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Report on Foundation Investigation

Proposed Housing
135 Anderson Street
Portland, Maine

for

TFH Architects
100 Commercial Street
Portland, ME 04101

November 4, 2004

TFH Record

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04390

Mr. David Merrill
TFH Architects
100 Commercial Street
Portland, ME 04101

Report on Foundation Investigation
Proposed Housing, 135 Anderson Street, Portland, Maine

Dear David:

This report presents our evaluation of the subsurface conditions and foundation requirements for the proposed housing at 135 Anderson Street (Lot 1) in Portland, Maine. This work was undertaken in accordance with our proposal dated September 14, 2004.

In summary, we recommend that the proposed building be founded on spread footings bearing on the existing fill, naturally deposited soil, or on compacted structural fill placed after removal of unsuitable soil. Intensive surface compaction of the existing fill will be required prior to earthwork and foundation construction for the building. Specific recommendations regarding foundation design and construction considerations are presented below.

Introduction

The proposed site is located at 135 Anderson Street in Portland, Maine. The project consists of three 3-story, wood-framed residential buildings with plan areas of approximately 1,400 square feet. The buildings will be constructed in phases. Phase I consists of the construction of Building #1 in the southern portion of Lot #2 (eastern portion of the site) and Phase III consists of Building #2 in the northern portion of Lot #2 and Building #3 in the western portion (Lot #1) of the site. Foundation requirements for Building #2 were presented in the report by Haley & Aldrich, Inc., dated May 19, 2003. Our report presents the foundation requirements for Building #3.

The existing ground surface within the site varies from approximately El. 11 in the west to El. 23 in the east. Within Building #3, ground surface is approximately El. 11. Building #3 will have the first floor at approximately El. 13.0 with a crawl space below the floor (no basement).

Subsurface Conditions

On February 11, 2003, Northern Test Boring, Inc. (Northern) drilled boring B-1 at the site under the observation of S. W. Cole Engineering, Inc. Northern drilled the boring at the location shown in Appendix A to a depth below ground surface of 22.0 feet. A log of the boring, prepared by S. W. Cole Engineering, Inc., is included in Appendix A. The boring was drilled using hollow stem augers. Standard Penetration Resistance (N) was measured at each sample interval in the overburden soil in accordance with ASTM test designation D1586.

The exploration log and related information depict subsurface conditions and water levels at the specific location at the time of the exploration. Soil conditions at other locations may differ from conditions at this location. Also, the passage of time may result in a change in groundwater conditions at the boring location.

The boring encountered two principal soil units, fill and marine deposit at the site. The soil units are discussed below in order of increasing depth below ground surface.

Fill - Fill is described as loose, brown silty SAND; to fine to medium SAND with various amounts of bricks and ceramics. Encountered thickness was 8.5 feet.

Marine Deposit – The marine deposit consists of medium stiff to soft, gray silty CLAY. The boring penetrated up to 13.5 feet into the clay.

The boring was drilled with hollow stem augers, and samples of the sand were recovered below the groundwater level. Therefore, the penetration resistance may have been affected by groundwater flow into the augers.

Water was reported in boring B-1 at a depth of 5.1 feet below ground surface. Observations of water were made over a relatively short period of time and may not reflect the stabilized groundwater condition. In addition, groundwater levels will fluctuate with season, precipitation, temperature and construction activities in the area. Therefore, groundwater levels during and following construction may vary from that indicated in the explorations.

Engineering Properties of the Clay Stratum

Shear strength of the clay was reported to vary from 250 psf to 1,250 psf. Shear strengths of the clay were compared with correlations of strength with stress history and compressibility for similar clays in the area. The correlations indicate that the clay is over consolidated; that is, the maximum previous stress of the deposit is greater than the existing overburden stress. It is likely that the clay became over consolidated due to desiccation resulting from a lowering of the groundwater level for an extended time period at some time in the geologic past.

The stress-strain or compressibility characteristics of clay are highly dependent on their stress history. If the soil is stressed within the limits of the maximum previous stress, the strain (settlement) will be proportional to the recompression ratio of the clay. If the applied stress exceeds the maximum previous stress, the strain will also be proportional to the virgin compression ratio of the clay. The magnitude of the virgin compression ratio is often on the order of 10 times (or more) the recompression ratio.

Recommendations For Foundation Design

Recommended Foundation Type and Design Criteria

The fill below Building #3 in its present condition is not considered suitable for support of the building. The boring indicates that the fill consists primarily of silty SAND with various amounts of gravel, bricks and ceramics. In our opinion, the fill will provide adequate support for the foundations provided the fill is compacted by Intensive Surface Compaction as described below. Therefore, it is our opinion that the building may be supported on the improved fill, naturally deposited, inorganic soil or on compacted structural fill placed after removal of unsuitable materials (fill containing wood and organics).

