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Report on Subsurface and Foundation Investigation

Proposed Housing
135 Cumberland Avenue
Portland, Maine

for

TFH Architects
100 Commercial Street
Portland, ME 04101

November 8, 2004

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November 8, 2004
04391

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

Report on Subsurface and Foundation Investigation
Proposed Housing, 135 Cumberland Avenue, Portland, Maine

Dear David:

This report presents our evaluation of the subsurface conditions and foundation requirements for the proposed housing at 135 Cumberland Avenue 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 approximately 4,870 square foot site is located at the northwest corner of the intersection of Cumberland Avenue and Anderson Street. The site is presently open and grass covered. Ground surface elevations within the site vary from approximately El. 65 to El. 72. The building will consist of a three-story, wood-framed structure with an at-grade basement for storage/mechanical and parking. Parking and storage/mechanical will be at approximately El. 65. Ground surface elevations within the limits of the building vary from approximately El. 65 to El. 72.

Subsurface Explorations

On October 20, 2004, W. H. Lavigne (Lavigne) of Standish, Maine excavated four test pits, TP1 to TP4, at the site at locations shown on Sheet 1, Site and Subsurface Exploration Plan. Lavigne excavated the test pits to depths below ground surface varying from 7.5 feet to 9.0 feet using a Link Belt 2700 excavator. Sebago Technics, Inc. monitored the test pits and prepared the logs included in Appendix A. Lavigne backfilled the test pits with the excavated material.

Sebago Technics determined the locations of test pits by taping from existing site features.

The test pits logs and related information depict subsurface conditions and water levels only at their specific locations at the time of excavation. Soil conditions at other locations may differ from conditions at these locations. Also, the passage of time may result in a change in groundwater conditions at exploration locations.

Subsurface Conditions

The test pits encountered two principal soil units at the site: fill and marine sand. Encountered thickness and generalized descriptions of these units are presented below in order of increasing depth below ground surface. Due to the complexity of the deposition process, strata thickness will vary and may be absent at specific locations.

Fill - Fill consists of brown, silty SAND with gravel (SM); to brown, well-graded SAND with gravel (SW) with varying amounts of bricks, cobbles, concrete, steel rebar and rubble. A 0.5 foot to 1.0 foot thick layer of black ash was encountered in the fill at varying depths. Test pits penetrated up to 8.5 feet into the fill.

Marine Sand - Marine sand consists of brown, well-graded SAND (SW) to light brown, poorly-graded SAND (SP). Test pits penetrated up to 2.0 feet into the marine sand.

Water was not observed in the test pits. However, observations of water were made over a relatively short period of time and may not reflect the stabilized groundwater level. In addition, water levels at the site will vary with season, precipitation, temperature and construction activity in the area. Therefore, water levels during and following construction will vary from those observed in the test pits.

Recommendations for Foundation Design

Recommended Foundation Type and Design Criteria

The fill below the building in its present condition is not considered suitable for support of the building. The test pits indicate that the fill consists primarily of silty SAND to well-graded SAND with various amounts of gravel, bricks, concrete and rubble. 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 square foot., equal to 700 multiplied by the least lateral dimension of the footing in feet, up to a maximum of 2,000 lbs. per square foot. All footings should be at least 1.5 feet wide.

Footings should be founded at least 4.5 feet below the unheated parking level or lowest adjacent ground surface exposed to freezing. Alternatively, in order to reduce the depth of excavation, footings may be founded at least 2.0 feet below the parking level provided a minimum of 2 inches of rigid insulation extending a minimum of 4 feet beyond the foundation wall or footing is provided above the footings to prevent the bearing surfaces from freezing. Design for less embedment and the use of insulation will require the approval of the appropriate code official.

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.

Prior to intensive surface compaction, we recommend that the building area be excavated to El. 63 and compaction applied to the subgrade at El. 63. 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 sec. 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, 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 and foundation construction, the site can be refilled to slab or pavement subgrade.

