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CONSULTANTS  
• GEOTECHNICAL  
• MATERIALS  
• ENVIRONMENTAL

October 25, 2004

Ms. Janelle Finck  
Fisk Land Surveying & Consulting Engineering Inc.  
1022 Main Street  
PO Box 8154  
Rapid City, South Dakota 57709

Subject: Preliminary Geotechnical Exploration  
Proposed Rooks Funeral Home  
Holiday Lane & Sheridan Lake Road  
Rapid City, South Dakota  
AET No. 18-01685

Dear Janelle:

### **INTRODUCTION**

This letter presents the results of the preliminary geotechnical exploration conducted for the proposed Rooks Funeral Home to be built on Lot 5 of Sandstone Ridge Subdivision and Lot 26R-1 of the revised Fairway Hills P.R.D. at the intersection of Holiday Lane and Sheridan Lake Road in Rapid City, South Dakota. This work was performed in accordance with AET's proposal dated October 14, 2004 and your written authorization to proceed on that same day.

### **PROJECT INFORMATION**

Based on the information provided we understand the new funeral home building will cover approximately 9000 square feet and be set back into the existing slope at the site. The building will have a semi-circle shape with a finish floor elevation of 3446.5 feet. To obtain this elevation, up to 10 feet of cut will be required on the southeast corner and approximately 15 feet of fill will be required on the southwest corner of the new building.

The project will include an asphalt paved parking lot to be built northeast of the building. It appears cuts and fill of five feet or less will be required across the parking lot area.

**RECEIVED**

**OCT 25 2004**

**Rapid City Growth  
Management Department**  
10/25/04

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## **FIELD EXPLORATION**

Four (4) standard penetration test (SPT) borings was drilled for the project on October 20, 2004. The borings were drilled at the approximate locations indicated on the attached Boring Location Map, Figure 1. Boring elevations were referenced to the rim elevation of the sanitary sewer manhole, given as elevation 3436.7 on the project drawings provided.

Soil sampling was performed according to the procedures described by ASTM: D 1586. Using this procedure, a two-inch O.D. split barrel sampler is driven into the soil by a 140-pound weight falling 30 inches. After an initial set of six inches, the number of blows required to drive the sampler an additional 12 inches is known as penetration resistance or N value. The N value is an index of the relative density of cohesionless soils and the consistency of cohesive soils.

As the samples were obtained in the field they were visually and manually classified by the crew chief in accordance with ASTM: D 2488. Representative portions of all samples were then sealed and returned to the laboratory for further examination and for verification of the field classification. Included as Figures 2 through 5 are the Logs of the Test Borings indicating the depth and identification of the various strata, the N value, the laboratory test data, water level information and pertinent information regarding the method of maintaining and advancing the drill holes. A copy of the Unified Soil Classification System is included as Figure 6 for your reference.

The soil samples remaining after the laboratory testing is complete will be retained for a period of 15 days. At that time they will be discarded. Please advise us in writing if you wish to have us retain them for a longer period of time.

## **SUBSURFACE CONDITIONS**

In general, the subsurface conditions encountered across the Lot consisted of 3 to up to 10 feet of fill overlying natural colluvial soils associated with the Sundance Formation. The fill was comprised of a mixture of sandy silt, silty sand and sandy clay with varying amounts of sandstone gravels. The underlying colluvial soils consisted of stiff to very stiff sandy lean clays with gravels and possible cobbles. Both the fill and the natural soils were moist and ranged in color from brown to tan to pink.

Groundwater was not encountered in any of the borings at the time of drilling. Groundwater levels should be expected to fluctuate seasonally and yearly. The time of year that the borings were drilled and the history of precipitation prior to drilling should be known when using the water level information on the soil boring logs to extrapolate water levels at other points in time.

**ENGINEERING ANALYSIS**

From a soils standpoint, it is our opinion the site is suitable for construction of the proposed funeral home and parking lot improvements. Conventional foundation, floor slab and retaining wall construction can be anticipated along with typical construction for the associated pavement for the parking lot and concrete flatwork for the remaining site improvements.

The fill across the site appears to be from past improvements to Sheridan Lake Road and the detention basin to the east. The fill, as well as the underlying natural soils, appear to be non-expansive soils that can be used below the proposed building and parking lot. Reworking of the fill should be anticipated below the building structure itself to ensure proper compaction (minimum of 92% of ASTM D 1557) to minimize the potential for differential settlement.

With a finish floor elevation of 3446.5, cuts up to 10 feet will be required into the existing slope (3.5H:1V) behind the building. The project drawings indicate a retaining wall will be built in this area. The height of the wall is given as variable with a maximum height of 12 feet. It is our opinion construction of such a wall is practical within the soils present and with proper design and construction, the stability of the existing slope will not be compromised.

