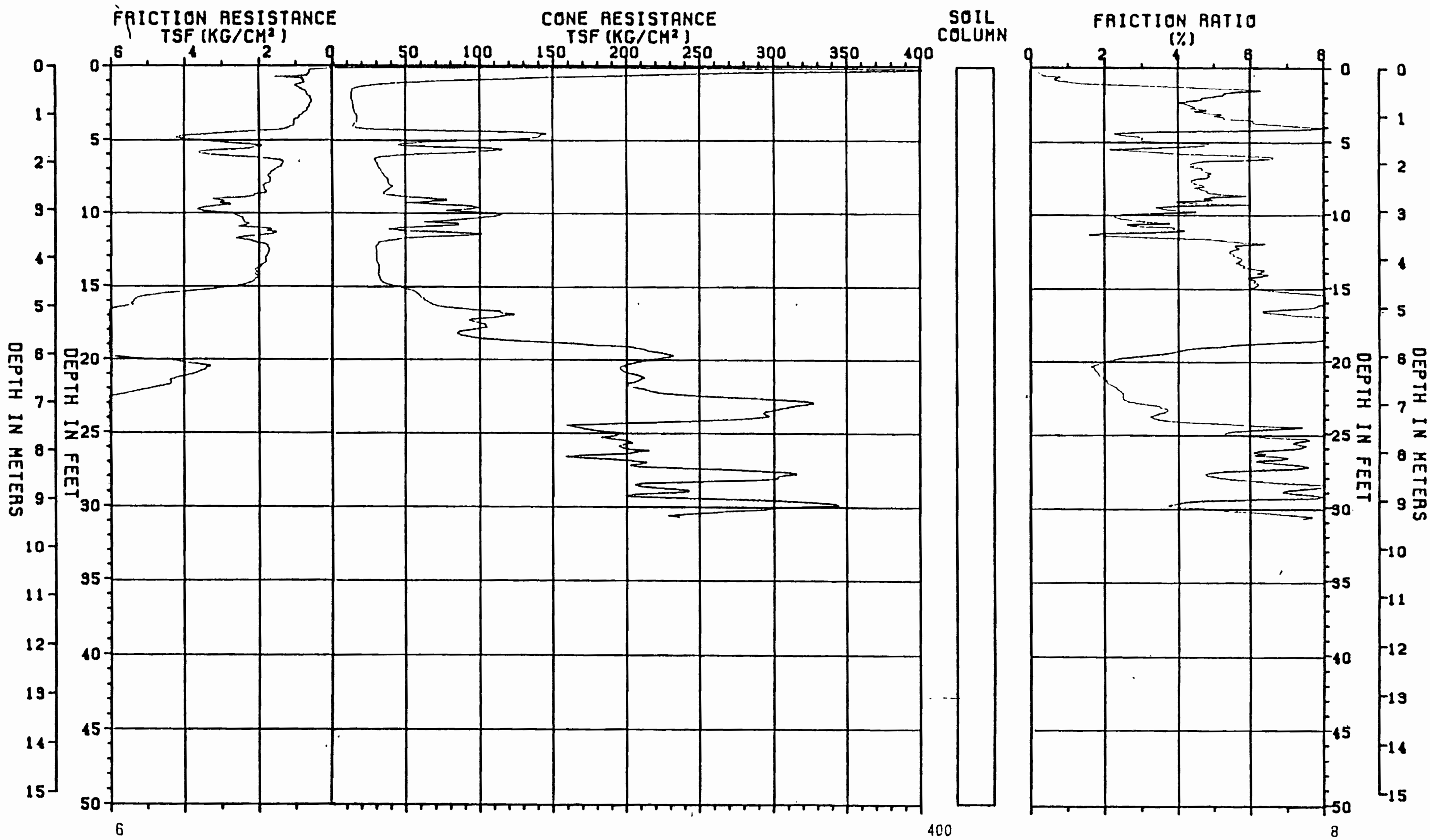
SOUNDING : CPT-2
PROJECT : CITY OF TORRANCE-AG FN 1987
PROJECT No: 89-230-3901
TEST DATE : 09-13-1988

LOCATION : TORRANCE CA
INSTRUMENT : F15CKE065
ELECTRONICS: T2
OPERATOR : MR/HA

Assumed Depth to Water (Feet)= 31 Soil Total Unit Weight (pcf) = 102

DEPTH (ft)	NORMALIZED CONE (tsf)	FRICTION RATIO (%)	SOIL BEHAVIOR TYPE	EQUIV RELATIVE DENSITY	EQUIV FRICTION ANGLE	EQUIV N)	EQUIV N1*	Su1= (C-T)/Nc (ksf)	Su2= Fs*A (ksf)
1.0	140.9	1.22	SAND TO SILTY SAND	60-70	40-42	40-50	40-60		
2.0	25.3	4.61	CLAYEY SILT-SILTY CLAY			20-25	25-40	1.68	1.17
3.0	27.9	4.72	CLAYEY SILT-SILTY CLAY			20-25	25-40	2.03	1.45
4.0	23.6	8.17	*SANDY CLAY-SILTY CLAY			25-40	40-60	0.92	0.92
5.0	133.4	3.70	*CLAYEY SAND-SANDY CLAY			>100	>100		
6.0	64.0	6.57	*SANDY CLAY-SILTY CLAY			80-100	60-100	2.80	2.80
7.0	49.1	4.70	*SANDY CLAY-SILTY CLAY			40-60	40-60	2.24	2.24
8.0	55.3	4.69	*SANDY CLAY-SILTY CLAY			40-60	60-80	2.63	2.63
9.0	104.8	3.91	*CLAYEY SAND-SANDY CLAY			80-100	>100		
10.0	149.2	0.00	SANDY GRAVEL TO SAND	40-50	40-42	25-40	20-25		
11.0	48.4	4.17	*SANDY CLAY-SILTY CLAY			40-60	40-60	2.54	2.54
12.0	39.0	5.55	*SANDY CLAY-SILTY CLAY			40-60	40-60	2.10	2.10
13.0	35.7	5.74	*SANDY CLAY-SILTY CLAY			40-60	40-60	2.03	2.03
14.0	36.7	6.45	*SANDY CLAY-SILTY CLAY			40-60	40-60	2.09	2.09
15.0	55.1	6.18	*SANDY CLAY-SILTY CLAY			60-80	60-80	3.24	3.24
16.0	72.6	8.09	*SANDY CLAY-SILTY CLAY			>100	>100	4.40	4.40
17.0	117.6	8.40	*SANDY CLAY-SILTY CLAY			>100	>100	7.33	7.33
18.0	89.6	9.84	*SANDY CLAY-SILTY CLAY			>100	>100	5.70	5.70
19.0	205.7	4.54	*CLAYEY SAND-SANDY CLAY			>100	>100		
20.0	208.8	1.90	SAND TO SILTY SAND	80-90	40-42	>100	>100		
21.0	204.3	1.95	SAND TO SILTY SAND	80-90	40-42	>100	>100		
22.0	206.1	2.47	*SILTY SAND-CLAYEY SAND			>100	>100		
23.0	292.4	3.53	*SILTY SAND-CLAYEY SAND			>100	>100		
24.0	231.7	4.29	*CLAYEY SAND-SANDY CLAY			>100	>100		
25.0	172.9	6.26	*SANDY CLAY-SILTY CLAY			>100	>100	12.80	12.80
26.0	190.1	6.06	*SANDY CLAY-SILTY CLAY			>100	>100	14.35	14.35
27.0	175.0	7.53	WEATHERED ROCK			>100	>100		
28.0	247.4	6.27	WEATHERED ROCK			>100	>100		
29.9	168.5	7.97	WEATHERED ROCK			>100	>100		

* - INDICATES OVERCONSOLIDATED OR CEMENTED MATERIAL



PROJECT: CITY OF TORRANCE-AG FN 1987
PROJECT NUMBER: 89-230-3901
INSTRUMENT NUMBER: F15CKE085
DATE: 09-13-1988

The Earth Technology Corporation

CONE PENETROMETER TEST

PROBE: CPT-2

CONE PENETROMETER TEST DATA

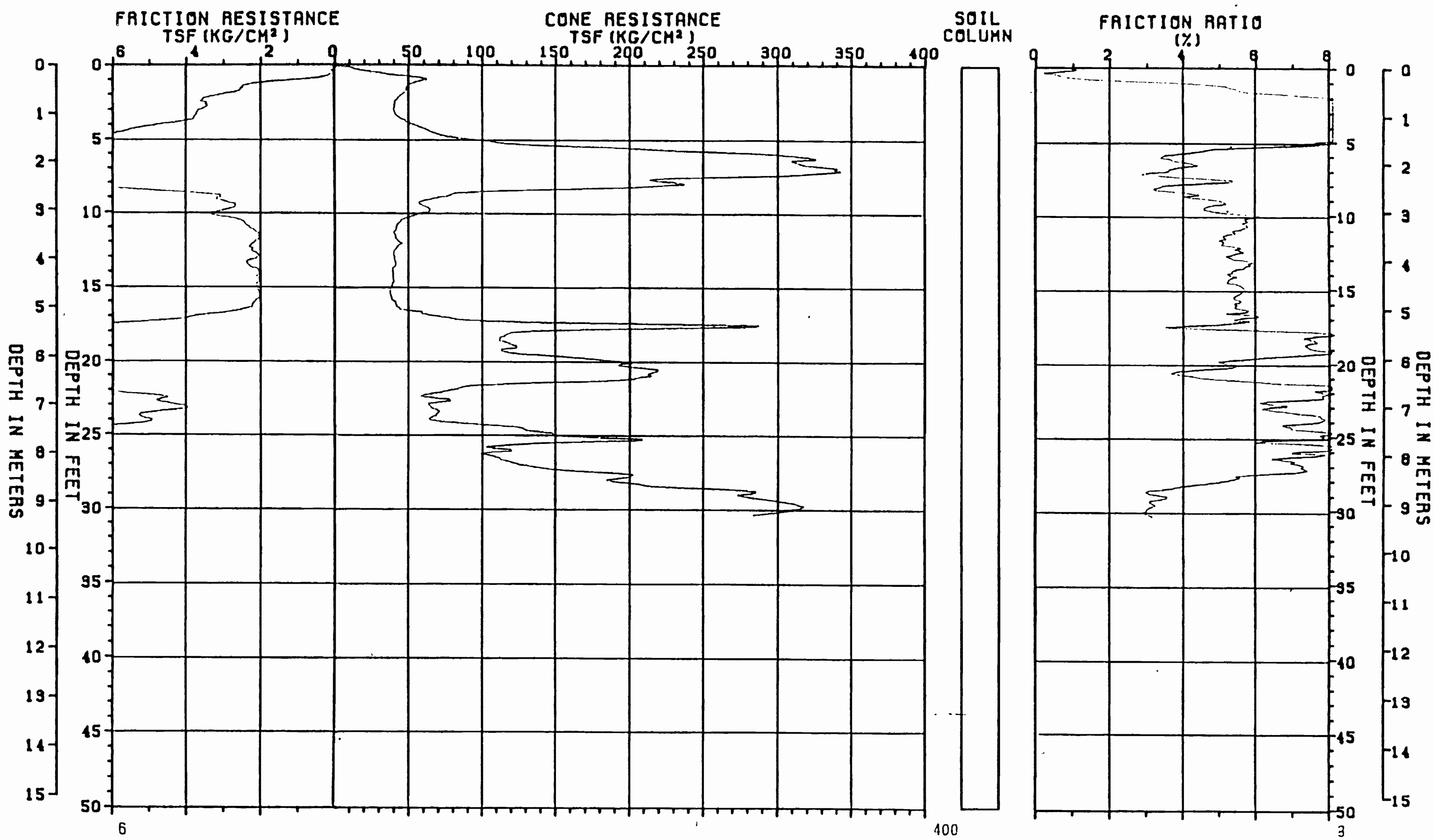
SOUNDING : CPT-3
PROJECT : CITY OF TORRANCE-AG FN 1987
PROJECT No: 89-230-3901
TEST DATE : 09-13-1988

LOCATION : TORRANCE CA
INSTRUMENT : F15CKE085
ELECTRONICS: T2
OPERATOR : MR/HA

Assumed Depth to Water (Feet)= 31 Soil Total Unit Weight (pcf) = 102

DEPTH (ft)	NORMALIZED CONE (tsf)	FRICTION RATIO (%)	SOIL BEHAVIOR TYPE	EQUIV RELATIVE DENSITY	EQUIV FRICTION ANGLE	EQUIV N1	EQUIV N1'	Su1= (C-T)/Nc (ksf)	Su2= Ps*A (ksf)
1.0	131.1	3.21	*CLAYEY SAND-SANDY CLAY			>100	>100		
2.0	86.9	7.79	*SANDY CLAY-SILTY CLAY			>100	>100	2.90	2.90
3.0	72.2	9.33	*SANDY CLAY-SILTY CLAY			>100	>100	2.64	2.64
4.0	94.0	9.30	*SANDY CLAY-SILTY CLAY			>100	>100	3.70	3.70
5.0	158.6	7.56	*SANDY CLAY-SILTY CLAY			>100	>100	6.62	6.62
6.0	458.4	3.35	*SILTY SAND-CLAYEY SAND			>100	>100		
7.0	306.2	5.59	WEATHERED ROCK			>100	>100		
8.0	328.1	3.36	*SILTY SAND-CLAYEY SAND			>100	>100		
9.0	85.9	4.96	*SANDY CLAY-SILTY CLAY			80-100	>100	4.25	4.25
10.0	71.5	6.02	*SANDY CLAY-SILTY CLAY			80-100	80-100	3.65	3.65
11.0	51.7	5.27	*SANDY CLAY-SILTY CLAY			40-60	60-80	2.72	2.72
12.0	54.9	4.97	*SANDY CLAY-SILTY CLAY			60-80	60-80	2.97	2.97
13.0	47.1	5.29	*SANDY CLAY-SILTY CLAY			40-60	60-80	2.62	2.62
14.0	45.0	5.13	*SANDY CLAY-SILTY CLAY			40-60	40-60	2.57	2.57
15.0	41.6	5.60	*SANDY CLAY-SILTY CLAY			40-60	40-60	2.43	2.43
16.0	44.8	5.32	*SANDY CLAY-SILTY CLAY			40-60	40-60	2.69	2.69
17.0	75.7	5.51	*SANDY CLAY-SILTY CLAY			80-100	80-100	4.69	4.69
18.0	139.4	8.25	*SANDY CLAY-SILTY CLAY			>100	>100	8.90	8.90
19.0	124.9	7.38	*SANDY CLAY-SILTY CLAY			>100	>100	8.15	8.15
20.0	190.2	5.06	*SANDY CLAY-SILTY CLAY			>100	>100	12.72	12.72
21.0	207.8	4.39	*CLAYEY SAND-SANDY CLAY			>100	>100		
22.0	71.9	7.72	*SANDY CLAY-SILTY CLAY			>100	>100	4.97	4.97
23.0	58.7	6.31	*SANDY CLAY-SILTY CLAY			80-100	80-100	4.13	4.13
24.0	59.1	7.62	*SANDY CLAY-SILTY CLAY			80-100	80-100	4.23	4.23
25.0	132.9	7.80	*SANDY CLAY-SILTY CLAY			>100	>100	9.82	9.82
26.0	104.8	7.04	*SANDY CLAY-SILTY CLAY			>100	>100	7.87	7.87
27.0	107.4	7.23	*SANDY CLAY-SILTY CLAY			>100	>100	8.22	8.22
28.0	161.9	5.19	*SANDY CLAY-SILTY CLAY			>100	>100	12.67	12.67
29.0	233.9	3.27	*SILTY SAND-CLAYEY SAND			>100	>100		

* - INDICATES OVERCONSOLIDATED OR CEMENTED MATERIAL



PROJECT: CITY OF TORRANCE-AG FN 1987
PROJECT NUMBER: 89-230-3901
INSTRUMENT NUMBER: F15CKE085
DATE: 09-13-1988

The Earth Technology Corporation

CONE PENETROMETER TEST

PROBE: CPT-3

Plate C8

CONE PENETROMETER TEST DATA

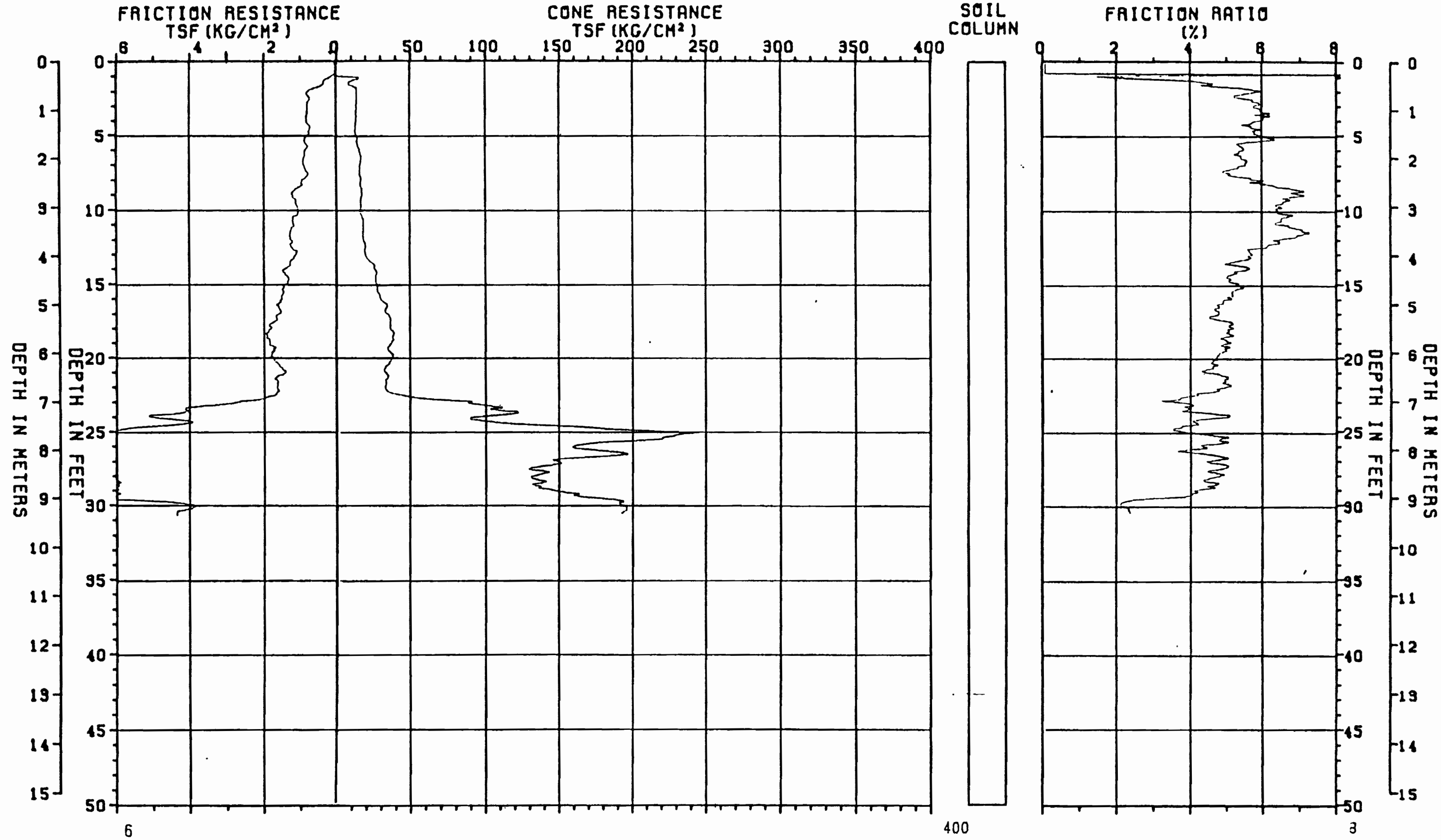
SOUNDING : CPT-4
PROJECT : CITY OF TORRANCE-AG FN 1987
PROJECT No: 89-230-3901
TEST DATE : 09-13-1988

LOCATION : TORRANCE CA
INSTRUMENT : F15CKE081
ELECTRONICS: T2
OPERATOR : MR/HA

Assumed Depth to Water (Feet)= 31 Soil Total Unit Weight (pcf) = 102

DEPTH (ft)	NORMALIZED CONE (tsf)	FRICTION RATIO (%)	SOIL BEHAVIOR TYPE	EQUIV RELATIVE DENSITY	EQUIV FRICTION ANGLE	EQUIV N1	EQUIV N1'	Su1= (C-1)/Nc (ksf)	Su2= Fs*A (ksf)
1.0	35.6	1.33	SILTY SAND-SANDY SILT	30-40	31-35	5-10	15-20		
2.0	28.1	5.82	*SANDY CLAY-SILTY CLAY			25-40	40-60	0.93	0.93
3.0	25.5	5.63	*SANDY CLAY-SILTY CLAY			25-40	25-40	0.93	0.93
4.0	22.9	5.87	SILTY CLAY TO CLAY			20-25	25-40	1.70	1.57
5.0	22.9	5.78	SILTY CLAY TO CLAY			20-25	25-40	1.88	1.66
6.0	24.5	5.37	CLAYEY SILT-SILTY CLAY			20-25	25-40	2.11	1.74
7.0	23.3	5.41	SILTY CLAY TO CLAY			20-25	25-40	2.10	1.74
8.0	23.6	5.56	SILTY CLAY TO CLAY			20-25	25-40	2.21	1.89
9.0	23.2	6.82	*SANDY CLAY-SILTY CLAY			25-40	25-40	1.13	1.13
10.0	21.2	6.21	SILTY CLAY TO CLAY			20-25	25-40	2.12	2.04
11.0	23.3	6.21	*SANDY CLAY-SILTY CLAY			25-40	25-40	1.20	1.20
12.0	22.5	6.43	*SANDY CLAY-SILTY CLAY			25-40	25-40	1.20	1.20
13.0	24.0	5.55	SILTY CLAY TO CLAY			20-25	25-40	2.62	2.26
14.0	30.6	5.51	*SANDY CLAY-SILTY CLAY			25-40	40-60	1.73	1.73
15.0	30.8	5.23	*SANDY CLAY-SILTY CLAY			25-40	25-40	1.79	1.79
16.0	33.4	5.04	*SANDY CLAY-SILTY CLAY			25-40	40-60	1.99	1.99
17.0	37.4	4.69	*SANDY CLAY-SILTY CLAY			25-40	40-60	2.29	2.29
18.0	37.9	5.08	*SANDY CLAY-SILTY CLAY			25-40	40-60	2.38	2.38
19.0	37.0	5.01	*SANDY CLAY-SILTY CLAY			25-40	40-60	2.37	2.37
20.0	36.6	4.60	*SANDY CLAY-SILTY CLAY			25-40	40-60	2.39	2.39
21.0	33.1	4.29	CLAYEY SILT-SILTY CLAY			25-40	25-40	4.40	2.92
22.0	31.5	4.84	CLAYEY SILT-SILTY CLAY			25-40	25-40	4.27	3.20
23.0	81.6	3.57	*CLAYEY SAND-SANDY CLAY			60-80	60-80		
24.0	81.2	4.93	*SANDY CLAY-SILTY CLAY			80-100	80-100	5.85	5.85
25.0	204.0	3.67	*CLAYEY SAND-SANDY CLAY			>100	>100		
26.0	138.4	4.23	*CLAYEY SAND-SANDY CLAY			>100	>100		
27.0	128.3	4.32	*CLAYEY SAND-SANDY CLAY			>100	>100		
28.0	118.6	4.69	*SANDY CLAY-SILTY CLAY			>100	>100	8.58	8.58
29.0	122.4	3.98	*CLAYEY SAND-SANDY CLAY			>100	>100		

* - INDICATES OVERCONSOLIDATED OR CEMENTED MATERIAL



PROJECT: CITY OF TORRANCE-AG FN 1987
PROJECT NUMBER: 89-230-3901
INSTRUMENT NUMBER: F15CKE081
DATE: 09-13-1988

The Earth Technology Corporation

CONE PENETROMETER TEST
PROBE: CPT-4

CONE PENETROMETER TEST DATA

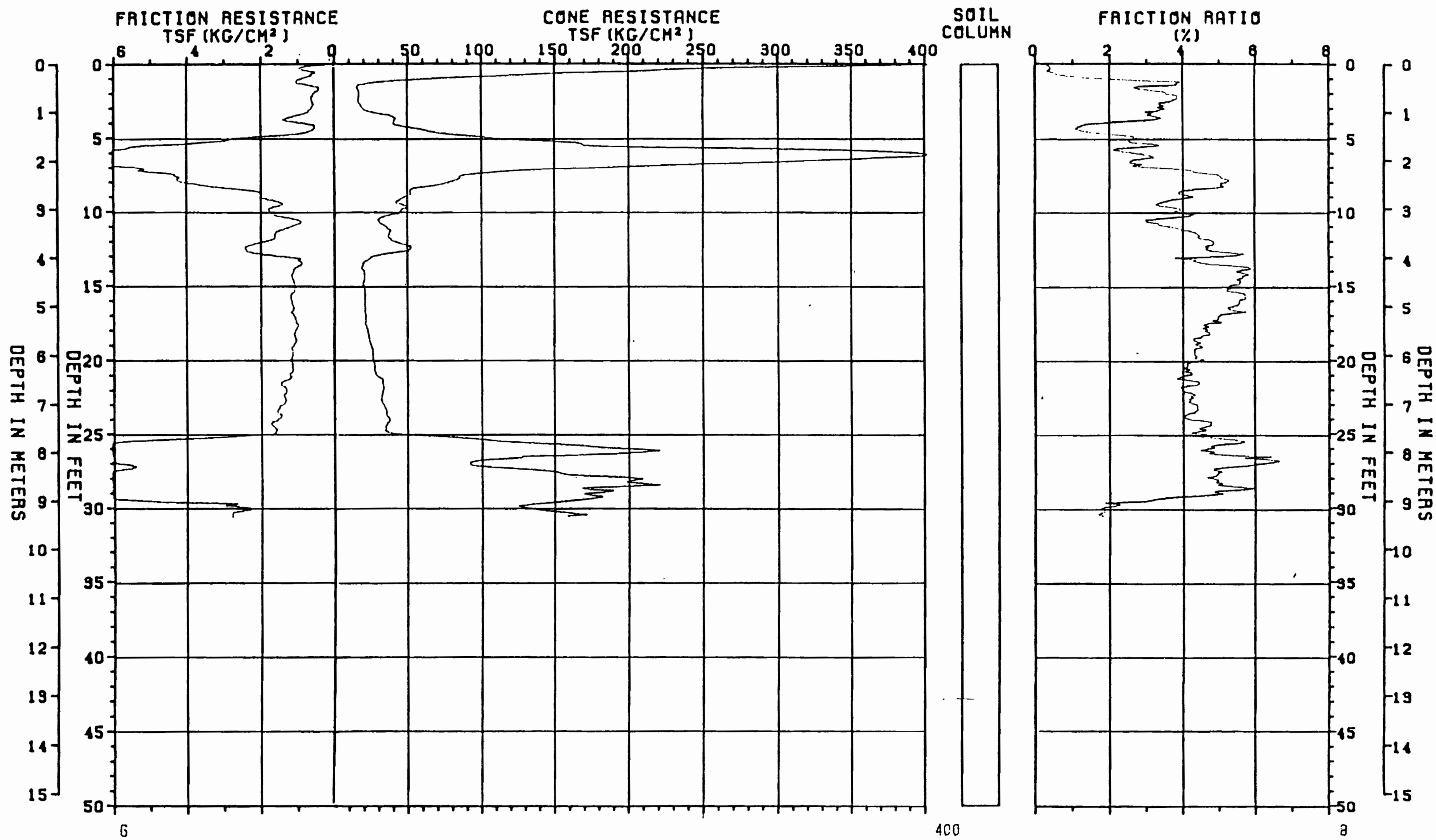
SOUNDING : CPT-5
PROJECT : CITY OF TORRANCE-AG FN 1987
PROJECT No: 89-230-3901
TEST DATE : 09-13-1988

LOCATION : TORRANCE CA
INSTRUMENT : F15CKE081
ELECTRONICS: T2
OPERATOR : MR/HA

Assumed Depth to Water (Feet)= 31 Soil Total Unit Weight (pcf) = 102

DEPTH (ft)	NORMALIZED CONE (tsf)	FRICTION RATIO (%)	SOIL BEHAVIOR TYPE	EQUIV RELATIVE DENSITY	EQUIV FRICTION ANGLE	EQUIV N1	EQUIV N1'	Su1= (C-T)/Nc (ksf)	Su2= Fs*A (ksf)
1.0	180.0	1.13	SAND TO SILTY SAND	60-70	40-42	60-80	80-100		
2.0	33.8	3.44	SANDY SILT-CLAYEY SILT	70-80	27-31	20-25	25-40		
3.0	34.9	3.23	SANDY SILT-CLAYEY SILT	70-80	27-31	20-25	25-40		
4.0	67.4	1.82	SILTY SAND-SANDY SILT	50-60	35-40	25-40	25-40		
5.0	171.8	2.66	*SILTY SAND-CLAYEY SAND			>100	>100		
6.0	599.2	2.54	*SILTY SAND-CLAYEY SAND			>100	>100		
7.0	261.7	2.83	*SILTY SAND-CLAYEY SAND			>100	>100		
8.0	107.0	5.10	*SANDY CLAY-SILTY CLAY			>100	>100	5.11	5.11
9.0	63.7	4.20	*SANDY CLAY-SILTY CLAY			40-60	60-80	3.14	3.14
10.0	59.7	3.67	SANDY SILT-CLAYEY SILT	90-100	27-31	40-60	40-60		
11.0	44.6	3.53	SANDY SILT-CLAYEY SILT	80-90	27-31	25-40	40-60		
12.0	52.1	4.75	*SANDY CLAY-SILTY CLAY			40-60	60-80	2.82	2.82
13.0	29.5	4.78	CLAYEY SILT-SILTY CLAY			25-40	25-40	3.25	2.40
14.0	23.4	5.37	SILTY CLAY TO CLAY			20-25	25-40	2.63	2.20
15.0	22.8	5.23	CLAYEY SILT-SILTY CLAY			20-25	25-40	2.62	2.14
16.0	22.7	5.46	SILTY CLAY TO CLAY			20-25	25-40	2.68	2.28
17.0	22.6	4.88	CLAYEY SILT-SILTY CLAY			15-20	25-40	2.73	2.08
18.0	24.0	4.51	CLAYEY SILT-SILTY CLAY			15-20	25-40	2.96	2.09
19.0	25.8	4.39	CLAYEY SILT-SILTY CLAY			20-25	25-40	3.26	2.23
20.0	26.1	4.38	CLAYEY SILT-SILTY CLAY			20-25	25-40	3.37	2.31
21.0	28.6	3.92	CLAYEY SILT-SILTY CLAY			20-25	25-40	3.79	2.31
22.0	31.5	3.90	CLAYEY SILT-SILTY CLAY			20-25	25-40	4.28	2.59
23.0	31.7	4.31	CLAYEY SILT-SILTY CLAY			25-40	25-40	4.39	2.94
24.0	34.4	4.08	CLAYEY SILT-SILTY CLAY			25-40	25-40	4.87	3.08
25.0	42.8	4.57	*SANDY CLAY-SILTY CLAY			40-60	40-60	3.10	3.10
26.0	179.7	4.58	*CLAYEY SAND-SANDY CLAY			>100	>100		
27.0	79.1	5.94	*SANDY CLAY-SILTY CLAY			>100	>100	6.03	6.03
28.0	176.6	4.79	*SANDY CLAY-SILTY CLAY			>100	>100	13.84	13.84
29.0	140.3	5.02	*SANDY CLAY-SILTY CLAY			>100	>100	11.17	11.17

* - INDICATES OVERCONSOLIDATED OR CEMENTED MATERIAL



PROJECT: CITY OF TORRANCE-AG FN 1987
PROJECT NUMBER: 89-230-3901
INSTRUMENT NUMBER: F15CKE081
DATE: 09-13-1988

The Earth Technology Corporation

CONE PENETROMETER TEST

PROBE: CPT-5

CONE PENETROMETER TEST DATA

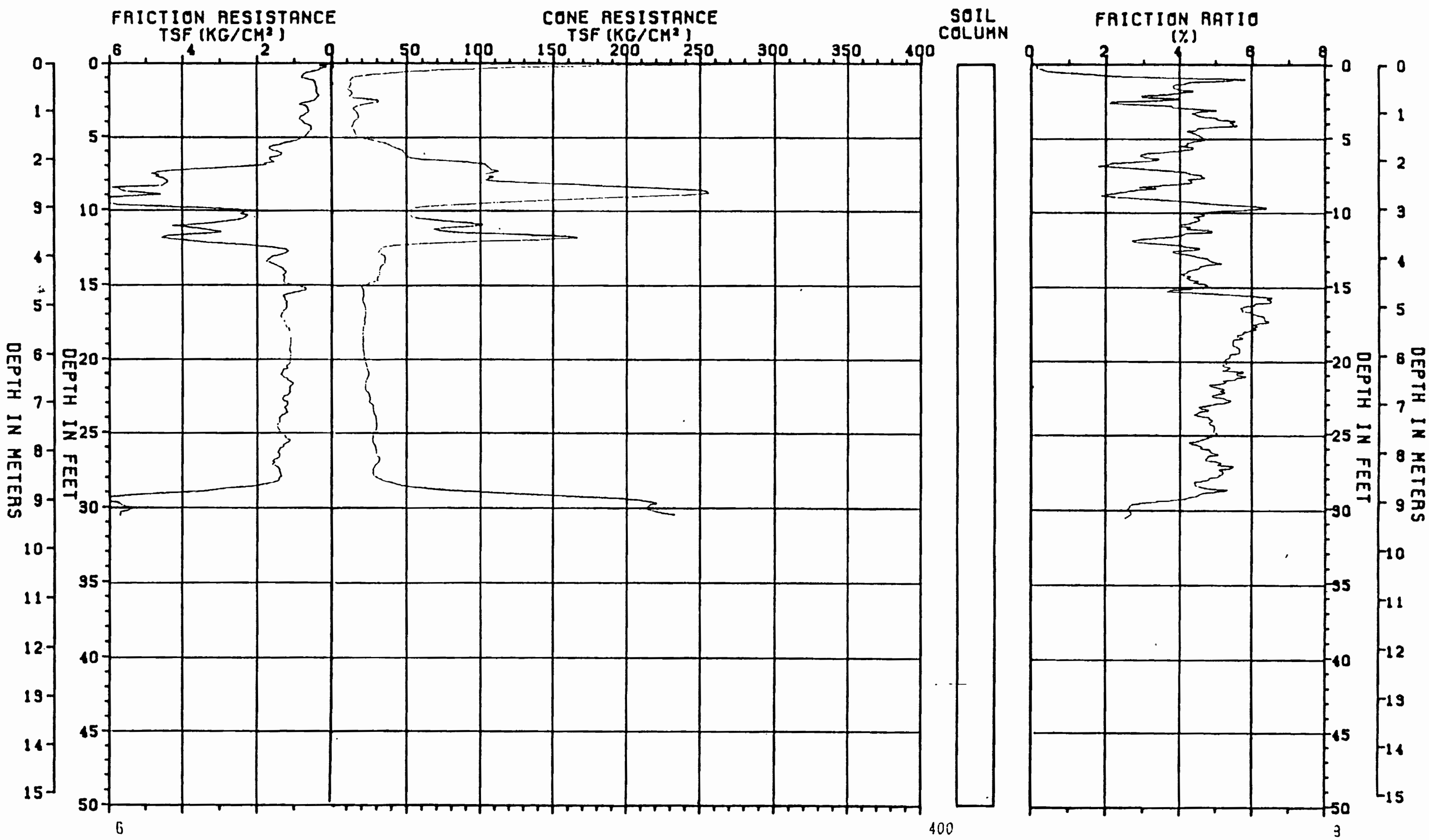
SOUNDING : CPT-6
PROJECT : CITY OF TORRANCE-AG FN 1987
PROJECT No: 89-230-3901
TEST DATE : 09-13-1988

LOCATION : TORRANCE CA
INSTRUMENT : F15CKE081
ELECTRONICS: T2
OPERATOR : MR/HA

Assumed Depth to Water (Feet)= 31 Soil Total Unit Weight (pcf) = 102

DEPTH (ft)	NORMALIZED CONE (tsf)	FRICTION RATIO (%)	SOIL BEHAVIOR TYPE	EQUIV RELATIVE DENSITY	EQUIV FRICTION ANGLE	EQUIV N1	EQUIV N1'	Su1= (C-T)/Nc (ksf)	Su2= Fs*A (ksf)
1.0	28.2	5.25	*SANDY CLAY-SILTY CLAY			25-40	25-40	0.82	0.82
2.0	26.2	2.87	SANDY SILT-CLAYEY SILT	50-60	27-31	10-15	20-25		
3.0	23.8	4.98	CLAYEY SILT-SILTY CLAY			20-25	25-40	1.72	1.30
4.0	22.0	5.55	SILTY CLAY TO CLAY			20-25	25-40	1.71	1.44
5.0	29.4	4.66	CLAYEY SILT-SILTY CLAY			25-40	25-40	2.43	1.72
6.0	70.9	2.85	SANDY SILT-CLAYEY SILT	80-90	31-35	40-60	40-60		
7.0	136.8	3.32	*CLAYEY SAND-SANDY CLAY			>100	>100		
8.0	155.5	3.93	*CLAYEY SAND-SANDY CLAY			>100	>100		
9.0	291.6	2.91	*SILTY SAND-CLAYEY SAND			>100	>100		
10.0	67.3	4.54	*SANDY CLAY-SILTY CLAY			60-80	60-80	3.44	3.44
11.0	116.7	4.10	*CLAYEY SAND-SANDY CLAY			>100	>100		
12.0	125.4	3.28	*CLAYEY SAND-SANDY CLAY			>100	>100		
13.0	40.5	4.73	*SANDY CLAY-SILTY CLAY			25-40	40-60	2.25	2.25
14.0	35.1	3.98	CLAYEY SILT-SILTY CLAY			25-40	25-40	3.99	2.44
15.0	21.3	4.27	CLAYEY SILT-SILTY CLAY			10-15	20-25	2.44	1.63
16.0	21.7	5.97	SILTY CLAY TO CLAY			20-25	25-40	2.55	2.38
17.0	23.0	6.28	*SANDY CLAY-SILTY CLAY			25-40	25-40	1.39	1.39
18.0	20.5	5.70	SILTY CLAY TO CLAY			20-25	25-40	2.51	2.25
19.0	20.4	5.60	SILTY CLAY TO CLAY			20-25	25-40	2.56	2.26
20.0	21.3	5.27	CLAYEY SILT-SILTY CLAY			20-25	25-40	2.72	2.26
21.0	23.0	5.50	SILTY CLAY TO CLAY			20-25	25-40	3.01	2.61
22.0	20.7	5.22	CLAYEY SILT-SILTY CLAY			15-20	25-40	2.75	2.27
23.0	24.5	4.46	CLAYEY SILT-SILTY CLAY			15-20	25-40	3.35	2.34
24.0	26.4	4.76	CLAYEY SILT-SILTY CLAY			20-25	25-40	3.70	2.75
25.0	24.2	4.85	CLAYEY SILT-SILTY CLAY			20-25	25-40	3.44	2.62
26.0	25.3	4.80	CLAYEY SILT-SILTY CLAY			20-25	25-40	3.66	2.76
27.0	25.1	5.44	SILTY CLAY TO CLAY			25-40	25-40	3.71	3.18
28.0	25.8	4.55	CLAYEY SILT-SILTY CLAY			20-25	25-40	3.88	2.77
29.0	91.9	4.41	*SANDY CLAY-SILTY CLAY			80-100	>100	7.29	7.29

* - INDICATES OVERCONSOLIDATED OR CEMENTED MATERIAL



PROJECT: CITY OF TORRANCE-AG FN 1987
PROJECT NUMBER: 89-230-3901
INSTRUMENT NUMBER: F15CKE081
DATE: 09-13-1988

The Earth Technology Corporation

CONE PENETROMETER TEST

PROBE: CPT-6

Plate C14

CONE PENETROMETER TEST DATA

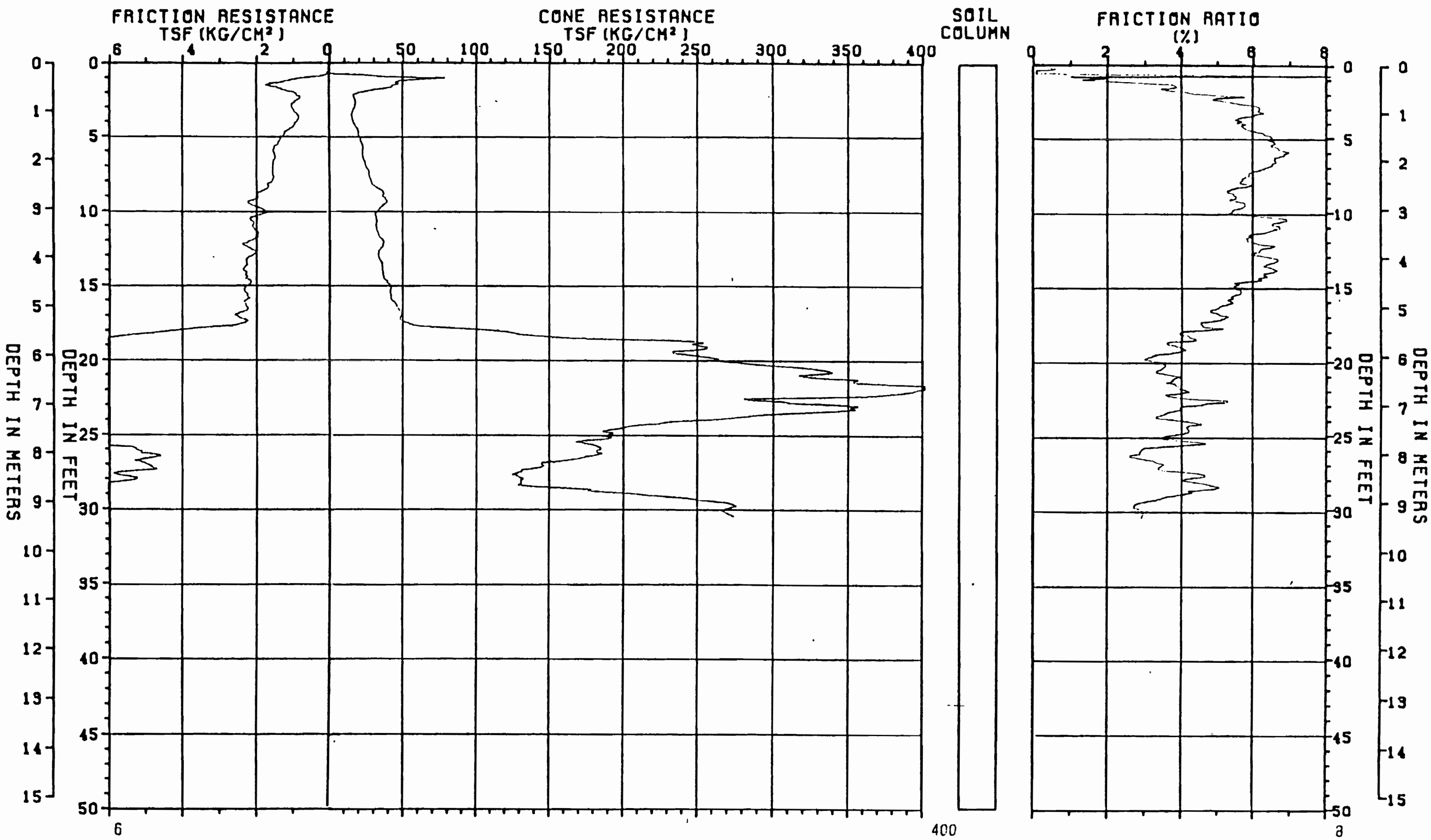
SOUNDING : CPT-7
PROJECT : CITY OF TORRANCE-AG FN 1987
PROJECT No: 89-230-3901
TEST DATE : 09-14-1988

LOCATION : TORRANCE CA
INSTRUMENT : F15CKE081
ELECTRONICS: T2
OPERATOR : MR/HA

Assumed Depth to Water (Feet)= 31 Soil Total Unit Weight (pcf) = 102

DEPTH (ft)	NORMALIZED CONE (tsf)	FRICTION RATIO (%)	SOIL BEHAVIOR TYPE	EQUIV RELATIVE DENSITY	EQUIV FRICTION ANGLE	EQUIV N1	EQUIV N1'	Su1= (C-T)/Nc (ksf)	Su2= Fs*A (ksf)
1.0	178.7	1.23	SAND TO SILTY SAND	60-70	40-42	80-100	80-100		
2.0	37.1	4.82	*SANDY CLAY-SILTY CLAY			25-40	40-60	1.24	1.24
3.0	30.3	6.03	*SANDY CLAY-SILTY CLAY			25-40	40-60	1.10	1.10
4.0	28.1	5.70	*SANDY CLAY-SILTY CLAY			25-40	25-40	1.09	1.09
5.0	33.7	6.29	*SANDY CLAY-SILTY CLAY			40-60	40-60	1.39	1.39
6.0	33.9	6.72	*SANDY CLAY-SILTY CLAY			40-60	40-60	1.47	1.47
7.0	36.3	6.17	*SANDY CLAY-SILTY CLAY			40-60	40-60	1.65	1.65
8.0	39.8	5.55	*SANDY CLAY-SILTY CLAY			40-60	40-60	1.88	1.88
9.0	48.1	5.39	*SANDY CLAY-SILTY CLAY			40-60	60-80	2.36	2.36
10.0	41.6	5.20	*SANDY CLAY-SILTY CLAY			40-60	40-60	2.11	2.11
11.0	39.5	6.61	*SANDY CLAY-SILTY CLAY			40-60	40-60	2.07	2.07
12.0	44.9	5.94	*SANDY CLAY-SILTY CLAY			40-60	60-80	2.43	2.43
13.0	39.2	6.33	*SANDY CLAY-SILTY CLAY			40-60	40-60	2.17	2.17
14.0	41.2	6.45	*SANDY CLAY-SILTY CLAY			40-60	60-80	2.35	2.35
15.0	46.7	5.39	*SANDY CLAY-SILTY CLAY			40-60	60-80	2.74	2.74
16.0	46.9	5.33	*SANDY CLAY-SILTY CLAY			40-60	60-80	2.82	2.82
17.0	51.5	5.10	*SANDY CLAY-SILTY CLAY			40-60	60-80	3.18	3.18
18.0	119.7	3.86	*CLAYEY SAND-SANDY CLAY			>100	>100		
19.0	253.8	3.88	*CLAYEY SAND-SANDY CLAY			>100	>100		
20.0	255.9	3.37	*SILTY SAND-CLAYEY SAND			>100	>100		
21.0	306.0	3.89	*CLAYEY SAND-SANDY CLAY			>100	>100		
22.0	374.6	4.12	WEATHERED ROCK			>100	>100		
23.0	319.0	3.92	*CLAYEY SAND-SANDY CLAY			>100	>100		
24.0	238.9	4.08	*CLAYEY SAND-SANDY CLAY			>100	>100		
25.0	169.2	3.44	*CLAYEY SAND-SANDY CLAY			>100	>100		
26.0	161.9	2.81	*SILTY SAND-CLAYEY SAND			>100	>100		
27.0	124.4	3.36	*CLAYEY SAND-SANDY CLAY			>100	>100		
28.0	111.6	3.97	*CLAYEY SAND-SANDY CLAY			>100	>100		
29.0	171.2	3.71	*CLAYEY SAND-SANDY CLAY			>100	>100		

* - INDICATES OVERCONSOLIDATED OR CEMENTED MATERIAL



PROJECT: CITY OF TORRANCE-AG FN 1987
PROJECT NUMBER: 89-230-3901
INSTRUMENT NUMBER: F15CKE081
DATE: 09-14-1988

The Earth Technology Corporation

CONE PENETROMETER TEST
PROBE: CPT-7

CONE PENETROMETER TEST DATA

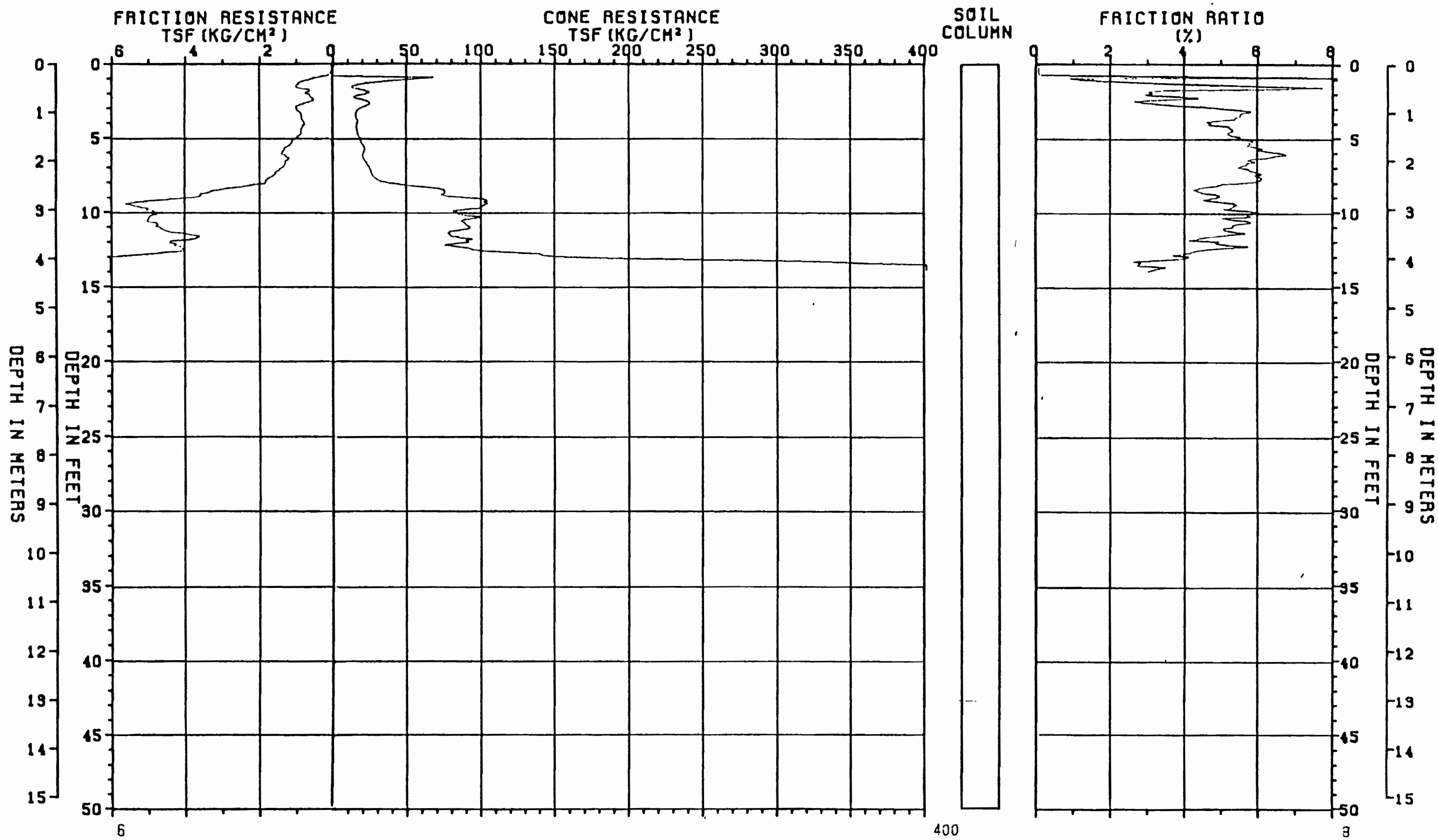
SOUNDING : CPT-8
PROJECT : CITY OF TORRANCE-AG FN 1987
PROJECT No: 89-230-3901
TEST DATE : 09-14-1988

LOCATION : TORRANCE CA
INSTRUMENT : F15CKE081
ELECTRONICS: T2
OPERATOR : MR/HA

Assumed Depth to Water (Feet)= 31 Soil Total Unit Weight (pcf) = 102

DEPTH (ft)	NORMALIZED CONE (tsf)	FRICTION RATIO (%)	SOIL BEHAVIOR TYPE	EQUIV RELATIVE DENSITY	EQUIV FRICTION ANGLE	EQUIV N1	EQUIV N1'	Su1= (C-T)/Nc (ksf)	Su2= Fs*A (ksf)
1.0	131.3	1.14	SAND TO SILTY SAND	50-60	40-42	40-60	40-60		
2.0	44.3	2.84	SANDY SILT-CLAYEY SILT	60-70	27-31	20-25	25-40		
3.0	32.6	5.45	*SANDY CLAY-SILTY CLAY			25-40	40-60	1.19	1.19
4.0	27.8	4.57	CLAYEY SILT-SILTY CLAY			20-25	25-40	2.17	1.50
5.0	30.4	5.59	*SANDY CLAY-SILTY CLAY			25-40	40-60	1.26	1.26
6.0	31.5	6.65	*SANDY CLAY-SILTY CLAY			40-60	40-60	1.37	1.37
7.0	36.5	5.65	*SANDY CLAY-SILTY CLAY			40-60	40-60	1.66	1.66
8.0	52.1	4.91	*SANDY CLAY-SILTY CLAY			40-60	60-80	2.47	2.47
9.0	118.2	4.60	*SANDY CLAY-SILTY CLAY			>100	>100	5.86	5.86
10.0	108.7	5.61	*SANDY CLAY-SILTY CLAY			>100	>100	5.57	5.57
11.0	116.5	4.96	*SANDY CLAY-SILTY CLAY			>100	>100	6.17	6.17
12.0	111.7	4.77	*SANDY CLAY-SILTY CLAY			>100	>100	6.10	6.10
13.0	179.2	3.97	*CLAYEY SAND-SANDY CLAY			>100	>100		

