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PROPOSED GEOTECHNICAL EXPLORATION OF AIR TRAFFIC CONTROL BUILDING NAS WHITING FIELD FL
7/19/2006
GALLET AND ASSOCIATES

Geotechnical Exploration

Proposed Air Traffic Control Building
NAS Whiting Field
Milton, Florida

Project 06PNTET0101G

July 19, 2006

Prepared For:
TETRA TECH NUS, Inc.
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July 19, 2006

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July 19, 2006

TETRA TECH NUS, Inc.
3360 Capital Circle N.E., Suite B
Tallahassee, FL 32308

Attention: Mr. Larry Smith, P.G.

Geotechnical Exploration
Proposed Air Traffic Control Building
NAS Whiting Field
Milton, Florida
Project 06PNTET0101G

Dear Mr. Smith:

As requested and with your authorization, Gallet & Associates is pleased to present the results of the geotechnical exploration and engineering evaluation for the project referenced above. This exploration was performed in general accordance to our proposal #06G0867, dated May 22, 2006.

The following report presents the results of our field and laboratory explorations; an evaluation of the subsurface conditions with respect to available project characteristics; and recommendations to aid in the design and construction of the proposed foundation systems. The purpose of this study was to explore the general subsurface conditions of the subject site and determine its effect on the support of the proposed development.

Gallet & Associates, Inc. appreciates the opportunity of assisting you on this phase of your project and look forward to providing you with our construction quality control services. Should you have any questions regarding this report or if we can be of further service to you, please contact our office.

Sincerely,
GALLET & ASSOCIATES

Ayoade Adeyefa, E.I.
Project Engineer
E.I. # 15988
July 19, 2006

Alain J. Gallet, P.E.
Principal Engineer
Florida P.E.# 35368
July 19, 2006

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EXECUTIVE SUMMARY

Mr. Larry Smith, P.G. with TETRA TECH NUS, Inc. authorized Gallet & Associates, Inc. to conduct a *Geotechnical Exploration* for a proposed Air Traffic Control Building at the NAS Whiting Field in Milton, Florida.

The proposed air traffic control building will consist of a 38 feet by 38 feet, seven (7) story structure to be built at NAS Whiting Field in Milton, Florida. The proposed building will be a concrete frame structure with a concrete slab on grade and elevated concrete floor slabs. At the time of preparing this report, the column loads and wall loads were not provided. However, based on our experience with similar projects, we anticipate the maximum column loads on the order of 600 to 800 kips and wall loads on the order of 5 to 10 kips per linear foot.

The geotechnical exploration indicated that the site could be prepared for the support of the proposed Air Traffic Control Building provided that the site preparation and construction are in accordance with the recommendations presented in this report.

The geotechnical exploration consisted of drilling and sampling five (5) Standard Penetration Test (SPT) borings with continuous samples to 10 feet, then 5 foot intervals thereafter in the proposed building area. Two (2) of the soil borings were drilled to 27 feet below the existing grade and three (3) of the soil borings were drilled to 77 feet below the existing grade. The field program for the geotechnical exploration and the depths of the borings were provided by TETRA TECH NUS, Inc.

In general, the soil brings initially penetrated a layer of 1.5 to 3-inch thick asphalt and 2 to 10-inch thick concrete pavement. The soil borings then typically encountered medium dense or loose/very loose, clayey or silty SAND (SC/SM) from depths 0 to 2 feet to depths ranging from 20 to 22 feet below grade. Underlying these sandy strata, the borings found layers of loose/medium dense, fine/medium grained SAND (SP) material to depths of roughly 60 to 65 feet below grade. Boring B-1 then disclosed very dense, fine/coarse SAND (SP) from 65 feet to a termination depth of 77 feet below existing grade. Boring B-4 encountered medium dense coarse sandy materials (SP) with some pea gravels from 60 feet to termination depth of 77 feet. At a depth interval of about 40 to 50 feet, boring B-5 penetrated very dense silty SAND (SM) with some traces of clay before disclosing medium dense/dense to termination depth of 77 feet below grade. Groundwater was not encountered by any of our borings at termination depth of 77 feet below grade.