It is our recommendation additional soil borings, along with the associated lab testing, be done prior to final design of the proposed project. Once complete specific design recommendations can be provided for foundations, floor slabs, grading and compaction, retaining walls and paved parking lots and access drives.

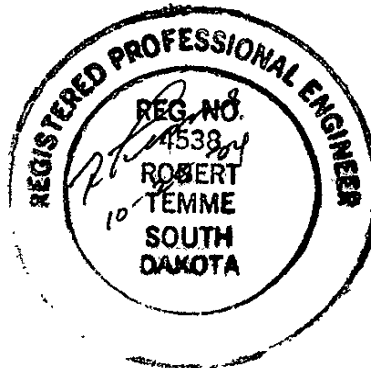
**CLOSING**

The recommendations contained in this letter represent our professional opinions. These opinions were arrived at in accordance with currently accepted engineering practices at this time and location. Other than this, no warranty is intended or implied. If you have any questions or need additional information, please call our office at (605) 388-0029.

Sincerely,



Robert Temme P.E.  
South Dakota Operations Manager







**SUBSURFACE BORING LOG**

Visual-Manual Classification Unless Verified by Laboratory Testing

AET JOB NO: <b>18-01685</b>		LOG OF BORING NO. <b>B-1</b>									
PROJECT: <b>Rooks Funeral Home; Rapid City, South Dakota</b>											
DEPTH IN FEET	SURFACE ELEVATION: <u>3436.0</u> MATERIAL DESCRIPTION	GEOLOGY	N	GW	SAMPLE TYPE	REC. IN.	FIELD & LABORATORY TESTS				
							WC	DEN	LL	PL	%-200
1	<b>Fill, Sandy Silt to Silty Sand with Sandstone Gravels, tan, moist (ML-SM)</b>	Fill	9		2L	18					
2											
3											
4	<b>Sandy Lean Clay With Some Gravel, dark brown, moist, stiff (CL)</b>	Mixed Colluvium	11		2L	18					
5											
6											
7	<b>Sandy Lean Clay With Trace Of Gravel, tan, moist, very stiff (CL)</b>		19		2L	18					
8											
9											
10	<b>END OF BORING</b>										
DEPTH: DRILLING METHOD		WATER LEVEL MEASUREMENTS									
10.0 3.25" HSA		DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	DRILLING FLUID LEVEL	WATER LEVEL			
		10/20/04	0922	--	--	10.0	--	None			
BORING COMPLETED: 10/20/04											
CC: BT CA: RT Rig: RC-1											

AET CORP 18-01685.GPJ AET CORP.GDT 10/25/04



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FIGURE 3

**SUBSURFACE BORING LOG**  
Visual-Manual Classification Unless Verified by Laboratory Testing

AET JOB NO: <u>18-01685</u>		LOG OF BORING NO. <u>B-2</u>									
PROJECT: <u>Rooks Funeral Home; Rapid City, South Dakota</u>											
DEPTH IN FEET	SURFACE ELEVATION: <u>3441.7</u> MATERIAL DESCRIPTION	GEOLOGY	N	GW	SAMPLE TYPE	REC. IN.	FIELD & LABORATORY TESTS				
							WC	DEN	LL	PL	%-200
1	<u>Fill, Sandy Lean Clay With Gravel, brown, moist (CL)</u>	Fill	40		2L	18					
2											
3	<u>Sandy Lean Clay, dark brown with orange/yellow sandstone gravels, moist, stiff (CL) possible cobbles</u>	Mixed Colluvium									
4											
5											
6	END OF BORING		12		2L	18					
7											
8											
9											
10											
11	END OF BORING		16		2L	18					
DEPTH: DRILLING METHOD		WATER LEVEL MEASUREMENTS									
<u>10.0</u>	<u>3.25" HSA</u>	DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	DRILLING FLUID LEVEL	WATER LEVEL			
		<u>10/20/04</u>	<u>0940</u>	--	--	<u>10.0</u>	--	<u>None</u>			
BORING COMPLETED: <u>10/20/04</u>											
CC: BT CA: RT Rig: RC-1											

AET CORP 18-01685.GPJ AET CORP.GDT 10/25/04



**SUBSURFACE BORING LOG**  
Visual-Manual Classification Unless Verified by Laboratory Testing

AET JOB NO: <u>18-01685</u>		LOG OF BORING NO. <u>B-3</u>										
PROJECT: <u>Rooks Funeral Home; Rapid City, South Dakota</u>												
DEPTH IN FEET	SURFACE ELEVATION: <u>3444.3</u>		GEOLOGY	N	GW	SAMPLE TYPE	REC. IN.	FIELD & LABORATORY TESTS				
	MATERIAL DESCRIPTION							WC	DEN	LL	PL	%-200
1	<u>Fill, Clayey Sand - Sandy Lean Clay With Some Sandstone Gravels, tan to pink, moist (CL-SC)</u>		Fill	28		2L	18					
2												
3												
4						2L	18					
5												
6												
7	<u>Sandy Lean Clay With Gravel, brown, moist, very stiff (CL)</u>		Mixed Colluvium									
8												
9												
10	END OF BORING			17		2L	18					
11												
DEPTH: DRILLING METHOD			WATER LEVEL MEASUREMENTS									
10.0	3.25" HSA		DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	DRILLING FLUID LEVEL	WATER LEVEL			
			10/20/04	1000	--	--	10.0	--	None			
BORING COMPLETED: 10/20/04												
CC: BT CA: RT Rig: RC-1												

