Nutting Engineers

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Geotechnical • Testing • Inspection

REPORT OF
GEOTECHNICAL EXPLORATION

SCHOONER WHARF BUILDING ADDITION
202 WILLIAMS STREET
KEY WEST, FLORIDA 33040

FOR

CHEN, MOORE, & ASSOCIATES
500 CYPRESS CREEK ROAD, SUITE 410
FORT LAUDERDALE, FLORIDA 33309

PREPARED BY

NUTTING ENGINEERS OF FLORIDA, INC.
2051 NW 112TH AVE, SUITE 126
MIAMI, FLORIDA 33172

PROJECT No. 786.19

DECEMBER 2011 (REVISED JANUARY 2012)

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December 14, 2011 (Revised January 30, 2012)

Mr. Oscar R. Bello, P.E.
Chen, Moore, & Associates
500 Cypress Creek Rd, Suite 410
Ft. Lauderdale, Florida 33309
Phone: (954) 730-0707
Fax: (954) 730-2030
Email: obello@chenmoore.com

Subject: Report of Geotechnical Exploration
Schooner Wharf Building Addition
202 William St.
Key West, Florida 33040
Project No. 786.19

Dear Mr. Bello:

Nutting Engineers of Florida, Inc. has performed a geotechnical exploration for the above proposed addition in Key West, Florida. The purpose of this exploration was to obtain information concerning the site and subsurface conditions at a specific location in order to provide site preparation and foundation design recommendations for support of the proposed construction. This report presents our findings and recommendations.

PROJECT INFORMATION

Per your email on November 21, 2011, review of the plans provided and our subsequent conversation on November 22, 2011 we understand that plans for this project include constructing a two story addition at the referenced site. It is also our understanding that the addition will be independent of the existing building, but connected by wood steps from the 2nd story to the top of the roof deck of the existing building. The 1st level of the building will be frangible or "break away" and used for storage.

NE should be notified in writing by the client of any changes in the proposed construction along with a request to amend our foundation analysis and/or recommendations within this report as appropriate.

GENERAL SUBSURFACE CONDITIONS

Subsurface Soil Exploration

The exploration of subsurface conditions included site observation, review of available data such as the Soil Survey of Monroe County and one Standard Penetration Test boring (ASTM D-1586). Initially two borings were proposed however only one was performed due to site access issues. The Standard Penetration Test boring was performed to a depth of 30 feet below the existing ground surface. The test boring report is presented in the Appendix of this report. The boring was established using approximate methods, namely a measuring wheel and available surface controls.

Soil Survey Maps

A review of the Soil Survey for Monroe County indicates that at the time the survey was conducted, the soils at the site were described as Urban land complex. This map unit is in constructed upland areas adjacent to areas of water throughout the keys. Individual areas are subject to rare flooding from hurricanes and other tropical storms. Elevations vary, depending on the thickness of the fill material, but they are dominantly +3 National Geodetic Vertical Datum (NGVD) of 1929. The Udorthents dominantly consist of crushed oolitic limestone or coral bedrock that has been spread over the original soil material. They commonly are about 32 inches of extremely gravelly sand underlain by about 40 inches of marl. The marl is underlain by coral bedrock. Other areas of soils are underlain by muck and other soil material. Houses and other urban structures cover up to 40 percent of most areas of the Udorthents; however, the natural soils can still be observed. We note that the maximum depth of the soil survey was approximately six feet.

Test Boring Results

In general, the test boring recorded a surface layer of asphalt, underlain by medium dense to dense quartz fine sand and limestone fragments to a depth of approximately six feet below grade. Below the sand layer, medium hard to hard limestone was encountered to approximately twelve feet below grade, followed by loose quartz fine sand to approximately twenty two feet. Soft to medium hard limestone was found from twenty two feet to thirty feet, the maximum depth explored. A detailed description of the soil profile is presented in the test boring records provided in the Appendix.

