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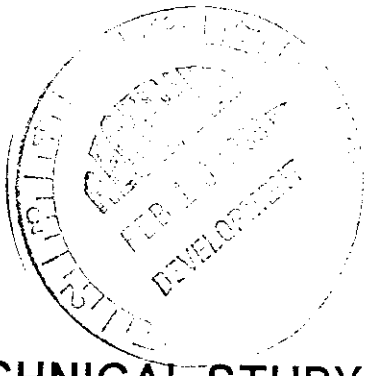
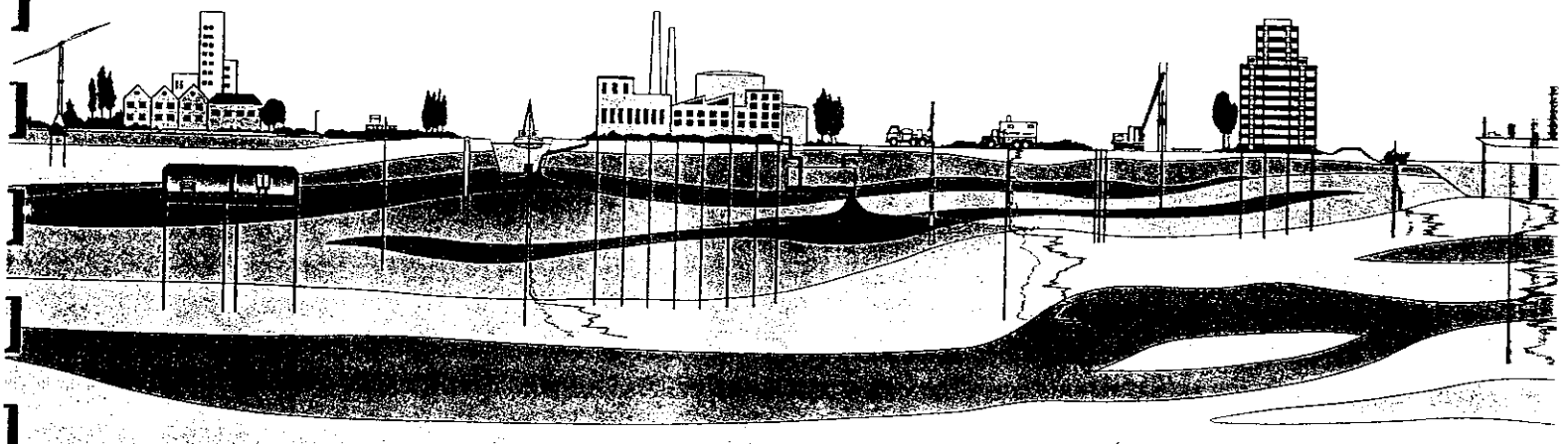
FUGRO

FUGRO-McCLELLAND (SOUTHWEST), INC.



PRELIMINARY GEOTECHNICAL STUDY
PROPOSED MAINTENANCE AND PRODUCTION FACILITY
SAN ANTONIO, TEXAS

HOUSING AUTHORITY OF THE CITY OF SAN ANTONIO
San Antonio, Texas



FUGRO-McCLELLAND (SOUTHWEST), INC.

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Report No. 1002-2391
February 15, 1995

Housing Authority of the City of San Antonio
818 S. Flores Street
P.O. Box 1300
San Antonio, Texas 78295-1300

Attention: Mr. Oscar Cervantes

Preliminary Geotechnical Study
Maintenance and Production Facility
San Antonio, Texas

Fugro-McClelland (Southwest), Inc., is pleased to present the report of a preliminary geotechnical study to the Housing Authority of the City of San Antonio (SAHA). This study was conducted at the location of a proposed SAHA maintenance and production facility in San Antonio, Texas. This work was performed in general accordance with our Proposal No 1002-2391, dated October 26, 1994, and was authorized by Mr. Cervantes in his facsimile transmission dated November 23, 1994.

This report contains general foundation design recommendations and construction guidelines. The information obtained during the field and laboratory investigation of the study is also included. During the field phase of the study, suspected waste material was encountered at the site, delaying the completion of this final report. A Phase II Environmental Site Assessment has been recently performed by Fugro Environmental. The results of that study are being presented under separate cover.

Fugro-McClelland (Southwest), Inc., appreciates the opportunity to be of assistance to SAHA on this project. Please call if you have any questions, or if we may be of additional assistance.

Sincerely,

FUGRO-McCLELLAND
(SOUTHWEST), INC.

