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Mr. E. D. McMillan,  
Road Design Engineer,  
Materials and Research Section,  
(Foundations Office).

September 14, 1961.

FILL STABILITY INVESTIGATION -  
W.S. 61-P-61 -- W.P. 26-61.

Re: Hwy. No. 65 - 10 Miles East of the  
Town of New Liskeard, District of  
Timashaning, Rep. of Dymond, Dist. #14.

Accompanying this memo, is our detailed report  
outlining the soil conditions at the above site, where it is  
proposed to realign Hwy. #65 between Chainages 301+89 and  
321+66. This will involve some shallow cuts and fills up to a  
maximum of 36'-0" in height.

Results of field and laboratory investigations, as well  
as the conclusions and recommendations, are contained in the report  
and should prove adequate for your future design work.

If, however, further clarification or additional in-  
formation is required, please feel free to contact our Office.

AM/MSF  
Attach.

*Altman*  
A. D. Storace,  
PRINCIPAL FOUNDATION ENGINEER

cc: Messrs. E. D. McMillan (2)  
H. A. Tragashea  
H. A. Mantle  
A. M. Teye  
C. E. Hunter  
E. W. Chapman  
E. B. Saint  
A. J. Zovich  
J. Day  
J. E. Crispier

P. Norman  
Foundations Office  
Gen. Files.

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# FILL STABILITY INVESTIGATION

at Hwy. No. 65

10 Miles East of the Town of New Liskeard,  
District of Timiskaming, Twp. of Dymond,  
District No. 14

W.P. 26-61

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W.J. 61-F-61

## 1. INTRODUCTION:

It is proposed to realign Hwy. #65 between Chainages 301+89 and 321+66, as shown on Dwg. No. 61-F-61A. This will involve some shallow cuts and fills up to a maximum of 28'-0" in height.

In order to determine whether the proposed fills will have an adequate Factor of Safety, a sub-soil investigation was carried out by this Section. Results and discussions, as well as conclusions and recommendations, are given in the following paragraphs of this report.

## 2. DESCRIPTION OF THE SITE AND GEOLOGY:

The site of the proposed fill is located approx. 10 miles East of the Town of New Liskeard. The surrounding area is fairly flat on the East side and hilly on the West side. The actual section investigated is located on the side of a hill with a slope of about 10%.

Physiographically, the site is located in the Timiskaming Clay Plains.

cont'd. /2 ...

### 3. FIELD AND LABORATORY WORK:

One sampled borehole, supplemented by one dynamic cone penetration test, was carried out at the site at a location where the proposed embankment will be 28'-0" high.

Undisturbed and split spoon samples were taken at various intervals. Samples recovered in the thin-walled and split spoon samplers were used to determine the following physical properties:

1. Natural Moisture Content.
2. Bulk Densities.
3. Grain Size Distributions.
4. Atterberg Limits.
5. Undrained Shear Strengths.
6. Consolidation Curves.

Results of these laboratory tests are summarized in appendix I of this report.

### 4. SUBSOIL CONDITIONS:

#### 4.1) General:

Detailed description of various soil types encountered during the investigation, are shown in Appendix I of this report. The estimated stratigraphical profile on Pag. 61-F-61a, is based upon this information.

#### 4.2) Med. Stiff Silty Sandy Clay with Organic Matter:

This layer was found to be about 7' thick, the lower boundary being at Elev. 720.0'. This layer has, presumably, been formed by water running down the hill, which deposited particles of clay and organic matter. The consistency is med. stiff with an average 'N' value of 3.

The average moisture content is 45.3%.

cont'd. /3 ...

4. SUBSOIL CONDITIONS: (cont'd.) ...

4.3) Loose Clayey Silt:

Underlying the silty sandy clay is a layer approx. 5'-0" in thickness, of loose clayey silt.

The sand percentage in this layer is small, only 2%, clay forms 22%, and the rest, 76%, is silt.

This layer is in a loose state with an average 'N' value of 2.

4.4) Soft to med. Stiff Varved Clay:

Immediately below the loose clayey silt is a stratum of dark grey varved clay extending for about 20'-0". The upper surface of this layer was found at Elev. 715.0'.