AET CORP 18-01685.GPJ AET CORP.GDT 10/25/04



**SUBSURFACE BORING LOG**  
Visual-Manual Classification Unless Verified by Laboratory Testing

AET JOB NO: <u>18-01685</u>		LOG OF BORING NO. <u>B-4</u>										
PROJECT: <u>Rooks Funeral Home; Rapid City, South Dakota</u>												
DEPTH IN FEET	SURFACE ELEVATION: <u>3453.9</u>		GEOLOGY	N	GW	SAMPLE TYPE	REC. IN.	FIELD & LABORATORY TESTS				
	MATERIAL DESCRIPTION							WC	DEN	LL	PL	%-200
1	Fill, Sandy Clay - Clayey Sand with Sandstone Gravel, brown to red, moist (CL-SC)		Fill	24		2L	18					
2												
3												
4												
5					16		2L	18				
6												
7												
8												
9												
10					9		2L	18				
11												
END OF BORING												
DEPTH: DRILLING METHOD		WATER LEVEL MEASUREMENTS										
10.0 3.25" HSA		DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	DRILLING FLUID LEVEL	WATER LEVEL				
		10/20/04	1020	--	--	10.0	--	None				
BORING COMPLETED: 10/20/04												
CC: BT CA: RT Rig: RC-1												

AET CORP 18-01685.GPJ AET CORP.GDT 10/25/04



UNIFIED SOIL CLASSIFICATION SYSTEM  
ASTM Designations: D 2487, D2488

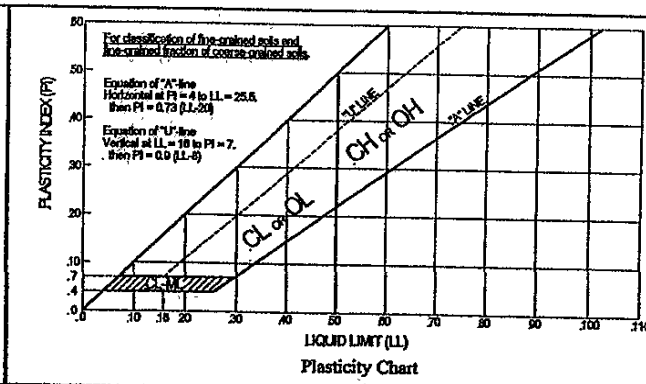
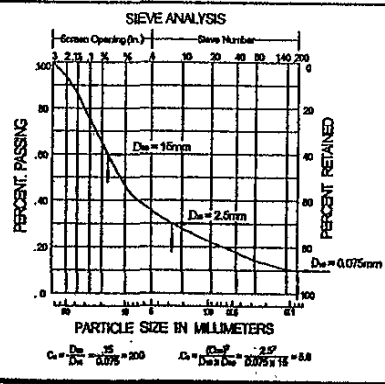
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Criteria for Assigning Group Symbols and Group Names Using Laboratory Tests<sup>A</sup>

				Soil Classification	
				Group Symbol	Group Name <sup>B</sup>
Coarse-Grained Soils More than 50% retained on No. 200 sieve	Gravels More than 50% coarse fraction retained on No. 4 sieve	Clean Gravels Less than 5% fines <sup>C</sup>	$Cu \geq 4$ and $1 \leq Cc \leq 3^E$	GW	Well graded gravel <sup>F</sup>
			$Cu < 4$ and/or $1 > Cc > 3^E$	GP	Poorly graded gravel <sup>F</sup>
		Gravels with Fines more than 12% fines <sup>C</sup>	Fines classify as ML or MH	GM	Silty gravel <sup>F,G,H</sup>
	Sands 50% or more of coarse fraction passes No. 4 sieve	Clean Sands Less than 5% fines <sup>D</sup>	$Cu \geq 6$ and $1 \leq Cc \leq 3^E$	SW	Well-graded sand <sup>I</sup>
			$Cu < 6$ and $1 > Cc > 3^E$	SP	Poorly-graded sand <sup>I</sup>
		Sands with Fines more than 12% fines <sup>D</sup>	Fines classify as ML or MH	SM	Silty sand <sup>G,H,I</sup>
Fine-Grained Soils 50% or more passes the No. 200 sieve  (see Plasticity Chart below)	Silts and Clays Liquid limit less than 50	inorganic	PI > 7 and plots on or above "A" line <sup>J</sup>	CL	Lean clay <sup>K,L,M</sup>
			PI < 4 or plots below "A" line <sup>J</sup>	ML	Silt <sup>K,L,M</sup>
		organic	Liquid limit - oven dried < 0.75	OL	Organic clay <sup>K,L,M,N</sup>
			Liquid limit - not dried		Organic silt <sup>K,L,M,O</sup>
	Silts and Clays Liquid limit 50 or more	inorganic	PI plots on or above "A" line	CH	Fat clay <sup>K,L,M</sup>
			PI plots below "A" line	MH	Elastic silt <sup>K,L,M</sup>
	organic	Liquid limit - oven dried < 0.75	OH	Organic clay <sup>K,L,M,P</sup>	
		Liquid limit - not dried		Organic silt <sup>K,L,M,Q</sup>	
Highly organic soil		Primarily organic matter, dark in color, and organic in odor	PT	Peat <sup>R</sup>	