Rene P. Gonzales, E.I.T.
Graduate Engineer

Gregory P. Stieben, P.E.
Geotechnical Manager

STATE OF TEXAS
GREGORY P. STIEBEN
59536
REGISTERED
PROFESSIONAL ENGINEER

RPG/GPS/(2391rpt.doc)
Copies Submitted: (4)

PRELIMINARY GEOTECHNICAL STUDY
MAINTENANCE AND PRODUCTION FACILITY
SAN ANTONIO, TEXAS

* * *

Report

to

HOUSING AUTHORITY OF THE CITY OF SAN ANTONIO
San Antonio, Texas

* * *

by

FUGRO-McCLELLAND (SOUTHWEST), INC.
11009 Osgood
San Antonio, Texas

February 1995

CONTENTS

ILLUSTRATIONS

SUMMARY

Fugro-McClelland (Southwest), Inc. performed a preliminary geotechnical study for a proposed SAHA maintenance and production facility in San Antonio, Texas. This report documents the study. It contains a brief synopsis of the project, field exploration and laboratory tests results, and engineering recommendations. This summary provides an overview of the report and is not intended to present all pertinent information.

Subsurface soil conditions were explored by drilling three soil borings. Laboratory tests were performed to measure the pertinent index and engineering properties of the foundation soils. Results of the field and laboratory phases were then analyzed to develop general geotechnical engineering recommendations to guide design and construction of the proposed building.

The principal findings and recommendations developed as part of this geotechnical study are summarized below:

1. The site is located at the intersection of San Marcos and Pendleton, adjacent to the Union Stockyards in San Antonio. A detailed layout of the proposed structure was unavailable. At the time of our field investigation, the site was undeveloped with varying topography.
2. Subsurface stratigraphy encountered at the site varied somewhat from one location to another. Two of the three borings encountered fill material to about 8-ft depth. The natural deposits at the site consisted of alluvium over strong Navarro clay. The alluvium varied from a lean clay to a clayey gravel.
3. The borings were advanced using dry auger drilling techniques. Groundwater was encountered at a depth of about 3 ft in one of the borings, 13.5-ft depth in another boring, and was not observed in the remaining boring.
4. Based on the results of the study, the proposed structure may be supported on a grid-beam stiffened slab, provided a specified amount of the near-surface material and all of the fill material is removed and replaced, and the structure can tolerate some movements.
5. If the estimated movements cannot be tolerated or if the existing fill material is to be left in place, the building may be structurally suspended and supported on drilled shaft foundations. Also, if the fill is left in place, a significant amount of preparation and maintenance in the parking areas underlain by fill should be expected.

Additional recommendations and considerations to aid in foundation construction are also presented. Groundwater control, site drainage, and construction monitoring are discussed.

INTRODUCTION

Project Description

The San Antonio Housing Authority is planning a new maintenance and production facility in San Antonio. The site is located northwest of the intersection of San Marcos and Pendleton Streets, as illustrated on the Vicinity Map, presented on Plate 1. A detailed layout of the proposed structure is unavailable. However, we understand that the maximum column loads will be on the order of 100 kips and that the building pad will be designed for a potential vertical rise (PVR) of 1 inch, or less.

On November 28, 1994, Fugro-McClelland (Southwest) initiated a preliminary geotechnical study for the planned building. This geotechnical study was performed to provide preliminary engineering recommendations to provide conceptual guidance for the design and construction of the foundations for the proposed structure. This work was performed in general accordance with our Proposal No 1002-2391, dated November 28, 1994, and was authorized by Mr. Oscar Cervantes facsimile transmission, dated November 23 1994.

Purposes and Scope

The purposes of this study were to explore the subsurface conditions at the site and to develop conceptual recommendations for the design and construction of the foundation for the planned building. These purposes were accomplished by performing the following scope of work:

1) drilling and sampling three exploratory borings to explore subsurface conditions and obtain samples for laboratory testing;
2) performing laboratory tests on selected soil samples from the borings to evaluate the pertinent physical and engineering properties; and
3) analyzing the field and laboratory data to develop foundation design and construction recommendations.

In general, field sampling, laboratory testing, and soil classifications and descriptions were in accordance with methods, procedures, and practices set forth by the American Society for Testing and Materials, 1993 Annual Book of ASTM Standards, where applicable.

Report Format

This report begins with descriptions of the subsurface investigation and laboratory testing programs. Findings from the field and laboratory programs follow in the section titled "Generalized Site Conditions." The subsequent section presents recommendations to guide design and construction of the foundations for the planned building. Concluding sections address construction surveillance and control, and the conditions of our recommendations

contained in the report. Illustrations follow the text and contain: a vicinity map; a site plan; the boring logs presenting field and laboratory data; and plates explaining the terms and symbols used on the logs.

SUBSURFACE INVESTIGATION

The subsurface exploration was begun on November 28, 1994 and completed on December 20, 1994. The field program consisted of three subsurface exploration borings. The sample borings, designated Borings 1 through 3, were all advanced to a nominal depth of 25 ft. The total depth explored was 75 ft.

The boring locations were selected by others, and staked by the field crew measuring from landmarks at the site. The locations were based on a "concept site plan" provided by the architect prior to the field exploration. The approximate locations of the borings are illustrated on a Plan of Borings presented on Plate 2. Boring 1 was drilled in the western portion of the site through a previously paved area, Boring 2 was made within the footprint of the old building location, and Boring 3 was done in a relatively low area to the northeast of the old building location.