* - INDICATES OVERCONSOLIDATED OR CEMENTED MATERIAL



PROJECT: CITY OF TORRANCE-AG FN 1987
PROJECT NUMBER: 89-230-3901
INSTRUMENT NUMBER: F15CKE081
DATE: 09-14-1988

The Earth Technology Corporation

CONE PENETROMETER TEST

PROBE: CPT-8

CONE PENETROMETER TEST DATA

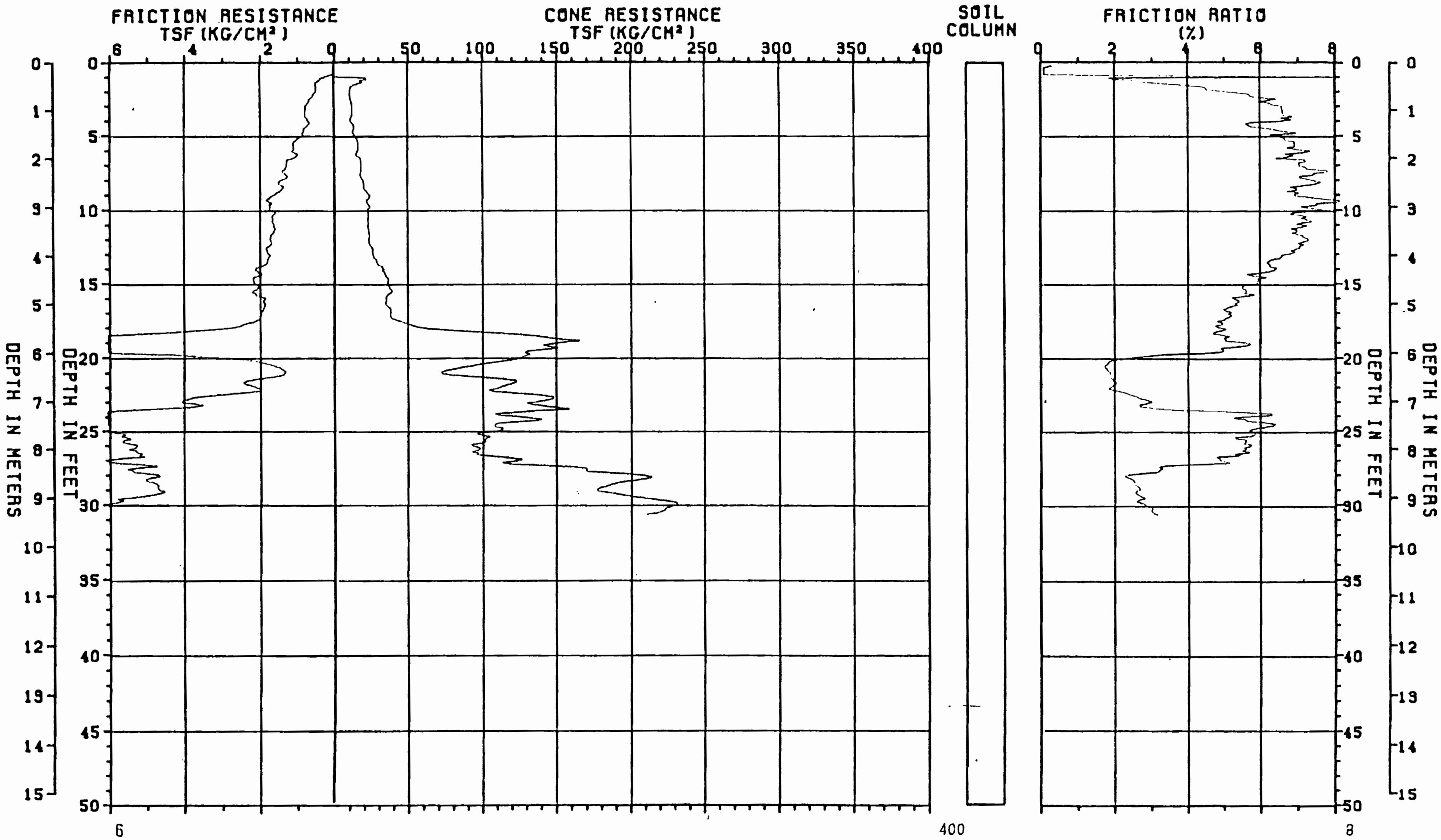
SOUNDING : CPT-9
PROJECT : CITY OF TORRANCE-AG FN 1987
PROJECT No: 89-230-3901
TEST DATE : 09-14-1988

LOCATION : TORRANCE CA
INSTRUMENT : F15CKE081
ELECTRONICS: T2
OPERATOR : MR/HA

Assumed Depth to Water (Feet)= 31 Soil Total Unit Weight (pcf) = 102

DEPTH (ft)	NORMALIZED CONE (tsf)	FRICTION RATIO (%)	SOIL BEHAVIOR TYPE	EQUIV RELATIVE DENSITY	EQUIV FRICTION ANGLE	EQUIV N1	EQUIV N1'	Su1= (C-T)/Nc (ksf)	Su2= Fs*A (ksf)
1.0	0.9	66.40	PEATS			1-5	5-10	0.07	0.07
2.0	20.9	4.93	CLAYEY SILT-SILTY CLAY			15-20	25-40	1.38	1.03
3.0	22.3	6.45	*SANDY CLAY-SILTY CLAY			25-40	25-40	0.81	0.81
4.0	18.3	6.39	SILTY CLAY TO CLAY			20-25	25-40	1.42	1.38
5.0	22.3	6.18	SILTY CLAY TO CLAY			20-25	25-40	1.83	1.73
6.0	23.9	7.22	*SANDY CLAY-SILTY CLAY			25-40	25-40	1.03	1.03
7.0	26.1	7.09	*SANDY CLAY-SILTY CLAY			25-40	40-60	1.18	1.18
8.0	27.6	7.32	*SANDY CLAY-SILTY CLAY			25-40	40-60	1.30	1.30
9.0	32.6	6.80	*SANDY CLAY-SILTY CLAY			40-60	40-60	1.60	1.60
10.0	29.7	7.09	*SANDY CLAY-SILTY CLAY			40-60	40-60	1.50	1.50
11.0	28.7	7.12	*SANDY CLAY-SILTY CLAY			25-40	40-60	1.49	1.49
12.0	28.9	7.16	*SANDY CLAY-SILTY CLAY			25-40	40-60	1.55	1.55
13.0	31.2	6.44	*SANDY CLAY-SILTY CLAY			40-60	40-60	1.72	1.72
14.0	38.8	6.26	*SANDY CLAY-SILTY CLAY			40-60	40-60	2.21	2.21
15.0	40.8	5.53	*SANDY CLAY-SILTY CLAY			40-60	40-60	2.38	2.38
16.0	38.7	5.21	*SANDY CLAY-SILTY CLAY			40-60	40-60	2.32	2.32
17.0	40.6	5.03	*SANDY CLAY-SILTY CLAY			40-60	40-60	2.49	2.49
18.0	64.4	4.96	*SANDY CLAY-SILTY CLAY			60-80	60-80	4.08	4.08
19.0	149.0	5.63	*SANDY CLAY-SILTY CLAY			>100	>100	9.73	9.73
20.0	121.1	2.17	SILTY SAND-SANDY SILT	70-80	35-40	60-80	60-80		
21.0	70.8	1.82	SILTY SAND-SANDY SILT	50-60	35-40	25-40	25-40		
22.0	104.6	1.76	SILTY SAND-SANDY SILT	60-70	35-40	40-60	40-60		
23.0	121.3	2.66	SILTY SAND-SANDY SILT	90-100	35-40	80-100	80-100		
24.0	121.7	5.17	*SANDY CLAY-SILTY CLAY			>100	>100	8.82	8.82
25.0	89.3	5.76	*SANDY CLAY-SILTY CLAY			>100	>100	6.57	6.57
26.0	85.2	5.44	*SANDY CLAY-SILTY CLAY			>100	>100	6.38	6.38
27.0	97.8	5.07	*SANDY CLAY-SILTY CLAY			>100	>100	7.48	7.48
28.0	181.0	2.26	SILTY SAND-SANDY SILT	90-100	35-40	>100	>100		
29.0	152.1	2.50	SILTY SAND-SANDY SILT	90-100	35-40	>100	>100		

* - INDICATES OVERCONSOLIDATED OR CEMENTED MATERIAL



PROJECT: CITY OF TORRANCE-AG FN 1987
PROJECT NUMBER: 89-230-3901
INSTRUMENT NUMBER: F15CKE081
DATE: 09-14-1988

The Earth Technology Corporation

CONE PENETROMETER TEST

PROBE: CPT-9

Plate C20

CONE PENETROMETER TEST DATA

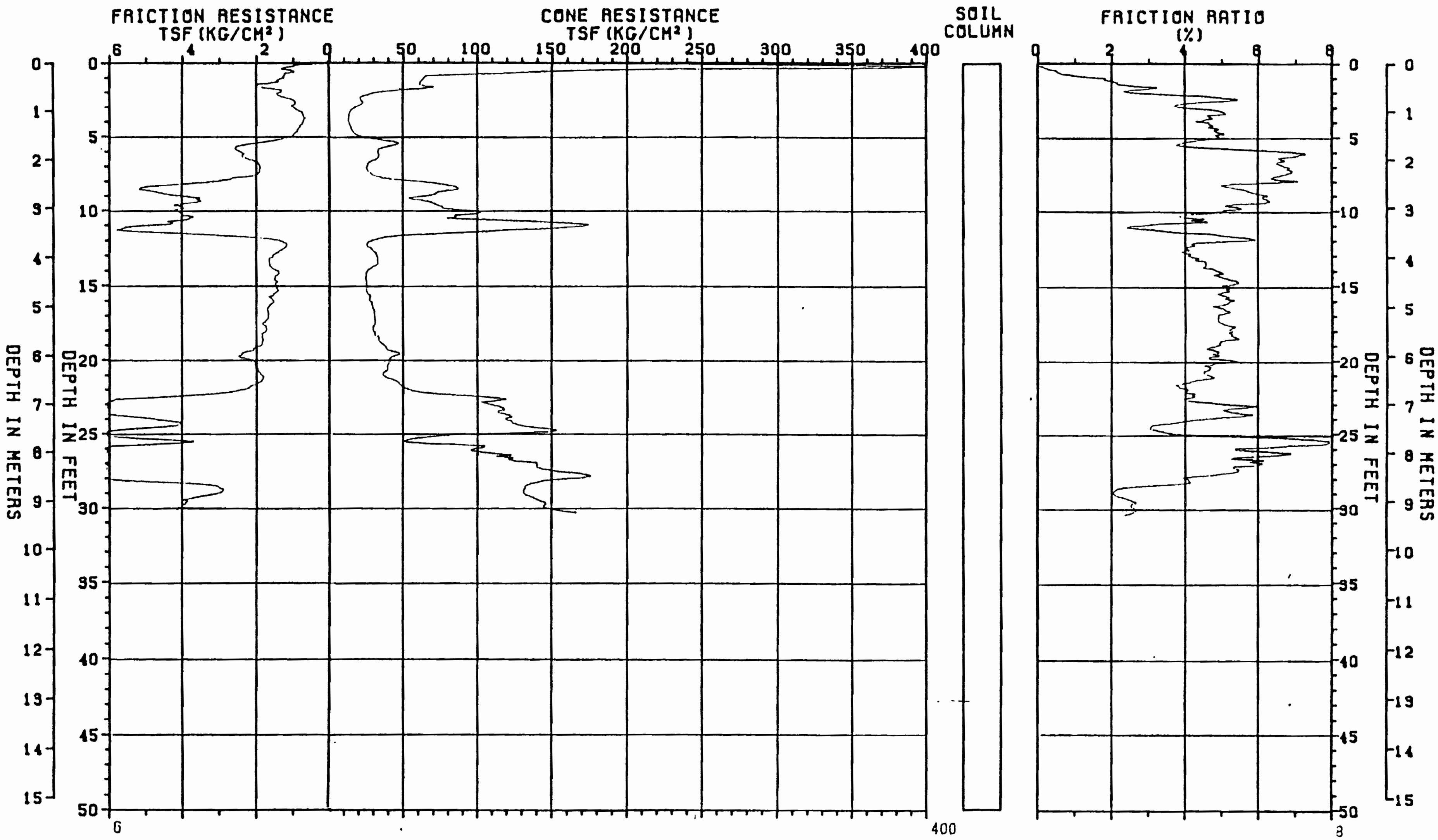
SOUNDING : CPT-10
PROJECT : CITY OF TORRANCE-AG FN 1987
PROJECT No: 89-230-3901
TEST DATE : 09-14-1988

LOCATION : TORRANCE CA
INSTRUMENT : F15CKE081
ELECTRONICS: T2
OPERATOR : MR/HA

Assumed Depth to Water (Feet)= 31 Soil Total Unit Weight (pcf) = 102

DEPTH (ft)	NORMALIZED CONE (tsf)	FRICTION RATIO (%)	SOIL BEHAVIOR TYPE	EQUIV RELATIVE DENSITY	EQUIV FRICTION ANGLE	EQUIV N1	EQUIV N1'	Su1= (C-T)/Nc (ksf)	Su2= Fs*A (ksf)
1.0	111.5	2.45	SILTY SAND-SANDY SILT	80-90	35-40	60-80	60-80		
2.0	73.0	3.54	*CLAYEY SAND-SANDY CLAY	90-100	27-31	40-60	60-80		
3.0	38.1	4.75	*SANDY CLAY-SILTY CLAY			25-40	40-60	1.39	1.39
4.0	23.8	4.72	CLAYEY SILT-SILTY CLAY			20-25	25-40	1.85	1.33
5.0	34.0	4.56	CLAYEY SILT-SILTY CLAY			25-40	25-40	2.81	1.95
6.0	51.7	7.13	*SANDY CLAY-SILTY CLAY			60-80	60-80	2.26	2.26
7.0	39.4	6.60	*SANDY CLAY-SILTY CLAY			40-60	40-60	1.79	1.79
8.0	76.7	5.29	*SANDY CLAY-SILTY CLAY			80-100	80-100	3.65	3.65
9.0	92.2	6.16	*SANDY CLAY-SILTY CLAY			>100	>100	4.56	4.56
10.0	113.4	4.73	*SANDY CLAY-SILTY CLAY			>100	>100	5.81	5.81
11.0	220.0	2.44	*SILTY SAND-CLAYEY SAND			>100	>100		
12.0	41.1	4.36	*SANDY CLAY-SILTY CLAY			25-40	40-60	2.22	2.22
13.0	39.4	4.24	CLAYEY SILT-SILTY CLAY			25-40	40-60	4.36	2.83
14.0	34.0	5.01	*SANDY CLAY-SILTY CLAY			25-40	40-60	1.93	1.93
15.0	30.0	5.30	*SANDY CLAY-SILTY CLAY			25-40	25-40	1.74	1.74
16.0	31.7	5.26	*SANDY CLAY-SILTY CLAY			25-40	40-60	1.89	1.89
17.0	33.3	5.11	*SANDY CLAY-SILTY CLAY			25-40	40-60	2.03	2.03
18.0	32.5	5.35	*SANDY CLAY-SILTY CLAY			25-40	40-60	2.03	2.03
19.0	36.8	4.90	*SANDY CLAY-SILTY CLAY			25-40	40-60	2.36	2.36
20.0	42.8	5.47	*SANDY CLAY-SILTY CLAY			40-60	40-60	2.81	2.81
21.0	36.9	4.79	*SANDY CLAY-SILTY CLAY			25-40	40-60	2.47	2.47
22.0	49.2	4.12	*SANDY CLAY-SILTY CLAY			40-60	40-60	3.36	3.36
23.0	96.9	6.07	*SANDY CLAY-SILTY CLAY			>100	>100	6.86	6.86
24.0	113.8	4.25	*CLAYEY SAND-SANDY CLAY			>100	>100		
25.0	135.8	4.23	*CLAYEY SAND-SANDY CLAY			>100	>100		
26.0	94.1	5.46	*SANDY CLAY-SILTY CLAY			>100	>100	7.06	7.06
27.0	110.0	6.04	*SANDY CLAY-SILTY CLAY			>100	>100	8.43	8.43
28.0	149.9	4.19	*CLAYEY SAND-SANDY CLAY			>100	>100		
29.0	110.2	2.14	SILTY SAND-SANDY SILT	70-80	35-40	60-80	60-80		

* - INDICATES OVERCONSOLIDATED OR CEMENTED MATERIAL



PROJECT: CITY OF TORRANCE-AG FN 1987
PROJECT NUMBER: 89-230-3901
INSTRUMENT NUMBER: F15CKE081
DATE: 09-14-1988

The Earth Technology Corporation

CONE PENETROMETER TEST
PROBE: CPT-10

CONE PENETROMETER TEST DATA

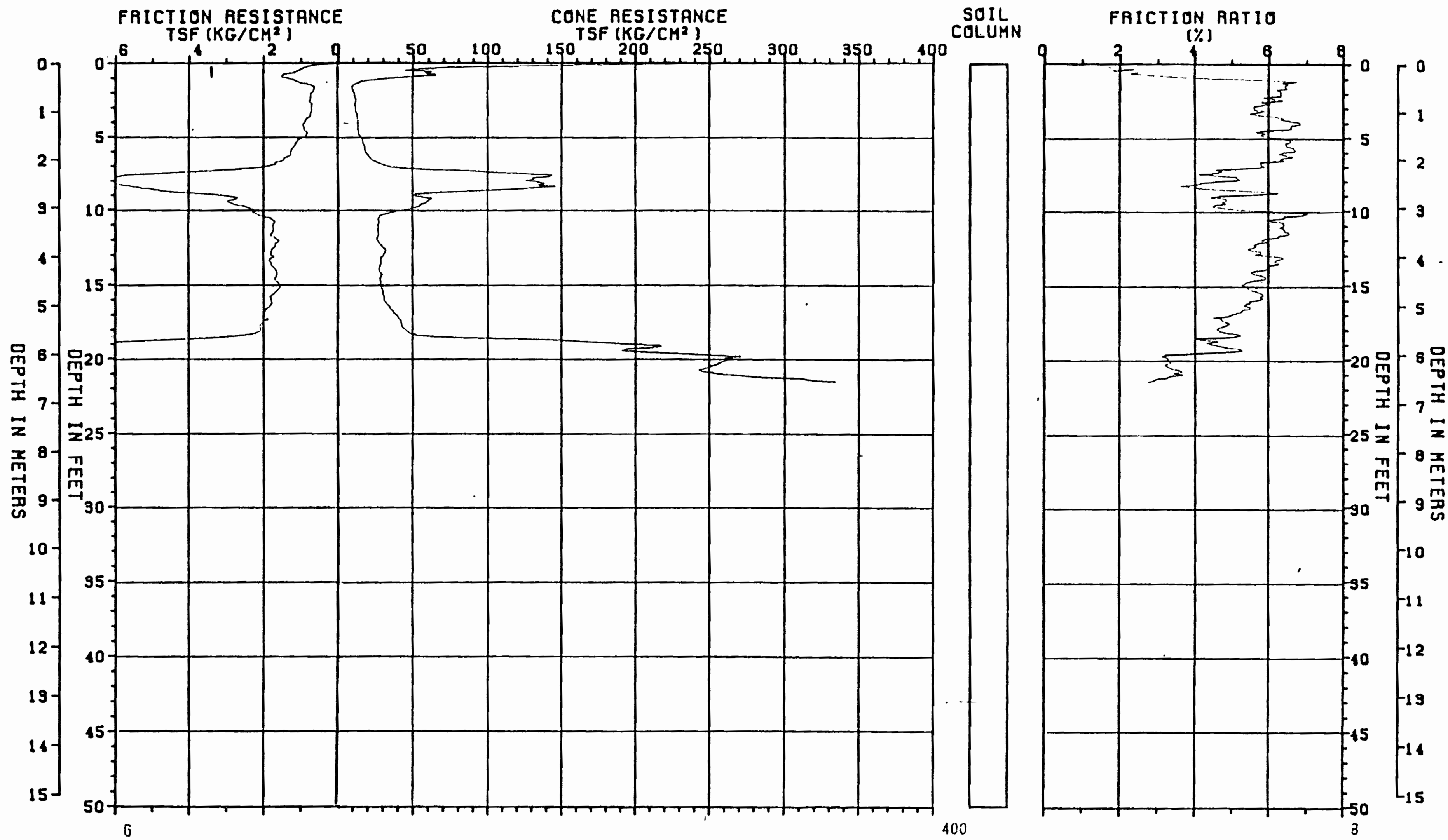
SOUNDING : CPT-11
PROJECT : CITY OF TORRANCE-AG FN 1987
PROJECT No: 89-230-3901
TEST DATE : 09-14-1988

LOCATION : TORRANCE CA
INSTRUMENT : F15CKE081
ELECTRONICS: T2
OPERATOR : MR/HA

Assumed Depth to Water (Feet)= 31 Soil Total Unit Weight (pcf) = 102

DEPTH (ft)	NORMALIZED CONE (tsf)	FRICTION RATIO (%)	SOIL BEHAVIOR TYPE	EQUIV RELATIVE DENSITY	EQUIV FRICTION ANGLE	EQUIV N1	EQUIV N1'	Su1= (C-T)/Nc (ksf)	Su2= Fs*A (ksf)
1.0	85.2	3.48	*CLAYEY SAND-SANDY CLAY			60-80	60-80		
2.0	22.7	6.31	*SANDY CLAY-SILTY CLAY			25-40	25-40	0.75	0.75
3.0	22.3	5.61	SILTY CLAY TO CLAY			20-25	25-40	1.62	1.38
4.0	23.0	6.58	*SANDY CLAY-SILTY CLAY			25-40	25-40	0.89	0.89
5.0	25.3	5.88	*SANDY CLAY-SILTY CLAY			25-40	25-40	1.04	1.04
6.0	28.8	6.70	*SANDY CLAY-SILTY CLAY			25-40	40-60	1.25	1.25
7.0	51.4	5.80	*SANDY CLAY-SILTY CLAY			60-80	60-80	2.34	2.34
8.0	175.0	5.22	*SANDY CLAY-SILTY CLAY			>100	>100	8.37	8.37
9.0	68.9	5.66	*SANDY CLAY-SILTY CLAY			80-100	80-100	3.40	3.40
10.0	54.0	5.19	*SANDY CLAY-SILTY CLAY			60-80	60-80	2.75	2.75
11.0	33.9	6.39	*SANDY CLAY-SILTY CLAY			40-60	40-60	1.77	1.77
12.0	32.2	5.89	*SANDY CLAY-SILTY CLAY			25-40	40-60	1.73	1.73
13.0	36.1	5.78	*SANDY CLAY-SILTY CLAY			40-60	40-60	2.00	2.00
14.0	31.4	5.98	*SANDY CLAY-SILTY CLAY			25-40	40-60	1.78	1.78
15.0	32.1	5.36	*SANDY CLAY-SILTY CLAY			25-40	40-60	1.87	1.87
16.0	33.2	5.83	*SANDY CLAY-SILTY CLAY			25-40	40-60	1.98	1.98
17.0	41.2	5.13	*SANDY CLAY-SILTY CLAY			40-60	40-60	2.53	2.53
18.0	45.9	4.66	*SANDY CLAY-SILTY CLAY			40-60	40-60	2.89	2.89
19.0	186.8	4.33	*CLAYEY SAND-SANDY CLAY			>100	>100		
20.0	188.5	4.53	*CLAYEY SAND-SANDY CLAY			>100	>100		

* - INDICATES OVERCONSOLIDATED OR CEMENTED MATERIAL



PROJECT: CITY OF TORRANCE-AG FN 1987
PROJECT NUMBER: 89-230-3901
INSTRUMENT NUMBER: F15CKE081
DATE: 09-14-1988

The Earth Technology Corporation

CONE PENETROMETER TEST

PROBE: CPT-11

Plate C24

CONE PENETROMETER TEST DATA

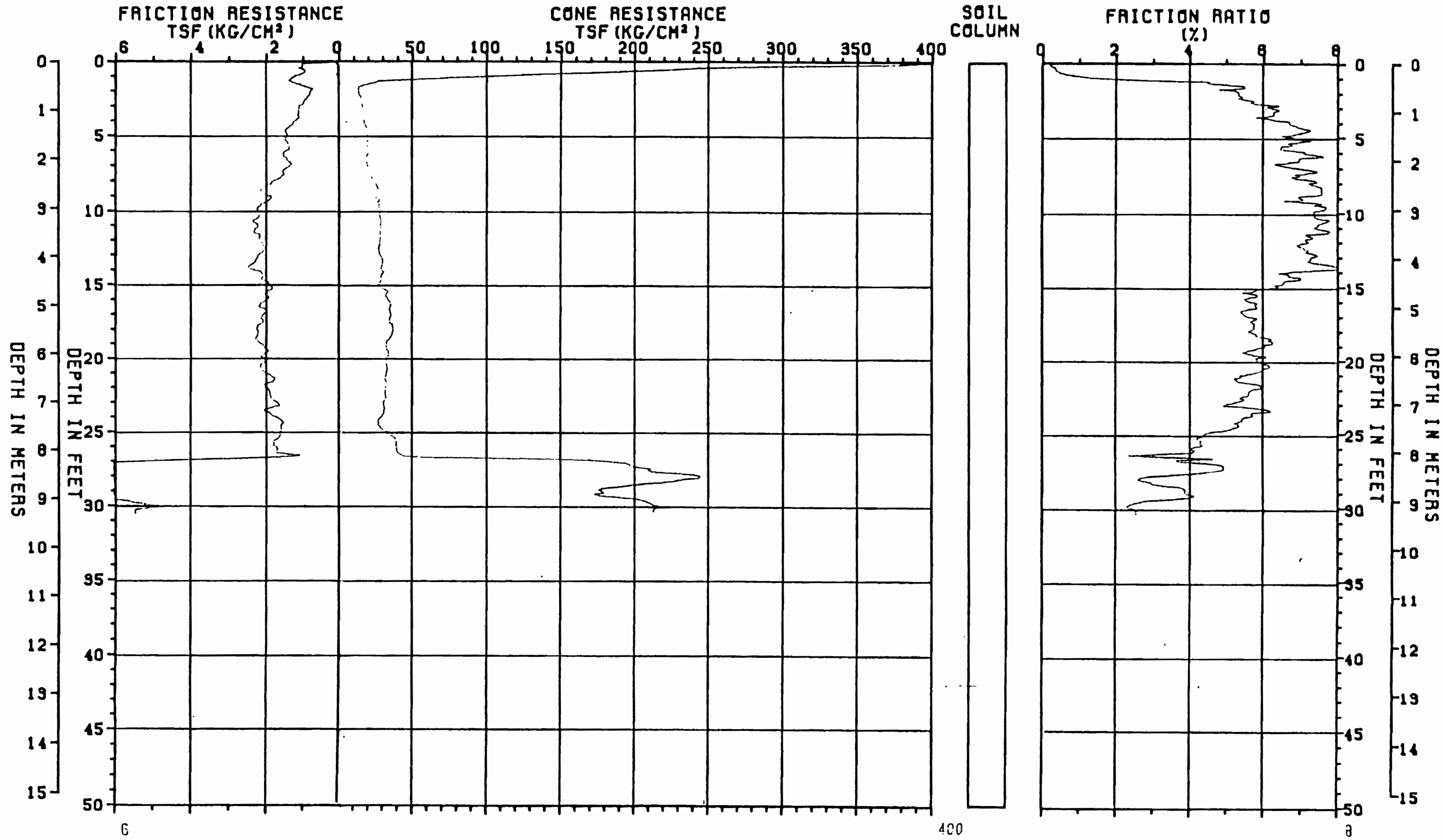
SOUNDING : CPT-12
PROJECT : CITY OF TORRANCE-AG FN 1987
PROJECT No: 89-230-3901
TEST DATE : 09-14-1988

LOCATION : TORRANCE CA
INSTRUMENT : F15CKE081
ELECTRONICS: T2
OPERATOR : MR/HA

Assumed Depth to Water (Feet)= 31 Soil Total Unit Weight (pcf) = 102

DEPTH (ft)	NORMALIZED CONE (tsf)	FRICTION RATIO (%)	SOIL BEHAVIOR TYPE	EQUIV RELATIVE DENSITY	EQUIV FRICTION ANGLE	EQUIV N1	EQUIV N1'	Su1= (C-T)/Nc (ksf)	Su2= Fs*A (ksf)
1.0	233.6	0.80	SAND TO SILTY SAND	60-70	42-45	80-100	80-100		
2.0	29.2	5.32	*SANDY CLAY-SILTY CLAY			25-40	25-40	0.97	0.97
3.0	31.6	6.05	*SANDY CLAY-SILTY CLAY			25-40	40-60	1.15	1.15
4.0	30.9	6.68	*SANDY CLAY-SILTY CLAY			40-60	40-60	1.21	1.21
5.0	33.5	6.45	*SANDY CLAY-SILTY CLAY			40-60	40-60	1.39	1.39
6.0	31.8	6.78	*SANDY CLAY-SILTY CLAY			40-60	40-60	1.38	1.38
7.0	29.8	6.44	*SANDY CLAY-SILTY CLAY			25-40	40-60	1.35	1.35
8.0	33.0	7.29	*SANDY CLAY-SILTY CLAY			40-60	40-60	1.56	1.56
9.0	34.8	7.43	*SANDY CLAY-SILTY CLAY			40-60	40-60	1.71	1.71
10.0	37.2	7.55	*SANDY CLAY-SILTY CLAY			40-60	40-60	1.88	1.88
11.0	36.6	7.43	*SANDY CLAY-SILTY CLAY			40-60	40-60	1.91	1.91
12.0	36.0	7.09	*SANDY CLAY-SILTY CLAY			40-60	40-60	1.94	1.94
13.0	34.4	7.33	*SANDY CLAY-SILTY CLAY			40-60	40-60	1.90	1.90
14.0	34.0	8.02	*SANDY CLAY-SILTY CLAY			40-60	40-60	1.93	1.93
15.0	32.0	6.50	*SANDY CLAY-SILTY CLAY			40-60	40-60	1.86	1.86
16.0	37.2	5.46	*SANDY CLAY-SILTY CLAY			40-60	40-60	2.23	2.23
17.0	38.7	5.49	*SANDY CLAY-SILTY CLAY			40-60	40-60	2.37	2.37
18.0	39.7	5.76	*SANDY CLAY-SILTY CLAY			40-60	40-60	2.49	2.49
19.0	34.2	6.25	*SANDY CLAY-SILTY CLAY			40-60	40-60	2.18	2.18
20.0	33.8	5.77	*SANDY CLAY-SILTY CLAY			25-40	40-60	2.21	2.21
21.0	32.7	5.75	*SANDY CLAY-SILTY CLAY			25-40	40-60	2.17	2.17
22.0	31.5	5.93	*SANDY CLAY-SILTY CLAY			25-40	40-60	2.14	2.14
23.0	29.2	5.20	*SANDY CLAY-SILTY CLAY			25-40	25-40	2.01	2.01
24.0	27.7	5.47	*SANDY CLAY-SILTY CLAY			25-40	25-40	1.95	1.95
25.0	30.1	4.55	CLAYEY SILT-SILTY CLAY			25-40	25-40	4.31	3.06
26.0	35.5	4.11	CLAYEY SILT-SILTY CLAY			25-40	25-40	5.22	3.33
27.0	146.7	3.67	*CLAYEY SAND-SANDY CLAY			>100	>100		
28.0	204.2	2.81	*SILTY SAND-CLAYEY SAND			>100	>100		
29.0	146.0	3.88	*CLAYEY SAND-SANDY CLAY			>100	>100		

* - INDICATES OVERCONSOLIDATED OR CEMENTED MATERIAL



PROJECT: CITY OF TORRANCE-AG FN 1987
PROJECT NUMBER: 89-230-3901
INSTRUMENT NUMBER: F15CKE081
DATE: 09-14-1988

The Earth Technology Corporation

CONE PENETROMETER TEST

PROBE: CPT-12

CONE PENETROMETER TEST DATA

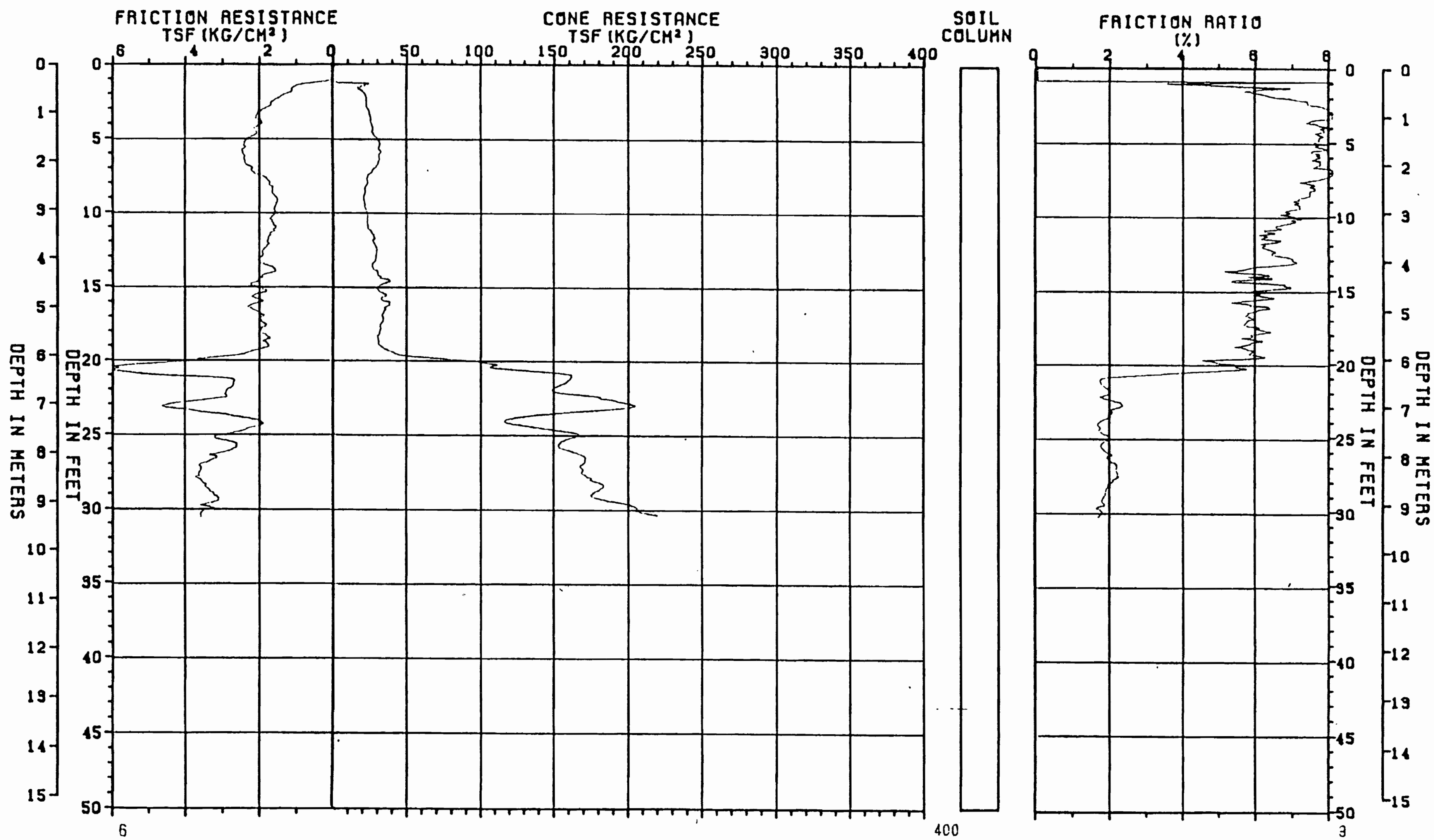
SOUNDING : CPT-13
PROJECT : CITY OF TORRANCE-AG FN 1987
PROJECT No: 89-230-3901
TEST DATE : 09-14-1988

LOCATION : TORRANCE CA
INSTRUMENT : F15CKE081
ELECTRONICS: T2
OPERATOR : MR/HA

Assumed Depth to Water (Feet)= 31 Soil Total Unit Weight (pcf) = 102

DEPTH (ft)	NORMALIZED CONE (tsf)	FRICTION RATIO (%)	SOIL BEHAVIOR TYPE	EQUIV RELATIVE DENSITY	EQUIV FRICTION ANGLE	EQUIV N1	EQUIV N1'	Su1= (C-T)/Nc (ksf)	Su2= Fs*A (ksf)
1.0	-0.1	0.00	SILTY CLAY TO CLAY			1-5	1-5	-0.01	-0.01
2.0	44.6	6.25	*SANDY CLAY-SILTY CLAY			40-60	60-80	1.49	1.49
3.0	44.7	7.90	*SANDY CLAY-SILTY CLAY			60-80	60-80	1.63	1.63
4.0	45.4	7.64	*SANDY CLAY-SILTY CLAY			60-80	60-80	1.78	1.78
5.0	49.3	7.63	*SANDY CLAY-SILTY CLAY			60-80	60-80	2.04	2.04
6.0	47.4	7.54	*SANDY CLAY-SILTY CLAY			60-80	60-80	2.07	2.07
7.0	38.6	8.23	*SANDY CLAY-SILTY CLAY			40-60	60-80	1.75	1.75
8.0	31.2	7.52	*SANDY CLAY-SILTY CLAY			40-60	40-60	1.47	1.47
9.0	28.2	7.08	*SANDY CLAY-SILTY CLAY			25-40	40-60	1.37	1.37
10.0	30.7	6.58	*SANDY CLAY-SILTY CLAY			40-60	40-60	1.55	1.55
11.0	30.2	6.62	*SANDY CLAY-SILTY CLAY			25-40	40-60	1.57	1.57
12.0	34.2	6.04	*SANDY CLAY-SILTY CLAY			40-60	40-60	1.84	1.84
13.0	34.2	6.81	*SANDY CLAY-SILTY CLAY			40-60	40-60	1.89	1.89
14.0	35.4	5.44	*SANDY CLAY-SILTY CLAY			25-40	40-60	2.01	2.01
15.0	33.3	6.87	*SANDY CLAY-SILTY CLAY			40-60	40-60	1.94	1.94
16.0	41.9	5.25	*SANDY CLAY-SILTY CLAY			40-60	40-60	2.51	2.51
17.0	36.0	5.78	*SANDY CLAY-SILTY CLAY			40-60	40-60	2.20	2.20
18.0	32.7	6.33	*SANDY CLAY-SILTY CLAY			40-60	40-60	2.04	2.04
19.0	32.8	5.33	*SANDY CLAY-SILTY CLAY			25-40	40-60	2.09	2.09
20.0	85.8	4.79	*SANDY CLAY-SILTY CLAY			80-100	80-100	5.70	5.70
21.0	156.5	2.32	SILTY SAND-SANDY SILT	90-100	35-40	>100	>100		
22.0	140.5	1.95	SILTY SAND-SANDY SILT	70-80	35-40	60-80	80-100		
23.0	187.6	2.29	SILTY SAND-SANDY SILT	90-100	35-40	>100	>100		
24.0	106.3	1.70	SILTY SAND-SANDY SILT	60-70	35-40	40-60	40-60		
25.0	148.6	1.91	SILTY SAND-SANDY SILT	70-80	35-40	80-100	80-100		
26.0	137.2	1.79	SAND TO SILTY SAND	70-80	35-40	60-80	60-80		
27.0	145.3	2.15	SILTY SAND-SANDY SILT	80-90	35-40	80-100	80-100		
28.0	148.0	2.03	SILTY SAND-SANDY SILT	80-90	35-40	80-100	80-100		
29.0	145.7	1.83	SILTY SAND-SANDY SILT	70-80	40-42	60-80	80-100		

* - INDICATES OVERCONSOLIDATED OR CEMENTED MATERIAL



PROJECT: CITY OF TORRANCE-AG FN 1987
PROJECT NUMBER: 89-230-3901
INSTRUMENT NUMBER: F15CKE081
DATE: 09-14-1988

The Earth Technology Corporation

CONE PENETROMETER TEST
PROBE: CPT-13

CONE PENETROMETER TEST DATA

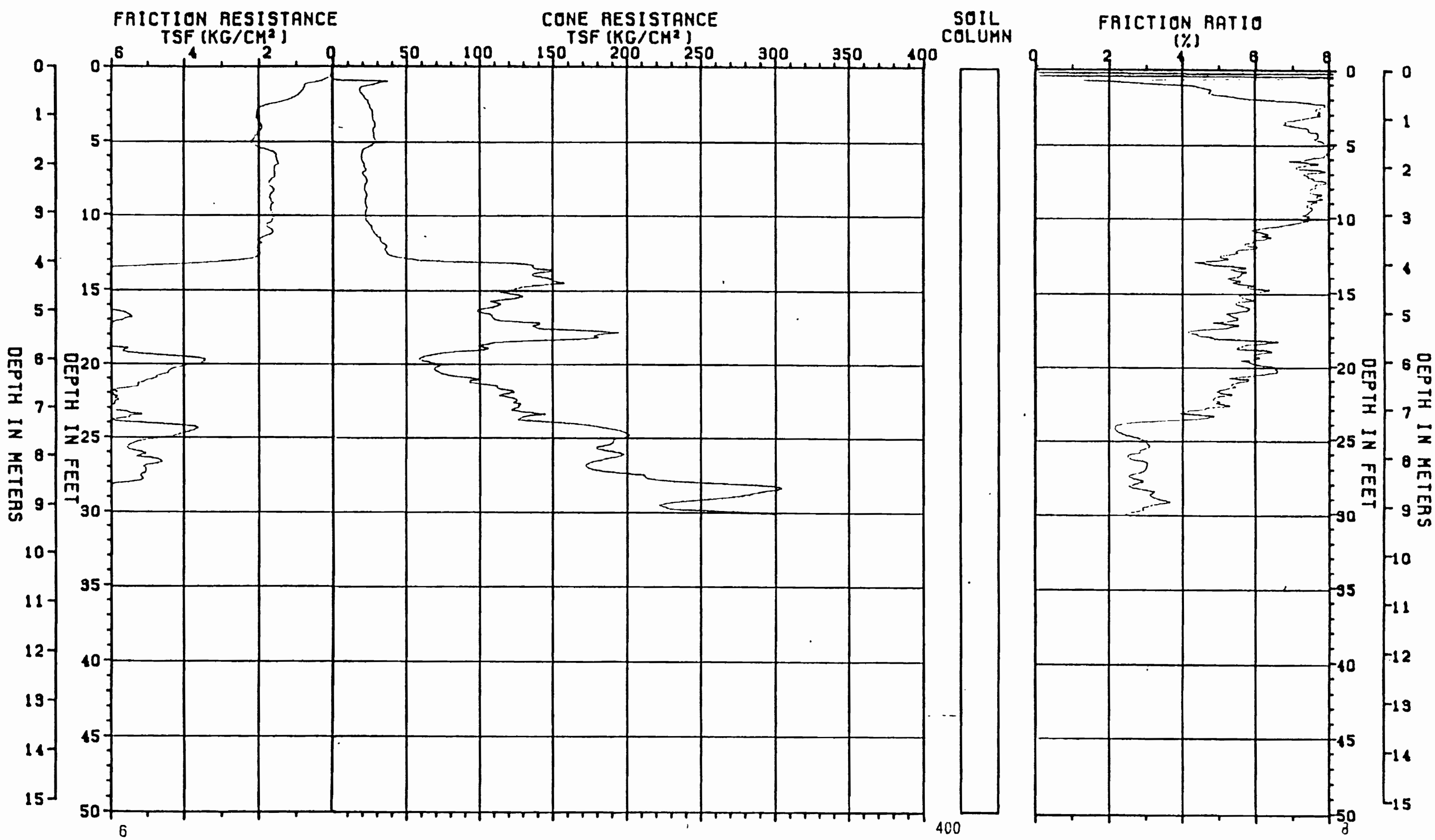
SOUNDING : CPT-14
PROJECT : CITY OF TORRANCE-AG FN 1987
PROJECT No: 89-230-3901
TEST DATE : 09-14-1988

LOCATION : TORRANCE CA
INSTRUMENT : F15CKE081
ELECTRONICS: T2
OPERATOR : MR/HA

Assumed Depth to Water (Feet)= 31 Soil Total Unit Weight (pcf) = 102

DEPTH (ft)	NORMALIZED CONE (tsf)	FRICTION RATIO (%)	SOIL BEHAVIOR TYPE	EQUIV RELATIVE DENSITY	EQUIV FRICTION ANGLE	EQUIV N1	EQUIV N1'	Su1= (C-T)/Nc (ksf)	Su2= Fs*A (ksf)
1.0	85.1	1.21	SAND TO SILTY SAND	50-60	35-40	25-40	25-40		
2.0	41.8	4.75	*SANDY CLAY-SILTY CLAY			40-60	40-60	1.39	1.39
3.0	48.8	7.52	*SANDY CLAY-SILTY CLAY			60-80	60-80	1.78	1.78
4.0	48.5	6.60	*SANDY CLAY-SILTY CLAY			60-80	60-80	1.90	1.90
5.0	46.3	7.47	*SANDY CLAY-SILTY CLAY			60-80	60-80	1.92	1.92
6.0	29.4	7.91	*SANDY CLAY-SILTY CLAY			40-60	40-60	1.27	1.27
7.0	32.6	6.99	*SANDY CLAY-SILTY CLAY			40-60	40-60	1.48	1.48
8.0	30.0	7.81	*SANDY CLAY-SILTY CLAY			40-60	40-60	1.41	1.41
9.0	29.4	7.54	*SANDY CLAY-SILTY CLAY			40-60	40-60	1.43	1.43
10.0	28.3	0.00	SAND TO SILTY SAND	0-10	31-35	1-5	1-5		
11.0	33.1	6.19	*SANDY CLAY-SILTY CLAY			40-60	40-60	1.72	1.72
12.0	42.0	5.82	*SANDY CLAY-SILTY CLAY			40-60	40-60	2.27	2.27
13.0	58.1	4.93	*SANDY CLAY-SILTY CLAY			60-80	60-80	3.24	3.24
14.0	158.0	5.66	*SANDY CLAY-SILTY CLAY			>100	>100	9.14	9.14
15.0	141.5	5.65	*SANDY CLAY-SILTY CLAY			>100	>100	8.40	8.40
16.0	120.9	5.41	*SANDY CLAY-SILTY CLAY			>100	>100	7.35	7.35
17.0	114.5	5.27	*SANDY CLAY-SILTY CLAY			>100	>100	7.13	7.13
18.0	188.9	4.05	*CLAYEY SAND-SANDY CLAY			>100	>100		
19.0	103.1	5.53	*SANDY CLAY-SILTY CLAY			>100	>100	6.72	6.72
20.0	64.4	5.49	*SANDY CLAY-SILTY CLAY			60-80	80-100	4.26	4.26
21.0	80.7	5.84	*SANDY CLAY-SILTY CLAY			>100	>100	5.48	5.48
22.0	115.6	4.92	*SANDY CLAY-SILTY CLAY			>100	>100	8.04	8.04
23.0	117.1	5.03	*SANDY CLAY-SILTY CLAY			>100	>100	8.31	8.31
24.0	114.3	4.11	*CLAYEY SAND-SANDY CLAY			>100	>100		
25.0	177.7	2.27	SILTY SAND-SANDY SILT	90-100	35-40	>100	>100		
26.0	156.6	2.87	*SILTY SAND-CLAYEY SAND			>100	>100		
27.0	148.8	2.95	*SILTY SAND-CLAYEY SAND			>100	>100		
28.0	179.4	2.57	*SILTY SAND-CLAYEY SAND			>100	>100		
29.0	238.3	3.08	*SILTY SAND-CLAYEY SAND			>100	>100		

* - INDICATES OVERCONSOLIDATED OR CEMENTED MATERIAL



PROJECT: CITY OF TORRANCE-AG FN 1987
PROJECT NUMBER: 89-230-3901
INSTRUMENT NUMBER: F15CKE081
DATE: 09-14-1988

The Earth Technology Corporation

CONE PENETROMETER TEST
PROBE: CPT-14

CONE PENETROMETER TEST DATA

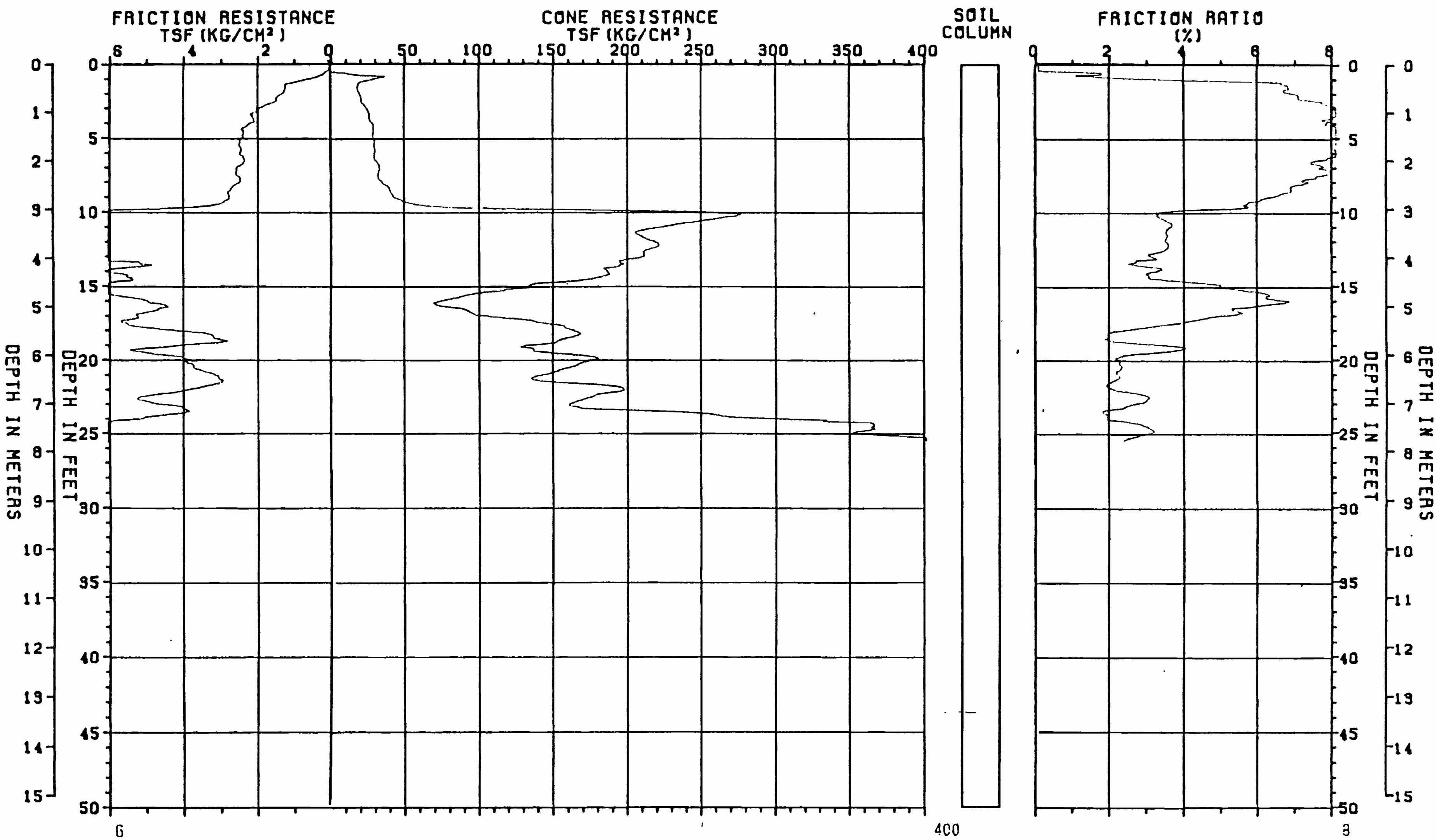
SOUNDING : CPT-15
PROJECT : CITY OF TORRANCE-AG FN 1987
PROJECT No: 89-230-3901
TEST DATE : 09-14-1988

