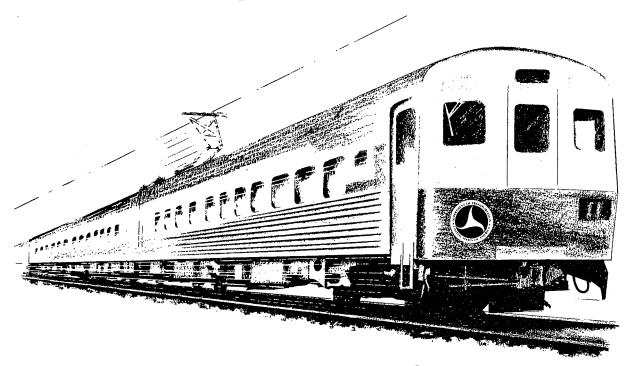
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# EXPLORATORY SOIL BORINGS AT TWO LOCATIONS FOR THE U.S. DEPARTMENT OF TRANSPORTATION

DESIGN STUDIES



FINAL REPORT AUGUST 1971



FEDERAL RAILROAD ADMINISTRATION
OFFICE OF HIGH-SPEED GROUND TRANSPORTATION

#### TECHNICAL REPORT STANDARD TITLE PAGE

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16. Abstract		***					
Exploratory borings and locations; southeast Kansas	l soil classi and northeas	fication studies a t New Mexico.	re reported	on for two			
The objective of the wo to enable a decision on the appropriately install a rail	part of the	sponsoring agency	cient sub-so as to where	il information to most			
Duplication of physical track support conditions and tions.	conditions deconomics o	most representativ f construction wer	e of present e important	railroad considera-			
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CONSULTING ENGINEERING

GEOLOGICAL INVESTIGATION

ENGINEERING INSPECTION

KANSAS AREA

\_ "hemphill the name you can trust" .



# REPORT FOR U. S. DEPARTMENT OF TRANSPORTATION TEST TRACK KANSAS

#### I - Introduction

#### A. Purpose of Survey

The purpose of the survey was to examine the proposed U. S. Department of Transportation test track site in Kansas from a geological and laboratory testing investigation through the use of samples obtained from prescribed test borings taken along its center-line.

#### B. Location of Site

The test track site is located 30 feet west of the centerline of the existing Santa Fe track between mile posts 161 and 163, approximately 11.3 miles northeast of El Dorado, Kansas on Highway 177, or 7.2 miles southwest of the small community of Cassoday, Kansas. The terrain of the site area is rolling with two hill areas necessitating excavation.

#### C. Test Borings

The following 16 test borings were augered, drilled and cored on April 16, 17, 23, 24, 1969 by means of a 750 Failing truck mounted core drill:

D i	C+-++		
Boring Number	Station <u>Number</u>	Description	Depth
#1	8513+00	Embankment	6.01
#2	8514+62	Embankment	6.01
#3	8517+00	Embankment	6.01
#4	8523+00	Excavation	16.21
<b>#</b> 5	8535+22	Excavation	13.0'
#6	8542+00	Embankment	6.0'
#7	8549+39	Embankment	6.01

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Page Two

Boring Number	Station Number	Description	Depth
#8	8560+00	Embankment	6.01
#9	8563+06	Embankment	. 6.01
#10	8568+76	Embankment	6.01
#11	8575+42	Embankment	7.81
#12	8582+00	Excavation	13.01
#13	8587+00	Excavation	18.0'
#14	8590+00	Embankment	6.0
#15	8594+00	Embankment	6.01
#16	8598+40	Embankment	6.01
		Total	134.01

#### · II – Geological Survey

#### A. Type Soils

Three representative soils were found to be present in the overburden section above the bed rock between Santa Fe mile posts 161 and 163, Kansas.

The uppermost of these three soils is best described as a clay, silty, black, moist and plastic varying in thickness from total absence in borings Nos. 8 and 16 to a maximum thickness of 3.8 feet in boring No. 11. Average thickness of this upper soil where present is 1.3 feet.

The next lower soil type beneath that of above when present is a clay, slightly silty, reddish brown, moist and plastic. It varies in thickness from total absence in boring Nos. 1, 2, 7, 8, 9, 11, 15 to a maximum of 5.3 feet in boring No. 12. The average thickness where present is 1.0 foot. In boring No. 11, 3 feet of this particular clay was used as a fill and noted immediately at the surface.

The third and lowest soil type where present is described as a gradational clay, mottled gray, yellow, tan, moist to wet (due to rainfall drainage at this time of year from ditching adjacent



Page Three

to present track), plastic, grading into this same colored clay-shale which is refusal to the penetrometer. This type was found to be absent in boring Nos. 1, 7, and 8 and reached a maximum thickness of 4.0 feet in boring No. 5. Average thickness of the unit where present was found to be 0.8 foot, wherein approximately half of this total thickness can be considered clay and the bottom half clay-shale or refusal.

#### B. Bed Rock

Bed rock as herein described will denote the top of the Fort Riley limestone of Permian Geologic Age. However, in most of the borings actual refusal occurs a few inches above the top of the limestone in a weathered form of shale that appears to be more of a clay-shale as mentioned above. The weathered and soft condition of the shale was evident from the poor core recovery in this thin interval immediately on top of the limestone.

The Fort Riley limestone in the borings was characterized by being mostly dense, buff to gray and of medium hardness in its pure state while in a number of instances it appeared shaley, interbedded with thin clay-shale to shale layers, and in some instances only minute shale laminae. Vugular openings due to solution in this near surface carbonate section occurred in borings Nos. 3, 7, 12 and 16. Less common than the vugs were vertical fractures found in boring Nos. 2, 13, and 14. According to the Kansas State Geological Survey, fractures or jointing occur quite common in the Fort Riley limestone.

Due to the affects of erosion on top the surface of the Fort Riley limestone and its interbedded shale layers, it would appear that its grade approximates 0.5 foot per 100 feet or expressed as 28 feet per mile or 0.3 degree of dip in a southwest direction. Less than one degree dip to the southwest is likewise accepted by the State Geological Survey.

#### C. Surface Ground Water

Although several drainage patterns cross through the two-mile area of the present and test track area, the general pattern of drainage for the area is to the southwest or parallel to the direction of the track.



Page Four

Only drainage water was encountered in several of the borings, this being due to their nearness to present ditching carrying or holding water after heavy rainfall this time of year. The water table for the area is reported at approximately 180 feet by a water well drilling firm active in the area.

#### III - Engineering Analysis

Conditions existing at proposed site location in Kansas offers a much more variable soil profile than those existing in New Mexico. There exist three basic types of soil at this location which may be used as fill or embankment material. Because of topography there may exist fills of approximately 6 feet. The silty clay uppermost soil has a remolded modified proctor compacted dry unit weight of 105.7 pounds per cubic foot with an optimum moisture content of 17%. Undisturbed samples obtained for this material indicate an average unconfined compressive strength of 2.0 ksf. Upon remolding the unconfined compressive strength was found to be an average of 6.0 ksf. The large increase in strength in the remolded state, compacted to 95% modified proctor density, results from the relatively large increase in dry unit weight of the material.

The next underlying material is a CH material with an undisturbed compressive strength averaging about 2.5 ksf. Remolded strength of this material compacted to 95% modified proctor density averaged about 6.0 ksf which was the same as overlying soil. The strength gain here again is contributed to the increased unit dry weight of the remolded compacted soil. Remolded unit dry weight of modified proctor for this material was 106 pounds per cubic foot with an optimum moisture content of 19%.

Soil lying just above the limestone and shale was a silty clay of good remolded unconfined compressive strength (averaging about 6 ksf). The modified proctor unit dry weight of this material was found to be 109 pounds per cubic foot with an optimum moisture content of 16.6%. This material might be classified as a CL material.

Since segregation of this material will be almost impossible during excavation, the resulting borrow will be a mixture of all three types of soil. No foreseen difficulties should arise from mixing these soils. Before placing and compacting these soils they should be thoroughly mixed if they are to be used together.

CONSULTING ENGINEERING

Page Five

Lime stabilization of this material would not be recommendable except for possibly the top six inches of the road bed to provide a tight durable surface on which to construct tracks. The lime content used in this layer should be sufficient to obtain a strength gain and not a percentage that sould reduce plasticity only. In this case as well as with the cement content additional tests would be necessary to recommend a percentage. This information could be made available upon request.

A detailed slope stability study of this material was not attempted since testing was conducted in accordance with specifications issued for bidding, and we do not feel that we have sufficient information from the investigation to make a detailed study.

The problem present at the Kansas site location which should arouse some discussion is the possibility of differential movement between sections of track that will be located on bed rock and those sections which will be placed on embankments. To prevent this occurrence it would be advisable to undercut bed rock at transition sections to allow at least 4.0 feet of fill to be placed. This would allow for a more uniform depth of fill; thus, more uniform compacted soil behavior.

HEMPHILL CORPORATION

John T. Fidt, Geglogist

B. D. Marks, III, B.S.C.E., M.S.C.E.

Soils Consultant

Jack F. Stewart, Engineer

DATE: April 22, 1969

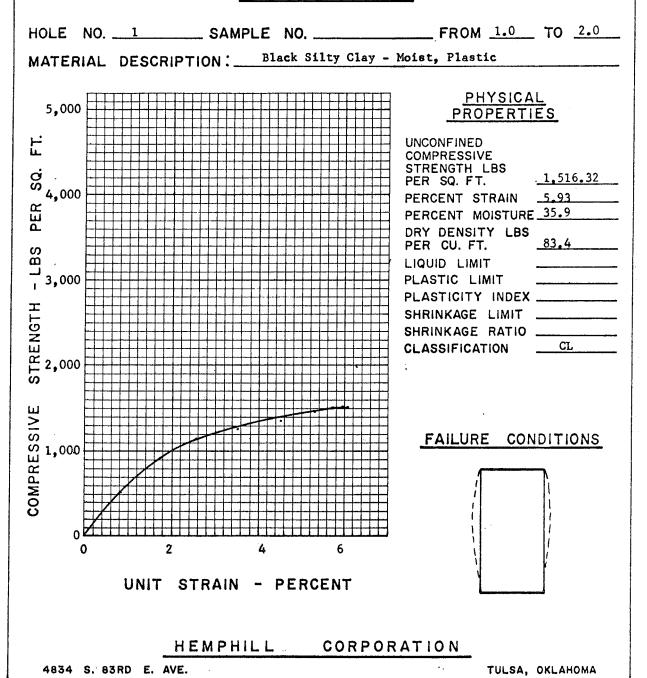
CLIENT: The Atchinson, Topeka and Santa Fe Railway System

PROJECT: U. S. Department of Transportation for Kansas Area,

Test Track



# TEST RESULTS



DATE: April 22, 1969

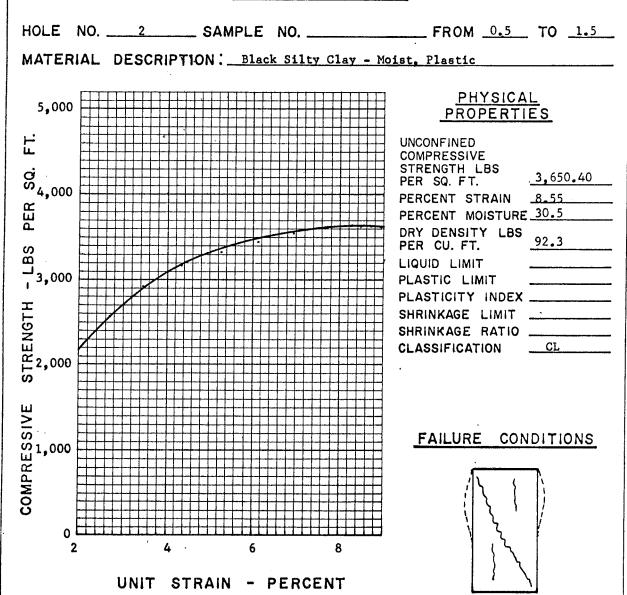
CLIENT: The Atchinson, Topeka and Santa Fe Railway System

PROJECT: U. S. Department of Transportation for Kansas Area,

Test Track



#### TEST RESULTS



CORPORATION

TULSA, OKLAHOMA

HEMPHILL

4834 S. 83RD E. AVE.

DATE: April 22, 1969

4834 S. 83RD E. AVE.

CLIENT: The Atchinson, Topeka and Santa Fe Railway System

PROJECT: U. S. Department of Transportation for Kansas Area,

Test Track



TULSA, OKLAHOMA

#### TEST RESULTS

HOLE NO. \_\_\_\_\_ FROM \_1.5 TO \_2.5 MATERIAL DESCRIPTION: Reddish Brown Clay, Slightly Silty - Moist, Plastic PHYSICAL 5,000 PROPERTIES Ë UNCONFINED **COMPRESSIVE** o, 4,000 STRENGTH LBS 1.352.16 PER SQ. FT. PERCENT STRAIN PERCENT MOISTURE 29.5 DRY DENSITY LBS 88.8 PER CU. FT. LIQUID LIMIT \_3,000 PLASTIC LIMIT PLASTICITY INDEX \_ STRENGTH SHRINKAGE LIMIT SHRINKAGE RATIO CLASSIFICATION COMPRESSIVE FAILURE CONDITIONS UNIT STRAIN - PERCENT