The proposed building is a 7- story concrete-framed structure with maximum column loads in the range of 600 to 800 kips. If the proposed building is supported on a shallow foundation system, the footings will experience total and differential settlements greater than tolerable limits. Therefore, we recommend that the proposed building be supported on a deep foundation system consisting of auger-cast piles or augered displacement piles.

A 14-inch and 16-inch diameter auger cast pile drilled to a depth of 50 feet below the existing grade can develop allowable capacities of 55 and 65 tons, respectively. A 14-inch and 16-inch diameter auger cast pile drilled to a depth of 60 feet below the existing grade can develop allowable capacities of 73 and 85 tons, respectively. A 14-inch and 16-inch diameter drilled to a depth of 70 feet below the existing grade can develop allowable capacities of 87 and 102 tons, respectively. These allowable values include a safety factor of 2.0 against an ultimate failure capacity computed using static equations. It is recommended that the piles be installed with a center-to-center spacing not less than 3 pile diameters. We recommend at least one (1) pile load test be performed to confirm the allowable pile capacity for each pile diameter and pile length to be installed during construction.

An alternative deep foundation system is augered displacement pile system. A 14-inch diameter pile drilled to depths of 40 and 50 feet below the existing grade can develop allowable capacities of 43 tons and 63 tons respectively. A 16-inch diameter pile drilled to depths of 40 and 50 feet below the existing grade can develop allowable capacities of 51 tons and 76 tons respectively. These allowable values include a safety factor of 2.0 against an ultimate failure capacity computed using static equations. The displacement pile system alternative if chosen should not be advanced beyond 50 feet depth due to the method of construction and the soil conditions at this site. Also, we recommend at least one (1) pile load test be performed to confirm the allowable pile capacity.

In order to assure that the auger-cast or augered displacement piles are properly installed, it is recommended that a geotechnical engineer or qualified soils technician under the supervision of the geotechnical engineer who is independent of the contractor perform continuous inspection during pile installation. An accurate record should be kept of the date, time, depth of penetration, the quantity of grout actually pumped into each pile hole, and other pertinent data for each pile.

It is possible that variations in soil conditions will be encountered during construction. In order to permit correlation between the anticipated subsurface conditions and the actual subsurface conditions encountered during the construction phase, we recommend that an engineer or qualified soils technician under the supervision of an engineer perform continuous inspection and review during the soils related phase of the construction. The actual construction means and methods are the responsibility of the contractor(s). The following construction related items pertain to general site preparation for the foundation support and are **not** intended to address all possible construction related concerns.

The summary presented above is considered to be general in nature, and should not be considered apart from this report. For more detailed design recommendations and specific site conditions, we recommend reviewing this report in its entirety.

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1.0 INTRODUCTION

This report presents the results of the geotechnical exploration performed for the Air Traffic Control Building to be located at the NAS Whiting Field in Milton, Florida. The purpose of this study was to explore the general subsurface conditions of the subject site and determine its effect on the support of the proposed facility. The services rendered by this firm during the course of this evaluation can be summarized as follows:

- Reviewed available in-house data such as results of similar evaluations in the site vicinity and published data including the U.S.G.S. Quadrangle map, and the Geologic Map of Florida.
- Performed a site reconnaissance and marked boring locations.
- Planned and performed five (5) Standard Penetration Test (SPT) borings across the site.
- Reviewed and analyzed all gathered data in order to evaluate the subsurface conditions with respect to the proposed development.
- Prepared this report, which includes the results of our field evaluations as well as our recommendations with respect to foundation design, foundation related site work, general site development, and quality control.

The conclusions and recommendations presented herein are based on currently accepted engineering principles and practices and on existing testing standards. The recommendations provided herein were developed from the information obtained from the field and laboratory programs that were performed at the specific locations and dates indicated on the boring logs. The nature and extent of variations throughout the geological profile may vary. If subsurface conditions are encountered other than those found within our authorized investigation, or if the location or structural characteristics of the proposed development should change, Gallet & Associates should be retained to review and revise the enclosed recommendations accordingly.

