

IMPORTANT

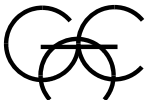
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GILES ENGINEERING ASSOCIATES, INC.



GILES ENGINEERING ASSOCIATES, INC.



Geotechnical Engineering Exploration and Analysis

Building 41 Roof Structure Repair
National Soldiers Home Historic District
Milwaukee, Wisconsin

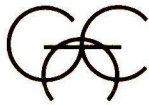
Prepared For:

Chequamegon Bay Engineering, Inc.
Milwaukee, Wisconsin

March 30, 2012
Project No. 1G-1201012



GILES
ENGINEERING ASSOCIATES, INC.



GILES

ENGINEERING ASSOCIATES, INC.

GEOTECHNICAL, ENVIRONMENTAL & CONSTRUCTION MATERIALS CONSULTANTS

- Atlanta, GA
- Baltimore/Wash. DC
- Dallas, TX
- Los Angeles, CA
- Milwaukee, WI
- Orlando, FL

March 30, 2012

Chequamegon Bay Engineering, Inc.
933 North Mayfair Road, Suite 109
Milwaukee, WI 53226

Attention: Mr. David J. Cleary, P.E.
Project Manager

Subject: Geotechnical Engineering Exploration and Analysis
Building 41 Roof Structure Repair
National Soldiers Home Historic District
Milwaukee, Wisconsin
Project No. 1G-1201012

Dear Mr. Cleary:

As requested, Giles Engineering Associates, Inc. conducted a *Geotechnical Engineering Exploration and Analysis* for the proposed project. The accompanying report describes the services that were conducted for the project and it provides geotechnical engineering-related findings, conclusions and recommendations that were derived from those services.

We sincerely appreciate the opportunity to provide geotechnical engineering consulting services for the proposed project. Please contact the undersigned if there are questions concerning the report or if we may be of further service.

Very truly yours,

GILES ENGINEERING ASSOCIATES, INC.

David M. Cornale, EIT
Staff Professional II

Jeffrey S. Miller, P.E.
Sr. Project Manager



ENCLOSURES

- Appendix A - Figure (1) and Test Boring Logs (2)
- Appendix B - Field Procedures
- Appendix C - Laboratory Testing and Classification
- Appendix D - General Information and Important Information about Your Geotechnical Report

Distribution: Chequamegon Bay Engineering, Inc.
Attn: David J. Cleary (2 via USPS, 1 via email: dcleary@cheqbayeng.com)

GEOTECHNICAL ENGINEERING EXPLORATION AND ANALYSIS

BUILDING 41 ROOF STRUCTURE REPAIR NATIONAL SOLDIERS HOME HISTORIC DISTRICT MILWAUKEE, WISCONSIN PROJECT NO. 1G-1201012

1.0 SCOPE OF SERVICES

This report provides the results of the *Geotechnical Engineering Exploration and Analysis* that Giles Engineering Associates, Inc. ("Giles") conducted regarding the proposed project. The *Geotechnical Engineering Exploration and Analysis* included several separate, but related, service areas referenced hereafter as the Geotechnical Subsurface Exploration Program, Geotechnical Laboratory Services, and Geotechnical Engineering Services. The scope of each service area was narrow and limited, as directed by our client and in consideration of the proposed project. The scope of each service area is briefly explained later.

Geotechnical engineering-related recommendations regarding a determination of the allowable foundation bearing capacity for design and construction of foundation support of temporary shoring for the proposed roof structure repair are provided in this report. Design of the temporary shoring structures are beyond Giles scope of services for this project. Environmental consulting was also beyond Giles authorized scope of services for this project.

2.0 SITE DESCRIPTION

A brief description of the site area is provided below. It is understood that the project civil and structural engineers have performed an evaluation of the site area.

The site of the proposed temporary roof shoring supports consists of a basement area within the north central portion of the existing Building 41 (Ward Memorial Hall). It is understood that the temporary shoring is planned to be supported on the basement floor/subgrade within the area approximately below the stage. The approximate site area is depicted on Figure 1, enclosed in Appendix A.

The ground (basement) surface in the site area consisted of a relatively level clay brick floor. Load bearing brick columns and walls generally surround the site area. Accumulated soil, debris and previous building components were within the basement in the site and surrounding areas. The basement floor surface is shallow relative to the surrounding exterior grades and appeared to be at approximately the same elevation as the exterior ground surface grades on the south side of the building.



3.0 PROJECT DESCRIPTION

It is understood that proposed project consists of constructing shoring to temporarily support the existing roof structure such that a deteriorated truss and purlin can be repaired in-place. Details of the proposed shoring structures were not yet available. It is assumed that the shoring is planned to be supported by steel plates or temporary concrete pads bearing on the basement floor or the basement floor subgrade. It is assumed that maximum individual temporary foundation bearing loads will be on the order of 5 to 10 kips.

4.0 GEOTECHNICAL SUBSURFACE EXPLORATION PROGRAM

The purpose of the Geotechnical Subsurface Exploration Program was to explore the subsurface conditions by coring the basement floor and drilling two geotechnical test borings at the site on March 19th, 2012. The floor slab coring was performed with a 3.75-inch diameter diamond bit wet-cut core barrel. The test borings were drilled with manual equipment and both of the test borings were advanced to a depth of 8± feet below the basement floor surface. The test boring locations were positioned on-site relative to the existing building features. The approximate test boring locations are shown on the *Test Boring Location Plan* (Figure 1) enclosed in Appendix A.

Soil samples were collected from the test borings, at certain depths, using a combination of thin-wall tube samples and Geoprobe samplers. Immediately after sampling, the recovered samples were retained and labeled at the site for identification. The basement floor cores were also labeled and retained after coring. The retained samples were transported to Giles' geotechnical laboratory as part of the Geotechnical Subsurface Exploration Program.

5.0 GEOTECHNICAL LABORATORY SERVICES

The retained samples were delivered to our geotechnical laboratory and classified using the descriptive terms and particle-size criteria shown on the *General Notes* in Appendix D, and by using the Unified Soil Classification System (ASTM D 2488-75) as a general guide. The classifications are shown on the *Records of Subsurface Exploration*, along with horizontal lines that show estimated depths of material change. Field-related information pertaining to the test borings is also shown on the *Records of Subsurface Exploration*. For simplicity and abbreviation, terms and symbols are used on the *Records of Subsurface Exploration*; the terms and symbols are defined on the *General Notes*.

Unconfined compressive strength, calibrated penetrometer resistance and moisture content tests were performed in Giles laboratory on the soil samples obtained from the subsurface exploration. Measurement of the thicknesses of the basement floor surface cores was performed in Giles laboratory. Additionally, a compressive strength test was performed on a 2.5-inch by 2.5 inch cube sample prepared from the core of the basement floor material (brick) obtained from Test Boring 2. Laboratory procedures are described in Appendix C.



6.0 MATERIAL CONDITIONS

As material sampling at the test borings was discontinuous, it was necessary for Giles to estimate conditions between sample intervals. The estimated conditions at the test borings are briefly discussed in this section and are described in more detail on the *Records of Subsurface Exploration*. Also, the conclusions and recommendations in this report are based on the estimated and encountered conditions.

6.1. Basement Floor

Yellow brown clay ("cream-city") brick was encountered at the basement floor surface. The brick floor surface thickness measured at each test boring is listed in Table 1 below, along with the result of the compressive strength test performed on a sample of the brick from Test Boring 2. Joints between the bricks were observed within each core. The joints were tight and appeared to be mortared. Additionally, a thin concrete surface (0.1± inches thick) was observed at the top surface of a portion of the core at Test Boring 1.

