GEOMATRIX

GEOTECHNICAL STUDY

MARKET PLACE TOWERS

Emeryville, California

Prepared for

THE MARTIN COMPANY
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GEOMATRIX

January 25, 1988
Project No. 1232B

The Martin Company
6425 Christie Avenue, Suite 406
Emeryville, California 94608

Attention: Mr. Walt Kaczmarek

Gentlemen:

We are pleased to submit the results of our geotechnical study for the Market Place Towers in Emeryville, California. The study included reviewing past geotechnical records, drilling supplemental exploratory borings, testing selected soil samples, and developing foundation support recommendations for the proposed eight-story building.

The accompanying report contains the results of the field exploration and laboratory testing programs, along with our recommendations and design criteria regarding foundation support, earthwork construction, and foundation installation for the proposed structure. Information obtained during the installation of pile foundations at the nearby Bay Center Office and Apartment complexes, as well as information obtained from the geotechnical study for seismically upgrading the existing five-story building, were used in developing foundation recommendations for the Market Place Towers.

A summary of the foundation recommendations and design criteria given in this report was transmitted to Mr. Andy Merovich, with DASSE Design, on December 16, 1987. A draft of this report was submitted to Mr. Merovich and Mr. Alan McKay (Alan R. McKay & Associates), and Jack Johannes (Brocchini Architects, Inc.) on December 28, 1987. Their comments have been taken into consideration during preparation of this final report.

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We appreciate the opportunity to work with you and your design team on this project. Please contact us if questions regarding this report arise of if we can be of further assistance.

Sincerely yours,
GEOMATRIX CONSULTANTS, INC.

Carl Basore

Carl Basore
Principal Engineer

CB/GLR/mb
Enclosures

cc: Alan R. McKay & Associates
Attention: Mr. Alan McKay

DASSE Design
Attention: Mr. Andy Merovich

Brocchini Architects, Inc.
Attention: Mr. Jack Johannes

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Emeryville, California

INTRODUCTION

This report presents the results of the geotechnical study undertaken for the proposed Market Place Towers in Emeryville, California. The project site is located between Powell and 64th Streets just east of Christie Avenue. The general location of the Market Place Towers development is shown on the Site and Boring Location Plan, Figure 1.

The purpose of this geotechnical study was to explore subsurface conditions and develop foundation recommendations and design criteria for the proposed Market Place Towers. Specifically, the scope of study included:

- drilling and sampling two borings to explore subsurface conditions;
- testing selected samples in the laboratory to assess the engineering properties of the underlying soils;
- describing subsurface conditions encountered in the exploratory borings and the results of laboratory tests;
- developing recommendations for the vertical and lateral load resistance of driven pile foundations;
- estimating the total and differential building settlements;
- preparing recommendations for supporting the concrete floor slab;
- providing a range of characteristic site period values for the soils at the site; and
- discussing pile installation considerations, including the minimum distance from the existing building, treatment of existing piles, and mitigation of vibrations in adjacent buildings during pile driving operations.

PROJECT DESCRIPTION

It is planned to remove the existing five-story-concrete building and replace it with a larger eight-story-steel-frame building. The new building will measure approximately 80 feet by 200 feet in plan dimensions and will be constructed adjacent to an existing one-story-concrete building. The ground-level floor slab will be constructed at essentially the same elevation as the existing floor slab. The general arrangement of the existing and new buildings is shown on the Site and Boring Location Plan, Figure 1.

Column spacing in the proposed Market Place Towers building will range between approximately 15 feet and 39 feet. Interior column loads will range between 850 kips and 1000 kips for both dead and live loads. Perimeter column loads will range between 200 kips and 650 kips for both dead and live loads.

FIELD EXPLORATION AND LABORATORY TESTING

A total of five exploratory borings were drilled at the site at the approximate locations shown on the Site and Boring Location Plan, Figure 1. Borings 1, 2, and 3 were drilled for the previous study in February 1987 to develop foundation recommendations for seismic strengthening of the existing five-story building. Borings 1 and 2 were drilled to a depth of 70 feet to provide data for the design of deep foundations for the proposed lateral load bracing system. Boring 3 was drilled to a depth of 21 feet to provide a general assessment of shallow soil conditions away from the five-story building area. Borings 4 and 5 were drilled for this study on November 24, 25, and 30, 1987. Borings 4 and 5 were drilled to 91-1/2 feet to provide information for design of pile foundations. All the borings were drilled using rotary wash techniques.

Soil samples were obtained from the exploratory borings to aid in identifying the underlying soils and for laboratory testing. A log of each boring was made in the field by examining the drill cuttings and soil samples. Final boring logs were prepared based on the field logs, soil sample examination in the laboratory, and laboratory test results. The Logs of Borings are presented on Figures A-1 through A-6 (Borings 4 and 5) and B-1 through B-5 (Borings 1, 2, and 3).

Soil samples obtained from selected depths were tested in the laboratory to evaluate the unconfined compressive strength, moisture content, and dry density of the site soils. Results of these tests are shown at the corresponding sample locations on the Logs of Borings, Figures A-1 through A-6 and B-1 through B-6. More detailed descriptions of the field exploration and laboratory testing programs for this study and the previous study are given in Appendix A and Appendix B, respectively.

SITE AND SUBSURFACE CONDITIONS

The two existing buildings that comprise the Market Place development are located on a relatively level site and are surrounded by concrete walkways and paved parking and roadway areas. A depressed truck loading dock is located near the northeast corner of the new building site. The existing five-story-concrete building will be removed for the proposed Market Place Towers building. The adjacent one-story-concrete building and nearby one and two-story-brick building will be remodeled. All the existing buildings are pile supported. Originally, the buildings were part of a manufacturing plant that covered the entire property. All the other plant buildings were removed during the late 1960's and early 1970's. The site was graded and paved to its present configuration in about 1975.

The site was reclaimed from the bay by placing fill on and near the shallow tidal flat that extended along the shoreline. The filling process was done in the early 1900's and most of the site was filled by 1925. The site slopes gently downward toward the west. The surface elevation ranges from 13 feet near the east side of the property to eight feet near the west side of the property.