We recommend that, for uniformity, the footings be proportioned for an allowable bearing stress in lbs. per sq. ft., equal to 700 multiplied by the least lateral dimension of the footing in feet, up to a maximum of 2,000 lbs. per sq. ft. All footings should be at least 1.5 feet wide.

Exterior footings should be founded at least 4.5 feet below the lowest adjacent ground surface exposed to freezing. Interior footings should be founded a minimum of 1.5 feet below the crawl space.

Compacted structural fill supporting footings should extend laterally from the footings to at least the limits defined by 1 horizontal to 1 vertical lines sloped outward and downward from points located at least 2 feet horizontally beyond the bottom edges of the footings.

In order to consider the impact of site filling and foundations bearing above the clay stratum, we performed a settlement analysis. Engineering evaluations were based on the anticipated consolidation of the clay stratum due to the combined stresses of the raise-in-grade and building loads.

Calculated total settlement is estimated on the order of 1.0 inch with differential settlement on the order of 0.5 inch. We anticipate that settlement of this magnitude is acceptable. However, Structural Design Consultants should determine final acceptability of settlement.

Prior to intensive surface compaction, we recommend that the building area be excavated to El. 9 and compaction applied to the subgrade at El. 9. Intensive surface compaction should be performed using a minimum 30,000 lb. vibratory roller operating at 30 cycles per sec. (Hz) and a forward speed of 1 to 2 feet per second. Compaction should consist of 10 coverages of the vibratory roller. The direction of each two successive coverages should be rotated perpendicular to the previous two coverages. Following intensive surface compaction, a minimum of two coverages of the roller should be applied without vibration to recompact the upper portion of the fill. Fill containing debris and wood and organics should be removed and replaced with structural fill prior to surface compaction. Any soft or unsuitable areas encountered should be excavated and replaced with compacted structural fill. After intensive surface compaction, the site can be refilled to original grade or the area below the building can remain at El. 9 for a crawl space below the first floor.

Ground Floor Slab

We understand that no basement will be constructed for Building #3 and that a crawl space will be provided. We recommend that a nominal thickness concrete slab be constructed on the subgrade below the building. Normal dampproofing and vapor barrier should be provided for the crawl space slab and foundation walls.

Seismic Design Considerations

We recommend that the building be designed in accordance with the seismic requirements of the latest edition of the International Building Code; the site classification is Class E; the site response coefficient F_a is 2.1 for a short period spectral response acceleration S_s of 0.37 g; the site response coefficient F_v is 3.5 for the one-second period spectral response acceleration S_1 of 0.10 g. The subgrade soils are not considered liquefaction susceptible after intensive surface compaction.

Lateral Foundation Loads

We recommend that lateral loads be resisted by bottom friction on the foundations. We recommend that a coefficient of friction equal to 0.35 be used for foundations bearing on soil.

Backfill Materials

Structural fill used for backfill below and adjacent to foundations should consist of sandy gravel to gravelly sand. It should be free of organic material, loam, trash, snow, ice, frozen soil and other objectionable material, and should conform to the following gradation:

Sieve Size	Percent Finer by Weight
6 in.	100
No. 4	30 to 90
No. 40	10 to 50
No. 200	0 to 8

Compacted structural fill should be placed in layers not exceeding 8 inches in loose measure and compacted by self-propelled vibratory equipment at the approximate optimum moisture content to a dry density of at least 95 percent of the maximum dry density, as determined in accordance with ASTM Test Designation D1557. In confined areas, the maximum particle size should be reduced to 3 inches and the loose layer thickness should be reduced to 6 inches, and compaction performed by hand-guided equipment.

Compacted structural fill on the outside of the foundation walls should extend laterally a minimum of 2 feet from the wall. Backfill beyond this limit on the outside of the building may consist of common fill. The top 12 inches of fill on the exterior of the building should consist of low permeability material to minimize water infiltration next to the building. Grading should provide for runoff away from the building.

Common fill may consist of inorganic mineral soil that can be placed in layers not exceeding 12 inches in thickness and compacted with a minimum of two systematic passes of the equipment placing the fill.

Construction Considerations

General

The primary purpose of this section of the report is to comment on items related to excavation, earthwork and related geotechnical aspects of proposed construction. It is written primarily for the engineer having responsibility for preparation of plans and specifications. Since it identifies potential construction problems related to foundations and earthwork, it will also aid personnel who monitor the construction activity.

Excavation, Lateral Support and Control of Water

We anticipate that foundation excavation can be accomplished with sloped open excavation and through the overburden soils, provided safe side slopes can be maintained. Some sloughing and raveling should be anticipated in temporary slopes. Temporary excavations should be made in accordance with all OSHA and other applicable regulatory agency requirements.