LOCATION : TORRANCE CA
INSTRUMENT : F15CKE081
ELECTRONICS: T2
OPERATOR : MR/HA

Assumed Depth to Water (Feet)= 31 Soil Total Unit Weight (pcf) = 102

DEPTH (ft)	NORMALIZED CONE (tsf)	FRICTION RATIO (%)	SOIL BEHAVIOR TYPE	EQUIV RELATIVE DENSITY	EQUIV FRICTION ANGLE	EQUIV N1	EQUIV N1'	Su1= (C-T)/Nc (ksf)	Su2= Fs*A (ksf)
1.0	75.7	1.66	SILTY SAND-SANDY SILT	50-60	35-40	25-40	25-40		
2.0	39.2	6.60	*SANDY CLAY-SILTY CLAY			40-60	40-60	1.30	1.30
3.0	44.0	8.04	*SANDY CLAY-SILTY CLAY			60-80	60-80	1.60	1.60
4.0	47.9	7.85	*SANDY CLAY-SILTY CLAY			60-80	60-80	1.87	1.87
5.0	46.5	8.20	*SANDY CLAY-SILTY CLAY			60-80	60-80	1.93	1.93
6.0	45.6	8.20	*SANDY CLAY-SILTY CLAY			60-80	60-80	1.99	1.99
7.0	47.5	7.85	*SANDY CLAY-SILTY CLAY			60-80	60-80	2.16	2.16
8.0	48.7	7.06	*SANDY CLAY-SILTY CLAY			60-80	60-80	2.31	2.31
9.0	57.9	6.36	*SANDY CLAY-SILTY CLAY			60-80	60-80	2.86	2.86
10.0	317.0	3.45	*SILTY SAND-CLAYEY SAND			>100	>100		
11.0	279.8	3.59	*CLAYEY SAND-SANDY CLAY			>100	>100		
12.0	265.2	3.42	*SILTY SAND-CLAYEY SAND			>100	>100		
13.0	248.4	3.00	*SILTY SAND-CLAYEY SAND			>100	>100		
14.0	213.6	3.20	*SILTY SAND-CLAYEY SAND			>100	>100		
15.0	149.1	4.87	*SANDY CLAY-SILTY CLAY			>100	>100	8.85	8.85
16.0	78.8	6.74	*SANDY CLAY-SILTY CLAY			>100	>100	4.77	4.77
17.0	114.9	4.77	*SANDY CLAY-SILTY CLAY			>100	>100	7.16	7.16
18.0	170.3	2.30	SILTY SAND-SANDY SILT	90-100	35-40	>100	>100		
19.0	132.4	3.41	*CLAYEY SAND-SANDY CLAY			>100	>100		
20.0	175.5	2.23	SILTY SAND-SANDY SILT	90-100	35-40	>100	>100		
21.0	137.8	2.14	SILTY SAND-SANDY SILT	80-90	35-40	80-100	80-100		
22.0	188.1	2.05	SILTY SAND-SANDY SILT	80-90	40-42	>100	>100		
23.0	149.2	2.39	SILTY SAND-SANDY SILT	90-100	35-40	>100	>100		
24.0	269.4	1.95	SAND TO SILTY SAND	90-100	40-42	>100	>100		

* - INDICATES OVERCONSOLIDATED OR CEMENTED MATERIAL



PROJECT: CITY OF TORRANCE-AG FN 1987
PROJECT NUMBER: 89-230-3901
INSTRUMENT NUMBER: F15CKE081
DATE: 09-14-1988

The Earth Technology Corporation

CONE PENETROMETER TEST
PROBE: CPT-15

Plate C32

CONE PENETROMETER TEST DATA

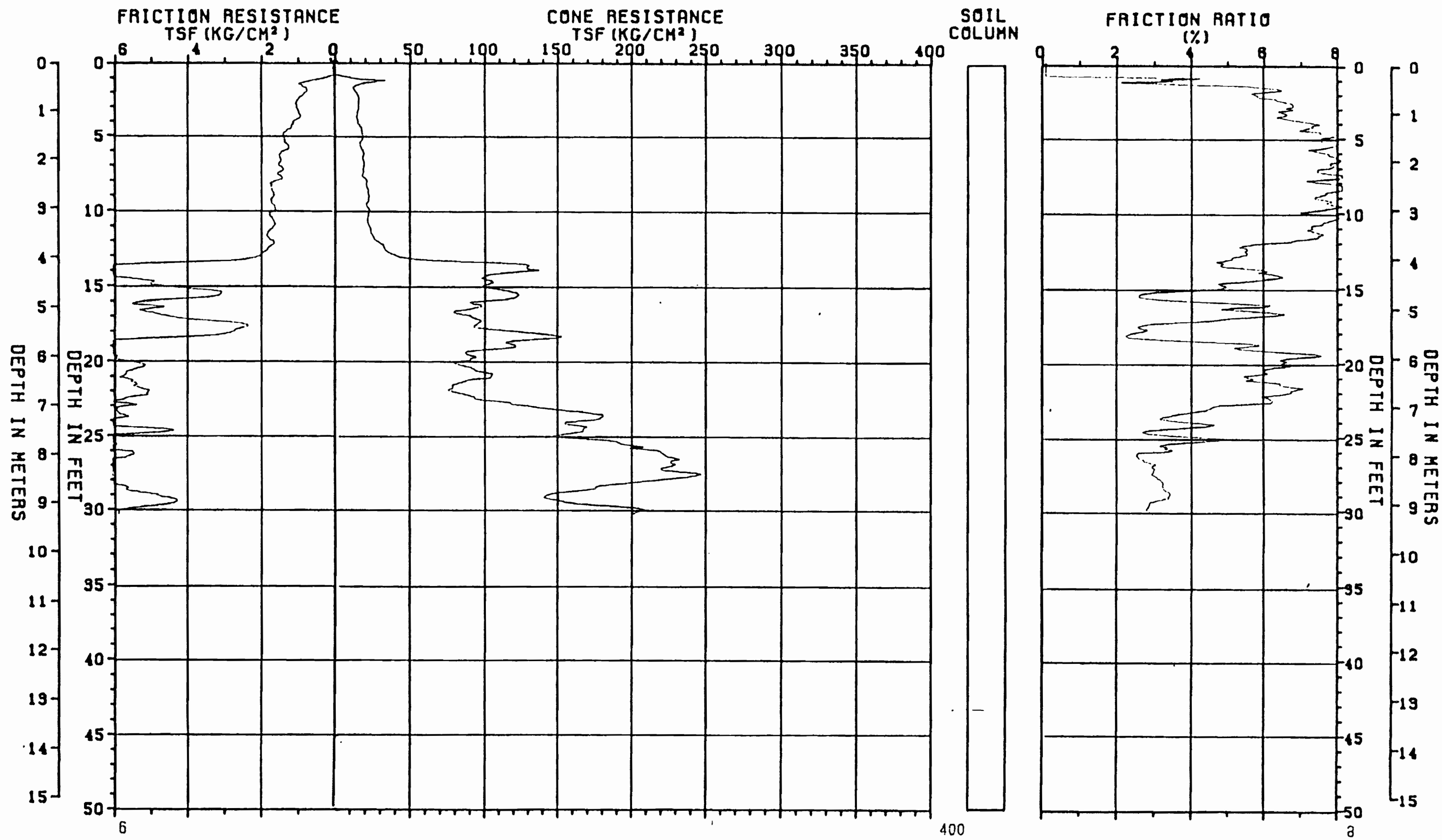
SOUNDING : CPT-16
PROJECT : CITY OF TORRANCE-AG FN 1987
PROJECT No: 89-230-3901
TEST DATE : 09-14-1988

LOCATION : TORRANCE CA
INSTRUMENT : F15CKE081
ELECTRONICS: T2
OPERATOR : MR/HA

Assumed Depth to Water (Feet)= 31 Soil Total Unit Weight (pcf) = 102

DEPTH (ft)	NORMALIZED CONE (tsf)	FRICTION RATIO (%)	SOIL BEHAVIOR TYPE	EQUIV RELATIVE DENSITY	EQUIV FRICTION ANGLE	EQUIV N1	EQUIV N1'	Su1= (C-T)/Nc (ksf)	Su2= Fs*A (ksf)
1.0	-0.1	0.00	SILTY CLAY TO CLAY			1-5	1-5	-0.01	-0.01
2.0	27.2	5.52	*SANDY CLAY-SILTY CLAY			25-40	25-40	0.90	0.90
3.0	28.8	6.47	*SANDY CLAY-SILTY CLAY			25-40	40-60	1.05	1.05
4.0	26.0	7.15	*SANDY CLAY-SILTY CLAY			25-40	40-60	1.01	1.01
5.0	29.5	7.42	*SANDY CLAY-SILTY CLAY			40-60	40-60	1.22	1.22
6.0	28.0	7.46	*SANDY CLAY-SILTY CLAY			25-40	40-60	1.21	1.21
7.0	28.6	7.67	*SANDY CLAY-SILTY CLAY			40-60	40-60	1.29	1.29
8.0	29.3	7.21	*SANDY CLAY-SILTY CLAY			40-60	40-60	1.38	1.38
9.0	30.0	7.25	*SANDY CLAY-SILTY CLAY			40-60	40-60	1.46	1.46
10.0	30.1	6.85	*SANDY CLAY-SILTY CLAY			40-60	40-60	1.52	1.52
11.0	28.5	7.17	*SANDY CLAY-SILTY CLAY			25-40	40-60	1.48	1.48
12.0	32.0	6.59	*SANDY CLAY-SILTY CLAY			40-60	40-60	1.72	1.72
13.0	44.5	5.24	*SANDY CLAY-SILTY CLAY			40-60	40-60	2.47	2.47
14.0	148.5	5.98	*SANDY CLAY-SILTY CLAY			>100	>100	8.59	8.59
15.0	114.3	4.86	*SANDY CLAY-SILTY CLAY			>100	>100	6.78	6.78
16.0	124.4	4.09	*CLAYEY SAND-SANDY CLAY			>100	>100		
17.0	89.6	5.58	*SANDY CLAY-SILTY CLAY			>100	>100	5.57	5.57
18.0	105.5	2.63	SILTY SAND-SANDY SILT	80-90	35-40	60-80	60-80		
19.0	119.9	5.42	*SANDY CLAY-SILTY CLAY			>100	>100	7.82	7.82
20.0	89.4	6.51	*SANDY CLAY-SILTY CLAY			>100	>100	5.94	5.94
21.0	102.6	5.33	*SANDY CLAY-SILTY CLAY			>100	>100	6.98	6.98
22.0	74.2	6.61	*SANDY CLAY-SILTY CLAY			>100	>100	5.13	5.13
23.0	109.8	4.09	*CLAYEY SAND-SANDY CLAY			>100	>100		
24.0	162.9	3.30	*CLAYEY SAND-SANDY CLAY			>100	>100		
25.0	144.5	3.20	*CLAYEY SAND-SANDY CLAY			>100	>100		
26.0	173.9	3.42	*CLAYEY SAND-SANDY CLAY			>100	>100		
27.0	194.3	2.97	*SILTY SAND-CLAYEY SAND			>100	>100		
28.0	200.8	3.03	*SILTY SAND-CLAYEY SAND			>100	>100		
29.0	130.0	3.36	*CLAYEY SAND-SANDY CLAY			>100	>100		

* - INDICATES OVERCONSOLIDATED OR CEMENTED MATERIAL



PROJECT: CITY OF TORRANCE-AG FN 1987
PROJECT NUMBER: 89-230-3901
INSTRUMENT NUMBER: F15CKE081
DATE: 09-14-1988

The Earth Technology Corporation

CONE PENETROMETER TEST

PROBE: CPT-16

CONE PENETROMETER TEST DATA

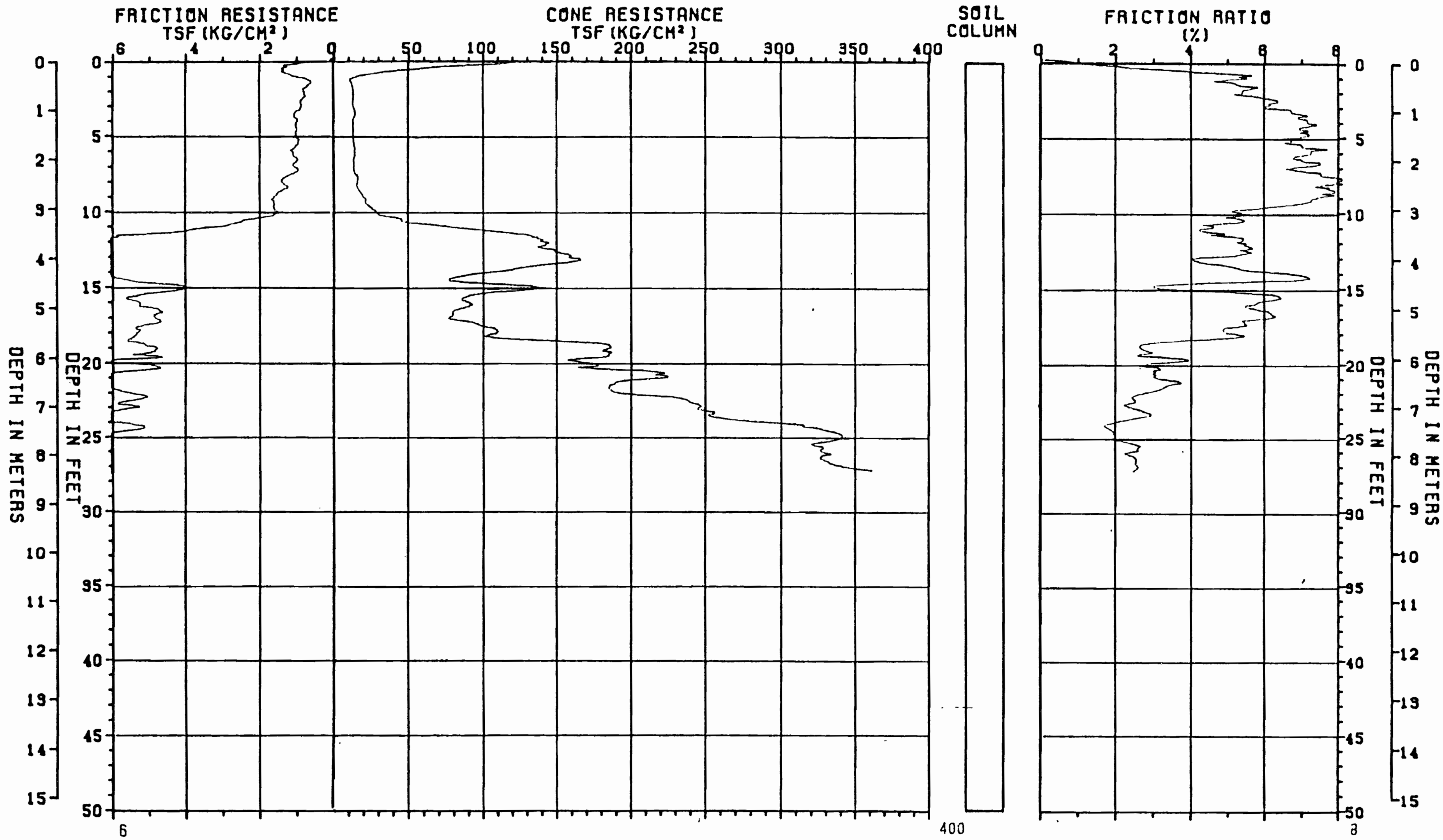
SOUNDING : CPT-17
PROJECT : CITY OF TORRANCE-AG FN 1987
PROJECT No: 89-230-3901
TEST DATE : 09-14-1988

LOCATION : TORRANCE CA
INSTRUMENT : F15CKE081
ELECTRONICS: T2
OPERATOR : MR/HA

Assumed Depth to Water (Feet)= 31 Soil Total Unit Weight (pcf) = 102

DEPTH (ft)	NORMALIZED CONE (tsf)	FRICTION RATIO (%)	SOIL BEHAVIOR TYPE	EQUIV RELATIVE DENSITY	EQUIV FRICTION ANGLE	EQUIV N1	EQUIV N1'	Su1= (C-T)/Nc (ksf)	Su2= Fs*A (ksf)
1.0	49.4	5.05	*SANDY CLAY-SILTY CLAY			40-60	60-80	1.43	1.43
2.0	28.2	5.55	*SANDY CLAY-SILTY CLAY			25-40	25-40	0.94	0.94
3.0	24.8	6.01	*SANDY CLAY-SILTY CLAY			25-40	25-40	0.90	0.90
4.0	23.1	6.79	*SANDY CLAY-SILTY CLAY			25-40	25-40	0.90	0.90
5.0	22.4	7.09	*SANDY CLAY-SILTY CLAY			25-40	25-40	0.92	0.92
6.0	22.6	7.59	*SANDY CLAY-SILTY CLAY			25-40	25-40	0.98	0.98
7.0	20.9	7.40	*SANDY CLAY-SILTY CLAY			25-40	25-40	0.94	0.94
8.0	21.3	8.98	*SANDY CLAY-SILTY CLAY			25-40	25-40	1.00	1.00
9.0	27.2	7.44	*SANDY CLAY-SILTY CLAY			25-40	40-60	1.33	1.33
10.0	35.2	5.70	*SANDY CLAY-SILTY CLAY			40-60	40-60	1.78	1.78
11.0	73.1	4.81	*SANDY CLAY-SILTY CLAY			80-100	80-100	3.86	3.86
12.0	166.6	5.34	*SANDY CLAY-SILTY CLAY			>100	>100	9.12	9.12
13.0	179.1	5.54	*SANDY CLAY-SILTY CLAY			>100	>100	10.09	10.09
14.0	141.6	5.11	*SANDY CLAY-SILTY CLAY			>100	>100	8.19	8.19
15.0	112.2	4.16	*CLAYEY SAND-SANDY CLAY			>100	>100		
16.0	92.9	6.33	*SANDY CLAY-SILTY CLAY			>100	>100	5.63	5.63
17.0	84.7	6.05	*SANDY CLAY-SILTY CLAY			>100	>100	5.26	5.26
18.0	112.2	4.81	*SANDY CLAY-SILTY CLAY			>100	>100	7.15	7.15
19.0	181.8	2.81	*SILTY SAND-CLAYEY SAND			>100	>100		
20.0	20.3	30.44	*SANDY CLAY-SILTY CLAY			25-40	25-40	1.30	1.30
21.0	215.8	2.91	*SILTY SAND-CLAYEY SAND			>100	>100		
22.0	175.5	3.10	*SILTY SAND-CLAYEY SAND			>100	>100		
23.0	223.6	2.13	SILTY SAND-SANDY SILT	90-100	40-42	>100	>100		
24.0	237.2	2.39	*SILTY SAND-CLAYEY SAND			>100	>100		
25.0	299.9	1.89	*SAND TO SILTY SAND	90-100	40-42	>100	>100		
26.0	286.5	2.51	*SILTY SAND-CLAYEY SAND			>100	>100		

* - INDICATES OVERCONSOLIDATED OR CEMENTED MATERIAL



PROJECT: CITY OF TORRANCE-AG FN 1987
PROJECT NUMBER: 89-230-3901
INSTRUMENT NUMBER: F15CKE081
DATE: 09-14-1988

The Earth Technology Corporation

CONE PENETROMETER TEST

PROBE: CPT-17

Plate C36

CONE PENETROMETER TEST DATA

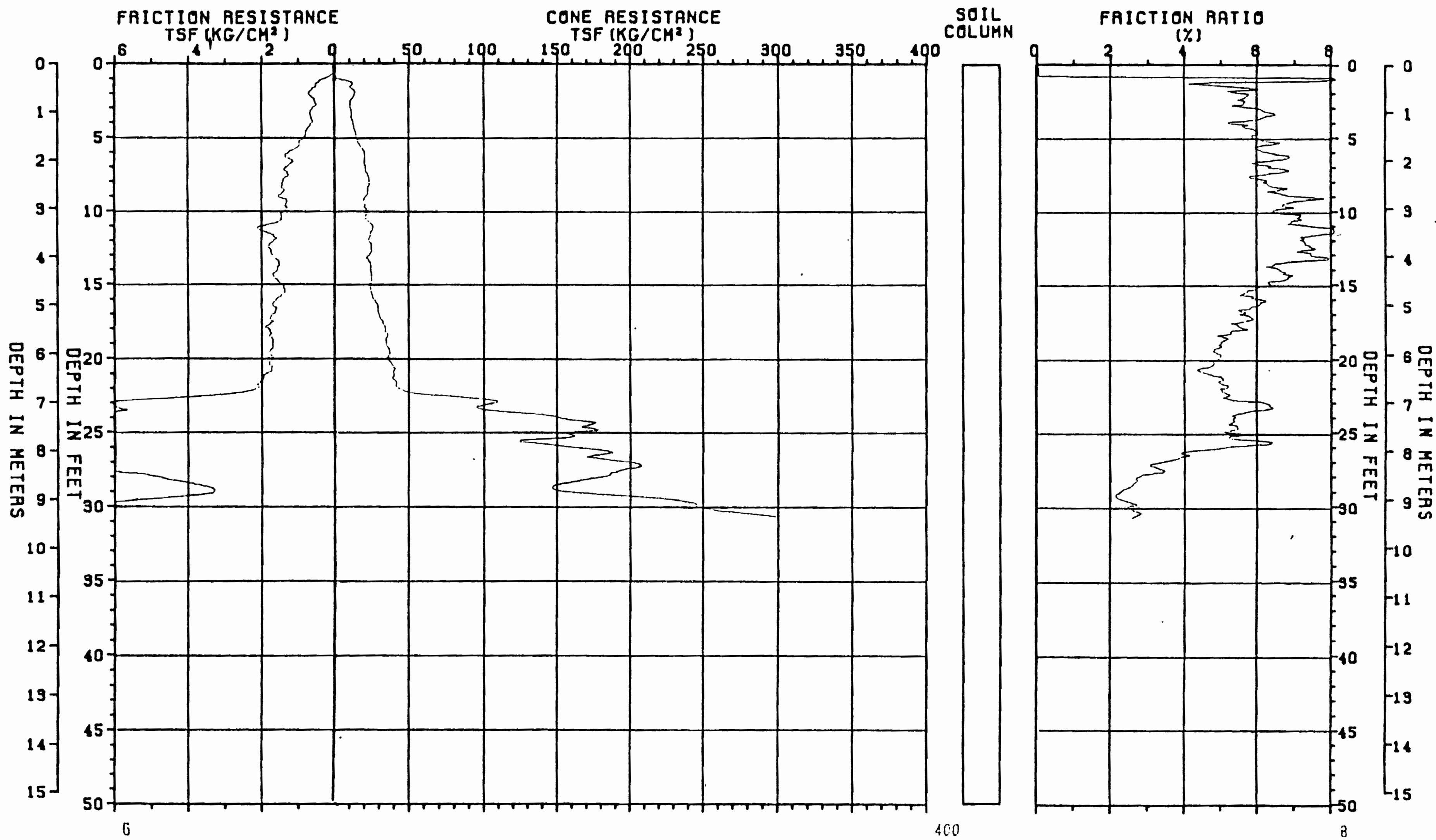
SOUNDING : CPT-18
PROJECT : CITY OF TORRANCE-AG FN 1987
PROJECT No: 89-230-3901
TEST DATE : 09-15-1988

LOCATION : TORRANCE CA
INSTRUMENT : F15CKE081
ELECTRONICS: T2
OPERATOR : MR/HA

Assumed Depth to Water (Feet)= 31 Soil Total Unit Weight (pcf) = 102

DEPTH (ft)	NORMALIZED CONE (tsf)	FRICTION RATIO (%)	SOIL BEHAVIOR TYPE	EQUIV RELATIVE DENSITY	EQUIV FRICTION ANGLE	EQUIV N1	EQUIV N1'	Su1= (C-T)/Nc (ksf)	Su2= Fs*A (ksf)
1.0	11.4	7.55	SILTY CLAY TO CLAY			10-15	20-25	0.66	0.66
2.0	25.4	5.65	*SANDY CLAY-SILTY CLAY			25-40	25-40	0.84	0.84
3.0	19.7	6.04	SILTY CLAY TO CLAY			20-25	25-40	1.42	1.31
4.0	20.5	5.69	SILTY CLAY TO CLAY			20-25	25-40	1.59	1.38
5.0	23.7	6.06	*SANDY CLAY-SILTY CLAY			25-40	25-40	0.97	0.97
6.0	30.7	6.45	*SANDY CLAY-SILTY CLAY			25-40	40-60	1.33	1.33
7.0	30.0	6.67	*SANDY CLAY-SILTY CLAY			25-40	40-60	1.36	1.36
8.0	32.5	6.21	*SANDY CLAY-SILTY CLAY			40-60	40-60	1.53	1.53
9.0	26.9	7.74	*SANDY CLAY-SILTY CLAY			25-40	40-60	1.31	1.31
10.0	27.7	6.49	*SANDY CLAY-SILTY CLAY			25-40	40-60	1.40	1.40
11.0	31.9	8.26	*SANDY CLAY-SILTY CLAY			40-60	40-60	1.66	1.66
12.0	28.6	7.21	*SANDY CLAY-SILTY CLAY			25-40	40-60	1.53	1.53
13.0	25.6	7.86	*SANDY CLAY-SILTY CLAY			25-40	40-60	1.40	1.40
14.0	27.5	6.71	*SANDY CLAY-SILTY CLAY			25-40	40-60	1.55	1.55
15.0	26.7	5.89	*SANDY CLAY-SILTY CLAY			25-40	25-40	1.54	1.54
16.0	29.9	5.99	*SANDY CLAY-SILTY CLAY			25-40	40-60	1.78	1.78
17.0	31.6	5.90	*SANDY CLAY-SILTY CLAY			25-40	40-60	1.92	1.92
18.0	35.1	5.20	*SANDY CLAY-SILTY CLAY			25-40	40-60	2.19	2.19
19.0	35.1	4.88	*SANDY CLAY-SILTY CLAY			25-40	40-60	2.25	2.25
20.0	36.1	4.75	*SANDY CLAY-SILTY CLAY			25-40	40-60	2.36	2.36
21.0	38.4	4.98	*SANDY CLAY-SILTY CLAY			25-40	40-60	2.57	2.57
22.0	44.1	4.98	*SANDY CLAY-SILTY CLAY			40-60	40-60	3.02	3.02
23.0	81.2	7.13	*SANDY CLAY-SILTY CLAY			>100	>100	5.74	5.74
24.0	143.2	5.33	*SANDY CLAY-SILTY CLAY			>100	>100	10.38	10.38
25.0	142.0	5.16	*SANDY CLAY-SILTY CLAY			>100	>100	10.50	10.50
26.0	156.6	4.06	*CLAYEY SAND-SANDY CLAY			>100	>100		
27.0	177.7	3.02	*SILTY SAND-CLAYEY SAND			>100	>100		
28.0	144.1	2.68	*SILTY SAND-CLAYEY SAND	90-100	35-40	>100	>100		
29.0	145.3	2.07	SILTY SAND-SANDY SILT	80-90	35-40	80-100	80-100		

* - INDICATES OVERCONSOLIDATED OR CEMENTED MATERIAL



PROJECT: CITY OF TORRANCE-AG FN 1987
PROJECT NUMBER: 89-230-3901
INSTRUMENT NUMBER: F15CKE081
DATE: 09-15-1988

The Earth Technology Corporation

CONE PENETROMETER TEST
PROBE: CPT-18

CONE PENETROMETER TEST DATA

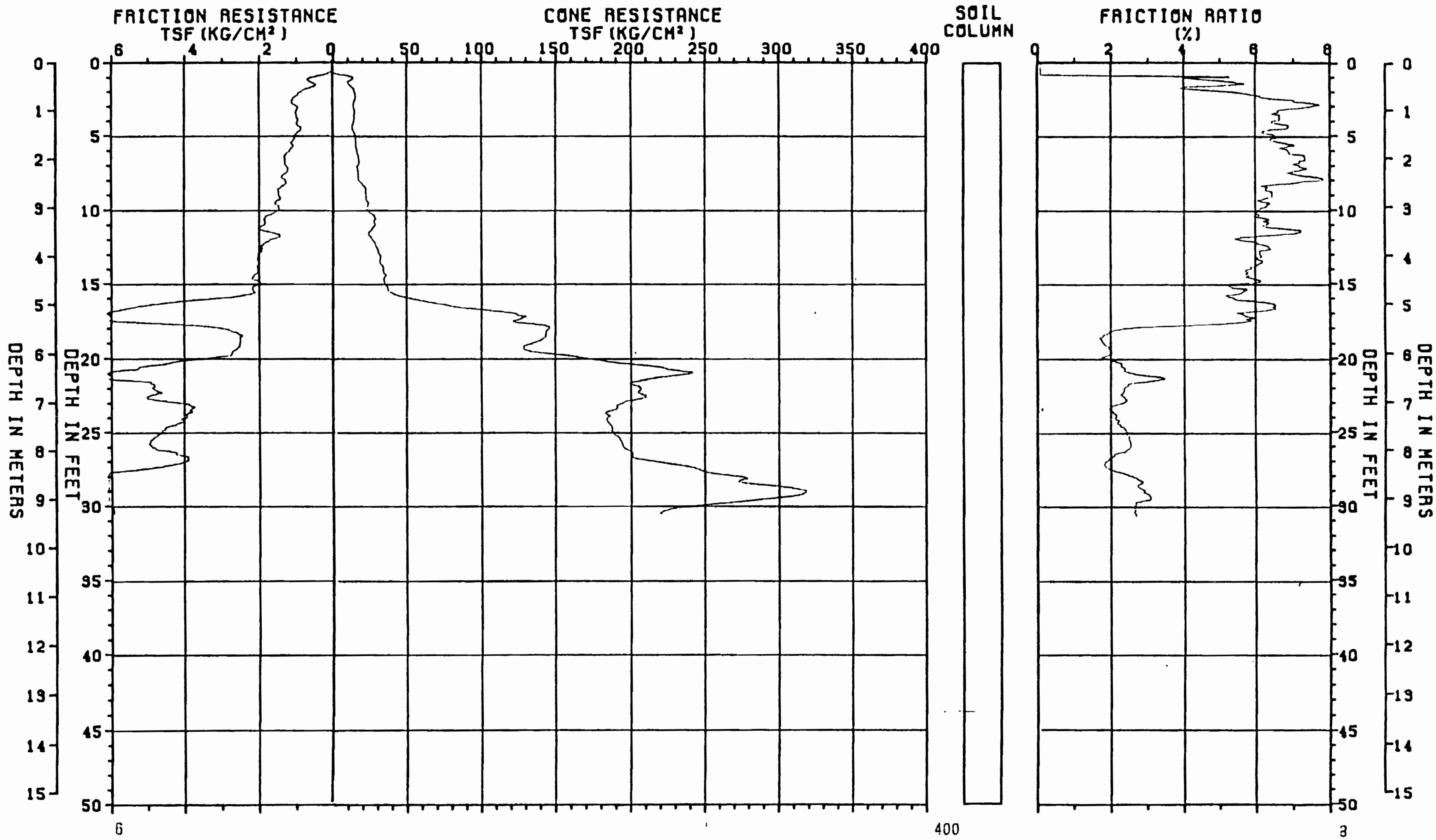
SOUNDING : CPT-19
PROJECT : CITY OF TORRANCE-AG FN 1987
PROJECT No: 89-230-3901
TEST DATE : 09-15-1988

LOCATION : TORRANCE CA
INSTRUMENT : F15CKE081
ELECTRONICS: T2
OPERATOR : MR/HA

Assumed Depth to Water (Feet)= 31 Soil Total Unit Weight (pcf) = 102

DEPTH (ft)	NORMALIZED CONE (tsf)	FRICTION RATIO (%)	SOIL BEHAVIOR TYPE	EQUIV RELATIVE DENSITY	EQUIV FRICTION ANGLE	EQUIV N1	EQUIV N1'	Su1= (C-T)/Nc (ksf)	Su2= Fs*A (ksf)
1.0	32.5	4.35	CLAYEY SILT-SILTY CLAY			25-40	25-40	1.88	1.23
2.0	29.9	5.73	*SANDY CLAY-SILTY CLAY			25-40	40-60	0.99	0.99
3.0	25.4	6.66	*SANDY CLAY-SILTY CLAY			25-40	40-60	0.92	0.92
4.0	24.3	6.52	*SANDY CLAY-SILTY CLAY			25-40	25-40	0.95	0.95
5.0	25.7	6.27	*SANDY CLAY-SILTY CLAY			25-40	25-40	1.06	1.06
6.0	25.7	6.79	*SANDY CLAY-SILTY CLAY			25-40	40-60	1.11	1.11
7.0	24.5	7.25	*SANDY CLAY-SILTY CLAY			25-40	40-60	1.10	1.10
8.0	25.3	6.95	*SANDY CLAY-SILTY CLAY			25-40	40-60	1.19	1.19
9.0	31.0	6.22	*SANDY CLAY-SILTY CLAY			25-40	40-60	1.52	1.52
10.0	31.1	5.88	*SANDY CLAY-SILTY CLAY			25-40	40-60	1.57	1.57
11.0	36.9	6.20	*SANDY CLAY-SILTY CLAY			40-60	40-60	1.93	1.93
12.0	34.0	5.93	*SANDY CLAY-SILTY CLAY			40-60	40-60	1.83	1.83
13.0	38.3	6.06	*SANDY CLAY-SILTY CLAY			40-60	40-60	2.13	2.13
14.0	40.4	5.62	*SANDY CLAY-SILTY CLAY			40-60	40-60	2.30	2.30
15.0	40.8	5.15	*SANDY CLAY-SILTY CLAY			40-60	40-60	2.38	2.38
16.0	59.2	5.91	*SANDY CLAY-SILTY CLAY			60-80	60-80	3.57	3.57
17.0	132.2	5.64	*SANDY CLAY-SILTY CLAY			>100	>100	8.24	8.24
18.0	151.9	2.01	SILTY SAND-SANDY SILT	80-90	35-40	80-100	80-100		
19.0	136.3	1.82	SILTY SAND-SANDY SILT	70-80	35-40	60-80	60-80		
20.0	138.7	2.43	SILTY SAND-SANDY SILT	90-100	35-40	80-100	80-100		
21.0	232.3	2.87	*SILTY SAND-CLAYEY SAND			>100	>100		
22.0	196.9	2.32	*SILTY SAND-CLAYEY SAND	90-100	40-42	>100	>100		
23.0	181.7	1.89	SAND TO SILTY SAND	80-90	40-42	>100	>100		
24.0	168.4	2.09	SILTY SAND-SANDY SILT	80-90	35-40	>100	>100		
25.0	168.8	2.39	SILTY SAND-SANDY SILT	90-100	35-40	>100	>100		
26.0	171.5	2.45	*SILTY SAND-CLAYEY SAND	90-100	35-40	>100	>100		
27.0	189.2	1.78	SAND TO SILTY SAND	80-90	40-42	>100	>100		
28.0	233.4	2.66	*SILTY SAND-CLAYEY SAND			>100	>100		
29.0	263.8	2.96	*SILTY SAND-CLAYEY SAND			>100	>100		

* - INDICATES OVERCONSOLIDATED OR CEMENTED MATERIAL



CONE PENETROMETER TEST

PROBE: CPT-19

PROJECT: CITY OF TORRANCE-AG FN 1987
PROJECT NUMBER: 89-230-3901
INSTRUMENT NUMBER: F15CKE081
DATE: 09-15-1988

The Earth Technology Corporation

CONE PENETROMETER TEST DATA

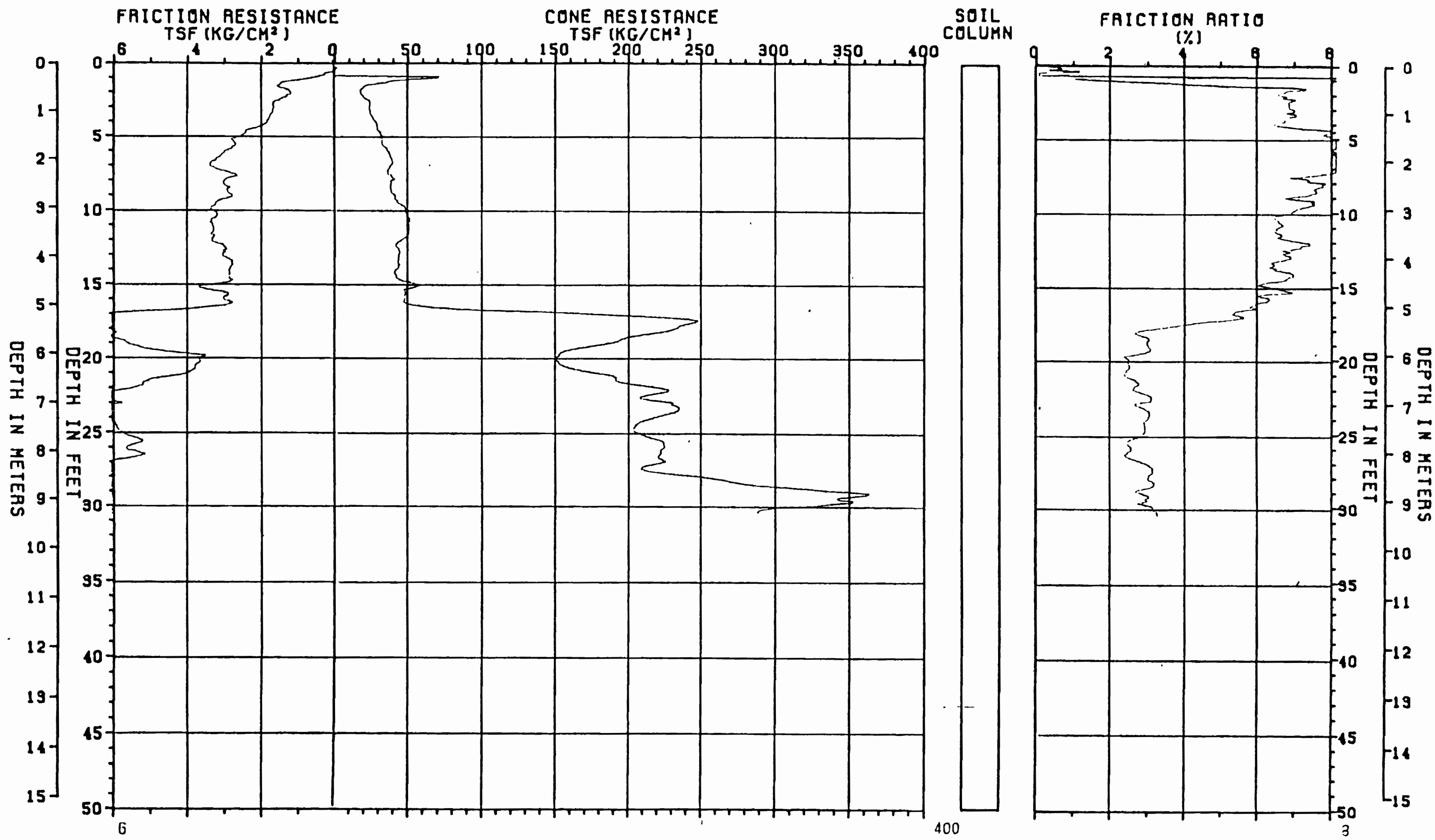
SOUNDING : CPT-20
PROJECT : CITY OF TORRANCE-AG FN 1987
PROJECT No: 89-230-3901
TEST DATE : 09-15-1988

LOCATION : TORRANCE CA
INSTRUMENT : F15CKE081
ELECTRONICS: T2
OPERATOR : MR/HA

Assumed Depth to Water (Feet)= 31 Soil Total Unit Weight (pcf) = 102

DEPTH (ft)	NORMALIZED CONE (tsf)	FRICTION RATIO (%)	SOIL BEHAVIOR TYPE	EQUIV RELATIVE DENSITY	EQUIV FRICTION ANGLE	EQUIV N1	EQUIV N1'	Su1= (C-T)/Nc (ksf)	Su2= Fs*A (ksf)
1.0	162.9	0.87	SAND TO SILTY SAND	50-60	40-42	40-60	40-60		
2.0	36.2	6.44	*SANDY CLAY-SILTY CLAY			40-60	40-60	1.21	1.21
3.0	43.7	6.74	*SANDY CLAY-SILTY CLAY			60-80	60-80	1.59	1.59
4.0	47.5	6.41	*SANDY CLAY-SILTY CLAY			60-80	60-80	1.86	1.86
5.0	52.0	7.84	*SANDY CLAY-SILTY CLAY			60-80	60-80	2.16	2.16
6.0	54.8	8.21	*SANDY CLAY-SILTY CLAY			80-100	80-100	2.39	2.39
7.0	56.2	8.63	*SANDY CLAY-SILTY CLAY			80-100	80-100	2.57	2.57
8.0	57.0	7.20	*SANDY CLAY-SILTY CLAY			80-100	80-100	2.71	2.71
9.0	54.2	6.82	*SANDY CLAY-SILTY CLAY			60-80	60-80	2.67	2.67
10.0	62.9	6.81	*SANDY CLAY-SILTY CLAY			80-100	80-100	3.21	3.21
11.0	63.7	6.46	*SANDY CLAY-SILTY CLAY			80-100	80-100	3.36	3.36
12.0	56.6	7.07	*SANDY CLAY-SILTY CLAY			80-100	80-100	3.07	3.07
13.0	52.2	6.78	*SANDY CLAY-SILTY CLAY			60-80	60-80	2.91	2.91
14.0	49.6	6.56	*SANDY CLAY-SILTY CLAY			60-80	60-80	2.84	2.84
15.0	61.0	6.14	*SANDY CLAY-SILTY CLAY			80-100	80-100	3.59	3.59
16.0	52.4	6.15	*SANDY CLAY-SILTY CLAY			60-80	60-80	3.16	3.16
17.0	174.4	5.43	*SANDY CLAY-SILTY CLAY			>100	>100	10.89	10.89
18.0	241.7	2.84	*SILTY SAND-CLAYEY SAND			>100	>100		
19.0	191.9	2.92	*SILTY SAND-CLAYEY SAND			>100	>100		
20.0	146.6	2.46	SILTY SAND-SANDY SILT	90-100	35-40	>100	>100		
21.0	167.9	2.31	SILTY SAND-SANDY SILT	90-100	35-40	>100	>100		
22.0	206.2	2.53	*SILTY SAND-CLAYEY SAND			>100	>100		
23.0	206.6	2.57	*SILTY SAND-CLAYEY SAND			>100	>100		
24.0	200.3	2.94	*SILTY SAND-CLAYEY SAND			>100	>100		
25.0	182.4	2.76	*SILTY SAND-CLAYEY SAND			>100	>100		
26.0	197.0	2.49	*SILTY SAND-CLAYEY SAND			>100	>100		
27.0	193.6	2.88	*SILTY SAND-CLAYEY SAND			>100	>100		
28.0	204.3	2.93	*SILTY SAND-CLAYEY SAND			>100	>100		
29.0	276.8	2.74	*SILTY SAND-CLAYEY SAND			>100	>100		

* - INDICATES OVERCONSOLIDATED OR CEMENTED MATERIAL



PROJECT: CITY OF TORRANCE-AG FN 1987
PROJECT NUMBER: 89-230-3901
INSTRUMENT NUMBER: F15CKE081
DATE: 09-15-1988

The Earth Technology Corporation

CONE PENETROMETER TEST
PROBE: CPT-20

Plate C42

CONE PENETROMETER TEST DATA

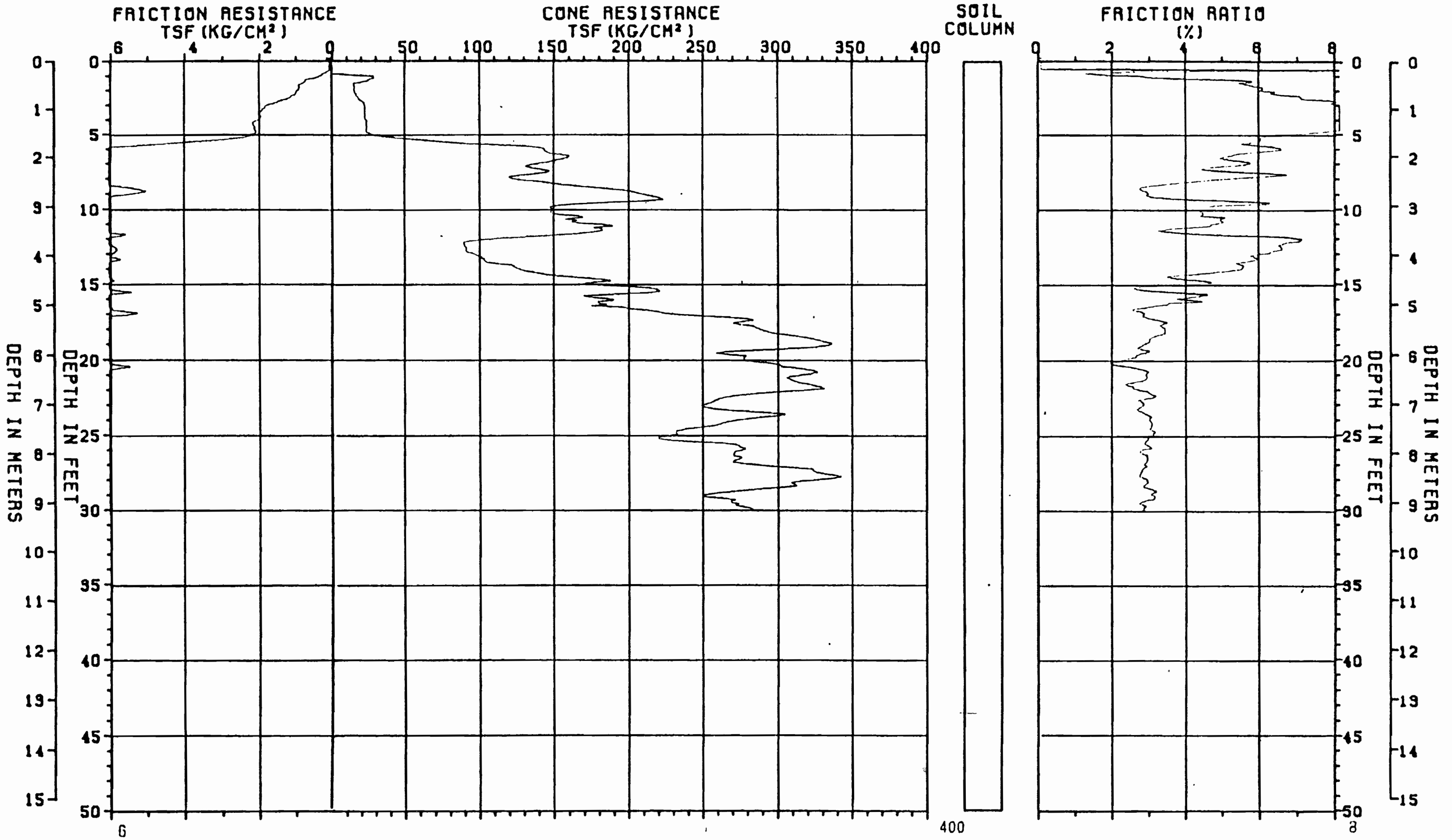
SOUNDING : CPT-21
PROJECT : CITY OF TORRANCE-AG FN 1987
PROJECT No: 89-230-3901
TEST DATE : 09-15-1988

LOCATION : TORRANCE CA
INSTRUMENT : F15CKE081
ELECTRONICS: T2
OPERATOR : MR/HA

Assumed Depth to Water (Feet)= 31 Soil Total Unit Weight (pcf) = 102

DEPTH (ft)	NORMALIZED CONE (tsf)	FRICTION RATIO (%)	SOIL BEHAVIOR TYPE	EQUIV RELATIVE DENSITY	EQUIV FRICTION ANGLE	EQUIV N1	EQUIV N1'	Su1= (C-T)/Nc (ksf)	Su2= Fs*A (ksf)
1.0	27.3	2.31	SANDY SILT-CLAYEY SILT	40-50	27-31	10-15	15-20		
2.0	31.0	5.72	*SANDY CLAY-SILTY CLAY			25-40	40-60	1.03	1.03
3.0	40.7	7.77	*SANDY CLAY-SILTY CLAY			60-80	60-80	1.48	1.48
4.0	39.4	8.51	*SANDY CLAY-SILTY CLAY			60-80	60-80	1.54	1.54
5.0	42.2	8.14	*SANDY CLAY-SILTY CLAY			60-80	60-80	1.75	1.75
6.0	212.5	5.77	*SANDY CLAY-SILTY CLAY			>100	>100	9.33	9.33
7.0	210.4	5.11	*SANDY CLAY-SILTY CLAY			>100	>100	9.67	9.67
8.0	165.5	6.60	*SANDY CLAY-SILTY CLAY			>100	>100	7.92	7.92
9.0	270.0	2.72	*SILTY SAND-CLAYEY SAND			>100	>100		
10.0	189.5	4.68	*CLAYEY SAND-SANDY CLAY			>100	>100		
11.0	201.2	4.84	*SANDY CLAY-SILTY CLAY			>100	>100	10.68	10.68
12.0	160.6	4.78	*SANDY CLAY-SILTY CLAY			>100	>100	8.78	8.78
13.0	107.8	6.47	*SANDY CLAY-SILTY CLAY			>100	>100	6.05	6.05
14.0	141.1	5.36	*SANDY CLAY-SILTY CLAY			>100	>100	8.16	8.16
15.0	209.1	3.89	*CLAYEY SAND-SANDY CLAY			>100	>100		
16.0	183.9	4.49	*CLAYEY SAND-SANDY CLAY			>100	>100		
17.0	225.2	2.46	*SILTY SAND-CLAYEY SAND			>100	>100		
18.0	283.7	3.26	*SILTY SAND-CLAYEY SAND			>100	>100		
19.0	327.6	2.91	*SILTY SAND-CLAYEY SAND			>100	>100		
20.0	262.5	2.64	*SILTY SAND-CLAYEY SAND			>100	>100		
21.0	307.7	2.63	*SILTY SAND-CLAYEY SAND			>100	>100		
22.0	303.0	2.24	*SILTY SAND-CLAYEY SAND			>100	>100		
23.0	240.4	0.84	SAND TO SILTY SAND	60-70	42-45	80-100	80-100		
24.0	276.6	2.79	*SILTY SAND-CLAYEY SAND			>100	>100		
25.0	210.0	2.90	*SILTY SAND-CLAYEY SAND			>100	>100		
26.0	237.4	2.75	*SILTY SAND-CLAYEY SAND			>100	>100		
27.0	234.9	2.86	*SILTY SAND-CLAYEY SAND			>100	>100		
28.0	277.6	2.66	*SILTY SAND-CLAYEY SAND			>100	>100		
29.0	237.5	2.89	*SILTY SAND-CLAYEY SAND			>100	>100		

* - INDICATES OVERCONSOLIDATED OR CEMENTED MATERIAL



PROJECT: CITY OF TORRANCE-AG FN 1987
PROJECT NUMBER: 89-230-3901
INSTRUMENT NUMBER: F15CKE081
DATE: 09-15-1988

The Earth Technology Corporation

CONE PENETROMETER TEST
PROBE: CPT-21

CONE PENETROMETER TEST DATA

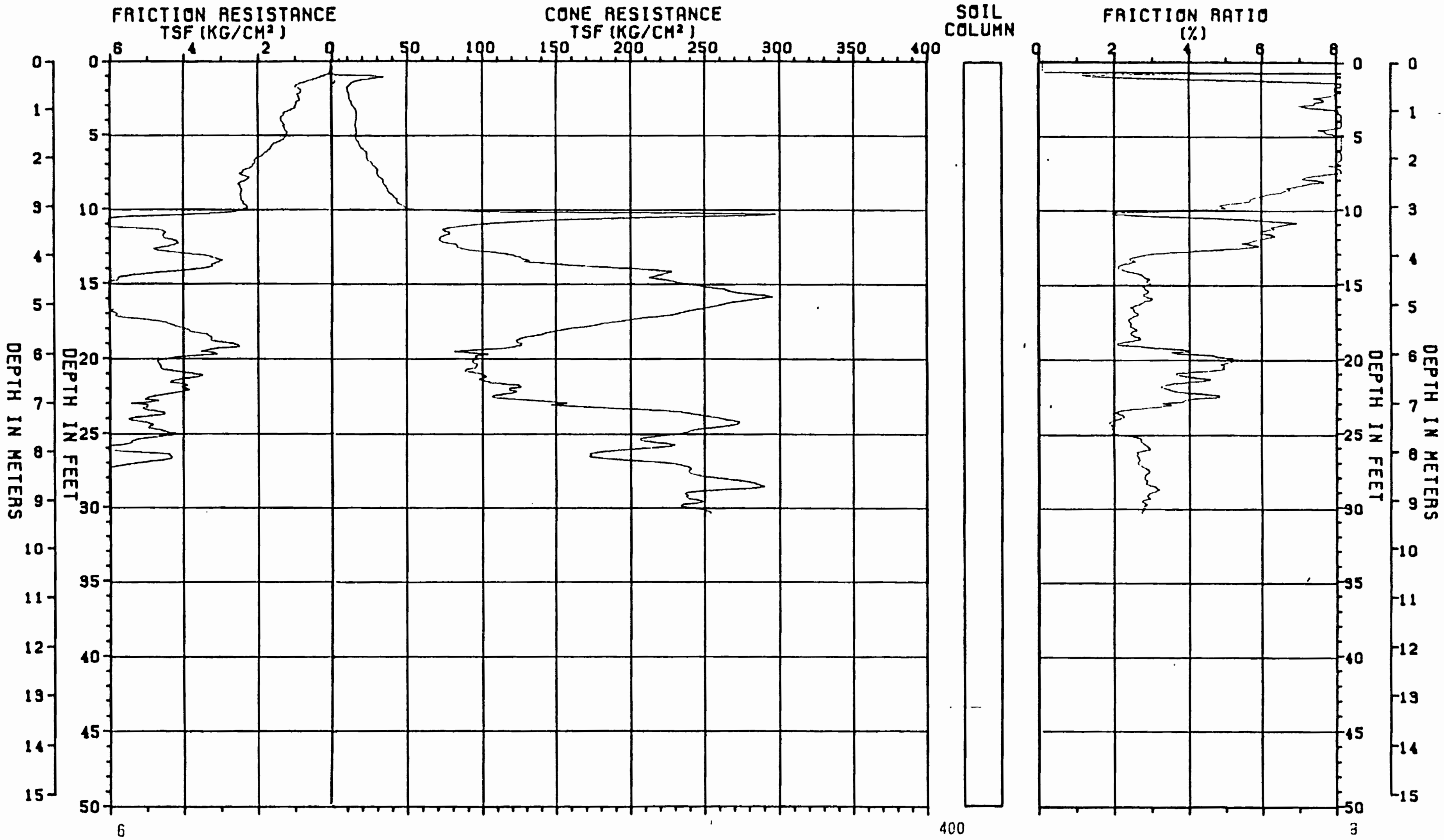
SOUNDING : CPT-22
PROJECT : CITY OF TORRANCE-AG FN 1987
PROJECT No: 89-230-3901
TEST DATE : 09-15-1988