Drilling and Sampling

The sample borings were drilled to their completion depths using dry auger drilling techniques utilizing solid stem augers. The borings were drilled with a truck-mounted Mobile Drill rig equipped with the following sampling tools: (1) continuous flight augers for advancing the holes dry and recovering disturbed samples; (2) thin-walled tubes for obtaining undisturbed samples of cohesive strata (ASTM D 1587-83); and (3) split-barrel samplers and drive weight assembly for obtaining samples and measuring the Standard Penetration Test (SPT) N-values of noncohesive and hard cohesive soil strata (ASTM D 1586-84). Samples were generally obtained at about 2-ft intervals to a depth of about 10 ft and at 5-ft intervals thereafter to the completion depth.

Boring Logs and Sample Handling

During drilling and sampling, a record of field observations was maintained in the form of field logs describing the visual identification of the subsurface materials encountered, and other pertinent field data. These logs were later edited to incorporate information obtained from laboratory examination and testing. The final boring logs for Borings 1 through 3, thus developed, are presented on Plates 3 through 5, respectively. Keys to terms and symbols used on the boring logs are presented on Plates 6 and 7.

To aid in field classification, the undrained compressive strength of cohesive samples was estimated using a calibrated hand penetrometer. The pocket penetrometer values, in tons per square foot (tsf) are shown on the logs. The compressive strength estimate in tons per

square foot (tsf) obtained with the pocket penetrometer are equivalent to the undrained shear strength of the soil in kips per square foot (ksf).

The SPT N-value is the number of blows of a 140 lb drop hammer falling 30 inches required to drive the SPT sampler the final 12 inches of an 18 inch sampling interval. Where very dense material is encountered, the actual penetration after the initial 6 inches seating of the sampler is recorded for a total of 50 blows. The blows required for the first 6 inches of sampler penetration (seating) are usually not considered representative of in situ densities due to the possible presence of loose material or cuttings from the drilling operations. Failure to attain the initial 6 inches of sampler penetration with 50 blows is generally referred to as refusal and is identified on the boring logs as "Ref" for the indicated amount of sampler penetration.

After recovery, each sample was removed from the sampler, examined and visually classified by a soil technician. All field sampling and testing was performed in general accordance with the applicable ASTM standards. Representative portions of each sample were then sealed, packaged, and transported to our laboratory for further examination and testing.

Depth to Water

The borings were advanced without the use of drilling fluids. At the completion of the field exploration, the boreholes were sounded for groundwater using a weighted measuring tape. Any depth to water measurements are recorded on the boring logs.

LABORATORY INVESTIGATION

General

The laboratory testing program was directed toward identification and classification of the foundation soils and evaluation of the unconfined shear strength; and primarily consisted of a series of standard classification and strength tests. To aid in soil classification, liquid and plastic limits, collectively termed Atterberg limits, were performed on selected cohesive soil samples. Water content measurements were made on selected samples to help establish the moisture content profile for each boring. The undrained shear strengths of selected samples were measured by performing unconfined compression tests; moisture content and unit dry weight were measured as routine portions of the compression test. The results of the laboratory classification and strength tests are presented on the individual boring logs on Plates 3 through 5.

Review

Descriptions of strata made in the field at the time the borings were drilled were modified in accordance with results of laboratory tests and visual examination in the laboratory. All recovered soil samples were examined, classified and described in accordance with ASTM D

2487-85, ASTM D 2488-84 and Unified Soil Classification procedures. Classifications of the soils and finalized descriptions of soil strata are shown on the attached boring logs.

GENERALIZED SITE CONDITIONS

Site Description

The site is located on San Marcos Street between the Union Stock yards and Pendleton street in San Antonio. Just to the south are a series of residential lots, and east of the site (across San Marcos street) is San Pedro Creek. A large building previously occupied the site; evidence of the old building foundation could be seen at several locations. The ground surface had some irregularities. However, the elevations were generally highest at the far western corner and dropped by about 20 ft in the eastern portion of the site. A detailed layout of the proposed structure is unavailable.

Site Geology

A review of available geologic information[1], indicates that the project site is located on the Fluviatile Terrace Deposits underlain, more likely than not, by the Navarro Group Formation. The alluvium soils are flood plain deposits and consist primarily of clays containing various amounts of silt, sand, and gravel. The Navarro Group clays encountered consist of the lower part of the formation and is composed of dominantly montmorillonitic, greenish-gray to brownish-gray clay, which weathers to a black clay.

