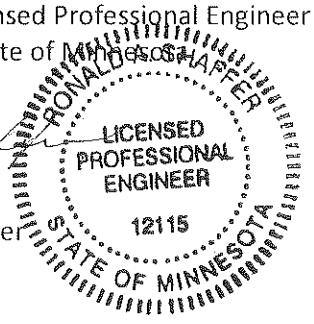
Geotechnical Evaluation Report

Two New Memorial Marker Walls
Columbarium Courtyard, Fort Snelling National Cemetery
34th Avenue South / Highway 494
Minneapolis, Minnesota

Prepared for

Anderson Engineering of Minnesota, LLC

Professional Certification:
I hereby certify that this plan, specification, or report was prepared by me or under my direct supervision and that I am a duly Licensed Professional Engineer under the laws of the State of Minnesota.



Ronald A. Shaffer, PE
Associate / Senior Engineer
License Number: 12115
August 4, 2010

Project BL-10-07064

Braun Intertec Corporation

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August 4, 2010

Project BL-10-07064

Michael Brandvold, PE
c/o Anderson Engineering of Minnesota, LLC
13605 1st Avenue North, Suite 100
Plymouth, MN 55441

Re: Geotechnical Evaluation
Two New Memorial Marker Walls
Columbarium Courtyard, Fort Snelling National Cemetery
34th Avenue South / Highway 494
Minneapolis, Minnesota

Dear Mr. Brandvold:

We are pleased to present this Geotechnical Evaluation Report for the Two New Memorial Marker Walls. A summary of our results, and a summary of our recommendations in light of the geotechnical issues influencing design and construction, is presented below. More detailed information and recommendations follow.

Summary of Results

Our borings indicate that the site for the new walls is underlain with previously placed fill soils to a depth of 14 feet below existing grades, overlying alluvium sand deposits. Based on penetration resistance testing, the fill is considered variably compacted and the alluvium sands are in a medium dense condition. Groundwater was not encountered in the borings.

Summary of Recommendations

The previously placed fill soils encountered in the borings do not appear suitable for foundation support based on the presence of debris and low penetration resistance test results (Boring ST-1). The attached report provides helical anchor and shallow soil correction options to support the proposed wall foundations, in lieu of removing and replacing all of the previously placed fill with engineered fill for foundation support.

Remarks

Thank you for making Braun Intertec your geotechnical consultant for this project. If you have questions about this report, or if there are other services that we can provide in support of our work to date, please call Ron Shaffer at 952.995.2234.

Sincerely,

BRAUN INTERTEC CORPORATION

Gregory J. Bauer, PE
Associate / Project Engineer

Ronald A. Shaffer, PE
Associate / Senior Engineer

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A. Introduction

A.1. Project Description

This Geotechnical Evaluation Report addresses the construction of two new Marker Memorial Walls. The walls will be on frost depth footings, approximately seven (7) feet above ground in height and constructed of cast-in-place concrete and cut stone. The scope of the project is illustrated on the diagram in the Appendix.

A.2. Purpose

The purpose of this geotechnical evaluation is to characterize subsurface geologic conditions at selected exploration locations and evaluate their impact on the design and construction of two Marker Memorial Walls.

A.3. Background Information and Reference Documents

To facilitate our evaluation, we were provided with or reviewed the following information or documents:

- Topographic map, shown in the Appendix.
- A Geotechnical Evaluation Report prepared by Braun Intertec Corporation (Braun Project BL-03-00682B) for the Proposed Fort Snelling National Cemetery Expansion, dated February 18, 2005.
- Geologic atlas

A.4. Site Conditions

Our referenced documents and past project experience in the general area indicate that the site is underlain with previously placed fill soils or native, alluvium sand deposits.