The separate layers of the varves are composed of dark grey clay of high plasticity and light grey silt. Clay layers generally range in thickness from 2" to 3", and the silt layers from 3/4" to 1-1/2".

The liquid limits obtained from the clay layers varied from 79% to 80%, while the plastic limits varied from 22.7% to 24.8%. The clay layers contain approx. 69% clay, 23% silt, and 1% sand. The silt layers are composed of approx. 73% silt, 26% clay, and 1% sand.

Unconsolidated triaxial tests gave a shear strength ranging from 418 lbs./sq.ft. to 555 lbs./sq.ft. Based on these values, the consistency of this stratum is estimated to be soft to med. stiff. The shear strength of 418 lbs./sq.ft. was obtained in the lower portion of this stratum.

Consolidation tests were carried out on the clay layers and the resulting Log. Pressure Void Ratio curves are attached to this report (Appendix I.)

cont'd. /A ...

4. SUBSOIL CONDITIONS: (cont'd.) ...

4.5) Very Dense Sand and Gravel:

This material was encountered below the varved clay and extends for about 3'-0". The density of this layer is very high, with an average 'N' value of 80. The average moisture content value of this layer is 9.9%. At elev. 687.5, bedrock was encountered.

5. GROUND WATER CONDITIONS:

The ground water table, at the time of the investigation, was found to be at the surface.

No artesian water conditions were encountered.

6. DISCUSSION AND RECOMMENDATIONS:

The proposed realignment of Hwy. No. 65 between Chainage 301+89 and 321+66 requires some shallow cuts and fills up to 28'-0" in height.

The critical condition for stability of an embankment constructed on soft to med. stiff clays generally occurs during, or immediately after, construction. Since it is probable that negligible consolidation of clay would take place during construction, the  $\phi - c$  method of stability analysis is applicable. Based on these assumptions, an analysis was carried out, assuming a top embankment width of 30 feet, and side slopes 2 horizontal to 1 vertical, in order to determine the Factor of Safety against a circular arc type of failure. The stress strain properties of the clay stratum, as determined in the laboratory, are such that little, if any, of the shear strength of the fill would be mobilized. For design purposes, therefore, the latter has been neglected.

6. DISCUSSION AND RECOMMENDATIONS: (cont'd.) ...

Analyses were carried out to determine the critical height of fill, and on the basis of these analyses, it was concluded that berms would be required for fills above 16 feet in height, for embankment stability. The required height and lengths of berms are given on Dwg. No. 61-F-61B. Berms and embankment should be constructed simultaneously.

Computations were carried out to determine the probable total consolidation settlements that will occur at the embankment due to the consolidation of the underlying clay strata. Because of the variable nature of the subsoil, such computations can be regarded only as a crude estimate. The computations which were based on the results of laboratory consolidation tests, indicated that the maximum consolidation settlements for fills of 28'-0" would be in the order of 32". It is impossible to estimate the time during which the consolidation will take place, because of the many drainage paths in the silt layers.

Drainage ditches should be provided along the berms as shown on Dwg. No. 61-F-61B.

It would be preferable to allow a period of 12 months to elapse before final paving. A flexible type of pavement is recommended because of the anticipated settlements.

7. SUMMARY:

1. The site is underlain by a layer of med. stiff sandy clay with organic matter, followed by a layer of loose clayey silt, underlain, in turn, by soft to med. stiff varved clay, followed by a stratum of very dense well graded sand and gravel, underlain by limestone bedrock.

cont'd. /6 ...



7. SUMMARY: (cont'd.) ...

2. Berms are required for fills exceeding 16 feet in height and the height of berms should be as indicated on Dwg. No. 61-P-61B. The embankment, including the berms, should be considered as a composite section and constructed simultaneously.

3. A flexible type of pavement is recommended because of the anticipated settlements. The final pavement operations should be carried out after a period of 12 months has elapsed.