2.0 PROJECT CHARACTERISTICS

The proposed project will consist of the construction of a new Air Traffic Control Building to be located at the NAS Whiting Field in Milton, Florida. The proposed facility will be a seven story concrete structure with interior columns, load bearing exterior walls, slab-on-grade construction, and elevated floor slabs. As at the time of preparing this report, the column loads and wall loads were not provided. However, based on our experience with similar projects, we anticipate the maximum column loads will range from 600 to 800 kips with the wall loads on the order of 5 to 10 kips per linear foot. Estimated maximum uniform floor slab load is 100 psf. No topographic information was available at the time of preparation of this report.

3.0 FIELD AND LABORATORY PROGRAMS

3.1 Field Investigation

The geotechnical exploration consisted of drilling and sampling five (5) Standard Penetration Test (SPT) borings with continuous samples to 10 feet, then 5 foot intervals thereafter in the proposed building area. Two (2) of the soil borings were drilled to 27 feet below the existing grade and three (3) of the soil borings were drilled to 77 feet below the existing grade. The field program for the geotechnical exploration and the depths of the borings were provided by TETRA TECH NUS, Inc.

The approximate location of each boring is shown on the attached Boring Location Plan on Figure No. 1. Gallet & Associates marked these locations in the field using existing features and turning right angles. Therefore, the location of these test borings should be considered only as accurate as the means and methods by which they were determined.

The sampling and penetration procedures of the SPT borings were accomplished in accordance with **ASTM D-1586**, using a power rotary drill rig. The standard penetration tests were performed by driving a standard 1-3/8" I.D. and 2" O.D. split spoon sampler with a 140 pound hammer falling 30 inches. The number of hammer blows required to drive the sampler a total of 18 inches, in 6-inch increments, were recorded. The penetration resistance or "N" value is the summation of the last two 6-inch increments and is illustrated on the attached boring logs adjacent to their corresponding depths. The penetration resistance is used as an index to derive soil parameters from various empirical correlations. The results of the test borings are shown on the Boring Logs in Appendix A.

3.2 Laboratory Testing

During the field investigation, a representative portion of each recovered sample was sealed in plastic containers and transported to our laboratory for further visual classification (**ASTM-2487**) and laboratory examination. The description and stratification of the subsoil conditions, using the Unified Soil Classification system, are illustrated in the form of soil profiles on the attached Boring Logs. Selected samples retrieved from the borings were tested for Index Properties, such as Natural Moisture Content (**ASTM D-2216**), Sieve Analysis (**ASTM D-422**) to aid in the soil classification and to provide input to our analyses.

In addition, two (2) Modified Proctor density tests (**ASTM D-1557**), were performed on selected representative samples of the subsoils at borings B-1 (5-6 feet below grade) and B-5 (10-15 feet below grade.

The results of the laboratory tests are shown on the boring logs, adjacent to the soil profiles, at their corresponding sample depths in Appendix A, and/or on the individual laboratory reporting sheets in Appendix B.

4.0 SUBSURFACE CONDITIONS

4.1 Geological Survey

Santa Rosa County lies in the Coastal Plain, a broad belt consisting of primarily unconsolidated sands, silts, and clay (Marsh, 1966). The elevated areas of northern Santa Rosa County are within the Escambia Terraced Lands physiographic province (Brooks, 1981). The province is characterized by a mature landscape dissected by southward flowing streams.

The area is underlain by sandy soils that grade downward into unconsolidated clastic sediments of the Plio-Pleistocene Citronelle Formation (Miller, 1986; Fernald & Patton, 1984). The sandy to clayey surficial horizons of the Citronelle Formation are time-equivalent to the hydrogeologic Sand & Gravel Aquifer. In this area, the Sand & Gravel Aquifer extends to an elevation of approximately -300' NGVD (FGS, 1991). The Sand & Gravel Aquifer is the primary source of drinking water in Santa Rosa County.