A.5. Scope of Services

Our scope of services for this project was originally submitted as a Proposal to Michael Brandvold, PE of Anderson Engineering of Minnesota, Tasks performed in accordance with our authorized scope of services included:

- Performing a reconnaissance of the site to evaluate equipment access to exploration locations.
- Staking and clearing exploration locations of underground utilities.
- Performing 2 penetration test borings to 15 feet.
- Preparing this report containing exploration logs, a summary of the geologic materials encountered and recommendations for structure subgrade preparation and the design of foundations.

We staked exploration locations by measuring dimensions from nearby buildings or other site features with a tape or surveyor's wheel at approximate right angles from those references. Surface elevations were interpolated from the topographic map provided in the Appendix.

Our scope of services was performed under the terms of our June 15, 2006, General Conditions.

B. Results

B.1. Exploration Logs

B.1.a. Log of Boring Sheets

Log of Boring sheets for our penetration test borings are included in the Appendix. The logs identify and describe the geologic materials that were penetrated and groundwater measurements.

Strata boundaries were inferred from changes in the penetration test samples and the auger cuttings. Because sampling was not performed continuously, the strata boundary depths are only approximate. The boundary depths likely vary away from the boring locations, and the boundaries themselves may also occur as gradual rather than abrupt transitions.

B.1.b. Geologic Origins

Geologic origins assigned to the materials shown on the logs and referenced within this report were based on: (1) a review of the background information and reference documents cited above, (2) visual classification of the various geologic material samples retrieved during the course of our subsurface exploration, and (3) available common knowledge of the geologic processes and environments that have impacted the site and surrounding area in the past.

B.2. Geologic Profile

B.2.a. Geologic Materials

The general geologic profile at the site consists (proceeding down from the ground surface) of 8 to 9 inches of topsoil overlying 14 feet of previously placed fill soils over native, alluvium sand deposits.

Penetration resistance values recorded in the fill ranged from 5 to 27 blows per foot (BPF) but generally variably compacted. Penetration resistance values recorded in the alluvium sand ranged from 13 to 14 BPF, indicating a medium dense condition.

B.2.b. Groundwater

Groundwater was not observed as our borings were advanced. Based on the moisture contents of the geologic materials encountered, it appears that groundwater was below the depths explored.

Seasonal and annual fluctuations of groundwater, however, should be anticipated.

C. Recommendations

C.1. Wall Foundations

C.1.a. Spread Footings

We assume the proposed walls will be founded on a foundation system placed at frost depth. We assume the foundation system would be spread footings. Based on the borings, the fill would not be directly suitable for footing support due to its variability indicating the fill was not placed in a controlled fashion and the presence of debris within the fill. Construction directly on the existing fill could result in differential settlement.

Since the depth of uncontrolled fill is about 14 feet, it would be expensive and conservative to remove all the fill from below the monuments and replace with engineered fill. One option to limit potential settlement would be to subcut 3 feet below the foundations and place and compact crushed rock (Class 5) below the monuments. The 3-foot subcut would provide a uniform subgrade below the footings, reduce settlement potential, and increase the bearing capacity of the soils. There still is a risk that some differential settlement could occur due to unknowns in the fill at depth, but it is our opinion this risk is small. Because this option is a cost savings approach, the risk of settlement should be assumed by the owner. We recommend footings be sized to exert a soil bearing pressure of not more than 1,500 pounds per square foot (psf) if this option is used.

C.1.b. Helical Anchors

A more conservative (and expensive) approach would be to use helical anchors for monument support. This would be the most logical system if the walls are placed at a later time in a phased construction. Using this approach, helical anchors would be placed at the base of the monument foundation not requiring deeper soil correction. The helical anchors would be extended through the fill down into the underlying alluvial sands. We would anticipate helical anchors of 25 to 35 feet could produce capacities of 5 to 10 tons.

D. Procedures

D.1. Penetration Test Borings

The penetration test borings were drilled with a drill rig equipped with hollow-stem auger. The borings were performed in accordance with ASTM D 1586. Penetration test samples were taken at 2 1/2- or 5-foot intervals. Actual sample intervals and corresponding depths are shown on the boring logs.

