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SUBSURFACE INVESTIGATION

FOR

HOLIDAY INN EXPRESS
SOUTHCREST PARKWAY
SOUTHAVEN, MISSISSIPPI

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REVISED

BY

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PURPOSE

The purposes of this subsurface investigation are as follows:

a. To determine the general characteristics of the subsurface soils within the area of the proposed construction;

b. To determine by field and laboratory testing, the physical characteristics of the foundation soils and the soil samples collected; and

c. To make recommendations for foundation construction at this particular location.

FIELD INVESTIGATION

Nine subsurface borings were made for the proposed Holiday Inn Express in Southaven, Mississippi. The borings were advanced with a truck mounted, powered continuous flight auger. Auger cuttings of the soil medium were collected at changes in strata and at intervals not exceeding five feet in depth. All samples were stored in sealed containers for later classification and testing. In addition, standard penetration resistance values (see ASTM D-1586-84) were determined and recorded on the boring logs for the various materials encountered. The Standard Penetration Test gives an indication of the in-place shear strength of cohesive soils and the relative density of cohesionless soils by recording the number of blows required, by a 140-pound hammer falling 30 inches, to drive a 2-inch O.D. splitspoon sampler one foot. Any static water levels noted in the borings while drilling or after completion of drilling and sampling operations at the site were measured and recorded on the boring logs.

LABORATORY INVESTIGATION

Laboratory testing of selected soil samples included visual classification, Atterberg limits on cohesive soils with determination of the plasticity index (PI), grain size analyses, and in situ moisture contents. Atterberg limits (ASTM D-4318-93) were run on the clayey soils in an effort to estimate the susceptibility of these soils to shrink and swell with changes in moisture content. Liquid and plastic limits were run on samples selected from some of the various materials encountered. The liquid limit (LL) is the moisture content at which a soil changes from a plastic state to a viscous liquid state. The plastic limit is the moisture content at which a soil changes from a solid state to a plastic state. The plasticity index is the numerical difference between the liquid limit and the plastic limit and is indicative of the relative activity or sensitivity of a cohesive soil.

Grain size analyses (ASTM D-422-63) were conducted on representative samples of the various soils encountered to determine the particle size distribution of materials comprising the strata. Results of these tests were utilized in classifying the soils by the Unified Soil Classification System and in estimating the California Bearing Ratio (CBR) of the soils. Classifications for each of the soil samples are shown on the boring logs and test results attached to this report.

To aid in the general interpretation of the soil conditions at the site, in situ moisture contents were determined for samples selected from the various soils encountered. This determination was made possible by placing extracted samples in sealed containers immediately upon removal from each interval. The results of these and other tests are recorded on the attached boring logs.

SUBSURFACE CONDITIONS

The proposed construction for Holiday Inn Express is located on Southcrest Parkway in Section 25, Township 1 South, Range 8 West, Southaven, Desoto County, Mississippi in the Loess Bluffs physiographic unit of Mississippi. This unit lies in the Gulf Coastal Plain physiographic province of North America. Structurally, the area is on the east flank of the Mississippi Embayment, north of the Mississippi-Arkansas trough, and northwest of the Senatobia Ridge. Stratigraphically, the soils in this area are mainly derived from the Pleistocene Loess deposits and the Eocene Kosciusko Formation. The loess is a wind-deposited material that tends to have uniform engineering properties. The Kosciusko Formation is a non-marine deltaic unit.

Nine borings were advanced at the site: four to depths of 15 feet; one to a depth of 40 feet; and, four to depths of 10 feet. The materials noted in the borings were predominantly lean clay (CL) with clayey sand (SC) noted below 30 feet in Boring No. B-5. Please see the Soils Data Table below. The soil colors were mainly brown, gray, and tan with some red. The Standard Penetration Test (SPT) blow-count data suggested the clays were medium to hard in consistency, and the relative density of the clayey sands was medium to dense.

Soils Data Table
Holiday Inn Express
Southaven, MS

Boring	CL	CL w/tr grav or w/grav	CL w/sd	SC	Total Depth
B-1	0' - 13 1/2'	13 1/2' - 15'			15'
B-2	0' - 15'				15'
B-3	2 1/2' - 5'	0' - 2 1/2'; 5' - 15'			15'
B-4		0' - 15'			15'
B-5	0' - 13 1/2'	13 1/2' - 30'		30' - 40'	40'
P-1	0' - 10'				10'
P-2	0' - 2 1/2'	2 1/2' - 10'			10'
P-3	0' - 10'				10'
P-4	0' - 2 1/2'		2 1/2' - 10'		10'

Depths are in feet (') below the surface.