LOCATION : TORRANCE CA
INSTRUMENT : F15CKE081
ELECTRONICS: T2
OPERATOR : MR/HA

Assumed Depth to Water (Feet)= 31 Soil Total Unit Weight (pcf) = 102

DEPTH (ft)	NORMALIZED CONE (tsf)	FRICTION RATIO (%)	SOIL BEHAVIOR TYPE	EQUIV RELATIVE DENSITY	EQUIV FRICTION ANGLE	EQUIV N1	EQUIV N1'	Su1= (C-T)/Nc (ksf)	Su2= Fs*A (ksf)
1.0	68.3	1.04	SAND TO SILTY SAND	40-50	35-40	20-25	20-25		
2.0	20.9	7.82	*SANDY CLAY-SILTY CLAY			25-40	25-40	0.69	0.69
3.0	24.8	7.27	*SANDY CLAY-SILTY CLAY			25-40	40-60	0.90	0.90
4.0	27.0	8.38	*SANDY CLAY-SILTY CLAY			40-60	40-60	1.05	1.05
5.0	25.4	7.78	*SANDY CLAY-SILTY CLAY			25-40	40-60	1.04	1.04
6.0	33.1	8.01	*SANDY CLAY-SILTY CLAY			40-60	40-60	1.44	1.44
7.0	38.9	7.92	*SANDY CLAY-SILTY CLAY			40-60	60-80	1.77	1.77
8.0	46.9	6.92	*SANDY CLAY-SILTY CLAY			60-80	60-80	2.22	2.22
9.0	53.7	6.08	*SANDY CLAY-SILTY CLAY			60-80	60-80	2.65	2.65
10.0	66.1	4.05	*CLAYEY SAND-SANDY CLAY			40-60	60-80		
11.0	125.4	6.81	*SANDY CLAY-SILTY CLAY			>100	>100	6.64	6.64
12.0	86.5	5.96	*SANDY CLAY-SILTY CLAY			>100	>100	4.71	4.71
13.0	129.4	3.44	*CLAYEY SAND-SANDY CLAY			>100	>100		
14.0	212.7	2.00	SAND TO SILTY SAND	90-100	40-42	>100	>100		
15.0	255.8	2.78	*SILTY SAND-CLAYEY SAND			>100	>100		
16.0	319.8	2.76	*SILTY SAND-CLAYEY SAND			>100	>100		
17.0	249.6	2.45	*SILTY SAND-CLAYEY SAND			>100	>100		
18.0	174.7	2.33	SILTY SAND-SANDY SILT	90-100	35-40	>100	>100		
19.0	124.6	2.12	SILTY SAND-SANDY SILT	70-80	35-40	60-80	60-80		
20.0	95.0	4.64	*SANDY CLAY-SILTY CLAY			>100	>100	6.32	6.32
21.0	90.7	3.96	*CLAYEY SAND-SANDY CLAY			80-100	80-100		
22.0	119.3	3.11	*CLAYEY SAND-SANDY CLAY			80-100	>100		
23.0	135.2	3.72	*CLAYEY SAND-SANDY CLAY			>100	>100		
24.0	230.1	2.17	*SILTY SAND-CLAYEY SAND	90-100	40-42	>100	>100		
25.0	212.9	1.76	SAND TO SILTY SAND	80-90	40-42	>100	>100		
26.0	198.3	2.79	*SILTY SAND-CLAYEY SAND			>100	>100		
27.0	180.4	2.54	*SILTY SAND-CLAYEY SAND			>100	>100		
28.0	208.1	2.70	*SILTY SAND-CLAYEY SAND			>100	>100		
29.0	203.9	2.98	*SILTY SAND-CLAYEY SAND			>100	>100		

* - INDICATES OVERCONSOLIDATED OR CEMENTED MATERIAL



PROJECT: CITY OF TORRANCE-AG FN 1987
PROJECT NUMBER: 89-230-3901
INSTRUMENT NUMBER: F15CKE081
DATE: 09-15-1988

The Earth Technology Corporation

CONE PENETROMETER TEST
PROBE: CPT-22

CONE PENETROMETER TEST DATA

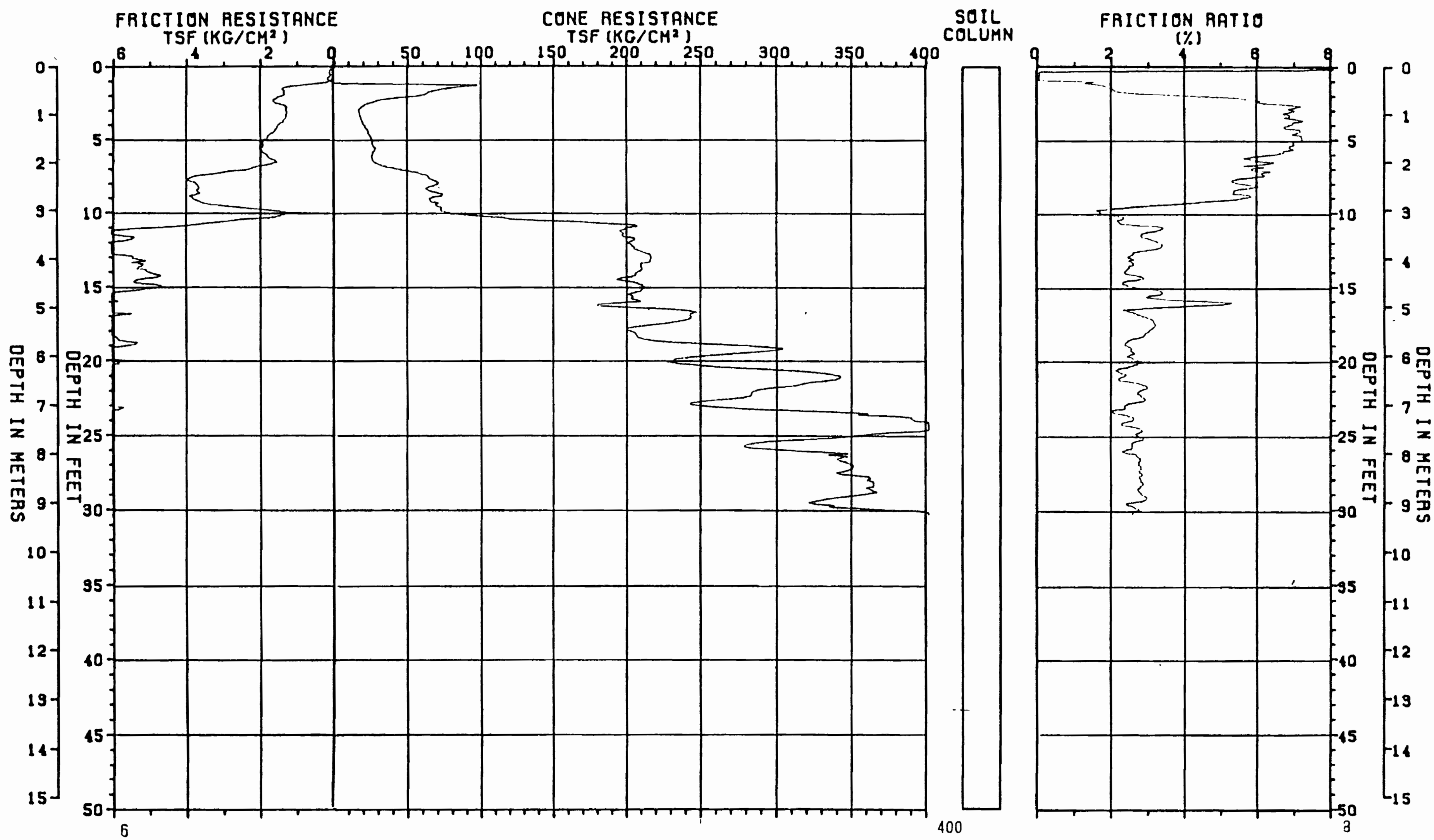
SOUNDING : CPT-23
PROJECT : CITY OF TORRANCE-AG FN 1987
PROJECT No: 89-230-3901
TEST DATE : 09-15-1988

LOCATION : TORRANCE CA
INSTRUMENT : F15CKE081
ELECTRONICS: T2
OPERATOR : MR/HA

Assumed Depth to Water (Feet)= 31 Soil Total Unit Weight (pcf) = 102

DEPTH (ft)	NORMALIZED CONE (tsf)	FRICTION RATIO (%)	SOIL BEHAVIOR TYPE	EQUIV RELATIVE DENSITY	EQUIV FRICTION ANGLE	EQUIV N1	EQUIV N1'	Su1= (C-T)/Nc (ksf)	Su2= Fs*A (ksf)
1.0	-0.0	0.00	SILTY CLAY TO CLAY			1-5	1-5	-0.01	-0.01
2.0	114.2	2.62	SILTY SAND-SANDY SILT	80-90	35-40	60-80	80-100		
3.0	32.4	6.90	*SANDY CLAY-SILTY CLAY			40-60	40-60	1.18	1.18
4.0	37.2	6.86	*SANDY CLAY-SILTY CLAY			40-60	40-60	1.45	1.45
5.0	42.3	7.09	*SANDY CLAY-SILTY CLAY			60-80	60-80	1.75	1.75
6.0	40.2	6.60	*SANDY CLAY-SILTY CLAY			40-60	60-80	1.75	1.75
7.0	67.6	6.08	*SANDY CLAY-SILTY CLAY			80-100	80-100	3.09	3.09
8.0	97.4	5.22	*SANDY CLAY-SILTY CLAY			>100	>100	4.65	4.65
9.0	86.5	5.72	*SANDY CLAY-SILTY CLAY			>100	>100	4.28	4.28
10.0	104.2	1.26	SAND TO SILTY SAND	50-60	35-40	25-40	40-60		
11.0	249.1	3.22	*SILTY SAND-CLAYEY SAND			>100	>100		
12.0	243.2	3.17	*SILTY SAND-CLAYEY SAND			>100	>100		
13.0	255.2	2.43	*SILTY SAND-CLAYEY SAND			>100	>100		
14.0	237.1	2.32	*SILTY SAND-CLAYEY SAND			>100	>100		
15.0	236.0	2.37	*SILTY SAND-CLAYEY SAND			>100	>100		
16.0	227.6	3.60	*CLAYEY SAND-SANDY CLAY			>100	>100		
17.0	257.2	2.64	*SILTY SAND-CLAYEY SAND			>100	>100		
18.0	207.4	3.04	*SILTY SAND-CLAYEY SAND			>100	>100		
19.0	265.0	2.30	*SILTY SAND-CLAYEY SAND			>100	>100		
20.0	229.6	2.52	*SILTY SAND-CLAYEY SAND			>100	>100		
21.0	324.0	2.20	*SAND TO SILTY SAND			>100	>100		
22.0	276.2	2.90	*SILTY SAND-CLAYEY SAND			>100	>100		
23.0	225.3	0.69	SAND TO SILTY SAND	60-70	42-45	80-100	80-100		
24.0	354.9	2.53	*SILTY SAND-CLAYEY SAND			>100	>100		
25.0	333.2	2.67	*SILTY SAND-CLAYEY SAND			>100	>100		
26.0	247.4	2.47	*SILTY SAND-CLAYEY SAND			>100	>100		
27.0	297.4	2.65	*SILTY SAND-CLAYEY SAND			>100	>100		
28.0	304.7	2.67	*SILTY SAND-CLAYEY SAND			>100	>100		
29.0	303.8	2.67	*SILTY SAND-CLAYEY SAND			>100	>100		

* - INDICATES OVERCONSOLIDATED OR CEMENTED MATERIAL



PROJECT: CITY OF TORRANCE-AG FN 1987
PROJECT NUMBER: 89-230-3901
INSTRUMENT NUMBER: F15CKE081
DATE: 09-15-1988

The Earth Technology Corporation

CONE PENETROMETER TEST
PROBE: CPT-23

Plate C48

CONE PENETROMETER TEST DATA

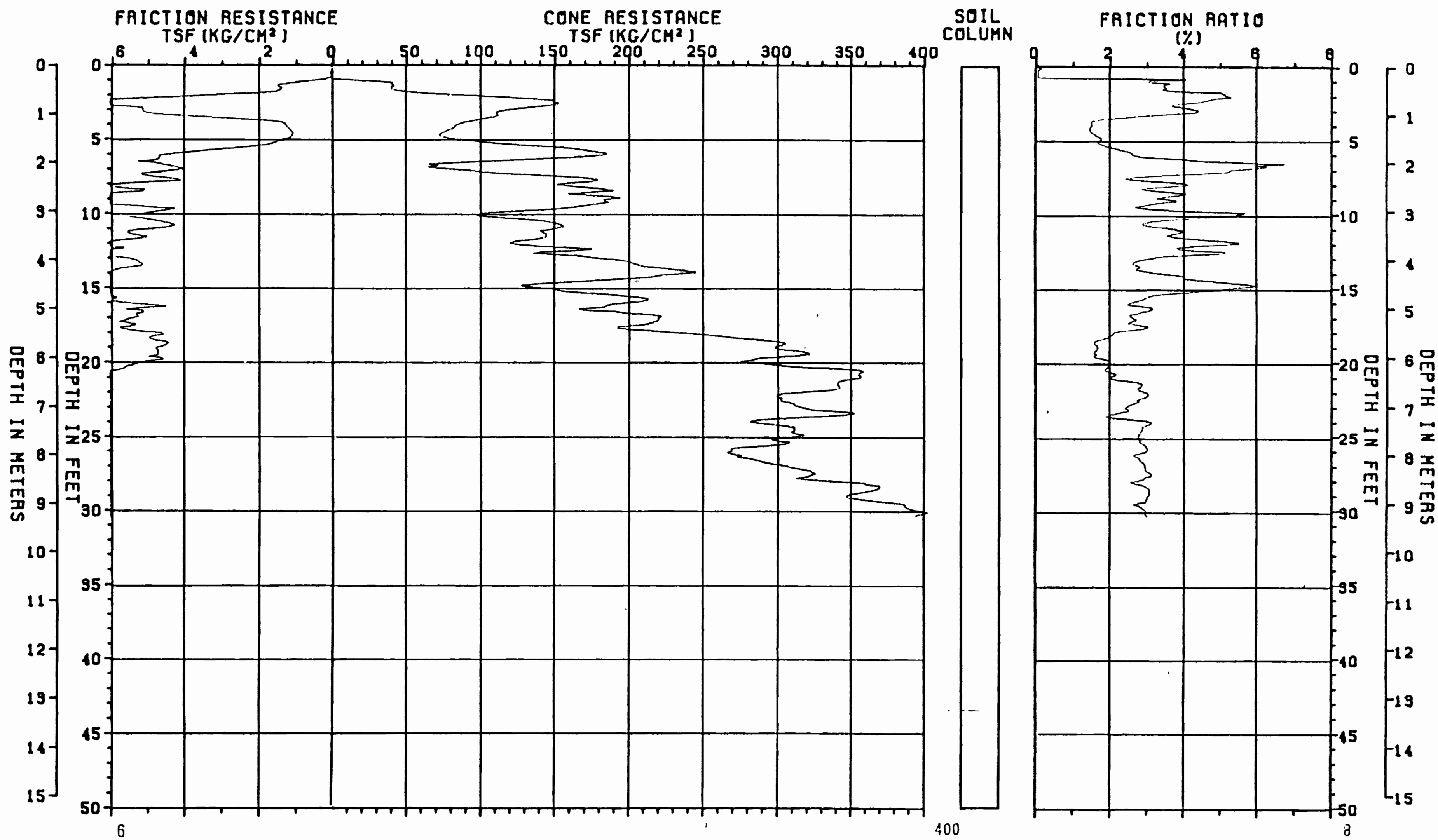
SOUNDING : CPT-24
PROJECT : CITY OF TORRANCE-AG FN 1987
PROJECT No: 89-230-3901
TEST DATE : 09-15-1988

LOCATION : TORRANCE CA
INSTRUMENT : F15CKE081
ELECTRONICS: T2
OPERATOR : MR/HA

Assumed Depth to Water (Feet)= 31 Soil Total Unit Weight (pcf) = 102

DEPTH (ft)	NORMALIZED CONE (tsf)	FRICTION RATIO (%)	SOIL BEHAVIOR TYPE	EQUIV RELATIVE DENSITY	EQUIV FRICTION ANGLE	EQUIV N1	EQUIV N1'	Su1= (C-T)/Nc (ksf)	Su2= Fs*A (ksf)
1.0	-0.1	0.00	SILTY CLAY TO CLAY			1-5	1-5	-0.01	-0.01
2.0	157.0	5.04	*SANDY CLAY-SILTY CLAY			>100	>100	5.25	5.25
3.0	223.9	4.13	*CLAYEY SAND-SANDY CLAY			>100	>100		
4.0	144.0	1.44	SAND TO SILTY SAND	60-70	40-42	60-80	60-80		
5.0	131.2	1.70	SAND TO SILTY SAND	70-80	35-40	60-80	60-80		
6.0	279.7	2.52	*SILTY SAND-CLAYEY SAND			>100	>100		
7.0	111.7	5.64	*SANDY CLAY-SILTY CLAY			>100	>100	5.12	5.12
8.0	220.7	3.87	*CLAYEY SAND-SANDY CLAY			>100	>100		
9.0	259.2	3.18	*SILTY SAND-CLAYEY SAND			>100	>100		
10.0	128.6	5.57	*SANDY CLAY-SILTY CLAY			>100	>100	6.60	6.60
11.0	189.9	3.47	*CLAYEY SAND-SANDY CLAY			>100	>100		
12.0	145.1	5.40	*SANDY CLAY-SILTY CLAY			>100	>100	7.93	7.93
13.0	204.2	3.10	*SILTY SAND-CLAYEY SAND			>100	>100		
14.0	280.1	3.08	*SILTY SAND-CLAYEY SAND			>100	>100		
15.0	150.7	5.42	*SANDY CLAY-SILTY CLAY			>100	>100	8.95	8.95
16.0	225.8	2.56	*SILTY SAND-CLAYEY SAND			>100	>100		
17.0	234.9	2.48	*SILTY SAND-CLAYEY SAND			>100	>100		
18.0	221.3	2.14	SILTY SAND-SANDY SILT	90-100	40-42	>100	>100		
19.0	305.6	1.57	SAND TO SILTY SAND	90-100	42-45	>100	>100		
20.0	25.7	20.54	*SANDY CLAY-SILTY CLAY			25-40	40-60	1.66	1.66
21.0	342.7	2.04	*SAND TO SILTY SAND			>100	>100		
22.0	320.2	2.71	*SILTY SAND-CLAYEY SAND			>100	>100		
23.0	288.4	2.28	*SILTY SAND-CLAYEY SAND			>100	>100		
24.0	269.3	2.53	*SILTY SAND-CLAYEY SAND			>100	>100		
25.0	277.9	2.70	*SILTY SAND-CLAYEY SAND			>100	>100		
26.0	235.9	2.93	*SILTY SAND-CLAYEY SAND			>100	>100		
27.0	252.8	2.84	*SILTY SAND-CLAYEY SAND			>100	>100		
28.0	262.5	2.82	*SILTY SAND-CLAYEY SAND			>100	>100		
29.0	292.0	2.98	*SILTY SAND-CLAYEY SAND			>100	>100		

* - INDICATES OVERCONSOLIDATED OR CEMENTED MATERIAL



PROJECT: CITY OF TORRANCE-AG FN 1987
PROJECT NUMBER: 89-230-3901
INSTRUMENT NUMBER: F15CKE081
DATE: 09-15-1988

The Earth Technology Corporation

CONE PENETROMETER TEST
PROBE: CPT-24

CONE PENETROMETER TEST DATA

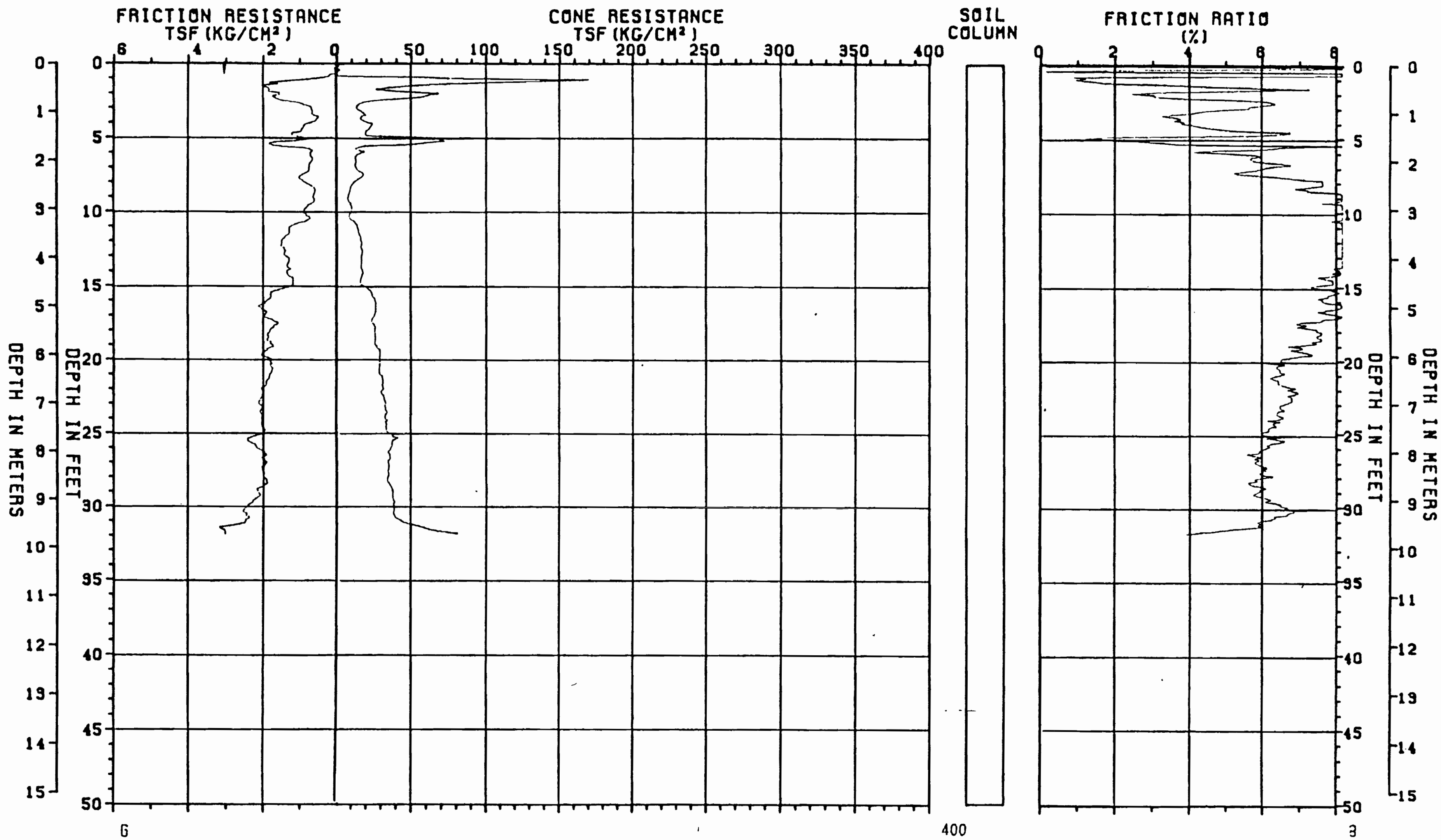
SOUNDING : CPT-25
PROJECT : CITY OF TORRANCE-AG FN 1987
PROJECT No: 89-230-3901
TEST DATE : 09-15-1988

LOCATION : TORRANCE CA
INSTRUMENT : F15CKE081
ELECTRONICS: T2
OPERATOR : MR/HA

Assumed Depth to Water (Feet)= 31 Soil Total Unit Weight (pcf) = 102

DEPTH (ft)	NORMALIZED CONE (tsf)	FRICTION RATIO (%)	SOIL BEHAVIOR TYPE	EQUIV RELATIVE DENSITY	EQUIV FRICTION ANGLE	EQUIV N1	EQUIV N1'	Su1= (C-T)/Nc (ksf)	Su2= Fs*A (ksf)
1.0	386.3	0.82	SANDY GRAVEL TO SAND	70-80	42-45	>100	>100		
2.0	119.8	2.93	*SILTY SAND-CLAYEY SAND	90-100	35-40	80-100	80-100		
3.0	25.9	4.71	CLAYEY SILT-SILTY CLAY			20-25	25-40	1.88	1.34
4.0	38.9	3.94	CLAYEY SILT-SILTY CLAY			25-40	25-40	3.04	1.82
5.0	109.1	1.52	SAND TO SILTY SAND	60-70	35-40	40-60	40-60		
6.0	19.6	5.67	SILTY CLAY TO CLAY			15-20	25-40	1.68	1.47
7.0	19.4	5.71	SILTY CLAY TO CLAY			15-20	25-40	1.74	1.53
8.0	14.2	7.47	SILTY CLAY TO CLAY			15-20	25-40	1.31	1.31
9.0	9.4	8.43	CLAY TO ORGANIC CLAY			10-15	15-20	0.87	0.87
10.0	10.9	10.24	CLAY TO ORGANIC CLAY			10-15	20-25	1.05	1.05
11.0	17.4	9.33	CLAY TO ORGANIC CLAY			20-25	25-40	1.78	1.78
12.0	20.3	8.99	*SANDY CLAY-SILTY CLAY			25-40	25-40	1.07	1.07
13.0	19.2	7.97	*SANDY CLAY-SILTY CLAY			20-25	25-40	1.04	1.04
14.0	20.2	7.72	*SANDY CLAY-SILTY CLAY			25-40	25-40	1.13	1.13
15.0	22.3	7.32	*SANDY CLAY-SILTY CLAY			25-40	25-40	1.28	1.28
16.0	28.2	7.59	*SANDY CLAY-SILTY CLAY			40-60	40-60	1.68	1.68
17.0	25.1	7.88	*SANDY CLAY-SILTY CLAY			25-40	40-60	1.52	1.52
18.0	26.0	7.43	*SANDY CLAY-SILTY CLAY			25-40	40-60	1.61	1.61
19.0	26.8	6.91	*SANDY CLAY-SILTY CLAY			25-40	40-60	1.70	1.70
20.0	28.1	6.33	*SANDY CLAY-SILTY CLAY			25-40	40-60	1.82	1.82
21.0	29.3	6.16	*SANDY CLAY-SILTY CLAY			25-40	40-60	1.94	1.94
22.0	28.2	6.70	*SANDY CLAY-SILTY CLAY			25-40	40-60	1.91	1.91
23.0	29.8	6.31	*SANDY CLAY-SILTY CLAY			25-40	40-60	2.06	2.06
24.0	30.9	5.96	*SANDY CLAY-SILTY CLAY			25-40	40-60	2.18	2.18
25.0	33.6	5.91	*SANDY CLAY-SILTY CLAY			40-60	40-60	2.42	2.42
26.0	31.0	5.81	*SANDY CLAY-SILTY CLAY			25-40	40-60	2.26	2.26
27.0	29.6	5.76	*SANDY CLAY-SILTY CLAY			25-40	40-60	2.20	2.20
28.0	28.7	5.63	*SANDY CLAY-SILTY CLAY			25-40	25-40	2.17	2.17
29.0	30.8	5.59	*SANDY CLAY-SILTY CLAY			25-40	40-60	2.38	2.38
30.0	31.4	6.53	*SANDY CLAY-SILTY CLAY			40-60	40-60	2.47	2.47

* - INDICATES OVERCONSOLIDATED OR CEMENTED MATERIAL



PROJECT: CITY OF TORRANCE-AG FN 1987
PROJECT NUMBER: 89-230-3901
INSTRUMENT NUMBER: F15CKE081
DATE: 09-15-1988

The Earth Technology Corporation

CONE PENETROMETER TEST
PROBE: CPT-25

Plate C52

APPENDIX D

Laboratory Testing

APPENDIX D: LABORATORY TESTING

During the laboratory phase of the investigation, many test procedures can be utilized, Brief descriptions of some of the more popular tests are provided below.

D.1 MOISTURE CONTENT DETERMINATIONS

Moisture content determinations are made in accordance with ASTM Method of Test D2216. This procedure calls for drying soil for 24 hours in an oven which maintains a constant temperature of $110^{o}C(+/-5^{o}C)$. Moisture content determined is expressed as a percentage of dry weight.

D.2 DRY UNIT WEIGHT

Dry unit weight is determined following any one of the sampling procedures outlined in Appendix A. Wet unit weight is first determined by dividing the moist weight of soil by the known volume. After a determination of moisture content as a decimal fraction of dry weight, dry unit weight is calculated by dividing the wet unit weight by the quantity, one plus moisture content.

D.3 ATTERBERG LIMITS

Atterberg Limits, liquid limit, and plastic limit are empirically developed tests designed for the purpose of identifying the boundaries whereby a plastic soil type changes from plastic to liquid (the liquid limit), and from plastic to solid (the plastic limit). The limit values are actually moisture contents expressed as a percentage of dry weight for the given boundary conditions. The Plastic Index is the difference between the liquid and plastic limits and represents the range of moisture content over which the soil maintains a plastic consistency. Liquid and plastic limit tests are briefly described below.

D.3.1 Liquid Limit

The liquid limit test is described by ASTM Standard Method D423. This test procedure calls for smoothing very moist soil into a standard, shallow, rounded bottom, brass dish. A standard grooving tool is used to cut a narrow slot across the soil. The brass dish is then lifted repeatedly about 0.4 inches and dropped to a hard rubber base at a rate of about two drops per second. The number of drops required to close the gap between the soil halves is recorded. The procedure is repeated at various moisture contents and a flow curve developed. The liquid limit is that moisture content at which 25 blows are required to close the soil gap.

D.3.2 Plastic Limit

The plastic limit test is described by ASTM Standard Method D424. For this test, soil is rolled out into fine threads on a piece of frosted glass. For a wet soil the procedure calls for repeatedly rolling out the soil then remolded during which the soil slowly dries. The plastic limit is defined as that moisture content at which the thread of soil crumbles at a diameter of 1/8 inch.

D.4 PARTICLE SIZE ANALYSIS

The particle size distribution test is described by ASTM Standard Method D422. Testing generally takes two forms, the mechanical sieve procedure and the hydro-meter test procedure. These test procedures may be used indefinitely or together for the same sample. The test procedures are briefly described below.

D.4.1 Sieve Analysis

The mechanical sieve analysis is designed for soil particles generally larger than 0.075 millimeters (No. 200 sieve). A sample of soil is first washed over the No. 200 sieve to remove the silt and clay-size particles. The material retained on the No. 200 sieve is oven dried. The dried soil is placed over a stack of standard sieves with known size openings. The sieve sizes diminish toward the bottom of the stack. The stack has a pan at the bottom and a lid at the top. The stack is agitated mechanically to cause the finer soil particles to fall through the larger sieves. After shaking, the amount of soil retained on each sieve and in the pan is weighed. Accumulative weights retained, expressed as a percentage of the entire sample dry weight, are calculated. The results are expressed as percentage passing the individual sieve sizes.

D.4.2 Hydrometer Analysis

The hydrometer test is designed to estimate the particle size distribution for the fine particles not readily discernible by ordinary sieving. For this test, the soil sample is thoroughly whipped by a mixer, similar to a malt mixer, into suspension in a water solution. After mixing, the specific gravity of the solution is measured over a period of 24 hours. Since the solution becomes lighter as soil particles fall out of solution, the particle size distribution can be estimated by relatively simple calculation.

D.5 EXPANSION TESTS

Expansion tests can take many forms. Expansion tests are typically empirically derived tests but certain forms have proven to be more popular than others. American Geotechnical generally utilizes one of the following procedures.

D.5.1 Expansion Index

Uniform Building Code Standard 29-2 describes the procedure for the Expansion Index tests. The test became popular in the early 1970s and was previously referred to as the ASCE Expansion Index test. The test requires that soil be compacted to about two inches thickness in a four-inch diameter mold. The soil is compacted in two layers. Each layer is compacted by 15 uniformly distributed blows with a 5.5 pound standard hammer falling 12 inches. A four-inch diameter by one inch high ring is trimmed from the compacted soil and weighed. By assuming a soil specific gravity of 2.7, the percent saturation of the sample is calculated. The entire procedure is repeated at various moisture contents until a percent saturation of between 49 and 51 percent is determined. That sample is placed in a device producing confining pressure of 144 psf (1 psi). The sample is then inundated and the amount of swell expressed as a ratio of the initial sample height times 1000 recorded as the Expansion Index.

D.5.2 Swell Test

The conventional swell test usually begins with soil at a known or specified dry unit weight and moisture content. Most frequently soil is remolded to 90 percent of the laboratory maximum dry unit weight at a moisture content at or near optimum. For remolding, American Geotechnical uses 2.5 inch inside diameter by one inch brass rings. After remolding, the soil is allowed to air dry at a temperature of about 100°F for a period of 24 hours. The sample is then subjected to a specified confining pressure. Values for confining pressure commonly include 60, 144, 150, 400, and 650 psf. After stabilizing under the specified confining pressure, the sample is inundated and the swell recorded as a percentage of the original sample height.

D.6 MAXIMUM DENSITY

The maximum density test originally referred to as the "Proctor" test is described by ASTM Standard Method D1557 and similar tests. The test has become increasingly more restrictive over the years. The present test standard is described herein.

The soil fraction passing the No. 4, or 3/4-inch, sieve is compacted in five layers in a four inch by 1/30 cubic foot or six inch diameter by 1/13.33 cubic foot mold. For the four inch mold, each soil layer is compacted by 25 blows with a 10 pound standard hammer falling 18 inches. For the six inch mold, 56 blows per layer is used for compaction. After compaction, the mold is trimmed and the soil dry unit weight and moisture content determined by conventional laboratory techniques. The procedure is repeated (usually four times) until the maximum dry unit weight can be determined by plotting dry unit weight versus moisture content. The moisture content corresponding to the maximum dry unit weight is referred to as the optimum moisture. The test is occasionally modified to three layers instead of five.

D.7 SHEAR STRENGTH

Shear strength is the measure of resistance for soil particles sliding past each other. Two fundamental test procedures are used to measure shear strength. The direct shear test described below is most often used.

Direct shear tests are commonly performed on samples remolded to a specified percentage (usually 90 percent) of the laboratory maximum density at about optimum moisture content. Testing ordinarily proceeds following an about 24-hour period of soaking while under the confining pressure specified for testing. Occasionally samples are sheared at optimum or other specified moisture content below saturation. Consolidated drained conditions are approximated by using a slow, strain-controlled approach, similar to that outlined in ASTM Method of Test D3080. Actual strain rate typically varies from about 0.05 inches per minute to 0.0002 inches per minute. When undrained strength is required, the sample is sheared very fast. When residual strength is required, the sample is repeatedly resheared until a minimum value is obtained. Ordinarily a number of test samples are sheared at various confining pressures in order to develop an envelope of shear strength which can be used to estimate shear strength anywhere within the range of confining pressures tested.

In addition to shearing remolded samples, relatively undisturbed samples are also commonly tested in the fashion described above.

D.8 CONSOLIDATED TESTS

The consolidated test is designed to measure the pressure-compression characteristics for soil samples. The American Geotechnical test apparatus has been designed to accommodate one inch high by 2.5 inch inside diameter ring samples. The sample is placed in the apparatus between two porous stones that permit transfer of consolidation test pressures while permitting the squeezing out or introduction of water. A seating load of 125 psf is applied after which additional loads are applied in an increasing geometric progression. With each increment of load, the corresponding sample deformation is recorded. The results of pressure compression readings are presented graphically with pressure on a log scale against deformation on a linear scale. The deformation scale is usually plotted as percent consolidation based on the original sample height or soil void ratio which decreases as the sample compresses.

At some point in the loading sequence, water is usually added to evaluate its effect. Usually after the loading sequence, the sample is unloaded incrementally in order to define the rebound characteristics. If specified by the project engineer, the time rate of consolidation at the specified test points is also recorded.

D.9 CHEMICAL TESTS

Chemical tests are commonly conducted to identify potentially harmful constituents. American Geotechnical ordinarily forwards samples to a local chemical laboratory for testing in conformance with standard procedures. Testing commonly includes sulfates and chlorides, as well as other tests such as PH and resistivity.

D.9.1 **Explanation Sheet for Chemical Test Data**

Chemical tests usually measure factors which apply to corrosion or breakdown of buried concrete and steel. Factors commonly measured include:

Resistivity (OHMS/CM^3)

Measures the soil's ability to resist electrical current. This is very important in corrosion of metal pipes. Basically, the higher the resistivity the lower the corrosion potential.

pH

Measures the acidity or alkalinity of soil. Resistivity and pH play an important part in corrosivity to buried metal as well as concrete.

Sulphates and Chlorides (%)

Sulphate and chloride contents are given in the description section of Figures D31 through D35. Sulphates and chlorides figure more important in concrete corrosion and breakdown than pH and resistivity.

In the soils tested, sulphate and chloride levels are at very low levels. These levels are low enough to be ignored for construction of foundations and appurtenances in near surface soils within the study area.

Perforation Factor

Figures D31 through D35 illustrate a method of estimating the life of different gauge buried metal pipes. As an example, in Boring B-2 at a depth of one to four feet, the expected life of a 16 gauge metal pipe would be 56 years (gauge factor=1xperforation factor=56).

APPENDIX E

Results of Laboratory Testing

Exca. No.	Depth (feet)	Soil Classification USCS	In Situ Dry Density (lbs./cu. ft.)	In Situ Moisture Content (%)	Degree of Saturation (%)	Expansion Index	Swell % (psi) 60	150	650	Other Tests (See graphs, plots, results attached)
B-1	2	CH	101	14.5	19		4.0	1.9	0.5	
	6	CH	92	29.3	32		19.1	13.7	6.8	Shear
	9	SC	101	24.8	28					
	15	SC	112	16.8	21					Consolidation
	29	SC	96	26.9	30					
B-2	3	CH	110	12.4	16	132	15.1	5.3	-1.8	Shear
	6	CH	96	26.6	30		12.2	7.7	1.0	
	9	SC	108	16.3	21					
	13	SC	102	21.9	26					
	18	SC	107	7.9	11					
	29	SC	89	10.7	15					
	1-4	CH								Chemical
B-3	1.5	CH	108	16.4	21		8.9	5.9	1.0	
	5	CH	114	6.1	9		4.6	1.5	-1.4	
	8	CH	107	8.8	12					Shear
	13	CH	95	23.9	28					
	20	CH	85	35.5	36					
	29	SM	98	7.3	10					
B-4	2	CH	103	18.5	23	168	29.1	22.8	8.4	
	5	CH	111	12.9	17		8.9	4.8	-0.1	
	8	CH	99	22.6	27					Shear
	14	CH	92	27.5	31					
	19	SC	84	9.8	14					
	29	CH	100	9.1	13					
	0-4	CH								Chemical R-Value = <5

SUMMARY OF LABORATORY TEST DATA

AMERICAN GEOTECHNICAL	F.N. 1987	JAN. 1989	TABLE E1

Exca. No.	Depth (feet)	Soil Classi-fication USCS	In Situ Dry Density (lbs./cu. ft.)	In Situ Moisture Content (%)	Degree of Saturation (%)	Expansion Index	Swell % 60	Swell % 150 (psi)	Swell % 650	Other Tests (See graphs, plots, results attached)
B-5	3	CH	81	39.1	38	222	37.3	24.2	11.8	
	6	CH	81	38.5	38		33.7	21.5	10.7	Shear
	10	CH	65	38.3	38					
	14	CH	86	33.3	35					
	20	SC	94	28.8	32					
	29	CH	101	13.6	18					
	1-4	CH								Chemical
B-6	2	CH	82	35.6	36	244	40.2	24.0	6.3	
	5	CH	83	34.7	36		38.2	23.8	8.4	Shear
	9	CH	95	25.9	29					Consolidation
	15	CH	118	11.1	15					
	20	SC	102	15.6	20					
	1-5	CH								Chemical
B-7	3	CH	83	36.0	37	313	32.3	23.0	12.9	
	7	CH	82	38.4	38		40.1	29.8	7.6	
	10	CH	91	31.5	34					
	14	CH	115	13.9	18					
	3-5	CH								Chemical
B-8	3	CH	84	36.1	37		40.0	25.4	14.2	
	6	CH	82	33.8	35					Shear
	9	CH	87	33.9	35		37.9	25.7	15.9	
	15	CH	111	12.9	17					
	20	CH	115	15.3	20					

SUMMARY OF LABORATORY TEST DATA

AMERICAN GEOTECHNICAL	F.N. 1987	JAN. 1989	TABLE E2

Exca. No.	Depth (feet)	Soil Classification USCS	In Situ Dry Density (lbs./cu. ft.)	In Situ Moisture Content (%)	Degree of Saturation (%)	Expansion Index	Swell % 60	Swell % 150 (psi)	Swell % 650	Other Tests (See graphs, plots, results attached)
B-9	2	CH	91	27.4	30					
	5	CH	90	31.0	33	204	31.0	24.4	10.5	
	9	CH	112	17.1	21		10.5	7.4	1.4	Shear
	13	CH	88	24.5	28					Consolidation
	18	SC	105	14.4	19					
	2-4	CH								R-Value = <5 Chemical
B-10	3	CH	95	25.6	29	82	26.1	14.3	8.4	
	6	CH	111	17.7	22		14.6	9.0	2.3	
	9	CH	110	17.5	22					Shear
	15	CH	90	31.0	33					
	20	CH	94	28.1	31					
	3-6	CH								Chemical
B-11	2	CH	83	37.1	37	211	30.5	25.0	11.6	
	5	CH	85	36.2	37	247				
	8	CH	81	36.6	37		34.0	22.6	10.3	
	13	CH	83	37.1	37					
	18	SC	111	18.0	22					
B-12	3	CH	93	27.9	31	237	44.6	33.9	16.8	Shear
	6	CH	92	29.5	32					Consolidation
	9	CH	83	31.3	33		37.4	25.5	12.9	
	15	CH	100	24.4	28					
	20	SC	100	8.3	12					
	1-3	CH								Chemical
	5-8	CH								Chemical

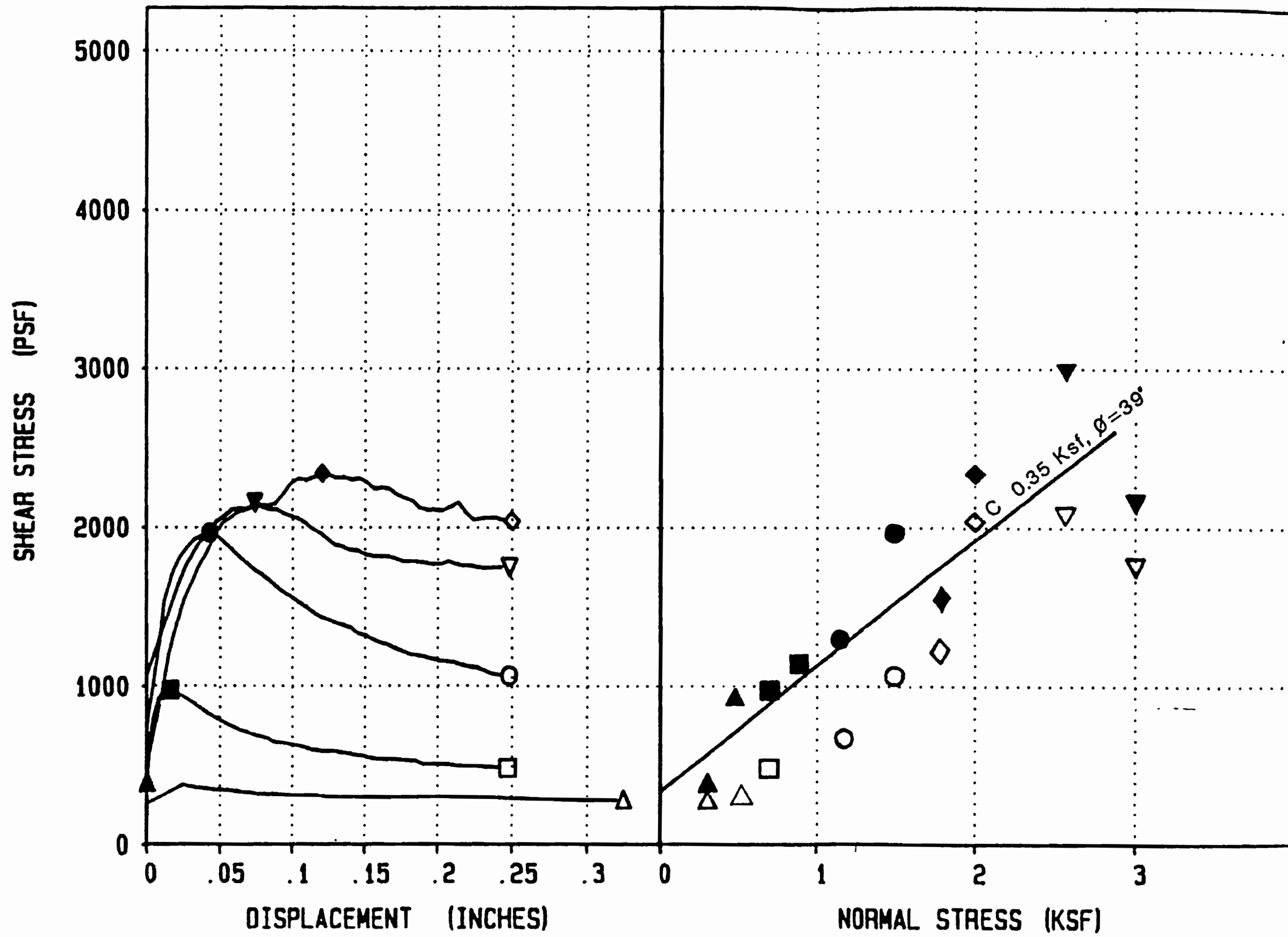
SUMMARY OF LABORATORY TEST DATA

AMERICAN GEOTECHNICAL	F.N. 1987	JAN. 1989	TABLE E3

Exca. No.	Depth (feet)	Soil Classi-fication USCS	In Situ Dry Density (lbs./cu. ft.)	In Situ Moisture Content (%)	Degree of Saturation (%)	Expansion Index	Swell % 60	(psi) 150	650	Other Tests (See graphs, plots, results attached)
B-13	3	CH	110	18.6	23		11.5	2.9	-2.9	
	6	CH	106	18.7	23		15.3	7.5	-3.1	
	3-6	CH								Chemical

SUMMARY OF LABORATORY TEST DATA

AMERICAN GEOTECHNICAL | F.N. 1987 | JAN. 1989 | TABLE E4



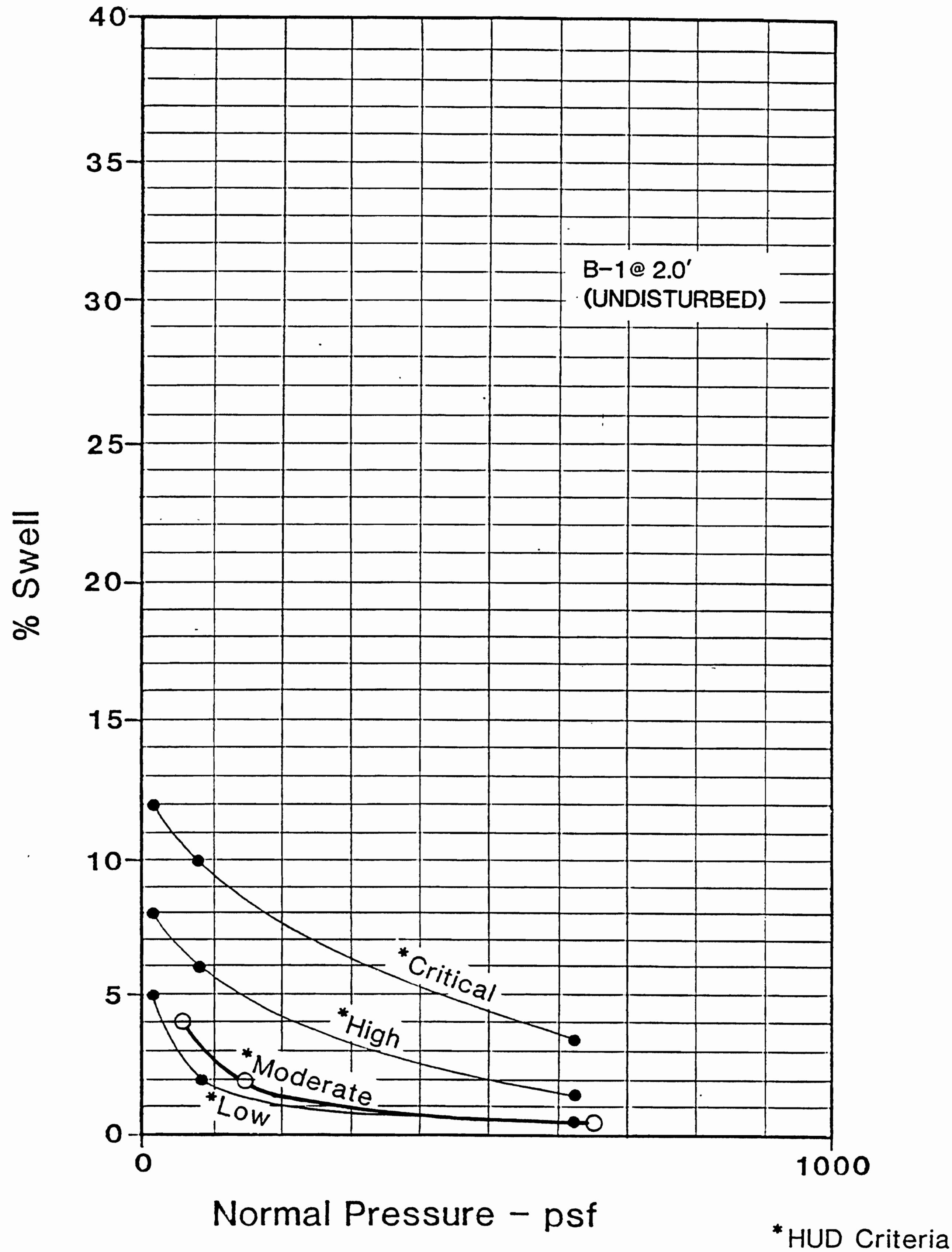
TESTING CONDITIONS

SYMBOL	SAMPLE #	NORMAL STRESS (PSF)	AVE. RATE (IN./HR.)	BEFORE TEST: DRY DENSITY (PCF)	BEFORE TEST: MOISTURE CONTENT	BEFORE TEST: DEG. OF SATURATION	AFTER TEST: SPECIFIC GRAVITY	AFTER TEST: MOISTURE CONTENT	AFTER TEST: DEG. OF SATURATION
▲	B13-3b	300	.067	93	27.9	95	2.65	41.6	100
■	B6-5a	700	.06	82.8	34.7	92	2.65	43.1	100
●	B1-6a	1500	.051	91.8	29.3	96	2.65	35.9	106
◆	B3-8a	2000	.097	106.7	8.8	42	2.65	18.7	109
▼	B10-9a	3000	.058	110.1	17.5	92	2.65	30.9	106