HEMPHILL CORPORATION

DATE: April 22, 1969

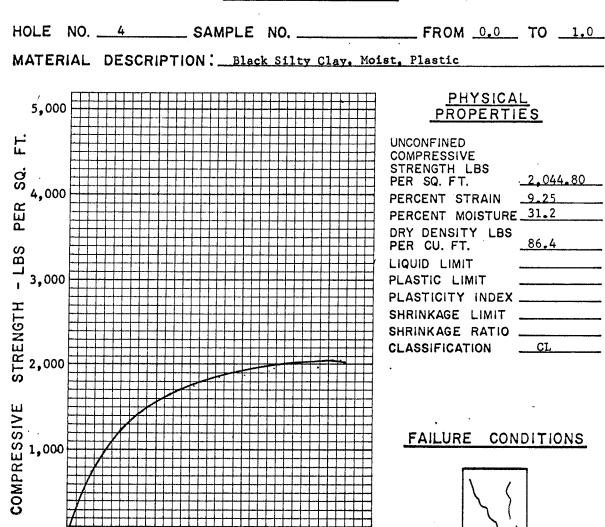
CLIENT: The Atchinson, Topeka and Santa Fe Railway System

PROJECT: U. S. Department of Transportation for Kansas Area,

Test Track



#### TEST RESULTS



UNIT STRAIN - PERCENT

HEMPHILL CORPORATION

4834 S. 83RD E. AVE.

DATE: April 22, 1969

CLIENT: The Atchinson, Topeka and Santa Fe Railway System

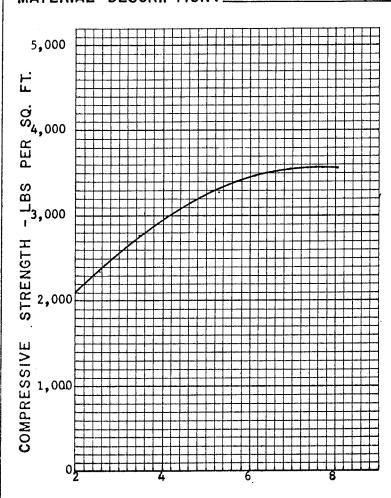
PROJECT: U. S. Department of Transportation for Kansas Area,

Test Track



#### TEST RESULTS

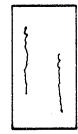
HOLE NO. \_\_6 \_\_\_ SAMPLE NO. \_\_\_\_ FROM \_\_2.0 TO \_\_3.0 \_\_\_\_\_\_ MATERIAL DESCRIPTION: \_\_\_\_ Reddish Brown Clay - Moist, Plastic



# PHYSICAL PROPERTIES

UNCONFINED COMPRESSIVE STRENGTH LBS 3,587.04 PER SQ. FT. PERCENT STRAIN 7.68 PERCENT MOISTURE 25.5 DRY DENSITY LBS 94.1 PER CU. FT. LIQUID LIMIT 39.8 PLASTIC LIMIT 25.8 PLASTICITY INDEX \_14.0 SHRINKAGE LIMIT \_\_17\_41 SHRINKAGE RATIO \_1.787 CLASSIFICATION \_CL\_ 58.8% -#200 Sieve

#### FAILURE CONDITIONS



UNIT STRAIN - PERCENT

HEMPHILL CORPORATION

4834 S. 83RD E. AVE.

DATE: April 22, 1969

4834 S. 83RD E. AVE.

CLIENT: The Atchinson, Topeka and Santa Fe Railway System

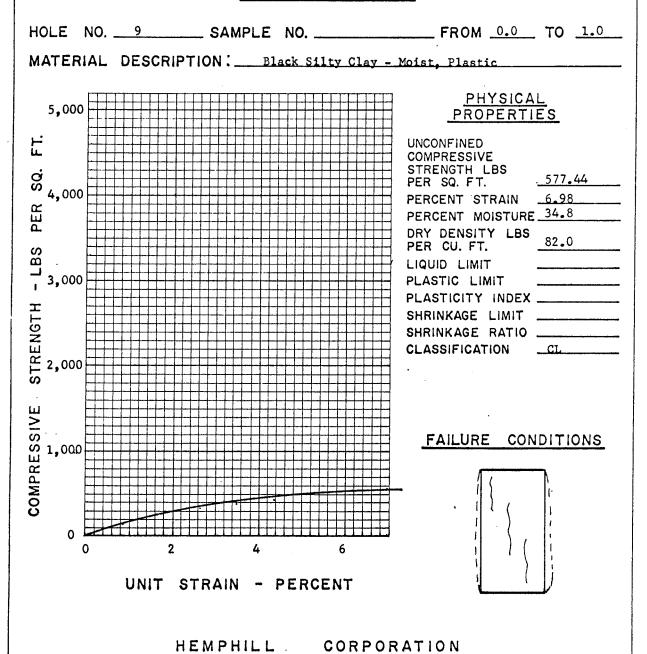
PROJECT: U. S. Department of Transportation for Kansas Area,

Test Track



TULSA, OKLAHOMA

#### TEST RESULTS



DATE: April 22, 1969

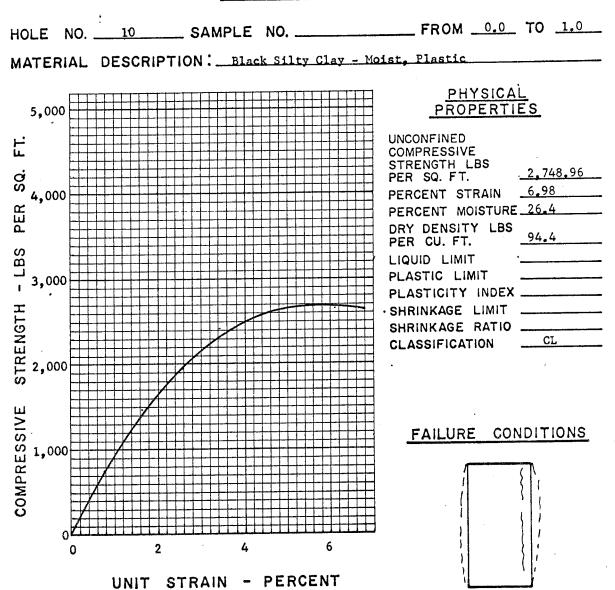
CLIENT: The Atchinson, Topeka and Santa Fe Railway System

PROJECT: U. S. Department of Transportation for Kansas Area,

Test Track



## TEST RESULTS



HEMPHILL CORPORATION

4834 S. 83RD E. AVE.

DATE: April 22, 1969

4834 S. 83RD E. AVE.

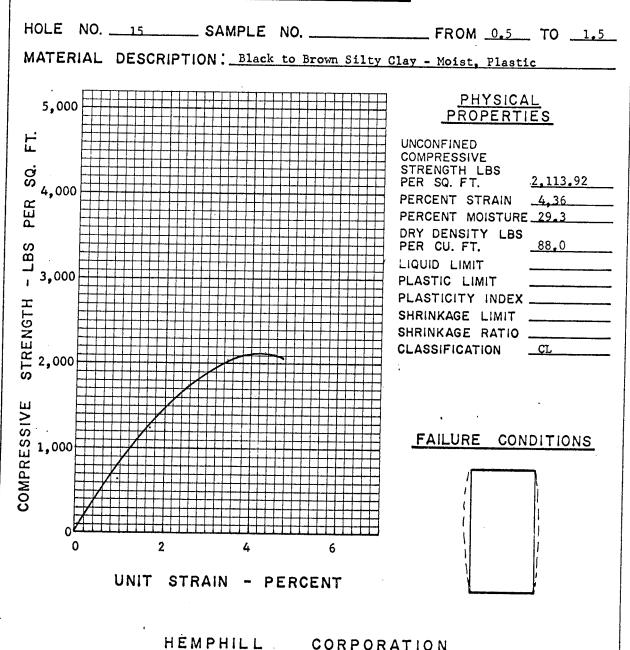
CLIENT: The Atchinson, Topeka and Santa Fe Railway System

PROJECT: U. S. Department of Transportation for Kansas Area,

Test Track



#### TEST RESULTS



CORPORATION

# MOISTURE - DENSITY CURVE

DATE: April 29, 1969

CLIENT: The Atchinson, Topeka and Santa Fe Railway System

PROJECT: U. S. Department of Transportation for Kansas Area, Test Track

MATERIAL: Black Silty Clay Topsoil

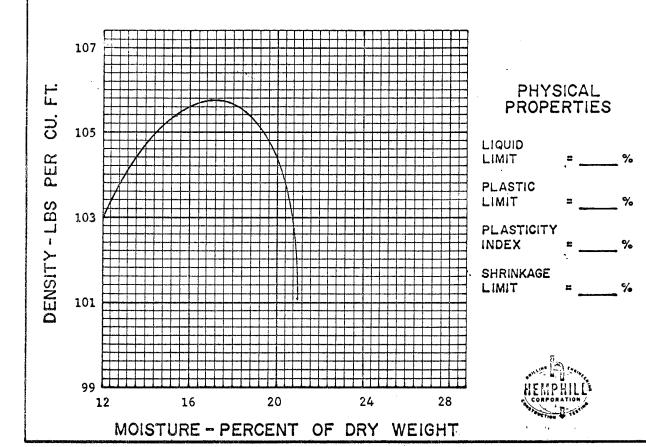
MATERIAL SOURCE: Approximate depth 0.0' - 1.3'

METHOD OF TEST: A.S.T.M. D 1557, Method A

TEST RESULTS

MAXIMUM DRY DENSITY = 105.7 LBS PER CU. FT.

OPTIMUM MOISTURE CONTENT = 17.0 %



DATE:

April 29, 1969

CLIENT: The Atchinson, Topeka and Santa Fe Railway System

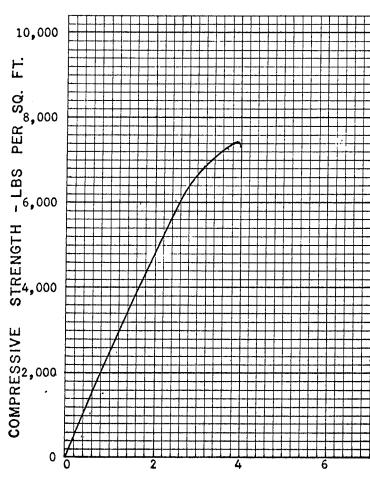
PROJECT: U. S. Department of Transportation for Kansas Area,

Test Track



#### TEST RESULTS

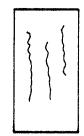
HOLE NO. Remolded SAMPLE NO. one (1) FROM 0.0 TO 1.3 MATERIAL DESCRIPTION: Black Silty Clay Topsoil



#### PHYSICAL PROPERTIES

UNCONFINED COMPRESSIVE STRENGTH LBS <u>7.454.88</u> PER SQ. FT. PERCENT STRAIN PERCENT MOISTURE 16.8 DRY DENSITY LBS 95% Max. PER CU. FT. LIQUID LIMIT PLASTIC LIMIT PLASTICITY INDEX \_ SHRINKAGE LIMIT SHRINKAGE RATIO CLASSIFICATION

#### FAILURE CONDITIONS



UNIT STRAIN - PERCENT

HEMPHILL . CORPORATION

4834 S. 83RD E. AVE.

DATE: April 29, 1969

CLIENT: The Atchinson, Topeka and Santa Fe Railway System

PROJECT: U. S. Department of Transportation for Kansas Area,

Test Track



TULSA, OKLAHOMA

#### TEST RESULTS

HOLE NO. Remolded SAMPLE NO. Two (2) FROM 0.0 TO 1.3 MATERIAL DESCRIPTION: Black Silty Clay Topsoil PHYSICAL 10,000 PROPERTIES UNCONFINED COMPRESSIVE STRENGTH LBS 7.737.12 PER SQ. FT. 8,000 3.78 PERCENT STRAIN PER PERCENT MOISTURE 18.9 DRY DENSITY LBS 95% Max. PER CU. FT. ഗ LIQUID LIMIT 6,000 PLASTIC LIMIT PLASTICITY INDEX STRENGTH SHRINKAGE LIMIT SHRINKAGE RATIO CLASSIFICATION 4,000 COMPRESSIVE FAILURE CONDITIONS 2,000 UNIT STRAIN - PERCENT CORPORATION

HEMPHILL

4834 S. 83RD E. AVE.

# MOISTURE - DENSITY CURVE

DATE:

April 29, 1969

CLIENT:

The Atchinson, Topeka and Santa Fe Railway System

PROJECT: U. S. Department of Transportation for Kansas Area, Test Track

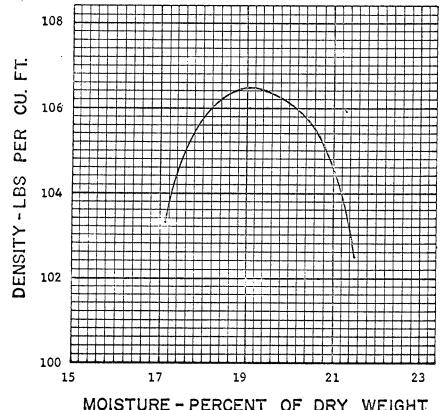
MATERIAL: Reddish Brown Clay, slightly silty

MATERIAL SOURCE: Approximate depth 1.5' - 3.0'

METHOD OF TEST: A.S.T.M. D 1557, Method A

TEST RESULTS

MAXIMUM DRY DENSITY = \_\_106.4 \_LBS PER CU. FT. OPTIMUM MOISTURE CONTENT = 19.1 %



#### PHYSICAL **PROPERTIES**

LIQUID LIMIT = 47.3 %

PLASTIC LIMIT

= 18.7 %

PLASTICITY INDEX

= 28.6 %

SHRINKAGE

LIMIT



MOISTURE - PERCENT OF DRY WEIGHT

DATE: April 29, 1969

CLIENT: The Atchinson, Topeka and Santa Fe Railway System

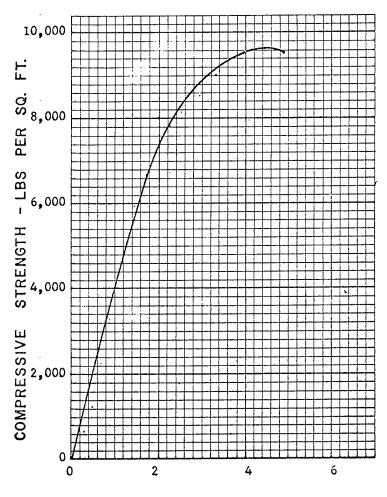
PROJECT: U. S. Department of Transportation for Kansas Area