D.2. Material Classification and Testing

D.2.a. Visual and Manual Classification

The geologic materials encountered were visually and manually classified in accordance with ASTM Standard Practice D 2488. A chart explaining the classification system is attached. Samples were placed in jars or bags and returned to our facility for review and storage.

D.3. Groundwater Measurements

The drillers checked for groundwater as the penetration test borings were advanced, and again after auger withdrawal. The boreholes were then backfilled or allowed to remain open for an extended period of observation as noted on the boring logs.

E. Qualifications

E.1. Variations in Subsurface Conditions

E.1.a. Material Strata

Our evaluation, analyses and recommendations were developed from a limited amount of site and subsurface information. It is not standard engineering practice to retrieve material samples from exploration locations continuously with depth, and therefore strata boundaries and thicknesses must be inferred to some extent. Strata boundaries may also be gradual transitions, and can be expected to vary in depth, elevation and thickness away from the exploration locations.

Variations in subsurface conditions present between exploration locations may not be revealed until additional exploration work is completed, or construction commences. If any such variations are revealed, our recommendations should be re-evaluated. Such variations could increase construction costs, and a contingency should be provided to accommodate them.

E.1.b. Groundwater Levels

Groundwater measurements were made under the conditions reported herein and shown on the exploration logs, and interpreted in the text of this report. It should be noted that the observation periods were relatively short, and groundwater can be expected to fluctuate in response to rainfall, flooding, irrigation, seasonal freezing and thawing, surface drainage modifications and other seasonal and annual factors.

E.2. Continuity of Professional Responsibility

E.2.a. Plan Review

This report is based on a limited amount of information, and a number of assumptions were necessary to help us develop our recommendations. It is recommended that our firm review the geotechnical aspects

of the designs and specifications, and evaluate whether the design is as expected, if any design changes have affected the validity of our recommendations, and if our recommendations have been correctly interpreted and implemented in the designs and specifications.

E.2.b. Construction Observations and Testing

It is recommended that we be retained to perform observations and tests during construction. This will allow correlation of the subsurface conditions encountered during construction with those encountered by the borings, and provide continuity of professional responsibility.