The upper 15 feet of soil encountered in the borings consisted of mixed clay and sand fill containing rock fragments, wood, concrete, and other debris underlain by bay sediments. Strata of stiff to very stiff silty and sandy clay, with occasional thin layers of gravelly material were encountered below a depth of 15 feet and extend to the depth of the borings (70 or 91-1/2 feet).

Groundwater was encountered at depths of 5 and 5-1/2 feet in Borings 4 and 5 which were drilled in November, 1987. Groundwater was not encountered in the other borings because rotary drilling techniques were used to advance the full depth of these borings.

More detailed descriptions of the subsurface conditions encountered at the site are presented on the Logs of Borings, Figures A-1 through A-6 (Borings 4 and 5) and Figures B-1 through B-5 (Borings 1, 2, and 3).

DISCUSSION

General

The upper 15 feet of heterogeneous fill and soft bay sediments encountered at the site are considered too weak and compressible to support the proposed eight-story building on shallow foundations without detrimental settlement. It is recommended, therefore, that the building be supported on deep foundations extending through the upper fill and soft bay sediments and deriving support in the underlying stiff silty and sandy clays. In view of the high groundwater level and weak fill material it will be more difficult to install drilled pier foundations than driven pile foundations. The main concern with pile foundations is the potential for developing vibrations during pile driving operations that might damage the adjacent buildings. Since the existing buildings are pile supported, it is our opinion that the probability of building damage resulting from pile induced vibrations is low. Therefore, driven piles are considered to be the most appropriate type of deep foundation for use at this site and are recommended for the Market Place Towers building.

Settlement

Maintaining existing grade at the site is beneficial because raising the grade by placing fill will result in nonuniform settlement, both in terms of magnitude and rate. The estimated range of settlement for different thicknesses of new fill placed to raise existing grade is given below for planning purposes.

Thickness of New Fill (feet)	Estimated Range of Settlement (inches)
0	0 - 1
2	1 - 2

We estimate that 95 percent of the above settlement values will occur within 10 years to 15 years after fill placement.

It is anticipated that the existing depressed truck loading dock will be filled in to an elevation consistent with the overall building site grade. This filling will also result in nonuniform settlement. The estimated range in settlement resulting from filling the depressed truck loading dock is expected to be an additional one inch to three inches. Higher settlement will occur at the center of the dock; lower settlement will occur at the corners of the dock.

Some differential settlement could occur between the ground-level floor slab and the pile supported columns and walls of the building if the floor slab is supported on grade. The magnitude of settlement is dependent on the thickness of new fill required to bring the building pad to grade and the sustained live loads supported by the slab. If finished grade is essentially at existing grade, as presently planned, then differential settlement of slab-on-grade floors could amount to 1/2-inch over a distance of 15 to 20 feet. If the depressed truck loading dock is backfilled to existing grade, then differential settlement of the slab-on-grade floor in that area could amount to one inch to three inches over a distance of approximately 30 feet.

Differential settlement of the ground level floor can be essentially eliminated by supporting the concrete floor slab on pile foundations. A structurally supported slab is recommended at the northeast corner of the building where increased settlements are expected due to backfilling the depressed loading dock. If finish grade is maintained at essentially existing grade, the floor slab for the remaining portion of the building may be supported on grade, providing some unevenness of the slab is acceptable. Otherwise, the entire floor slab should be supported on pile foundations.

Settlement of the Market Place Towers building, if supported on driven pile foundations, is expected to be nominal. Specifically, total and differential building settlements are not expected to exceed 1/2 inch.

RECOMMENDATIONS

Foundations

Based on the anticipated building loads and subsurface conditions encountered in the borings, it is our opinion that 12-inch-square, prestressed-concrete piles are appropriate piles for this project. Accordingly, the design criteria presented in this report are for 12-inch-square, prestressed-concrete piles. It is recommended that piles in groups be spaced at least four feet apart, measured from the centers of adjacent piles. A minimum group of two piles should be used to support individual column loads. In addition, piles subject to transient uplift loads should be adequately tied into the pile cap using either the pile prestressing strands or reinforcing steel dowels. Specific foundation recommendations and design criteria are given in the following sections of this report.

Load Resistance

Vertical Load Resistance - It is recommended that vertical load capacity of foundation piles be based on the pile capacity design curves shown on Figure 2. The solid curve is for combined dead and live structural loads. The pile capacity can be increased 33 percent to resist downward transient (wind or seismic) loads. The dashed curve is for transient wind or seismic uplift loads.

The pile design curve for compression loads is based on developing skin frictional resistance below a depth of 15 feet from existing grade. The depth shown on the pile capacity graph is measured from the existing grade. In determining the required pile lengths, the depth of the pile cap can be deducted from the lengths shown. The resistance of the upper 15 feet of mixed fill and bay sediments is taken into account in developing the design curve for uplift loads.

If finished grade is raised two or more feet above existing grade, sufficient settlement is expected to occur to impose downdrag loads on the foundations piles. Within 10 feet of areas where fill is placed to raise existing grade, it is recommended that the following downdrag loads be added to the structural loads to be resisted by each pile:

Thickness of New Fill (feet)	Design Downdrag Load (kips)
0	0
2	10
4	12

Lateral Load Resistance - Resistance to seismically or wind induced transient lateral loads can be developed by passive earth pressure acting against the sides of pile caps and grade beams. For design purposes, a passive earth pressure equal to a fluid weighing 400 pounds per cubic foot is recommended for use against the face of pile caps or grade beams which are in direct contact with the soil. Lateral load resistance can also be developed by adhesion between the soil and the sides of the grade beams oriented in the direction of the load. A uniform adhesion value of 400 pounds per square foot acting on the sides of the grade beams can be used to resist lateral loads. Adhesion along the bottom of pile-supported grade beams should be neglected, since any settlement of the fill would reduce or eliminate soil adhesion on the bottom of the grade beams. If additional lateral resistance is required, the lateral load capacity of the foundation piles is commonly taken into account.