Stratigraphy

Subsurface conditions were explored at the site by three borings, which encountered somewhat varying conditions. Two of the three borings encountered fill material to about 8-ft depth. The natural soils revealed at the site consist of alluvial deposits overlying strong clays of the Navarro Formation. The subsurface conditions have been generalized into the follow major strata:

Stratum	Depth, ft From	To	Description
I	0	8	Uncontrolled Fill Material
II	8	18 to 23	Lean Sandy Clay with Gravel and Clayey Gravel (Alluvium)
III	18 to 23	25+	Tan and Gray Fat Clay (Navarro)

[1] The University of Texas at Austin Bureau of Economic Geology, (1983), "Geologic Atlas of Texas, San Antonio Sheet".

As noted above, one of the borings did not encounter fill material. The following paragraphs describe some of the measured properties of the three strata.

Stratum I. Boring 2 was drilled within the footprint of the old building location and encountered about 7 ft of fill material consisting of silty sand and gravelly sand. Based on SPT blow counts, the material is loose to very dense in condition. Atterberg limits tests indicate the material is non-plastic. In addition, the material contained some construction debris, consisting of brick fragments, rebar, etc.

At the Boring 3 location, the fill material consisted of coal ash and clinker. The material consisted of coarse sand-sized particles and was locally cemented. Based on SPT blow counts, the material would be expected to be generally weak and compressible. The fill at that location was also water bearing.

Stratum II. Alluvial deposits of Stratum II were encountered near the surface in Boring 1 and below the fill in Borings 2 and 3. The material was present to depths ranging from 18.5 to 25 below the surface. At the Boring 1 and 2 locations, Stratum II consisted of a tan sandy lean clay (CL) with gravel. The material is generally hard in consistency, with unconfined compressive strengths and pocket penetrometer readings typically over 4 tsf. The measured liquid limits of the material ranged from 31 to 37, and computed plasticity index values ranged from 11 to 21. The plasticity characteristics of the tested samples indicate a medium shrink/swell potential.

The Stratum II deposits revealed by Boring 3 consisted of a clayey gravel (GC) to a depth of 23 ft. Based on SPT blow counts, the material is very dense in condition. As in the case of the overlying fill, this material was water bearing. At Boring 3, the clayey gravel was underlain by a lean clay similar to the Stratum II material in the other two borings.

Stratum III. The Stratum III soils consisted of strong clay of the Navarro Formation. The material is classified as highly-plastic clay (CH). These soils are also hard in consistency with penetrometer readings over 4.5 tsf. The material had liquid limits ranging from 85 to 87, and plasticity indices ranging from 61 to 65. Based on correlations with the plasticity characteristics, this strata would be expected to have a very high potential for volume change (shrink/swell) resulting from moisture fluctuations[2].

Groundwater

The borings were advanced without the use of drilling fluids. During the drilling and sampling operations, the borings were observed for signs of groundwater. Water was detected in Borings 1 and 3. At the Boring 1 location, the water was about 13.5 ft below the ground surface after one hour. At the Boring 3 location, the water was only about 3 ft below the ground

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2 Peck, R.B., Hanson, W.E., and Thornburn, T.H., (1974) Foundation Engineering, Second Edition, John Wiley & Sons, Inc., New York, Pg. 337.

surface. No free water was observed in Boring 2. It should be noted that fluctuations in groundwater level may occur, and the groundwater level may rise during extended periods of precipitation.

Variations in Subsurface Conditions

Subsurface conditions have been obtained at the boring locations only. Since considerable variation was found in subsurface conditions at boring locations, all parties should recognize that even more variation may be possible between boring locations. In addition, the soil stratigraphy described above, and on the boring logs, is based on interpretation of the technician's observations during sampling, and classification of the soil samples. The boundaries between soil layers are approximate, and transitions between soil types may be gradual.

STRUCTURAL CONSIDERATIONS

SAHA is planning a maintenance and production facility at the intersection of San Marcos and Pendleton in San Antonio. José Luis Hernández - Architects, Inc. is performing architectural design for the structure. Mr. Steve Persyn, P.E. is providing structural design services. Details of the proposed structure were unavailable. However, maximum expected column loads will be on the order of 100 kips and the building pad is to be designed for a PVR of 1 inch, or less.

FOUNDATION EVALUATION

General

A suitable foundation for any structure must satisfy two independent criteria with respect to the underlying foundation soils. First, the foundation must have an adequate factor of safety against exceeding the bearing capacity of the foundation soils. Second, the vertical movement of the foundation due to swelling or compression of the foundation material must be within tolerable limits for the structure.

Bearing Capacity Considerations

The fill material encountered at this site, particularly the fill at the Boring 3 location, is relatively weak, and is therefore not suitable for foundation support. The underlying natural soils are relatively strong, and should be adequate for support. Adequate foundation design will require either: 1) removal of the fill material and replacement with a strong inert fill, or 2) use of a structurally supported slab and deep (drilled pier) foundations. If the fill is removed and replaced, the foundation may consist of a grid-beam stiffened slab system. For estimating

purposes only, we would anticipate that if deep foundations are required, that they would need to be on the order of 24 inches in diameter and about 30 ft deep.