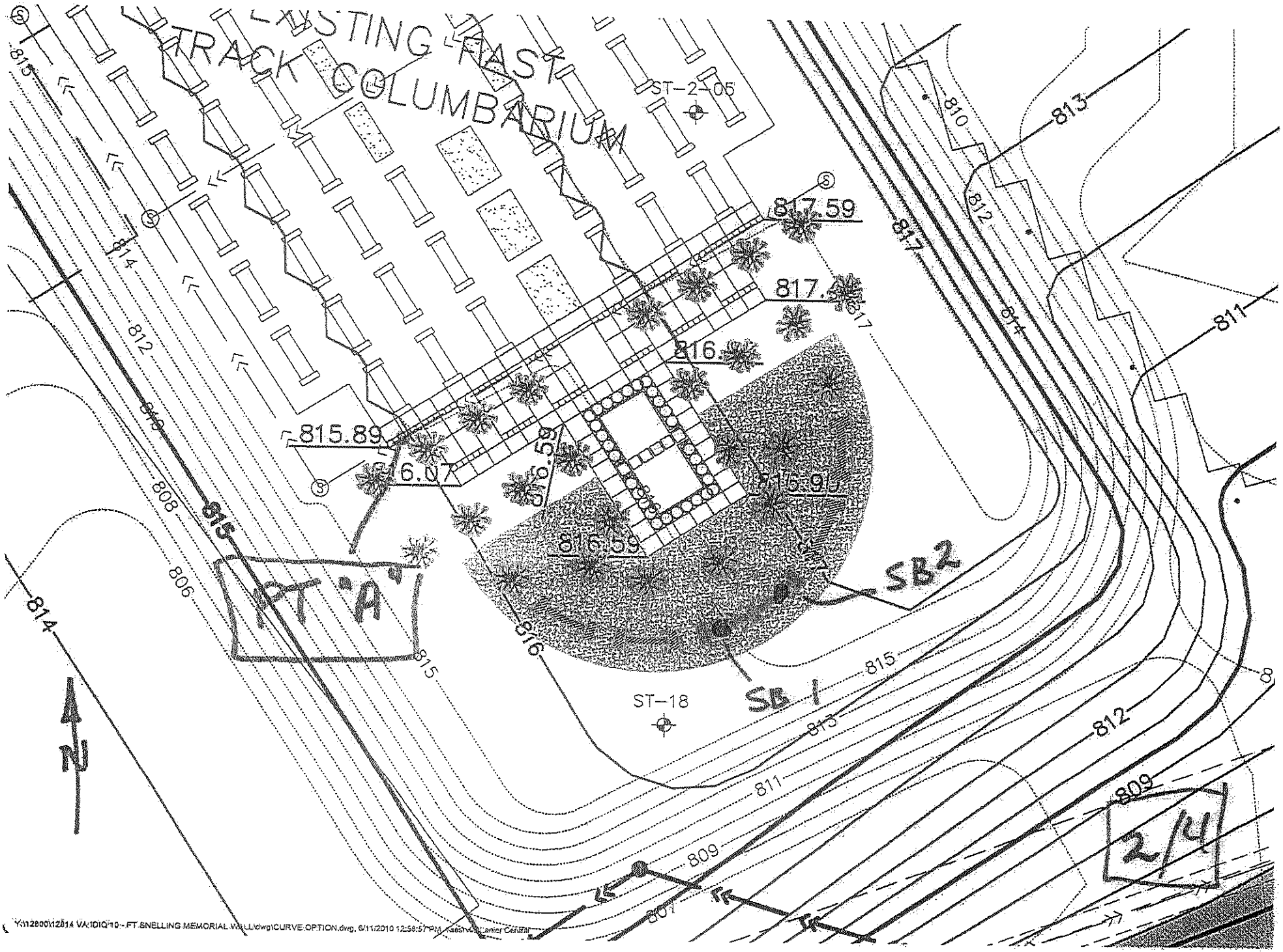
E.3. Use of Report

This report is for the exclusive use of the parties to which it has been addressed. Without written approval, we assume no responsibility to other parties regarding this report. Our evaluation, analyses and recommendations may not be appropriate for other parties or projects.

E.4. Standard of Care

In performing its services, Braun Intertec used that degree of care and skill ordinarily exercised under similar circumstances by reputable members of its profession currently practicing in the same locality. No warranty, express or implied, is made.

Appendix


EXISTING FAST TRACK COLUMBARIUM
ST-2-05
817.59
817.4
816
815.89
816.07
816.59
816.59
815.95
816.59
SB 2
SB 1
FT "A"
ST-18
815
814
813
812
811
810
809
808
807
806
N
2/4

BRAUN INTERTEC

LOG OF BORING

Braun Project BL-10-07064
GEOTECHNICAL EVALUATION
Two New Memorial Marker Walls
34th Avenue South / Highway 494
Minneapolis, Minnesota

BORING: **ST-1**

LOCATION: See Attached Sketch

DRILLER: J. Chermak | METHOD: 3 1/4" HSA, Autohammer | DATE: 7/5/10 | SCALE: 1" = 4'