TABLE 1 – BRICK CORE SAMPLE THICKNESS AND COMPRESSIVE STRENGTH		
Test Boring	Thickness (inches)	Compressive Strength (psi)
1	2.5	--
2	2.3	2432

Approximately 2 and 3 inches of silty fine to coarse sand with gravel, classified as fill material, was encountered below the clay brick floor surface at Test Borings 2 and 1, respectively. Brick fragments were also within the silty sand at Test Boring 2. Voids between the brick surface and the underlying silty sand with gravel were not observed in the test borings.

6.2. Floor Subgrade Soils

Soil consisting of native very stiff to hard silty clay with trace sand and gravel was encountered below sand and gravel fill and brick floor and extended to the test boring termination depth of 8± feet below grade. The upper 4± feet of the silty clay contained fissures with calcareous deposits in the fissures. Additionally, a wet seam was encountered at the lower portion of the fissured silty clay at Test Boring 2, at a depth of approximately 4 feet.

7.0 GROUNDWATER CONDITIONS

It is estimated that the water table was deeper than the maximum test boring depth of 8± feet below-ground at the test borings when the Geotechnical Subsurface Exploration Program was conducted. However, a perched groundwater condition was encountered at Test Boring 2, at a depth of 4± feet below grade at the time of drilling. Groundwater and perched water conditions will fluctuate and may also develop and/or exist at shallower depths seasonally.



The estimated groundwater table and perched water depths are only approximations based on the colors and relative water content of the retained soil samples, and water levels that were encountered at the test borings. The actual water table depths may be higher or lower than estimated. If a more precise depth estimate is needed, groundwater observation wells are recommended to be installed and observed at the site. Giles can install and observe the wells, if it is decided that observation wells are necessary.

8.0 CONCLUSIONS AND RECOMMENDATIONS

8.1. Temporary Shoring Foundation Support Recommendations

Spread Footing Bearing Capacity

The foundation analysis was conducted with the understanding that the temporary shoring foundations are planned to bear either upon the existing brick floor or the underlying soil subgrade. Based on test borings, footings bearing on suitable existing soil or the brick surface may be designed using a 6,000 psf maximum, net, allowable soil bearing capacity. It is recommended that isolated footings be spaced at least one footing with from adjacent footings. More closely spaced footings may need to be designed for a lower allowable bearing capacity due to stress overlap affects. Isolated footing pads are recommended to be at least 24 inches wide for geotechnical considerations, regardless of the calculated foundation bearing stress. A maximum subgrade modulus (k_{v1}) value of 180 pounds per square inch per inch (psi/in) may alternatively be used for foundation design. The modulus provided is based on a 1 foot by 1 foot rigid plate. It is recommended that a structural engineer or architect provide specific foundation details including footing dimensions, reinforcing, and other details.

The soil at the assumed foundation bearing elevations is expected to be suitable to support spread footings designed for a maximum 6,000 psf foundation bearing pressure. However, if the foundations are to be supported by the brick floor, it is recommended that the floor be evaluated at individual footing locations to determine if voids are present below the floor surface. Voids were not encountered at the test boring locations but could be present in other locations and not observed unless properly evaluated. If a potential presence of voids below the brick floor is detected, the floor should be removed to permit foundations to bear within suitable bearing native soil.

Foundation Support Soil Requirements

Footing pads are recommended to be directly and entirely supported by suitable-bearing native soil, the brick floor surface or on engineered fill placed continuous from a suitable bearing native soil sub-grade. A level bearing surface is recommended directly below the footing bearing grade; therefore, if the floor surface is used for direct footing support, a leveling material may be required to create a suitable level bearing surface. Based on the recommended 6,000 psf allowable bearing capacity, the unconfined compressive strength of cohesive (clayey)



foundation support soil, such as silty clay, is recommended to be at least 3.0 tons per square foot (tsf). It is further recommended that the strength characteristics of soil within the entire foundation influence zone (determined by Giles during construction) meet or exceed the recommended values, unless Giles approves lesser values.

It is recommended that Giles evaluate foundation support soil immediately before foundation construction. The purpose of the recommended evaluation is to confirm that the foundation will be properly supported and confirm that the support soil is similar to the conditions described on the *Records of Subsurface Exploration*. In the event that another firm performs the recommended foundation evaluation of foundation support soil, they should use appropriate means and methods and Giles must be notified if the composition or strength characteristics of foundation support soil differ from those shown on the *Records of Subsurface Exploration* so that alterations to our recommendations can be made if needed.

Soil that is within the foundation influence zone but does not meet the recommended strength criteria (described above), or is otherwise unsuitable, is recommended to be improved in-place by surface compaction, where possible, or replaced. Unsuitable bearing material could be replaced with engineered fill, such as well-graded aggregate, or lean-mix Portland cement concrete (with a minimum 28-day compressive strength of 500 psi). Giles can provide recommendations pertaining to soil over-excavation and replacement at the time of construction. As an option to soil replacement footing pads could be stepped or thickened to extend through unsuitable bearing materials. It is recommended that a structural engineer or architect provide the specific details of stepped or thickened footings.

Estimated Foundation Settlement

The post-construction total and differential settlements of temporary shoring foundations designed and constructed based on the recommendations of this report and within the limits of the site area are estimated to be less than about 0.75 inch and 0.5 inch, respectively. The post-construction angular distortion is estimated to be less than about 0.002 inch per inch across a distance of 20 feet or more.

Existing Construction Considerations

The foundations for the temporary shoring are not recommended to bear within the influence area of existing foundations, without further evaluation. It is recommended that Giles be present on-site during the foundation construction so that proper foundation support is confirmed. Care must be taken to protect the existing building during construction of the temporary shoring.



8.2. Recommended Construction Materials Testing Services

This report was prepared assuming that Giles will perform Construction Materials Testing ("CMT") services during construction of the proposed development. In general, CMT services are recommended (and expected) to at least include observation and testing of: foundation, support soil and other construction materials. It might be necessary for Giles to provide supplemental geotechnical recommendations based on the results of CMT services and specific details of the project not known at this time.

8.3. Basis of Report

This report is based on *Giles'* proposal, which is dated October 7, 2011 and is referenced by *Giles'* proposal number 1GP-1110013. The actual services for the project varied somewhat from those described in the proposal because of the conditions that were encountered while performing the services and in consideration of the proposed project.

This report is strictly based on the project description given earlier in this report. *Giles* must be notified if any parts of the project description or our assumptions are not accurate so that this report can be amended, if needed. This report is based on the assumption that the facility will be designed and constructed according to the codes that govern construction at the site.

The conclusions and recommendations in this report are based on estimated subsurface conditions as shown on the *Records of Subsurface Exploration*. *Giles* must be notified if the subsurface conditions that are encountered during construction of the proposed development differ from those shown on the *Records of Subsurface Exploration* because this report will likely need to be revised. General comments and limitations of this report are given in the appendix.