Sediments of the Citronelle Formation are comprised of sands, silts, and clays, with minor amounts of gravel. This formation is not of a type associated with radon generation; EPA has classified Santa Rosa County as Zone 3: indoor average radon concentrations less than 2 Pico curies per liter.

4.2 Subsurface Soil Conditions

In general, the soil brings initially penetrated a layer of 1.5 to 3-inch thick asphalt and 2 to 10-inch thick concrete pavement. The soil borings then typically encountered medium dense or loose/very loose, clayey or silty SAND (SC/SM) from depths 0 to 2 feet to depths ranging from 20 to 22 feet below grade. Underlying these sandy strata, the borings found layers of loose/medium dense, fine/medium grained SAND (SP) material to depths of roughly 60 to 65 feet below grade. Boring B-1 then disclosed very dense, fine/coarse SAND (SP) from 65 feet to a termination depth of 77 feet below existing grade. Boring B-4 encountered medium dense coarse sandy materials (SP) with some pea gravels from 60 feet to termination depth of 77 feet. At a depth interval of about 40 to 50 feet, boring B-5 penetrated very dense silty SAND (SM) with some traces of clay before disclosing medium dense/dense to termination depth of 77 feet below grade. Groundwater was not encountered by any of our borings at termination depth of 77 feet below grade.

The use of pocket penetrometer did not produce any results because of the granular nature of the recovered samples.

For a more detailed description of the subsurface conditions encountered, please refer to the individual Boring Logs in Appendix A. It must be noted that the stratification lines indicated on the Boring Logs represent the approximate boundaries between major soil types and the actual transition may be gradual.

4.3 Groundwater Conditions

The depth to the groundwater table was measured at the time of completion for each of the test borings. At completion, groundwater was not encountered by any of our borings at the termination depth of 77 feet below grade. Note, that due to the relatively short time frame of the field investigation, the groundwater may not have had sufficient time to stabilize. The groundwater table in these areas will fluctuate in response to local variations of precipitation. Based upon the information we obtained from TETRA TECH NUS, Inc.'s field representative, who has done many well monitoring and other related field works at this site; groundwater level is usually encountered and a depth of 100 feet and below.

5.0 DESIGN RECOMMENDATIONS

The following design recommendations have been developed based on the previously described Project Characteristics (Section 2.0), the Subsurface Conditions (Section 4.0), and our experience with similar site and subsurface conditions. Should the site plan or structural characteristics change, this office should be notified so that we may review our recommendations in light of such changes.

5.1 General

The geotechnical exploration indicated that the site is suitable for the support of the proposed Air Traffic Control Building provided that the site preparation and construction are in accordance with the recommendations presented in this report.

Although no organic debris or obvious deleterious materials were encountered by any of our borings, we caution that burn pits, burial pits, organic debris, construction debris or other deleterious materials could exist across the site, between or away from our borings. Debris fill may not become evident until construction. Any deleterious materials, if observed should be removed and replaced with structural fill or other suitable materials.

5.2 Foundation Support

The proposed building is a 7- story concrete-framed structure with maximum column loads in the range of 600 to 800 kips. If the proposed building is supported on a shallow foundation system, the footings will experience total and differential settlements greater than tolerable limits. Therefore, we recommend that the proposed building be supported on a deep foundation system consisting of auger-cast piles or augered displacement piles.

A 14-inch and 16-inch diameter auger cast pile drilled to a depth of 50 feet below the existing grade can develop allowable capacities of 55 and 65 tons, respectively. A 14-inch and 16-inch diameter auger cast pile drilled to a depth of 60 feet below the existing grade can develop allowable capacities of 73 and 85 tons, respectively. A 14-inch and 16-inch diameter drilled to a depth of 70 feet below the existing grade can develop allowable capacities of 87 and 102 tons, respectively. These allowable values include a safety factor of 2.0 against an ultimate failure capacity computed using static equations. It is recommended that the piles be installed with a center-to-center spacing not less than 3 pile diameters. We recommend at least one (1) pile load test be performed to confirm the allowable pile capacity for each pile diameter and pile length to be installed during construction.