Elev. feet	Depth feet	Symbol	Description of Materials (Soil- ASTM D2488 or D2487, Rock-USACE EM1110-1-2908)	BPF	WL	Tests or Notes
817.0	0.0					
816.3	0.7	FILL	FILL: Silty Sand, fine- to medium-grained, dark brown, moist. (Topsoil)			The ground surface elevations at the borehole locations were interpolated by the topographic survey provided.
		FILL	FILL: Silty Sand, fine-grained, brown, moist.	12		
				5		
808.0	9.0			5		
		FILL	FILL: Silty Sand, fine- to medium-grained, with a trace of Bituminous Pavement, dark brown, moist.	13		
805.0	12.0					
		FILL	FILL: Silty Sand, fine-grained, brown, moist.	6		The solid bar symbol in the WL column indicates the observed dry cave-in depth after withdrawal of auger.
803.0	14.0					
		SP	POORLY GRADED SAND, fine- to medium-grained, with Gravel, light brown, dry, medium dense. (Alluvium)	13		
801.0	16.0					
			END OF BORING.			
			Water not observed while drilling.			
			Water not observed to cave-in depth of 12 feet.			
			Boring immediately backfilled.			

(See Descriptive Terminology sheet for explanation of abbreviations)

LOG OF BORING 07064.GPJ BRAUN.GDT 8/4/10 14:46

BRAUN INTERTEC

LOG OF BORING

Braun Project BL-10-07064
GEOTECHNICAL EVALUATION
Two New Memorial Marker Walls
34th Avenue South / Highway 494
Minneapolis, Minnesota

BORING: **ST-2**

LOCATION: See Attached Sketch

DRILLER: J. Chermak | METHOD: 3 1/4" HSA, Autohammer | DATE: 7/5/10 | SCALE: 1" = 4'

Elev. feet	Depth feet	Symbol	Description of Materials (Soil- ASTM D2488 or D2487, Rock-USACE EM1110-1-2908)	BPF	WL	Tests or Notes
817.0	0.0					
816.2	0.8	FILL	FILL: Silty Sand, fine-grained, with a trace of Gravel, dark brown, moist. (Topsoil)			
		FILL	FILL: Silty Sand, fine-grained, with a trace of Coarse Sand, dark brown, moist.	27		
				8		
809.0	8.0			14		
		FILL	FILL: Clayey Sand, with a trace of Wood Chips, brown and gray, moist.			
806.0	11.0			11		
		FILL	FILL: Clayey Sand, brown, moist.			
803.0	14.0			10		
		SP	POORLY GRADED SAND, fine- to medium-grained, with Gravel, light brown, dry, medium dense. (Alluvium)			
801.0	16.0			14		
			END OF BORING.			
			Water not observed while drilling.			
			Water not observed to cave-in depth of 12 feet.			
			Boring immediately backfilled.			

(See Descriptive Terminology sheet for explanation of abbreviations)

LOG OF BORING 07064.GPJ BRAUN.GDT 8/4/10 14:46

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LOG OF BORING

Braun Project BL-03-00682A
GEOTECHNICAL EVALUATION
Fort Snelling Cemetery Expansion
Fort Snelling National Cemetery
Minneapolis, Minnesota

BORING: **ST-18-04**

LOCATION: See attached sketch.

DRILLER: M. McWilliams | METHOD: 3 1/4" HSA Autohammer | DATE: **2/9/04** | SCALE: **1" = 4'**

Depth feet	Symbol	Description of Materials (Soil- ASTM D2488 or D2487, Rock-USACE EM1110-1-2908)	BPF	WL	PID ppm	Tests or Notes
0.0						
0.5	SC / SM	CLAYEY SAND, fine- to medium-grained, dark brown, frozen. (Topsoil)			3.3	
		SILTY SAND, fine- to medium-grained, brown, frozen. (Alluvium)				
3.0	SP-SM	POORLY GRADED SAND with SILT, fine- to medium-grained, with a trace of Gravel, brown, moist, medium dense. (Alluvium)	16		1.0	
10.5		END OF BORING.	12		1.1	
		Water not observed while drilling.				
		Boring immediately backfilled.				