1G-1201012-entirereport/12Geo01/dmc



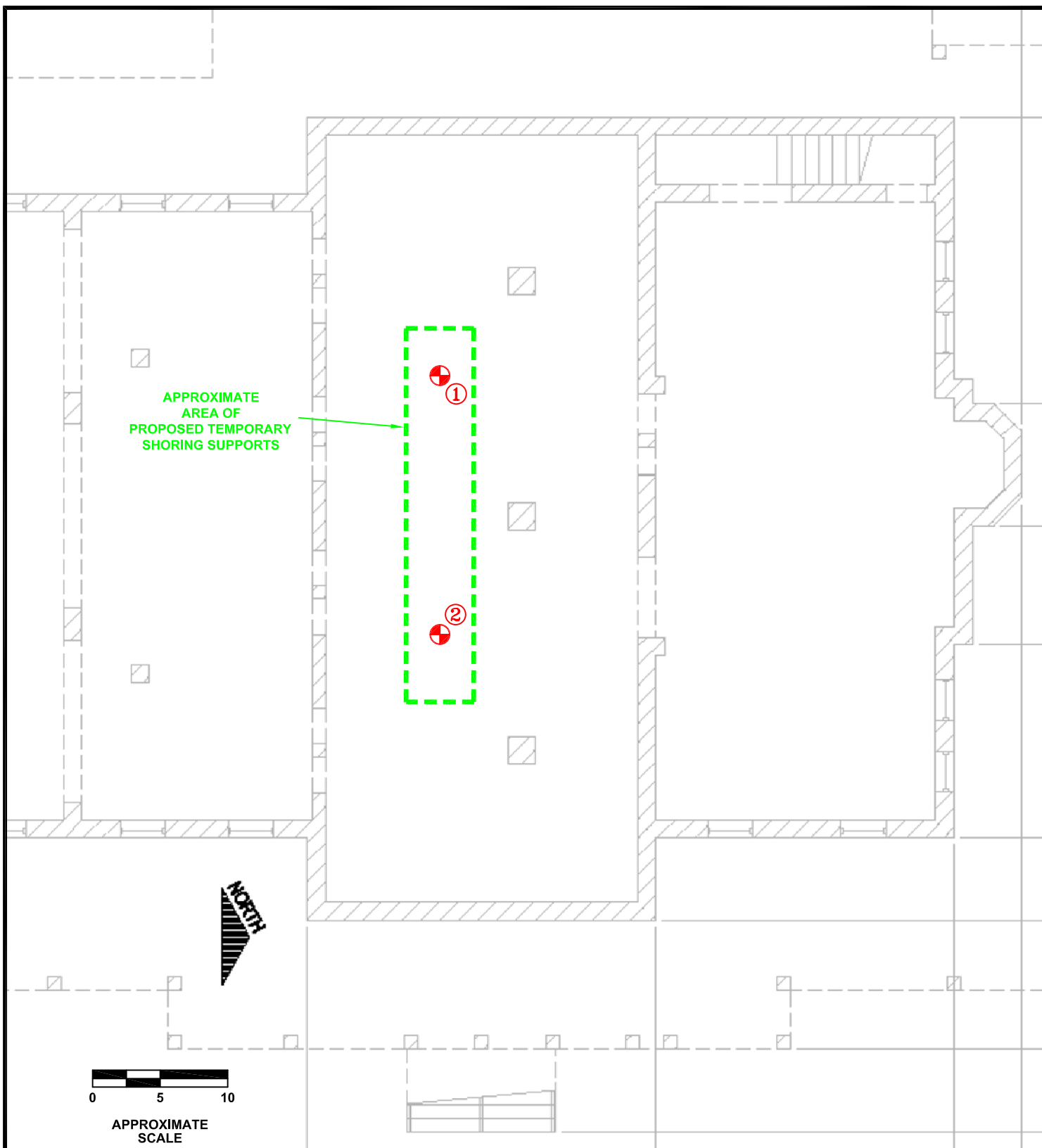
APPENDIX A

FIGURES AND TEST BORING LOGS

The Test Boring Location Plan contained herein was prepared based upon information supplied by *Giles'* client, or others, along with *Giles'* field measurements and observations. The diagram is presented for conceptual purposes only and is intended to assist the reader in report interpretation.

The Test Boring Logs and related information enclosed herein depict the subsurface (soil and water) conditions encountered at the specific boring locations on the date that the exploration was performed. Subsurface conditions may differ between boring locations and within areas of the site that were not explored with test borings. The subsurface conditions may also change at the boring locations over the passage of time.





LEGEND:



GEOTECHNICAL TEST BORING

NOTES:

- 1.) TEST BORING LOCATIONS AND SITE AREA ARE APPROXIMATE.
- 2.) BASE MAP DEVELOPED FROM THE "BASEMENT LEVEL / FOUNDATION PLAN - EXISTING CONDITIONS" (DWG. NO. G100), DATED 3-7-12, PREPARED BY PLUNKETT RAYSICH ARCHITECTS, LLP.

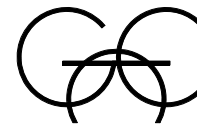


GILES ENGINEERING ASSOCIATES, INC.
N8 W22350 JOHNSON DRIVE, SUITE A1
WAUKESHA, WI 53186 (262)544-0118

FIGURE 1
TEST BORING LOCATION PLAN
BUILDING 41 ROOF STRUCTURE REPAIR
NATIONAL SOLDIERS HOME HISTORIC DISTRICT
MILWAUKEE, WISCONSIN

DESIGNED	DRAWN	SCALE	DATE	REVISED
DMC	JSZ	approx. 1"=10'	03-30-12	--
PROJECT NO.: 1G-1201012			CAD No. 1g1201012-blp	

RECORD OF SUBSURFACE EXPLORATION



**GILES ENGINEERING
ASSOCIATES, INC.**

Atlanta Dallas
Los Angeles Milwaukee
Orlando Washington, D.C.

BORING NO. & LOCATION:

1

SURFACE ELEVATION:

PROJECT:

Building 41 Roof Structure Repair

PROJECT LOCATION:

National Soldiers Home Historic District

COMPLETION DATE:

3/19/12

FIELD REPRESENTATIVE:

David Cornale

Milwaukee, Wisconsin

GILES PROJECT NUMBER: 1G-1201012

MATERIAL DESCRIPTION	Feet Below Surface	Sample No. & Type	N	q _u (tsf)	q _p (tsf)	q _s (tsf)	w (%)	PID	NOTES
2.5"± Yellow-Brown Clay Brick		1-DB							
3"± Brown Silty fine to coarse Sand, little Gravel (Fill)-Moist		2-TS		4.7	3.5		18		
Brown and Gray-Brown Silty Clay, trace Sand and Gravel-Damp (fissured with calcareous deposits in fissures)		3-TS		7.6	4.5+		18		
(wet seam at 4± feet)		4-TS		6.3	4.5		20		
Brown Silty Clay, trace Sand and Gravel-Moist	5								
		5-PS			4.0		17		

Boring Terminated at 8 Feet

WATER OBSERVATION DATA

REMARKS



WATER ENCOUNTERED DURING DRILLING: 4.0 ft.

TS=1.5" diameter thin wall tube sampler



WATER LEVEL AFTER REMOVAL: 6.5 ft.

PS=1.25" diameter GeoProbe sampler



CAVE DEPTH AFTER REMOVAL: 6.5 ft.



WATER LEVEL AFTER HOURS:

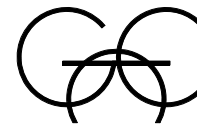


CAVE DEPTH AFTER HOURS:

Changes in strata indicated by the lines are approximate boundary between soil types. The actual transition may be gradual and may vary considerably between test borings. Location of test boring is shown on the Boring Location Plan.

NORMAL BORING LOGS 1G1201012.GPJ GIL_CORP.GDT 3/30/12

RECORD OF SUBSURFACE EXPLORATION



**GILES ENGINEERING
ASSOCIATES, INC.**

Atlanta Dallas
Los Angeles Milwaukee
Orlando Washington, D.C.