Test Track

#### TEST RESULTS

HOLE NO. Remolded SAMPLE NO. one (1) FROM 1.5' TO 3.0'

# MATERIAL DESCRIPTION: Reddish Brown Clay, slightly silty



#### PHYSICAL PROPERTIES

UNCONFINED COMPRESSIVE STRENGTH LBS 9.672.48 PER SQ. FT. PERCENT STRAIN PERCENT MOISTURE 20.1 DRY DENSITY LBS 95% Max. PER CU. FT. 47.3 LIQUID LIMIT PLASTIC LIMIT 18.7 28.6 PLASTICITY INDEX SHRINKAGE LIMIT SHRINKAGE RATIO CL CLASSIFICATION

#### FAILURE CONDITIONS



UNIT STRAIN - PERCENT

HEMPHILL

CORPORATION

4834 S. 83RD E. AVE.

DATE: April 29, 1969

CLIENT: The Atchinson, Topeka and Santa Fe Railway System

PROJECT: U. S. Department of Transportation for Kansas Area

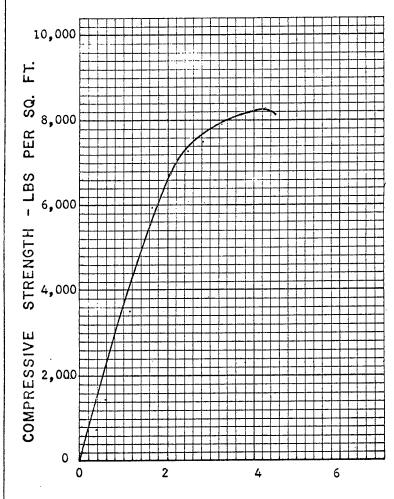
Test Track



#### TEST RESULTS

HOLE NO. Remolded SAMPLE NO. two (2) FROM 1.5' TO 3.0'

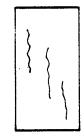
MATERIAL DESCRIPTION: Reddish Brown Clay, slightly silty



#### PHYSICAL PROPERTIES

UNCONFINED
COMPRESSIVE
STRENGTH LBS
PER SQ. FT. 8,271.36
PERCENT STRAIN 4.20
PERCENT MOISTURE 20.8
DRY DENSITY LBS
PER CU. FT. 95% Max.
LIQUID LIMIT 47.3
PLASTICITY INDEX
SHRINKAGE LIMIT
SHRINKAGE RATIO
CLASSIFICATION
CI

#### FAILURE CONDITIONS



UNIT STRAIN - PERCENT

HEMPHILL CORPORATION

4834 S. 83RD E. AVE.

#### MOISTURE - DENSITY CURVE

DATE: April 29, 1969

CLIENT: The Atchinson, Topeka and Santa Fe Railway System

PROJECT: U. S. Department of Transportation for Kansas Area, Test Track

MATERIAL: Mottled gray, yellow, tan clay with shale particles

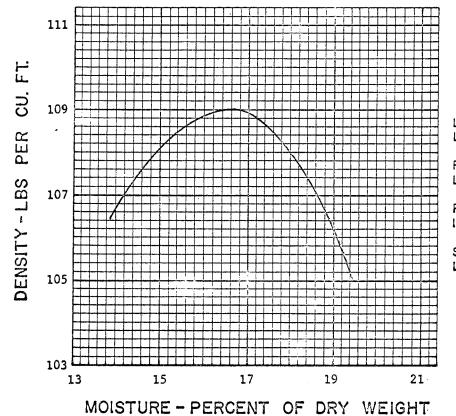
MATERIAL SOURCE: Approximate depth 3.0' - 3.7'

METHOD OF TEST: A.S.T.M. D 1557, Method A

#### TEST RESULTS

MAXIMUM DRY DENSITY = 109.0 LBS PER CU. FT.

OPTIMUM MOISTURE CONTENT = 16.6 %



# PHYSICAL PROPERTIES

LIQUID LIMIT

= 31.5 %

PLASTIC

LIMIT

= \_20.5 %

PLASTICITY

INDEX

= 11.0 %

SHRINKAGE

LIMIT

= \_\_\_\_ %



DATE: April 29, 1969

CLIENT: The Atchinson, Topeka and Santa Fe Railway System

PROJECT: U. S. Department of Transportation for Kansas Area

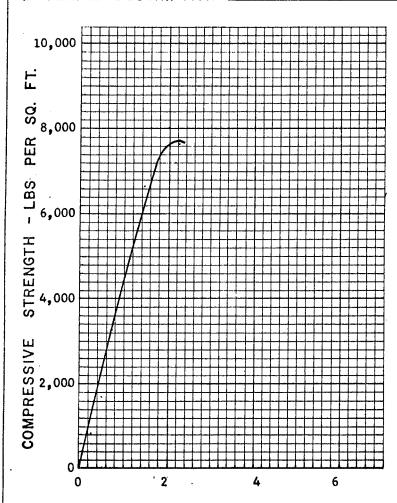
Test Track



#### TEST RESULTS

HOLE NO. Remolded SAMPLE NO. One (1) FROM 3.0 TO 3.7

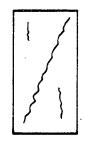
MATERIAL DESCRIPTION: Mottled gray, yellow, tan clay with shale particles



#### PHYSICAL PROPERTIES

UNCONFINED COMPRESSIVE STRENGTH LBS 7,704.00 PER SQ. FT. 2.17 PERCENT STRAIN PERCENT MOISTURE 17.1 DRY DENSITY LBS 95% Max PER CU. FT. 31.5 LIQUID LIMIT 20.5 PLASTIC LIMIT PLASTICITY INDEX 11.0 SHRINKAGE LIMIT SHRINKAGE RATIO CLASSIFICATION

#### FAILURE CONDITIONS



UNIT STRAIN - PERCENT

HEMPHILL

CORPORATION

4834 S. 83RD E. AVE.

DATE: April 29, 1969

CLIENT: The Atchinson, Topeka and Santa Fe Railway System

PROJECT: U. S. Department of Transportation for Kansas Area,

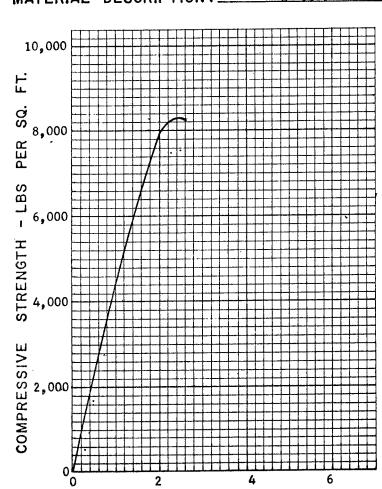
Test Track



# TEST RESULTS

HOLE NO. Remolded SAMPLE NO. Two (2) FROM 3.0 TO 3.7

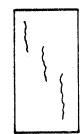
MATERIAL DESCRIPTION: Mottled gray, yellow, tan clay with shale particles



## PHYSICAL PROPERTIES

UNCONFINED COMPRESSIVE STRENGTH LBS 8,228,16 PER SQ. FT. PERCENT STRAIN PERCENT MOISTURE 16.4 DRY DENSITY LBS 95% Max PER CU. FT. LIQUID LIMIT 20.5 PLASTIC LIMIT PLASTICITY INDEX \_\_11\_0 SHRINKAGE LIMIT SHRINKAGE RATIO CLASSIFICATION

#### FAILURE CONDITIONS



UNIT STRAIN - PERCENT

HEMPHILL CORPORATION

4834 S. 83RD E. AVE.

		BC	ORI	NG LOG			HOLE NO.	1
PROJECT U.S.	Departi	ment of T	rans	portation - Test Track - K	ansa	S	SHEET NO. 1 OF	ļ.
HOLE LOCATION S				ee Boring Location Plan			DATE 4-16-69	
6MD. ELEV. 1417	.2 ° 6.W	. ELEV.		NORED BY Risenhoover			LOGGED BY John Ei	dt
SAMPLER DATA 2"	Split	Spoon		WT. OF MAN		140#		
PENETROMETER DATA				WT. OF HAM	MER		FALL OF NAMESER	
AUSER DATA				CORE BARREL & BIT DATA	<del>,</del>	<del>, , ,</del>		
ELEY. AND SCALE	3	NO. OF BLOW PER FOOT		DESCRIPTION OF MATERIALS (Type, Color, Texture, Considency)	% CORE	STANTE RO.	REMARKS (Drilling Characteristics, Dri Fluid Loss, Casing Date, El	
1.	=//			Clay, Silty, Black, Plastic, Moist			Air Drilling	
1415.2 2.		12/22		Limestone, Tan to Gray,				
				Dense, Medium Hard w/Very Thin Interbedded Tan Shal Layers				
	墨			Refusal: Permian Age -			Coring	4.2
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			TULS	A. OKLAHOMA			THOLE NO.	

			BOR	NG LOG			HOLE NO.	2
PROJECT IT	S. Dena	rtm	Name and Address of the Owner, where the Party of the Owner, where the Party of the Owner, where the Owner, which is the Owner, which	portation - Test Track - Kan	1585		**************************************	¥ ]
HOLE LOCATION		ion	8514+62				DATE 4-16-69	
	1416.7	G.W.	. ELEV.	NORED BY Risenhoover			LOGGED BY John Eight FALL OF HAMMER 30"	
SAMPLER DATA	2" S	pli	t Spoon	WY. OF HAMME		140		
PENETROMETER	DATA			WT. OF HAMME	<u> </u>	NTV	FALL OF NAMEER Heavy Duty	
AUSER DATA		-		CORE BARREL & BIT DATA		7		
ELEV.	DEPTH AND	LECERS	NO. OF BLOWS PER FOOT	DESCRIPTION OF MATERIALS (Type, Color, Texture, Considency)	RECOVERY	ğ æ	REMARKS (Drilling Characteristics, 1 Fluid Loss, Casing Data,	Drilling Eu \
1416.7	SCALE	۳ [	% X X X X	(1)	K W .		Line Cay, criming acuted	
	3			Clay, Silty, Black		. [	Air Drilling	0.
	$\exists$			Grading into Reddish	.	i	Shelby Tube	1.
	3			Brown, Plastic, Moist			DITETON INDE	¥.
↓	2.0-		<del>┫</del> <del>┩┩┩┩</del>				-	
1413.8	2.9		3/5 1		.		,	
	3.0	7		Gradational Clay, Silty.				
	3	$\mathcal{Z}$		to Clay-Shale, Mottled Yellow, Tan, Brown,				
		1		Slightly Moist.				
	式		7	Refusal: Permian Age -				
1412.9	3,5	1	<del></del>	Ft. Riley member			Coring	4.
	主	琩	]	Limestone, Gray, Dense, Medium Hard w/Thin Layers				
	3	量	]	of Interbedded Tan Shale				
	畫	茔	3	Note: Natural Vertical	100	6		
2 1 2 2 2	6.0			Fractures from 4.5 = 5.3.				6.
1410.7	-0.0			Bottom of Hole				
	Ξ			Do o o o o o o o o o o o o o o o o o o	Ì			
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					B	OR	ING LOG			HOLE NO	). 3
PROJECT U.	S. Den	artm	ent	: 0:	f T	rans	portation - Test Track - K	ansa	S	SHEET MO. 1	OF 1
							ee Boring Location Plan.			DATE 4-17-69	
680. ELEV.							Misenhoover			LOGGED BY John	Eidt
SAMPLER DAT		plit			n_		. WT. OF HAM	MER	140#	FALL OF NAMMER	30"
PENETROMETER							WT. OF HAM	MER		FALL OF NAMESER	
AUGER DATA							CORE BARREL & BIT DATA		NX H	eavy Duty	
ELEV. 1417.5	DEPTH AND SCALE	TEGENO.		PER	BLOV FOOT		DESCRIPTION OF MATERIALS (Type, Color, Texture, Consistency)	% CORE	SALENTE TO.	REMARKS (Drilling Characteristic Fluid Loss, Cesing D	is, Drilling late, Etc.)
1416.5	1.0						Clay, Silty, Black, Moist Plastic			Air Drilli	ng
1415.0	2.5						Clay, Slightly Silty, Reddish Brown, Moist, Plastic			Shelby Tube	1.5 2.5
1414.5	3.0						Clay, to Clay-Shale, Yellow Refusal: Permian Age - Ft, Riley member				
·							Limestone, Buff, Shaley, Dense, Medium Soft, Vugular from 4.1 to 4.6			Coring	4.0
1411.5	6.0	喜	.				Note: Drainage or seepage water at 3.2	100	8		6.0
							Bottom of Hole				
		H	EMP	HIL	114		ELBY DRILLING COMPANY SA, OKLAHOMA	<u>.l</u>	٠.	HOLEN	<b>O</b> . 3