An alternative deep foundation system is augered displacement pile system. A 14-inch diameter pile drilled to depths of 40 and 50 feet below the existing grade can develop allowable capacities of 43 tons and 63 tons respectively. A 16-inch diameter pile drilled to depths of 40 and 50 feet below the existing grade can develop allowable capacities of 51 tons and 76 tons respectively. These allowable values include a safety factor of 2.0 against an ultimate failure capacity computed using static equations. The displacement pile system alternative if chosen should not be advanced beyond 50 feet depth due to the method of construction and the soil conditions at this site. Also, we recommend at least one (1) pile load test be performed to confirm the allowable pile capacity.

In order to assure that the auger-cast or augered displacement piles are properly installed, it is recommended that a geotechnical engineer or qualified soils technician who is independent of the contractor perform continuous inspection during pile installation. An accurate record should be kept of the date, time, depth of penetration, the quantity of grout actually pumped into each pile hole, and other pertinent data for each pile.

5.3 Settlement Analyses

The actual magnitude of settlement that will occur beneath foundations will depend upon the variations within the subsurface soil profile, the actual structural loading conditions, the embedment depth of the footings, the actual thickness of compacted fill or cut, and the quality of the earthwork operations.

Assuming that the foundation related site work and foundation design is completed in accordance with the enclosed it is our professional opinion that the settlement performance can be reduced to within tolerable limits for the type of structure considered. We anticipate that the maximum total post-construction settlement for the proposed structure supported by a deep foundation system consisting of auger cast or augered displacement piles will be on the order of 1.0 inch, with a maximum differential settlement of 0.5 inches. If the final grading plans are different than the anticipated grades, we recommend that a copy be forwarded to our office in order to evaluate the actual settlement and its impact on the proposed structures.

5.4 Floor Slab

The floor slab for the building area can be supported on the on-site material provided that the exposed subgrade within the building areas is densified with a large vibratory compactor (e.g. DYNAPAC CA-15 or equivalent). The densification should extend approximately 10 feet beyond the building perimeter. We further recommend that the floor slab subgrade elevation be maintained at a minimum of 2 feet above the groundwater level. The groundwater level is currently at approximately 10 feet below existing grade.

It is recommended that the floor slab be supported on at least 4 inches of relatively clean granular material, such as sand, sand and gravel, or crushed stone. The on-site sand material will not satisfy this requirement. This is to help distribute concentrated loads and equalize moisture beneath the slab. This granular material should have 100 percent passing the 1-1/2 inch sieve and a maximum of 10 percent passing the No. 200 sieve. The fines should have a maximum Plasticity Index of 6 and Liquid Limit of 25. The purpose of the granular material is to help distribute concentrated loads, equalize moisture beneath the slab, and provide an all-weather working surface.

A vertical modulus of subgrade reaction or "k" will be required for floor slab design. Based on past results with similar soils, a modulus of subgrade reaction or "k" of 150 pounds per cubic inch (pci, pounds per square inch per inch of deflection) may be used. The "k" value will increase if the thickness of base stone is increased.

5.5 On-Site Fill Suitability

Based upon information obtained during our investigation, on-site soils within the limits of this investigation are generally suitable as structural fill within the building area. Our laboratory test results indicated that the sandy soils encountered in the upper 6 feet are suitable for structural fill.

Therefore, it is our professional opinion that on-site soils free of topsoil and organics may be used as fill material provided they have a Liquid Limit (LL) not exceeding 40 percent and a Plasticity Index (PI) not exceeding 15 percent, and that the soils are moisture conditioned to within 2 percentage points of optimum moisture content prior to placement and compaction.

The on-site soils average natural moisture content ranges from roughly 1 to 39 percent. Therefore, if the on-site soils are used as fill moisture conditioning (i.e. drying/wetting) should be anticipated to achieve proper compaction level.

Two bulk samples were obtained from borings B-1 (5-6 ft) and B-5 (10-15 ft). The samples consisted of silty sand. The results indicate that the soils from borings B-1 and B-5 have Modified Proctor maximum dry densities of 120.4 pcf and 122.7 pcf at optimum moisture contents of 9.4 and 8.6 percent, respectively.