Note: Substantially different subsurface conditions may exist at alternate locations. Buried debris may or may not be identified or adequately delineated by soil borings. Test pit excavation can provide more insight into such conditions and rock lithology if present. Such conditions may be revealed during site development activities or other related activities. Should additional assurance be desired by the client, further subsurface investigation could be performed.

Groundwater Information

The groundwater level was encountered at depths of approximately three feet below the existing ground surface. Please review the paragraphs presented below regarding water table information and accuracy. The immediate depth to groundwater measurements presented in this report may not provide a reliable indication of stabilized or long term depth to groundwater at this site.

Water table elevations can vary dramatically with time through rainfall, droughts, storm events, flood control activities, nearby surface water bodies, tidal activity, pumping and many other factors. For these reasons, this immediate depth to water data **should not** be relied upon alone for project design considerations.

Further information regarding stabilized groundwater elevations at the site could be developed upon specific request. Additional evaluation might include monitoring of piezometers, survey of the project area for evidence of current groundwater elevation influences such as well fields, obvious construction dewatering, tidal activity, flood control canals and other surface water bodies.

ANALYSIS AND RECOMMENDATIONS

The test boring performed for this project revealed that the soils within the soil profile consist primarily of sands in a loose to medium dense state, followed by limestone at a depth of approximately six feet. It is therefore our opinion that the proposed improvements may be supported on shallow foundations, pending proper site preparation.

Once the site has been prepared in accordance with our site preparation recommendations presented in this report, the proposed construction may be supported on a shallow foundation system using an allowable soil bearing pressure of ***2,500 pounds per square foot.***

We recommend a minimum width of 24 inches for continuous footings and 36 inches for individual footings, even though the soil bearing pressure may not be fully developed in all cases. We recommend that the bottom of footings be at least 12 inches below the lowest adjacent finished grade. The foundations should be constructed in accordance with the local building codes and good standard practice.

It is our opinion that the floor slab system may be constructed as a slab on grade. We recommend that a vapor barrier be placed between the soil and concrete.

Foundation Settlement

Shallow foundations designed, supported, and constructed in accordance with the recommendations of this report are estimated to sustain a maximum total settlement of approximately one inch. Differential settlement between adjacent foundations should be

approximately one-half of the total settlement. Distortions that occur along the wall footings due to differential settlement should not be more than 1 in 500.

Floor Slab

It is our opinion that the floor slab system may be constructed as a slab on grade. We recommend that the procedures described under the "Site Preparation" section of this report be used to prepare the floor slab subgrades. We recommend that a vapor barrier be placed between the soil and concrete.

Site Preparation

All construction debris and deleterious materials should be stripped and removed from the construction area. A representative of NE shall observe the excavation and compaction operations on a full time basis to verify the engineering intent is accomplished.

Once the site has been cleared, the soil should be compacted until a density equivalent to at least 98 percent of the modified Proctor maximum dry density (ASTM D-1557) is achieved to a depth of at least 12 inches below the compacted surface.

Any additional new fill material required to attain finished floor grade shall be a suitable, free-draining material, defined as that which meets the requirements of ASTM D-2487 Unified Classifications GW, GP, GP-GM or SW, or as approved by NE, containing no more than 2 percent organic matter and with no debris.

This fill material shall be placed in lifts not exceeding 12-inches in loose thickness and compacted with 10 overlapping passes (5 in each direction) with a large self propelled vibratory compactor. Each lift should be compacted to a least 98 percent of maximum density as determined by AASHTO T-180 and ASTM D-1557.

Following site and building pad construction as discussed above, the foundation area should be excavated and the footings formed. The bottom of foundation excavations should be compacted after excavation to develop a minimum density requirement of 98 percent of the maximum modified Proctor dry density, for a minimum depth of one (1) foot below the bottom of the footing depth, as determined by field density compaction tests. The floor slab area should also be compacted in the same manner.