		W1.510PA		1	BC	OR	ING LOG			HOLE NO. 4
PROJECT U	. S. Depa	rtn	ent	of	Tı	an	sportation - Test Track - K	ansa	S	SHEET KO: 1 OF 1
MOLE LOCATIO						<u></u>				DATE 4-24-69
EMO. ELEV.	1422.41						MORED BY Risenhoover			LOGGED BY John Eidt
SAMPLER DAT	ra 2" Sp	lit	Sp	000			WT. OF HAM		140#	
PENETROMETE	R DATA						WT. OF HAM			FALL OF NAMMER
AUSER DATA				<del></del>			CORE BARREL & BIT DAYA	NX	Hea	vy Duty
ELEV. 3422.4	DEPTH AND SCALE		P	OF B	001		DESCRIPTION OF MATERIALS (Type, Color, Texture, Consistency)	% COSE	SALEPLE RO.	CHARKS (Drilling Cherecteristics, Drilling Rudd Less, Casing Date, Etc.) All Drilling 0.0
							Clay, Silty, Black, Moist, Plastic			Shelby Tube 1.0
1421.3			H	++	+	╫	Clay, Slightly Silty,			Air Drilling
1	3		Ш		#	$\dagger \dagger$	Reddish Brown			
	2.5		<u> 213</u>	Ш	$\coprod$	Ц				
Ī	3/	X				$\prod$				
			$\ \cdot\ $							
1418.4	4.0	1	+++	+	#	+	Consideration Class Class			
1	3/	7					Gradation Clay - Clay-Shal Gray Tan, Slightly Moist	٢		
]			$\  \  \ $				and Slightly Plastic in			
	12	Z	$\  \cdot \ $				Upper Part Only Refusal: Permian Age -			
1417.1	5.3				$\coprod$	Ш	Ft. Riley member			
	書	ゴ		TT	Π	Π	Limestone, Buff to Gray, Dense, Medium Hard			Coring 6.0
Ì		丑					Dense, Medium Hard W/Interbedded Thin Tan.			COLTUR 0.0
-	3	量	$\  \  \ $				Medium Soft Shale Laminae			·
		拉	$\  \  \ $				and Becoming Shaley Limestone From 14.7 - 16.2			
1	#						THE WITE LIGHT TAS . TO S			
	#	耳								•
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-	3	国	$\  \ $				·	100	k	
		王	$\  \  \ $				·			
	車	丑								
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1400 21	16.2	围								16.2
				11	T	П	Bottom of Hole	Г		
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1	7									•
	$\exists$						·			
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				E	OR	ING LOG			HOLE NO	. 5	
PROJECT U.	S. Dep	arts	ent	of	Trans	sportation - Test Track - K	ansa	5	SHEET NO. 1	CF 1	
NOLE LOCATIO									DATE 4-24-69		
€MD. ELEV.						MORED BY Risenhoover			LOSSED BY John	Eidt	
SAMPLER DAT	A 2"	Spli	t Sr	oon		WT. OF MAIN		140	# FALL OF HAMMER	3011	
PEHETROMETER DATA WT. OF HAMMER FALL OF HAMMER											
AUSER DATA CORE BARREL & BIT DATA NX Heavy Duty											
ELEV.	DEPTH AND SCALE	LEGERO		ER FOO	T	DESCRIPTION OF MATERIALS (Type, Color, Texture, Consistency)	% CORE	SAUNE ED.	REMARKS (Drilling Characteristic Fluid Loss, Casing D		
1416.1	0.4					Clay, Silty, Black, Slight Moist w/Chunks of Free Limestone on Surface	y		Air Drilli	ng	
1,413.9	2.2					Clay, Slightly Silty, Reddish Brown, Moist, Plastic					
	3.0		14/	123		Gradational Clay - Clay Shale, Gray Tan, Slightly Moist and Plastic From 2.2 - 3.0					
1409.9	6.2					Refusal: Permian Age - Ft. Riley member					
						Limestone, Buff to Gray, Shaley From 6.2 to 11.5 (Rather than interbedded) Medium Soft Where Shaley and Then Grading into Dense			Coring	<b>7.</b> 5	
	·					Medium Hard Limestone					
1203.1	13.00						87%			30.0	
1			$\dagger\dagger\dagger$	$\dagger \dagger \dagger$	╀┼┼┫	Bottom of Hole	-			13.0	
	Lammina.										
			MPH			LESY DRILLING COMPANY					
			.mrr	I la la (		ilby drilling company Ba, oklahoma	- ساوست		HOLE NO	<b>)</b> , 5	
	. —										

					OR	ING LOG			HOLE NO. 7	
angles ?!	Q D-m-	andres.	nu d				2000		SHEET NO. 1 OF 1	
						sportation - Test Track - Ka See Boring Location Plan	iiisa:	5	DATE 4-17-69	┪
MOLE LOCATIO	1400.0				7	MORE BY Risenhoover			LCGSED BY John Eidt	
SAMPLER DAT						WT. OF NAME	MER	140		-
PENETROMETE		atomic ()	<u> </u>	<u> </u>		WT. OF HAM			FALL OF HAMMER	- 1
AUSER DATA						CODE BARREL & BIT DATA		avy	Duty NX	-
ACOUN DAIN		7	110	OF BL	29440		_	,		
ELEV.	DEPTH AMD SCALE O O	CESSE	P	er foc		DESCRIPTION OF MATERIALS (Type, Color, Texture, Consistency)	* COSE	SALTAE CO	(Drilling Observationships, Drilling Field Loss, Cosing Date, Etc.)	
						Clay, Silty, Black, Plastic Moist	,		Air Drilling	
1398.3	1.7	月	$\frac{1}{1}$		+ + +	Limestone, Gray to Tan, Medium Soft, Shaley			(Attempted Penetration @ 1.5')	
1397.5	2	7				Clay-Shale, Yellow, Moist (Saved Jar Sample) Refusal: Permian Age - Ft. Riley member				
1790.		喜				Limestone, Buff-Gray, Dense, Medium Hard w/Vugs From 4.4 - 4.5	_		Coring 4.2	
1394.0	6,C						100		6,0	
						Bottom of Hole				
·		HI	EMPH			ELBY DRILLING COMPANY	<u> </u>	<del>-</del>	HOLENO ?	
					TU	SA, OKLAHOMA			HOLE NO. 7	

BETHN AND SQUEOUS PRE FOOT PRE FOOT PRE FOOT SQUEOUS PRO			BOR	ING LOG	HOLE NO. 8
See Boring Location Flam  Station 8560400  See Boring Location Flam  See Boring Location Flam  See Boring Location Flam  See Boring Boring Flam  See Boring Flam  See Boring Flam  See Boring Boring Flam  See Flam  See Boring Flam  S	project U.	S. Depart	ment of Tran	sportation - Test Track - Kansas	
MATHER DATA 2" Split Shoon  WT. OF MARKET 140.0F FAIL OF RAMMER 30."  WESTERNAME AND WT. OF MARKET FAIL OF RAMMER 30."  WESTERNAME AND HEAVY DATA HEAVY DA			8560+00	See Boring Location Plan	
PRETENENTIAL DATA  ORT MARKE A HT DATA  HERV AND	ELEV.	1398.31 6.4	r. ELEV.		
REPORT BATE A HE DATA Heavy Dity NX  REAL AND BY PER FOOT	SAMPLER DATA	2" Split	Spoon		
BETTH AND SALE SELENT AND SALE SELENT PER FOOT  (Pys., Color, Various, Consistency)  (Pys., Color, Various, Color, Co	<u>Penetrometer</u>	DATA			
Mixture of Limestone Boulders, Clay and Clay- Shale at Surface Refusal: Fernian Age - Ft. Biley member Hard Wilmey Shale in Core From 2.0 - 2.2° and Several Very Thin Slightly Weathered Shale Layers Below  Bottom of Hole  Mixture of Limestone Boulders, Clay and Clay- Shale at Surface Refusal: Fernian Age - Ft. Biley member Coring 2.0  Coring 2.0  Bottom of Hole	AUSER DATA				
Mixture of Linestone Boulders, Clay and Clay- Shale at Surface Refusal: Fermian Age - Ft. Filey member Linestone, Buff to Gray, Dense, Medium Hard to Hard w/Liney Shale in Core From 2.0 - 2.2' and Several Very Thin Slightly Weathered Shale Layers Below  Bottom of Hole  Air Drilling Air Drilling Air Drilling Air Drilling Corine 2.0  Corine 2.0  Corine 2.0  Air Drilling		AND B		DESCRIPTION OF MATERIALS (Type, Color, Texture, Consistency)	EMARKS (Drilling Characteristics, Drilling Floid Loss, Cosing Data, Etc.)
Dense, Medium Hard to Core Hard Wilney Shale in Core From 2.0 - 2.2' and Several Very Thin Shightly Weathered Shale Layers Below  Bottom of Hole  Bottom of Hole  6.0	1397.8			Boulders, Clay and Clay- Shale at Surface Refusal: Permian Age - Ft, Riley member	Air Drilling
Prom 2.0 - 2.2 and Several Very Thin Slightly Weathered Shale Layers Below 92.5%  Bottom of Hole  6.0	ĺ			Limestone, Buff to Gray, Dense, Medium Hard to	Coming 2.0
Prom 2.0 - 2.2 and Several Very Thin Slightly Weathered Shale Layers Below 92.5%  Bottom of Hole  6.0				Hard w/Limey Shale in Core	COLLEGE
Bottom of Hole	7200 8			Very Thin Slightly Weathered Shale Layers	
				7.41	

						ING LOG			HOLE NO	r on constant of the Constant
						portation - Test Track - K	ansa	s	SHEET NO. 1	or 1
				See E	or	ing Location Plan	<del></del>		DATE 4-17-69	
			ELEV.			BORED BY Risenboover WT. OF NAME	MED	740:	LOGGED BY John E	30 n
<u>Sampler Dati</u> Penetrometer		<u>, 1, 1,                                </u>	APOOS.		٠ ,	WT. OF NAM		2407	FALL OF NAMMER	<u> </u>
AUSER DATA						CORE BARREL & BIT DATA		avy I	Outy NX	
ELEV.	DEPTH CAND SCALE		PER	BLOWS FOOT	%	DESCRIPTION OF MATERIALS (Type, Color, Texture, Consistency)	X COSTE ECCOVERY	SALPLE TO.	EMARKS (Drilling Cherocheristic Floid Loss, Caping D Air ) Pillii	is, Driffing ata, Etc.)
1394-0	<u> </u>					Clay, Silty, Black, Plastic	<del></del>		Shelby Tube	
1392,8	1.2			<del>                                      </del>	Ш	` .	'			-
1392,6	1.5					Clay-Shale, Mottled Yellow Tan, Brown, Slightly Moist Refusal: Permian Age - Ft. Riley member				
					.	Limestone, Buff to Gray, Dense, Medium Soft to Medium Soft to Medium Hard			Coring	2,0
1390,6	3.4	田山			₩	Clay-Shale Mottled Yellow	1009			
1390.4	_3.6 ⊐≡					Tan, Medium Soft, Slightly Moist Limestone, Gray, Dense, Medium Hard w/Interbedded				
1388.0	6.0	富上				Medium Hard w/Interbedded Thin Leminae of Tan, Medium Soft Shale				6.0
		ŀ	$\Pi\Pi$		П	Bottom of Hole				Ē
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		HE	мрніі			LEY DRILLING COMPANY A. OKLAHOMA		· ·	HOLEN	<b>)</b> , 9

Main   Department of Transportation - Test Track - Kansas   SHEI MA   0	water the state of		žu.	OR	ING LOG			HOLEN	<b>)</b> . 10
CONTRIBUTE DATA  2" Split Spoon  MI OF MARKET  WI OF MARKE	paoject U.	S. Depar	tment of	rans	portation - Test Track - Ka	insas	3		<b>0</b> # 1
AND STATE OF THE S	HOLE LOCATIO	M Statio	n 8568+76	Şe	e Boring Location Plan			DATE 4-23-69	
COME BARREL & MIN MAN	ొరి. ELEV.				MAID BY Risenhoover			LOSSED BY John	
REN. DEFINITION OF BLUES.  REN. DEFINITION OF BL	SAMPLER DAT	A 2" S	plit Spoor	<u> </u>		MER	140#		
BEY, AND SELECTION OF MATERIALS (Proc. Oler, Textus, Conditions)  SULF, SILF, SILF, Conditions of Materials (Proc. Oler, Textus, Conditions)  Clay, Silty, Black, Moist Plastic  Clay, Silty, Moist Plastic  Coring 1.7  Coring 1.7  Shelty Tube 1.0  Coring 1.7	ENETROMETE	DATA		·	WT. OF HAS	MER		FALL OF MAMMER	<del>, ,</del>
REFORM PROPRIES ANTENNA CONTROL OF ANTENNA CONTROL	AUGER DATA				CORE BARREL & BIT DATA	Неа	vy Du	ity NX	
Clay, Silty, Black, Moist Plastic  Ciny, Rednish Erown, Slickly Silty, Moist Plastic  Craditional From Clay- Shale Yellow Tan, Medium Hard to Shale, Tan, Liney, Medium Hard with Interbedded Dense, Medium Hard with Tot Crey, Medium Hard with Yery Thin Layors of Tan, Medium Soft Shale  Bottom of Hole  Clay, Silty, Black, Moist Plastic  Coring  1.7  Coring 1.7  Coring 1.7  Coring 6.0		AMD 3	PER FOO	T		% CONERY	SEPTE RO.	(Oriting Characterist	ks, Drilling
Clay, Recaish Brown, Sitghtly Moist Placido  Ordational From Clay- Shale, Yellow Yan, Medium Hard to Shale, Tan, Liney Medium Hard, Linetveded Dense, Medium Hard, Linestone Refusal: Permian Age - Fr. Riley member  Idmestone, Dense, Buff to Gray, Medium Bort Wylery Thin Layors of Tan, Medium Soft Shale  Bottom of Hole  6.0		3			Clay, Silty, Black, Moist Plastic			· · · · · · · · · · · · · · · · · · ·	
Gradational From Clay— Shale, Yellow Tan, Medium Hard to Shale, Tan, Liney Medium Hard w/Interbeded Dense, Medium Hard, Limestone, Dense, Buff to Gray, Medium Hard w/Very Thin Layers of Tan, Medium Soft Shale  Bottom of Hole  Coring  1.7	1	1.3=			Clay, Reddish Brown, Slightly Silty, Moist				
Shale, Yellow Tan, Medium Hard to Shale, Tan, Limey Medium Hard w/Interbedded Dense, Medium Hard w/Interbedded Limestone Refusal: Permian Age - 100% Ft. Riley membar Limestone, Dense, Buff to Gray, Medium Hard w/Very Thin Layers of Tan, Medium Soft Shale 6.0  Bottom of Hole		-			Gradational From Clay-			Coring	1.7
Limestone, Denso, Buff to Gray, Medium Hard w/Very Thin Layers of Tan, Medium Soft Shale 6,0  Bottom of Hole	503.4	2,5			Shale, Yellow Tan, Medium Hard to Shale, Tan, Limey Medium Hard w/Interbedded Dense, Medium Hard, Limestone Refusal: Permian Age	1009	1		
	237 C	5.0			Limestone, Dense, Buff to Gray, Mccium Hard w/Very				6.0
		7			Bottom of Hole				
HEMPHILL & CHELEY DRILLING COMPANY									
TULSA, OKLAHOMA HOLE NO. 10			HEMPHILL &			<u></u>		HOLEN	2 10