(See Descriptive Terminology sheet for explanation of abbreviations)

LOG OF BORING 0300682A.GPJ BRAUN.GDT 8/4/10 14:50

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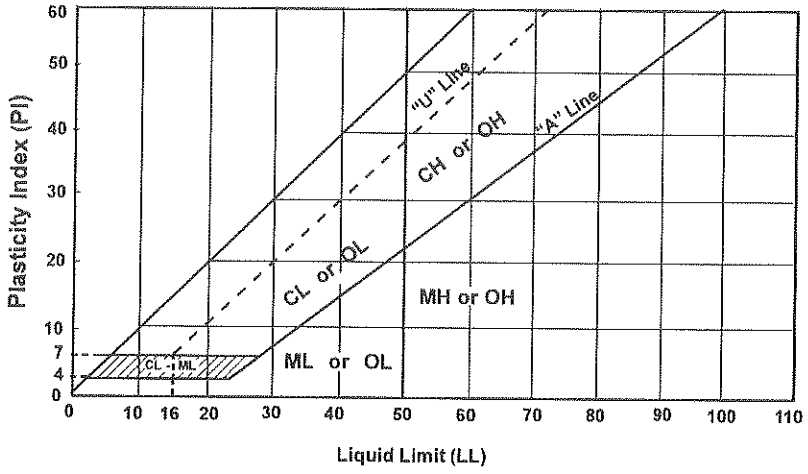
Descriptive Terminology of Soil

Standard D 2487 - 00
Classification of Soils for Engineering Purposes (Unified Soil Classification System)

Criteria for Assigning Group Symbols and Group Names Using Laboratory Tests [a]				Soils Classification	
				Group Symbol	Group Name [b]
Coarse-grained Soils more than 50% retained on No. 200 sieve	Gravels More than 50% of coarse fraction retained on No. 4 sieve	Clean Gravels 5% or less fines [e]	$C_u \geq 4$ and $1 \leq C_c \leq 3$ [c]	GW	Well-graded gravel [d]
			$C_u < 4$ and/or $1 > C_c > 3$ [c]	GP	Poorly graded gravel [d]
		Gravels with Fines More than 12% fines [e]	Fines classify as ML or MH	GM	Silty gravel [d f g]
			Fines classify as CL or CH	GC	Clayey gravel [d f g]
	Sands 50% or more of coarse fraction passes No. 4 sieve	Clean Sands 5% or less fines [i]	$C_u \geq 6$ and $1 \leq C_c \leq 3$ [c]	SW	Well-graded sand [h]
			$C_u < 6$ and/or $1 > C_c > 3$ [c]	SP	Poorly graded sand [h]
		Sands with Fines More than 12% [i]	Fines classify as ML or MH	SM	Silty sand [f g h]
			Fines classify as CL or CH	SC	Clayey sand [f g h]
Fine-grained Soils 50% or more passed the No. 200 sieve	Silts and Clays Liquid limit less than 50	Inorganic	PI > 7 and plots on or above "A" line [j]	CL	Lean clay [k l m]
			PI < 4 or plots below "A" line [j]	ML	Silt [k l m]
		Organic	Liquid limit - oven dried / Liquid limit - not dried < 0.75	OL	Organic clay [k l m n]
				OL	Organic silt [k l m o]
	Silts and clays Liquid limit 50 or more	Inorganic	PI plots on or above "A" line	CH	Fat clay [k l m]
			PI plots below "A" line	MH	Elastic silt [k l m]
		Organic	Liquid limit - oven dried / Liquid limit - not dried < 0.75	OH	Organic clay [k l m p]
				OH	Organic silt [k l m q]
Highly Organic Soils	Primarily organic matter, dark in color and organic odor			PT	Peat