Piles

For areas or structures that may require piles, we have performed a pile analysis. The results of our analysis indicate that structural pile capacities on the order of 30 tons may be supported on 16-inch diameter augercast piles installed to tip depths of approximately nine feet below the existing ground surface. We note that this depth is subject to further evaluation after completion of pile installation monitoring as outlined below. The actual

depths should be expected to vary depending on the drilling conditions encountered during installation of these piles. The depths of the pile tips as recommended in this report are based on the ground surface elevations as they existed at the time the test boring was performed. The piling contractor shall submit the proposed pile design to Nutting Engineers of Florida, Inc. for their review and comment prior to proceeding with pile installation. We note that the onsite soils are suitable for support of any first floor slabs as slabs on grade, following compaction of bearing soils to at least 98 percent of the maximum dry density.

The Florida Building Code (FBC) requires that any piles designed for greater than 40 tons should be load tested in order to verify the pile capacity. Therefore, a pile load test will not be required for this project as described in the FBC.

AUGERCAST PILE CAPACITY TABLE

Pile Diameter (Inches)	Depth Below Existing Ground (Ft)	Allowable Compressive Capacity (Tons)	Allowable Tension Capacity (Tons)	Minimum Grout Strength (psi) ($0.25\ f'_c$)
16	9-10	30	18	3000

Pile Observations

At least three production profile piles within the addition shall be installed in the presence of the Nutting project geotechnical engineer. Final pile installation criteria for the remainder of the production piles will be provided after this time. It is important that the installation of all piles be under the full time observation of a representative of Nutting Engineers to verify the piles will support the structural loading.

Pile Reinforcement

We recommend that at a minimum, one full length #6 reinforcing steel bar utilizing centralizers be installed in each pile. Additional reinforcing may be required depending on the structural engineer's requirements.

We recommend that a structural engineer be retained to determine the spacing and locations of the pile foundation system. Discussions should be initiated between the owners, structural engineer, contractor, and Nutting Engineers to provide detailed specifications for the foundation installation work.

GENERAL INFORMATION

The contents of this report are for the exclusive use of the client, the client's design & construction team and governmental authorities for this specific project exclusively. Information conveyed in this report shall not be used or relied upon by other parties or for other projects without the expressed written consent of Nutting Engineers of Florida, Inc.

Our client for this geotechnical evaluation was:

Chen, Moore, & Associates
500 Cypress Creek Rd, Suite 410
Ft. Lauderdale, Florida 33309

This report discusses geotechnical considerations for this site based upon observed conditions and our understanding of proposed construction for foundation support. Environmental issues including (but not limited to), soil and/or groundwater contamination are beyond our scope of service for this project.

Changes in the submitted project details or the discovery of any site or varying subsurface conditions prior to and/or during construction which deviate from the data obtained in this exploration should be immediately reported to us so that the condition or change can be evaluated and appropriate action taken. We request the opportunity to review the final plans and specifications to assure that the intent of the recommendations of this report is properly interpreted and incorporated.

The vibratory compaction equipment will cause vibrations that may be felt by persons within adjacent buildings and could cause cosmetic damage to existing structures. The contractor should exercise due care during the performance of the vibratory compaction work. If such vibrations are not considered tolerable, then alternate foundation modification techniques should be considered.

Excavations of five feet or more in depth should be sloped or shored in accordance with OSHA and State of Florida requirements. Materials removed from any excavation should not be stockpiled immediately adjacent to the open excavation as this load may cause a sudden collapse of the sidewalls. In October of 1989, as published in the Federal Registrar, Volume 54, No. 209, the United States Department of Labor, Occupational Safety and Health Administration (OSHA) amended its; "Construction Standards for excavations, 29CRF part 1926, subpart P".

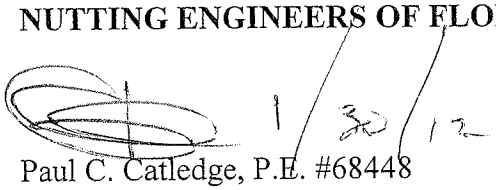
It is mandated by this federal regulation that all excavations, whether they be utility trenches, basement excavation or footing excavations, be constructed in accordance with the new OSHA guidelines. The contractor is solely responsible for designing and constructing stable, temporary excavations and should shore, slope, or bench the sides of the excavations as required to maintain stability of both the excavation sides and bottom.