Foundation Movement Considerations

As indicated earlier, the fill material encountered at this site is relatively weak and compressible. Therefore, to avoid excessive foundation settlement, it will be necessary to remove and replace the fill with a strong inert fill material. In areas where no existing fill is present, such as at the Boring 1 location, about 2 ft of inert fill should be placed under a slab foundation to result in a PVR of less than 1 inch. Some minor differential movements should be expected to occur across the site between the currently filled and the non-filled areas.

From a geotechnical perspective, it may not be necessary to remove and replace the fill if the structure is supported on a deep foundation system. The decision to remove the fill or to leave it in place will probably be made once the environmental concerns at the site have been fully addressed. In the event the decision is made to leave the fill in place, it should be recognized that some surface movements in parking areas, flatwork, and utility connections are likely to occur. Special consideration will need to be given to the pavement design, particularly in areas of heavy truck traffic. The use of geo-grids and/or geo-fabrics should be considered.

CONSTRUCTION CONSIDERATIONS

Groundwater Control

If any excavations are made at the site, particularly in the area of Boring 3, significant amounts of groundwater seepage should be expected. A detailed dewatering or drainage plan should be anticipated. Shallow excavations in the higher portions of the site would not be expected to experience as significant a problem.

Site Drainage

The optimum performance of any foundation system is dependent on positive site drainage. Positive drainage of all storm waters away from foundations should be included in the design of this project. Parking lots and service drives should be designed to prevent the ponding of water either on or along the edges of the pavements and curbs. This positive drainage should be carefully maintained throughout the life of the building.

The contractor should provide for positive drainage of the site during construction. This consideration should be included in the project specifications.

Deep Foundations

If deep drilled piers are planned for the site, the use of casing should be anticipated. This will be particularly important in the areas containing water-bearing fill material. Other than

the use of casing to control water inflow and sloughing soils, installation of the piers should relatively routine.

Construction Surveillance and Control

Engineering overview and on-site surveillance during subgrade preparation, fill placement and compaction, and foundation construction is essential to provide a well-constructed system. For the site preparation anticipated at this site, we recommend these construction activities be monitored by Fugro-McClelland (Southwest) to provide the necessary overview and verify the intent of our recommendations. These subgrade preparation services would include monitoring and testing of fill placement and compaction, and field observations and laboratory testing to evaluate the quality of construction materials. We would be pleased to discuss a scope of work with you and submit a proposal to provide these services.

ADDITIONAL STUDY

The purpose of this current study was to provide preliminary conceptual geotechnical recommendations for the development of the site, and is not intended for final design purposes. Considering the variable nature of the subsoils at this site, a number of additional soil borings will be needed to delineate the presence and thickness of fill material. Borings already done as part of this study and the environmental site assessment may be used to supplement future evaluations. If deep foundations are to be used, a few borings need to be sampled to a depth of about 40 ft to provide the necessary design parameters.

CONDITIONS

Since some variation was found in subsurface conditions at boring locations, all parties involved should take notice that even more variation may be encountered between boring locations. Statements in the report as to subsurface variation over given areas are intended only as estimations from the data obtained at specific boring locations.

It is recommended that, upon completion of the plans and specifications and the incorporation of the recommendations herein, Fugro-McClelland (Southwest), Inc., be retained to review such plans to insure proper interpretation and implementation of the recommendations contained in this report in the interest of the best compromise between cost and performance.

The professional services that form the basis for this report have been performed using that degree of care and skill ordinarily exercised, under similar circumstances, by reputable geotechnical engineers practicing in the same locality. No other warranty, expressed or implied, is made as to the professional advice set forth.

The results, conclusions, and recommendations contained in this report are directed at, and intended to be utilized within, the scope of work as presented in this report. This report is

not intended to be used for any other purposes. Fugro-McClelland (Southwest), Inc. makes no claim or representation concerning any activity or condition falling outside the specified purposes to which this report is directed, said purposes being specifically limited to the scope of work as defined in said report. Inquiries as to said scope of work or concerning any activity or condition not specifically contained therein should be directed to Fugro-McClelland for a determination and, if necessary, further investigation.