	BOR	ING LOG		HOLE NO. 11
gomen U.S. Departm	ent of Tran	sportation - Test Track - K	ansas	SHEET NO. 1 OF 1
	8575+42	See Boring Location Plan		DATE 4-24-69
"). ELEV. 1397.8° 6.W.	ELEV.	MAED BY Risenhoover		LOSSED BY John Eidt
THER DATA 2" Split	Spoon	WT. OF MAR	MER 140	
HETROMETER DATA	FALL OF MANAGER			
USER DATA		CORE BARREL & BIT DATA		
ELEV. A.D. SGLEO	NO. OF BLOWS PER FOOT	DESCRIPTION OF MATERIALS (Type, Color, Texture, Completency)	% ODE ECOVERY SALTIE	REMARKS  (Drilling Characteristics, Drilling Fluid Less, Cozing Duta, Etc.)
3.0 3.0 3.0 3.0 3.0 3.0 3.0 3.0 3.0 3.0		Clay, Slightly Silty. Reddish Brown, Moist. Plastic (All Fill)  Clay, Silty, Black, Wet From Adjacent Ditch Drainage, Plastic  Clay, Yellow Gray Grading into Clay-Shale @ 6.8  Refusal: Permian Age - Ft. Riley member		Air Drilling  (Attempted Penetration from 6.5-6.8 total 5 blows)

	BOR	ing log		HOLE NO. 12
PROJECT U.S. De	partment of Trans	sportation - Test Track - Ka	ansas	SHEET NO. 1 OF 1
		See Boring Location Plan		BATE 4-23-69
T. ELEV. 1399.21	G.W. ELEV.	MAID BY Risenhoover		105655 BY John Eidt
SATTIER DATA		. WT. OF HAM		FALL OF MAMMER
PENET CHETER DATA	·	WT. OF NAM		FALL OF MAINTER
AUGER DATA		,	Heavy Dut	
CLEV. AND SCILE.	HO. OF BLOWS PER FOOT		% ONE RECOVERY SAENE R3.	REMARKS (Drilling Oberockerholds, Drilling Floid Less, Cosing Deta, Etc.)
3 45 8.2 0.5		Clay, Silty, Black, Moist, Plastic		Air Drilling
5,8		Clay, Slightly Silty, Reddish-Brown, Moist, Plastic		
5-92 2 7.0		Clay, Yellow Gray, Moist Plastic (Carrying drainage water from present rail- road ditch) Grading into Clay-Shale from 6.8-7.0° Refusal: Permian Age - Ft. Riley member		Coring 7.5
1386.2 13.0		Limestons, Buff to Gray, Dense, Medium Hard w/Thin Layers of Tan, Medium Soft Limey Shale from 8.0-8.2, 9.9-10.4, and Vugs Noted in Limestone from 10.4-10.8	96.4%	
7385.2		Bottom of Hole		
		IELDY DRILLING COMPANY LBA, OKLAHOMA		HOLENO, 12

				Ī	30R	ING LOG			HOLE	<b>(O</b> . 13	
PROJECT U.	S. Depa	rtze	ent	of	Trans	sportation - Test Track - Ka	nsas	3	SHEET NO. 1	OF 3	
						ee Boring Location Plan			DATE 4-23-6	9	
erro. ELEV.						MOMEN BY Risenhoover			logged by Jo	hn Eidt	_
SAMPLER DATA						WT. OF HAM	MER		FALL OF HAMMER		_
PENSTRO!!STER			<del></del>			WT. OF HAM	MER		FALL OF NAMMER		_
AUSER DATA		.,				CORE BARREL & BIT DATA	He	avy	Duty NX		
ELEV.	DEPTH AND SCALE	CESSII	i	OF BI	XOT	DESCRIPTION OF MATERIALS (Type, Color, Texture, Consistency)	KECONERY	SALVTE KD.	REMA (Drilling Characte Fluid Loss, Casi	ristics, Drilling	
3 396.2	0.5					Clay, Silty, Black, Moist, Plastic			Air Drilli	.ng	
1.593.2						Clay, Slightly Silty, Reddish-Brown, Moist, Plastic				,	
392.2						Clay, Tan Gray, More Moist Than Above Clay, Plastic w/Trace of Gravel Grading into a Clay-Shale from 4.3-4.5 Refusal: Permian Age - Ft. Riley member		•	Coring	4,5	
3378.7	18.6					Limestone, Buff to Gray, Dense, Medium Soft to Medium Hard w/Vertical Fracture from 4.5-5.5; Shale, Tan, Limey, Medium Soft from 5.7-6.1, from 7.5-7.9, from 11.4-11.6, and 13.4-13.6 and 15.3-15.4; Open Vertical Fracturing from 15.4 to 16.7; Also Glosed Gross-Vertical Fractures Noted from 8.0-9.0				18.	0
						Bottom of Hole					
	=	_									
		Н	EMP	HILL		HELBY DRILLING COMPANY		•	HOLE	NO .	13

•									:				
					سبي		O	R	ING LOG			HOLE NO.	14
PROJECT U.	S. Dep	artm	er	1±.	0	£	<u>Pr</u>	n:	sportation - Test Track - Ka	nsa	3	311241 7741 37	f )
THE LOCATION	Sta-	tion	3	3 59	0-	+00	_	٤	See Boring Location Plan			DATE 4-23-69	<del></del>
	1392.0								RECEIP BY Risenhoover WT. OF MARKE	re	1.04	LOGGED BY John Ei	dt
	2" Sp	lit	SI	000	n				WT. OF KARM		140#	FALL OF NAMMER	
<u>EMETROMSTER</u> Juser data	DAIA						_		CORE BARREL & BIT DAYA		eavy	Duty NX	
ELEV.	DEPTH AND SCALE	CESSI		Pi	R	BLO FOOT		***	<u></u>	X COSE RECOVERY	SABPLE NO.	REMARKS (Drilling Characteristics, E Fluid Loss, Casing Date,	rilling Etc.)
. 393 ,0	1.0								Clay, Silty, Black, Moist, Plastic			Air Drilling	
	2.0=		3/	5					Clay, Slightly Silty, Red, Moist, Plastic				
359.2	_2. <del>8</del>								Clay, Yellowish-Gray.	*			2.9
385.7	ر چ-3.3	温							Clay, Yellowish-Gray, Slightly Moist, Grading into Clay-Shale Refusal: Permian Age -			Shelby Tube Coring	3.2 3.5
	·	盟					H	4	Ft. Riley member				
1546.0									Limestone, Buff to Gray. Dense, Shaley from 3.3 to 3.7 and Containing a Vertical Fracture from 3.3 to 4.5	92%			6.0
	<b></b>		T						Bottom of Hole				
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								ING LOG			HOLE NO. 15
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								sportation - Test Track - Ka	insa	3	SHEET NO. 1 OF 1
	1386.0						<u>se</u>	e Boring Location Plan  BORED BY Risenhoover			DATE 4-23-69 LOGGED BY John Eidt
THER DAT								WY. OF HAM	150	LINA	
NETROMETE		10.	<u> </u>	الزد	וועע			WT. OF HAM		<u> 140#</u>	FALL OF MARMER
SER DATA	V-110							CORE BARREL & BIT DATA		Hea	vy Duty NX
ELEV. 386.0	DEPTH AND SCALE	CESI		Pi	OF E	001			% CORE		
	3		T	П	$\prod$			Clay, Silty, Black to Brow	1		Air Drilling 0.5
								Moist, Plastic			Shelby Tube
383.5	2.5 		+				+	Clay_Shale, Mottled Yellow			(Attempted Shelby Tube @ 2.5 but obtained
382,8	3.2- -		1					Brown Gray, Medium Hard (Note: Too Hard to Push and too Soft to Recover			jar sample only) 3.0 Coring
Part of the Part o		量			1	H	$\downarrow \downarrow$	Core) Refusal: Permian Age - Ft. Riley member			
								Limestone, Buff to Gray, Dense, Medium Hard w/ a Few Very Thin Laminae of	93%		
330,0	6.0	丑	+	$\parallel$	$\prod$	H		Shale, Tan, Medium Hard			6,0
i						$\ $		Bottom of Hole			
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		***************************************			BOF	ING LOG	HOLE NO. 16
ו השנסבק	S. Dep	arim	ent	of	Tran	sportation - Test Track - Kansas s	HEET NO. 1 OF 1
					) 5		DATE 4-23-69
5	1382.81						OGGED BY John Eidt
ESTITES DA		plit	: Sp	oon			FALL OF HAMMER 30"
POSTER NEED			·				ALL OF NAMMER
AZUCER DATA							I CY INA
ELEV. 7.382.8	DEPTH AND SCALE	LEGERO		O. OF B		DESCRIPTION OF MATERIALS 병원 및 말 (Type, Color, Texture, Considency) 공원	REMARKS (Drilling Characteristics, Drilling Fluid Loss, Casing Date, Etc.)
్ ేస్ప్లర	1.2		8			Clay, Slightly Silty, Reddish Brown, Moist, Plastic	Air Drilling
1380.7	2.1					Medium Soft, Tan to Tan Shale w/Interbedded Dense Limestone Refusal: Permian Age - Ft. Riley member	oring 1.3
1376.8	6,0					Limestone, Buff to Gray, B2.76 Dense, Medium Hard w/ an Occassional Thin Laminae of Tan, Medium Soft Shale also a Vug Noted at 5.3 and Shale, Tan, Medium Soft from 5.5 to 5.7	6,0
						Bottom of Hole	
	1.	HE	мРн	اللا		LBY DRILLING COMPANY A. OKLAHOMA	HOLE NO. 16



NEW MEXICO ARFA

\_ "hemphill the name you can trust" \_

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# REPORT FOR U. S. DEPARTMENT OF TRANSPORTATION TEST TRACK NEW MEXICO

#### I - Introduction

#### A. Purpose of Survey

The purpose of the survey was to examine the proposed U. S. Department of Transportation test track site in New Mexico from a geological and laboratory testing investigation through the use of samples obtained from prescribed test borings taken along its center-line and potential borrow areas.

#### B. Location of Site

The test track site is located 30 feet south of the centerline of the existing Santa Fe track between mile posts 684 and 686, between Melrose and Cantara, New Mexico, while the borrow borings were taken 60 feet south of the existing track. The natural terrain of the site is relatively flat.

#### C. Test Borings

The following 17 test borings were augered and drilled on April 23, 24, 1969 by means of a 1500 Failing truck mounted core drill:

Bori Numb		Station Number	Description	Depth
#1	(30' south of center-	1950+00	Embankment	6.0'
#2	line of existing	1958+00	Embankment	6.01
#3	track)	1966+00	Embankment	6.0'
#4		1974+00	Embankment	6.0'
<b>#</b> 5		1982+00	Embankment	6.01
#6		1990+00	Embankment	6.0'



#### U. S. DEPARTMENT OF TRANSPORTATION

Page Two

Boring Number		Station Number	Description	Depth
#7		1998+00	Embankment	6.01
#8		2006+00	Embankment	6.01
#9		2014+00	Embankment	6.01
#10		2022+00	Embankment	6.01
#11		2030+00	Embankment	6.0'
#B <b>-</b> 12	(60' south	1950+00	Borrow	6.0'
#B <b>-</b> 13	of center- line of	1965+00	Borrow	6.0'
#8-14	existing track)	1980+00	Borrow	6.01
#B <b>-</b> 15		1995+00	Borrow	6.01
#8-16	•	2010+00	Borrow	6.0'
#8-17		2025+00	Borrow	6.01
			Total	102.0'

#### II - Geological Survey

#### A. Type Soils

Only two representative soils were found to be present in the 6 feet of subsurface investigation throughout the two mile test track site between Santa Fe mile posts 684 and 686, New Mexico.

The upper soil consisted of brown silt, very little if any moisture, having a very slight amount of clay. The thickness in the eleven center line borings ranged from as little as 0.5 foot to a maximum of 2.0 feet. The average thickness was 1.2 feet. That in the six borrow borings ranged from 1.8 to 2.5 feet, with an average of 2.2 feet.

The lower soil consisted of sand, very silty and very fine grained, multicolored white-reddish white to tan, very limey with a trace of clay and varying amounts of caliche particles. Larger



#### U. S. DEPARTMENT OF TRANSPORTATION

Page Three

sizes of caliche were noted in the western half of the test track site commencing with boring No. 7 thru ll. The sand is of Tertiary Geologic Age and is referred to as the Ogallala Formation, with the caliche characterizing the nearby terrace deposits of Recent Geologic Age.

#### B. Bed Rock

 $6.0 \, ^{\rm l}$  feet being the maximum depth of investigation, bed rock was not encountered anywhere in the test track site.

#### C. Surface Ground Water

No moisture or drainage water was encountered in any of the borings and it is reported the static water level is at a considerable depth in the area.