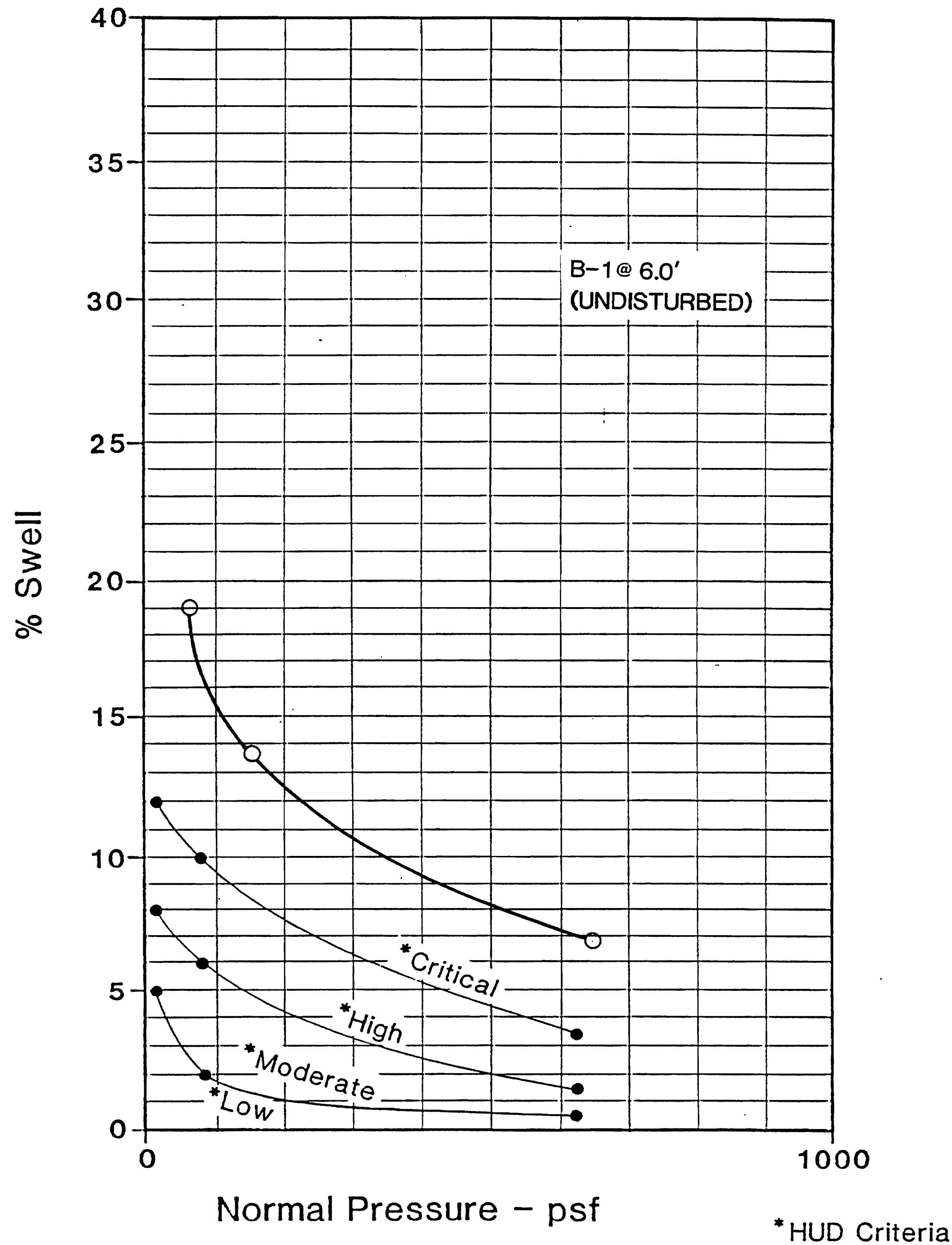
Average strength from all borings tested

PROJECT # 1987	DIRECT SHEAR TEST PLOT	JAN. 1989	AMERICAN GEOTECHNICAL

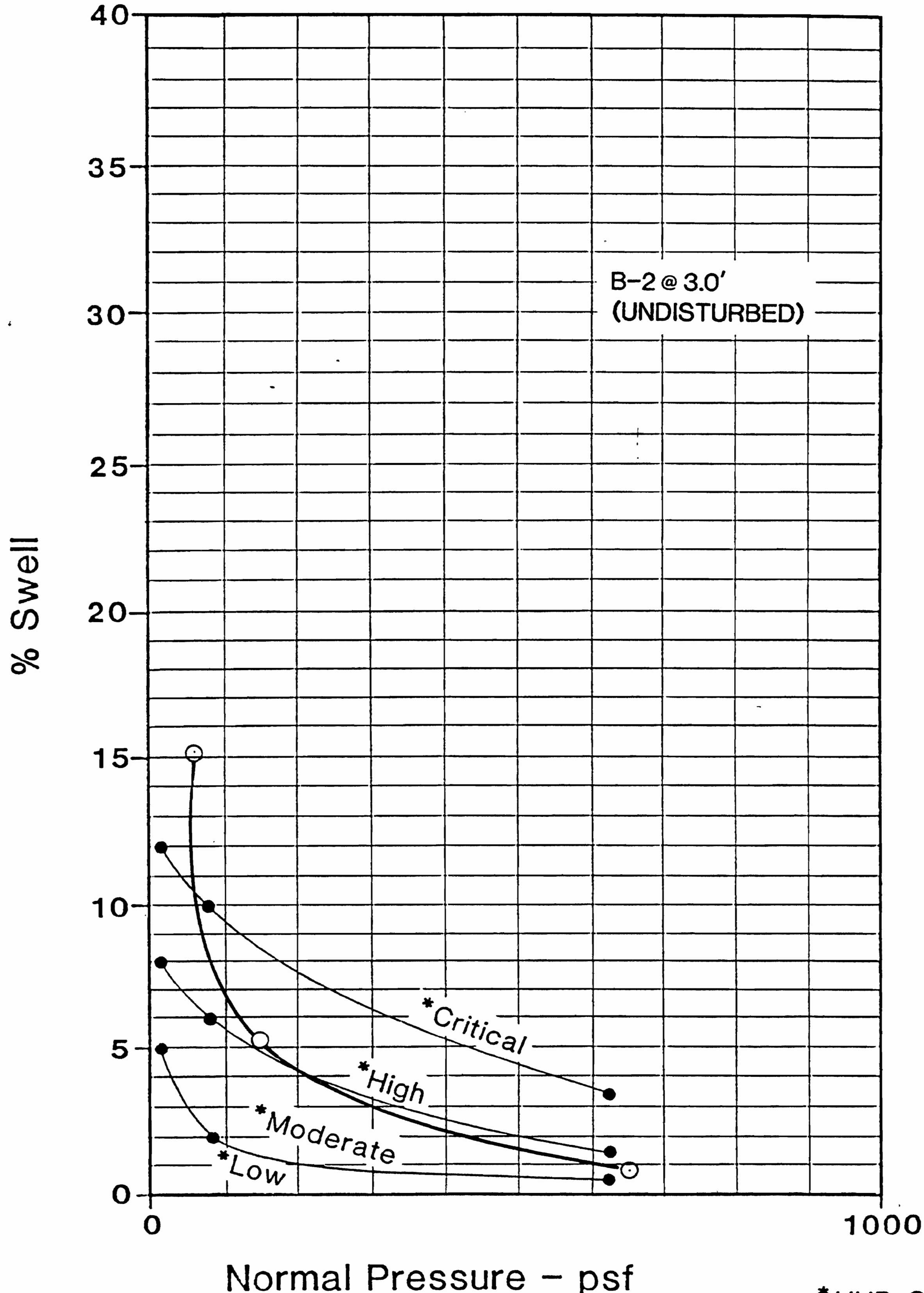
PLATE E1



SWELL / PRESSURE DIAGRAM			Plate E2
AMERICAN GEOTECHNICAL	F.N. 1987	JAN. 1989	

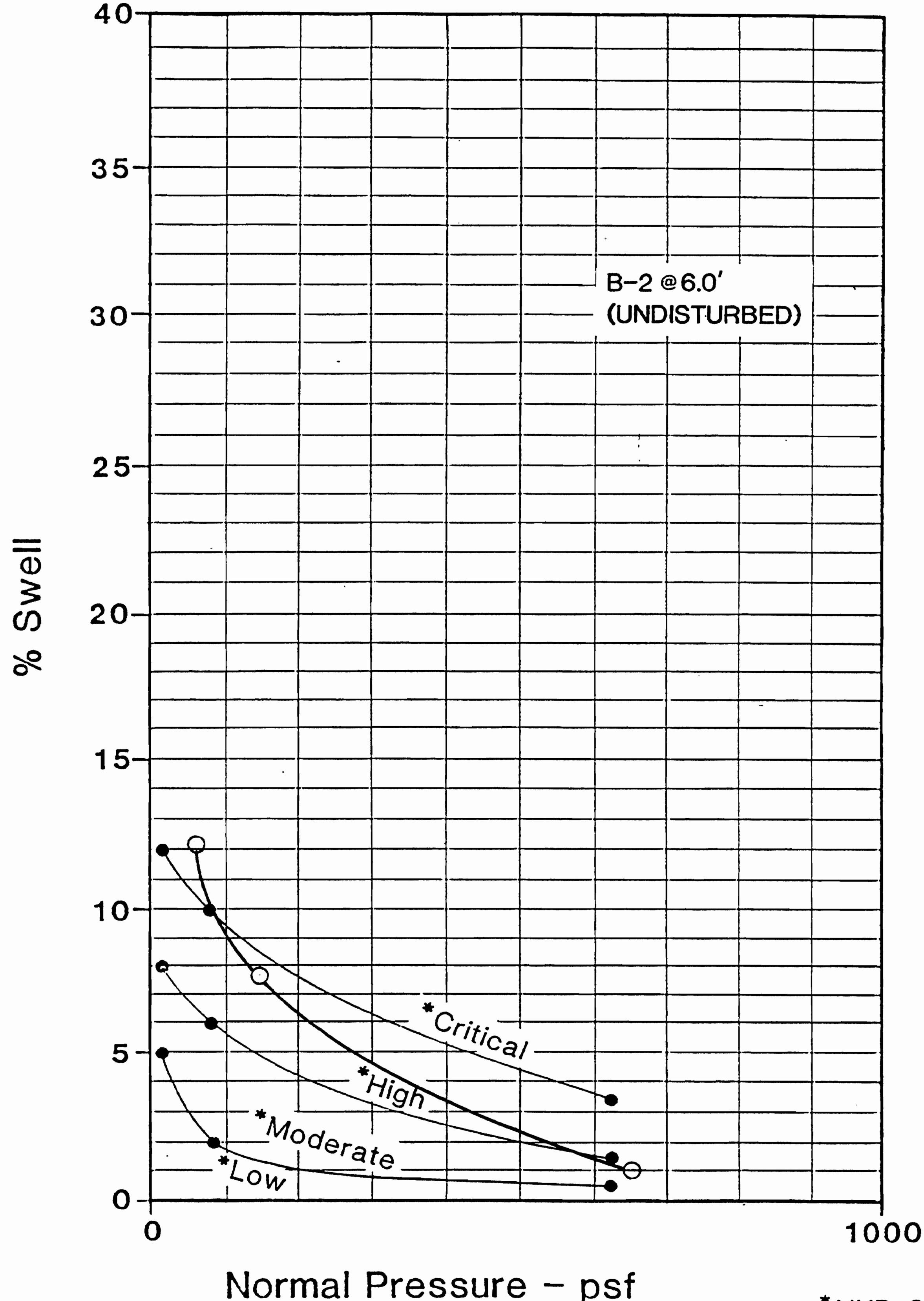


SWELL / PRESSURE DIAGRAM			Plate E3
AMERICAN GEOTECHNICAL	F.N. 1987	JAN. 1989	



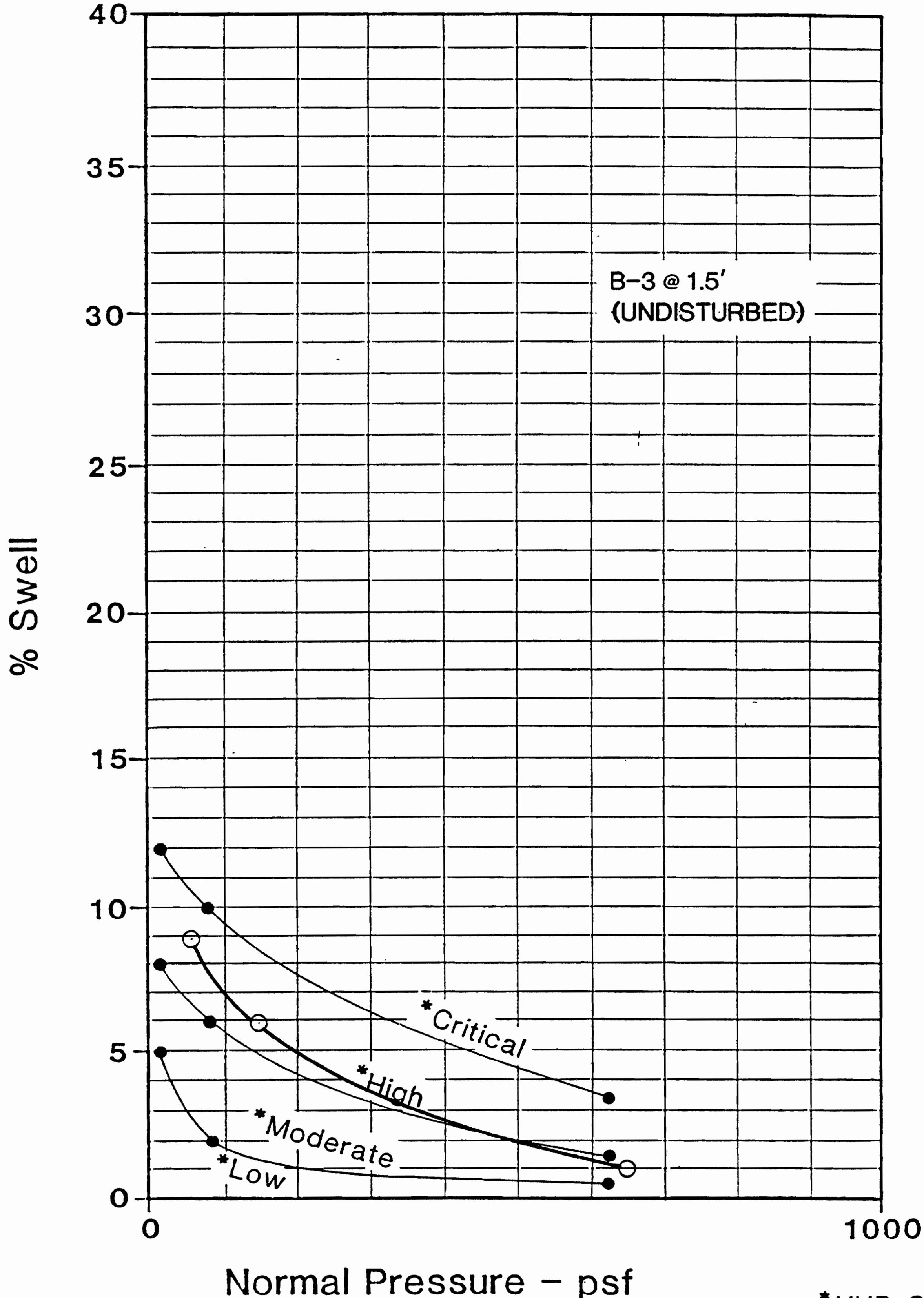
*HUD Criteria

SWELL / PRESSURE DIAGRAM			Plate E4
AMERICAN GEOTECHNICAL	F.N. 1987	JAN. 1989	



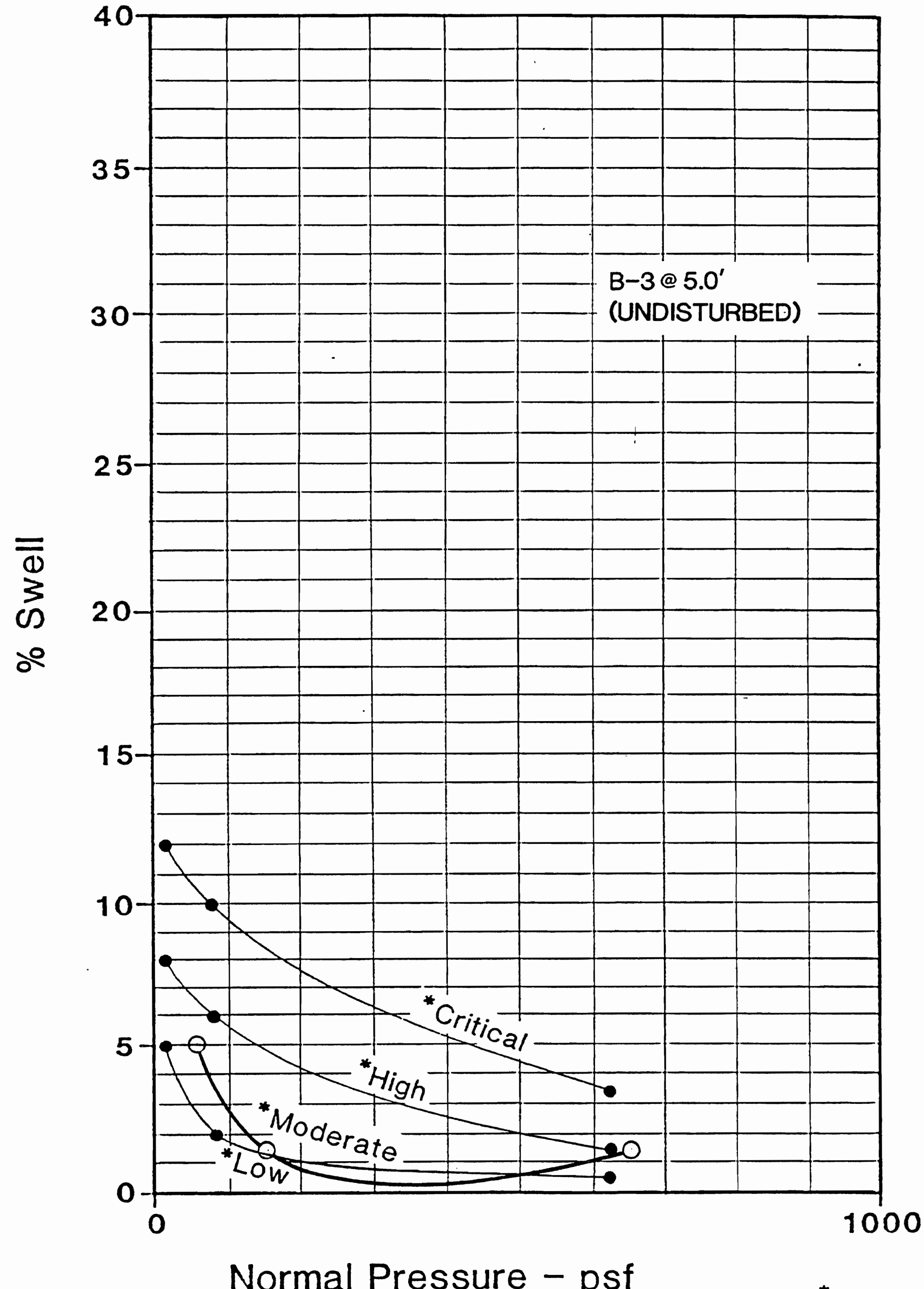
*HUD Criteria

SWELL / PRESSURE DIAGRAM			Plate E5
AMERICAN GEOTECHNICAL	F.N. 1987	JAN. 1989	



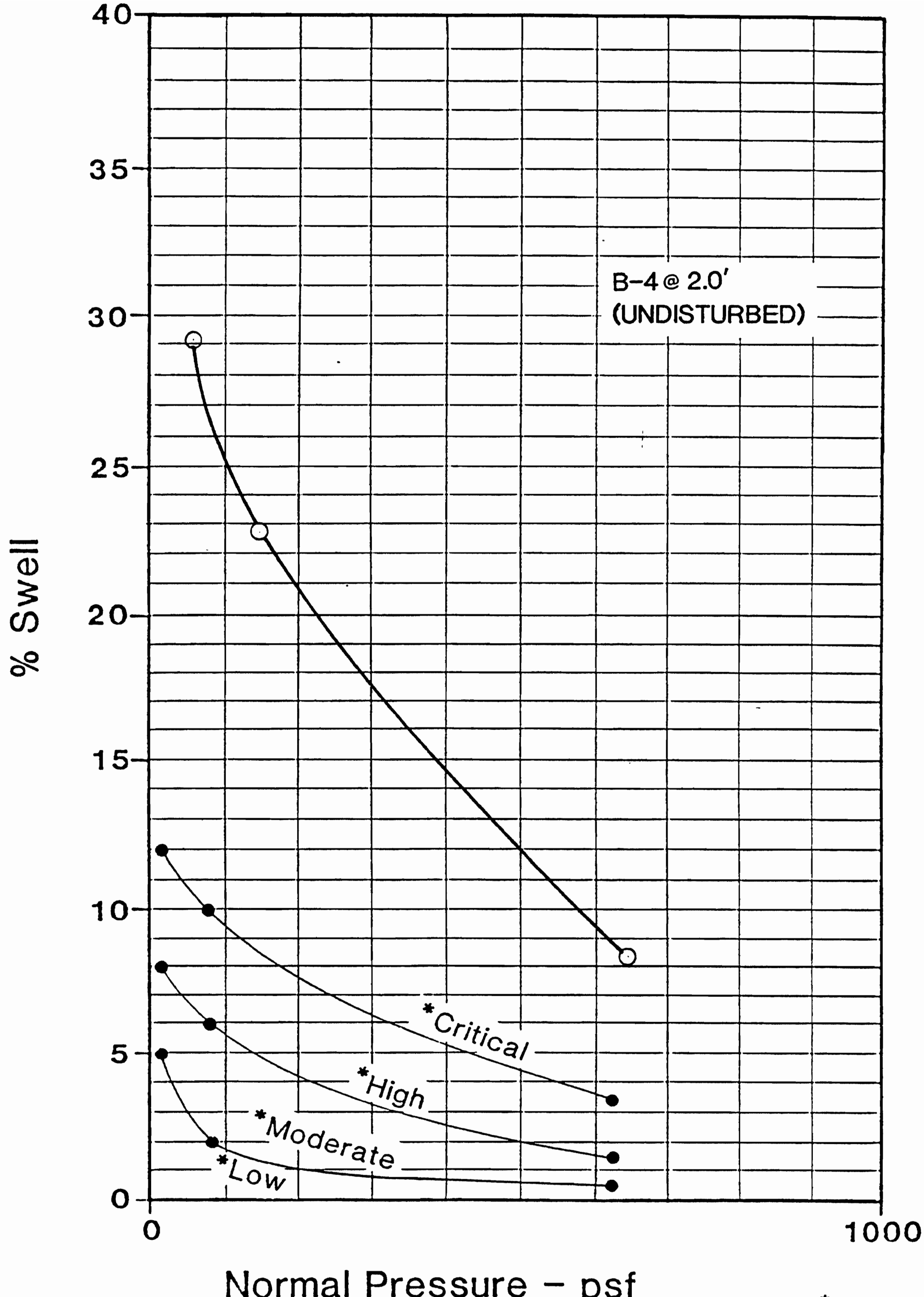
*HUD Criteria

SWELL / PRESSURE DIAGRAM			Plate E6
AMERICAN GEOTECHNICAL	F.N. 1987	JAN. 1989	



*HUD Criteria

SWELL / PRESSURE DIAGRAM			Plate E7
AMERICAN GEOTECHNICAL	F.N. 1987	JAN. 1989	



*HUD Criteria

SWELL / PRESSURE DIAGRAM			Plate E8
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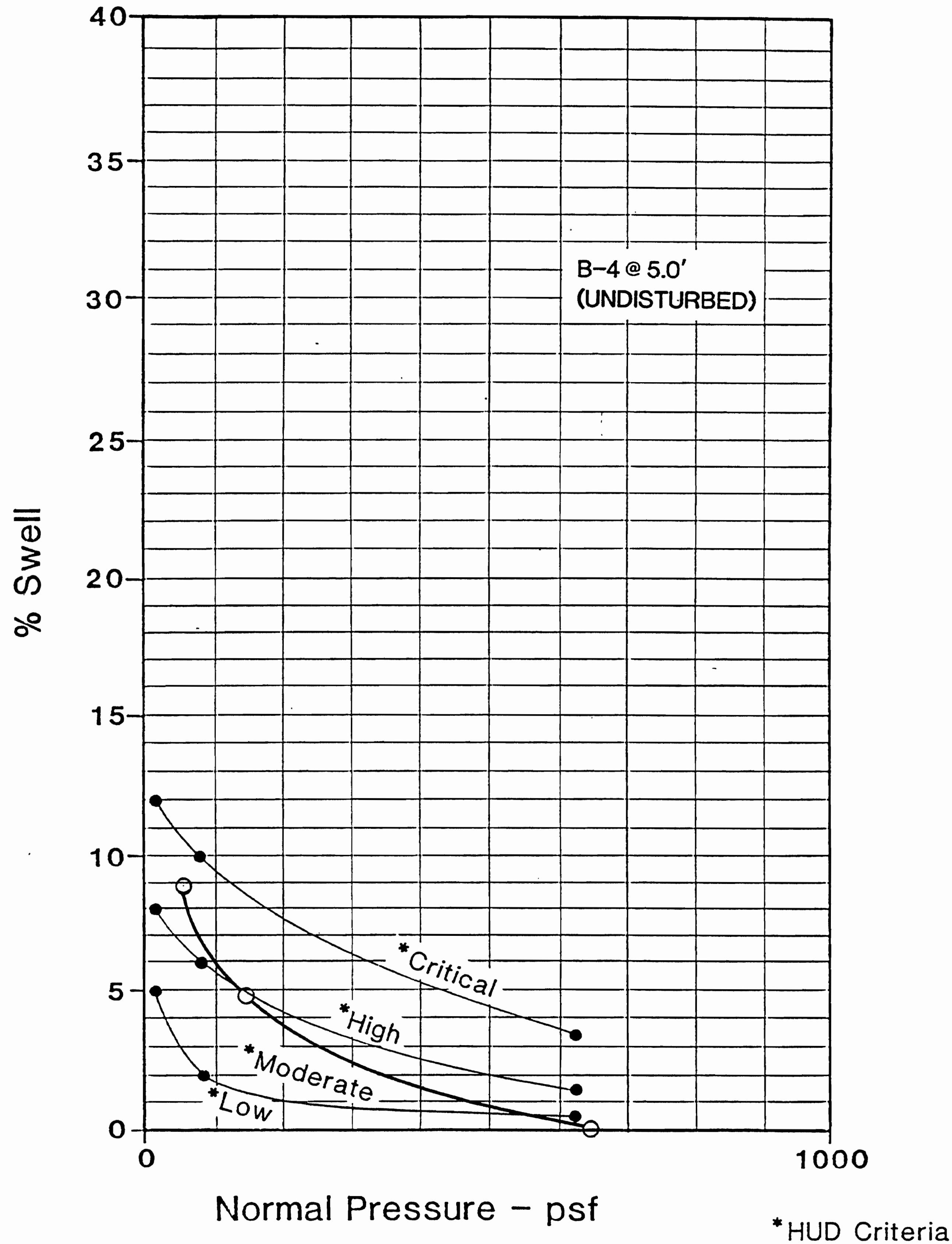
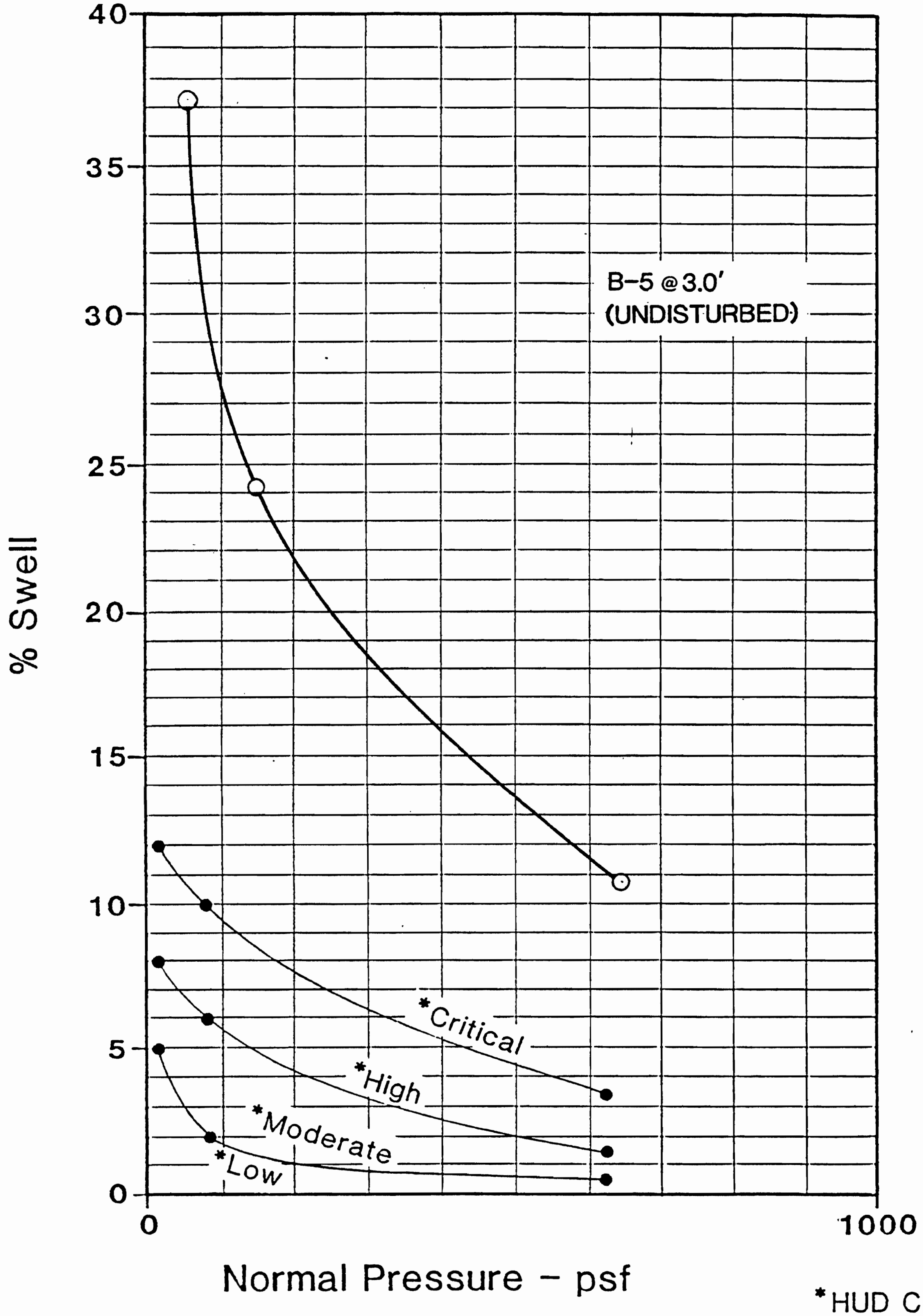


SWELL / PRESSURE DIAGRAM			Plate E9
AMERICAN GEOTECHNICAL	F.N. 1987	JAN. 1989	



*HUD Criteria

SWELL / PRESSURE DIAGRAM			Plate E10
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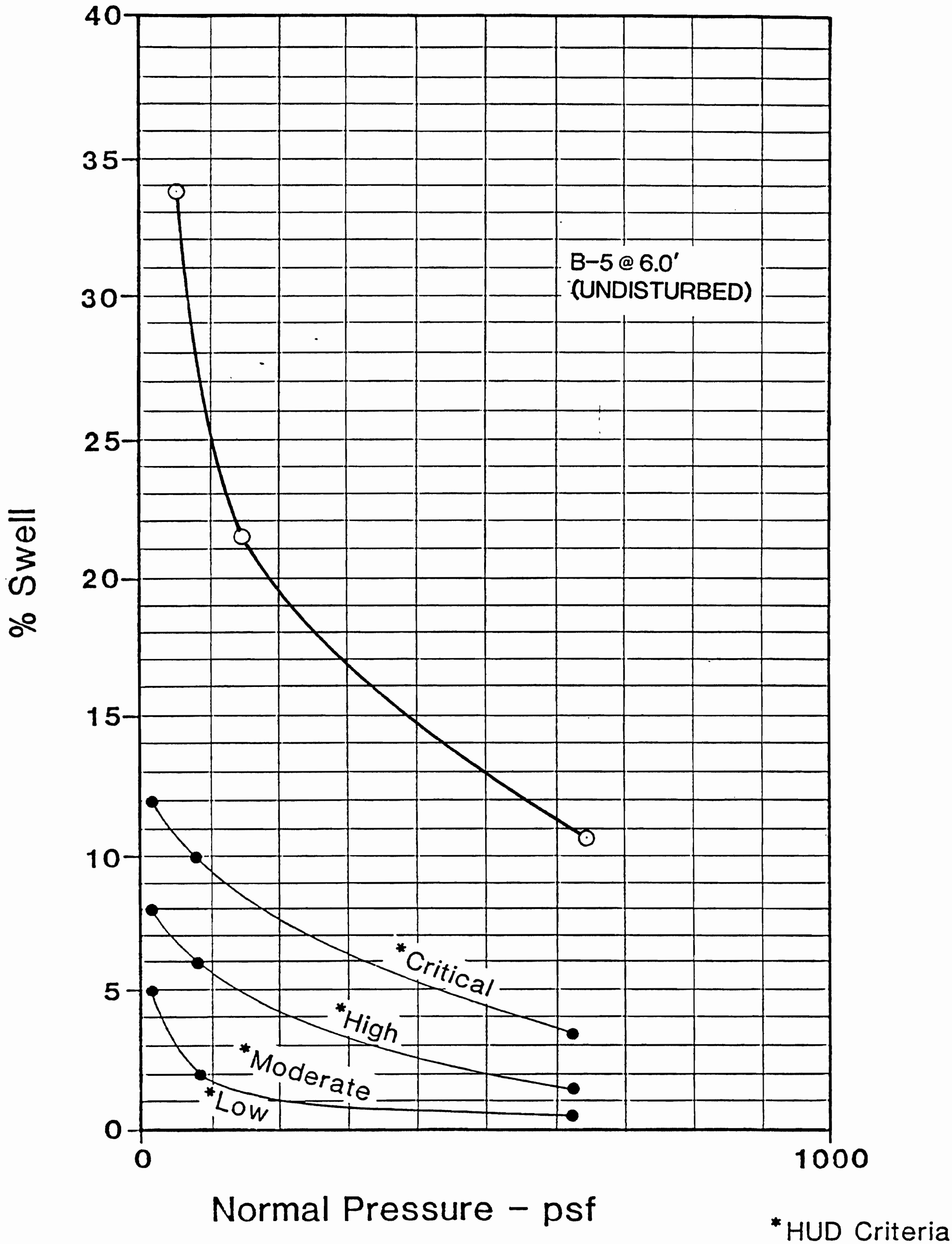

SWELL / PRESSURE DIAGRAM			Plate E11
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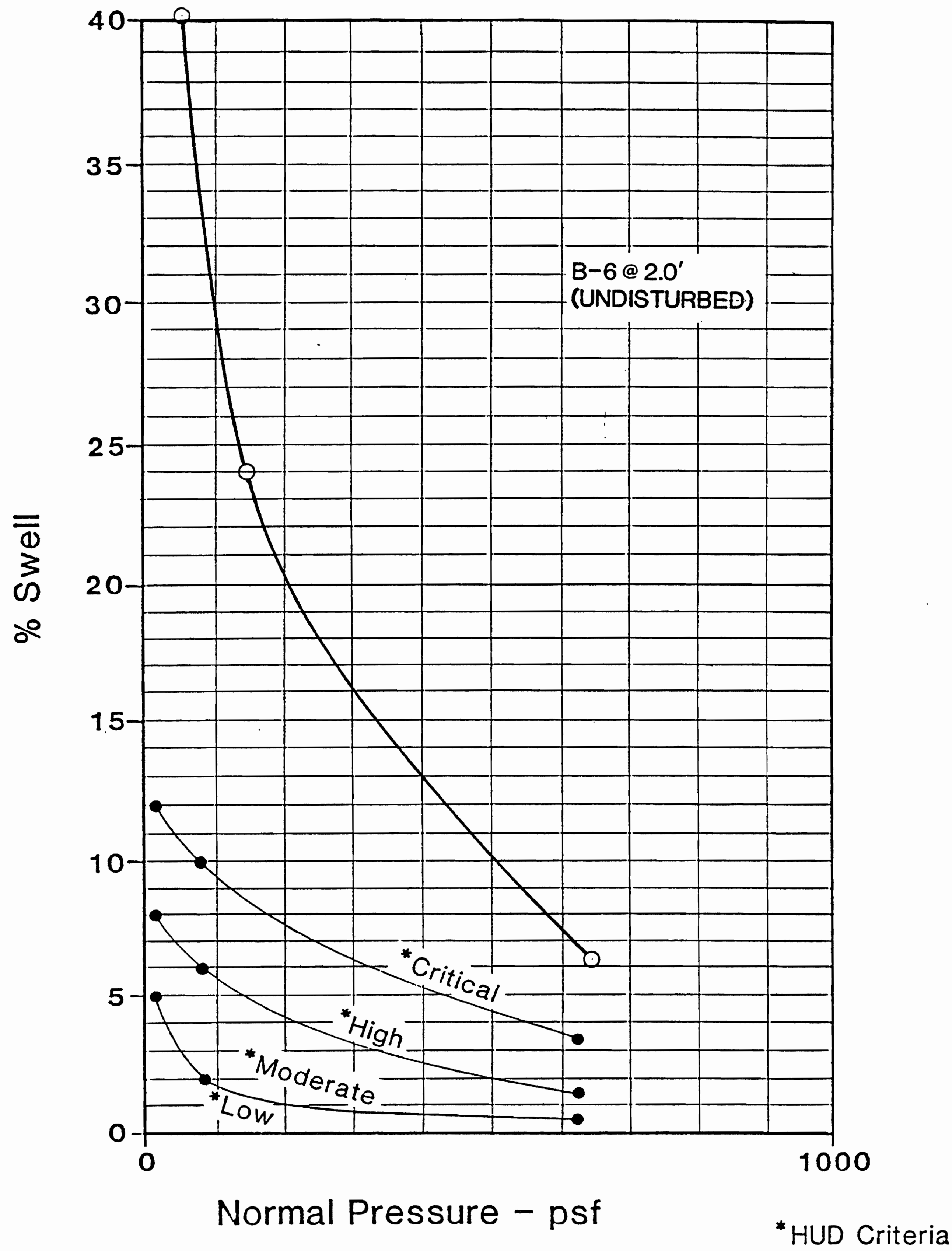

SWELL / PRESSURE DIAGRAM			Plate E12
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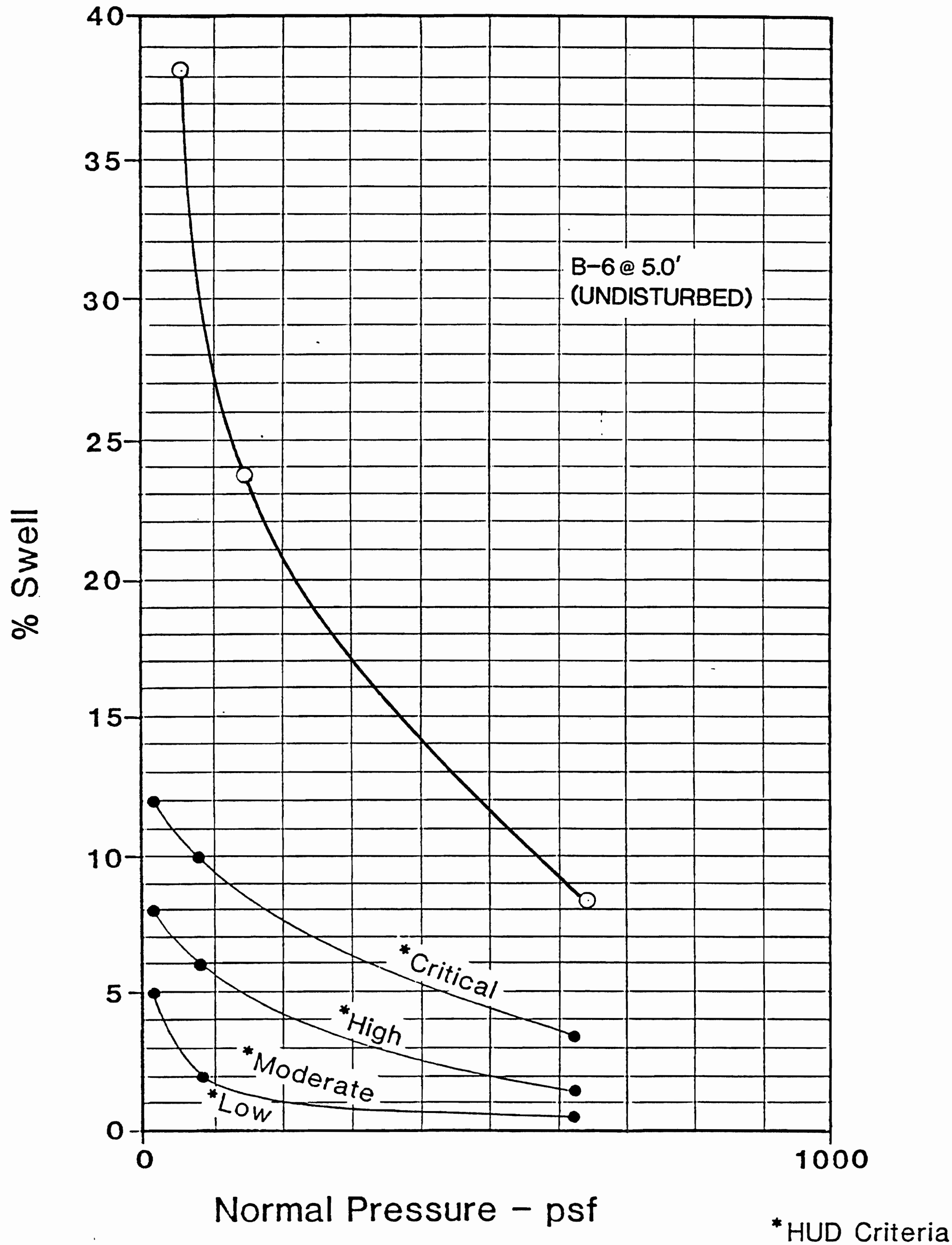
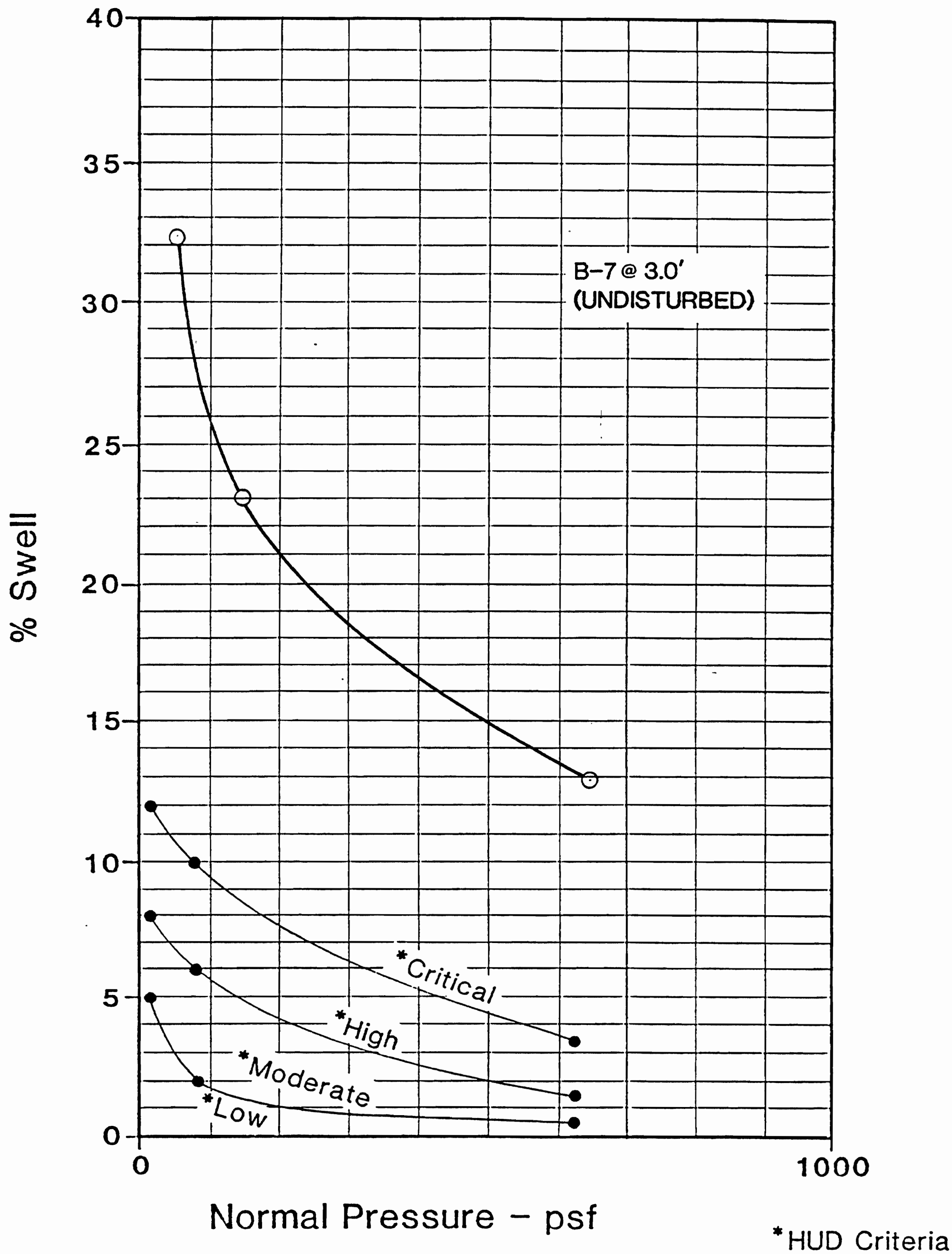


SWELL / PRESSURE DIAGRAM			Plate E13
AMERICAN GEOTECHNICAL	F.N. 1987	JAN. 1989	



SWELL / PRESSURE DIAGRAM			Plate E14
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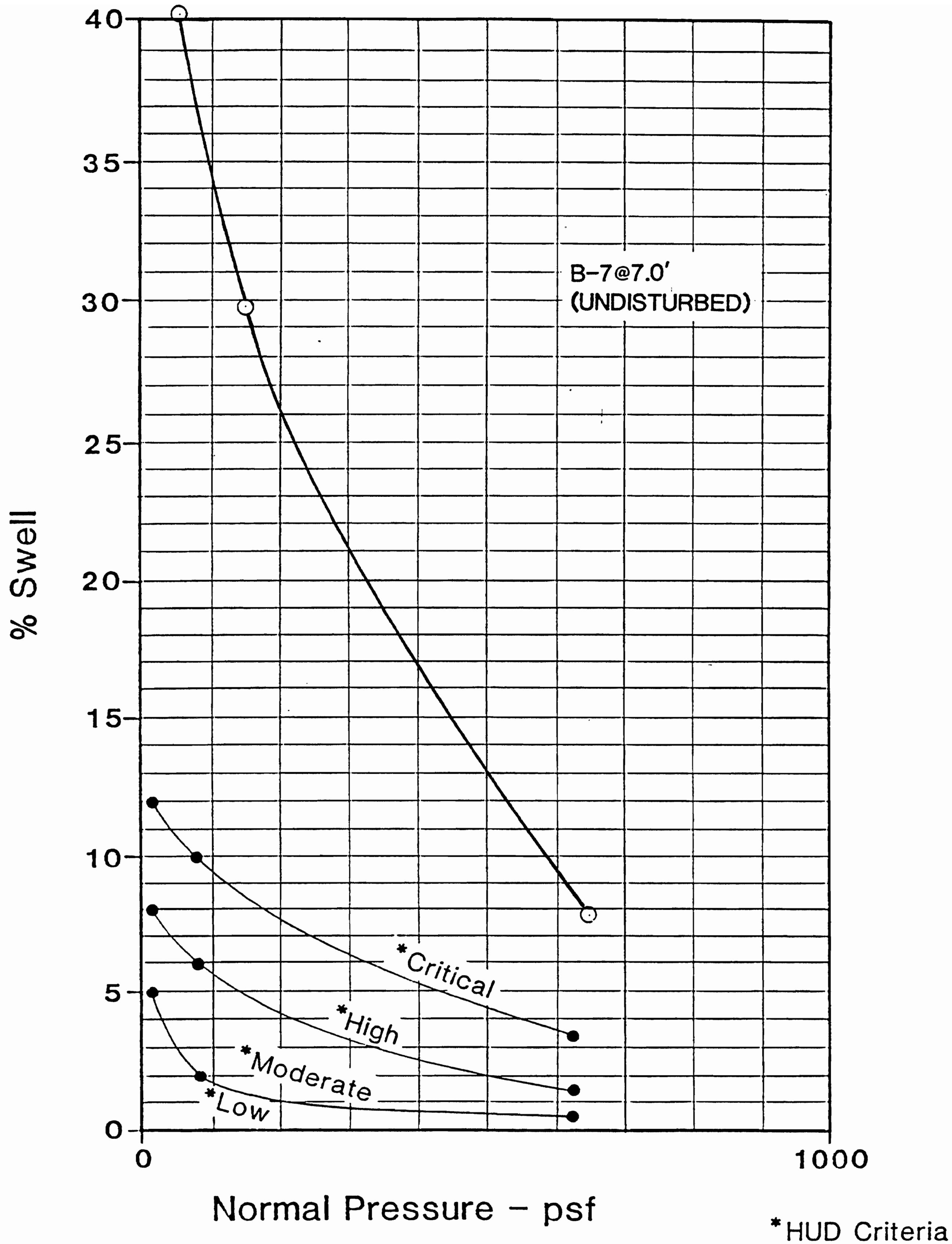

SWELL / PRESSURE DIAGRAM			Plate E15
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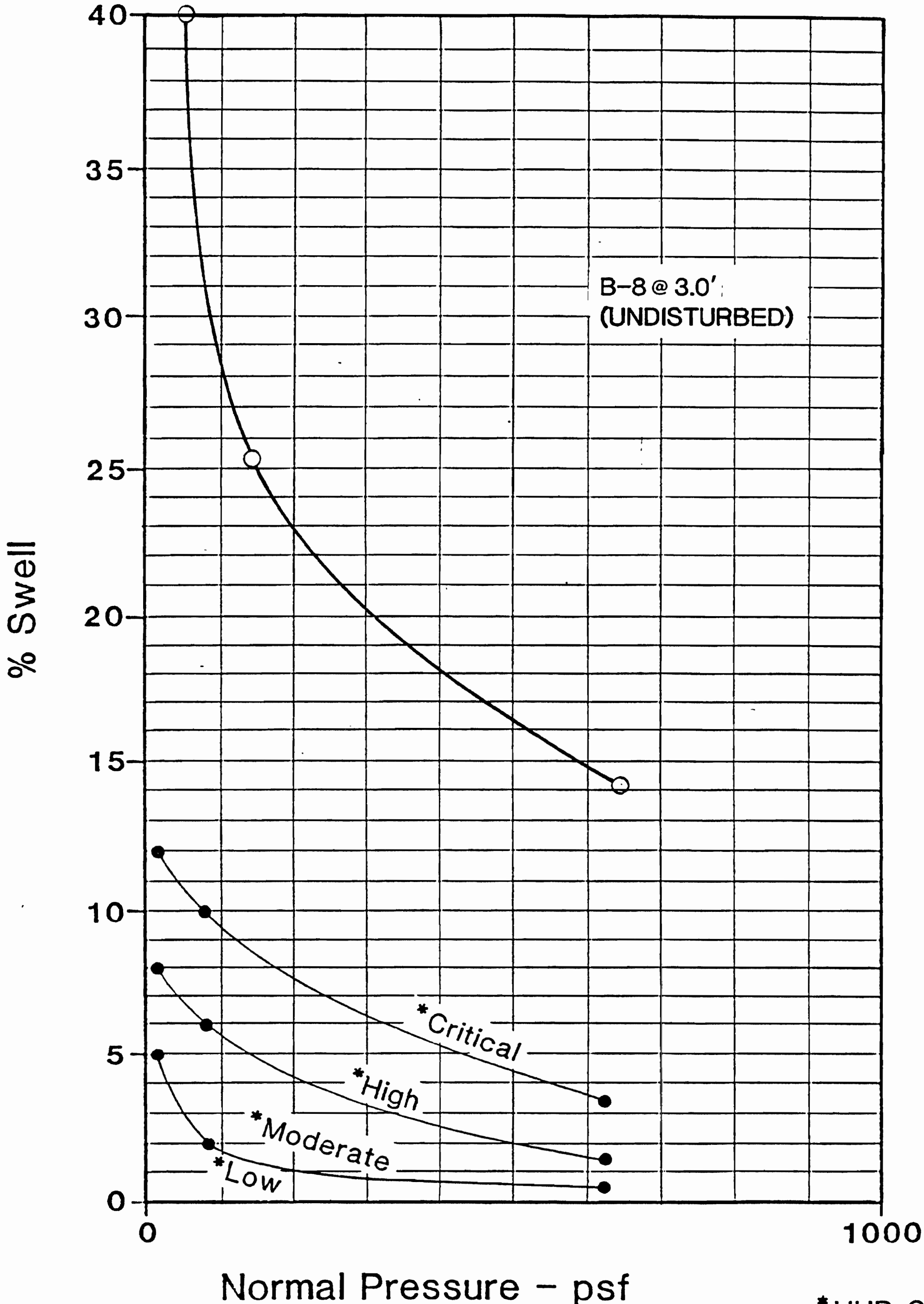