The lateral load capacity of 12-inch-square, prestressed-concrete piles was evaluated using a computer program that takes the nonlinear behavior of soil into account. The lateral load resistance of piles increases with increasing deflection of the pile. For purposes of this analysis, the lateral load causing a 1/2 inch deflection of the pile head for both the free head and fixed head condition was computed. Increased lateral resistance can be developed if greater pile deflection is allowed. However, 1/2 inch seems reasonable for short-term loading associated with wind or seismic forces. Results of the analysis are as follows:

Pile Head Condition	Lateral Load (kips)	Maximum Bending Moment (inch-kips)
Free	11	400
Fixed	21	1,000

The above lateral load capacity values are for a single pile. Because of interaction between adjacent piles, the capacity of pile groups to resist lateral loads is less than the sum of the capacity of individual piles. Accordingly, the lateral resistance of piles in groups should be reduced, depending on the spacing between adjacent piles. Reduction factors for lateral resistance of piles in groups are given below:

Spacing Between Piles (feet)	Reduction Factor on Single Pile Capacity (percent)
4	60
6	80
8	100

No! Percentage of Single Pile Capacity.

Indicator Piles

In order to evaluate variations in pile lengths across the structure and to assess the pile driving criteria, it is recommended that at least 15 indicator piles be driven at the site prior to casting piles for production pile driving. The pile locations should be selected to provide good coverage across the building site. The indicator piles should be cast at least five feet longer than design length to allow the piles to be driven deeper into the bearing soils, if necessary.

It is recommended that a limited program of dynamic pile monitoring also be undertaken during installation of the indicator piles to provide information regarding pile capacity. A full program of dynamic pile monitoring was undertaken at the nearby Bay Center Office complex. Information from that monitoring program has been used in developing recommendations for the Market Place Towers site. In order to assess pile capacity, it is recommended that the indicator piles be monitored during a brief restriking of the piles at least one week after they are driven.

Dynamic pile monitoring consists of measuring force and acceleration near the top of the pile during driving and analyzing the data with a pile analyzer. By analyzing piles during the indicator pile program, an assessment of pile capacity and pile lengths can be obtained. Appropriate pile driving criteria can also be obtained from the pile measurements. A specific program of dynamic pile monitoring can be developed as part of the indicator pile program.

Concrete Floor Slab

Concrete floor slabs may be supported on grade or on pile foundations depending on the acceptable level of performance. Some differential settlement is expected to occur between the first-level floor slab and the pile-supported columns and walls of the building if the floor slab is supported on grade. The magnitude of the floor settlement is dependent on the thickness of new fill required to bring the building pad to grade and the loads imposed on the floor slab over its lifetime. If finished grade is essentially at or below existing grade, settlement of slab-on-grade floors could amount to 1/2 inch. In this case, if some unevenness and minor cracking of the floor is acceptable then the first-level floor slab could be supported on grade. However, backfilling the existing truck loading dock at the northeast corner of the building will result in increased settlement, unevenness, and cracking of the floor slab. It is therefore recommended that the concrete floor slab within 10 feet of the existing truck loading dock be supported on pile foundations.

If a concrete slab-on-grade floor is chosen, it should be supported on at least two feet of compacted select fill. For protection against moisture migration from the soil into the building, it is recommended that the slab be underlain by a minimum of four inches of open-graded gravel to act as a capillary moisture break. A moisture-proof membrane should then be installed over the gravel and covered with approximately two inches of sand to protect the membrane during construction. The sand should be moistened immediately prior to placing the concrete. The sand and gravel layers constitute the upper six inches of select fill beneath the concrete slab-on-grade floor.

The open-graded gravel should be clean crushed rock meeting the following grading requirements:

Sieve Size	Percent Passing Sieves
1 inch	100
3/4 inch	90 - 100
No. 4	0 - 10

If some unevenness and cracking of the floor slab is unacceptable or if the finished grade is more than six inches higher than the existing grade, then it is recommended that the entire first-level floor slab be supported on pile foundations. A structural pile-supported floor slab will be a reasonably good barrier against moisture migration from the soil into the building. If additional protection against dampness of the floor slab is desired, then the capillary moisture break and vapor barrier recommendations given previously for a concrete slab-on-grade floor should be followed.

Site Period

The characteristic site period for the building site has been calculated for use in defining the minimum earthquake force as specified in the building code. The site period value is dependent on the depth to bedrock or "rock like" material and the shear moduli of the soil layers comprising the soil profile at the site.

Based on a review of geologic maps and reports it is estimated that the depth to bedrock at the site is between 200 feet and 300 feet. The soil profile used in the analysis consisted of 15 feet of medium stiff clay underlain by stiff to very stiff clay to the depth of the borings (91 feet). It was assumed that very stiff clay extends below a depth of 91 feet to the bedrock surface.

In order to account for uncertainties in the depth to bedrock and the shear moduli of the soil layers comprising the site profile, these parameters were varied to arrive at a range of site period values representative of conditions anticipated at the site. Based on this parametric study, it is estimated that the characteristic site period, Ts, at the building site is between 1.1 seconds and 1.6 seconds.

Earthwork

After the existing building has been removed, the new building site should be cleared of concrete foundations, walls, and slabs. The concrete debris should be hauled from the site and not used as fill onsite.

After the site has been cleared, the building pad should be brought to grade by excavating or filling. If it is decided to support a portion of the concrete floor slab on grade, the building site should be subexcavated to allow placement of two feet of compacted select fill.

Prior to placing fill, the exposed soil should be compacted to the requirements given herein for fill. Fill should be placed in uniform lifts not exceeding eight inches in uncompacted thickness and compacted to a minimum of 90 percent compaction as determined by ASTM Designation D1557. Before compaction begins, the fill should be brought to a water content that will permit proper compaction by either: (1) aerating the material if it is too wet, or (2) spraying it with water if it is too dry. Each lift should be thoroughly mixed to insure a uniform distribution of water content.