#### III - Engineering Analysis

The uppermost soil existing at the New Mexico site could be classified as a CL material with a compacted modified proctor of 118 pounds per cubic foot at an optimum moisture content of 11.4%. Unconfined compressive strength of a remolded sample compacted to 95 per cent modified proctor was 3.0 ksf. The low unconfined compressive strength in this case results from lack of clay sufficient to contribute cohesive strength.

The underlying soil, a very fine grained sand of medium density, was completely lacking in plasticity and may be classified as a SF material. This material yielded a modified proctor compacted unit weight of 118 pounds per cubic foot at an optimum moisture content of 11%. Thus, the compaction properties of the two existing natural soils is very similar.

The New Mexico site offers ideal conditions for construction of a uniformly conditioned test site. Since soil conditions are uniform throughout the section and very little excavation or embankment would be necessary; differential settlements of the track bed might be expected to be negligible. Environmental conditions existing at this site would also be a most ideal situation for controlled research.

Based on topography at the site and existing soils, the following may be considered an adequate subgrade design. Excavation to an elevation of 3998 feet would expose the sandy, non-plastic

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#### U. S. DEPARTMENT OF TRANSPORTATION

Page Four

material throughout the test section. A one to two foot base for track foundation could be constructed above this material by using silty clay material (excavated) stabilized with Portland cement. The one to two foot of soil-cement base would offer an ideal track bed foundation. The existing material promises to respond to cement stabilization very favorably since it is a very friable low plasticity material. After treatment it would be unexpected to find unconfined compressive strengths greatly in excess of those obtained on raw soil. Additional tests would be required to find optiment cement content required for this particular material. If such information is required in the future planning and design of the test section, it could be made available on request.

HEMPHILL CORPORATION

John T. Exit, Geologist

B. D. Marks, III, B.S.C.E., M.S.C.E.

Soils Consultant

Jack F. Stewart, Engineer

# MOISTURE - DENSITY CURVE

DATE: April 29, 1969

CLIENT: The Atchinson, Topeka and Santa Fe Railway System

PROJECT: U. S. Department of Transportation for New Mexico Area,

Test Track

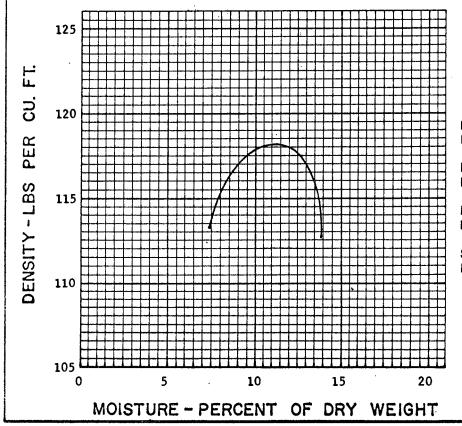
MATERIAL! Brown Silt Topsoil

MATERIAL SOURCE:

METHOD OF TEST: ASTM D 1557, Method A

# TEST RESULTS

MAXIMUM DRY DENSITY = 118.4 LBS PER CU. FT. OPTIMUM MOISTURE CONTENT = 11.4 %



#### PHYSICAL **PROPERTIES**

LIQUID LIMIT

PLASTIC LIMIT

PLASTICITY INDEX

= NP

SHRINKAGE LIMIT



# UNCONFINED COMPRESSION TEST

DATE: May 5, 1969

CLIENT: The Atchinson, Topeka and Santa Fe Railway System

PROJECT: U. S. Department of Transportation for New Mexico Area,

Test Track



### TEST RESULTS

HOLE NO. Remolded SAMPLE NO. One (1) FROM TO MATERIAL DESCRIPTION: Brown Silt Topsoil PHYSICAL 5,000 PROPERTIES UNCONFINED COMPRESSIVE STRENGTH LBS 2,966,40 PER SQ. FT. 4,000 3.33 PERCENT STRAIN PER PERCENT MOISTURE \_\_ 12.0 DRY DENSITY LBS 95% Max. PER CU. FT. BS LIQUID LIMIT 3,000 PLASTIC LIMIT PLASTICITY INDEX \_\_N.P. STRENGTH SHRINKAGE LIMIT SHRINKAGE RATIO OL CLASSIFICATION 2,000 ш > FAILURE CONDITIONS 1,000 COMPRES

UNIT STRAIN - PERCENT

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HEMPHILL CORPORATION

4834 S. 83RD E. AVE.

TULSA, OKLAHOMA

# MOISTURE - DENSITY CURVE

DATE:

April 29, 1969

CLIENT: The Atchinson, Topeka and Santa Fe Railway System

PROJECT: U. S. Department of Transportation for New Mexico Area,

Test Track

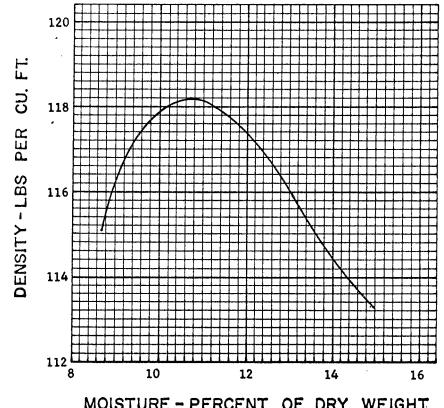
MATERIAL: Caliche with silt and fine grain sand

MATERIAL SOURCE:

METHOD OF TEST: ASTM D 1557, Method A

## TEST RESULTS

MAXIMUM DRY DENSITY = 118.2 LBS PER CU. FT. OPTIMUM MOISTURE CONTENT = 10.5 %



#### PHYSICAL **PROPERTIES**

LIQUID LIMIT

= 25.2 %

PLASTIC

LIMIT

= 15.9 %

PLASTICITY

INDEX

= 9.3 %

SHRINKAGE

LIMIT



MOISTURE - PERCENT OF DRY WEIGHT

WHE LOCATION Station 1950+00 See Boring Location Plan DATE 4-24-69  WHO SELEV. 4401.5° G.W. ELEV. BORED BY Woodall LOSSED BY Same  WIT. OF HAMMER 140# FALL OF HAMMER 30"  WIT. OF HAMMER PALL OF HAMMER  WIT. OF HAMMER FALL OF HAMMER	NE COLIGIO Station 1950+00 Sas Boring Location Flam DATE 4-24-69  S. HEV. 44-01.5' 6.W. HEV. MORED N WOODARD 14-04-5' FAUL OF MARKET 30"  WITHER DATA 2" Split Spoon WIT. OF MARKET 14-04-5' FAUL OF MARKET 30"  SECONDARY DATA CORE MARKET 18 BY MARK  BEV. AND STRONG PER PORT OF THE CORE FOR THE MARKET 14-04-5' FAUL OF M			BOR	ING LOG			HOLE NO. 1
Station 1950+00 See Boring Location Fian DAT 425-67 DATE OF THE PARK 2" Split Spoon WT. OF MANMER 1405 ALL OF MANMER 30" MY. OF MANMER 2" Split Spoon WT. OF MANMER 1405 ALL OF MANMER 30" MY. OF MANMER 2" Split Spoon WT. OF MANMER 30" MY. OF MANMER 3	NE LOCATION Station 1950+00 Sea Boring Location Flam DATE 14-267  REV. 4400,51 & W. H.W. W. MORE W Modell 1 (9588 W Same Plan All of MARKET 1405 All of MARKET 30"  REV. 4400,50 & W. OF ELOW PER PRINCE OF MATERIALS (PRINCE DATE AND PER PRINCE DATE	raojea u	I. S. Depa	rtment of Tran	sportation - Test Track - N	lew M	exi	CO SHEET NO. 1 OF 1
MIN. ALOU, 51 G.W. RIV.  MIN. BIAN 2" Split Spoon  W. OF MANNER 140 FAMLER 30"  MIN. DOTH AND AND BIAN. BIR. BIR. BIR. BIR. BIR. BIR. BIR. BIR	THE PART 2 Split Spoon WT. of MARKET 1405 MALL 30 MARKET 1405 MALL 30							DATE 4-24-69
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BILLAND BLACK BLAC	BEY. DEFIN AND SOURCE OF SOURCE OF MATERIALS (Type, Caker, Texture, Consideracy)  1400.5 SOURCE OF SOURCE	Penetrom <mark>ete</mark>	R DATA			MER		FALL OF NAMMEN
BIY. ARD SULES SUL	REV. MID SULTON OF MATERIALS (Decision Control of Carry Sitistics, Control of Carry, Erosum State, Control of Carry, Erosum Stand, Very Sitisty, Very Fine Grained, Reddish White to Tan Liney, W/Trace of Clay and Veriable Amounts of Caliche Particles Tertiary Age - Ogalisla Formation  12/20/15  Bottom of Hole    Control of Carry Sitisty   Very Fine Grained, Reddish White to Tan Liney, W/Trace of Clay and Veriable Amounts of Caliche Particles Tertiary Age - Ogalisla Formation    12/20/15   12	AUSER DATA			CORE BARREL & BIT DATA			
Silt, Very Silth Amount of Clay, Brown  of Clay, Brown  Sand, Very Silty, Very Fine Grained, Reddish White to Tam, Liney, Wartable Amounts of Calidhe Particles Tertiary Age - Ogalisla Formation  Bottom of Hole  Rottom of Hole	Silt, Very Slight Amount of Clay, Hown    Sand, Very Silty, Very Fine Grained, Reddish White to Tan, Limoy, W/Trace of Cley and Veriable Amounts of Caliche Farticles   12/20/15   12/20/15     Bottom of Hole   Bottom of Hole   Bottom of Hole		AND 5	PER FOOT		% COSE RECOVERY	SAMPLE 180.	(Drilling Characteristics, Drilling
Sand, Very Silty, Very Fine Graned, Reddish White to Tan, Limey, W/Trace of Clay and Variable Amounts of Caliche Farticles Tertiary Age - Ogallala Formation  Bottom of Hole  Bottom of Hole	Sand, Very Silty, Very Fine Grained, Reddish White to Tan, Liney, Wrace of Clay and Variable Amounts of Caliche Particles Tertiary Age - Ogallala Formation  Bottom of Hole  Bottom of Hole			*	Silt, Very Slight Amount of Clay, Brown			Air Drilling
4395.5 6.0 Bottom of Hole	4395.5 6.0 Bottom of Hole		1.5	7/5/4	Sand, Very Silty, Very Fine Grained, Reddish White to Tan, Limey, w/Trace of Clay and Variable Amounts of Caliche Particles Tertiary Age - Ogallala			
		4395.5	4.5	718       1   1   1   1   1   1				6,0
i	HEMPHILL & SHELDY DRILLING COMPANY				Bottom of Hole			

		BOR	ING LOG		<del>,</del>	HOLE NO. 2
PROISCE II. S	S. Departa		sportation - Test Track - No	er Mey	1 00	
			ee Boring Location Plan	ew Mex	<u>1 (()</u>	DATE 4-24-69
1		V. ELEV.			-	LOGGED BY Same
	'2" Split		WT. OF HAM	MER 14	0#	FALL OF HAMMER 30"
PENETRO"ETER D	_		WT. OF MAR	MER		FALL OF MAMMER
AUSER DATA			CORE BARREL & BIT DATA			
ELEV.	DEPTH CO	NO. OF BLOWS PER FOOT	DESCRIPTION OF MATERIALS (Type, Color, Texture; Consistency)	K CORE RECOVERY SAMPLE	9	REMARKS (Drilling Characteristics, Drilling
4400.4	SCALE O	2222		200		Fluid Lass, Casing Data, Etc.)
4398.9	1.5		Silt, Very Slight Amount of Clay, Brown			Air Drilling
	3.0	2/3/7	Sand, Very Silty, Very Fine Grained, Reddish White to Tan, Limey.			
	4.5		w/Trace of Clay and Variable Amounts of Caliche Particles Tertiary Age - Ogallala			
4394,4	6.6	8/9 <b>/1</b> a	Formation			6.0
	# 1		Bottom of Hole			
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	HE		LEY DRILLING COMPANY			HOLE NO. 2

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			sportation - Test Track - N	ew Mexico	
			Boring Location Plan		DATE 4-24-69
	4398.1° 6.		BORED BY Woodall		LOSGED BY Same
owned by		t Spoon	WT, OF NA		
ENETLOWERE			WT. OF NA	TATEK	FALL OF HAMMER
USER DATA		T 112 27 212112	COME BARMEL & BIT DATA	<del></del>	
elev. 4398 "3.	SCALE STA	NO. OF BLOWS PER FOOT	DESCRIPTION OF MATERIALS (Type, Color, Texture, Consistency)	% COSE RECOVERY SAUME NO.	REMARKS (Drilling Characteristics, Drilling Fluid Loss, Cosing Data, Etc.)
4398.0	1,3		Silt, Very Slight Amount of Clay, Brown		Air Drilling
Crypts (* actiqueau esca	1.50	19/10/11	Sand, Very Silty, Very Fine Grained, Reddish White to Tan, Limey,		
	3.0-		w/Trace of Clay and Variable Amounts of		
	4.0		Caliche Particles Tertiary Age - Ogallala Formation		
+392.3	5.5	)8/9/9			
772.3	0.0 (17)		Bottom of Hole	<del>   </del>	6,0
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	M.		LBY DRILLING COMPANY A, OKLAHOMA		HOLE NO. 3