Lowest Level Floor

We understand that approximately one-half of the lowest level floor will consist of bituminous concrete for parking. The remainder of the lowest level will consist of mechanical, tenant storage, and laundry rooms. We recommend that the lowest level floor slab in this area be designed as an earth-supported slab-on-grade bearing on a minimum 6-inch thickness of compacted structural fill. All existing fill containing debris should be removed from within the slab limits prior to placing fill. All fill placed below the floor slabs for raise-in-grade should consist of compacted structural fill. Normal dampproofing and vapor barriers should be provided below the slab.

We recommend the following pavement section for the lowest level:

3 in. bituminous concrete, placed in two layers
15 in. sand or gravel subbase course

Subbase course materials should conform to the following gradation:

Sand or Gravel (Maine DOT Standard Specification, Highways and Bridges; Section 703.06b, Type D)

Sieve Size	Percent Finer by Weight
4 in.	100
¼ in.	25-70
No. 40	0-30
No. 200	0-7

(Note: Type D aggregate should be modified to a maximum 4 inch size. Compacted structural fill may be substituted for gravel subbase course.)

All unsuitable material should be removed from within the limits of the building. Fill required below the pavement section should consist of compacted structural fill. Compacted structural fill and pavement subbase should be placed in layers not exceeding eight inches (8") in thickness and compacted to a dry density of at least 95 percent of maximum dry density, as determined in accordance with ASTM Test Designation D1557.

It should be noted that the subgrade soils may be frost-susceptible. Therefore, pavement roughness due to non-uniform frost movement may occur. To eliminate such non-uniform frost movement would require approximately 4.5 feet of structural fill subbase. However, it is common practice to tolerate seasonal movement to avoid the high cost of the added thickness of subbase.

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 D; the site response coefficient F_a is 1.5 for a short period spectral response acceleration S_s of 0.37g; the site response coefficient F_v is 2.4 for the one-second period spectral response acceleration S_1 of 0.10g. The subgrade soils are not considered liquefaction susceptible.

Lateral Foundation Loads

We recommend that lateral loads be resisted by bottom friction on footings. We recommend that a coefficient of friction equal to 0.40 be used for footings bearing on soil or crushed stone. If this does not provide sufficient resistance, we will study the problem in more detail to take into account other factors.

Lateral Soil Pressure

We recommend that foundation walls which are restrained at the top and backfilled be designed to resist a lateral earth pressure calculated on the basis of an equivalent fluid unit weight of 55 pounds per cubic feet. This fluid unit weight assumes an at-rest earth pressure coefficient of 0.45 and a free-draining backfill. Portions of the foundation wall with unbalanced earth loads should have a perimeter foundation drain. The drain should consist of a perforated pipe surrounded by crushed stone and filter fabric constructed at the exterior base of wall. Gravity discharge should be provided.

Backfill Materials

Structural fill used below foundations and floor slabs and for backfill adjacent to walls 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
3 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 eight 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 loose layer thickness should be reduced to 6 inches and compaction performed by hand-guided vibratory equipment.

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. Prospective contractors for this project must evaluate the construction problems on the basis of their own knowledge and experience in the Portland, Maine area and on the basis of similar projects in other localities, taking into account their proposed construction methods, procedures, equipment and personnel.

Excavation, Lateral Support and Control of Water

We anticipate that foundation excavation will require lateral support along Cumberland Avenue and Anderson Street. Excavations up to 9 feet or more below existing grade will be required for foundation construction. We anticipate that excavation support will require sheeting and bracing to support the existing sidewalks and streets. Temporary excavations should be made in accordance with all OSHA and other applicable regulatory agency requirements. We recommend that the Contractor's proposed method for excavation support be designed by a registered professional engineer and submitted to the owner or owner's representative for review and comment.

We suggest that any ash encountered during excavation be segregated and temporarily stockpiled on site and used as backfill. We anticipate that the ash may remain on-site provided it is buried. Any ash that is removed from the site will likely require environmental testing and disposal as special waste.

Water was not encountered in the test pits and may not be present during construction. However, if encountered, open pumping from sumps can likely control groundwater. In general, the contractor should control groundwater and water from runoff and other sources by methods which prevent disturbance of bearing surfaces or 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 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 preparation of foundation 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 are 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 test pits. The nature and extent of variations between the explorations 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 need 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:	Sheet 1	- Site and Subsurface Exploration Plan
	Appendix A	- Logs of Test Pits

Appendix A

Logs of Test Pits

SEBAGO TECHNICS, INC.