The miscellaneous fill obtained from onsite excavations may be used as fill, except where select fill is required, provided the material is a clean soil or soil-rock mixture free of debris, deleterious materials, and rock larger than six inches in largest dimension. All imported fill should be a select, non-expansive material. The material should be a soil or soil-rock mixture free of organic matter or other deleterious material. It should not contain rocks or lumps over six inches in largest dimension, and no more than 15 percent of the material should be larger than 2-1/2 inches in size. In addition, the material should meet the following quality requirements:

Maximum Plasticity Index	15
Maximum percent passing the No. 200 sieve	50

Construction Considerations

Minimum Pile Distance From Existing Building - The minimum distance which piles can be driven adjacent to the existing building is controlled by the physical limitations of the pile driving equipment. Conversations with a pile driving contractor indicate that piles can be driven within 30 inches of the adjacent building wall measured to the center of the pile.

Treatment of Existing Piles - The existing building is supported on pile foundations. However, the locations and the type of piles used are not known. They are most likely timber piles but could be cast-in-place concrete piles.

The lack of information regarding foundations for the existing building could result in some of the existing piles interfering with the new piles. There are two approaches to resolving such a conflict. One approach is to leave the existing piles in place and design the new piles to avoid the existing piles. If new piles are driven adjacent to old piles then some reduction in new pile capacity is expected. The following reduction factors are recommended:

Clear Distance Between New and Existing Piles (feet)	Capacity Reduction Factor (percent)
2.0 or more	100
1.9 - 1.0	85
< 1.0	60

The decreased capacity may be compensated for by driving the piles deeper.

The second approach is to pull existing piles that conflict with new pile locations. This approach is applicable for timber piles, but not for concrete piles. After the timber pile is pulled, the resulting opening should be backfilled with gravel unless the center of the new pile is within two inches of the center of the existing pile. If new piles are driven within two feet of the pulled-existing pile then the capacity-reduction factors mentioned previously should be used.

It is recommended that the existing piles be cut off at or near groundwater level (approximately five feet in depth) and the resulting excavation backfilled with compacted fill as described under the Earthwork section. Timber piles will probably not be exposed above the groundwater level.

Pile Installation - The fill that overlies the site contains some construction debris. As a result, it is recommended that each pile location be predrilled through the fill and bay sediments, approximately 15 feet, to reduce the chance of breakage or misalignment of the piles. The predrill auger should be 12 inches in diameter.

The pile contractor should select a hammer that is capable of driving the piles to their design tip elevations without overstressing the concrete in either compression or tension. It is recommended that the piles be driven with a hammer having a rated energy of at least 50,000 foot-pounds.

Preliminary pile driving criteria, consisting of minimum and refusal blow counts, have been developed for two different hammer energies. The criteria are intended to be used as a guide for driving the indicator piles. The driving criteria should be reviewed and modified as necessary after the indicator pile and dynamic pile monitoring programs have been completed and before production pile driving starts.

Rated Hammer Energy (foot-pounds)	Pile Capacity (tons)	Minimum Blow Count (blows/foot)	Refusal Blow Count (blows/foot)
50,000	50	10	60
	100	15	90
70,000	50	7	40
	100	10	60

The general driving criteria for installation of piles are as follows:

- o Drive piles to their design tip elevation.
- o If driving resistance is below the minimum blow count, continue driving the pile until the minimum blow count criteria is met.
- o If hard driving resistance is encountered above the design tip elevation, driving can stop provided the pile tip is within five feet of design tip elevation and the driving resistance meets the refusal blow count criteria.

Vibrations - Pile driving operations may cause vibrations in the adjacent buildings. Because of its proximity to the new building, the adjacent one story concrete building is expected to experience larger vibrations than the one and two story brick buildings located west of the new building site. However, in view of the type of construction, generally good physical condition, and pile foundation support, the adjacent concrete building is expected to be strong enough to resist the higher vibrations. The nearby brick buildings are believed to be far enough away from the new construction so as not to experience detrimental vibrations from the pile driving operations.

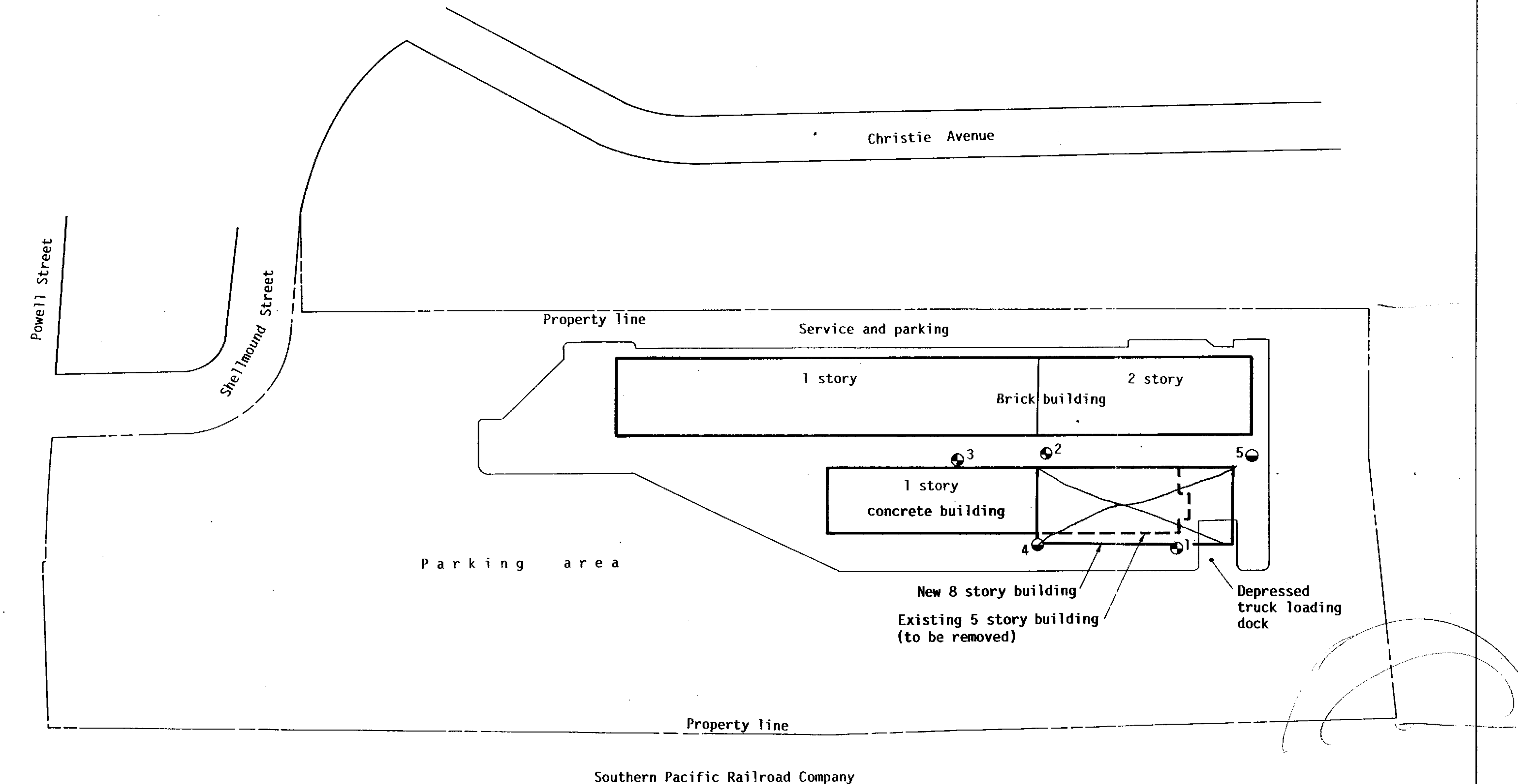
It is recommended that the adjacent buildings be observed during indicator pile program for signs of vibration damage. If severe vibrations are experienced they should be measured and compared with the threshold velocity values given below. If the measured velocities are higher than the threshold values or the buildings show signs of distress, then the pile driving operations should be modified so as to reduce the velocity to an acceptable level. This modification may result in deeper predrilling or change in pile driving hammer. The following allowable peak velocities are recommended for the two buildings.