If conditions are encountered which are not consistent with the findings presented in this report, or if proposed construction is moved from the location investigated, this office shall be notified immediately so that the condition or change can be evaluated and appropriate action taken.

The Geotechnical Engineer warrants that the findings, recommendations, specifications, or professional advice contained herein, have been presented after being prepared in accordance with general accepted professional practice in the field of foundation engineering, soil mechanics and engineering geology. No other warranties are implied or expressed.

We appreciate the opportunity to be of service on this project. If we can be of any further assistance, or if you need additional information, please contact us at your convenience.

Sincerely,
NUTTING ENGINEERS OF FLORIDA, INC.



Paul C. Catledge, P.E. #68448
Senior Engineer

Attachments: Test Boring Location Plan
Test Boring Report
Soil Classification Criteria
Limitations of Liability

NUTTING ENGINEERS OF FLORIDA, INC.
ESTABLISHED 1967

SCHOONER WHARF BUILDING ADDITION
202 WILLIAM STREET
KEY WEST, FLORIDA 33040

APPROXIMATE TEST LOCATION

NOT TO SCALE

FIGURE 1

Nutting Engineers of Florida Inc. | Established 1967
Your Project is Our Commitment
1310 Neptune Drive
Boynton Beach, FL 33426
Telephone: 561-736-4900
Fax: 561-737-9975

BORING NUMBER B-1

PROJECT NUMBER 786.19

CLIENT Chen Moore & Associates

PROJECT NAME Schooner Wharf Building Addition

PROJECT LOCATION 202 William Street, Key West, FL 33040

DATE STARTED 12/7/11 COMPLETED 12/7/11

SURFACE ELEVATION REFERENCE Same as road crown

DRILLING METHOD Standard Penetration Boring

GROUND WATER LEVELS:

LOGGED BY T. Simmons CHECKED BY C. Gworek

▽ AT TIME OF DRILLING 3.0 ft

APPROXIMATE LOCATION OF BORING As located on site plan

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	Blows	N-Value
0		2-inch ASPHALT			
		Tan quartz fine SAND and LIMESTONE FRAGMENTS	SS 1	57-63-54-37	117
		▽ Gray quartz fine SAND, some limestone fragments	SS 2	26-19-20-10	39
5		Gray quartz fine SAND, some wood and concrete	SS 3	8-7-5-50/3"	12
		Lt. tan LIMESTONE FRAGMENTS, some quartz fine sand	SS 4	50/5"	100+
			SS 5	36-41-43-26	84
10			SS 6	19-17-13-11	30
		Lt. tan slightly silty quartz fine SAND			
15			SS 7	3-4-4	8
20			SS 8	4-4-4	8
		Lt. tan LIMESTONE FRAGMENTS, little quartz fine sand			
25			SS 9	9-11-10	21
30			SS 10	14-11-12	23
		Bottom of hole at 30.0 feet.			

▲ SPT N VALUE ▲
10 20 30 40
PL MC LL
20 40 60 80
☐ FINES CONTENT (%) ☐
20 40 60 80

TEST NUTTING BOREHOLE 786.19 CHEN MOORE & ASSOCIATES - SCHOONER WHARF BUILDING ADDITION.GPJ GINT US.GDT 12/7/11

SOIL AND ROCK CLASSIFICATION CRITERIA

SAND/SILT

N-VALUE (bpf)	RELATIVE DENSITY
0 – 4	Very Loose
5 – 10	Loose
11 – 29	Medium
30 – 49	Dense
>50	Very dense
100	Refusal

CLAY/SILTY CLAY

N-VALUE (bpf)	UNCONFINED COMP. STRENGTH (tsf)	CONSISTENCY
<2	<0.25	v. Soft
2 – 4	0.25 – 0.50	Soft
5 – 8	0.50 – 1.00	Medium
9 – 15	1.00 – 2.00	Soft
16 – 30	2.00 – 4.00	v. Stiff
>30	>4.00	Hard