Most of the material encountered in the borings was lean clay (CL) to lean clay with gravel (CL) as can be seen in the Soils Data Table above. These clays were brown, tan, and gray; tan; tan, gray, and brown; red, brown, and tan; brown; brown and tan; tan and gray; tan and brown; and tan and red in color. Consistencies were medium to hard as inferred from SPT blow counts that ranged from 5 blows to 36 blows (average 16 blows). Percent passing through the #200 grain-size sieve varied from

60.4 percent to 98.6 percent and averaged 92.1 percent. These are low to medium plasticity clays with plasticity indices ranging from 10 percent to 20 percent (average 13.9 percent) and liquid limits ranging from 31 percent to 42 percent (average 35 percent). Small to moderate changes in volume could be noted with changes in moisture content. Field moisture contents ranged from 8.3 percent to 23.0 percent and averaged 16.5 percent. These lean clays can lose strength with increases in moisture content.

One stratum of red to tan and gray clayey sand with gravel (SC) was noted in Boring No. B-5 (see Soils Data Table above). Field moisture contents were 21.1 percent in each sample; 20 percent and 35 percent passed the #200 grain-size sieve. The clay content lent low plasticity to the sand: plasticity indices were 13 percent and 15 percent and liquid limits were 29 percent and 43 percent. No significant changes in volume are anticipated with changes in moisture content. Relative densities of the sand were medium to dense as inferred from SPT blow counts of 20 blows and 35 blows.

No static water levels were noted during or after completion of drilling and sampling operations as noted on the Soils Data Table above. The actual water table at the site can only be determined with long-term observations. We note that groundwater conditions in this area do fluctuate during the year with variations in rainfall and other environmental factors. Therefore, the groundwater levels and soil moisture contents will vary throughout the year and will probably be different if tested at a different time.

RECOMMENDATIONS FOR SITE PREPARATION AND FOUNDATIONS

We understand that this project will consist of adding a new Holiday Inn Express in Southaven, Mississippi. The following conclusions and recommendations are based on our understanding of the proposed construction, information gathered during the exploration, accepted geotechnical engineering principles and practices, and our experience with similar sites and subsurface conditions. This report has been prepared for the exclusive use of Roy Patel, Brandon, Mississippi in the planning and design of the building. We request that we be informed of any significant changes to the proposed construction so we might review our recommendations in light of the new information. We should also be given an opportunity to review the final foundation and grading plans, as well as applicable portions of the project specifications, prior to construction.

Final plans and specifications were not available at the time of this geotechnical report, but the footprint of the building will be on a construction area that is essentially flat. Based upon our interpretation of the soil conditions at the site, it is our opinion that the proposed construction could be supported using a pile foundation. Further details of our recommendations are discussed below.

SITE PREPARATION

As noted above, the materials noted in the borings were predominantly lean clay (CL) with some traces of gravel and with clayey sand (SC) noted below 30 feet. The Standard Penetration Test (SPT) blow-count data suggested the clays were medium to hard in consistency, and the relative density of the clayey sands was medium to dense.

The soil strengths at this site are variable with low to medium strength down to approximately 3 feet. The next layer was not continuous across the building but it is a high strength layer estimated to be 3 to 5 feet thick. The third layer is estimated to be from a depth of 8 feet to 23 feet and is a medium strength material. The final layer from 23 feet to the depth of the boring at 40 feet is a high strength material.

Any type of slab foundation for a 5-story hotel, built on the given site, would require one of the following options, Option A - excavating 15 feet of material and replacing it with compacted select fill. Option B - a drilled pile foundation would have to be founded on the hard lean clay at a minimum of 25 feet deep. Option C - A Geopier foundation could be used but this is a proprietary design and is required to be designed by the company.

Following excavation we recommend that the subgrade in all fill areas be evaluated by a geotechnical engineer or his representative prior to fill placement. The engineer may recommend proof-rolling the areas as a means of evaluating the suitability of the subgrade for fill. Proof-rolling consists of systematically patrolling the area preferably in perpendicular directions, utilizing a heavily loaded dump truck (minimum 20 tons) or other suitable vehicle approved by the engineer. Any areas which pump or rut excessively and which cannot be densified by continued rolling should be undercut to suitable material and properly backfilled. If the construction footprint is too small for proof-rolling, numerous density tests or hand held cone penetration tests should be conducted to determine soft areas. The measured penetration resistance at each location can be subsequently converted to an in situ bearing capacity for the foundation.