**Notes**  
<sup>A</sup>Based on the material passing the 3-in (75-mm) sieve.  
<sup>B</sup>If field sample contained cobbles or boulders, or both, add "with cobbles or boulders, or both" to group name.  
<sup>C</sup>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  
<sup>D</sup>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

$Cu = D_{60}/D_{10}$      $Cc = (D_{30})^2/D_{10} \times D_{60}$   
<sup>F</sup>If soil contains  $\geq 15\%$  sand, add "with sand" to group name.  
<sup>G</sup>If fines classify as CL-ML, use dual symbol GC-GM, or SC-SM.  
<sup>H</sup>If fines are organic, add "with organic fines" to group name.  
<sup>I</sup>If soil contains  $\geq 15\%$  gravel, add "with gravel" to group name.  
<sup>J</sup>If Atterberg limits plot is batched area, soils is a CL-ML silty clay.  
<sup>K</sup>If soil contains 15 to 29% plus No. 200 add "with sand" or "with gravel", whichever is predominant.  
<sup>L</sup>If soil contains  $\geq 30\%$  plus No. 200, predominantly sand, add "sandy" to group name.  
<sup>M</sup>If soil contains  $\geq 30\%$  plus No. 200, predominantly gravel, add "gravelly" to group name.  
<sup>N</sup>PI  $\geq 4$  and plots on or above "A" line.  
<sup>O</sup>PI < 4 or plots below "A" line.  
<sup>P</sup>PI plots on or above "A" line.  
<sup>Q</sup>PI plots below "A" line.  
<sup>R</sup>Fiber Content description shown below.



ADDITIONAL TERMINOLOGY NOTES USED BY AET FOR SOIL IDENTIFICATION AND DESCRIPTION

Grain Size		Gravel Percentages		Consistency of Plastic Soils		Relative Density of Non-Plastic Soils	
Term	Particle Size	Term	Percent	Term	N-Value, BPF	Term	N-Value, BPF
Boulders	Over 12"	A Little Gravel	3% - 14%	Very Soft	less than 2	Very Loose	0 - 4
Cobbles	3" to 12"	With Gravel	15% - 29%	Soft	2 - 4	Loose	5 - 10
Gravel	#4 sieve to 3"	Gravelly	30% - 50%	Firm	5 - 8	Medium Dense	11 - 30
Sand	#200 to #4 sieve			Stiff	9 - 15	Dense	31 - 50
Fines (silt & clay)	Pass #200 sieve			Very Stiff	16 - 30	Very Dense	Greater than 50
<b>Moisture/Frost Condition (MC Column)</b>		<b>Layering Notes</b>		<b>Fiber Content of Peat</b>		<b>Organic/Roots Description (if no lab tests)</b>	
D (Dry):	Absence of moisture, dusty, dry to touch.	Laminations:	Layers less than 1/2" thick of differing material or color.	Term	Fiber Content (Visual Estimate)	Soils are described as <i>organic</i> , if soil is not peat and is judged to have sufficient organic fines content to influence the soil properties. <i>Slightly organic</i> used for borderline cases.	
M (Moist):	Damp, although free water not visible. Soil may still have a high water content (over "optimum").	Lenses:	Pockets or layers greater than 1/2" thick of differing material or color.	Fibric Peat:	Greater than 67%	With roots:	Judged to have sufficient quantity of roots to influence the soil properties.
W (Wet/ Waterbearing):	Free water visible intended to describe non-plastic soils. Waterbearing usually relates to sands and sand with silt.			Hemic Peat:	33 - 67%	Trace roots:	Small roots present, but not judged to be in sufficient quantity to significantly affect soil properties.
F (Frozen):	Soil frozen			Sapric Peat:	Less than 33%		