ROCK

N-VALUE (bpf)	RELATIVE HARDNESS	ROCK CHARACTERISTICS
$N \geq 100$	Hard to v. hard	Local rock formations vary in hardness from soft to very hard within short vertical and horizontal distances and often contain vertical solution holes of 3 to 36 inch diameter to varying depths and horizontal solution features. Rock may be brittle to split spoon impact, but more resistant to excavation.
$25 \leq N \leq 100$	Medium hard to hard	
$5 \leq N \leq 25$	Soft to medium hard	

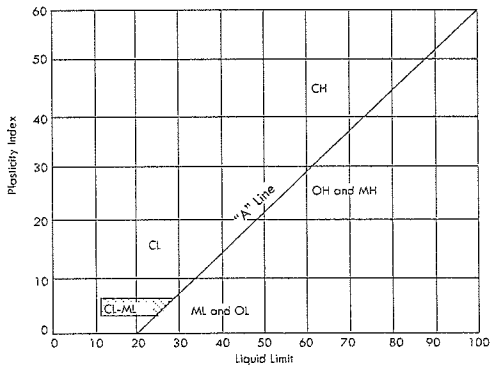
PARTICLE SIZE

Boulder	>12 in.
Cobble	3 to 12 in.
Gravel	4.76 mm to 3 in.
Sand	0.074 mm to 4.76 mm
Silt	0.005 mm to 0.074 mm
Clay	<0.005 mm

DESCRIPTION MODIFIERS

0 – 5%	Slight trace
6 – 10%	Trace
11 – 20%	Little
21 – 35%	Some
>35%	And

Major Divisions			Group Symbols	Typical names	Laboratory classification criteria
Coarse-grained soils (More than half of material is *larger* than No. 200 sieve size)	Gravels (More than half of coarse fraction is larger than No. 4 sieve size)	Clean gravels (Little or no fines)	GW	Well-graded gavels, gravel-sand mixtures, little or no fines	Determine percentages of sand and gravel from grain-size curve. Depending on percentage of fines (fraction smaller than No. 200 sieve size), coarse-grained soils are classified as follows: Less than five percent.....GW, GP, SW, SP; More than 12 percent.....GM, GC, SM, SC; 5 to 12 percent.....*Borderline* cases requiring dual systems**
			GP	Poorly graded gravels, gravel-sand mixtures, little or no fines	$C_u = \frac{D_{60}}{D_{10}}$ greater than 4; $C_z = \frac{(D_{30})^2}{D_{10} x D_{60}}$ *between* 1 and 3
					Not meeting all gradation requirements for GW
		Gravels with fines (Appreciable amount of fines)	GW* d u	Silty gravels, gravel-sand-silt mixtures	Atterberg limits below "A" line or P.I. less than 4
			GC	Clayey gravels, gravel-sand-clay mixtures	Atterberg limits above "A" line with P.I. greater than 7
					Above "A" line with P.I. between 4 and 7 are *borderline* cases requiring use of dual symbols.
	Sands (More than half of coarse fraction is smaller than No. 4 sieve size)	Clean sands (Little or no fines)	SW	Well-graded sands, gravelly sands, little or no fines	$C_u = \frac{D_{60}}{D_{10}}$ greater than 6; $C_z = \frac{(D_{30})^2}{D_{10} x D_{60}}$ *between* 1 and 3
			SP	Poorly graded sands, gravelly sands, little or no fines	Not meeting all gradation requirements for SW
		Sands with fines (Appreciable amount of fines)	SM* d u	Silty sands, sand-silt mixtures	Atterberg limits below "A" line or P.I. less than 4
			SC	Clayey sands, sand-clay mixtures	Atterberg limits above "A" line with P.I. more than 7
					Limits plotting in hatched zone with P.I. between 4 and 7 are *borderline* cases requiring use of dual system.
Fine-grained soils (More than half of material is *smaller* than No. 200 sieve size)	Silts and clays (Liquid limit less than 50)		ML	Inorganic silts and very fine sands, rock flour, silty or clayey fine sands or clayey silts with slight plasticity	
			CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy, clays, silty clays, lean clays	
			OL	Organic silts and organic silty clays of low plasticity	
	Silts and clays (Liquid limit greater than 50)		MH	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts	
			CH	Inorganic clays or high plasticity, fat clays	
			OH	Organic clays of medium to high plasticity, organic silts	
	Highly organic soils		PT	Peat and other highly organic soils	