Select structural-fill material should be placed in maximum loose lifts of 8 inches and should be compacted to 98 percent standard Proctor density (ASTM D-698-91) within 2 percentage points of optimum moisture content. Sufficient field density tests should be conducted to insure compaction requirements are met during construction. As a rule of thumb, we recommend that two density tests per lift be performed for each 2000 square feet of surface area. In addition, monitoring of fill construction and compaction will result in minimizing future settlement of the fill and the structure. Therefore, we believe that it is important that a qualified geotechnical engineer or certified technician monitor earthwork operations and that this work not be controlled by the earthwork contractor.

The select, structural-fill material should consist of a material having a liquid limit of less than 40 percent and a plasticity index between 8 percent and 20 percent. The excavated materials that include topsoil should not serve as select fill and should be disposed of outside the foundation area. Excavated material that meets the specifications described here could be used as select fill.

FOUNDATION STRENGTHS

The foundation system should bear in the compacted select fill at a minimum depth 24 inches below the finished grade elevation. Minimum depths needed to offset wind forces should be verified by your structural engineer. All foundation members should be reinforced both top and bottom, sufficient to resist differential movement, and the completed foundation system should provide for uniform distribution of applied loads to the bearing soils. The maximum soil pressure under the foundation members should not exceed 2.7 kips per square foot for continuous foundation units or 3.0 kips per square foot for individual spread footings. Foundations sized in accordance with recognized criteria for the above stated allowable soil bearing pressure should provide a factor of safety of 2.0 - 3.0 against ultimate failure of the soil medium with total estimated settlements of 1 inch, more or less.

The building could be founded on end bearing piles at a depth of 25 feet on the very stiff to hard lean clay (CL). The maximum soil pressure under the foundation members should not exceed 12 kips per square foot for individual piles. Foundations sized in accordance with recognized criteria for the above stated allowable soil bearing pressure should provide a factor of safety of 2.0 against ultimate failure of the soil medium.

SITE MAINTENANCE

Note that the soils at this site contain lean clays (CL) that can lose strength with increases in moisture content. It is important to properly control the moisture content of these soils during construction. Recent inspections of several buildings that have had differential movement have noted water exiting from gutters beside the foundations and inadequate grades for the swales that should remove surface water. The final site-grading plan should provide for quick runoff of surface waters away from the building foundations in all directions. Any beds for flowers and shrubs should not be boxed in and should be sloped down away from the building foundation. Sprinkler systems located close to the building foundation should be controlled by nearby soil moisture content and not specific time schedules. In addition, any foundation soils in exposed excavations that become wet or soft should be removed and replaced prior to footing installation. The landscape plans should insure that large water consuming trees and shrubs are not located within 50 feet of the perimeter of the foundation members. Where any large trees or stumps are removed or where any plumbing or electrical trenches are cut under the foundation, select fill material should be used and compacted.

All foundation recommendations made in this report are contingent upon proper execution of the earthwork requirements noted herein. We believe that it is very important that a qualified geotechnical engineer, familiar with working with such soils, be present during foundation construction.

RECOMMENDATIONS FOR PARKING AREAS AND ACCESS DRIVES

As noted above, the near-surface material occurring under the paving construction area consisted of lean clay (CL) materials with small traces of gravel and sand. Consistency of these clay materials, as inferred from Standard Penetration Test (SPT) data, was stiff to hard.

The foundation soil should be excavated a minimum of 1 foot, independent of the amount of select fill to be used, to remove any topsoil, debris, and organics. The soils at this site are variable in both strength and composition. Every effort should be made to insure that the exposed soils do not "dry out" during construction. Any soft or wet areas encountered during construction which cannot be stabilized should be undercut and filled with compacted select material.

We recommend proof-rolling the area as a means of evaluating the suitability of the subgrade for fill or pavement support. Proof-rolling is defined above. We recommend that, after proof-rolling, the subgrade soils for any cut sections should be compacted to 98 percent standard Proctor density (ASTM D-698-91) within 2 percentage points of optimum moisture content to a depth of 8 inches.

Compacted fill should then be placed to bring the subgrade up to elevation where required. Prior to placing the select fill in any area, we recommend that the subgrade be evaluated by a geotechnical engineer or his representative to determine the suitability of the subgrade.

Select-fill material should consist of a soil having a liquid limit of not more than 40 percent and a plasticity index between 8 percent and 22 percent. This soil should be placed in maximum loose lifts of 8 inches and also compacted to a minimum of 98 percent standard Proctor density. Compaction for the entire site could be attained using a rubber tired or sheeps foot roller. After preparation of the subgrade, the remaining pavement structure can then be placed according to the recommendations provided below.