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ETY, ELY. 4999, 31 6W. ELFY. BOOCH BY Woodall  WIT. OF MARKER 140.6 FALL OF MARKER 30"  FIRE DATA WIT. OF MARKER 140.6 FALL OF MARKER 30"  REP. AND PS FOR FOR FOR FOR FOR FOR FOR FOR FOR FOR			w Mexico		1
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BEY. AND SCALE (1979, Goler, Texture, Consistency)  4398.3 1.0 Silt, Very Slight Amount of Clay, Brown Fine Grained, Reddish White to Tan, Limey, W/Trace of Clay and Variable Amounts of Caliche Particles Tertiary Age - Ogallala Formation  Bottom of Hole  Bottom of Hole	AUGER DATA	CORE BARREL & BIT DATA			
1.57    Sand, Very Silty, Very Fine Grained, Reddish White to Tan. Limey, w/Trace of Clay and Variable Amounts of Caliche Particles Tertiary Age - Ogallala Formation    Bottom of Hole   Bottom	ELEV. AND E PER F	OT DESCRIPTION OF MATERIALS	% COSE RECOVERY SALPILE NO.	REMARKS (Drilling Cherocteristics, Drill Fluid Loss, Cosing Date, Etc	ling )
Sand, Very Silty, Very Fine Grained, Reddish White to Tan, Limey, W/Trace of Clay and Variable Amounts of Caliche Particles Tertiary Age - Ogallala Formation  Bottom of Hole  Sand, Very Silty, Very Fine Grained, Reddish White to Tan, Limey, W/Trace of Clay and Variable Amounts of Caliche Particles Tertiary Age - Ogallala Formation  6.0	4398.3	Silt, Very Slight Amount of Clay, Brown		Air Drilling	
Bottom of Hole  6.0	1.5	Fine Grained, Reddish White to Tan, Limey, w/Trace of Clay and Variable Amounts of Caliche Particles Tertiary Age - Ogallala			
	<b>→</b> 1/36 (1711)				5.0

		BOR	ING LOG		HOLE NO. 5
PROJECT U.	. S. Dapart	ment of Trans	portation - Test Track - N	ew Mexico	SHEET NO. 1 05 1
MORE LOCATIO	n Station	1982+00 S	See Boring Location Plan		DATE 4-24-09
	4798.21 6.1		- BOSED BY Woodall	MER 140#	FALL OF HAMMER 30"
CAMPLE IN		Split Spoon	WT. OF NAME		FALL OF NAMMER
p <u>eneten "lijea</u> Auger bata	7 DATA		CORE BARREL & BIT DATA		
ACCER DATA		NO. OF BLOWS		w = L	REMARKS
ELEV. 4398.2	DEPTH GO	PER FOOT	DESCRIPTION OF MATERIALS (Type, Color, Texture, Consistency)	X COSE RECOVERY SLUME NO.	(Dritting Characteristics, Dritting Fluid Loss, Casing Data, Etc.)
4397.2	0.5		Silt, Very Slight Amount of Clay, Brown		Air Drilling
	2.0	5/11/13	Sand, Very Silty, Very Fine Grained, Reddish White to Tan, Limey,		
- per constitution of the		N. E. C.	w/Trace of Clay and Variable Amounts of Caliche Particles Tertiary Age - Ogallala		
a de de de de de de de de de de de de de	4.5	9/11/12	Formation		
4392.2	6.0∃∷				6.0
			Bottom of Hole		
			TELBY DRILLING COMPANY		
		HEMPHILL & SI	HELBY DRILLING COMPANY LSA, OKLAHOMA		HOLE NO. 5

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Sonaism II	S Desire		ING LOG portation - Test Track - No	ew Marino	HOLE NO. 6 SHEET NO. 1 GV 1
HOLE LOCATION			e Boring Location Plan	en mexico	DATE 4-24-69
ern, ELEV. Li	98.44 6.W.	ELEV.	Woodall Woodall	***************************************	LOSSED BY Same
Secreter Data	2" 3plit 5	Spoon	WT. OF HAZE	MER 140#	FALL OF HAMMER 30"
Penetro''ster	DATA		WT. OF NAME	MER	FALL OF NAMMER
AUSER DATA			COME BARMEL & BIT DATA		
ELEV. 4398.4	ESPTH CO.O	NO. OF BLOWS PER FOOT	DESCRIPTION OF MATERIALS (Type, Color, Texture, Consistency)	% CO:3 RECOVERY SAMPLE RO.	REMARKS (Drilling Cherocteristics, Drilling Fluid Less, Cosing Data, Etc.)
4396.4	3. TITTI E		Silt, Very Slight Amount of Clay, Brown w/Increasing Clay Content		Air Drilling
4 193 . 4	3,000	-1/58	Sand, Very Silty, Very Fine Grained, Reddish White to Tan, Limey, w/Trace of Clay and Variable Amounts of Caliche Particles		•
-592.	6	)/11/12	Tortiary Age - Ogallala Formation		6.0
			Bottom of Hole		
			•		
			•		
THE RESERVE TO THE PERSON OF T			•		
	3				
Bruston Bruston	HOL	MPHILL & SHE	LBY DRILLING COMPANY	اسطسا	HOLE NO. 6

	BOR	ING LOG		HOLE NO. 7
maisor F. S. Denner		portation - Test Track - Ne	w Mexico	SHEET NO. 1 CF 1
ing location Statical		ee Boring Location Plan		DATE 4-23-69
		BORED BY Woodall		LOGGED BY Same
/ <del></del>	Split Spoon	WT. OF NAM		FALL OF HAMMER 30"
FELTY BATA		CORE BARREL & BIT DATA	Sel CX	TALL OF MARINER
AUGES DATS	VA CE NOWS	COAL BARACE & SIL DAIA	TETT	DE MARKS
ELEV. DEPTH AND SCALE	NO. OF BLOWS PER FOOT  SET TOO	DESCRIPTION OF MATERIALS (Type, Color, Texture, Consistency)	% COCK RECOVERY SAUPLE R9.	(Drilling Characteristics, Drilling Fluid Loss, Cosing Date, Etc.)
		Silt, Very Slight Amount of Clay, Brown		Air Drilling
2. = 3	0.00	Sand, Very Silty, Very Fine Grained, Reddish		
	21/21/31	White to Tan, Limey, w/Trace of Clay and Varying Amounts and Sizes of Caliche		
4.4		Tertiary Age - Ogallala Formation		
4.5L. 6.0-1	7/7/7	Bottom of Hole		6,0
		BOTTOM OI NOIS		
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1 7			1 1 1	

RELECT U. S. Descriment of Transportation - Test Track - New Mexico SHEET MO. 1 OF 1 ONE LOCATION Station 2006+00 See Boring Location Plan DATE 4-23-69 TO. ELEV. A-401.2° G.W. ELEV. BORED BY Woodall LOCAGED BY Same SEMENTS PAYA 2" Split Spoon WT. OF NAMMER 140# FALL OF NAMMER 30" EMETTED 13 DATA WT. OF NAMMER FALL OF NAMMER		BOR	ING LOG	- MT-12-12-12-12-12-12-12-12-12-12-12-12-12-	HOLE NO. 8
NE DECENTE State 2006+00 See Boring Location Plan  DATE 4-22-69  DESCRIPTION OF MARKET 14-04 MILES OF MARKET 30"  WH. OF MARKET 14-04 MILES AND SERVING SERVIN	molect U. S. Deserta	ent of Trans	portation - Test Track - Ne	w Mexico	The state of the s
WITH TYPE 2" Split Spoon  WITH OF MARKER 140 FALL OF MARKER 30"  WITH OF MARKER 141 OF MARKER 30"  WITH OF MARKER 141 OF MARKER 30"  WITH OF MARKER 141 OF MARKER 30"  WITH OF MARKER 141 OF MARKER 30"  WITH OF MARKER 141 OF MAR	80				
REV. DOTA COME MARKEL & BIT DATA  REV. AND SQUE OF ELOWS PER FOOT COME MARKEL & BIT DATA  REV. AND SQUE OF ELOWS PER FOOT COME MARKEL & BIT DATA  REV. AND SQUE OF ELOWS PER FOOT COME (Texture, Condidency) Revenue of Clay Sque of Clay Revown Winter to Tan, Limey, W/Trace of Clay and Varying Amounts and Sizes of Caliche Tertiary Age - Ogallala  4.5  6.0  Bottom of Hole  WI. OF MARKER FALL OF MARKEL & BIT DATA  REMARKS  (Pres. General & BIT DATA  Air Drilling  Air Drilling  Air Drilling  Air Drilling  Air Drilling  Air Drilling  Bottom of Hole	879. ELEV. 4401.2° 6.W	V. ELEV.	BOXED BY Woodall		
EERV. DOTH NATE A BIT DATA  EERV. CALE OF BLOWS PAR FOOT PAR FOOT ALL THINKS (Type, Color, Tartwe, Conditioner)  Solt, Very Slight Amount of Clav. Brown  1.5  Sand, Very Slity, Very Fine Grained, Reddish White to Tan, Liney, Virace of Clay and Varying Amounts and Sizes of Caliche Tertiary Age - Ogallala  1.5  DEXCRIFE & BIT DATA  EEMARY (Brilling Cherowfrike, Drilling Road Less, Cning Date, Etc.)  Sand, Very Slity, Very Fine Grained, Reddish White to Tan, Liney, Wirace of Clay and Varying Amounts and Sizes of Caliche Tertiary Age - Ogallala  Formation  Bottom of Hole  Bottom of Hole	SAMMER PAYA 2" Split	Spoon	WT. OF NAME	MER 140#	FALL OF HAMMER 30"
EEV. AND COLOR PRO PER POOT CHAPTERIALS (Type, Gale, Terbun, Cardidanary)  Silt, Very Silty, Very Silty, Very Silty, Very Fine Grained, Reddish White to Tan, Limey, Trace of Clay and Varying Amounts and Sizes of Caliche  Tertiary Age - Ogallala  Bottom of Hole  Bottom of Hole	PEHETOD IR DATA		WT. OF MAR	MER	FALL OF MAMMER
ERV. ADD SERVING OF MATERIAL SERVING Consideration (priming Characteristics, brilling Characteri	AUSER DATA		COME BARREL & BIT DATA		
Silt, Very Slight Amount of Clav, Brown  1.4  Sand, Very Silty, Very Fine Grained, Reddish White to Tan, Liney, W/Trace of Clay and Varying Amounts and Sizes of Caliche Tertiary Age - Ogallala Formation  Bottom of Hole  Bottom of Hole	ELEV. AND	PER FOOT		% COSE RECOVERY SALPLE RO.	(Drilling Characteristics, Drilling
Sand, Very Silty, Very Fine Grained, Reddish White to Tan, Liney, W/Trace of Clay and Varying Amounts and Sizes of Caliche Tertiary Age - Ogallala Formation  Bottom of Hole  Bottom of Hole  Sand, Very Silty, Very Fine Grained, Reddish White to Tan, Liney, W/Trace of Clay and Varying Amounts and Sizes of Caliche Tertiary Age - Ogallala Formation  Bottom of Hole			Silt, Very Slight Amount of Clay, Brown		Air Drilling
Bottom of Hole	3.0	0/23/13	Sand, Very Silty, Very Fine Grained, Reddish White to Tan, Limey, w/Trace of Clay and Varying Amounts and Sizes of Caliche Tertiary Age - Ogallala		
	4 (95,2 <b>0.0</b> (4)(7)		Doddon of Uolo		
} <b>→                                     </b>			•		
HEMPHILL & SHELBY DRILLING COMPANY TULBA, OKLAHOMA HOLE NO. 8	HI HI			<u> </u>	THOLENO 9

PROJECT U. S. Department of Transportation - Test Track - New Mexico SHEET MO.  NOTE LOCATION Station 2014+00 See Boring Location Plan DATE 4-2  CPD. ELEV. 44401.5° G.W. ELEV. BORED BY Woodall LOGGED BY  CAMPER DATA 2" Split Spoon WT. OF HAMMER 140# FALL OF HAMMER DATA  PRINCETROMETER DATA WT. OF HAMMER FALL OF HAMMER FALL OF HAMMER CORE BARREL & BIT DATA  CORE BARREL & BIT DATA  CORE BARREL & BIT DATA  CORE BARREL & BIT DATA  CORE BARREL & BIT DATA  CORE BARREL & BIT DATA  CORE BARREL & BIT DATA  CORE BARREL & BIT DATA  Air I  CALOU. 5 1.0 - Sold Sold Sold Sold Sold Sold Sold Sold	23-69 Same MMER 30"
MATE LOCATION Station 2014+00 See Boring Location Plan  CTD. ELEV. 4401.5° G.W. ELEV.  SAMPLES DATA 2" Split Spoon  WI. OF HAMMER 140# FALL OF HA  PARTICULATION DESCRIPTION OF MATERIALS  FALL OF MA  COME BARREL & BIT DATA	Same  LAMER 30 M  LAMER  REMARKS  Characteristics, Drilling ss, Cosing Data, Etc.)
PARTER DATA 2" Split Spoon WY. OF HAMMER 140# FALL OF HAMMER DATA  WY. OF HAMMER 140# FALL OF HAMMER FALL OF HAMMER FALL OF HAMMER FALL OF HAMMER FALL OF HAMMER FALL OF HAMMER FALL OF HAMMER FALL OF HAMMER FALL OF HAMMER FALL OF HAMMER FALL OF HAMMER FALL OF HAMMER FALL OF HAMMER FALL OF HAMMER FALL OF HAMMER 140# FALL OF HA	REMARKS Characteristics, Drilling ss, Cosing Data, Etc.)
PARTITION STATE  ELEV. AND SCALE  OR Salt Very Slight Amount of Clay, Brown w/Increasing Clay Content  Sand, Very Silty, Very Fine Grained, Reddish	REMARKS Characteristics, Driving ss, Casing Data, Etc.)
CORE BARREL & BIT DATA    CORE BARREL & BIT DATA     CORE BARREL & BIT DATA     CORE BARREL & BIT DATA     CORE BARREL & BIT DATA     CORE BARREL & BIT DATA     CORE BARREL & BIT DATA     CORE BARREL & BIT DATA     CORE BARREL & BIT DATA     CORE BARREL & BIT DATA     CORE BARREL & BIT DATA     CORE BARREL & BIT DATA	REMARKS Characteristics, Driffing ss, Casing Data, Etc.)
ELEV. AND SCALE  Ol. 5  NO. OF BLOWS PER FGOT  DESCRIPTION OF MATERIALS (Type, Color, Texture, Consistency)  Silt, Very Slight Amount of Clay, Brown w/Increas- ing Clay Content  Sand, Very Silty, Very Fine Grained, Reddish	Characteristics, Driving ss, Casing Data, Etc.)
PER FOOT  DESCRIPTION OF MATERIALS  (Type, Color, Texture, Consistency)  Silt, Very Slight Amount of Clay, Brown w/Increasing Clay Content  Sand, Very Silty, Very Fine Grained, Reddish	Characteristics, Driving ss, Casing Data, Etc.)
Silt, Very Slight Amount of Clay, Brown w/Increasing Clay Content  Sand, Very Silty, Very Fine Grained, Reddish	Orilling
The Grained, Reddish	
w/Trace of Clay and Varying Amounts and Sizes of Caliche Tertiary Age - Ogallala Formation	
4395.5 6.0 -	6.0
HEMPHILL & SHELBY DRILLING COMPANY TULSA, OKLAHOMA	LE NO. 9