*HUD Criteria

SWELL / PRESSURE DIAGRAM			Plate E16
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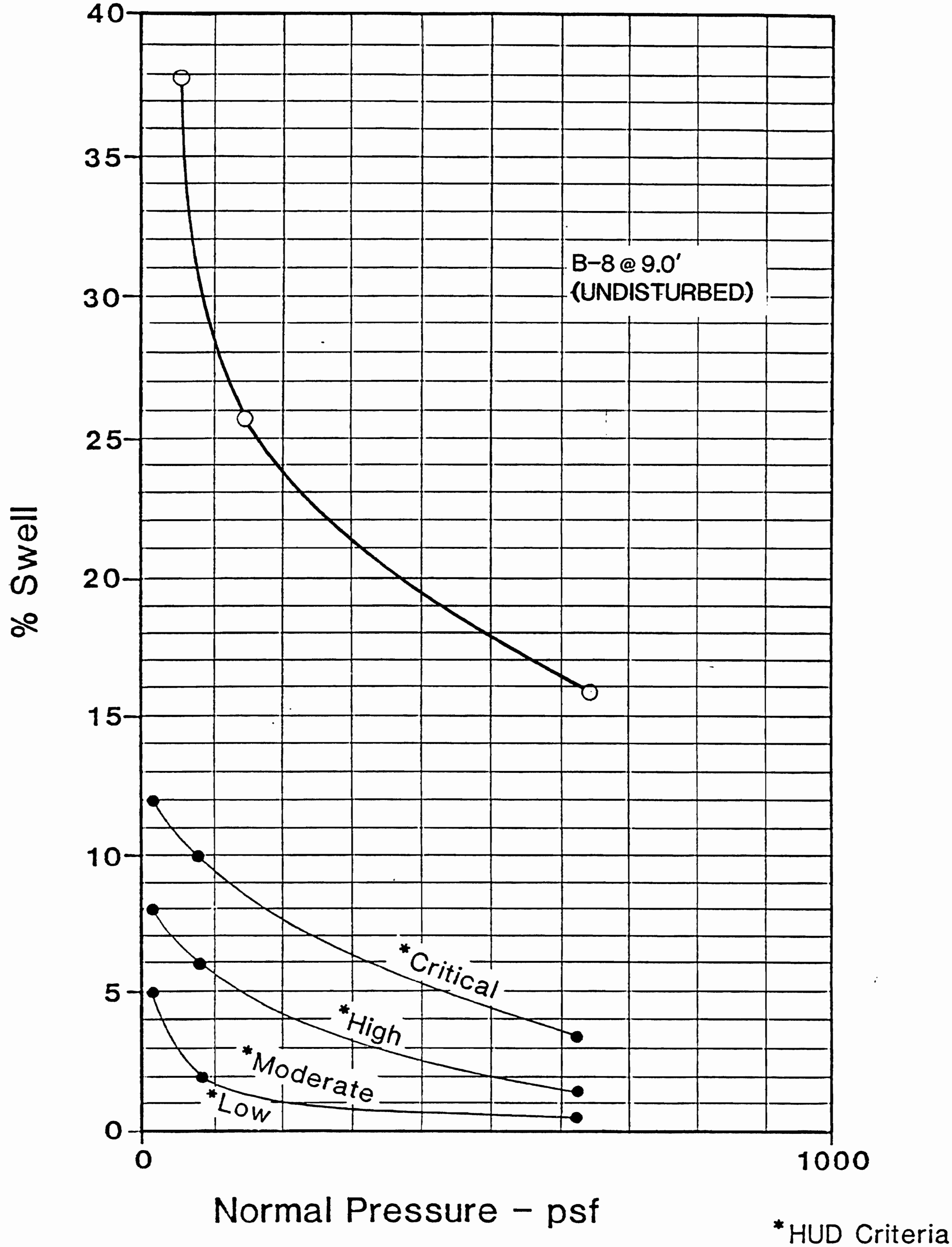

SWELL / PRESSURE DIAGRAM			Plate E17
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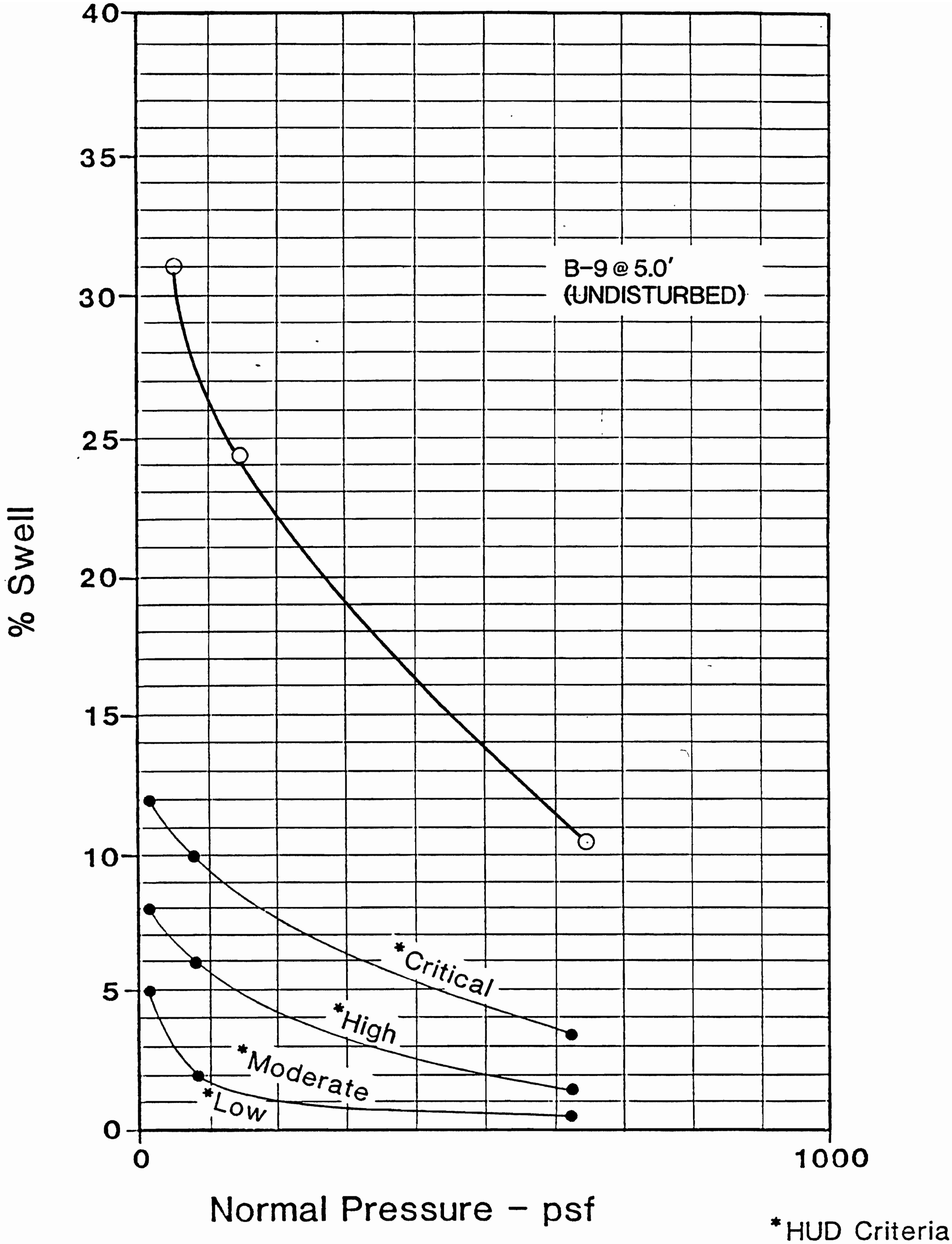
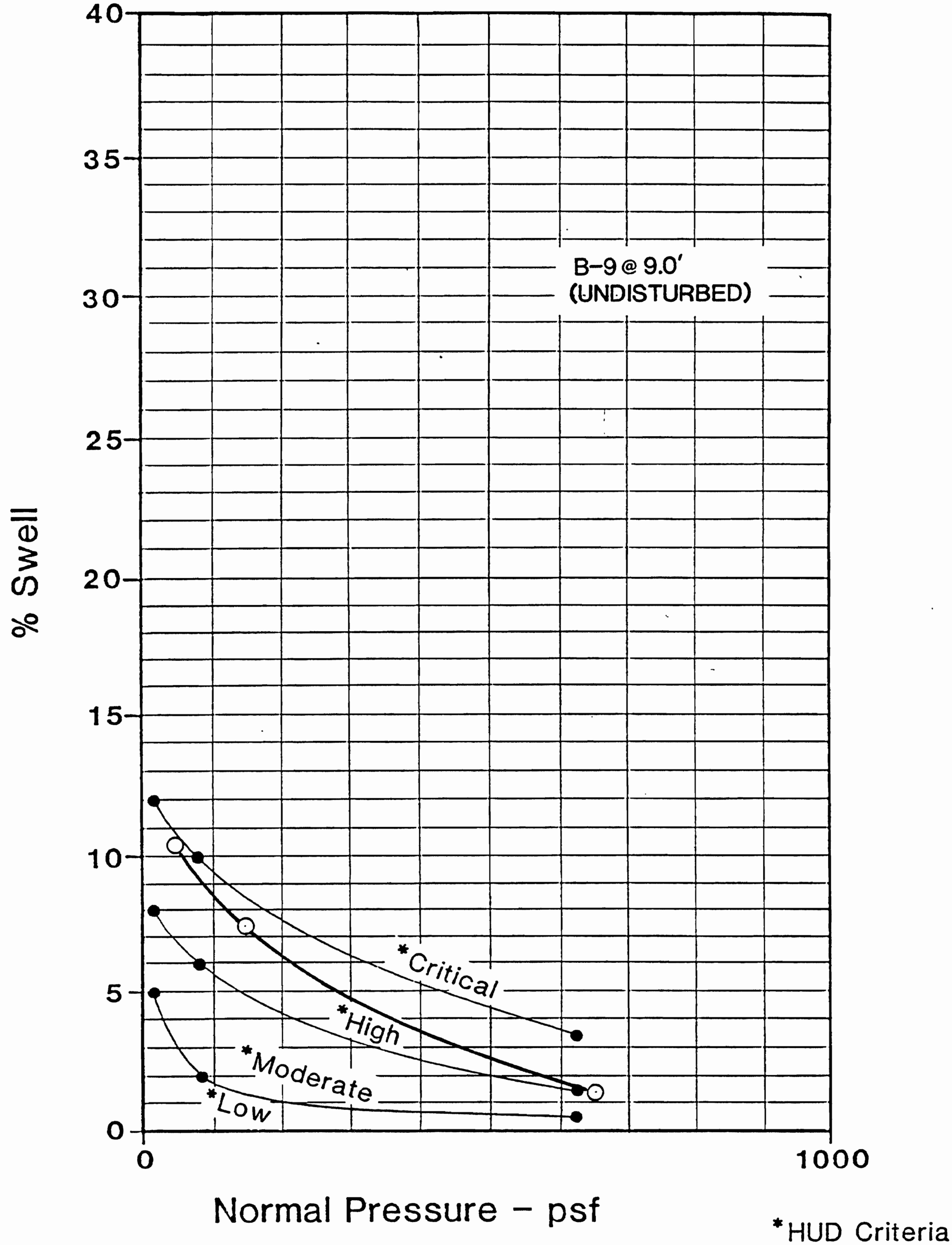
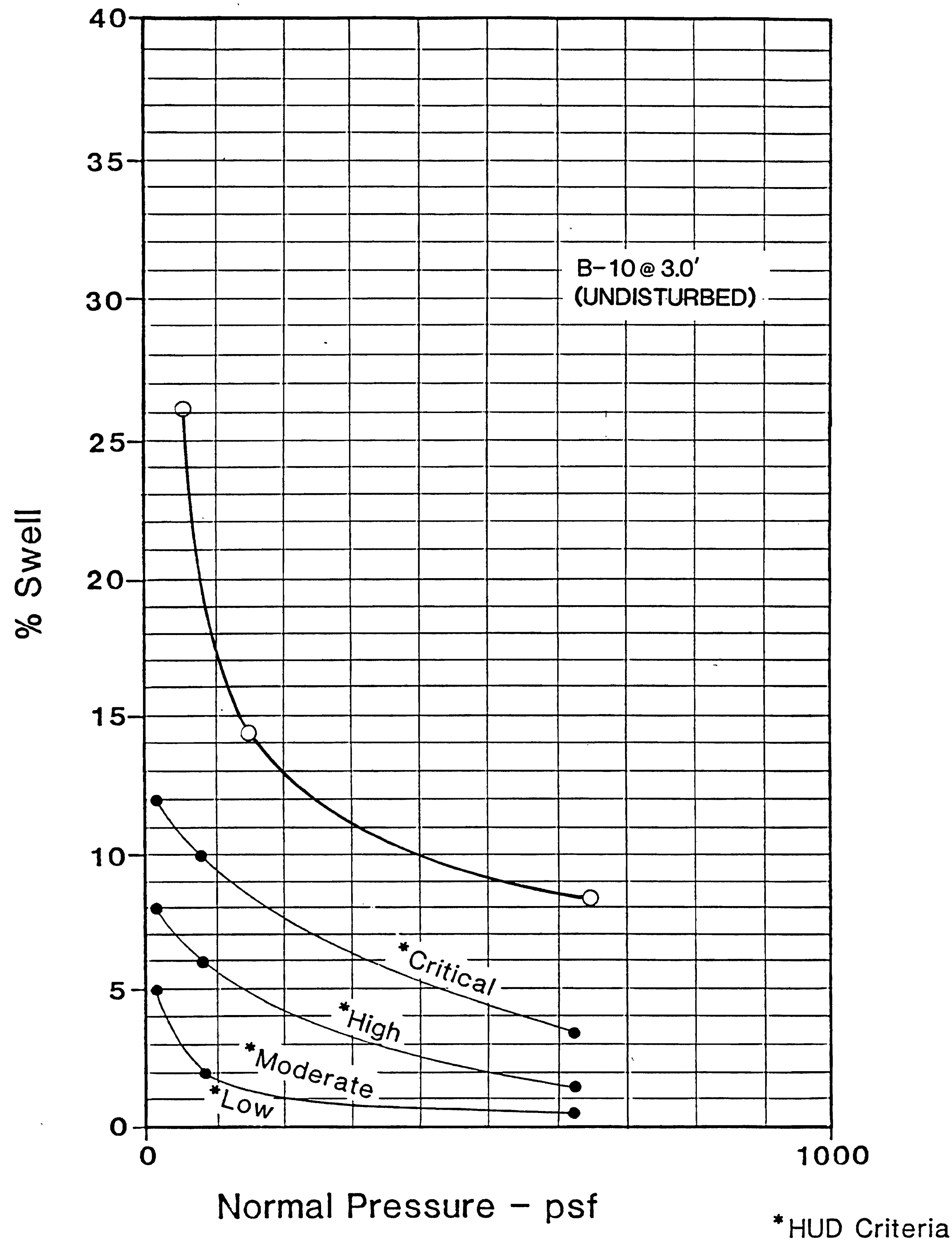


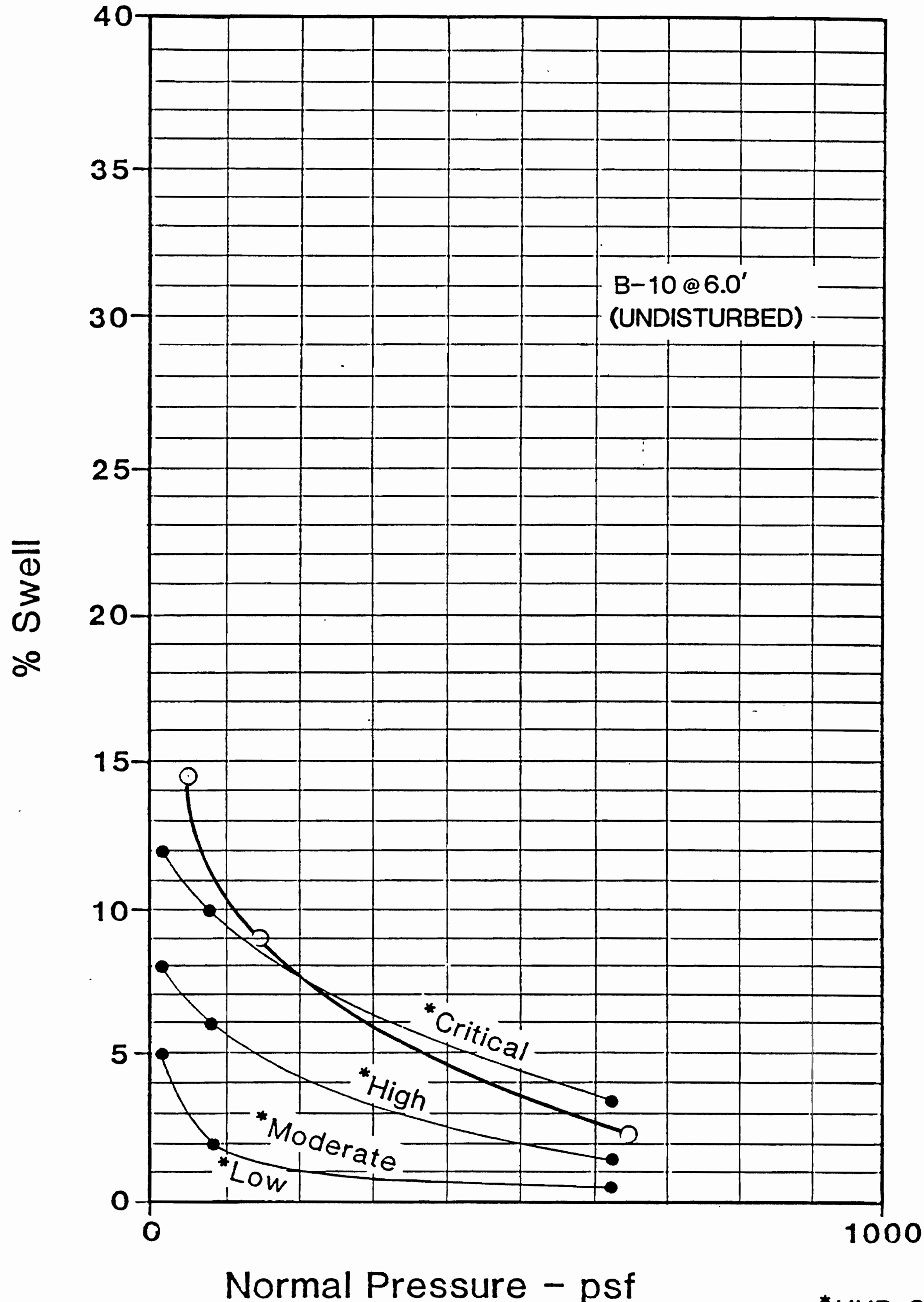
SWELL / PRESSURE DIAGRAM			Plate E18
AMERICAN GEOTECHNICAL	F.N. 1987	JAN. 1989	



SWELL / PRESSURE DIAGRAM			Plate E19
AMERICAN GEOTECHNICAL	F.N. 1987	JAN. 1989	

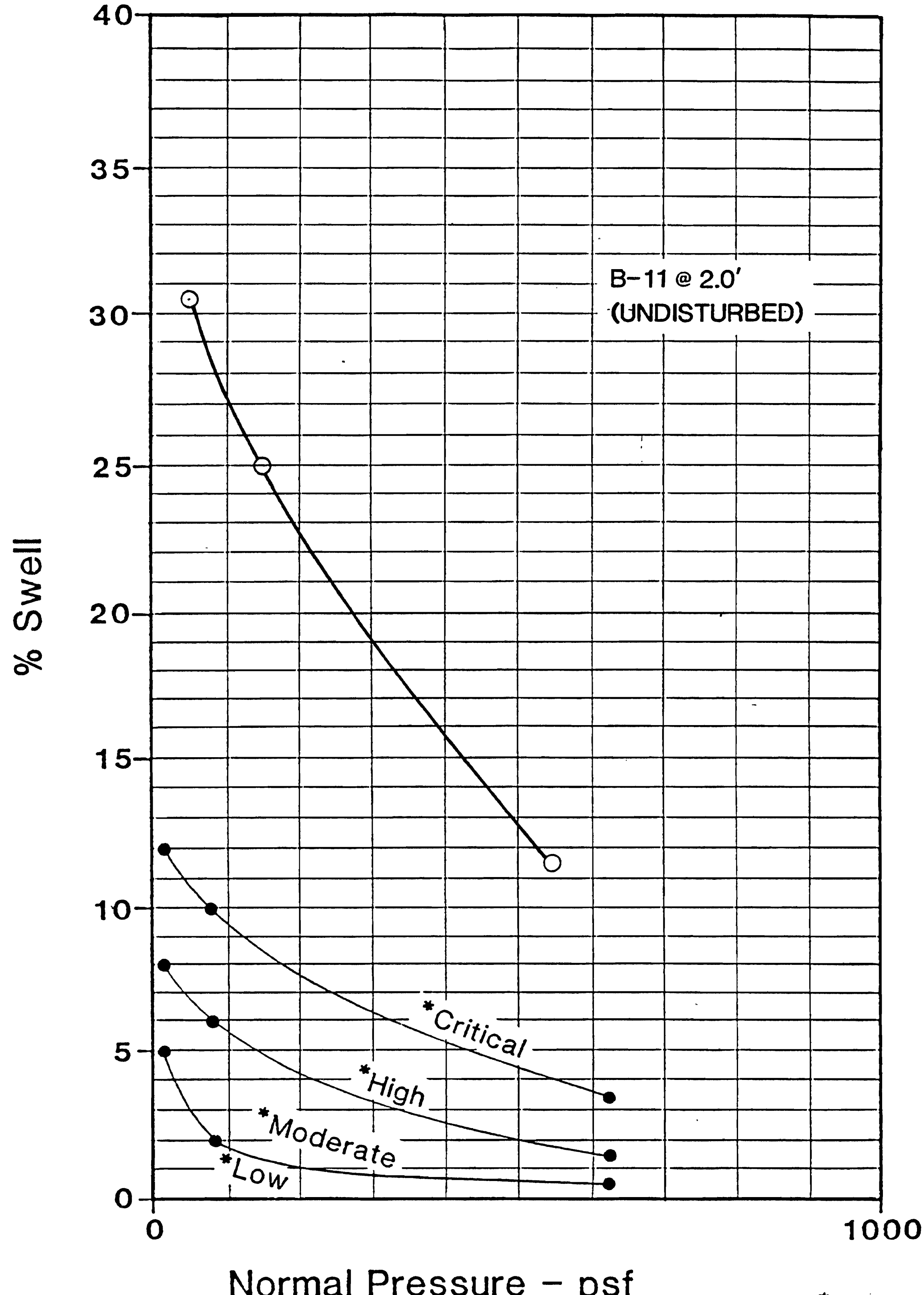


SWELL / PRESSURE DIAGRAM			Plate E20
AMERICAN GEOTECHNICAL	F.N. 1987	JAN. 1989	



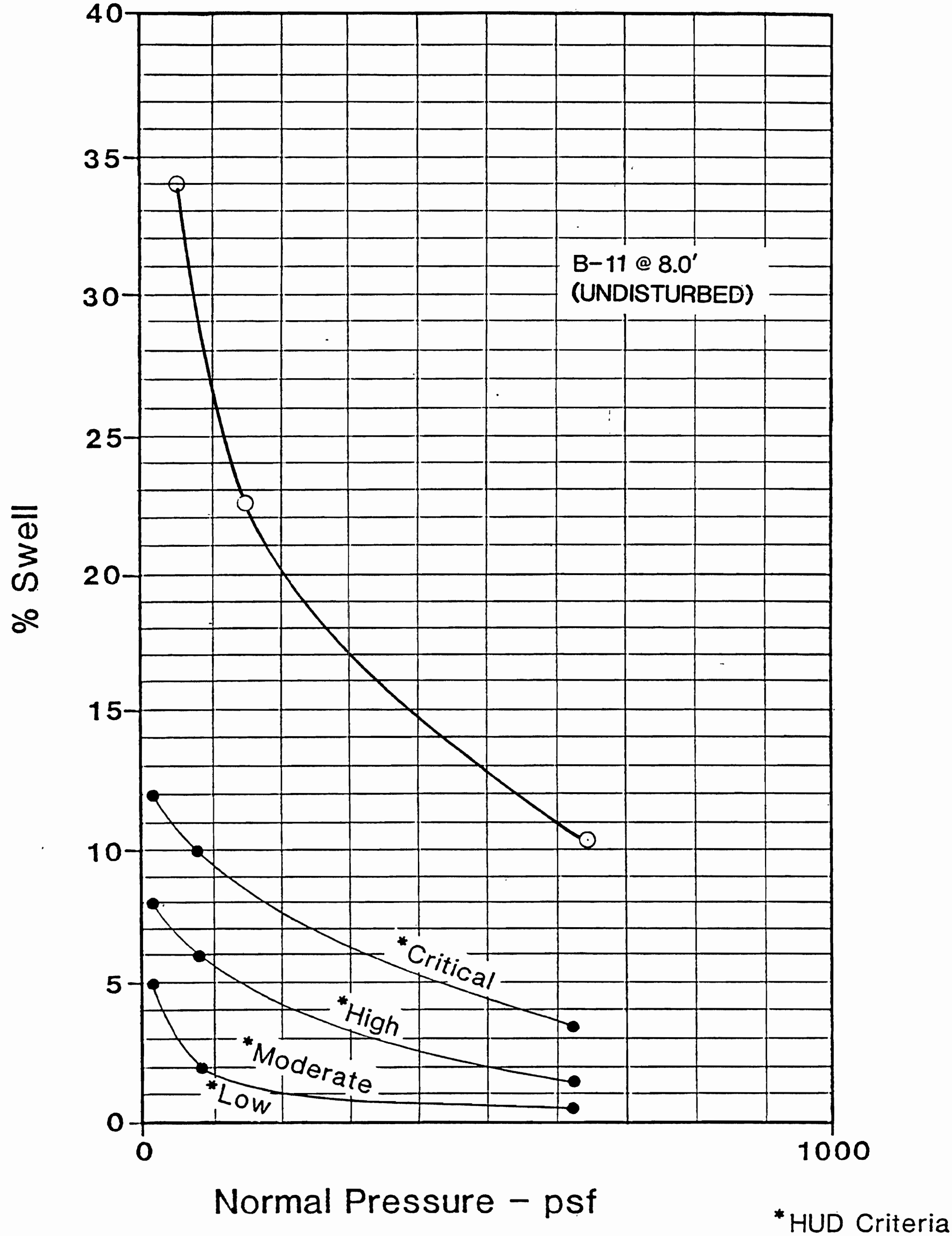
*HUD Criteria

SWELL / PRESSURE DIAGRAM			Plate E21
AMERICAN GEOTECHNICAL	F.N. 1987	JAN. 1989	

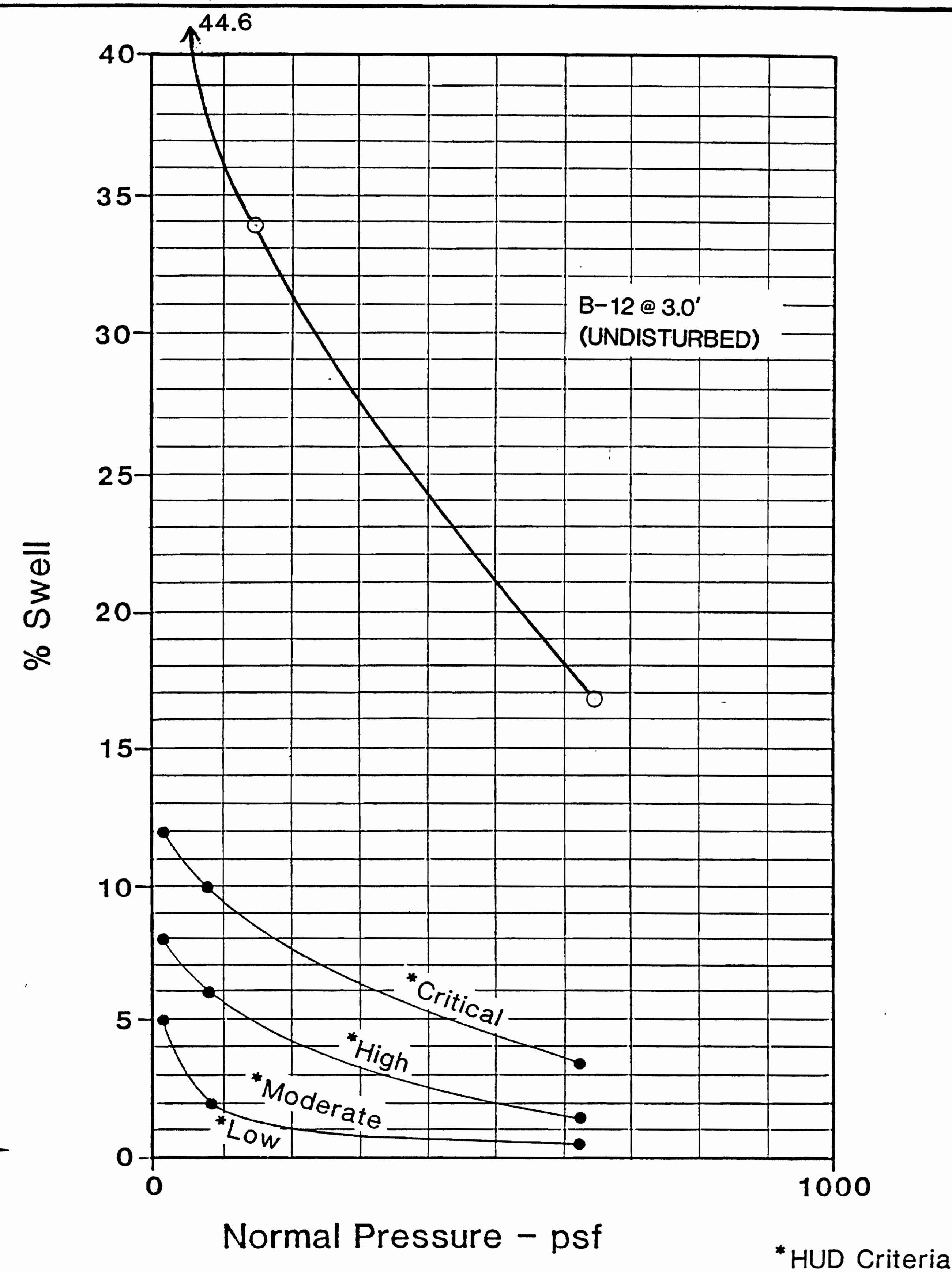


*HUD Criteria

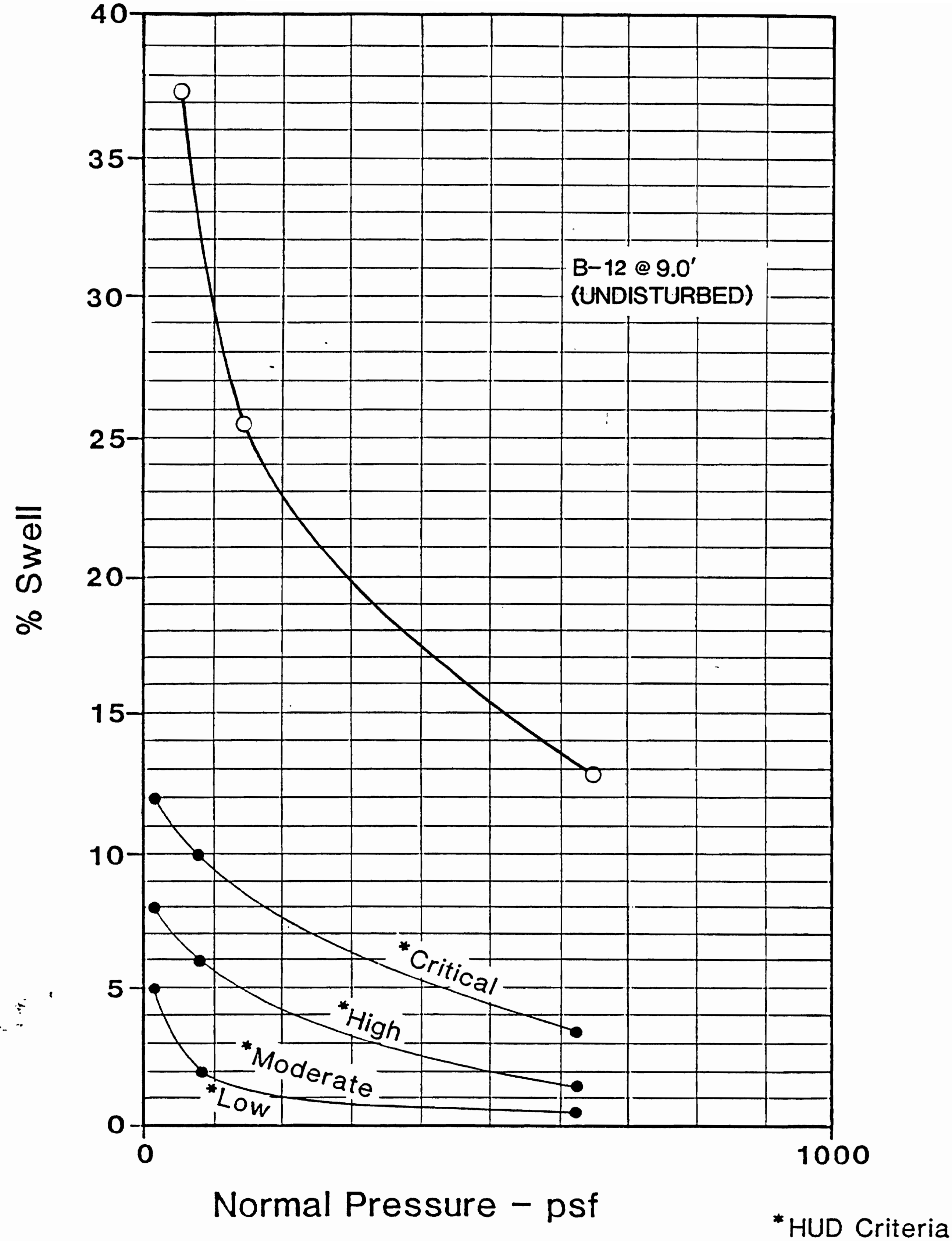
SWELL / PRESSURE DIAGRAM			Plate E22
AMERICAN GEOTECHNICAL	F.N. 1987	JAN. 1989	



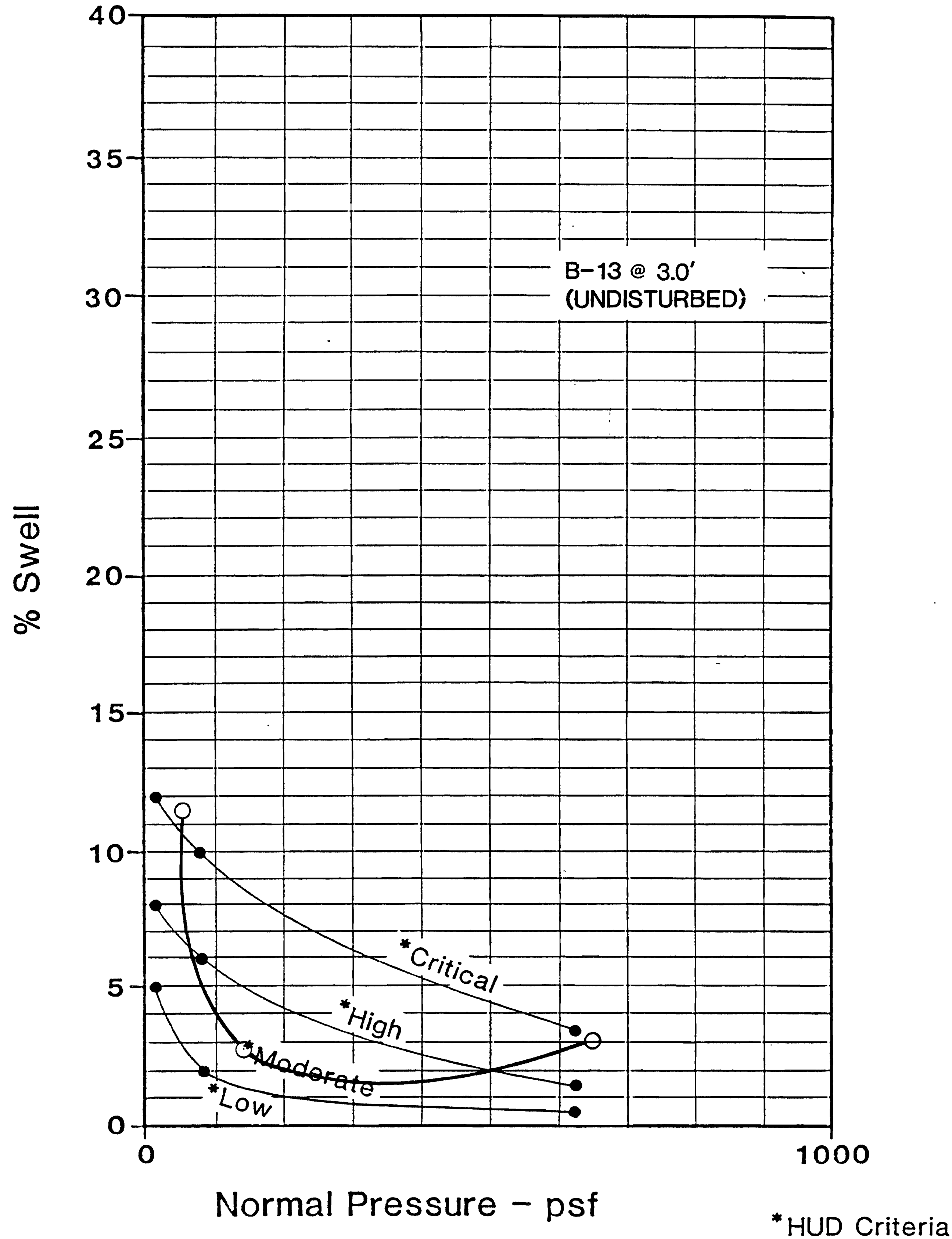
SWELL / PRESSURE DIAGRAM			Plate E23
AMERICAN GEOTECHNICAL	F.N. 1987	JAN. 1989	



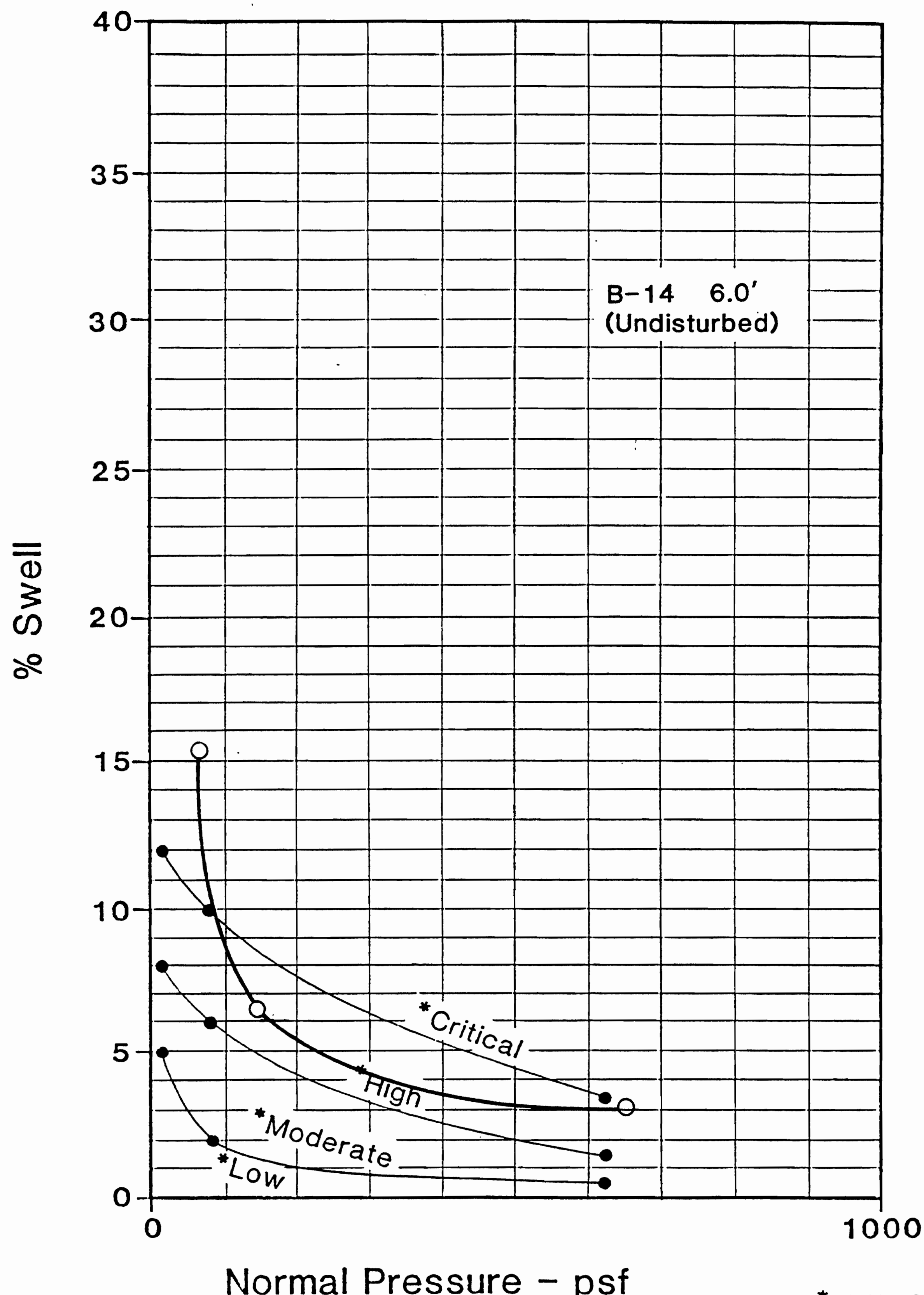
SWELL / PRESSURE DIAGRAM			Plate E24
AMERICAN GEOTECHNICAL	F.N. 1987	JAN. 1989	



SWELL / PRESSURE DIAGRAM			Plate E25
AMERICAN GEOTECHNICAL	F.N. 1987	JAN. 1989	



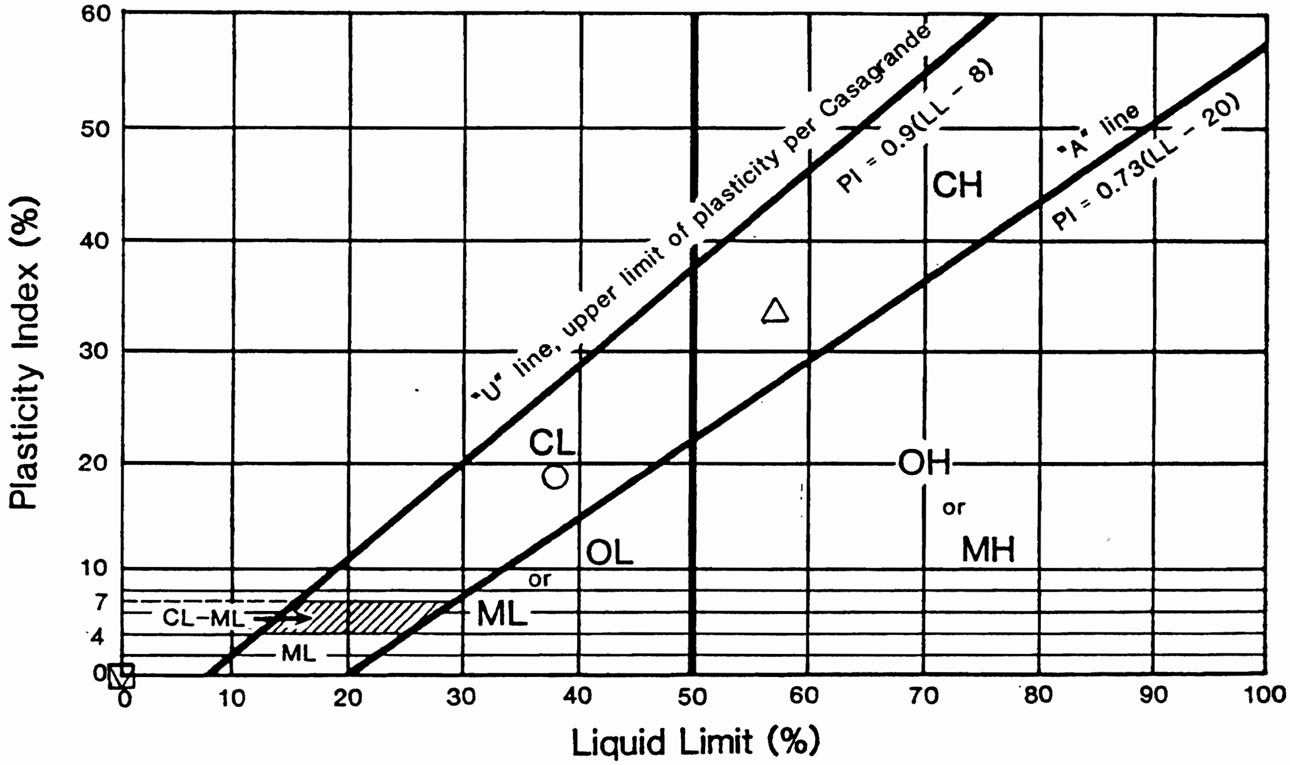
SWELL / PRESSURE DIAGRAM			Plate E26
AMERICAN GEOTECHNICAL	F.N. 1987	JAN. 1989	



*HUD Criteria

SWELL / PRESSURE DIAGRAM			Plate E27
AMERICAN GEOTECHNICAL	F.N. 1987	JAN. 1989	

Plasticity Chart

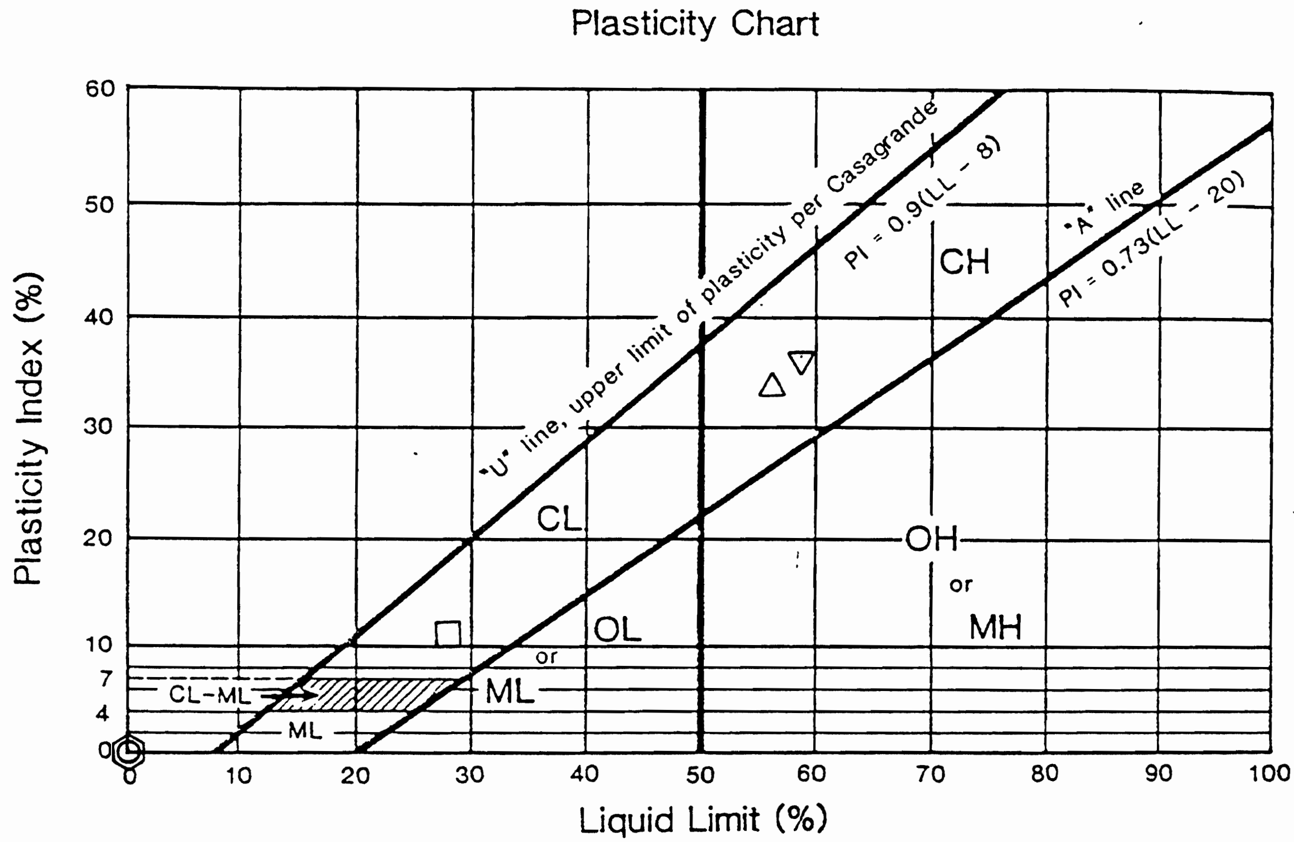


Symbol	Excavation Number	Depth (feet)	Natural Moisture Content (%)	Liquid Limit (%)	Plasticity Index (%)	Passing No. 200 Sieve (%)	Liquidity Index (%)	Unified Soil Class. Symbol
○	B-1	2.0	14.5	38	19	49	—	CL
—	B-1	9.0	24.8	—	—	14	—	SC
△	B-2	6.0	26.6	57	34	80	—	CH
□	B-2	9.0	16.3	0	0	23		SC
▽	B-2	18.0	7.9	0	0	37		SM

ATTERBERG LIMITS AND PLASTICITY CHART

AMERICAN GEOTECHNICAL | F.N. 1987 | JAN. 1989

Plate E28

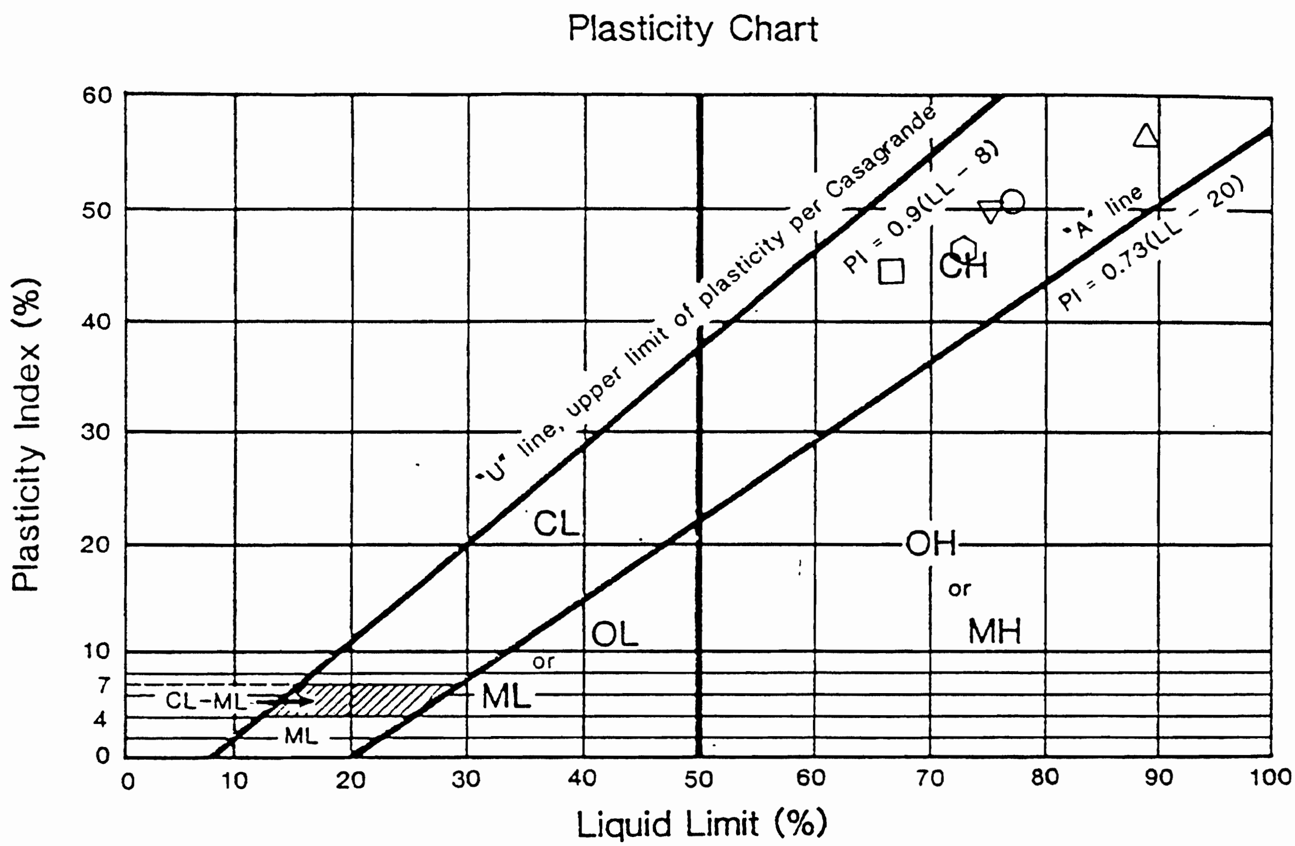


Symbol	Excavation Number	Depth (feet)	Natural Moisture Content (%)	Liquid Limit (%)	Plasticity Index (%)	Passing No. 200 Sieve (%)	Liquidity Index (%)	Unified Soil Class. Symbol
○	B-3	5.0	6.1	0	0	18	—	SC
—	B-3	8.0	8.8	—	—	9	—	SP
△	B-4	2.0	18.5	56	34	68	—	CH
□	B-4	5.0	12.9	28	11	28	—	SC
▽	B-4	8.0	22.6	59	38	82	—	CH
⬡	B-4	19.0	9.8	0	0	34	—	SC