a. Based on the material passing the 3-in (75mm) sieve.
b. If field sample contained cobbles or boulders, or both, add "with cobbles or boulders or both" to group name.
c. $C_u = D_{60} / D_{10}$ $C_c = \frac{(D_{30})^2}{D_{10} \times D_{60}}$
d. If soil contains ≥15% sand, add "with sand" to group name.
e. Gravels with 5 to 12% fines require dual symbols:
GW-GM well-graded gravel with silt
GW-GC well-graded gravel with clay
GP-GM poorly graded gravel with silt
GP-GC poorly graded gravel with clay
f. If fines classify as CL-ML, use dual symbol GC-GM or SC-SM.
g. If fines are organic, add "with organic fines" to group name.
h. If soil contains ≥ 15% gravel, add "with gravel" to group name.
i. Sands with 5 to 12% fines require dual symbols:
SW-SM well-graded sand with silt
SW-SC well-graded sand with clay
SP-SM poorly graded sand with silt
SP-SC poorly graded sand with clay
j. If Atterberg limits plot in hatched area, soil is a CL-ML, silty clay.
k. If soil contains 10 to 29% plus No. 200, add "with sand" or "with gravel" whichever is predominant.
l. If soil contains ≥ 30% plus No. 200, predominantly sand, add "sandy" to group name.
m. If soil contains ≥ 30% plus No. 200 predominantly gravel, add "gravelly" to group name.
n. PI ≥ 4 and plots on or above "A" line.
o. PI < 4 or plots below "A" line.
p. PI plots on or above "A" line.
q. PI plots below "A" line.



Laboratory Tests

DD	Dry density, pcf	OC	Organic content, %
WD	Wet density, pcf	S	Percent of saturation, %
MC	Natural moisture content, %	SG	Specific gravity
LL	Liquid limit, %	C	Cohesion, psf
PL	Plastic limit, %	∅	Angle of internal friction
PI	Plasticity index, %	qu	Unconfined compressive strength, psf
P200	% passing 200 sieve	qp	Pocket penetrometer strength, tsf

Particle Size Identification

Boulders	over 12"
Cobbles	3" to 12"
Gravel	
Coarse	3/4" to 3"
Fine	No. 4 to 3/4"
Sand	
Coarse	No. 4 to No. 10
Medium	No. 10 to No. 40
Fine	No. 40 to No. 200
Silt	< No. 200, PI < 4 or below "A" line
Clay	< No. 200, PI ≥ 4 and on or above "A" line

Relative Density of Cohesionless Soils

Very loose	0 to 4 BPF
Loose	5 to 10 BPF
Medium dense	11 to 30 BPF
Dense	31 to 50 BPF
Very dense	over 50 BPF

Consistency of Cohesive Soils

Very soft	0 to 1 BPF
Soft	2 to 3 BPF
Rather soft	4 to 5 BPF
Medium	6 to 8 BPF
Rather stiff	9 to 12 BPF
Stiff	13 to 16 BPF
Very stiff	17 to 30 BPF
Hard	over 30 BPF

Drilling Notes

Standard penetration test borings were advanced by 3 1/4" or 6 1/4" ID hollow-stem augers unless noted otherwise, Jetting water was used to clean out auger prior to sampling only where indicated on logs. Standard penetration test borings are designated by the prefix "ST" (Split Tube). All samples were taken with the standard 2" OD split-tube sampler, except where noted.

Power auger borings were advanced by 4" or 6" diameter continuous-flight, solid-stem augers. Soil classifications and strata depths were inferred from disturbed samples augered to the surface and are, therefore, somewhat approximate. Power auger borings are designated by the prefix "B."

Hand auger borings were advanced manually with a 1 1/2" or 3 1/4" diameter auger and were limited to the depth from which the auger could be manually withdrawn. Hand auger borings are indicated by the prefix "H."

BPF: Numbers indicate blows per foot recorded in standard penetration test, also known as "N" value. The sampler was set 6" into undisturbed soil below the hollow-stem auger. Driving resistances were then counted for second and third 6" increments and added to get BPF. Where they differed significantly, they are reported in the following form: 2/12 for the second and third 6" increments, respectively.

WH: WH indicates the sampler penetrated soil under weight of hammer and rods alone; driving not required.

WR: WR indicates the sampler penetrated soil under weight of rods alone; hammer weight and driving not required.

TW indicates thin-walled (undisturbed) tube sample.

Note: All tests were run in general accordance with applicable ASTM standards.