BORING NO. & LOCATION:

2

SURFACE ELEVATION:

PROJECT:

Building 41 Roof Structure Repair

PROJECT LOCATION:

National Soldiers Home Historic District

COMPLETION DATE:

3/19/12

FIELD REPRESENTATIVE:

David Cornale

Milwaukee, Wisconsin

GILES PROJECT NUMBER: 1G-1201012

MATERIAL DESCRIPTION	Feet Below Surface	Sample No. & Type	N	q _u (tsf)	q _p (tsf)	q _s (tsf)	w (%)	PID	NOTES
2.3"± Yellow-Brown Clay Brick		1-DB							
2"± Brown Silty fine to medium Sand, some Gravel-Moist (contains Brick fragments)		2-TS		3.8	4.0		19		
Brown and Gray-Brown Silty Clay, trace Sand and Gravel-Damp (fissured with calcareous deposits in fissures)		3-TS		6.1	4.5		18		
Brown Silty Clay, trace Sand and Gravel-Moist		4-TS			3.5		17		
	5-								
		5-PS			3.0		20		

Boring Terminated at 8 Feet

WATER OBSERVATION DATA

REMARKS



WATER ENCOUNTERED DURING DRILLING: None

TS=1.5" diameter thin wall tube sampler



WATER LEVEL AFTER REMOVAL: None

PS=1.25" diameter GeoProbe sampler



CAVE DEPTH AFTER REMOVAL: 6.5 ft.



WATER LEVEL AFTER HOURS:



CAVE DEPTH AFTER HOURS:

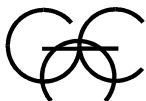
Changes in strata indicated by the lines are approximate boundary between soil types. The actual transition may be gradual and may vary considerably between test borings. Location of test boring is shown on the Boring Location Plan.

NORMAL BORING LOGS 1G1201012.GPJ GIL_CORP.GDT 3/30/12

APPENDIX B

FIELD PROCEDURES

The field operations were conducted in general accordance with the procedures recommended by the American Society for Testing and Materials (ASTM) designation D 420 entitled "Standard Guide for Sampling Rock and Rock" and/or other relevant specifications. Soil samples were preserved and transported to *Giles'* laboratory in general accordance with the procedures recommended by ASTM designation D 4220 entitled "Standard Practice for Preserving and Transporting Soil Samples." Brief descriptions of the sampling, testing and field procedures commonly performed by *Giles* are provided herein.



GENERAL FIELD PROCEDURES

Test Boring Elevations

The ground surface elevations reported on the Test Boring Logs are referenced to the assumed benchmark shown on the Boring Location Plan (Figure 1). Unless otherwise noted, the elevations were determined with a conventional hand-level and are accurate to within about 1 foot.

Test Boring Locations

The test borings were located on-site based on the existing site features and/or apparent property lines. Dimensions illustrating the approximate boring locations are reported on the Boring Location Plan (Figure 1).

Water Level Measurement

The water levels reported on the Test Boring Logs represent the depth of “free” water encountered during drilling and/or after the drilling tools were removed from the borehole. Water levels measured within a granular (sand and gravel) soil profile are typically indicative of the water table elevation. It is usually not possible to accurately identify the water table elevation with cohesive (clayey) soils, since the rate of seepage is slow. The water table elevation within cohesive soils must therefore be determined over a period of time with groundwater observation wells.

It must be recognized that the water table may fluctuate seasonally and during periods of heavy precipitation. Depending on the subsurface conditions, water may also become perched above the water table, especially during wet periods.

Borehole Backfilling Procedures

Each borehole was backfilled upon completion of the field operations. If potential contamination was encountered, and/or if required by state or local regulations, boreholes were backfilled with an “impervious” material (such as bentonite slurry). Borings that penetrated pavements, sidewalks, etc. were “capped” with Portland Cement concrete, asphaltic concrete, or a similar surface material. It must, however, be recognized that the backfill material may settle, and the surface cap may subside, over a period of time. Further backfilling and/or re-surfacing by *Giles’* client or the property owner may be required.



FIELD SAMPLING AND TESTING PROCEDURES

Auger Sampling (AU)

Soil samples are removed from the auger flights as an auger is withdrawn above the ground surface. Such samples are used to determine general soil types and identify approximate soil stratifications. Auger samples are highly disturbed and are therefore not typically used for geotechnical strength testing.

Split-Barrel Sampling (SS) – (ASTM D-1586)

A split-barrel sampler with a 2-inch outside diameter is driven into the subsoil with a 140-pound hammer free-falling a vertical distance of 30 inches. The summation of hammer-blows required to drive the sampler the final 12-inches of an 18-inch sample interval is defined as the “Standard Penetration Resistance” or N-value is an index of the relative density of granular soils and the comparative consistency of cohesive soils. A soil sample is collected from each SPT interval.

Shelby Tube Sampling (ST) – (ASTM D-1587)

A relatively undisturbed soil sample is collected by hydraulically advancing a thin-walled Shelby Tube sampler into a soil mass. Shelby Tubes have a sharp cutting edge and are commonly 2 to 5 inches in diameter.

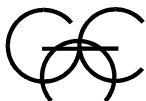
Bulk Sample (BS)

A relatively large volume of soils is collected with a shovel or other manually-operated tool. The sample is typically transported to *Giles’* materials laboratory in a sealed bag or bucket.

Dynamic Cone Penetration Test (DC) – (ASTM STP 399)

This test is conducted by driving a 1.5-inch-diameter cone into the subsoil using a 15-pound steel ring (hammer), free-falling a vertical distance of 20 inches. The number of hammer-blows required to drive the cone 1¾ inches is an indication of the soil strength and density, and is defined as “N”. The Dynamic Cone Penetration test is commonly conducted in hand auger borings, test pits and within excavated trenches.

- Continued -



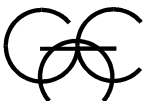
GILES ENGINEERING ASSOCIATES, INC.

Ring-Lined Barrel Sampling – (ASTM D 3550)

In this procedure, a ring-lined barrel sampler is used to collect soil samples for classification and laboratory testing. This method provides samples that fit directly into laboratory test instruments without additional handling/disturbance.

Sampling and Testing Procedures

The field testing and sampling operations were conducted in general accordance with the procedures recommended by the American Society for Testing and Materials (ASTM) and/or other relevant specifications. Results of the field testing (i.e. N-values) are reported on the Test Boring Logs. Explanations of the terms and symbols shown on the logs are provided on the appendix enclosure entitled "General Notes".



APPENDIX C

LABORATORY TESTING AND CLASSIFICATION

The laboratory testing was conducted under the supervision of a geotechnical engineer in accordance with the procedures recommended by the American Society for Testing and Materials (ASTM) and/or other relevant specifications. Brief descriptions of laboratory tests commonly performed by *Giles* are provided herein.



LABORATORY TESTING AND CLASSIFICATION

Photoionization Detector (PID)

In this procedure, soil samples are “scanned” in *Giles’* analytical laboratory using a Photoionization Detector (PID). The instrument is equipped with an 11.7 eV lamp calibrated to a Benzene Standard and is capable of detecting a minute concentration of **certain** Volatile Organic Compound (VOC) vapors, such as those commonly associated with petroleum products and some solvents. Results of the PID analysis are expressed in HNu (manufacturer’s) units rather than actual concentration.

Moisture Content (w) (ASTM D 2216)

Moisture content is defined as the ratio of the weight of water contained within a soil sample to the weight of the dry solids within the sample. Moisture content is expressed as a percentage.

Unconfined Compressive Strength (qu) (ASTM D 2166)

An axial load is applied at a uniform rate to a cylindrical soil sample. The unconfined compressive strength is the maximum stress obtained or the stress when 15% axial strain is reached, whichever occurs first.

Calibrated Penetrometer Resistance (qp)

The small, cylindrical tip of a hand-held penetrometer is pressed into a soil sample to a prescribed depth to measure the soils capacity to resist penetration. This test is used to evaluate unconfined compressive strength.