Building Designation	Peak Velocity (feet/second)
Brick Building	1
Concrete Building	2

BASIS FOR RECOMMENDATIONS

The recommendations made in this report are based on the assumption that the soil conditions do not deviate appreciably from those disclosed in the exploratory borings. If any variations or undesirable conditions are encountered during construction, the effects of these conditions on the recommendations presented herein should be evaluated and, if necessary, supplemental recommendations developed. The recommendations are also made for the specific project described in this report. Significant changes in the location, type of structure, or loading conditions should be evaluated as to their effects on the recommendations.

It is recommended that we review the foundation and grading plans and specifications to determine that the intent of the recommendations presented herein have been properly interpreted and incorporated into the contract documents. In addition, a representative of our firm should observe the pile driving operations and site grading work to verify that the subsurface conditions used as a basis for the recommendations are encountered throughout the site.



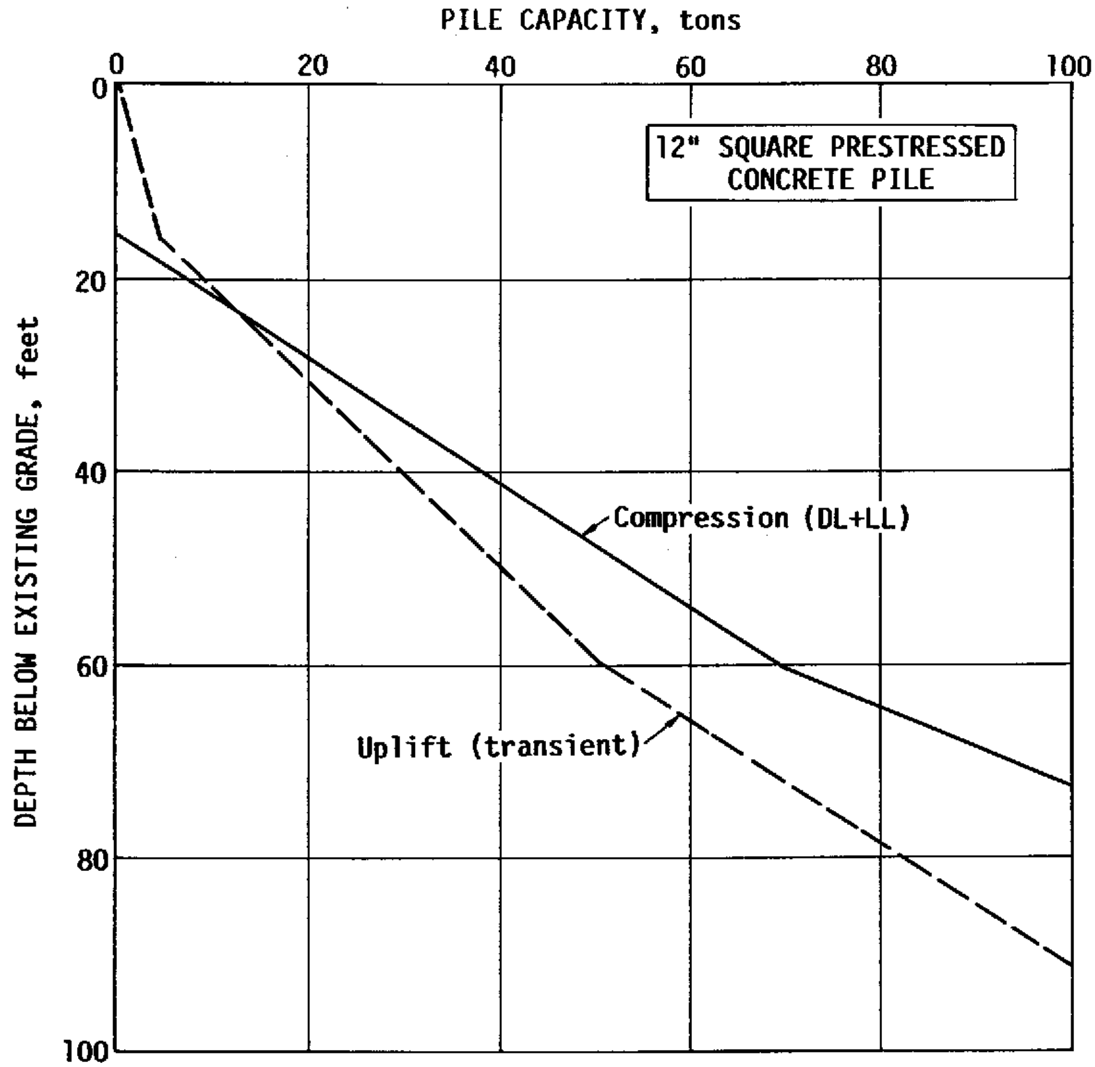
EXPLANATION

1 ◐ Soil borings for previous study

4 ◒ Soil borings for this study

SITE AND BORING LOCATION PLAN
Market Place Towers
Emeryville, California

GEOMATRIX	Project No. 1232B	Figure 1



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PILE CAPACITY DESIGN CURVES
Market Place Towers
Emeryville, California