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ELEV. AND SAIL PER FOOT DESCRIPTION OF MATERIALS (Drilling Cherectoristics, Drilling Fine Grained, Reddish White to Tan, Limey, W/Trace of Clay and Varying Amounts and Sizes of Caliche Tertiary Age — Ogallala Formation    DEFTH AND PRI POST   DESCRIPTION OF MATERIALS (Drilling Cherectoristics, Drilling (Drilling Cherectoristics, Drilling Floid Less, Cosing Defe, Etc.)    Air Drilling   Air Drilling			8(	)RI	NG LOG			HOLE NO. 10	)
THE LOCATION Station 2022+00 See Boring Location Plan  THE WARD STATION 2022+00 See Boring Location Plan  THE WARD STATION 2022+00 See Boring Location Plan  THE WARD STATION STATIAN STATION STATION STATIAN STATION STATION STATION STATION STATION	PROJECT U.S.	Depart	ment of T	cans	portation - Test Track - N	ew M	exico	SHEET NO. 1 CF	1
ACCURATE MANA 2" Split Spoon WT. OF MANUER 140.5 FALL OF MANUER 300"  WT. OF MANUER TAIL OF MANUER TAIL OF MANUER 150"  RIV. ADD FES FOOT PER FOOT PRODUCTION OF MATERIALS (Productional Color Fee Foot Production Color Fee Foot									
WILD MARKER DAYA  SET MINE DAYA  SET	70. ELEV. 4403	9 6.4	M. ELEV.		BORED BY Woodall			LOGGED BY Same	
BET DEFIN AND BET DEFENDENT DESCRIPTION OF MATERIALS (Type, Colon, Texture, Centebody)  SAME DEFINITION OF MATERIALS (Type, Colon, Texture, Co	AMPLER DATA	2" Spl4	it Spoon		WT. OF HAL	WER	1404	FALL OF HAMMER 30"	
BEYN AND SALES PER PORT DESCRIPTION OF MATERIALS (PROGRESSION OF MATER	ENETROMETER DATA				WT. OF HAS	MER		FALL OF HAMMER	
RIV. 2015    Pa Foot   Description of Materials   Page   P	AUSER DATA				CORE BARGEL & BIT DATA				
O.5-   Julio   Gilay, Brown w/Increas- ing Clay Content	ELEV. AMI	)   5	PER FOOT			% COSE	SALPLE NO.	(Drilling Characteristics, Drilling	P <b>S</b>
Sand, Very Silty, Very Fine Orained, Reddish White to Tan, Idney, W/Trace of Clay and Varying Amounts and Sizes of Caliche Torriary Age - Ogallala Formation  Bottom of Hole  6.0	0.		4/10/16		of Clay. Brown w/Increas-			Air Drilling	
Tertiary Age - Ogaliala  Source   3/8/9   Formation   6,0    Bottom of Hole   6,0    Hold   1    Hold					Fine Grained, Reddish White to Tan, Limey, W/Trace of Clay and Warying Amounts and Sizes				
	397.9 6.		3/8/9		Tertiary Age - Ogallala			6.	0
HEMPHILL & SHELBY DRILLING COMPANY				Ξ	ottom of Hole				
		HE	EMPHILL &	BHEL	BY DRILLING COMPANY				

		BOR	ING LOG	,	HOLE NO. 11
alect II	S. Denarb	ment of Trans	sportation - Test Track - N	ew Mexico	SHEET MO. 1 05 1
IS LOCATION		2030+00 S	ee Boring Location Plan		DATE 4-23-69
		V. ELEV.	BORED BY Woodall		LOGGED BY Same
FR PAT		t Spoon		MER 140#	
7.77	DATA		WT. OF HAM	MER	FALL OF MARRIER
272 5374			CORE BARGEL & BIT DATA	<b>,</b> , , , , , , , , , , , , , , , , , ,	
e.ev.	CEPTH CE	NO. OF BLOWS PER FOOT	DESCRIPTION OF MATERIALS (Type, Color, Texture, Consistency)	% COSE RECOVERY SAUME 180.	REMARKS (Drilling Characteristics, Drilling Fluid Loss, Casing Data, Etc.)
-02.2			Silt, Very Slight Amount of Clay, Brown		Air Drilling
102.2	1.2-	50/25	Sand, Very Silty, Very Fine Grained, Reddish		
	2,5		White to Tan, Limey, w/Trace of Clay and Varying Amounts and Sizes		
		10/21/22	of Caliche Tertiary Age - Ogallala Formation		
	4,57		TOTMA OLON		
	6.0	340/44/44			6.0 🖯
7,~	0.0 0.4	╂┼┼┼┼┼┼	Bottom of Hole		
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		HEMPHILL & SI	HELEY DRILLING COMPANY LSA, OKLAHOMA		HOLE NO. 11

	BOR	ING LOG		HOLE NO. E-12
MANEG U. S. Depart	tment of Trans	portation - Test Track - Ne	w Mexico	SHEET NO. 1 07 ]
		See Boring Location Plan		DATE 4-24-69
77. 88V. 4402.01 G	S.W. ELEY.	BOOKD BY Woodall		LOSSED BY Same
Characa wally		WT. OF HAM	MER	FALL OF HAMMER
PROPERTY TO BATA		WT. OF HAM	MER	FALL OF HAMMER
2010 2474		COZE BARGEL & BIT DAYA		
ELEV. DEPTH CELEV. SCALE O	NO. OF ELOWS PER FOOT	DESCRIPTION OF MATERIALS (Type, Color, Texture, Consistency)	K CCZE RECOVERY SALPHE NO.	REMARKS (Dritting Characteristics, Dritting Fluid Less, Casing Data, Etc.)
11711TC 2.00.00 2.00		Silt, Very Slight Amount of Clay, Brown		Air Drilling
4396.0 6.0		Sand, Very Silty, Very Fine Grained, Reddish White to Tan, Limey, w/Trace of Clay and Varying Amounts of Caliche Particles Tertiary Age - Ogallala Formation		6.0
		Bottom of Hole		
		ILBY DRILLING COMPANY	<u> </u>	HOLE NO. E-12

		BOR	ING LOG		HOLE NO. E-13
PONIECT II	S. Danarts		sportation - Test Track - N	lew Mexic	
MOLE LOCATION	Station	n 1965+00	See Boring Location Plan		DATE 4-24-69
elev.	4399.3' 6.W.		ECHE BY Woodall		LOGSED BY Same
נאלע במנייי	1		WT. OF HAL		FALL OF HARMER
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	EATA		WT. OF HAM	MER .	FALL OF HAMMER
TR BATA			CORE BARREL & BIT DATA	<del>, , , , ,</del>	
ELEV.	AHD SALE OF SA	RO. OF ELOWS PER FOOT	DESCRIPTION OF MATERIALS (Type, Color, Texture, Consistency)	A COCSE RECOVERY SAMPLE RO.	REMARKS (Drilling Cherocharistics, Drilling Fluid Loss, Costing Datio, Etc.)
Control of the second			Silt, Very Slight Amount of Clay, Brown		Air Drilling
357.3	2.0=		Sand, Very Silty, Very		
· Accident distances			Fine Grained, Reddish White to Tan, Limey, w/Trace of Clay and Varying Amounts of		
in the second of the second of			Caliche Particles Tertiary Age - Ogallala Formation		6.0
-393.3	6.0- 福	<del></del>	N. 14 4 17.7		0.01
- Land	= 1		Bottom of Hole		
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	لبلتسيا		EL DY DELL ING COMPANY		<u> </u>
	H		ELBY DRILLING COMPANY SA, OKLAHOMA		HOLE NO. B-13

		٧ ١ ١٧٠ لاسنا	ING LOG		HOLE NO. B-1
រុះព ប. s. d	epartmen		sportation - Test Track -	New Mexico	SHEET NO. 1 OF
LOCATION Sta			ee Boring Location Plan		DATE 4-24-69
. ELEV. #399.4	G.W. EL	LEV.	MORED BY Woodall		LOGGED BY Same
TER FURA	··.		WT. OF NJ		FALL OF HAMMER
THE DATA			WT. OF NU	<u>Veser</u>	FALL OF MARMER
ERYA	-,		COME BARMEL & BIT DATA		
ELEV. DEPTH AND SCALE		KO. OF ELOWS PER FOOT	DESCRIPTION OF MATERIALS (Type, Color, Texture, Consistency)	K COSE RECOVERY SMLTIC FD.	REMARKS (Drilling Characteristics, Drilling Fluid Less, Casing Data, Etc.)
27.3			Silt, Very Slight Amount of Clay, Brown  Sand, Very Silty, Very Fine Grained, Reddish	-	Air Drilling
6.0	3 110		White to Tan, Limey, w/Trace of Clay and Varying Amounts of Caliche Particles Tertiary Age - Ogallala Formation		6.
			Bottom of Hole		

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			3	BOR	ING LOG			HOLE NO.	B-15
					portation - Test Track - N	еw Ме	xico		1
	N Statio				ee Boring Location Plan			DATE 4-24-69	
	4400.8	G.W. E	ELEV.		MOMED BY Woodall	AMPR		LOSSED BY Same	
AMPLER DAT					VOT. OF MAI	-		FALL OF HAMMER FALL OF HAMMER	
ENTY TOTAL	DATA				WT. OF MAI CORE BARREL & BIT DATA	GREK		PALL OF RESULTSEE	
ANNE CITCH		<del>-</del>	NO. OF B	LOVE .	CORE MARKEL & DIT DATA	T			
ELEV.	DEPTH AND SCALE		PER FO	701	DESCRIPTION OF MATERIALS (Typa, Color, Texture, Consistency)	% COZE	SAMPLE FFD.	REMARKS (Drilling Characteristics, Dri Fluid Loss, Casing Data, El	해ag tc)
a control of the cont					Silt, Very Slight Amount of Clay, Brown			Air Drilling	
-39 <b>7.</b> 8	3.0				Sand, Very Silty, Very Fine Grained, Reddish White to Tan, Limey, w/Trace of Clay and Varying Amounts of Caliche Particles Tertiary Age - Ogallala Formation				6.0
					Bottom of Hole				
		HEN	APHILL	8 SH	ELBY DRILLING COMPANY		<del>                                     </del>		B. 7 F
					BA, OKLAHOMA		•	HOLE NO.	U-17

·//		BC	RING LOG		HOLE NO. B-16
	S. Departm				
	Station		See Boring Location Plan	<del></del>	DATE 4-24-69
	4402.0° 6.4	V. ELEV.	BORED BY Woodall		LOCGED BY Same
SAMPLER DATA WT. OF HAMMER PEHETROMETER DATA WT. OF HAMMER					FALL OF HAMMER
USER DATA	VAIA		CORE BARREL & BIT DATA		FALL OF NAMMER
1		NO. OF BLOWS		. 7 7	
ELEV. 402.0	SCATE STATE	PER FOOT	DESCRIPTION OF MATERIALS (Typo, Color, Texture, Consistency)	SALIPLE NO.	REMARKS (Drilling Characteristics, Drilling Field Less, Casing Data, Etc.)
The state of the s			Silt, Very Slight Amount of Clay, Brown		Air Drilling
400.2	_1.8= _= _=		Sand, Very Silty, Very Fine Grained, Reddish		
			White to Tan, Limey, w/Trace of Clay and Varying Amounts of		
To promittee on .			Caliche Particles Tertiary Age - Ogallala Formation		
1396.0	6,0-				6.0
•	Ē		Bottom of Hole		•
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.60.03	<b>=</b> ;				•
The state of the s	unlumminfun.				
and Company					
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	HE	MPHILL & S	HELBY DRILLING COMPANY	<del></del>	HOLE NO. B-16

	HOLE NO. B-17   SHEET #0. 1 0 1
	SHEEL MO. T ALL T
AL COUNTRY DOG VILLE LAND AND AND AND AND AND AND AND AND AND	DATE 4-24-69
	LOSSED BY Same
	FALL OF HARMER
	FALL OF HAMMER
CORE BARREL & BIT DATA	
NO. OF BLOWS PER FOOT DESCRIPTION OF MATERIALS SCALE (Type, Color, Texture, Considency)	REMARYS (Drilling Characteristics, Drilling Fluid Less, Casing Data, Etc.)
Silt, Very Slight Amount of Clay, Brown  Sand, Very Silty, Very	Air Drilling
Fine Grained, Reddish White to Tan, Limey, w/Trace of Clay and Varying Amounts of Caliche Particles Tertiary Age - Ogallala Formation	6.0
Bottom of Hole	
HEMPHILL & SHELBY DRILLING COMPANY TULSA, OKLAHOMA	HOLE NO. B-17