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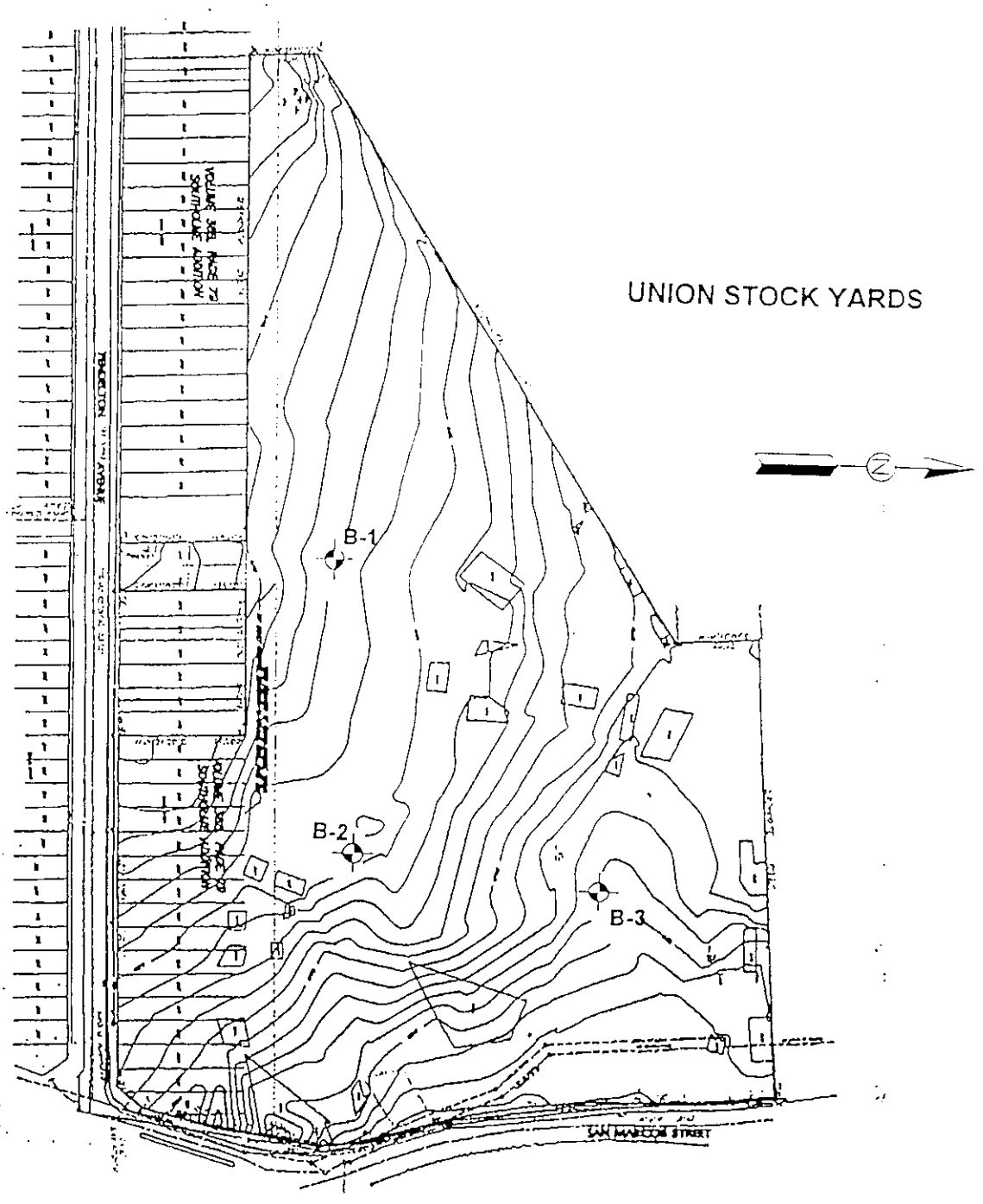
FUGRO



Not to Scale

PLAN OF BORINGS
PROPOSED MAINTENANCE AND PRODUCTION FACILITY
SAN ANTONIO, TEXAS

FUGRO-McCLELLAND (SOUTHWEST), INC.

PLATE 2

LOG OF BORING NO. 1

SAHA PROPOSED MAINTENANCE FACILITY

SAN ANTONIO, TEXAS

TYPE: Flight Auger

LOCATION: See Plate 2

DEPTH, FT	SYMBOL	SAMPLES	BLOWS PER FOOT OR REC/(RQD),%	STRATUM DESCRIPTION	LAYER ELEV./ DEPTH	WATER CONTENT, %	LIQUID LIMIT, %	PLASTIC LIMIT, %	PLASTICITY INDEX(PI),%	PASSING NO. 200 SIEVE,%	UNIT DRY WEIGHT, PCF	COMPRESSIVE STRENGTH TSF
				1.5" Asphalt over 4" Base								
				CLAY (CL), dark brown, lean, very stiff	0.2							
					0.5	19	37	16	21			3.5 (P)
			19	-tan, silty, with many gravel, 2' to 4'								
										76		
5			30	-gray, 4.5' to 15'								
				-calcareous pockets, 4.5' to 6'								
				-hard, below 6'								
						11	37	16	21		131	4.1 (U)
												4.5+ (P)
												4.5+ (P)
10												
						12	31	20	11		129	3.7 (U)
15												
			ref/3"	-sandy, with gravel below 18'								
20						12						
			33	CLAY (CH), tan and gray, fat, very stiff	23.5							
25						29	85	24	61	99		
					25.0							
				Note: Water observed at 18.5' during drilling. After 1 hour water depth measured at 13.5'								