Figure
2

Project No.
1232B

APPENDIX A

FIELD EXPLORATION AND LABORATORY TESTING FOR THIS STUDY

FIELD EXPLORATION

Exploratory Borings 4 and 5 were drilled for this study at the locations shown on the Site and Boring Location Plan, Figure 1. The borings were drilled on November 24, 25, and 30, 1987. The borings were drilled with a Failing drill rig operated by MDS Diversified Services of Oakland, California. The borings were advanced to a depth of approximately 10 feet using six-inch-diameter flight augers and then to the final depth of 91-1/2 feet using four-inch-diameter, rotary-wash, drilling equipment. Mr. McDanial Smith of MDS Diversified Services performed the drilling and sampling. Messrs Greg Raines and P.C. Sien of our firm observed the drilling and sampling operations and logged the borings in the field.

While drilling Boring 4, an unidentified black oily product was encountered between five and 10 feet in depth. This boring was subsequently finished and backfilled with grout. All cuttings and drilling fluid were retained on site, transferred to sealed 55 gallon drums, and moved to the rear of the existing five-story-concrete building. Boring 5 did not encounter any unidentified products and was therefore backfilled with soil cuttings. Concrete patches were placed over the top of both borings.

Samples of the soils encountered in the borings were obtained using a Modified California drive sampler (2-inch-inside diameter, 2-1/2-inch-outside diameter) lined with thin brass tubes. The sampler was driven into the soil at the bottom of the boring with a 140-pound hammer falling 30 inches. Typically, the sampler was driven 18 inches into the soil and the blow count recorded for each six inches of penetration. The blow count recorded on the Logs of Borings is for the final 12 inches of penetration or as otherwise noted. When the sampler was withdrawn from the boring, the tubes containing the soil samples were withdrawn and carefully sealed to preserve the natural moisture content of the soil. The samples were then delivered to the laboratory for examination and testing.

Soils were classified according to the Unified Soil Classification System. Preliminary visual soil classifications were made in the field and verified by reexamination of the soil samples in the laboratory and by test results.

The approximate ground surface elevation at each boring location was obtained from a topographic survey map of the site prepared by Cullen Engineering Associates, Inc. and dated November 23, 1987. The approximate water level depth was obtained at the time of drilling, when encountered, while using the flight-auger drilling equipment.

Logs of Borings 4 and 5 were prepared from the field and laboratory data and are presented in Figures A-1 through A-6.

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LABORATORY TESTING

The water content, dry density, and unconfined compressive strength were determined for selected samples to evaluate the strength and density of the underlying soils. The results of these tests are shown at the corresponding sample locations on the Logs of Borings, Figures A-1 through A-6 (Borings 4 and 5).

PROJECT: Market Place Towers, Emeryville, California	Log of Boring No. 4

BORING LOCATION: See Site and Boring Location Plan, Figure 1

DATE STARTED: November 24, 1987 | DATE FINISHED: November 25, 1987 | NOTES:

DRILLING METHOD: Rotary Wash

HAMMER WEIGHT: 140 pounds | DROP: 30 inches

SAMPLER: 2-inch Modified California

DEPTH (feet)	Sample No.	Blows/Foot	MATERIAL DESCRIPTION (SURFACE ELEVATION: 10 ft +/-)	Moisture Content (%)	Dry Density (pcf)	Unconf. Compr. Strength (psf)
0			CONCRETE SLAB			
			SILTY SAND FILL Loose, brown, medium grained, with coarse grained gravel } With brick fragments			
5	1	6	SILTY CLAY FILL Soft, dark gray, with rock fragments, petroleum and tar product	33	82	410
10	2	20	SILTY SAND (SP-SM) Brown, medium grained	24	102	6780
			SILTY CLAY (CL) Very stiff, brown mottled with gray			
15	3	19	Becoming stiff	28	94	3270
20	4	22		29	95	2880
			SANDY CLAY (CL) Stiff, gray-brown, fine grained sand } With gravelly clay lense			
25			SILTY CLAY (CL) Stiff, gray-brown mottled with red			

Project No.: 1232B | **Geomatrix Consultants** | Figure A-1

PROJECT:	Market Place Towers Emeryville, California	Log of Boring No. 4

DEPTH (feet)	SAMPLES: Sample No.	SAMPLES: Sample	SAMPLES: Blows/Foot	MATERIAL DESCRIPTION	LABORATORY TESTS: Moisture Content (%)	LABORATORY TESTS: Dry Density (pcf)	LABORATORY TESTS: Unconf. Compr. Strength (psf)
	5		19	SANDY CLAY (CL) Stiff, gray mottled with orange, fine to medium grained sand	24	100	3540
35				GRAVEL (GP) Dark gray, fine grained			
				SILTY CLAY (CL) Gray and green			
40				SANDY CLAY (CL) Stiff, gray-brown, coarse grained sand, with fine grained gravel			
	6		26		19	109	2600
				} With gravel lense			
45							
50				CLAYEY GRAVEL (GC) Dense, orange-brown, coarse grained			
	7		40		20	106	3720
				SANDY CLAY (CL) Stiff, orange mottled with light brown, medium grained sand			
55				SILTY CLAY (CL) Stiff, orange			
60				Becoming sandy			
	8		25		17	115	2750
				SANDY CLAY (CL) Stiff, gray, fine grained sand			