Vane-Shear Strength (qs)

The blades of a vane are inserted into the flat surface of a soil sample and the vane is rotated until failure occurs. The maximum shear resistance measured immediately prior to failure is taken as the vane-shear strength.

Loss-on-Ignition (ASTM D 2974; Method C)

The Loss-on-Ignition (L.O.I.) test is used to determine the organic content of a soil sample. The procedure is conducted by heating a dry soil sample to 440°C in order to burn-off or “ash” organic matter present within the sample. The L.O.I. value is the ratio of the weight loss due to ignition compared to the initial weight of the dry sample. L.O.I. is expressed as a percentage.



Particle Size Distribution (ASTB D 421, D 422, and D 1140)

This test is performed to determine the distribution of specific particle sizes (diameters) within a soil sample. The distribution of coarse-grained soil particles (sand and gravel) is determined from a "sieve analysis," which is conducted by passing the sample through a series of nested sieves. The distribution of fine-grained soil particles (silt and clay) is determined from a "hydrometer analysis" which is based on the sedimentation of particles suspended in water.

Consolidation Test (ASTM D 2435)

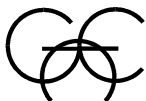
In this procedure, a series of cumulative vertical loads are applied to a small, laterally confined soil sample. During each load increment, vertical compression (consolidation) of the sample is measured over a period of time. Results of this test are used to estimate settlement and time rate of settlement.

Classification of Samples

Each soil sample was visually-manually classified, based on texture and plasticity, in general accordance with the Unified Soil Classification System (ASTM D-2488-75). The classifications are reported on the Test Boring Logs.

Laboratory Testing

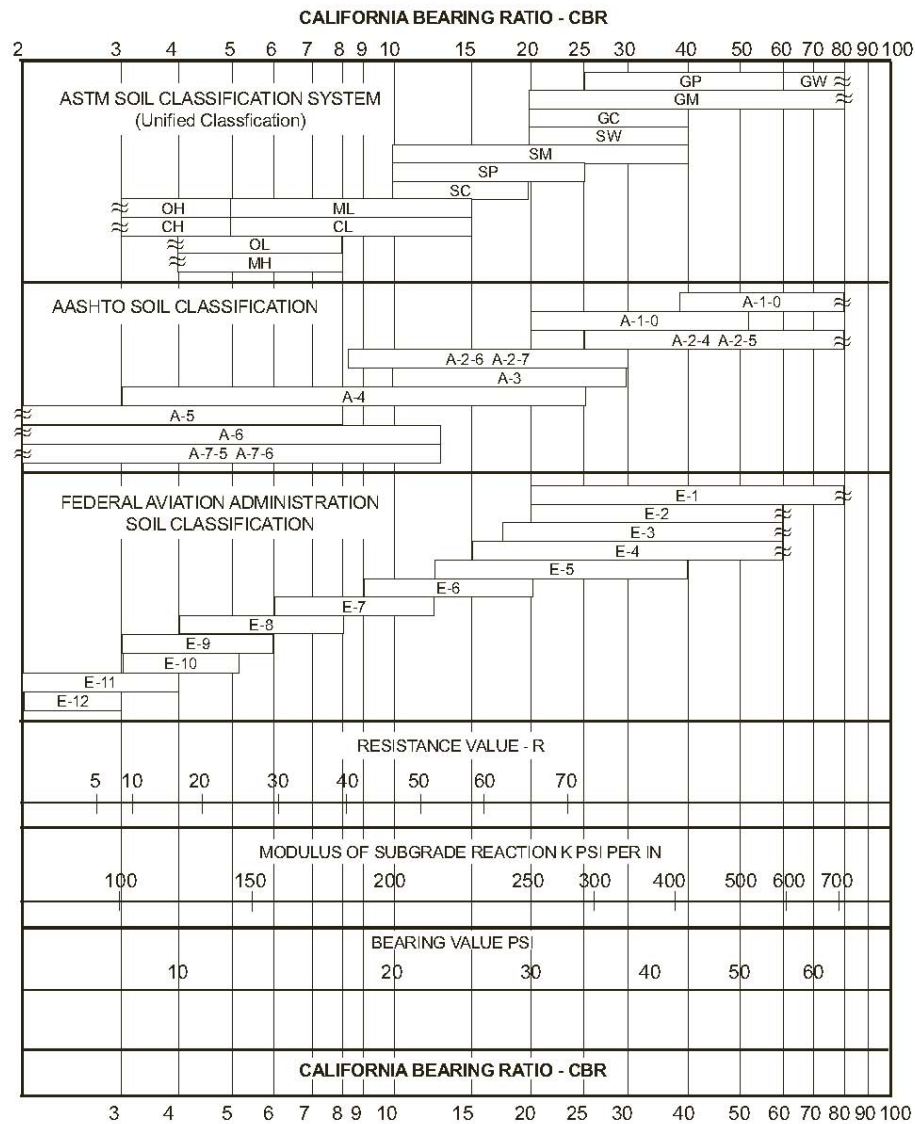
The laboratory testing operations were conducted in general accordance with the procedures recommended by the American Society for Testing and Materials (ASTM) and/or other relevant specifications. Results of the laboratory tests are provided on the Test Boring Logs or other appendix enclosures. Explanation of the terms and symbols used on the logs is provided on the appendix enclosure entitled "General Notes."



California Bearing Ratio (CBR) Test ASTM D-1833

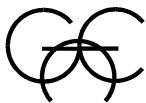
The CBR test is used for evaluation of a soil subgrade for pavement design. The test consists of measuring the force required for a 3-square-inch cylindrical piston to penetrate 0.1 or 0.2 inch into a compacted soil sample. The result is expressed as a percent of force required to penetrate a standard compacted crushed stone.

Unless a CBR test has been specifically requested by the client, the CBR is estimated from published charts, based on soil classification and strength characteristics. A typical correlation chart is below.



APPENDIX D

GENERAL INFORMATION



GILES ENGINEERING ASSOCIATES, INC.

GENERAL COMMENTS

The soil samples obtained during the subsurface exploration will be retained for a period of thirty days. If no instructions are received, they will be disposed of at that time.

This report has been prepared exclusively for the client in order to aid in the evaluation of this property and to assist the architects and engineers in the design and preparation of the project plans and specifications. Copies of this report may be provided to contractor(s), with contract documents, to disclose information relative to this project. The report, however, has not been prepared to serve as the plans and specifications for actual construction without the appropriate interpretation by the project architect, structural engineer, and/or civil engineer. Reproduction and distribution of this report must be authorized by the client and *Giles*.

This report has been based on assumed conditions/characteristics of the proposed development where specific information was not available. It is recommended that the architect, civil engineer and structural engineer along with any other design professionals involved in this project carefully review these assumptions to ensure they are consistent with the actual planned development. When discrepancies exist, they should be brought to our attention to ensure they do not affect the conclusions and recommendations provided herein. The project plans and specifications may also be submitted to *Giles* for review to ensure that the geotechnical related conclusions and recommendations provided herein have been correctly interpreted.

The analysis of this site was based on a subsoil profile interpolated from a limited subsurface exploration. If the actual conditions encountered during construction vary from those indicated by the borings, *Giles* must be contacted immediately to determine if the conditions alter the recommendations contained herein.

The conclusions and recommendations presented in this report have been promulgated in accordance with generally accepted professional engineering practices in the field of geotechnical engineering. No other warranty is either expressed or implied.