ATTERBERG LIMITS AND PLASTICITY CHART

AMERICAN GEOTECHNICAL | F.N. 1987 | JAN. 1989

Plate E29

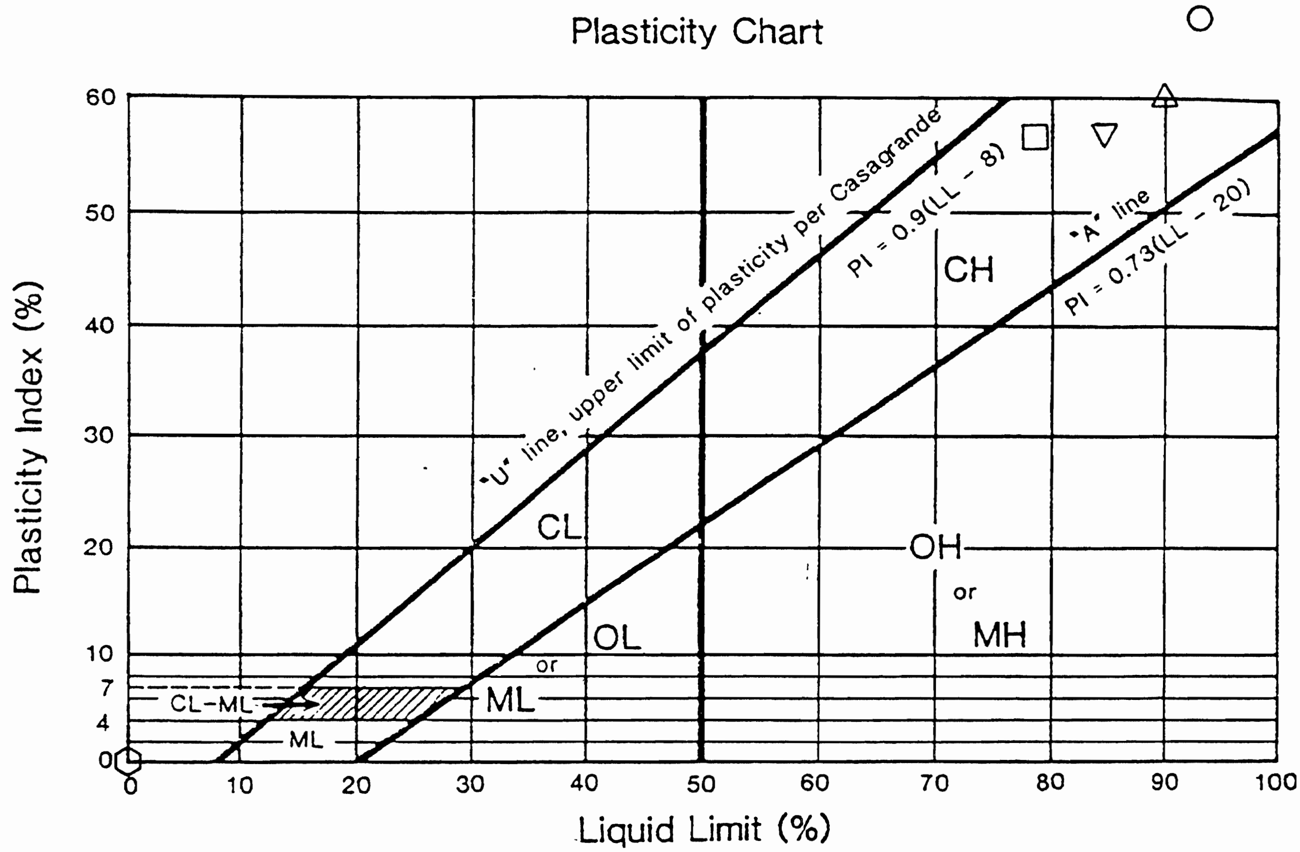


Symbol	Excavation Number	Depth (feet)	Natural Moisture Content (%)	Liquid Limit (%)	Plasticity Index (%)	Passing No. 200 Sieve (%)	Liquidity Index (%)	Unified Soil Class. Symbol
○	B-5	3.0	39.1	77	51	85	—	CH
△	B-5	10.0	38.3	89	57	91	—	CH
□	B-5	20.0	28.8	66	45	77	—	CH
▽	B-6	2.0	35.6	75	50	92	—	CH
⬡	B-6	9.0	25.9	72	47	79	—	CH

ATTERBERG LIMITS AND PLASTICITY CHART

AMERICAN GEOTECHNICAL | F.N. 1987 | JAN. 1989

Plate E30

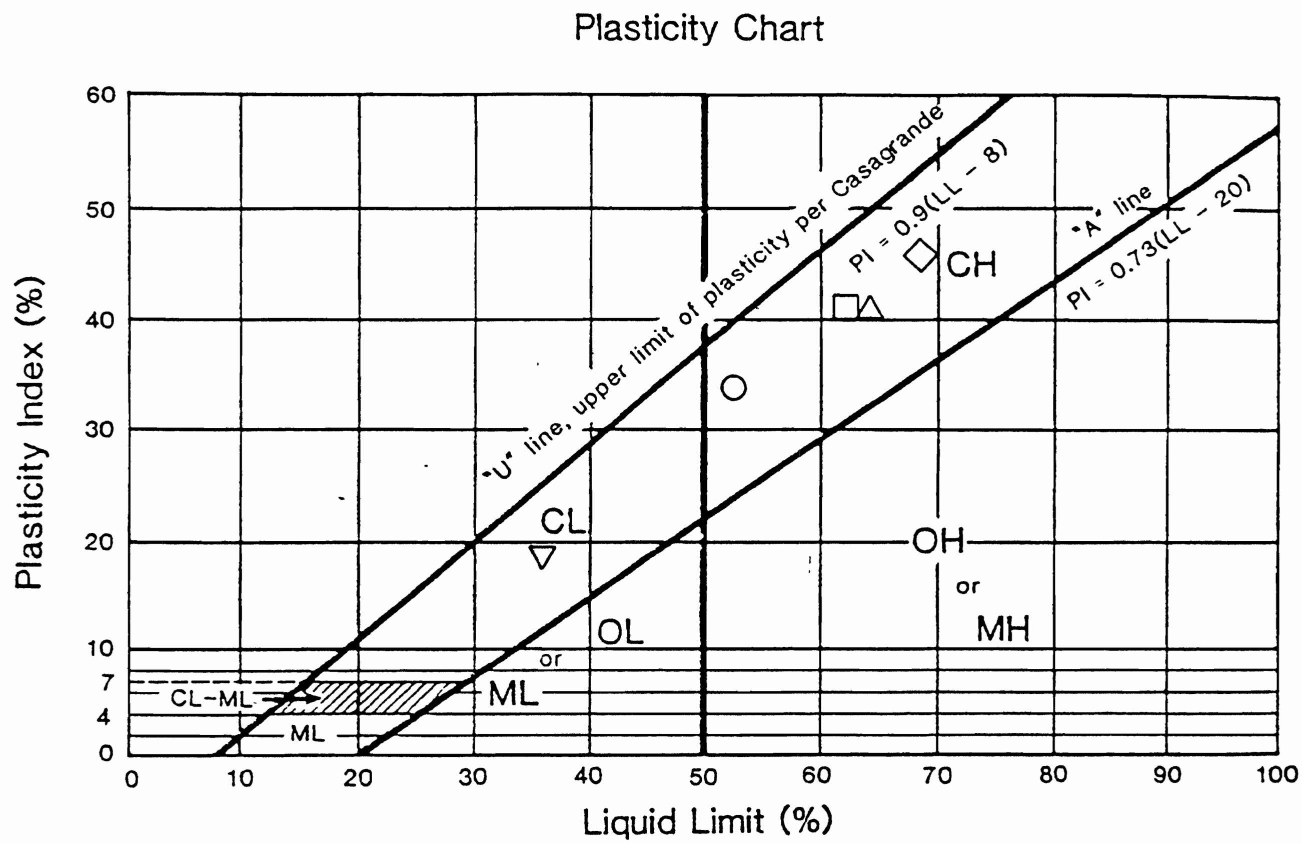


Symbol	Excavation Number	Depth (feet)	Natural Moisture Content (%)	Liquid Limit (%)	Plasticity Index (%)	Passing No. 200 Sieve (%)	Liquidity Index (%)	Unified Soil Class. Symbol
○	B-7	3.0	36.0	92	67	—	—	CH
△	B-7	7.0	38.5	90	60	85	—	CH
□	B-8	3.0	36.1	79	57	83	—	CH
▽	B-8	9.0	33.9	84	57	82	—	CH
⬡	B-8	15.0	12.9	0	0	31	—	SC

ATTERBERG LIMITS AND PLASTICITY CHART

AMERICAN GEOTECHNICAL | F.N. 1987 | JAN. 1989

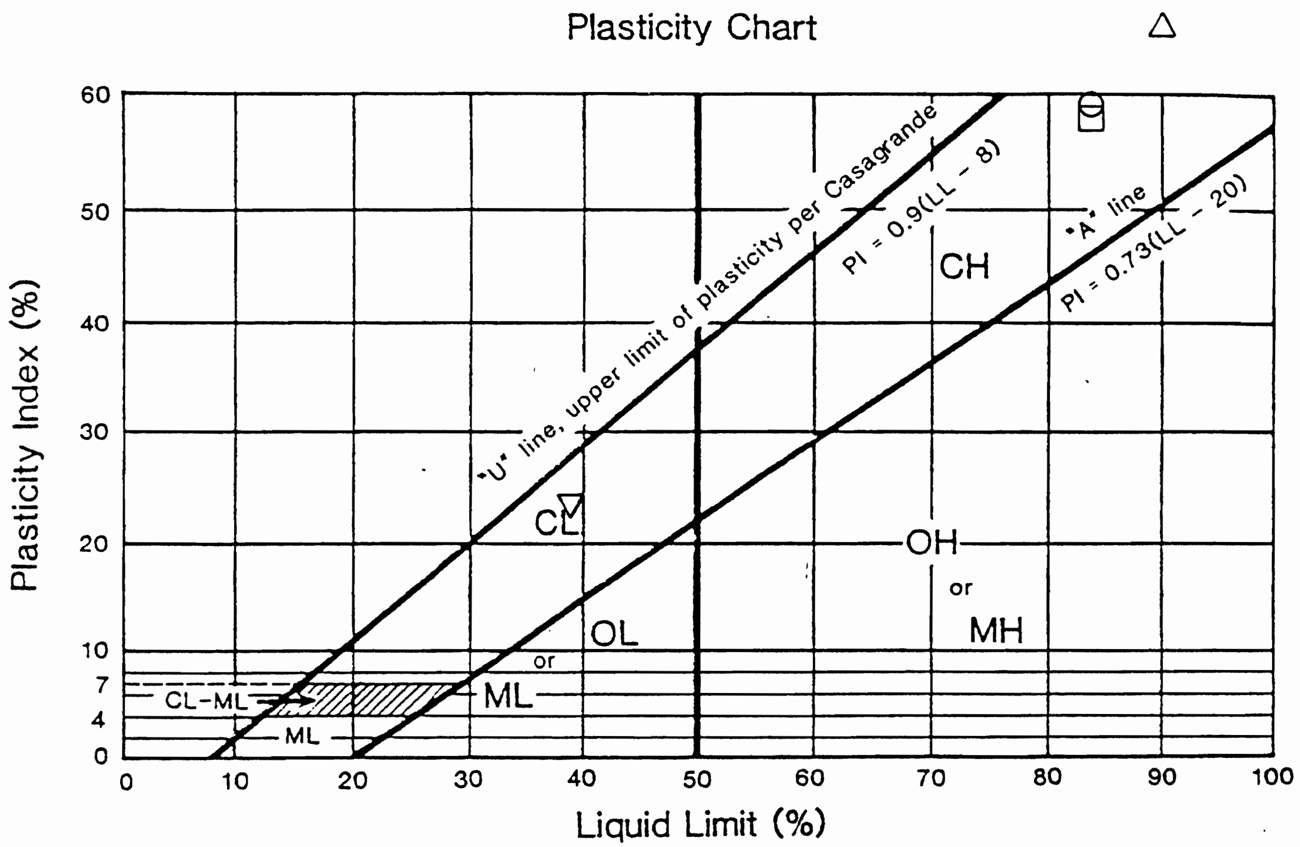
Plate E31



Symbol	Excavation Number	Depth (feet)	Natural Moisture Content (%)	Liquid Limit (%)	Plasticity Index (%)	Passing No. 200 Sieve (%)	Liquidity Index (%)	Unified Soil Class. Symbol
○	B-9	2.0	27.4	52	34	—	—	CH
△	B-9	5.0	31.0	64	41	—	—	CH
□	B-10	3.0	25.6	62	41	60	—	CH
▽	B-10	6.0	17.7	36	19	11	—	SC/CL
⬡	B-10	15.0	31.0	74	43	75	—	CH
◇	B-10	20.0	28.1	69	47	73	—	CH

ATTERBERG LIMITS AND PLASTICITY CHART

AMERICAN GEOTECHNICAL	F.N. 1987	JAN. 1989	Plate E32

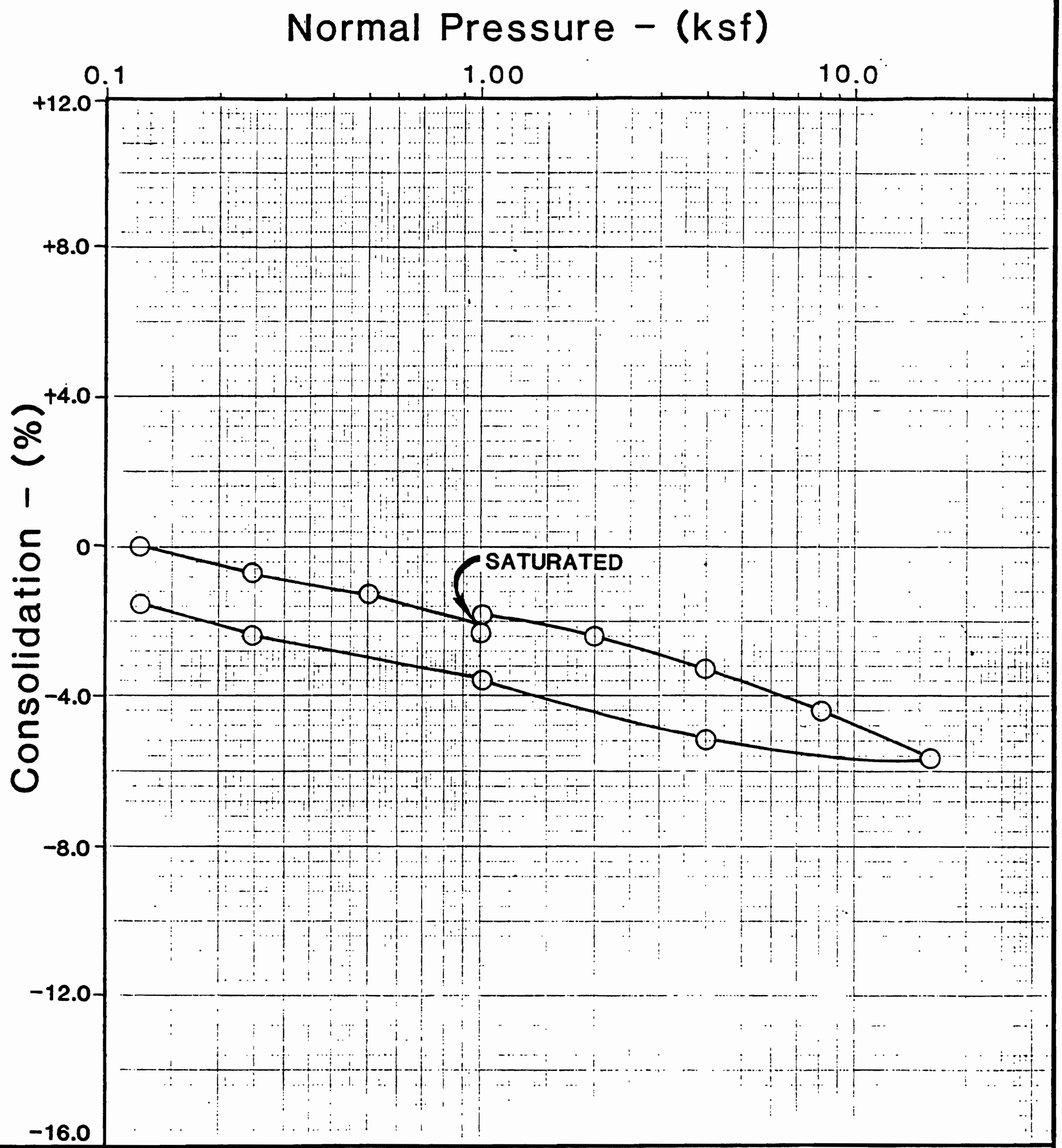


Symbol	Excavation Number	Depth (feet)	Natural Moisture Content (%)	Liquid Limit (%)	Plasticity Index (%)	Passing No. 200 Sieve (%)	Liquidity Index (%)	Unified Soil Class. Symbol
○	B-11	5.0	36.2	84	59	96	—	CH
△	B-11	8.0	36.6	90	66	91	—	CH
□	B-12	6.0	29.5	84	58	80	—	CH
▽	B-13	3.0	18.6	39	23	53	—	CL

ATTERBERG LIMITS AND PLASTICITY CHART

AMERICAN GEOTECHNICAL | F.N. 1987 | JAN. 1989

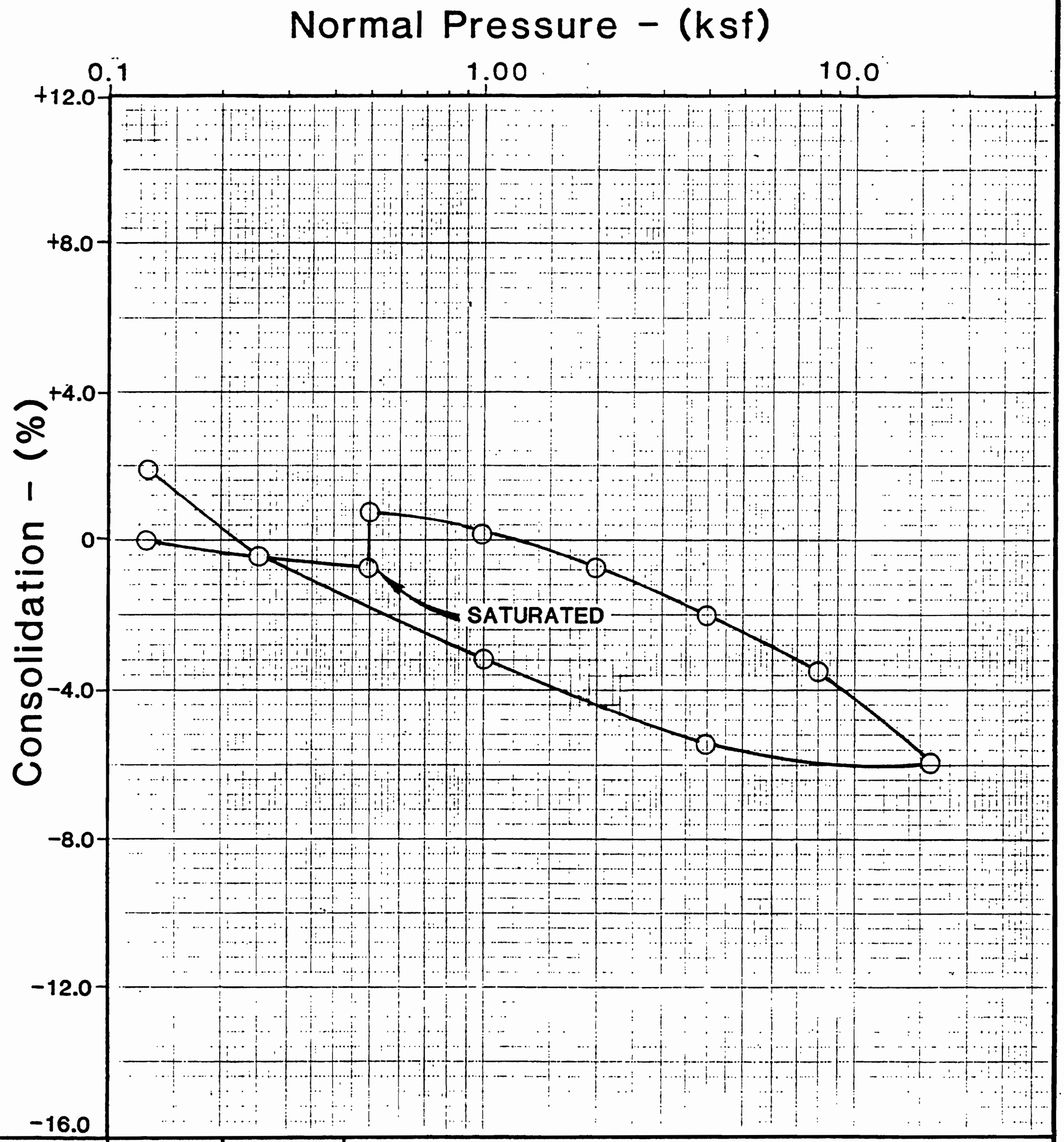
Plate E33



Symbol	Exca. No.	Depth (feet)	Description
○	B-1	15.0	Brown Clayey Sand (SC) - UNDISTURBED

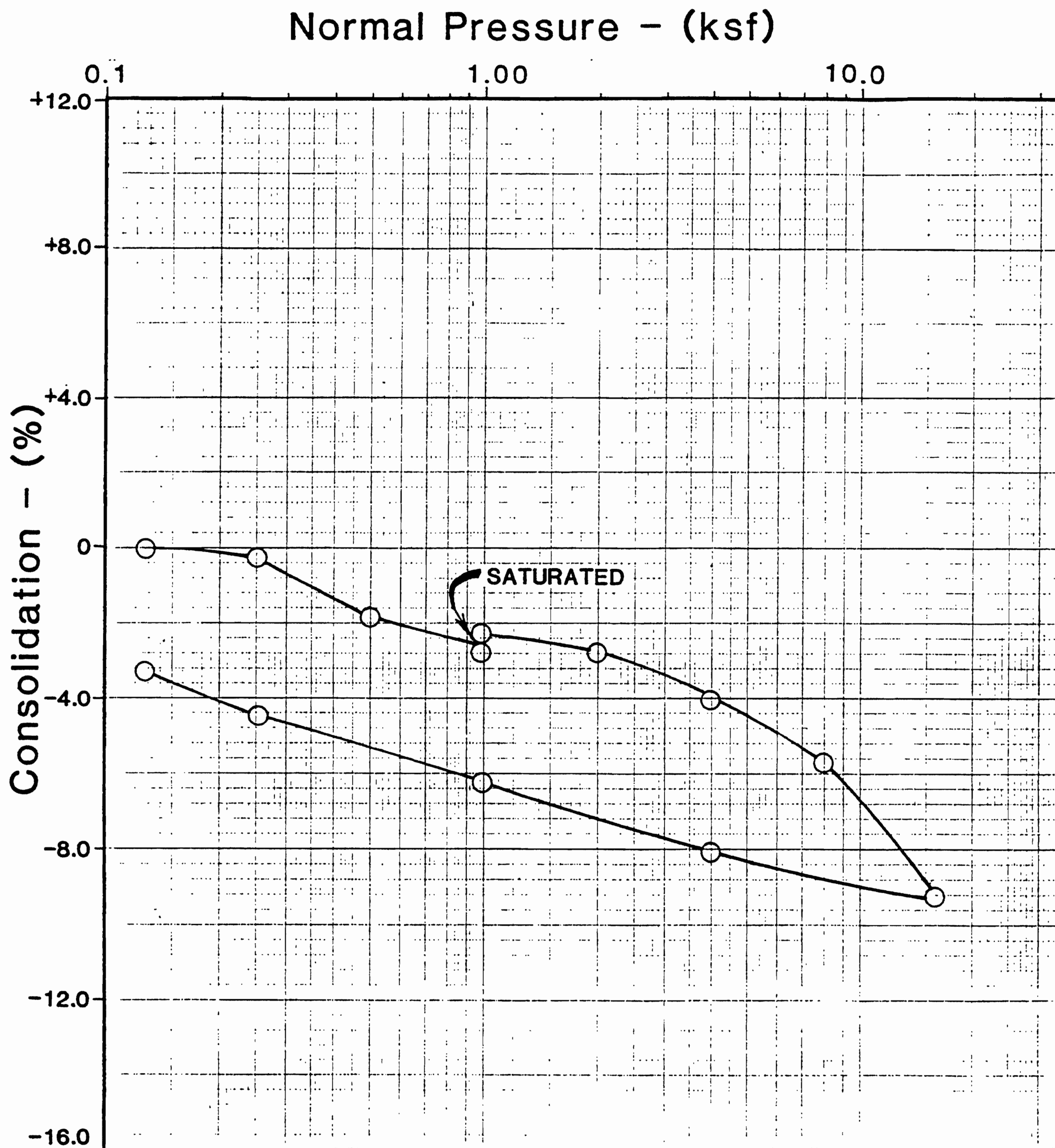
CONSOLIDATION - PRESSURE CURVE

AMERICAN GEOTECHNICAL	F.N. 1987	Jan. 1989	Plate E34



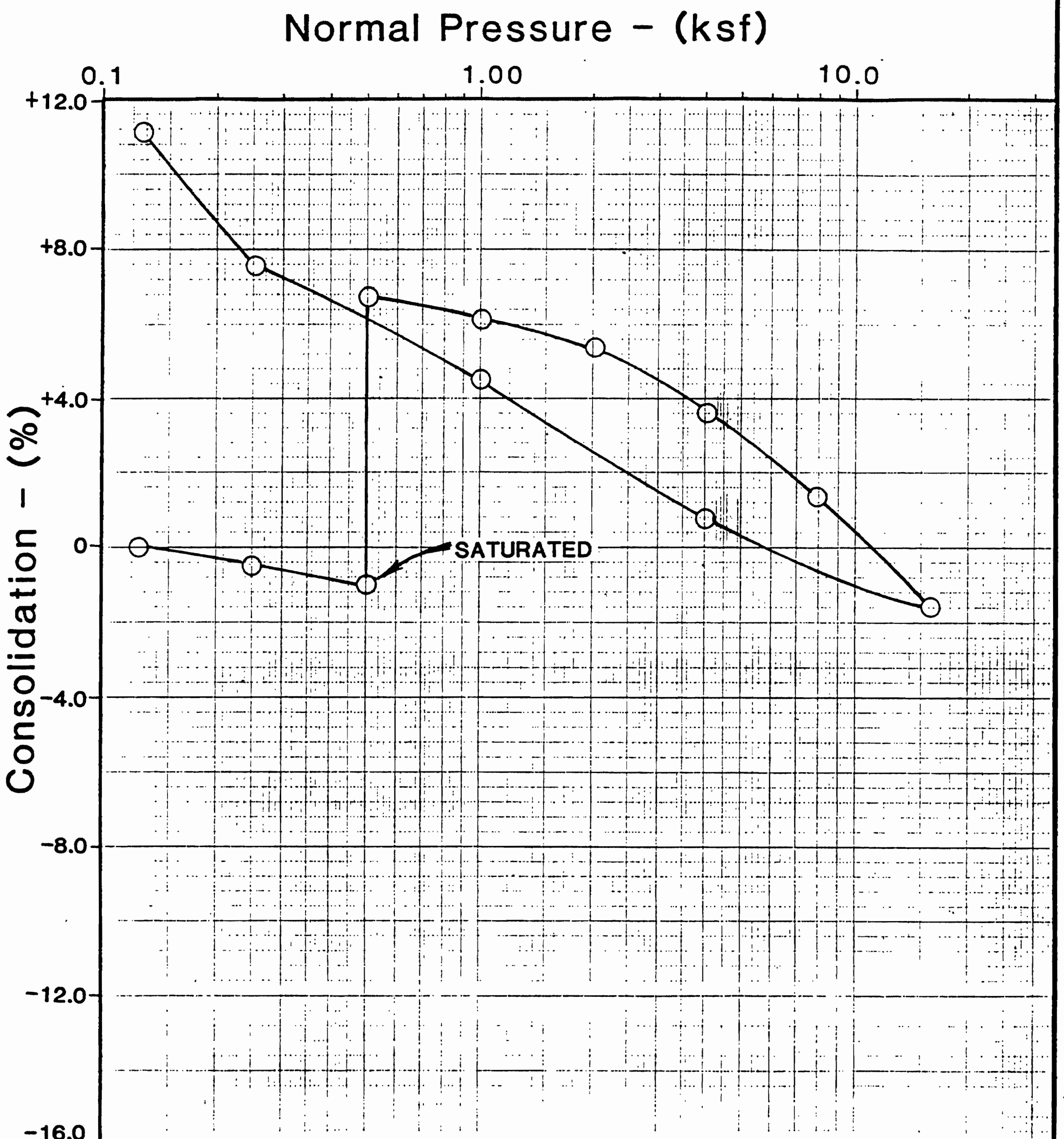
Symbol	Exca. No.	Depth (feet)	Description
○	B-6	9.0	OLIVE SILTY CLAY (CL) - UNDISTURBED

CONSOLIDATION - PRESSURE CURVE			Plate E35
AMERICAN GEOTECHNICAL	F.N. 1987	JAN. 1989	



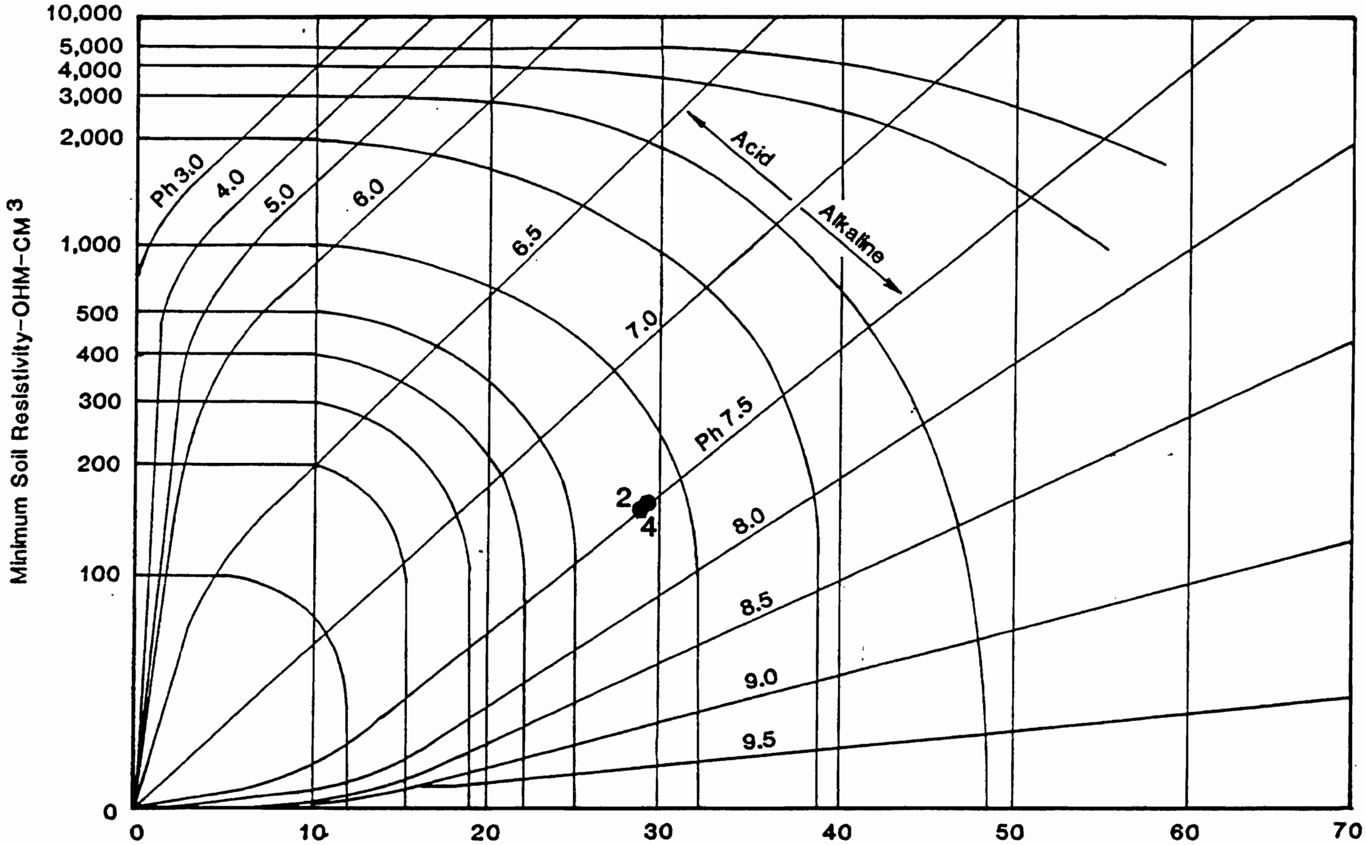
Symbol	Exca. No.	Depth (feet)	Description
○	B-9	13.0	BLACK CLAY (CL) - UNDISTURBED

CONSOLIDATION - PRESSURE CURVE			Plate E36
AMERICAN GEOTECHNICAL	F.N. 1987	JAN. 1989	



Symbol	Exca. No.	Depth (feet)	Description
○	B-13	6.0	OLIVE CLAY (CL) - UNDISTURBED

CONSOLIDATION - PRESSURE CURVE			Plate E37
AMERICAN GEOTECHNICAL	F.N. 1987	JAN. 1989	



PERFORATION FACTOR

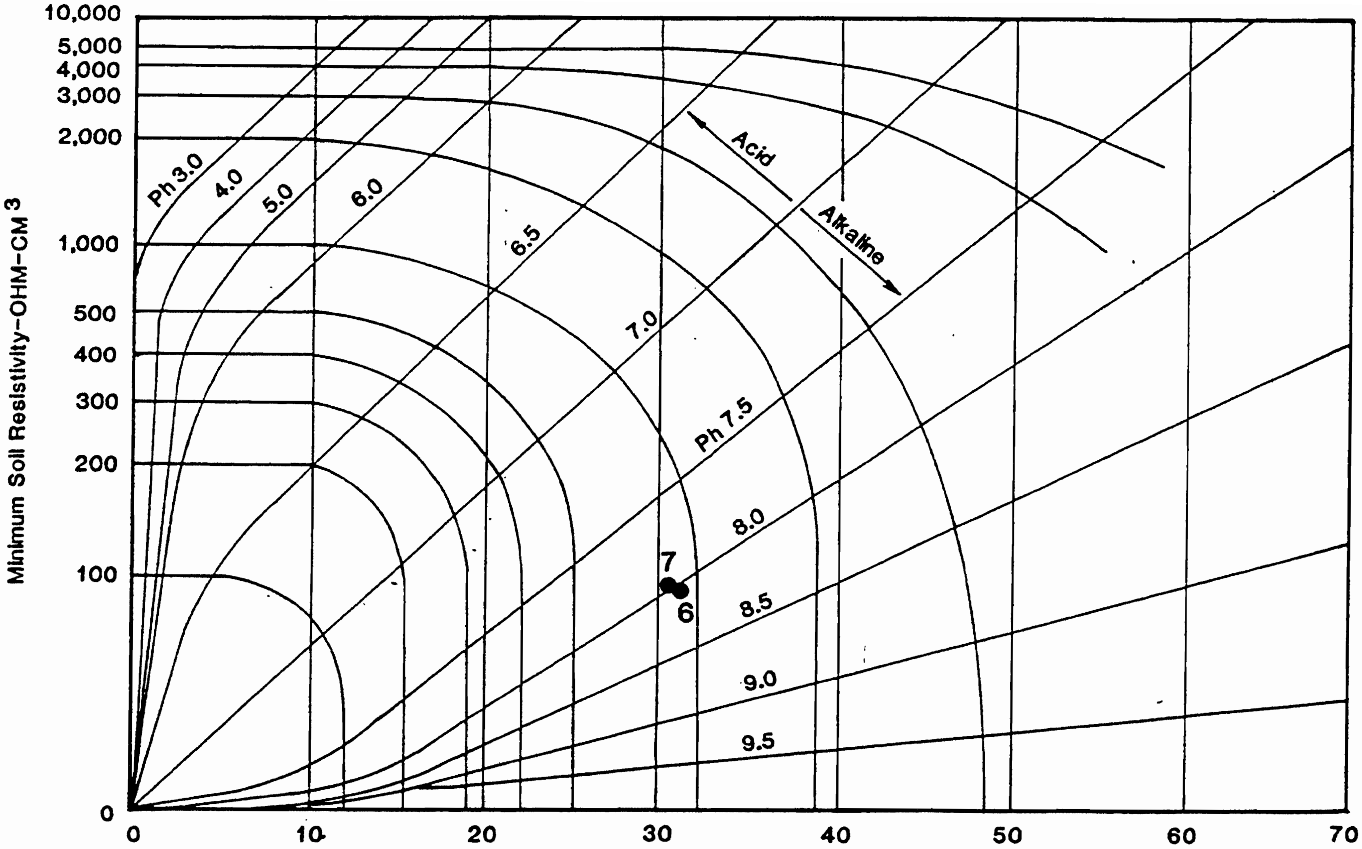
Gage	16	14	12	10	8	6	2	0	000
Gage Factor	1.0	1.3	1.8	2.3	2.8	3.3	4.3	5.0	6.0

Perforation Factor X Gage Factor Approximate years to perforate

Symbol	Classification	Resistivity	Ph	Perf. Factor
2	B-2: 1-4' Silty clay, dark gray, moist, stiff Sulphates: 0.19% Chlorides: 0.11%	698	7.9	27
4	B-4: 0-4' Silty clay, dark gray, dry, stiff Sulphates: 0.028% Chlorides: 0.014%	698	8.0	27

Reference: California Division of Highways Magazine. Jan.-Feb. 1961

CHEMICAL TEST DATA			Plate E38
AMERICAN GEOTECHNICAL	F.N. 1987	JAN. 1989	



PERFORATION FACTOR

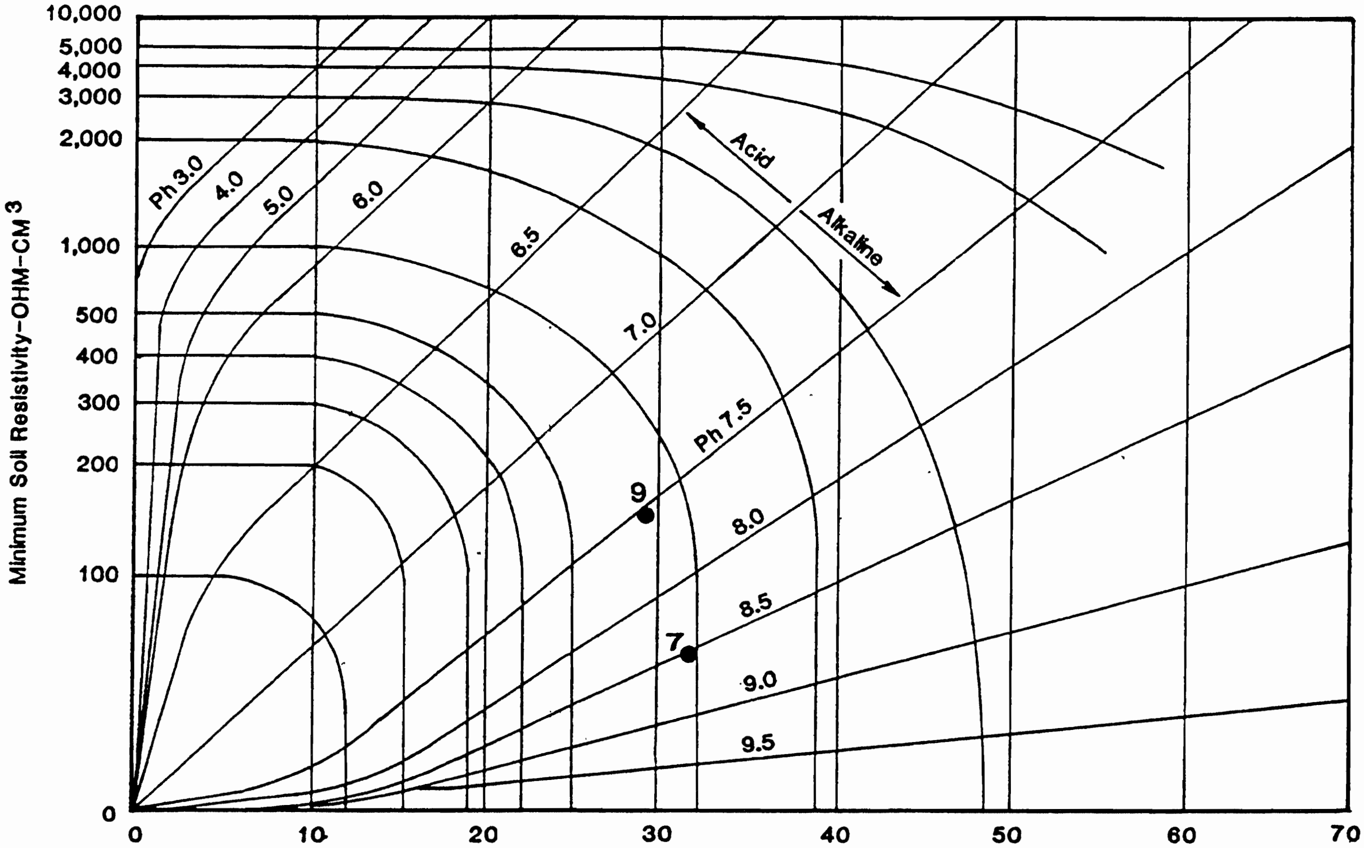
Gage	16	14	12	10	8	6	2	0	000
Gage Factor	1.0	1.3	1.8	2.3	2.8	3.3	4.3	5.0	6.0

Perforation Factor X Gage Factor   Approximate years to perforate

Symbol	Classification	Resistivity	Ph	Perf. Factor
5	B-5: 1-4' Silty clay, dark gray, moist to very moist, firm Sulphates: 0.009% Chlorides: 0.005%	817	8.1	32
6	B-6: 1-5' Silty clay, dark gray, moist, stiff Sulphates: 0.016% Chlorides: 0.006%	767	8.0	31

Reference: California Division of Highways Magazine. Jan.-Feb. 1961

CHEMICAL TEST DATA			Plate E39
AMERICAN GEOTECHNICAL	F.N. 1987	JAN. 1989	



PERFORATION FACTOR

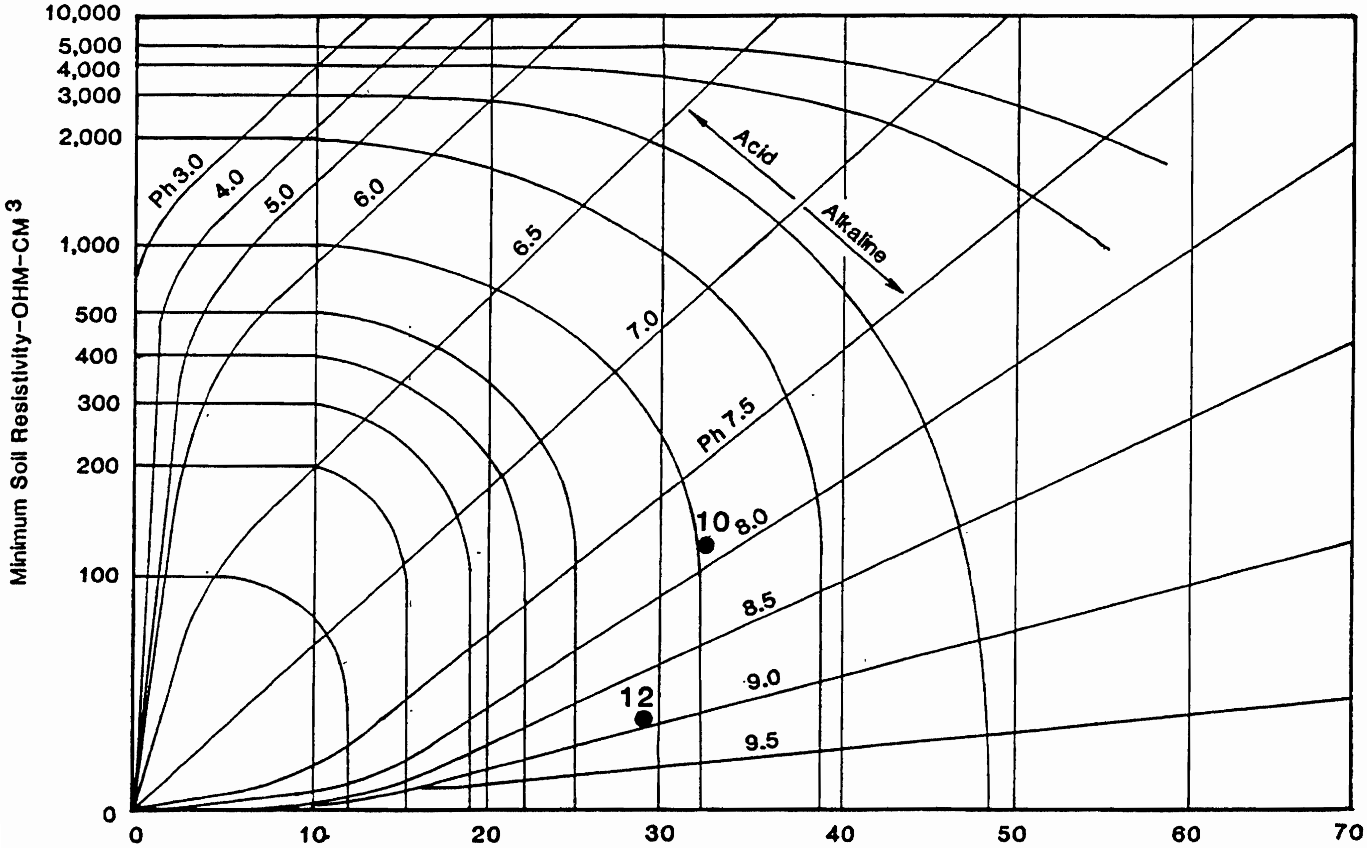
Gage	16	14	12	10	8	6	2	0	000
Gage Factor	1.0	1.3	1.8	2.3	2.8	3.3	4.3	5.0	6.0

Perforation Factor X Gage Factor Approximate years to perforate

Symbol	Classification	Resistivity	Ph	Perf. Factor
7	B-7: 3-5' Silty clay, dark gray, moist, firm to stiff Sulphates: 0.008% Chlorides: 0.004%	961	8.5	32
9	B-9: 2-4' Silty clay, dark gray, moist, firm to stiff Sulphates: 0.004% Chlorides: 0.010%	866	7.6	29

Reference: California Division of Highways Magazine. Jan.-Feb. 1961

CHEMICAL TEST DATA			Plate E40
AMERICAN GEOTECHNICAL	F.N. 1987	JAN. 1989	



PERFORATION FACTOR

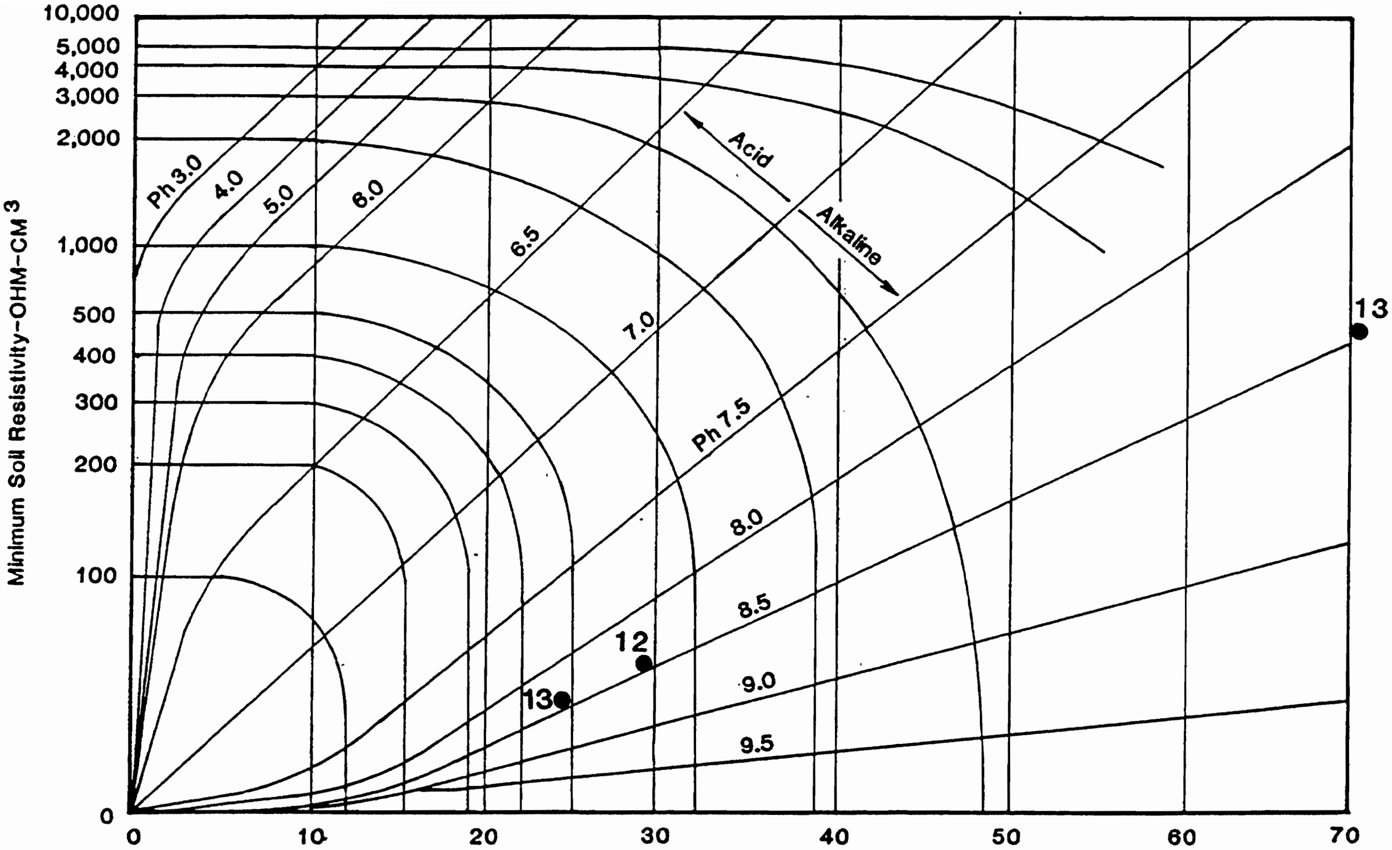
Gage	16	14	12	10	8	6	2	0	000
Gage Factor	1.0	1.3	1.8	2.3	2.8	3.3	4.3	5.0	6.0

Perforation Factor X Gage Factor   Approximate years to perforate

Symbol	Classification	Resistivity	Ph	Perf. Factor
10	B-10: 3-6' Silty clay, dark gray, moist, stiff to very stiff Sulphates: 0.008% Chlorides: 0.005%	1130	7.8	32
12 (1)	B-12: 1-3' Silty clay, dark gray, moist, stiff Sulphates: 0.014% Chlorides: 0.003%	779	8.9	29

Reference: California Division of Highways Magazine. Jan.-Feb. 1961

CHEMICAL TEST DATA			Plate E41
AMERICAN GEOTECHNICAL	F.N. 1987	JAN. 1989	



PERFORATION FACTOR

Gage	16	14	12	10	8	6	2	0	000
Gage Factor	1.0	1.3	1.8	2.3	2.8	3.3	4.3	5.0	6.0

Perforation Factor X Gage Factor Approximate years to perforate

Symbol	Classification	Resistivity	Ph	Perf. Factor
12 (2)	B-12: 5-8' Silty clay, light gray, stiff Sulphates: 0.025% Chlorides: 0.003%	751	8.4	29
13	B-13: 3-6' Silty clay, very dark gray, moist, firm Sulphates: 0.042% Chlorides: 0.009%	477	8.4	24

Reference: California Division of Highways Magazine. Jan.-Feb. 1961

CHEMICAL TEST DATA			Plate E42
AMERICAN GEOTECHNICAL	F.N. 1987	JAN. 1989	

ASSOCIATED SOILS ENGINEERING, INC.
Consulting Foundation Engineers
3310 AIRPORT WAY · P.O. BOX 47 · LONG BEACH, CALIF. 90801-0047 · PHONE 213/426-7990
FAX 213/426-6424

TO: American Geotechnical
25202 Crenshaw Boulevard, Suite 101
Torrance, California 90505

DATE: October 18, 1988

Attention: Alex Perez

Project No. 87-10019 A

Reference: Your Job #FN1987

Transmitted: 3 Copy Copies of the Following: **For:**

(x) Herewith	( ) Foundation Investigation Report	( ) Your Use
( ) Under Separate Cover	( ) Compaction Test Report	( ) Your Files
( ) Via Messenger	( ) Plans	(x) As Requested
	(x) Other	( ) Distribution as required

Description: Results of laboratory test samples submitted to this office on September 28, 1988.