TEST PIT LOG

Test Pit No. TP1

Page 1 of 1

PROJECT	PROPOSED HOUSING	PROJECT NO.	04391
OCATION	ANDERSON STREET AT CUMBERLAND AVENUE, PORTLAND, MAINE	PROJECT MGR.	K. RECKER
LIENT	TFH ARCHITECTS	FIELD REP	K. B. STEPHENSON
CONTRACTOR	W. H. LAVIGNE	DATE	10/20/04
EQUIPMENT	LINK BELT 2700	WEATHER	Sunny, 50-60s

Ground El. 71.6 ft | Location: See Plan | Groundwater depths/entry rates (in/min): N/E

El. Datum

Depth (ft)	Sample ID	Stratum Change Depth (ft)	USCS Group Symbol	Visual-Manual Identification & Description (density/consistency, color, GROUP NAME & SYMBOL, % oversized, max particle size, structure, odor, moisture, optional descriptions, geologic interpretation)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
			SM	Brown, silty SAND with gravel (SM), brick, cobbles, concrete, brick foundation walls, 20-25% cobbles/rubble, mps = 2.0 ft., grass roots to 0.5 ft., dry	10	10	30	20	15	15				
2														
				-FILL-										
4		4.0		Gray and black ASH, dry										
				-FILL-										
		4.5	SW	Brown well-graded SAND with gravel (SW), mps = 1.0 in., dry	5	10	20	15	50					
6														
8														
				Bottom of exploration at 8.5 ft. below ground surface No refusal										
10														

Obstructions:

Remarks: walls unstable- rapid collapse

Standing water in completed pit:
at depth Not Encountered ft.
measured after ____ hrs. elapsed

Boulders:

Diameter (in.)	Number		Approx. vol. (cu. ft.)
12 to 24	2	=	
over 24	--	=	

Test Pit Dimensions:
Pit Depth 8.5 Ft.
Pit Length X Width 10.0 Ft. X 5.0 Ft.

SEBAGO TECHNICS, INC.	# TEST PIT LOG	Test Pit No. **TP2** Page 1 of 1

PROJECT	PROPOSED HOUSING	PROJECT NO.	04391
LOCATION	ANDERSON STREET AT CUMBERLAND AVENUE, PORTLAND, MAINE	PROJECT MGR.	K. RECKER
CLIENT	TFH ARCHITECTS	FIELD REP	K. B. STEPHENSON
CONTRACTOR	W. H. LAVIGNE	DATE	10/20/04
EQUIPMENT	LINK BELT 2700	WEATHER	Sunny, 50-60s

Ground El. 70.9 ft | Location: See Plan | Groundwater depths/entry rates (in/min): N/E

El. Datum

Depth (ft)	Sample ID	Stratum Change Depth (ft)	USCS Group Symbol	Visual-Manual Identification & Description (density/consistency, color, GROUP NAME & SYMBOL, % oversized, max particle size, structure, odor, moisture, optional descriptions, geologic interpretation)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
			SM	Brown, silty SAND with gravel (SM), brick, cobbles, rebar, brick foundation walls, 20-25% cobbles/rubble, mps = 2.0 ft., grass roots to 0.5 ft., dry	10	10	30	20	15	15				
2	2.0													
	S1													
4	4.0													
				-FILL-										
6														
8														
				Bottom of exploration at 8.0 ft. below ground surface No refusal										
10														

Obstructions:

Remarks:

Standing water in completed pit:
at depth Not Encountered ft.
measured after ______ hrs. elapsed

Boulders:

Diameter (in.)	Number		Approx. vol. (cu. ft.)
12 to 24	4	=	
over 24	--	=	

Test Pit Dimensions:
Pit Depth 8.0 Ft.
Pit Length X Width 10.0 Ft. X 4.0 Ft.