**GUIDE SPECIFICATIONS FOR SUBGRADE AND GRADE PREPARATION
FOR FILL, FOUNDATION, FLOOR SLAB AND PAVEMENT SUPPORT;
AND SELECTION, PLACEMENT AND COMPACTION OF FILL SOILS
USING STANDARD PROCTOR PROCEDURES**

1. Construction monitoring and testing of subgrades and grades for fill, foundation, floor slab and pavement; and fill selection, placement and compaction shall be performed by an experienced soils engineer and/or his representatives.
2. All compaction fill, subgrades and grades shall be (a) underlain by suitable bearing material; (b) free of all organic, frozen, or other deleterious material, and (c) observed, tested and approved by qualified engineering personnel representing an experienced soils engineer. Preparation of subgrades after stripping vegetation, organic or other unsuitable materials shall consist of (a) proof-rolling to detect soil, wet yielding soils or other unstable materials that must be undercut, (b) scarifying top 6 to 8 inches, (c) moisture conditioning the soils as required, and (d) recompaction to same minimum in-situ density required for similar materials indicated under Item 5. Note: compaction requirements for pavement subgrade are higher than other areas. Weather and construction equipment may damage compacted fill surface and reworking and retesting may be necessary to assure proper performance.
3. In overexcavation and fill areas, the compacted fill must extend (a) a minimum 1 foot lateral distance beyond the exterior edge of the foundation at bearing grade or pavement subgrade and down to compacted fill subgrade on a maximum 0.5(H):1(V) slope, (b) 1 foot above footing grade outside the building, and (c) to floor subgrade inside the building. Fill shall be placed and compacted on a 5(H):1(V) slope or must be stepped or benched as required to flatten if not specifically approved by qualified personnel under the direction of an experienced soil engineer.
4. The compacted fill materials shall be free of deleterious, organic, or frozen matter, shall contain no chemicals that may result in the material being classified as "contaminated", and shall be low-expansive with a maximum Liquid Limit (ASTM D-423) and Plasticity Index (ASTM D-424) of 30 and 15, respectively, unless specifically tested and found to have low expansive properties and approved by an experienced soils engineer. The top 12 inches of compacted fill should have a maximum 3-inch-particle diameter and all underlying compacted fill a maximum 6-inch-diameter unless specifically approved by an experienced soils engineer. All fill materials must be tested and approved under the direction of an experienced soils engineer prior to placement. If the fill is to provide non-frost susceptible characteristics, it must be classified as a clean GW, GP, SW or SP per the Unified Soil Classification System (ASTM D-2487).
5. For structural fill depths less than 20 feet, the density of the structural compacted fill and scarified subgrade and grades shall not be less than 95 percent of the maximum dry density as determined by Standard Proctor (ASTM-698) with the exception of the top 12 inches of pavement subgrade which shall have a minimum in-situ density of 100 percent of maximum dry density, or 5 percent higher than underlying fill materials. Where the structural fill depth is greater than 20 feet, the portions below 20 feet should have a minimum in-place density of 100 percent of its maximum dry density of 5 percent greater than the top 20 feet. The moisture content of cohesive soil shall not vary by more than -1 to +3 percent and granular soil ± 3 percent of the optimum when placed and compacted or recompacted, unless specifically recommended/approved by the soils engineer monitoring the placement and compaction. Cohesive soils with moderate to high expansion potentials ($PI > 15$) should, however, be placed, compacted and maintained prior to construction at a moisture content 3 ± 1 percent above optimum moisture content to limit further heave. The fill shall be placed in layers with a maximum loose thickness of 8 inches for foundations and 10 inches for floor slabs and pavement, unless specifically approved by the soils engineer taking into consideration the type of materials and compaction equipment being used. The compaction equipment should consist of suitable mechanical equipment specifically designed for soil compaction. Bulldozers or similar tracked vehicles are typically not suitable for compaction.
6. Excavation, filling, subgrade and grade preparation shall be performed in a manner and sequence that will provide drainage at all times and proper control of erosion. Precipitation, springs and seepage water encountered shall be pumped or drained to provide a suitable working platform. Springs or water seepage encountered during grading/foundation construction must be called to the soil engineer's attention immediately for possible construction procedure revision or inclusion of an underdrain system.
7. Non-structural fill adjacent to structural fill should typically be placed in unison to provide lateral support. Backfill along walls must be placed and compacted with care to ensure excessive unbalanced lateral pressures do not develop. The type of fill material placed adjacent to below-grade walls (i.e. basement walls and retaining walls) must be properly tested and approved by an experienced soils engineer with consideration for the lateral pressure used in the wall design.
8. Whenever, in the opinion of the soils engineer or the Owner's Representatives, an unstable condition is being created either by cutting or filling, the work shall not proceed into that area until an appropriate geotechnical exploration and analysis has been performed and the grading plan revised, if found necessary.



CHARACTERISTICS AND RATINGS OF UNIFIED SOIL SYSTEM CLASSES FOR SOIL CONSTRUCTION *									
Class	Compaction Characteristics	Max. Dry Density Standard Proctor (pcf)	Compressibility and Expansion	Drainage and Permeability	Value as an Embankment Material	Value as Subgrade When Not Subject to Frost	Value as Base Course	Value as Temporary Pavement	
								With Dust Palliative	With Bituminous Treatment
GW	Good: tractor, rubber-tired, steel wheel or vibratory roller	125-135	Almost none	Good drainage, pervious	Very stable	Excellent	Good	Fair to poor	Excellent
GP	Good: tractor, rubber-tired, steel wheel or vibratory roller	115-125	Almost none	Good drainage, pervious	Reasonably stable	Excellent to good	Poor to fair	Poor	
GM	Good: rubber-tired or light sheepsfoot roller	120-135	Slight	Poor drainage, semipervious	Reasonably stable	Excellent to good	Fair to poor	Poor	Poor to fair
GC	Good to fair: rubber-tired or sheepsfoot roller	115-130	Slight	Poor drainage, impervious	Reasonably stable	Good	Good to fair **	Excellent	Excellent
SW	Good: tractor, rubber-tired or vibratory roller	110-130	Almost none	Good drainage, pervious	Very stable	Good	Fair to poor	Fair to poor	Good
SP	Good: tractor, rubber-tired or vibratory roller	100-120	Almost none	Good drainage, pervious	Reasonably stable when dense	Good to fair	Poor	Poor	Poor to fair
SM	Good: rubber-tired or sheepsfoot roller	110-125	Slight	Poor drainage, impervious	Reasonably stable when dense	Good to fair	Poor	Poor	Poor to fair
SC	Good to fair: rubber-tired or sheepsfoot roller	105-125	Slight to medium	Poor drainage, impervious	Reasonably stable	Good to fair	Fair to poor	Excellent	Excellent
ML	Good to poor: rubber-tired or sheepsfoot roller	95-120	Slight to medium	Poor drainage, impervious	Poor stability, high density required	Fair to poor	Not suitable	Poor	Poor
CL	Good to fair: sheepsfoot or rubber-tired roller	95-120	Medium	No drainage, impervious	Good stability	Fair to poor	Not suitable	Poor	Poor
OL	Fair to poor: sheepsfoot or rubber-tired roller	80-100	Medium to high	Poor drainage, impervious	Unstable, should not be used	Poor	Not suitable	Not suitable	Not suitable
MH	Fair to poor: sheepsfoot or rubber-tired roller	70-95	High	Poor drainage, impervious	Poor stability, should not be used	Poor	Not suitable	Very poor	Not suitable
CH	Fair to poor: sheepsfoot roller	80-105	Very high	No drainage, impervious	Fair stability, may soften on expansion	Poor to very poor	Not suitable	Very poor	Not suitable
OH	Fair to poor: sheepsfoot roller	65-100	High	No drainage, impervious	Unstable, should not be used	Very poor	Not suitable	Not suitable	Not suitable
Pt	Not suitable		Very high	Fair to poor drainage	Should not be used	Not suitable	Not suitable	Not suitable	Not suitable

* "The Unified Classification: Appendix A - Characteristics of Soil, Groups Pertaining to Roads and Airfields, and Appendix B - Characteristics of Soil Groups Pertaining to Embankments and Foundations," Technical Memorandum 357, U.S. Waterways Experiment Station, Vicksburg, 1953.