5.6 Uplift Resistance

Under wind loading conditions, the deep foundations may also be subject to uplift forces. The uplift capacity of individual pile may be taken as 30 percent of the design axial compression capacities as indicated in Section 5.2.

5.7 Lateral Resistance

For auger cast and augered displacement piles, we recommend a finite-element approach using P-y curves to determine the lateral capacity of the piles. The table below provides input values necessary to construct P-y curves for the encountered strata:

Layer Depths (ft)	**Material**	**Friction Angle, (deg)**	**Cohesion, c (ksf)**	**Horizontal Subgrade Modulus, k (pci)**	**Unit Weight, (pcf)**
0.0-20.0	Loose Sand	28	--	150	110
20.0-35.0	Loose Sand	30	--	150	110
35.0-50.0	Medium Dense Sand	32	--	200	110
50.0-65.0	Medium Dense Sand	35	--	200	115
65.0-77.0	Medium Dense Sand	32	--	200	110

Analyses to determine the lateral capacity of deep foundations were not performed. We would be pleased to perform these analyses after a pile type and size have been selected.

5.8 Lateral Earth Pressures

Any below-grade walls will be subjected to either "at-rest" or "active" lateral earth pressures. Walls, which are fixed at the top and bottom, may be subject to "at-rest" earth pressures. This "at-rest" pressure may be calculated as the equivalent pressure exerted by a fluid density of 52 pcf for above the water level. Walls which are not restrained at the top and allowed sufficient movement to mobilize "active" pressures should be designed using an equivalent fluid density of 34 pcf for above the water level.

These values do not include the effects of surcharge loads or sloping backfill and may be used only for walls above the groundwater table. Therefore, the presence of any groundwater due to surface water intrusion should be handled with the use of a drainage layer behind the walls with a collection pipe discharging accumulated water away from the walls. In addition, weep holes may be beneficial in dissipating hydrostatic pressure for walls not associated with buildings.

5.9 Drainage Considerations

Adequate drainage should be provided at the site in order to minimize increase in moisture content of the foundation soils. Excessive moisture can significantly reduce the soil's bearing capacity and contribute to foundation settlement. Furthermore, for the protection of the foundation soils, we recommend that the parking lots, walkways and general ground surface be sloped away from the structures on all sides. Curbs adjacent to landscaped areas should be set deep enough so that water percolating into the soil will not have free access to the pavement base materials.

In addition, roof drainage and surface water run-off from the adjacent slope should be collected by a system of gutters and downspouts and transmitted by pipe to the stormwater drainage system or discharge a minimum of five (5) feet away from the structures. As an alternative, splashblocks may be used as long as the ground surface is paved and slopes away from the structure.

5.10 Slope Design

The on-site soils having a medium dense relative density or better, can be classified as "Type C" according to the Construction Standard for Excavations (29 CFR Part 1926.650-.652, Subpart P) promulgated by the Occupational Safety and Health Administration (**OSHA**).

Therefore, temporary slopes in confined areas should typically be cut no steeper than 1.5(H):1(V). Slopes excavated in lower consistency soils or from which water is seeping should be sloped at a maximum of 2.0(H):1(V). However, current **OSHA** regulations should be observed for the temporary slopes. During construction, these temporary slopes should be regularly inspected for signs of movement or unsafe condition.

Permanent slopes that will require landscape maintenance should be graded flatter (approximately 3(H):1(V)). **It is also recommended that a minimum distance of 10 feet be provided between the top edge of any slope and any proposed structure.** Positive drainage should be maintained with ditches or channels at the top and bottom of slopes. In the fill slope areas, the pavement curbs at the tops of the slopes can serve as channels to divert water away from the slope face. For erosion protection, a protective cover of grass or other vegetation should be established on permanent slopes as soon as possible.