SEBAGO TECHNICS, INC.	TEST PIT LOG	Test Pit No. TP3
		Page 1 of 1

PROJECT	PROPOSED HOUSING	PROJECT NO.	04391
LOCATION	ANDERSON STREET AT CUMBERLAND AVENUE, PORTLAND, MAINE	PROJECT MGR.	K. RECKER
CLIENT	TFH ARCHITECTS	FIELD REP	K. B. STEPHENSON
CONTRACTOR	W. H. LAVIGNE	DATE	10/20/04
EQUIPMENT	LINK BELT 2700	WEATHER	Sunny, 50-60s

Ground El. 66.5 ft	Location	See Plan	Groundwater depths/entry rates (in/min): N/E
El. Datum			

Depth (ft)	Sample ID	Stratum Change Depth (ft)	USCS Group Symbol	Visual-Manual Identification & Description (density/consistency, color, GROUP NAME & SYMBOL, % oversized, max particle size, structure, odor, moisture, optional descriptions, geologic interpretation)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Toughness	Plasticity	Strength
			SM	Brown, silty SAND with gravel (SM), brick, cobbles, concrete, brick foundation walls, 20-25% cobbles/rubble, mps = 2.0 ft., grass roots to 0.3 ft., dry	10	10	30	20	15	15				
2				-FILL-										
		3.0												
				Gray and black ASH, dry										
		3.5		-FILL-										
4			SW	Brown well-graded SAND with gravel (SW), mps = 1.0 in., dry	10	10	20	30	30					
6				-FILL-										
		6.5												
	6.5 S1 7.5		SP	Light brown poorly-graded SAND (SP), mps = 0.02 in., dry -MARINE DEPOSITS-					95	5				
8				Obstruction in center of test pit at 7.5 ft.- possible pipe Bottom of exploration at 7.5 ft. below ground surface No refusal										
10														

Obstructions: Pipe-like obstruction encountered in bottom of pit at 7.5 ft.

Remarks:

Standing water in completed pit:
at depth Not Encountered ft.
measured after ______ hrs. elapsed

Boulders:

Diameter (in.)	Number		Approx. vol. (cu. ft.)
12 to 24	2	=	
over 24	--	=	

Test Pit Dimensions:
Pit Depth 7.5 Ft.
Pit Length X Width 10.0 Ft. X 4.0 Ft.

SEBAGO TECHNICS, INC.

TEST PIT LOG

Test Pit No. **TP4**

Page 1 of 1

PROJECT	PROPOSED HOUSING	PROJECT NO.	04391
LOCATION	ANDERSON STREET AT CUMBERLAND AVENUE, PORTLAND, MAINE	PROJECT MGR.	K. RECKER
CLIENT	TFH ARCHITECTS	FIELD REP	K. B. STEPHENSON
CONTRACTOR	W. H. LA VIGNE	DATE	10/20/04
EQUIPMENT	LINK BELT 2700	WEATHER	Sunny, 50-60s

Ground El. 66.5 ft | Location: See Plan | Groundwater depths/entry rates (in/min): N/E

El. Datum

Depth (ft)	Sample ID	Stratum Change Depth (ft)	USCS Group Symbol	Visual-Manual Identification & Description (density/consistency, color, GROUP NAME & SYMBOL, % oversized, max particle size, structure, odor, moisture, optional descriptions, geologic interpretation)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
			SM	Brown, silty SAND with gravel (SM), brick, cobbles, rebar, brick foundation walls, 20-25% cobbles/rubble, mps = 2.5 ft., grass roots to 0.4 ft., dry	10	10	30	20	15	15				
2														
4				-FILL-										
6		6.0		Gray and black ASH, traces brick, dry										
				-FILL-										
		7.0												
	7.0 S1 8.0		SW	Brown well-graded SAND (SW), trace fine gravel, mps = 0.75 in., dry			20	25	55					
8				-MARINE DEPOSITS-										
				Bottom of exploration at 9.0 ft. below ground surface No refusal										
10														

Obstructions:

Remarks:

Standing water in completed pit:
at depth: Not Encountered ft.
measured after: ___ hrs. elapsed

Boulders:

Diameter (in.)	Number	Approx. vol. (cu. ft.)
12 to 24	4	=
over 24	2	=

Test Pit Dimensions:
Pit Depth: 9.0 Ft.
Pit Length X Width: 10.0 Ft. X 4.0 Ft.