** Not suitable if subject to frost.



UNIFIED SOIL CLASSIFICATION SYSTEM (ASTM D-2487)

Major Divisions		Group Symbols		Typical Names		Laboratory Classification Criteria			
<div>Coarse-grained soils (more than half of material is larger than No. 200 sieve size)</div> <div><div>Gravels (More than half of coarse fraction is larger than No. 4 sieve size)</div><div><div>Clean gravels (little or no fines)</div><div>GP</div><div>Well-graded gravels, gravel-sand mixtures, little or no fines</div></div><div><div>Gravels with fines (appreciable amount of fines)</div><div><div>GM^a</div><div>d</div><div>u</div><div>Silty gravels, gravel-sand-silt mixtures</div></div><div>GC</div><div>Clayey gravels, gravel-sand-clay mixtures</div></div><div>Sands (More than half of coarse fraction is smaller than No. 4 sieve size)</div><div><div>Clean sands (Little or no fines)</div><div>SW</div><div>Well-graded sands, gravelly sands, little or no fines</div></div><div><div>SP</div><div>Poorly graded sands, gravelly sands, little or no fines</div></div><div><div>Sands with fines (Appreciable amount of fines)</div><div><div>SM^a</div><div>d</div><div>u</div><div>Silty sands, sand-silt mixtures</div></div><div>SC</div><div>Clayey sands, sand-clay mixtures</div></div></div> <div><div>Determine percentages of sand and gravel from grain-size curve.</div><div>Depending on percentage of fines (fraction smaller than No. 200 sieve size), coarse-grained soils are classified as follows: GW, GP, SW, SP GM, GC, SM, SC</div><div><div>Borderline cases requiring dual symbols^b</div><div>Less than 5 percent: More than 12 percent: 5 to 12 percent:</div></div></div>						<div>$C_u = \frac{D_{60}}{D_{10}}$ greater than 4; $C_c = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ between 1 and 3</div> <div>Not meeting all gradation requirements for GW</div> <div><div>Atterberg limits below "A" line or P.I. less than 4</div><div>Limits plotting within shaded area, above "A" line with P.I. between 4 and 7 are <i>borderline</i> cases requiring use of dual symbols</div></div> <div><div>Atterberg limits above "A" line or P.I. greater than 7</div></div>			
						<div>$C_u = \frac{D_{60}}{D_{10}}$ greater than 4; $C_c = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ between 1 and 3</div> <div>Not meeting all gradation requirements for SW</div> <div><div>Atterberg limits below "A" line or P.I. less than 4</div><div>Limits plotting within shaded area, above "A" line with P.I. between 4 and 7 are <i>borderline</i> cases requiring use of dual symbols</div></div> <div><div>Atterberg limits above "A" line or P.I. greater than 7</div></div>			
						<div>Plasticity Chart</div>			

^a Division of GM and SM groups into subdivisions of d and u are for roads and airfields only. Subdivision is based on Atterberg limits, suffix d used when L.L. is 28 or less and the P.I. is 6 or less; the suffix u is used when L.L. is greater than 28.

^b Borderline classifications, used for soils possessing characteristics of two groups, are designated by combinations of group symbols. For example GW-GC, well-graded gravel-sand mixture with clay binder.

GENERAL NOTES

SAMPLE IDENTIFICATION

All samples are visually classified in general accordance with the Unified Soil Classification System (ASTM D-2487-75 or D-2488-75)

DESCRIPTIVE TERM (% BY DRY WEIGHT)

Trace:	1-10%
Little:	11-20%
Some:	21-35%
And/Adjective	36-50%

PARTICLE SIZE (DIAMETER)

Boulders:	8 inch and larger
Cobbles:	3 inch to 8 inch
Gravel:	coarse - $\frac{3}{4}$ to 3 inch fine - No. 4 (4.76 mm) to $\frac{3}{4}$ inch
Sand:	coarse - No. 4 (4.76 mm) to No. 10 (2.0 mm) medium - No. 10 (2.0 mm) to No. 40 (0.42 mm) fine - No. 40 (0.42 mm) to No. 200 (0.074 mm)
Silt:	No. 200 (0.074 mm) and smaller (non-plastic)
Clay:	No 200 (0.074 mm) and smaller (plastic)

SOIL PROPERTY SYMBOLS

Dd:	Dry Density (pcf)
LL:	Liquid Limit, percent
PL:	Plastic Limit, percent
PI:	Plasticity Index (LL-PL)
LOI:	Loss on Ignition, percent
Gs:	Specific Gravity
K:	Coefficient of Permeability
w:	Moisture content, percent
qp:	Calibrated Penetrometer Resistance, tsf
qs:	Vane-Shear Strength, tsf
qu:	Unconfined Compressive Strength, tsf
qc:	Static Cone Penetrometer Resistance (correlated to Unconfined Compressive Strength, tsf)
PID:	Results of vapor analysis conducted on representative samples utilizing a Photoionization Detector calibrated to a benzene standard. Results expressed in HNU-Units. (BDL=Below Detection Limit)

N:	Penetration Resistance per 12 inch interval, or fraction thereof, for a standard 2 inch O.D. (1 $\frac{1}{8}$ inch I.D.) split spoon sampler driven with a 140 pound weight free-falling 30 inches. Performed in general accordance with Standard Penetration Test Specifications (ASTM D-1586). N in blows per foot equals sum of N-Values where plus sign (+) is shown.
Nc:	Penetration Resistance per 1 $\frac{3}{4}$ inches of Dynamic Cone Penetrometer. Approximately equivalent to Standard Penetration Test N-Value in blows per foot.
Nr:	Penetration Resistance per 12 inch interval, or fraction thereof, for California Ring Sampler driven with a 140 pound weight free-falling 30 inches per ASTM D-3550. Not equivalent to Standard Penetration Test N-Value.

DRILLING AND SAMPLING SYMBOLS

SS:	Split-Spoon
ST:	Shelby Tube - 3 inch O.D. (except where noted)
CS:	3 inch O.D. California Ring Sampler
DC:	Dynamic Cone Penetrometer per ASTM Special Technical Publication No. 399
AU:	Auger Sample
DB:	Diamond Bit
CB:	Carbide Bit
WS:	Wash Sample
RB:	Rock-Roller Bit
BS:	Bulk Sample
Note:	Depth intervals for sampling shown on Record of Subsurface Exploration are not indicative of sample recovery, but position where sampling initiated

SOIL STRENGTH CHARACTERISTICS

COHESIVE (CLAYEY) SOILS

COMPARATIVE CONSISTENCY	BLOWS PER FOOT (N)	UNCONFINED COMPRESSIVE STRENGTH (TSF)
Very Soft	0 - 2	0 - 0.25
Soft	3 - 4	0.25 - 0.50
Medium Stiff	5 - 8	0.50 - 1.00
Stiff	9 - 15	1.00 - 2.00
Very Stiff	16 - 30	2.00 - 4.00
Hard	31+	4.00+

NON-COHESIVE (GRANULAR) SOILS

RELATIVE DENSITY	BLOWS PER FOOT (N)
Very Loose	0 - 4
Loose	5 - 10
Firm	11 - 30
Dense	31 - 50
Very Dense	51+

DEGREE OF PLASTICITY	PI	DEGREE OF EXPANSIVE POTENTIAL	PI
None to Slight	0 - 4	Low	0 - 15
Slight	5 - 10	Medium	15 - 25
Medium	11 - 30	High	25+
High to Very High	31+		



Important Information About Your Geotechnical Engineering Report

Subsurface problems are a principal cause of construction delays, cost overruns, claims, and disputes.