PROJECT: Market Place Towers, Emeryville, California

Log of Boring No. 4

DEPTH (feet)	Sample No.	Sample	Blows/Foot	MATERIAL DESCRIPTION	Moisture Content (%)	Dry Density (pcf)	Unconf. Compr. Strength (psf)
65				SANDY CLAY (CL) Stiff, orange, medium to coarse grained sand			
				SILTY CLAY (CL) Very stiff, gray			
70	9		41	GRAVELLY CLAY (CL) Very stiff, gray mottled with orange and dark brown, fine grained gravel } With clayey gravel lense	23	100	5890
75							
				SILTY CLAY (CL) Very stiff, orange mottled gray			
80	10		38		20	108	4270
				SANDY CLAY (CL) Very stiff, gray mottled with orange, with fine grained gravel			
85				SILTY CLAY (CL) Very stiff, light brown			
90	11		62	GRAVELLY CLAY (CL) Very stiff, orange, fine grained gravel	17	112	5130
				Bottom of boring at 91.5 feet			
95							

PROJECT: Market Place Towers, Emeryville, California

Log of Boring No. 5

BORING LOCATION: See Site and Boring Location Plan, Figure 1

DATE STARTED: November 25, 1987 | DATE FINISHED: November 30, 1987 | NOTES:

DRILLING METHOD: Rotary Wash

HAMMER WEIGHT: 140 pounds | DROP: 30 inches

SAMPLER: 2-inch Modified California

SURFACE ELEVATION: 10 ft +/-

DEPTH (feet)	Sample No.	Blows/Foot	MATERIAL DESCRIPTION	Moisture Content (%)	Dry Density (pcf)	Unconf. Compr. Strength (psf)
			CONCRETE SLAB			
			SANDY CLAY FILL Soft, brown, medium grained sand			
			SILTY CLAY FILL Medium stiff, gray-brown			
5	1	58	SANDY CLAY FILL Soft, black and green, medium grained sand, with gravel, concrete, brick, wood, and shell fragments	22	105	
10	2	4	SANDY CLAY (CL) Soft to medium stiff, dark gray, laminated, fine grained sand } With fine grained gravel	35	86	490
15	3	15	SANDY CLAY (CL) Stiff, light brown, fine grained sand, with occasional gravel Becoming gray with iron stains	24	101	
			SAND AND GRAVEL (SP/GP) Gray, coarse grained sand to fine grained gravel			
20	4	29	SANDY CLAY (CL) Very stiff, gray-brown, medium grained sand, with occasional gravel	18	108	
25			GRAVEL (GP) Gray, fine grained			
			SILTY CLAY (CL) Stiff, brown			
			GRAVEL (GP) Gray, fine grained			

Project No.: 1232B

Geomatrix Consultants

Figure A-4

PROJECT: Market Place Towers, Emeryville, California	Log of Boring No. 5

DEPTH (feet)	SAMPLES: Sample No.	SAMPLES: Sample	SAMPLES: Blows/Foot	MATERIAL DESCRIPTION	LABORATORY TESTS: Moisture Content (%)	LABORATORY TESTS: Dry Density (pcf)	LABORATORY TESTS: Unconf. Compr. Strength (psf)
	5		20	SILTY CLAY (CL) Stiff to very stiff, gray with iron oxide stains and calcite inclusions	26	98	4170
35							
40	6		35	} With gravel	22	104	5750
45							
				SANDY CLAY (CL) Stiff, orange-brown, with coarse grained gravel			
50	7		34		26	97	3150
				Becoming less gravelly			
55				SANDY CLAY (CL) Very stiff, blue-gray mottled with light brown, coarse grained sand Becoming light brown and very sandy			
60	8		57	SANDY CLAY (CL) Very stiff, orange-brown, fine grained sand, with occasional gravel	21	104	2750

Project No.: 1232B

Geomatrix Consultants

Figure A-5

PROJECT:	Market Place Towers Emeryville, California	Log of Boring No. 5

DEPTH (feet)	Sample No.	Blows/Foot	MATERIAL DESCRIPTION	Moisture Content (%)	Dry Density (pcf)	Unconf. Compr. Strength (psf)
65			SANDY CLAY (CL) Very stiff, orange-brown, fine grained sand, with occasional gravel			
			GRAVEL AND SAND (GP/SP)			
70	9	56	SANDY CLAY (CL) Very stiff, light brown mottled with orange, medium grained sand, with gravel	17	113	
			Becoming more gravelly			
75						
80	10	36	SILTY CLAY (CL) Very stiff, light brown mottled with dark brown	21	107	9940
85			Becoming orange-brown			
90	11	32		22	105	7170
			Bottom of boring at 91.5 feet			
95						

Project No.: 1232B	Geomatrix Consultants	Figure A-6

GEOMATRIX

APPENDIX B

FIELD EXPLORATION AND LABORATORY TESTING FOR PREVIOUS STUDY

FIELD EXPLORATION

Exploratory Borings 1 through 3 were drilled for a previous geotechnical study at The Market Place and were presented in our report dated April 3, 1987. The borings were drilled at the approximate locations shown on the Site and Boring Location Plan, Figure 1 on February 18 and 19, 1987 by Pitcher Drilling Company of Palo Alto, California using rotary-wash, drilling equipment. Mr. Juan Hernandez of our firm observed the drilling and sampling operations and logged the borings.

Samples of the soils encountered in the borings were obtained using a Modified California, drive sampler (2-inches-inside diameter and 2-1/2-inches-outside diameter) with thin brass liners. The sampler was driven 18 inches into the soil at the bottom of the hole by a 140-pound hammer falling 30 inches. The brass liners containing the samples were removed from the sampler, sealed to preserve the natural moisture content of the soil, and brought to the laboratory for examination and testing.

Soils were classified in accordance with the Unified Soil Classification System. Preliminary visual soil classifications were made in the field and verified by further examination of the samples in the laboratory. Logs of Borings 1, 2, and 3 were prepared from field and laboratory data and are presented on Figures B-1 through B-5.