COMPLETION DEPTH: 25.0 ft

DATE: 12-20-94 PROJECT NO. 1002-2391

U=Unconfined P=Pocket Penetrometer
Q=Unconsolidated-Undrained Triaxial T=Torvane

LOG OF BORING NO. 2

SAHA PROPOSED MAINTENANCE FACILITY
SAN ANTONIO, TEXAS

TYPE: Flight Auger

LOCATION: See Plate 2

DEPTH, FT	SYMBOL	SAMPLES	BLOWS PER FOOT OR REC/(RQD),%	STRATUM DESCRIPTION	LAYER ELEV./ DEPTH	WATER CONTENT, %	LIQUID LIMIT, %	PLASTIC LIMIT, %	PLASTICITY INDEX(PI),%	PASSING NO. 200 SIEVE,%	UNIT DRY WEIGHT, PCF	COMPRESSIVE STRENGTH TSF
			75/9"	FILL, light brown, silty sand and gravelly sand, very dense, with construction debris (bricks, rebar, etc.)								
			41	-dense, 3' to 5'		15	NP	NP	NP			
5			8	-loose below 5'			NP	NP	NP			
			20	CLAY (CL), tan, lean, sandy, with calcareous pockets	7.0	20						
10												
			17	-light gray below 13.5'								
15												
			50/5"	CLAY (CH), gray, fat, very stiff to hard	18.5					99		
20												
			33									
25					25.0	28	87	22	65			

Notes:
1) No groundwater was observed.
2) 'NP' indicates non-plastic.

COMPLETION DEPTH: 25.0 ft

DATE: 12-20-94

PROJECT NO. 1002-2391

U=Unconfined P=Pocket Penetrometer
Q=Unconsolidated-Undrained Triaxial T=Torvane

Fugro ⊡ McClelland

PLATE 4

FUGRO

LOG OF BORING NO. 3

SAHA PROPOSED MAINTENANCE FACILITY
SAN ANTONIO, TEXAS

TYPE: Flight Auger

LOCATION: See Plate 2

DEPTH, FT	SYMBOL	SAMPLES	BLOWS PER FOOT OR REC/(RQD),%	STRATUM DESCRIPTION	LAYER ELEV./ DEPTH	WATER CONTENT, %	LIQUID LIMIT, %	PLASTIC LIMIT, %	PLASTICITY INDEX(PI),%	PASSING NO. 200 SIEVE,%	UNIT DRY WEIGHT, PCF	COMPRESSIVE STRENGTH TSF
			10	1.5" asphalt over 3" Base								
				COAL ASH and CLINKER, dark gray, coarse sand-sized particles, locally cemented	0.2 0.4							
			2									
5			15									
			ref/4"									
			50/5"	CLAYEY GRAVEL (GC), brown, very dense	8.5							
10												
			50/6"									
15						10						
			77									
20												
			57	CLAY (CL), gray, lean, hard	23.0							
25					25.0	12	26	13	13			
				Note: Groundwater encountered at approximately 3-ft depth.								

COMPLETION DEPTH: 25.0 ft

DATE: 11-28-94 PROJECT NO. 1002-2391

U=Unconfined P=Pocket Penetrometer
Q=Unconsolidated-Undrained Triaxial T=Torvane

TERMS AND SYMBOLS USED ON BORING LOGS FOR ROCK

ROCK TYPES


LIMESTONE


DOLOMITE


SANDSTONE


HIGHLY WEATHERED LIMESTONE


SHALE


CONGLOMERATE


DOLOMITIC LIMESTONE


CLAYSTONE


GRANITE

SAMPLER TYPES


Thin-walled Tube


Rock Core


Standard Penetration Test


Auger Sample


TRD Cone Penetration Test


Dry Core

HARDNESS

Friable	-Crumbles under hand pressure
Low Hardness	-Can be carved with a knife
Moderately Hard	-Can be scratched easily with a knife
Very Hard	-Cannot be scratched with a knife

SOLUTION & VOID CONDITIONS

Void	Interstice;a general term for pore space or other openings in rock.
Cavities	Small solutional concavities.
Vuggy	Containing small cavities, usually lined with a mineral of different composition from that of the surrounding rock.
Vesicular	Containing numerous small,unlined cavities, formed by expansion of gas bubbles or steam during solidification of the rock.
Porous	Containing pore, interstices, or other openings which may or may not interconnect.
Cavernous	Containing cavities or caverns, sometimes quite large. Most frequent in limestones and dolomites.

WEATHERING GRADES OF ROCKMASS[1]

TERM	DESCRIPTION
Slightly	Discoloration indicates weathering of rock material and discontinuity surfaces.
Moderately	Less than half of the rock material is decomposed or disintegrated to a soil.
Highly	More than half of the rock material is decomposed or disintegrated to a soil.
Completely	All rock material is decomposed and/or disintegrated to soil.The original mass structure is still largely intact.
Residual Soil	All rock material is converted to soil.The mass structure and material fabric are destroyed.