Plasticity Chart

LIMITATIONS OF LIABLILITY

WARRANTY

We warranty that the services performed by Nutting Engineers of Florida, Inc. are conducted in a manner consistent with that level of care and skill ordinarily exercised by members of the profession in our area currently practicing under similar conditions at the time our services were performed. ***No other warranties, expressed or implied, are made***. While the services of Nutting Engineers of Florida, Inc. are a valuable and integral part of the design and construction teams, we do not warrant, guarantee or insure the quality, completeness, or satisfactory performance of designs, construction plans, specifications we have not prepared, nor the ultimate performance of building site materials or assembly/construction.

SUBSURFACE EXPLORATION

Subsurface exploration is normally accomplished by test borings; test pits are sometimes employed. The method of determining the boring location and the surface elevation at the boring is noted in the report. This information is represented in the soil boring logs and/or a drawing. The location and elevation of the borings should be considered accurate only to the degree inherent with the method used and may be approximate.

The soil boring log includes sampling information, description of the materials recovered, approximate depths of boundaries between soil and rock strata as encountered and immediate depth to water data. The log represents conditions recorded specifically at the location where and when the boring was made. Site conditions may vary through time as will subsurface conditions. The boundaries between different soil strata as encountered are indicated at specific depths; however, these depths are in fact approximate and dependent upon the frequency of sampling, nature and consistency of the respective strata. Substantial variation between soil borings may commonly exist in subsurface conditions. Water level readings are made at the time and under conditions stated on the boring logs. Water levels change with time, precipitation, canal level, local well drawdown and other factors. Water level data provided on soil boring logs shall not be relied upon for groundwater based design or construction considerations.

LABORATORY AND FIELD TESTS

Tests are performed in *general* accordance with specific ASTM Standards unless otherwise indicated. All criteria included in a given ASTM Standard are not always required and performed. Each test boring report indicates the measurements and data developed at each specific test location.

ANALYSIS AND RECOMMENDATIONS

The geotechnical report is prepared primarily to aid in the design of site work and structural foundations. Although the information in the report is expected to be sufficient for these purposes, it shall not be utilized to determine the cost of construction nor to stand alone as a construction specification. Contractors shall verify subsurface conditions as may be appropriate prior to undertaking subsurface work.

Report recommendations are based primarily on data from test borings made at the locations shown on the test boring reports. Soil variations commonly exist between boring locations. Such variations may not become evident until construction. Test pits sometimes provide valuable supplemental information that derived from soil borings. If variations are then noted, the geotechnical engineer shall be contacted in writing immediately so that field conditions can be examined and recommendations revised if necessary.

The geotechnical report states our understanding as to the location, dimensions and structural features proposed for the site. ***Any significant changes of the site improvements or site conditions must be communicated in writing to the geotechnical engineer immediately*** so that the geotechnical analysis, conclusions, and recommendations can be reviewed and appropriately adjusted as necessary.

CONSTRUCTION OBSERVATION

Construction observation and testing is an important element of geotechnical services. The geotechnical engineer's field representative (G.E.F.R.) is the "owner's representative" observing the work of the contractor, performing tests and reporting data from such tests and observations. ***The geotechnical engineer's field representative does not direct the contractor's construction means, methods, operations or personnel.*** The G.E.F.R. does not interfere with the relationship between the owner and the contractor and, except as an observer, does not become a substitute owner on site. The G.E.F.R. is responsible for his/her safety, but has no responsibility for the safety of other personnel at the site. The G.E.F.R. is an important member of a team whose responsibility is to observe and test the work being done and report to the owner whether that work is being carried out in general conformance with the plans and specifications. The enclosed report may be relied upon solely by the named client.