5.11 Pavement Areas

In areas where pavement elements will be removed for the purpose of building construction, the exposed pavement subgrade should be thoroughly proofrolled after construction and the pavement to be replaced should be consistent with the existing pavement conditions. The existing pavement conditions have 1.5 to 3 inches of asphalt underlain by an average of 6 inches of concrete over the densified subgrade.

6.0 GENERAL EARTHWORK RECOMMENDATIONS

It is possible that variations in soil conditions will be encountered during construction. In order to permit correlation between the anticipated subsurface conditions and the actual subsurface conditions encountered during the construction phase, we recommend that an engineer or qualified soils technician perform continuous inspection and review during the soils related phase of the construction. The actual construction means and methods are the responsibility of the contractor(s). The following construction related items pertain to general site preparation for the foundation support and are **not** intended to address all possible construction related concerns.

6.1 Site Preparation

Topsoil, vegetation, organic debris or other deleterious material should be removed from the area of the proposed construction. Topsoil and organic soils should be placed in non-structural areas, such as landscaped zones. Demolished asphalt and concrete pavements should also be removed from construction areas.

After rough grade has been established and prior to placement of any fill material, the exposed subgrade should be densified using a heavy vibratory roller having a maximum static weight of 12,000 lbs. capable of exerting a minimum impact energy of 20,000 lbs. (i.e. **DYNAPAC CA-15** or equivalent). A sufficient number of overlapping passes should be made by the vibratory roller in order to obtain a minimum density of 95 percent of the modified Proctor maximum dry density (**ASTM D-1557**) as tested to a minimum depth of 12 inches.

It should be pointed out that the enclosed recommendations could be amended depending on the actual finish grade elevations. We request permission to evaluate the finish site plans and possibly amend our recommendations accordingly.

6.2 Fill Selection, Placement and Compaction

All material to be used, as fill should be inspected, tested and approved by a geotechnical engineer from our office. Off-site borrow materials may be used as fill within the building and pavement areas provided that their Liquid Limit (**LL**) and Plasticity Index (**PI**) do not exceed 40 and 15, respectively, and that they contain a maximum of 10 percent passing the No. 200 sieve.

In building areas, structural fill should be extended a minimum of 10 feet outside all building lines. The fill should be placed in thin loose lifts not exceeding 8 inches in thickness and compacted accordingly. Based on our experience with soils similar to those on this site and similar type of construction, we recommend that the following minimum level of compaction based on the modified Proctor compaction test, **ASTM D-1557**:

- Building Areas - 95 percent of the soil's maximum modified Proctor density value **(ASTM D-1557)** at +3 to –3 percentage points of its optimum moisture content

In order for the fill material to perform as intended, the fill must be placed in a manner which results in a uniform fill compacted within the moisture and density ranges previously outlined. Density testing must be on fill soils to verify this performance as construction progresses. We recommend that the density be performed on each lift at a frequency of no less than 1 test for each 5,000 square feet of fill placement in building areas, and no less than 1 test for each 10,000 square feet of all other fill operations.

6.3 Pile Inspection

In order to assure that the selected pile system is properly installed, it is recommended that a geotechnical engineer or qualified soils technician under the supervision of a geotechnical engineer who is independent of the contractor perform continuous inspection during pile installation. An accurate record should be kept of the date, time, depth of penetration, the quantity of grout actually pumped into each pile hole, driving resistance and other pertinent data for each specific pile.

6.4 Construction Dewatering

Groundwater was not encountered by any of our borings at termination depth of 77 feet below grade. Based on our field observation and the anticipated finish floor elevation, densification to improve the upper loose sand soils are not anticipated to encounter the groundwater table. Should dewatering become necessary due to perched water conditions, shallow excavations could be dewatered with the use of a perimeter ditch and/or sump pumps outside the limits of the foundation. In any event, dewatering should be such that the groundwater level is controlled to a minimum depth of 2 feet below the elevation that is being compacted.

6.5 Seismic Site Coefficient

The site class used for evaluating seismic loads was determined using the International Building Code, 2006 Edition. From Table 1613.5.2 and the results of our test borings, the site class was determined to be E.