We anticipate that groundwater may be encountered during excavation for footings. If encountered, open pumping from sumps can likely control groundwater. In general, the contractor should control groundwater and water from other sources by methods that prevent disturbance of adjacent soils and allow construction in-the-dry.

Subgrade Preparation

The subgrade soil is susceptible to disturbance from construction traffic. Equipment and personnel should not be permitted to travel across exposed footing bearing surfaces or exposed slab subgrades. Any subgrade areas that are disturbed should be recompacted or excavated and replaced with compacted structural fill prior to placing of concrete. Subgrades should be protected against freezing temperatures if exposed during construction. Final excavation to subgrade should be performed using equipment with smooth-edge buckets.

Construction Monitoring

The foundation recommendations contained herein are based on the known and predictable behavior of a properly engineered and constructed foundation. Monitoring of the foundation construction is required to enable the geotechnical engineer to keep in contact with procedures and techniques used in construction. Therefore, we recommend that a person qualified by training and experience be present to provide monitoring at the site during excavation of bearing surfaces and placement of compacted structural fill.

Limitations of Recommendations

This report has been prepared for specific application to the subject project in accordance with generally accepted geotechnical engineering practices. In the event that any changes in the nature, design or location of the building is planned, the conclusions and recommendations contained in this report should not be considered valid, unless the changes are reviewed and the conclusions of this report modified or verified in writing.

The recommendations presented herein are based in part on the data obtained from the referenced boring. The nature and extent of variations from the exploration may not become evident until construction. If variations then appear evident, it will be necessary to re-evaluate the recommendations of this report.

We request that we be provided the opportunity for a general review of final design and specifications in order to determine that our earthwork and foundation recommendations have been interpreted and implemented in the design and specifications as they were intended.

It has been a pleasure to work with you on this project. Please do not hesitate to contact us if you have any questions or require additional information.

Sincerely,

SEBAGO TECHNICS, INC.

Kenneth L. Recker, P.E.
Geotechnical Engineering Manager

STATE OF MAINE
KENNETH L. RECKER #5435
REGISTERED PROFESSIONAL ENGINEER

KLR:klr/jc

Enclosures:
Appendix A - Log of Borings

Appendix A

Log of Borings

S.W.COLE ENGINEERING, INC.

BORING LOG

BORING NO.:	B-1
SHEET:	1 OF 1
PROJECT NO.:	03-0067E
DATE START:	2/11/03
DATE FINISH:	2/11/03
ELEVATION:	11' +/-
SWC REP.:	KBG

PROJECT / CLIENT: 135 ANDERSON STREET / PROP

LOCATION: PORTLAND, MAINE

DRILLING FIRM: NORTHERN TEST BORINGS DRILLER: MIKE NADEAU

	TYPE	SIZE	HAMMER WT.	HAMMER FALL
CASING:	HSA	2 1/4" I.D.		
SAMPLER:	SS	1 3/8" I.D.	140 lb	30"
CORE BARREL:				

WATER LEVEL INFORMATION

WATER 5.1' BELOW GROUND SURFACE ON 2/12/03

CASING BLOWS PER FOOT	SAMPLE NO.	PEN.	REC.	DEPTH @ BOT	SAMPLER BLOWS PER 6" 0-6	6-12	12-18	18-24	DEPTH	STRATA & TEST RESULTS	PID TEST RESULTS (PPM)
AUGER	1D	24"	13"	3.0'	3	3	3	3		BROWN GRAVELLY SILTY SAND TRACE BRICK, TRACE CERAMIC (FILL) ~LOOSE~	ND
	2D	24"	3"	7.0'	1	1	1	1	5.5'	BROWN FINE TO MEDIUM SAND SOME SILT (FILL) ~LOOSE~	ND
	3D	24"	24"	12.0'	WOH/24"				8.5'	GRAY SANDY SILTY CLAY ~SOFT~	ND
	4D	24"	24"	17.0'	WOM/12"		1	1	14.0'	GRAY SILTY CLAY ~MEDIUM~	ND
	5D	24"	24"	22.0'	WOM/24"						ND
									22.0'	BOTTOM OF EXPLORATION AT 22.0' NOT REFUSAL 3/4" PVC MONITORING WELL SET AT 20.0' WITH 10' OF SCREEN (20' - 10' BELOW GROUND SURFACE) FILTER SAND PACK TO 10' BELOW SURFACE NATIVE BACKFILL TO SURFACE	

SAMPLES:
D=SPLIT SPOON
U=3" SHELBY TUBE
U=3.5" SHELBY TUBE

SOIL CLASSIFIED BY:
[ ] DRILLER - VISUALLY
[X] SOIL TECH.-VISUALLY
[ ] LABORATORY TEST

REMARKS: ND = NON-DETECTABLE

STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY BETWEEN SOIL TYPES AND THE TRANSITION MAY BE GRADUAL.

2

BORING NO.: B-1