JOINT DESCRIPTION

SPACING	INCLINATION	SURFACES
Very Close <2"	Horizontal 0-5	Slickensided-Polished,grooved
Close 2"-12"	Shallow 5-35	Smooth-Planar
Medium Close 12"-3'	Moderate 35-65	Irregular-Undulating or granular
Wide >3'	Steeply 65-85	Rough-Jagged or pitted
	Vertical 85-90	

BEDDING THICKNESS[2]

Very Thick	>4'
Thick	2'-4'
Thin	2"-2'
Very Thin	1/2"-2"
Laminated	0.08"-1/2"
Thinly-Laminated	<0.08"

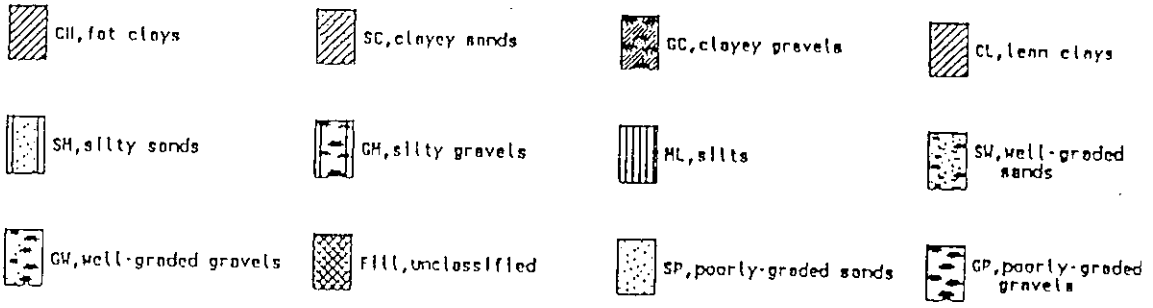
REFERENCES:
1)British Standard(1981) Code of Practice for Site Investigation,BS 5930.

2)The Bridge Div.,Tx.Highway Dept. Foundation Exploration & Design Manual 2nd Edition,revised June,1974.

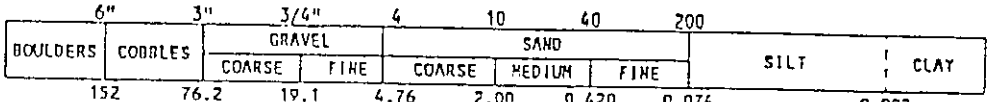
Information on each boring log is a compilation of subsurface conditions and soil and rock classifications obtained from the field as well as from laboratory testing of samples. Strata have been interpreted by commonly accepted procedures. The stratum lines on the logs may be transitional and approximate in nature. Water level measurements refer only to those observed at the times and places indicated, and may vary with time, geologic condition or construction activity.

TERMS AND SYMBOLS USED ON BORING LOGS FOR SOIL

SOIL TYPES



SOIL GRAIN SIZE
U.S. STANDARD SIEVE



SOIL GRAIN SIZE IN MILIMETERS

STRENGTH OF COHESIVE SOILS [2]

CONSISTENCY	UNDRAINED SHEAR STRENGTH Kips Per Sq. Ft.
Very Soft	Less Than 0.25
Soft	0.25 to 0.50
Firm	0.5 to 1.00
Stiff	1.00 to 2.00
Very Stiff	2.00 to 4.00
Hard	greater than 4.00

DENSITY OF GRANULAR SOILS [2]

NUMBER OF BLOWS PER FT., N	RELATIVE DENSITY
0-4	Very Loose
4-10	Loose
10-30	Medium
30-50	Dense
Over 50	Very Dense

STRUCTURE [1]

DESCRIPTION	CRITERIA
Stratified	Alternating layers of varying material or color with layers at least 6 mm thick.
Laminated	Alternating layers of varying material or color with the layers less than 6 mm thick.
Fissured	Breaks along definite planes of fracture with little resistance to fracturing.
Slickensided	Fracture planes appear polished or glossy, sometimes striated.
Blocky	Cohesive soil that can be broken down into small angular lumps which resist further breakdown.
Lensed	Inclusions of small pockets of different soils.

MOISTURE

Dry	-No water evident in sample; fines less than plastic limit.
Moist	-Sample feels damp; fines near the plastic limit
Very Moist	-Water visible on sample; fines greater than plastic limit and less than liquid limit
Wet	-Sample bears free water ; fines greater than liquid limit.

INCLUSIONS [1]

Parting	-Inclusion <1/8" thick extending through sample
Seam	-Inclusion 1/8" to 3" thick extending through sample.
Layer	-Inclusion >3" thick extending through sample.
Trace	-<5% of sample.
Few	-5% to 10% of sample.
Little	-10 to 25% of sample.
Some	-30% to 45% of sample.

REFERENCES:

1) ASTM D 2488

2) Peck, Hanson, and Thornburn, (1974), Foundation Engineering.

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