LABORATORY TEST

Water content, dry density, and unconfined compressive strength were determined for selected samples to evaluate the strength and density of the soils encountered at the site. The results of these tests, along with the resistance to penetration of the sampler, are shown at the corresponding sample locations on the Logs of Borings, Figures B-1 through B-5 (Borings 1, 2, and 3).

Project: THE MARKET PLACE
Emeryville, California

Log of Boring No. 1

Type of Boring: Rotary wash
Date Drilled: February 18, 1987
Hammer Weight : 140 lbs.
Remarks:

Surface Elevation:

Depth, Ft.	Samples	Blows/Ft.	MATERIAL DESCRIPTION	Moisture Content, %	Dry Density, pcf	Unconfined Compressive Strength, psf
			Concrete slab			
			Concrete and asphalt			
			SILTY CLAY FILL Black, medium stiff, with petroleum odor			
5	1	10	SILTY CLAY FILL(?) (CL-CH) Dark brown, soft to medium stiff, with rock fragments, wood, petroleum odor			
10	2	0				
15	3	41	SILTY CLAY (CL) Brown, stiff, with rock fragments	29	95	2240
20	4	26	SILTY CLAY (CL) Light brown, stiff	23	103	1280
25	5	50/2"	Increasing gravel content at 25'	No recovery		
30	6	49	SILTY CLAY (CL) Blue-gray, stiff to very stiff	29	94	2490
35	7	39		26	97	1620
40	8	72		26	95	3970
45	9	50	SILTY CLAY (CL) Orange-brown, stiff to very stiff	24	99	2735

Project: THE MARKET PLACE
Emeryville, California

Log of Boring No. 1

Type of Boring: Rotary wash
Date Drilled: February 18, 1987
Hammer Weight : 140 lbs.
Remarks:

Surface Elevation:

Depth, Ft.	Samples	Blows/Ft.	MATERIAL DESCRIPTION	Moisture Content, %	Dry Density, pcf	Unconfined Compressive Strength, psf
			SILTY CLAY (CL) Orange-brown, stiff to very stiff			
50	10	92/9"	SANDY CLAY (CL) Orange-brown, very stiff to hard, with gravel			
55	11	50/4"	SILTY CLAY (CL) Orange-brown mottled with gray, very stiff	25	96	1840
60	12	85		19	106	3420
65	13	68	SANDY CLAY (CL) Brown, very stiff to hard, with rock fragments	18	104	3420
70	14	50/4"		18	108	5750
			Bottom of boring			
75						
80						
85						
90						

Proj. No. 1232A | GEOMATRIX CONSULTANTS | Figure B-2

Project: THE MARKET PLACE
Emeryville, California

Log of Boring No. 2

Type of Boring: Rotary wash
Date Drilled: February 19, 1987
Hammer Weight : 140 lbs.
Remarks:

Surface Elevation:

Depth, Ft.	Samples	Blows/Ft.	MATERIAL DESCRIPTION	Moisture Content, %	Dry Density, pcf	Unconfined Compressive Strength, psf
			Concrete slab			
			SILTY CLAY FILL (CL) Black, stiff			
5	1	6	SANDY CLAY FILL(?) (CL) Dark brown, soft to medium stiff, with gravel and wood ∇	21	99	
10	2	48	SILTY SAND FILL(?) (SM) Black, dense, with wood, petroleum odor	21	99	
15	3	30	SILTY CLAY (CL) Orange-brown, stiff	30	92	2330
20	4	41		26	100	3540
25	5	29		25	98	1665
			Becoming SANDY CLAY (CL) at 29'			
30	6	48		27	96	560
35	7	37	SILTY CLAY (CL) Dark gray, stiff to very stiff	30	92	1570
			SILTY CLAY (CL) Orange-brown, very stiff			
40	8	53		21	106	3310
45	9	35	SANDY CLAY (CL) Gray-brown, stiff to very stiff	25	100	1735

Proj. No. 1232A | GEOMATRIX CONSULTANTS | Figure B-3

Project: THE MARKET PLACE
Emeryville, California

Log of Boring No. 2

Type of Boring: Rotary wash
Date Drilled: February 19, 1987
Hammer Weight: 140 lbs.
Remarks:

Surface Elevation:

Depth, Ft.	Samples	Blows/Ft.	MATERIAL DESCRIPTION	Moisture Content, %	Dry Density, pcf	Unconfined Compressive Strength, psf
			SANDY CLAY (CL) Gray-brown, stiff to very stiff			
50	10	35	Becoming SILTY CLAY at 49'	48	72	1285
			CLAYEY GRAVEL (GC) Gray-brown, dense			
55	11	77	SILTY CLAY (CL) Orange-brown, very stiff to hard, with rock fragments	21	104	2960
60	12	50/3"				
65	13	47				
			Becoming SANDY CLAY (CL) at 68'			
70	14	50/4"		18	111	1990
			Bottom of boring			
75						
80						
85						
90						

Proj. No. 1232A
GEOMATRIX CONSULTANTS
Figure B-4

Project: THE MARKET PLACE
Emeryville, California

Log of Boring No. 3

Type of Boring: Rotary wash
Date Drilled: February 19, 1987
Hammer Weight: 140 lbs.
Remarks:

Depth, Ft.	Samples	Blows/Ft.	MATERIAL DESCRIPTION	Moisture Content, %	Dry Density, pcf	Unconfined Compressive Strength, psf
			Surface Elevation:			
			Concrete slab			
	1	27	SILTY CLAY FILL (CL) Gray-brown, stiff	18	103	
5	2	50/4"	SILTY CLAY FILL (CL) Dark brown, stiff, with wood and rock fragments, petroleum odor	16	104	
			Concrete, asphalt, and wood rubble at 6'			
10	3	50/3"		No recovery		
15	4	42	CLAYEY GRAVEL FILL (?) (GC) Orange-brown, dense, with some wood			
20	5	42	SILTY CLAY (CL) Orange-brown, very stiff, with small gravel	26	95	4350
			Bottom of boring			
25						
30						
35						
40						
45						