Based on the type of soils encountered, we anticipate that a CBR value greater than 3 will be representative of the strength of the prepared subgrade soils and compacted fill placed at this site, assuming proper control of the soil moisture content. It is our assumption that the parking lot and access drive will be used by the guests, employees, and a minimum of two-axle trucks for any deliveries; this precludes street traffic. Based on that assumption and the soil properties, we have selected a Structural Number (SN) of 2.3 for the parking lot and 2.9 for the access drive design and the dumpster pad (based on AASHTO Guide for Design of Pavement Structures, Chapter 4, Low-Volume Road Design, 1986). One of the following pavement alternatives should be used, assuming proper compaction of the subgrade soils:

LIGHT PARKING

Alternative #1

a) Base Course - Five (5) inches of hot mixed Bituminous Base course (BB-1, Type 6) conforming to Mississippi State Highway Department (MSHD) Specifications.

b) Surface Course - One and one half (1 ½) inches of hot mixed bituminous Surface Course (SC-1, Type 8) conforming to MSHD Specifications.

Alternative # 2

a) Granular Subbase - Six (6) inches of crushed limestone, No. 610 conforming to MSHD Specifications.

b) Base Course - Four (4) inches of hot mixed Bituminous Base, (BB-1, Type 6) conforming to MSHD Specifications.

c) Surface Course - One and one-half (1 ½) inches of hot mixed bituminous Surface Course, (SC-1, Type 8) conforming to MSHD Specifications.

Alternative #3

Surface Course - Five (5) inches of Portland Cement Concrete.

ACCESS ROADS

Alternative #1

a) Base Course - Six and one-half (6 ½) inches of hot mixed Bituminous Base, (BB-1, Type 6) conforming to (MSHD) Specifications.

b) Surface Course - One and one-half (1 ½) inches of hot mixed bituminous Surface Course, (SC-1, Type 8) conforming to MSHD Specifications.

Alternative # 2

Surface - Six (6) inches of Portland Cement Concrete.

DUMPSTER PAD

Surface - Six (6) inches of Portland Cement Concrete. The dumpster pad should be the total length of dumpster and the garbage truck.

The concrete pavement recommendations are for non-reinforced Portland Cement concrete pavement placed on a eight-inch-thick 610 limestone base course placed on the compacted subgrade. The base course should be compacted to a minimum of 98 percent standard Proctor density immediately prior to concrete placement. The concrete should have a minimum 28-day flexural strength of 650 psi and a compressive strength of 4000 psi. Joint spacing, joint configuration, mix design, mix placement, and curing should conform to the recommendations of the American Concrete Institute (ACI) and the Portland Cement Association (PCA).

Applicable Mississippi State Highway Department specifications and structural number coefficients utilized in the pavement recommendations are provided as follows:

a) Bituminous Surface Course - Structural Coefficient = 0.44- hot mixed bituminous Surface Course (SC-1, Type 8) - Mississippi Standard Specifications for Road and Bridge Construction (1990 edition), Section 703, Pages 703-14&15 or from the AASHTO Interim Guide for Design of Pavement Structures.

b) Bituminous Base Course - Structural Coefficient = 0.34 - hot mixed Bituminous Base Course (BB-1, Type 6) - Mississippi Standard Specifications for Road and Bridge Construction (1990 edition), Section 703, Pages 703-14&15 or from the AASHTO Guide.

c) Granular subbase - Structural Coefficient = 0.11 - crushed limestone, No. 610, ASTM D 2940-98 Specifications or from the AASHTO Guide.

All pavement design recommendations made in this report are contingent upon proper execution of the subgrade requirements noted herein. We believe that it is very important that a qualified geotechnical engineer, familiar with working with such soils, be present after excavation and during proof-rolling, fill, and compaction. In addition, sufficient field-density tests should be taken to insure that the compaction criteria are satisfied, and to reduce the possibility of settlement at this location. It is important that a good drainage system be established to quickly remove surface water, thus leaving no standing water.

REPORT LIMITATIONS

The recommendations made in this report are based on the assumption that the borings are representative of the subsurface conditions throughout the site. Therefore, we cannot warrant that our boring logs represent subsurface conditions at other locations or times. If during construction, any unusual or significantly different conditions are encountered, we should be advised in order to review the changed conditions, and subsequently reconsider any of the above recommendations.

Further, we are available to review those portions of the plans and specifications relating to earthwork and foundations for this particular project and request that we be retained to do so in order to determine whether the plans and specifications are consistent with the recommendations contained within this report. In addition, we are available to observe foundation construction procedures, including interpretation of the use of on-site materials and compaction of the structural fill, quality control of concrete placement, and other field observations and quality-control measures as required.