Results: B-4 @ 0-4 - "R" less than 5
B-9 @ 0-4 - "R" less than 5

BY Gerald Gray, Vice President

Plate E43

File No. 1987
January 25, 1989
October 5, 1989 - REVISED

American Geotechnical
A CALIFORNIA CORPORATION

APPENDIX F

Geotechnical Guidelines for Grading

American Geotechnical
A CALIFORNIA CORPORATION

GEOTECHNICAL GUIDELINES FOR GRADING PROJECTS

December 1988

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GEOTECHNICAL GUIDELINES FOR GRADING PROJECTS

1.0 GENERAL

These guidelines should be considered to be a portion of the project specifications. The contractor should not vary from these guidelines without prior recommendation by the geotechnical consultant and approval of the client or his authorized representative. Recommendations by the geotechnical consultant and/or client should not be considered to preclude requirements for approval by the controlling agency. If disputes arise out of the interpretation of these grading guidelines, the geotechnical consultant shall provide the governing interpretation.

2.0 OBLIGATIONS OF PARTIES

The geotechnical consultant should be authorized by the client to provide observation and testing services during grading. The geotechnical consultant will report his findings and recommendations to the client or his authorized representative. The client should be chiefly responsible for all aspects of the project. The client or his authorized representative has the responsibility of reviewing the findings and recommendations of the geotechnical consultant. During grading the client or his authorized representative should remain on site or should remain reasonably accessible to all concerned parties in order to make decisions necessary to maintain the flow of the project.

3.0 SITE PREPARATION

3.1 Prior to any site preparation or grading, the client should arrange and attend a meeting among the grading contractor, the design engineer, the geotechnical consultant, and representatives of the appropriate governing authorities as well as any other concerned parties. All parties should be given at least 48 hours notice.

3.2 Clearing and grubbing should consist of the removal of vegetation and otherwise deleterious natural materials from the areas to be graded. Clearing and grubbing should extend to the outside of all proposed excavation and fill areas.

3.3 Demolition should include removal of buildings, structures, foundations, reservoirs, utilities (including underground pipelines, septic tanks, leach fields, seepage pits, cisterns, mining shafts, tunnels, etc.), and other man-made surface and subsurface improvements from the areas to be graded. Demolition of utilities should include proper capping and/or rerouting of pipelines at the project perimeter and cutoff and capping of wells in accordance with the requirements of the governing authorities. Trees, plants, or man-made improvements not planned to be removed or demolished should be protected by the contractor. Debris generated during clearing, grubbing, and/or demolition operations should be removed from areas to be graded and disposed of off-site.

4.0 SITE PROTECTION

4.1 Protection of the site during the period of demolition and grading should be the responsibility of the contractor. The contractor should be responsible for the stability of all temporary excavations including buttress and retaining wall cuts.

4.2 The contractor should control dust at all times.

4.3 Precautions should be taken during the performance of site clearing, excavating, and grading to protect the work site from flooding, ponding, erosion, and all other damage by poor or improper surface drainage.

4.4 During periods of rainfall, the geotechnical consultant should be kept informed by the contractor as to the nature of remedial or preventative work being performed. Following periods of rainfall, the contractor should contact the geotechnical consultant and arrange a visual inspection of the site in order to assess rain-related damage. Adversely affected soil will be classified as unsuitable material and should be subject to overexcavation and replacement with compacted fill or other remedial grading.

5.0 EXCAVATIONS

5.1 Material which is unsuitable should be excavated under the observation and recommendations of the geotechnical consultant. Unsuitable material includes, but may not be limited to, dry, loose, soft, wet, organic, compressible, natural soil, and fractured, weathered, soft bedrock and non-engineered or otherwise deleterious fill material.

5.2 Unless otherwise recommended by the geotechnical consultant and approved by regulating agencies, permanent cut slopes should not be steeper than 2:1 (horizontal to vertical).

6.0 COMPACTED FILL

6.1 Prior to placement of compacted fill, the contractor should request a review by the geotechnical consultant of the exposed ground surface. Unless otherwise recommended, the exposed ground surface should be scarified (six inches minimum), watered or dried as needed, thoroughly blended to achieve near optimum moisture conditions, then thoroughly compacted to a minimum of 90 percent of the maximum density.

6.2 Compacted fill should then be placed in thin horizontal lifts not exceeding eight inches in loose thickness prior to compaction. Each lift should be watered or dried as needed, thoroughly blended to achieve near optimum moisture conditions, then thoroughly compacted by mechanical methods. Depending on the type of soil and compaction equipment, thinner lifts could be recommended. Each lift should be treated in a like manner until the desired finished grades are achieved. The contractor should have suitable and sufficient mechanical compaction equipment, watering apparatus and mixing capability on the job site to handle the amount of fill being placed. If necessary, excavation equipment should be "shut down" temporarily in order to permit proper compaction of fills. Earth moving equipment should only be considered a supplement and not substituted for conventional compaction equipment.

6.3 Unless otherwise specified, the minimum degree of compaction required is 90 percent of the laboratory maximum density. Depending on the soil type, depth of fill and/or other conditions, higher relative compaction could be recommended. Maximum density should be determined in accordance with ASTM Method of Test D1557, Method A or C.

6.4 Fill should be tested for compliance with the recommended relative compaction and moisture conditions. Field density testing should conform to ASTM Method of Test D1556, D2922 and/or D2937. Tests should be taken for about every two vertical feet or 1,000 cubic yards of fill placed. Where gravel is encountered, dry density should be corrected by the subtraction/elimination method. Actual test intervals may vary as field conditions dictate. Fill not found to be in conformance with the grading recommendations should be removed or otherwise handled as recommended by the geotechnical consultant. The contractor should assist the geotechnical consultant by digging test pits for testing compacted fill. As recommended by the geotechnical consultant, the contractor should "shut down" or remove grading equipment from an area being tested.

Maximum density testing may be required of samples obtained directly from the fill areas in order to verify conformance with the specifications. Processing of these additional samples may take two or more working days. The contractor may elect to move the operation to other areas within the project, or may continue placing compacted fill pending laboratory and field test results. Should he elect the second alternative, fill placed is done so at the contractor's risk.

6.5 For field testing purposes, near optimum moisture will vary with material type and other factors including compaction procedure. Near optimum moisture may be specifically recommended in Preliminary Investigation Reports and/or may be evaluated during grading. As a preliminary guideline, near optimum moisture should be considered from one percent below to three percent above optimum.

Prior to placement of additional compacted fill following an overnight or other grading delay, the exposed surface or previously compacted fill should be processed by scarification, watered, or dried as needed, thoroughly blended to near optimum moisture conditions, then recompacted. Where wet, dry, or other unsuitable material exists to depths of greater than eight inches, the unsuitable material should be overexcavated.

Excavated on-site material which is acceptable to the geotechnical consultant may be utilized as compacted fill. Where import materials are required for use on site, the geotechnical consultant should be notified at least 72 hours in advance of importing in order to sample and test materials from proposed borrow sites.

6.6 Rocks up to a maximum diameter of 12 inches may be utilized within the compacted fill provided they are placed in such a manner that nesting of the rock is avoided and compaction is achieved. Rocks greater than six inches in maximum diameter should not be placed in the upper four feet of compacted fill. Fill should be placed and thoroughly compacted over and around all rock. The amount of rock should not exceed 40 percent by dry weight passing the 3/4-inch sieve size.

During the course of grading operations, rocks or similar irreducible materials greater than 12 inches maximum diameter (oversized material) may be generated. These rocks should not be placed within the compacted fill unless accepted and placed in conformance with the geotechnical consultant's recommendations.

6.7 Unless otherwise recommended by the geotechnical consultant and approved by the regulating agencies, permanent fill slopes should not be steeper than 2:1 (horizontal to vertical).

7.0 TRENCH BACKFILL

7.1 Utility trench backfill should, unless otherwise recommended, be compacted by mechanical means. The degree of compaction should be a minimum of 90 percent of the laboratory maximum density unless otherwise recommended. As an alternative, where agreed to in advance by the geotechnical consultant, granular material (sand equivalent greater than 30) may be thoroughly jetted in place. Jetting should only be considered to apply to trenches no greater than two feet in width and four feet in depth. Following jetting operations, trench backfill should be thoroughly mechanically compacted and/or wheel-rolled from the surface.

7.2 Backfill of exterior and interior trenches extending below a 1:1 projection from the outer edge of foundations should be mechanically compacted.

7.3 Clean granular backfill and/or bedding are not recommended in slope areas unless provisions are made for a drainage system to mitigate the potential buildup of seepage forces.

8.0 STATUS OF GRADING

Prior to proceeding with any grading operation, the geotechnical consultant should be notified at least two working days in advance in order to schedule the necessary observation and testing services. Prior to any significant expansion or cutback in the grading operation, the geotechnical consultant should be provided with adequate notice (i.e., two days) in order to make appropriate adjustments in observation and testing services. Following completion of grading operations, and/or between phases of a grading operation, the geotechnical consultant should be provided with at least two working days notice in advance of commencement of additional grading operations.

APPENDIX G

References

File No. 1987
January 25, 1989
October 5, 1989 - REVISED

American Geotechnical
A CALIFORNIA CORPORATION

REPORTS REVIEWED FOR THIS STUDY

American Geotechnical

Address	Project No.	Date
2927 Lomita Boulevard	1081	12/27/83
NW Corner PCH and Ocean Avenue	1149	8/31/84
23315 Audrey Avenue	1293	7/27/84
3916 - 234th Street	1346	10/17/84
23311 Los Codona	1364	12/4/84
5229 Bindewald Road	1395	1/10/85
23514 Ladeene Avenue	1438	3/26/85
24402 Los Codona	1456	4/15/85
23314 Anza Avenue	1726	5/20/86
23448 Carlow Road	1749	6/10/86
23226 Ocean Avenue	1788	7/21/86
4437 - 234th Street West	1799	8/5/86
5301 Highgrove Street	1804	11/1/86
23451 Carlow Road	1988	5/11/87
23305 Carlow Road	2028	7/7/87
23621 Evalyn Avenue	2245	5/31/88

Pacific Soils

23142 Ocean Boulevard	8409	12/24/69

Donald R. Warren Company

Tract 25456	F59-1612	1/25/60
Tract 25788	F60-775	7/12/60
Tract 26551	F61-457	7/3/61
Lots 1-70, 87-90 and 103-111, inclusive		

Western Laboratories

Tract 22851, Lots 1-93	W.O. 2391	9/25/64
Tract 23065, Lots 1-13	W.O. 2411	10/19/64
Tract 23369, Lots 1-14	W.O. 2508	2/19/65
Tract 22851, Lots 1-11, 28-47 and 78-84	W.O. 2391	3/4/65
Tract 23369, Lots 1-14	W.O. 2508	6/15/65
Tract 22851, Lots 1-93 (Addendum)	W.O. 2391	7/30/65
Tract 22851, Lot 19	W.O. 2391	3/25/66
23930 Ocean, 86-Unit Complex	W.O. 2956	5/2/67

File No. 1987
January 25, 1989
October 5, 1989 - REVISED

American Geotechnical
A CALIFORNIA CORPORATION

APPENDIX H

Miscellaneous Graphics

ADDITIONAL SUBSURFACE INVESTIGATION

EXPANSIVE SOIL STUDY, PHASE II
NO. PORTION OF SOUTHWOOD RIVIERA TRACT
TORRANCE, CALIFORNIA

FILE NO. 1987.02 JULY 26, 1990

A CALIFORNIA CORPORATION
American Geotechnical
SOIL, FOUNDATION AND GEOLOGIC STUDIES

American Geotechnical

A CALIFORNIA CORPORATION

ADDITIONAL SUBSURFACE INVESTIGATION

EXPANSIVE SOIL STUDY, PHASE II
NO. PORTION OF SOUTHWOOD RIVIERA TRACT
TORRANCE, CALIFORNIA

FILE NO. 1987.02 JULY 26, 1990

25202 Crenshaw Boulevard, Suite 101, Torrance, CA 90505 (213) 539-9983 FAX (213) 539-7267
5755 Oberlin Drive, Suite 104, San Diego, CA 92121 (619) 457-2711 FAX (619) 457-0814
1250 North Lakeview Avenue, Suite T, Anaheim, CA 92807 (714) 970-0255 FAX (714) 970-0142

American Geotechnical

A CALIFORNIA CORPORATION

July 26, 1990 File No. 1987.02

Mr. Ralph C. Grippo
Director, Department of Building and Safety
City of Torrance
3031 Torrance Boulevard
Torrance, California 90503

SUBJECT: **ADDITIONAL SUBSURFACE INVESTIGATION**
Expansive Soil Study, Phase II
Northern Portion of Southwood Riviera Tract
Torrance, California

Dear Mr. Grippo:

This letter presents our findings of additional subsurface investigation to study soil expansivity at the northern portion of the Southwood Rivieria Tract in Torrance.

Scope of Services

The scope of the work performed for this investigation included the following:

* Drilling of twelve borings and excavation of four test pits;
* Collection of soil samples for laboratory testing;
* Expansion Index (E.I.) testing of samples collected;
* Preparation of this report summarizing our field/laboratory investigation and providing conclusions regarding the expansivity of soil in the study area.

Study Area Description

The area covered for this report is the northern portion of the Southwood Riviera section of the City of Torrance. The study area is bounded on the north by Lomita Boulevard, on the south by Calle Mayor Avenue and 231st Place, on the east by Hawthorne Boulevard and on the west by Anza Avenue. Test pits were performed at two locations. Two test pits were excavated at 3870 W. 234th Street (Lopez residence). Two test pits were excavated in the city park located in the southeast corner of Lomita Boulevard and Anza Avenue.

Background

The Southwood Riviera section of Torrance was developed primarily during the 1960's and consists of portions of about 14 tracts. In 1978, the Building and Safety Department declared the Southwood Riviera section a problem area and began requiring soils investi-

25202 Crenshaw Boulevard, Suite 101, Torrance, CA 90505 (213) 539-9983 FAX (213) 539-7267
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1250 North Lakeview Avenue, Suite T, Anaheim, CA 92807 (714) 970-0255 FAX (714) 970-0142

gations for new additions, pools and spas. This was in response to approximately ten years of complaints from homeowners about expansive soil related damage.

In recent years, a few homeowners and realtors selling property in the area alleged that property has been devalued because the City has labeled the area a "problem area" and placed expansive soil restrictions on construction within the area. The Southwood Riviera Homeowners Association requested the City of Torrance for assistance in 1987 to have the City investigate the options available for removing the "special" condition for the area. As per that request, a study was conducted by American Geotechnical in 1987 and the findings were presented in the American Geotechnical report titled, "Revised Expansive Soil Study", January 25, October 5, 1989, F.N. 1987.01. This study is an extension of the 1987 study.

The purpose of this study was to provide more detailed information concerning limits of expansive soil in the northern portion of the study area. Residents of Tract 2778 located within the northern portion of the study area are requesting removal from the problem area. The residents claimed that since structures within Tract 2778 were experiencing fewer problems, they were not within the very highly expansive soils which is the apparent cause of widespread distress within the Southwood Riviera area.

Field Investigation

Subsurface conditions throughout the northern portion of Southwood Riviera were explored by drilling twelve test borings and excavating four test pits. Approximate locations of the borings and test pits are shown on Plate 1.

Borings at ten locations were drilled with truck-mounted, hollow-stem auger drilling equipment. The borings were drilled to a depth of 6.0 feet each. Each boring was logged by visual and tactile methods. Shelby tube samples were recovered for laboratory testing. At two locations, (i.e., Bore Hole No.s B-12 and B-13) hand driven Shelby samplers were used to collect soil samples to a depth of approximately 2.5 feet. At the two sites, hand-dug test pits were excavated to a depth of approximately 6.0 feet. Representative bulk samples were collected from the borings and test pits for laboratory testing.

Logs of the boreholes and excavation pits are presented in Appendix A. In the 1987 study by American Geotechnical, thirteen boreholes were drilled in the southern portion of the Southwood Riviera tract. Hence, the boreholes for the present study are numbered beginning from 14.

Laboratory Testing

All soil samples obtained during drilling were re-examined in the laboratory to confirm field soil classifications and to select samples for testing. The testing program included the determination of moisture content and expansion characteristics. A summary of laboratory test results are presented in Appendix B.

Conclusions

The conclusions in this report are based upon additional field exploration of the northern portion of Southwood Riviera and laboratory testing of representative soil samples collected at each location. Test results indicate that soils, except for some localized areas within the entire northern portion of Southwood Riviera, have highly to very highly expansive characteristics. Therefore, it is our opinion that Tract 2778 is within an area of highly to very highly expansive soil.

If an individual homeowner within Tract 2778 wishes to be excluded from the City's special study area requirements, that owner should provide a site specific geotechnical study to demonstrate soil at that location is not highly to very highly expansive. Otherwise, recommendations presented in our previous report should remain applicable.

We trust this is the information you require at this time. Please do not hesitate to contact us if you need additional information.

Respectfully submitted,
AMERICAN GEOTECHNICAL

Ron A. Hays
Project Engineer

Gregory W. Axten
Principal Engineer
G.E. 103

REGISTERED PROFESSIONAL ENGINEER
GREGORY W. AXTEN
No. GE103
Exp. 3-31-94
GEOTECHNICAL
STATE OF CALIFORNIA

APPENDIX A

Test Excavation Logs

TEST EXCAVATION LOG No. B-14

F.N. 1987-02

Sheet: 1 of 1

Project/Client: Expansive Soil Study II/City of Torrance

Start: 15 MAY 90

Location: 23021 Adolph Avenue, Torrance, California

End: 15 MAY 90

Estimated Surface Elevation: — '± Total Depth: 6.0' Rig Type: 8" Hollow Stem Auger

Field Description By: IM

Surface Conditions: Lawn

Subsurface Conditions: **FORMATION: Classification, color, moisture, tightness, etc.**

Depth-Feet	Sample Type (Sampler / Bulk)	Blow Counts Blows/Foot	Dry Unit Weight Pcf	Moisture Content %	Laboratory Tests	USCS Symbol	Graphic Log	Field Description
0	Sampler					CH		Sandy, Silty CLAY, dark brown, moist, stiff.
	Sampler		87	26	EI=98			
	Sampler		108	10	EI=86			becomes more sandy with depth
4.25								
	Sampler					SM		Silty SAND, reddish brown, moist, medium dense to dense.
5								
6.00								

NOTES: No groundwater encountered during drilling. No caving. Boring terminated @6'. Sampler type: Shelby Tube.

American Geotechnical

Plate A-1

TEST EXCAVATION LOG No. B-15

F.N. 1987-02

Project/Client: Expansive Soil Study II/City of Torrance

Sheet: 1 of 1

Location: 23119 Adolph Avenue, Torrance, California

Start: 15 MAY 90

Estimated Surface Elevation: — '± Total Depth: 6.0' Rig Type: 8" Hollow Stem Auger

End: 15 MAY 90

Field Description

By: IM

Surface Conditions:

Lawn

Subsurface Conditions: **FORMATION: Classification, color, moisture, tightness, etc.**

Depth-Feet	Sample Type (SMPLER / BULK)	Blow Counts Blows/Foot	Dry Unit Weight Pcf	Moisture Content %	Laboratory Tests	USCS Symbol	Graphic Log	Depth	Field Description
0						CH			Silty CLAY, brown, moist, medium stiff.
	SMPLER				EI=143				
	SMPLER		103	17	EI=81				Color change to reddish brown, becomes more sandy with depth.
	SMPLER		97	16	EI=39	SC		4.50	Clayey Fine SAND, light brown , moist, medium dense to dense
5									
								6.00	

NOTES: No groundwater encountered during drilling. No caving. Boring terminated @6'. Sampler type: Shelby Tube.

American Geotechnical

Plate A-2

TEST EXCAVATION LOG No. B-16

F.N. 1987-02

Sheet: 1 of 1

Project/Client: Expansive Soil Study II/City of Torrance

Start: 15 MAY 90

Location: 3922 231st Street, Torrance, California

End: 15 MAY 90

Estimated Surface Elevation: — '± Total Depth: 6.0' Rig Type: 8" Hollow Stem Auger

Field Description

By: IM

Surface Conditions: Lawn

Subsurface Conditions: FORMATION: Classification, color, moisture, tightness, etc.

Depth-Feet	Sample Type (SMPLER / BULK)	Blow Counts Blows/Foot	Dry Unit Weight Pcf	Moisture Content %	Laboratory Tests	USCS Symbol	Graphic Log	Field Description
0	SMPLER					CH		Silty CLAY, dark gray, moist, stiff.
	SMPLER		101	19	EI=131			
	SMPLER		97	26	EI=125			becomes more sandy with depth
5	SMPLER				EI=72			color changes to light brown
6.00								

NOTES: No groundwater encountered during drilling. No caving. Boring terminated @6'. Sampler type: Shelby Tube.

American Geotechnical

Plate A-3

TEST EXCAVATION LOG No. B-17

F.N. 1987-02

Project/Client: Expansive Soil Study II/City of Torrance

Sheet: 1 of 1

Location: 3915 231st Place, Torrance, California

Start: 15 MAY 90

Estimated Surface Elevation: — '± Total Depth: 6.0' Rig Type: 8" Hollow Stem Auger

End: 15 MAY 90

Field Description By: IM

Surface Conditions: Lawn

Subsurface Conditions: FORMATION: Classification, color, moisture, tightness, etc.

Depth-Feet	Sample Type (SMPLER / BULK)	Blow Counts Blows/Foot	Dry Unit Weight Pcf	Moisture Content %	Laboratory Tests	USCS Symbol	Field Description
0						CH	Silty CLAY, dark gray, moist, stiff.
	SMPLER		99	18	EI=150		
	SMPLER		80	28	EI=147		
	SMPLER		109	15	EI=105		
5							
							6.00

NOTES: No groundwater encountered during drilling. No caving. Boring terminated @6'. Sampler type: Shelby Tube.

American Geotechnical

Plate A-4

TEST EXCAVATION LOG No. B-18

F.N. 1987-02

Project/Client: Expansive Soil Study II/City of Torrance

Sheet: 1 of 1

Location: 23132 Audrey Avenue, Torrance, California

Start: 15 MAY 90

Estimated Surface Elevation: — '± Total Depth: 6.0' Rig Type: 8" Hollow Stem Auger

End: 15 MAY 90

Depth-Feet	Sample Type SMPLER	Sample Type BULK	Blow Counts Blows/Foot	Dry Unit Weight Pcf	Moisture Content %	Laboratory Tests	USCS Symbol	Graphic Log	Field Description By: IM
									Surface Conditions: Lawn
									Subsurface Conditions: FORMATION: Classification, color, moisture, tightness, etc.
0							SC		Clayey SAND, reddish brown, moist, medium dense.
						EI=47			
						EI=15			
						EI=2			
5									
									6.00

NOTES: No groundwater encountered during drilling. No caving. Boring terminated @6'. Sampler type: Shelby Tube.

TEST EXCAVATION LOG No. B-19

F.N. 1987-02

Project/Client: Expansive Soil Study II/City of Torrance

Sheet: 1 of 1

Location: 4205 230th Place, Torrance, California

Start: 15 MAY 90

Estimated Surface Elevation: — '± Total Depth: 6.0' Rig Type: 8" Hollow Stem Auger

End: 15 MAY 90

Field Description By: IM

Surface Conditions: Lawn

Subsurface Conditions: FORMATION: Classification, color, moisture, tightness, etc.

Depth-Feet	Sample Type (SMPLER / BULK)	Blow Counts Blows/Foot	Dry Unit Weight Pcf	Moisture Content %	Laboratory Tests	USCS Symbol	Graphic Log	Description
0						CH		Silty CLAY, dark gray, moist, stiff.
	SMPLER		85	29	EI=156			
	SMPLER		86	32	EI=132			
	SMPLER		84	34	EI=144			
5								
								6.00

NOTES: No groundwater encountered during drilling. No caving. Boring terminated @6'. Sampler type: Shelby Tube.

American Geotechnical

Plate A-6

TEST EXCAVATION LOG No. B-20

F.N. 1987-02

Project/Client: Expansive Soil Study II/City of Torrance

Sheet: 1 of 1

Location: 4311 230th Place, Torrance, California

Start: 15 MAY 90

Estimated Surface Elevation: — '± Total Depth: 6.0' Rig Type: 8" Hollow Stem Auger

End: 15 MAY 90

Depth-Feet	Sample Type (SMPLER / BULK)	Blow Counts Blows/Foot	Dry Unit Weight Pcf	Moisture Content %	Laboratory Tests	USCS Symbol	Graphic Log	Field Description By: IM
								Surface Conditions: Lawn
								Subsurface Conditions: FORMATION: Classification, color, moisture, tightness, etc.
0						CL		Sandy, Silty CLAY, dark gray, moist, stiff, becomes more plastic with depth.
	SMPLER				EI=68			
	SMPLER		102	20	EI=88			
	SMPLER		97	20	EI=116			becomes highly plastic
5								
6.00								

NOTES: No groundwater encountered during drilling. No caving. Boring terminated @6'. Sampler type: Shelby Tube.

American Geotechnical

Plate A-7

TEST EXCAVATION LOG No. B-21

F.N. 1987-02

Project/Client: Expansive Soil Study II/City of Torrance

Sheet: 1 of 1

Location: 23133 Ladeene Avenue Off Calle Mayor, Torrance, California

Start: 15 MAY 90

Estimated Surface Elevation: — '± Total Depth: 6.0' Rig Type: 8" Hollow Stem Auger

End: 15 MAY 90

Field Description

By: IM

Surface Conditions: Lawn

Subsurface Conditions: FORMATION: Classification, color, moisture, tightness, etc.

Depth-Feet	Sample Type (Sampler / Bulk)	Blow Counts Blows/Foot	Dry Unit Weight Pcf	Moisture Content %	Laboratory Tests	USCS Symbol	Description
0						CH	Silty CLAY, dark gray, moist, stiff.
	Sampler		94	22	EI=148		
	Sampler		91	27	EI=151		
	Sampler		96	18	EI=148		Color change to brown.
5							
6.00							

NOTES: No groundwater encountered during drilling. No caving. Boring terminated @6'. Sampler type: Shelby Tube.

American Geotechnical

Plate A-8

TEST EXCAVATION LOG No. B-22

F.N. 1987-02

Project/Client: Expansive Soil Study II/City of Torrance

Sheet: 1 of 1

Location: 23115 Kent Avenue, Torrance, California

Start: 15 MAY 90

Estimated Surface Elevation: — '± Total Depth: 6.0' Rig Type: 8" Hollow Stem Auger

End: 15 MAY 90

Field Description By: IM

Surface Conditions: Lawn

Subsurface Conditions: FORMATION: Classification, color, moisture, tightness, etc.

Depth-Feet	Sample Type (SMPLER / BULK)	Blow Counts Blows/Foot	Dry Unit Weight Pcf	Moisture Content %	Laboratory Tests	USCS Symbol	Graphic Log	Depth	Description
0						CH			Silty CLAY, dark gray, moist, stiff.
	SMPLER				EI=146				
	SMPLER		105	15	EI=133				
	SMPLER		104	14	EI=13	SC		4.50	Clayey SAND, brown, moist, dense
5								6.00	

NOTES: No groundwater encountered during drilling. No caving. Boring terminated @6'. Sampler type: Shelby Tube.

American Geotechnical

Plate A-9

TEST EXCAVATION LOG No. B-23

F.N. 1987-02

Project/Client: Expansive Soil Study II/City of Torrance

Sheet: 1 of 1

Location: 23105 Galva Avenue, Torrance, California

Start: 15 MAY 90

Estimated Surface Elevation: — '± Total Depth: 6.0' Rig Type: 8" Hollow Stem Auger

End: 15 MAY 90

Field Description By: IM

Surface Conditions: Lawn

Subsurface Conditions: FORMATION: Classification, color, moisture, tightness, etc.

Depth-Feet	Sample Type (Sampler / Bulk)	Blow Counts Blows/Foot	Dry Unit Weight Pcf	Moisture Content %	Laboratory Tests	USCS Symbol	Graphic Log	Description
0						SC		Clayey SAND, brown, moist, loose.
					EI=21			
			101	19	EI=2			becomes very wet
5								
								6.00

NOTES: No groundwater encountered during drilling. No caving. Boring terminated @6'. Sampler type: Shelby Tube.

American Geotechnical

Plate A-10

TEST EXCAVATION LOG No. B-24

F.N. 1987-02

Project/Client: Expansive Soil Study II/City of Torrance

Sheet: 1 of 1

Location: 23103 Ocean Avenue, Torrance, California

Start: 25 MAY 90

Estimated Surface Elevation: — '± Total Depth: 2.0' Rig Type: Hand Shelby

End: 25 MAY 90

Depth-Feet	Sample Type (SMPLER / BULK)	Blow Counts Blows/Foot	Dry Unit Weight Pcf	Moisture Content %	Laboratory Tests	USCS Symbol	Graphic Log	Field Description By: IM
								Surface Conditions: Lawn
								Subsurface Conditions: FORMATION: Classification, color, moisture, tightness, etc.
0	SMPLER		87	15	EI=156	CH		Silty CLAY, dark gray, moist, stiff
								2.00
5								

NOTES: No groundwater encountered during drilling. No caving. Boring terminated @2'. Sampler type: Shelby Tube.

American Geotechnical

Plate A-11

TEST EXCAVATION LOG No. B-25

F.N. 1987-02

Project/Client: Expansive Soil Study II/City of Torrance

Sheet: 1 of 1

Location: 23139 Ocean Avenue, Torrance, California

Start: 25 MAY 90

Estimated Surface Elevation: — '± Total Depth: 2.0' Rig Type: Hand Shelby

End: 25 MAY 90

Depth-Feet	Sample Type (Sampler / Bulk)	Blow Counts Blows/Foot	Dry Unit Weight Pcf	Moisture Content %	Laboratory Tests	USCS Symbol	Graphic Log	Field Description By: IM
								Surface Conditions: Lawn
								Subsurface Conditions: FORMATION: Classification, color, moisture, tightness, etc.
0	Sampler		85	18	EI=131	CH		Silty CLAY, dark gray, moist, stiff
								2.00
5								

NOTES:

American Geotechnical

Plate A-12

TEST EXCAVATION LOG No. TP-1

F.N. 1987-02

Project/Client: Expansive Soil Study II/City of Torrance

Location: City Park off Lomita Blvd. near Anza Avenue

Sheet: 1 of 1

Estimated Surface Elevation: — ' ±

Total Depth: 6.0'

Start: 17 MAY 90 End: 17 MAY 90

Depth-Feet	Sample Type (Bulk / Knocker / Shelby / Sand Cone)	Dry Unit Weight pcf	Moisture Content %	Rel. Compaction %	LABORATORY TESTS	USCS Symbol	Graphic Log	Field Description — By: IM
								Surface Conditions: **Lawn**
								Subsurface Conditions: **FORMATION: Classification, color, moisture, tightness, etc.**
0						SP		SAND, reddish brown, moist, loose, with clay seams
1								
2								
2.5–3	Bulk				EI=53			test performed on sand and clay mix
3								
4								
4.5–5	Bulk				EI=1			
5								
6								

NOTES: Sample type: Bulk

American Geotechnical

TEST EXCAVATION LOG No. TP-2

F.N. 1987-02

Project/Client: Expansive Soil Study II/City of Torrance

Location: City Park off Lomita Blvd. near Anza Avenue

Sheet: 1 of 1

Estimated Surface Elevation: — '±

Total Depth: 6.0'

Start: 17 MAY 90 End: 17 MAY 90

Depth-Feet	Sample Type: Bulk	Sample Type: Knocker	Sample Type: Shelby	Sample Type: Sand Cone	Dry Unit Weight pcf	Moisture Content %	Rel. Compaction %	LABORATORY TESTS	USCS Symbol	Graphic Log	Field Description (By: IM)
											Surface Conditions: **Lawn**
											Subsurface Conditions: **FORMATION: Classification, color, moisture, tightness, etc.**
0									SP		SAND, reddish brown, moist, loose, with clay seams
	X							EI=24			
1											
2											
3	X							EI=0			becomes wet with seepage (water from irrigation).
4											
5											
6											

NOTES: Sample type: Bulk

American Geotechnical

Plate A-14

TEST EXCAVATION LOG No. TP-4 F.N. 1987-02

Project/Client: Expansive Soil Study II/City of Torrance Location: Lopez Residence, 3870 W. 234th St., Torr., CA Sheet: 1 of 1

Estimated Surface Elevation: — '± Total Depth: 6.0' Start: 17 MAY 90 End: 17 MAY 90

Depth-Feet	Sample Type (Bulk / Knocker / Shelby / Sand Cone)	Dry Unit Weight pcf	Moisture Content %	Rel. Compaction %	LABORATORY TESTS	USCS Symbol	Field Description (By: IM)
							Surface Conditions: **Lawn**
							Subsurface Conditions: **FORMATION: Classification, color, moisture, tightness, etc.**
0						SP	SAND, reddish brown, dry, dense (FILL)
	Bulk				EI=0		
1							
	Bulk				EI=123		interbedded with, dry, hard, black clay to 2.25 feet. (test performed on clay seam)
2							
						CH	Silty CLAY, dark gray, slightly moist, stiff
3							
4	Bulk				EI=125		
5							
6							

NOTES: Sample type: Bulk

American Geotechnical

Plate A-16

TEST EXCAVATION LOG No. TP-3

Project/Client: Expansive Soil Study II/City of Torrance

Location: Lopez Residence, 3870 W. 234th St., Torr., CA

F.N. 1987-02

Sheet: 1 of 1

Estimated Surface Elevation: — '±

Total Depth: 5.5'

Start: 17 MAY 90 End: 17 MAY 90

Field Description By: IM

Surface Conditions: **Lawn**

Subsurface Conditions: **FORMATION: Classification, color, moisture, tightness, etc.**

Depth-Feet	Sample Type (Bulk / Knocker / Shelby / Sand Cone)	Dry Unit Weight pcf	Moisture Content %	Rel. Compaction %	LABORATORY TESTS	USCS Symbol	Graphic Log	Description
0						SC		Clayey SAND, brown, moist, medium dense, with clay seams (FILL)
0.5–1	Bulk				EI=71			
1.5–2	Bulk				EI=32			
2.25						CH		Silty CLAY, dark gray, slightly moist, stiff
5.5								

NOTES: Sample type: Bulk

American Geotechnical

Plate A-15

American Geotechnical

File No. 1987.02
July 26, 1990

SUMMARY OF LABORATORY TEST DATA

Exca. No.	Depth (feet)	Soil Classification USCS	In Situ Dry Density (lbs./cu.ft.)	In Situ Moisture Content (%)	Expansion* Index(EI)
B-14	0.5-2	CH	87	26	98
	4.5-6	CH	108	10	87
B-15	0.5-2	CH	-	-	143
	2.5-4	CL	103	17	81
	4.5-6	CL	97	16	39
B-16	0.5-2	CH	101	19	131
	2.5-4	CH	97	26	125
	4.5-6	CH	-	-	72
B-17	0.5-2	CH	99	18	150
	2.5-4	CH	80	28	147
	4.5-6	CH	109	15	105
B-18	0.5-2	SC	-	-	47
	2.5-4	SC	-	-	15
	4.5-6	SC	-	-	2
B-19	0.5-2	CH	85	29	156
	2.5-4	CH	86	32	132
	4.5-6	CH	84	34	144
B-20	0.5-2	CL	-	-	68
	2.5-4	CL	102	20	88
	4.5-6	CH	97	20	116
B-21	0.5-2	CH	94	22	148
	2.5-4	CH	91	27	151
	4.5-6	CH	96	18	148
B-22	0.5-2	CH	-	-	146
	2.5-4	CH	105	15	133
	4.5-6	SC	104	14	13

SUMMARY OF LABORATORY TEST DATA

AMERICAN GEOTECHNICAL	F.N. 1987.02	TABLE B1.1

Exca. No.	Depth (feet)	Soil Classi-fication USCS	In Situ Dry Density (lbs./cu.ft.)	In Situ Moisture Content (%)	Expansion Index (EI)*
B-23	0.5-2	SC	-	-	21
	4.5-6	SC	101	19	2
B-24	0.5-2	CH	87	15	156
B-25	0.5-2	CH	85	18	131
TP-1	2.5-3	SP	-	-	53
	4.5-5	SP	-	-	1
TP-2	0.5-1	SP	-	-	24
	3-3.5	SP	-	-	0
TP-3	0.5-1	SC	-	-	71
	1.5-2	SC	-	-	32
TP-4	0.5-1	SP	-	-	0
	1.5-2	CH	-	-	123
	4-4.5	CH	-	-	125

*CLASSIFICATION OF EXPANSIVE SOIL

EI	EXP. POTENTIAL
0 - 20	Very Low
21 - 50	Low
51 - 90	Medium
91 - 130	High
130 -	Very High

From Uniform Building Code Table 29-C

SUMMARY OF LABORATORY TEST DATA

AMERICAN GEOTECHNICAL	F.N. 1987.02	TABLE B1.2

TEST EXCAVATION LOG No. B-14

F.N. 1987-02

Project/Client: Expansive Soil Study II/City of Torrance

Sheet: 1 of 1

Location: 23021 Adolph Avenue, Torrance, California

Start: 15 MAY 90

Estimated Surface Elevation: — '± Total Depth: 6.0' Rig Type: 8" Hollow Stem Auger

End: 15 MAY 90

Field Description

By: IM

Surface Conditions: Lawn

Subsurface Conditions: FORMATION: Classification, color, moisture, tightness, etc.

Depth-Feet	Sample Type (SMPLER / BULK)	Blow Counts Blows/Foot	Dry Unit Weight Pcf	Moisture Content %	Laboratory Tests	USCS Symbol	Graphic Log	Field Description
0						CH		Sandy, Silty CLAY, dark brown, moist, stiff.
	SMPLER		87	26	EI=98			
	SMPLER		108	10	EI=86			becomes more sandy with depth
4.25						SM		Silty SAND, reddish brown, moist, medium dense to dense.
5	SMPLER							
6.00								

NOTES: No groundwater encountered during drilling. No caving. Boring terminated @6'. Sampler type: Shelby Tube.

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Plate A-1

TEST EXCAVATION LOG No. B-15

F.N. 1987-02

Project/Client: Expansive Soil Study II/City of Torrance

Sheet: 1 of 1

Location: 23119 Adolph Avenue, Torrance, California

Start: 15 MAY 90

Estimated Surface Elevation: — '± Total Depth: 6.0' Rig Type: 8" Hollow Stem Auger

End: 15 MAY 90

Field Description By: IM

Surface Conditions: Lawn

Subsurface Conditions: **FORMATION: Classification, color, moisture, tightness, etc.**

Depth-Feet	Sample Type (SMPLER / BULK)	Blow Counts Blows/Foot	Dry Unit Weight Pcf	Moisture Content %	Laboratory Tests	USCS Symbol	Graphic Log	Depth	Field Description
0						CH			Silty CLAY, brown, moist, medium stiff.
	SMPLER				EI=143				
	SMPLER		103	17	EI=81				Color change to reddish brown, becomes more sandy with depth.
	SMPLER		97	16	EI=39	SC		4.50	Clayey Fine SAND, light brown , moist, medium dense to dense
5									
								6.00	

NOTES: No groundwater encountered during drilling. No caving. Boring terminated @6'. Sampler type: Shelby Tube.

TEST EXCAVATION LOG No. B-16

F.N. 1987-02

Project/Client: Expansive Soil Study II/City of Torrance

Sheet: 1 of 1

Location: 3922 231st Street, Torrance, California

Start: 15 MAY 90

Estimated Surface Elevation: — '± Total Depth: 6.0' Rig Type: 8" Hollow Stem Auger

End: 15 MAY 90

Field Description By: IM

Surface Conditions: Lawn

Subsurface Conditions: FORMATION: Classification, color, moisture, tightness, etc.

Depth-Feet	Sample Type (SMPLER / BULK)	Blow Counts Blows/Foot	Dry Unit Weight Pcf	Moisture Content %	Laboratory Tests	USCS Symbol	Graphic Log	Field Description
0						CH		Silty CLAY, dark gray, moist, stiff.
	SMPLER		101	19	EI=131			
	SMPLER		97	26	EI=125			becomes more sandy with depth
	SMPLER				EI=72			color changes to light brown
5								
6.00								

NOTES: No groundwater encountered during drilling. No caving. Boring terminated @6'. Sampler type: Shelby Tube.

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Plate A-3

TEST EXCAVATION LOG No. B-17

F.N. 1987-02

Project/Client: Expansive Soil Study II/City of Torrance

Sheet: 1 of 1

Location: 3915 231st Place, Torrance, California

Start: 15 MAY 90

Estimated Surface Elevation: — '± Total Depth: 6.0' Rig Type: 8" Hollow Stem Auger

End: 15 MAY 90

Depth-Feet	Sample Type: SMPLER	Sample Type: BULK	Blow Counts Blows/Foot	Dry Unit Weight Pcf	Moisture Content %	Laboratory Tests	USCS Symbol	Graphic Log	Field Description (By: IM)
									Surface Conditions: Lawn
									Subsurface Conditions: FORMATION: Classification, color, moisture, tightness, etc.
0							CH		Silty CLAY, dark gray, moist, stiff.
	X			99	18	EI=150			
	X			80	28	EI=147			
	X			109	15	EI=105			
5									
									6.00

NOTES: No groundwater encountered during drilling. No caving. Boring terminated @6'. Sampler type: Shelby Tube.

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Plate A-4

TEST EXCAVATION LOG No. B-18

F.N. 1987-02

Project/Client: Expansive Soil Study II/City of Torrance

Sheet: 1 of 1

Location: 23132 Audrey Avenue, Torrance, California

Start: 15 MAY 90

Estimated Surface Elevation: — '± Total Depth: 6.0' Rig Type: 8" Hollow Stem Auger

End: 15 MAY 90

Depth-Feet	Sample Type (SMPLER / BULK)	Blow Counts Blows/Foot	Dry Unit Weight Pcf	Moisture Content %	Laboratory Tests	USCS Symbol	Graphic Log	Field Description By: IM
								Surface Conditions: Lawn
								Subsurface Conditions: **FORMATION: Classification, color, moisture, tightness, etc.**
0						SC		Clayey SAND, reddish brown, moist, medium dense.
	SMPLER				EI=47			
	SMPLER				EI=15			
	SMPLER				EI=2			
5								
								6.00

NOTES: No groundwater encountered during drilling. No caving. Boring terminated @6'. Sampler type: Shelby Tube.

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Plate A-5

TEST EXCAVATION LOG No. B-19

F.N. 1987-02

Sheet: 1 of 1

Project/Client: Expansive Soil Study II/City of Torrance

Start: 15 MAY 90

Location: 4205 230th Place, Torrance, California

End: 15 MAY 90

Estimated Surface Elevation: — '± Total Depth: 6.0' Rig Type: 8" Hollow Stem Auger

Depth-Feet	Sample Type: SMPLER	Sample Type: BULK	Blow Counts Blows/Foot	Dry Unit Weight Pcf	Moisture Content %	Laboratory Tests	USCS Symbol	Graphic Log	Field Description (By: IM)
									Surface Conditions: Lawn
									Subsurface Conditions: FORMATION: Classification, color, moisture, tightness, etc.
0							CH		Silty CLAY, dark gray, moist, stiff.
	▮			85	29	EI=156			
	▮			86	32	EI=132			
	▮			84	34	EI=144			
5									
									6.00

NOTES: No groundwater encountered during drilling. No caving. Boring terminated @6'. Sampler type: Shelby Tube.

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Plate A-6

TEST EXCAVATION LOG No. B-20

F.N. 1987-02

Project/Client: Expansive Soil Study II/City of Torrance

Sheet: 1 of 1

Location: 4311 230th Place, Torrance, California

Start: 15 MAY 90

Estimated Surface Elevation: — '± Total Depth: 6.0' Rig Type: 8" Hollow Stem Auger

End: 15 MAY 90

Field Description By: IM

Surface Conditions: Lawn

Subsurface Conditions: FORMATION: Classification, color, moisture, tightness, etc.

Depth-Feet	Sample Type (SMPLER / BULK)	Blow Counts Blows/Foot	Dry Unit Weight Pcf	Moisture Content %	Laboratory Tests	USCS Symbol	Field Description
0						CL	Sandy, Silty CLAY, dark gray, moist, stiff, becomes more plastic with depth.
	SMPLER				EI=68		
	SMPLER		102	20	EI=88		
	SMPLER		97	20	EI=116		becomes highly plastic
5							
6.00							

NOTES: No groundwater encountered during drilling. No caving. Boring terminated @6'. Sampler type: Shelby Tube.

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Plate A-7

TEST EXCAVATION LOG No. B-21

F.N. 1987-02

Project/Client: Expansive Soil Study II/City of Torrance

Sheet: 1 of 1

Location: 23133 Ladeene Avenue Off Calle Mayor, Torrance, California

Start: 15 MAY 90

Estimated Surface Elevation: — '± Total Depth: 6.0' Rig Type: 8" Hollow Stem Auger

End: 15 MAY 90

Field Description By: IM

Surface Conditions: Lawn

Depth-Feet	Sample Type (SMPLER / BULK)	Blow Counts Blows/Foot	Dry Unit Weight Pcf	Moisture Content %	Laboratory Tests	USCS Symbol	Subsurface Conditions: FORMATION: Classification, color, moisture, tightness, etc.
0						CH	Silty CLAY, dark gray, moist, stiff.
	SMPLER		94	22	EI=148		
	SMPLER		91	27	EI=151		
	SMPLER		96	18	EI=148		Color change to brown.
5							
6.00							

NOTES: No groundwater encountered during drilling. No caving. Boring terminated @6'. Sampler type: Shelby Tube.

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Plate A-8

TEST EXCAVATION LOG No. B-22

F.N. 1987-02

Project/Client: Expansive Soil Study II/City of Torrance

Sheet: 1 of 1

Location: 23115 Kent Avenue, Torrance, California

Start: 15 MAY 90

Estimated Surface Elevation: — '± Total Depth: 6.0' Rig Type: 8" Hollow Stem Auger

End: 15 MAY 90

Field Description By: IM

Surface Conditions: **Lawn**

Depth-Feet	Sample Type (SMPLER / BULK)	Blow Counts Blows/Foot	Dry Unit Weight Pcf	Moisture Content %	Laboratory Tests	USCS Symbol	Graphic Log	Subsurface Conditions: FORMATION: Classification, color, moisture, tightness, etc.
0						CH		Silty CLAY, dark gray, moist, stiff.
	SMPLER				EI=146			
	SMPLER		105	15	EI=133			
4.50	SMPLER		104	14	EI=13	SC		Clayey SAND, brown, moist, dense
5								
6.00								

NOTES: No groundwater encountered during drilling. No caving. Boring terminated @6'. Sampler type: Shelby Tube.

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Plate A-9

TEST EXCAVATION LOG No. B-23

F.N. 1987-02

Project/Client: Expansive Soil Study II/City of Torrance

Sheet: 1 of 1

Location: 23105 Galva Avenue, Torrance, California

Start: 15 MAY 90

Estimated Surface Elevation: — '± Total Depth: 6.0' Rig Type: 8" Hollow Stem Auger

End: 15 MAY 90

Field Description By: IM

Surface Conditions: Lawn

Depth-Feet	Sample Type (SMPLER / BULK)	Blow Counts Blows/Foot	Dry Unit Weight Pcf	Moisture Content %	Laboratory Tests	USCS Symbol	Graphic Log	Subsurface Conditions: **FORMATION: Classification, color, moisture, tightness, etc.**
0						SC		Clayey SAND, brown, moist, loose.
	SMPLER				EI=21			
	SMPLER		101	19	EI=2			becomes very wet
5								
6.00								

NOTES: No groundwater encountered during drilling. No caving. Boring terminated @6'. Sampler type: Shelby Tube.

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Plate A-10

TEST EXCAVATION LOG No. B-24

F.N. 1987-02

Project/Client: Expansive Soil Study II/City of Torrance

Sheet: 1 of 1

Location: 23103 Ocean Avenue, Torrance, California

Start: 25 MAY 90

Estimated Surface Elevation: — '± Total Depth: 2.0' Rig Type: Hand Shelby

End: 25 MAY 90

Depth-Feet	Sample Type (SMPLER / BULK)	Blow Counts Blows/Foot	Dry Unit Weight Pcf	Moisture Content %	Laboratory Tests	USCS Symbol	Graphic Log	**Field Description** By: IM Surface Conditions: Lawn Subsurface Conditions: **FORMATION: Classification, color, moisture, tightness, etc.**
0	SMPLER		87	15	EI=156	CH		Silty CLAY, dark gray, moist, stiff
								2.00
5								

NOTES: No groundwater encountered during drilling. No caving. Boring terminated @2'. Sampler type: Shelby Tube.

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Plate A-11

TEST EXCAVATION LOG No. B-25

F.N. 1987-02

Project/Client: Expansive Soil Study II/City of Torrance

Sheet: 1 of 1

Location: 23139 Ocean Avenue, Torrance, California

Start: 25 MAY 90

Estimated Surface Elevation: — '± Total Depth: 2.0' Rig Type: Hand Shelby

End: 25 MAY 90

Field Description By: IM

Surface Conditions: Lawn

Depth-Feet	Sample Type (SMPLER / BULK)	Blow Counts Blows/Foot	Dry Unit Weight Pcf	Moisture Content %	Laboratory Tests	USCS Symbol	Graphic Log	Subsurface Conditions: FORMATION: Classification, color, moisture, tightness, etc.
0	SMPLER		85	18	EI=131	CH		Silty CLAY, dark gray, moist, stiff
								2.00
5								

NOTES:

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Plate A-12

TEST EXCAVATION LOG No. TP-1

F.N. 1987-02

Project/Client: Expansive Soil Study II/City of Torrance

Location: City Park off Lomita Blvd. near Anza Avenue

Sheet: 1 of 1

Estimated Surface Elevation: — '±

Total Depth: 6.0'

Start: 17 MAY 90 End: 17 MAY 90

Field Description By: IM

Surface Conditions: **Lawn**

Subsurface Conditions: **FORMATION: Classification, color, moisture, tightness, etc.**

Depth-Feet	Sample Type: Bulk	Sample Type: Knocker	Sample Type: Shelby	Sample Type: Sand Cone	Dry Unit Weight pcf	Moisture Content %	Rel. Compaction %	LABORATORY TESTS	USCS Symbol	Graphic Log	Field Description
0									SP		SAND, reddish brown, moist, loose, with clay seams
1											
2											
2.5–3	Bulk							EI=53			test performed on sand and clay mix
3											
4											
4.5–5	Bulk							EI=1			
5											
6											

NOTES: Sample type: Bulk

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TEST EXCAVATION LOG No. **TP-2** F.N. **1987-02**

Project/Client: **Expansive Soil Study II/City of Torrance** Location: City Park off Lomita Blvd. near Anza Avenue Sheet: **1** of **1**

Estimated Surface Elevation: ± '± Total Depth: **6.0'** Start: **17 MAY 90** End: **17 MAY 90**

Depth-Feet	Sample Type: Bulk	Sample Type: Knocker	Sample Type: Shelby	Sample Type: Sand Cone	Dry Unit Weight pcf	Moisture Content %	Rel. Compaction %	LABORATORY TESTS	USCS Symbol	Graphic Log	Field Description (By: **IM**) — Surface Conditions: **Lawn**; Subsurface Conditions: **FORMATION: Classification, color, moisture, tightness, etc.**
0									SP		SAND, reddish brown, moist, loose, with clay seams
0.5–1	Bulk							EI = 24			
1											
2											
3–3.5	Bulk							EI = 0			becomes wet with seepage (water from irrigation).
4											
5											
6											

NOTES: **Sample type: Bulk**

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TEST EXCAVATION LOG No. TP-4

F.N. 1987-02

Project/Client: Expansive Soil Study II/City of Torrance

Location: Lopez Residence, 3870 W. 234th St., Torr., CA

Sheet: 1 of 1

Estimated Surface Elevation: — '±

Total Depth: 6.0'

Start: 17 MAY 90 End: 17 MAY 90

Depth-Feet	Sample Type (Bulk / Knocker / Shelby / Sand Cone)	Dry Unit Weight pcf	Moisture Content %	Rel. Compaction %	LABORATORY TESTS	USCS Symbol	Graphic Log	Field Description By: IM
								Surface Conditions: **Lawn**
								Subsurface Conditions: **FORMATION: Classification, color, moisture, tightness, etc.**
0						SP		SAND, reddish brown, dry, dense (FILL)
	Bulk				EI=0			
1								
	Bulk				EI=123			interbedded with, dry, hard, black clay to 2.25 feet. (test performed on clay seam)
2								
						CH		Silty CLAY, dark gray, slightly moist, stiff
3								
4	Bulk				EI=125			
5								
6								

NOTES: Sample type: Bulk

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Plate A-16

TEST EXCAVATION LOG No. TP-3

Project/Client: **Expansive Soil Study II/City of Torrance** Location: Lopez Residence, 3870 W. 234th St., Torr., CA

F.N. **1987-02** Sheet: **1** of **1**

Estimated Surface Elevation: — '± Total Depth: **5.5'** Start: **17 MAY 90** End: **17 MAY 90**

Field Description By: **IM**

Surface Conditions: **Lawn**

Subsurface Conditions: **FORMATION: Classification, color, moisture, tightness, etc.**

Depth-Feet	Sample Type (Bulk / Knocker / Shelby / Sand Cone)	Dry Unit Weight pcf	Moisture Content %	Rel. Compaction %	LABORATORY TESTS	USCS Symbol	Field Description
0						SC	Clayey SAND, brown, moist, medium dense, with clay seams (FILL)
0.5–1	Bulk				EI=71		
1.5–2	Bulk				EI=32		
2.25						CH	Silty CLAY, dark gray, slightly moist, stiff
5.5							

NOTES: **Sample type: Bulk**

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