The following information is provided to help you manage your risks.

Geotechnical Services Are Performed for Specific Purposes, Persons, and Projects

Geotechnical engineers structure their services to meet the specific needs of their clients. A geotechnical engineering study conducted for a civil engineer may not fulfill the needs of a construction contractor or even another civil engineer. Because each geotechnical engineering study is unique, each geotechnical engineering report is unique, prepared *solely* for the client. No one except you should rely on your geotechnical engineering report without first conferring with the geotechnical engineer who prepared it. *And no one — not even you — should apply the report for any purpose or project except the one originally contemplated.*

Read the Full Report

Serious problems have occurred because those relying on a geotechnical engineering report did not read it all. Do not rely on an executive summary. Do not read selected elements only.

A Geotechnical Engineering Report Is Based on A Unique Set of Project-Specific Factors

Geotechnical engineers consider a number of unique, project-specific factors when establishing the scope of a study. Typical factors include: the client's goals, objectives, and risk management preferences; the general nature of the structure involved, its size, and configuration; the location of the structure on the site; and other planned or existing site improvements, such as access roads, parking lots, and underground utilities. Unless the geotechnical engineer who conducted the study specifically indicates otherwise, do not rely on a geotechnical engineering report that was:

- not prepared for you,
- not prepared for your project,
- not prepared for the specific site explored, or
- completed before important project changes were made.

Typical changes that can erode the reliability of an existing geotechnical engineering report include those that affect:

- the function of the proposed structure, as when it's changed from a parking garage to an office building, or from a light industrial plant to a refrigerated warehouse,

- elevation, configuration, location, orientation, or weight of the proposed structure,
- composition of the design team, or
- project ownership.

As a general rule, *always* inform your geotechnical engineer of project changes—even minor ones—and request an assessment of their impact. *Geotechnical engineers cannot accept responsibility or liability for problems that occur because their reports do not consider developments of which they were not informed.*

Subsurface Conditions Can Change

A geotechnical engineering report is based on conditions that existed at the time the study was performed. *Do not rely on a geotechnical engineering report* whose adequacy may have been affected by: the passage of time; by man-made events, such as construction on or adjacent to the site; or by natural events, such as floods, earthquakes, or groundwater fluctuations. *Always* contact the geotechnical engineer before applying the report to determine if it is still reliable. A minor amount of additional testing or analysis could prevent major problems.

Most Geotechnical Findings Are Professional Opinions

Site exploration identifies subsurface conditions only at those points where subsurface tests are conducted or samples are taken. Geotechnical engineers review field and laboratory data and then apply their professional judgment to render an opinion about subsurface conditions throughout the site. Actual subsurface conditions may differ—sometimes significantly—from those indicated in your report. Retaining the geotechnical engineer who developed your report to provide construction observation is the most effective method of managing the risks associated with unanticipated conditions.

A Report's Recommendations Are *Not* Final

Do not overrely on the construction recommendations included in your report. *Those recommendations are not final*, because geotechnical engineers develop them principally from judgment and opinion. Geotechnical engineers can finalize their recommendations only by observing actual

subsurface conditions revealed during construction. *The geotechnical engineer who developed your report cannot assume responsibility or liability for the report's recommendations if that engineer does not perform construction observation.*

A Geotechnical Engineering Report Is Subject to Misinterpretation

Other design team members' misinterpretation of geotechnical engineering reports has resulted in costly problems. Lower that risk by having your geotechnical engineer confer with appropriate members of the design team after submitting the report. Also retain your geotechnical engineer to review pertinent elements of the design team's plans and specifications. Contractors can also misinterpret a geotechnical engineering report. Reduce that risk by having your geotechnical engineer participate in prebid and preconstruction conferences, and by providing construction observation.

Do Not Redraw the Engineer's Logs

Geotechnical engineers prepare final boring and testing logs based upon their interpretation of field logs and laboratory data. To prevent errors or omissions, the logs included in a geotechnical engineering report should *never* be redrawn for inclusion in architectural or other design drawings. Only photographic or electronic reproduction is acceptable, *but recognize that separating logs from the report can elevate risk.*

Give Contractors a Complete Report and Guidance

Some owners and design professionals mistakenly believe they can make contractors liable for unanticipated subsurface conditions by limiting what they provide for bid preparation. To help prevent costly problems, give contractors the complete geotechnical engineering report, *but* preface it with a clearly written letter of transmittal. In that letter, advise contractors that the report was not prepared for purposes of bid development and that the report's accuracy is limited; encourage them to confer with the geotechnical engineer who prepared the report (a modest fee may be required) and/or to conduct additional study to obtain the specific types of information they need or prefer. A prebid conference can also be valuable. *Be sure contractors have sufficient time to perform additional study.* Only then might you be in a position to give contractors the best information available to you, while requiring them to at least share some of the financial responsibilities stemming from unanticipated conditions.

Read Responsibility Provisions Closely

Some clients, design professionals, and contractors do not recognize that geotechnical engineering is far less exact than other engineering disciplines. This lack of understanding has created unrealistic expectations that

have led to disappointments, claims, and disputes. To help reduce the risk of such outcomes, geotechnical engineers commonly include a variety of explanatory provisions in their reports. Sometimes labeled "limitations" many of these provisions indicate where geotechnical engineers' responsibilities begin and end, to help others recognize their own responsibilities and risks. *Read these provisions closely.* Ask questions. Your geotechnical engineer should respond fully and frankly.

Geoenvironmental Concerns Are Not Covered

The equipment, techniques, and personnel used to perform a *geoenvironmental* study differ significantly from those used to perform a *geotechnical* study. For that reason, a geotechnical engineering report does not usually relate any geoenvironmental findings, conclusions, or recommendations; e.g., about the likelihood of encountering underground storage tanks or regulated contaminants. *Unanticipated environmental problems have led to numerous project failures.* If you have not yet obtained your own geoenvironmental information, ask your geotechnical consultant for risk management guidance. *Do not rely on an environmental report prepared for someone else.*

Obtain Professional Assistance To Deal with Mold

Diverse strategies can be applied during building design, construction, operation, and maintenance to prevent significant amounts of mold from growing on indoor surfaces. To be effective, all such strategies should be devised for the *express purpose* of mold prevention, integrated into a comprehensive plan, and executed with diligent oversight by a professional mold prevention consultant. Because just a small amount of water or moisture can lead to the development of severe mold infestations, a number of mold prevention strategies focus on keeping building surfaces dry. While groundwater, water infiltration, and similar issues may have been addressed as part of the geotechnical engineering study whose findings are conveyed in this report, the geotechnical engineer in charge of this project is not a mold prevention consultant; ***none of the services performed in connection with the geotechnical engineer's study were designed or conducted for the purpose of mold prevention. Proper implementation of the recommendations conveyed in this report will not of itself be sufficient to prevent mold from growing in or on the structure involved.***

Rely on Your ASFE-Member Geotechnical Engineer for Additional Assistance

Membership in ASFE/The Best People on Earth exposes geotechnical engineers to a wide array of risk management techniques that can be of genuine benefit for everyone involved with a construction project. Confer with you ASFE-member geotechnical engineer for more information.



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