8. MISCELLANEOUS:

The field work was carried out during the period of June 25, 1961 to June 27, 1961, by the Longyear skid-mounted core drills, adapted for soil sampling, under the supervision of Mr. W. W. Kulmatickas, Project Foundation Engineer, Materials and Research Section.

September 1961.

REPORT PREPARED BY:

.....  
W. W. Kulmatickas  
PROJECT FOUNDATION ENGINEER.

REPORT APPROVED BY:

.....  
K. G. Selby,  
CH. PROJECT FOUNDATION ENGR.



/

APPENDIX I.

# SUMMARY OF FIELD & LABORATORY TESTS

JOB 61-F-61

W.P. 26-61

HOLE NO.	SAMP NO.	SAMPLE DEPTH (FEET)	MATERIAL DESCRIPTION	PENET'N RESIST. BLOWS/FT	MOIST. CONT. %	PLASTIC LIMIT %	LIQUID LIMIT %	SHEAR STRENGTH p.s.f.	UNIT WEIGHT p.c.f.	REMARKS
1	S1	3'-4.5'	Med. stiff silty sandy clay with org. matter.	8	45.8	-	-	-	-	
	T2	8'-9'	Loose sandy silt.	Pushed	29.4	-	-	-	-	
	T3	13'-14.5'	Soft varved clay.	2	47.0	-	-	-	-	
	T4	15'-16.5'	Soft varved clay.	-	78.2	24.8	80.1	-	-	
				Pushed	-	-	-	TR=450	-	
				-	30.5	-	-	V=440	101.5	
	T5	19'-20.5'	Med. stiff varved clay.	-	78.9	22.8	79.0	V=636	-	
				Pushed	-	-	-	-	-	
				-	30.1	-	-	TR=515	102.5	
	T6	24'-26'	Med. stiff varved clay.	-	82.4	24.7	80.3	V=682	-	
				Pushed	-	-	-	-	102.5	
				-	-	-	-	TR=555	-	
	T7	29'-31'	Soft varved clay.	-	-	-	-	TR=418	-	
				Pushed	66.7	-	-	-	106.1	
				-	-	-	-	V=352	-	
	S8	32'-33.5'	Very dense well graded sand and gravel.	50	9.6	-	-	-	-	
	S9	36'-37.5'	Very dense well graded sand and gravel.	111	10.3	-	-	-	-	
			S denotes split spoon sample.							
			T " shelby tube "							

# DEPARTMENT OF HIGHWAYS - ONTARIO

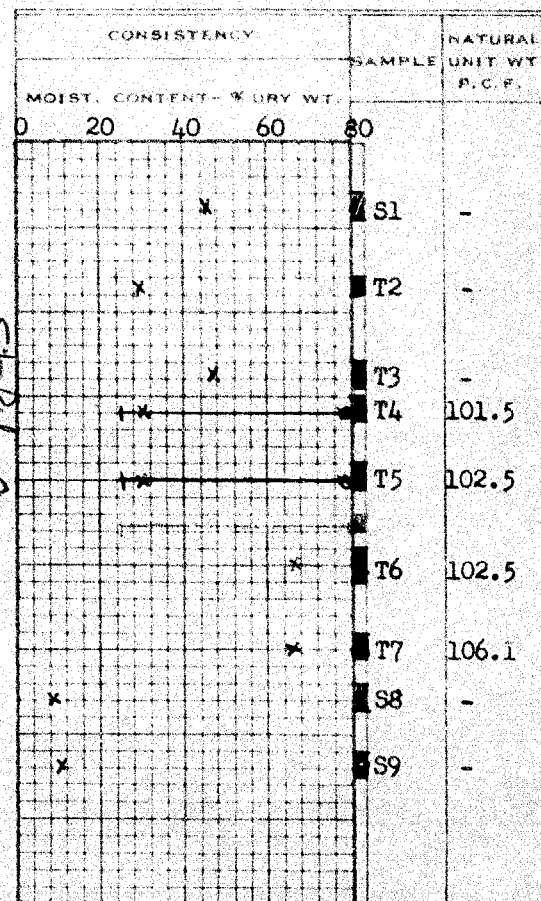
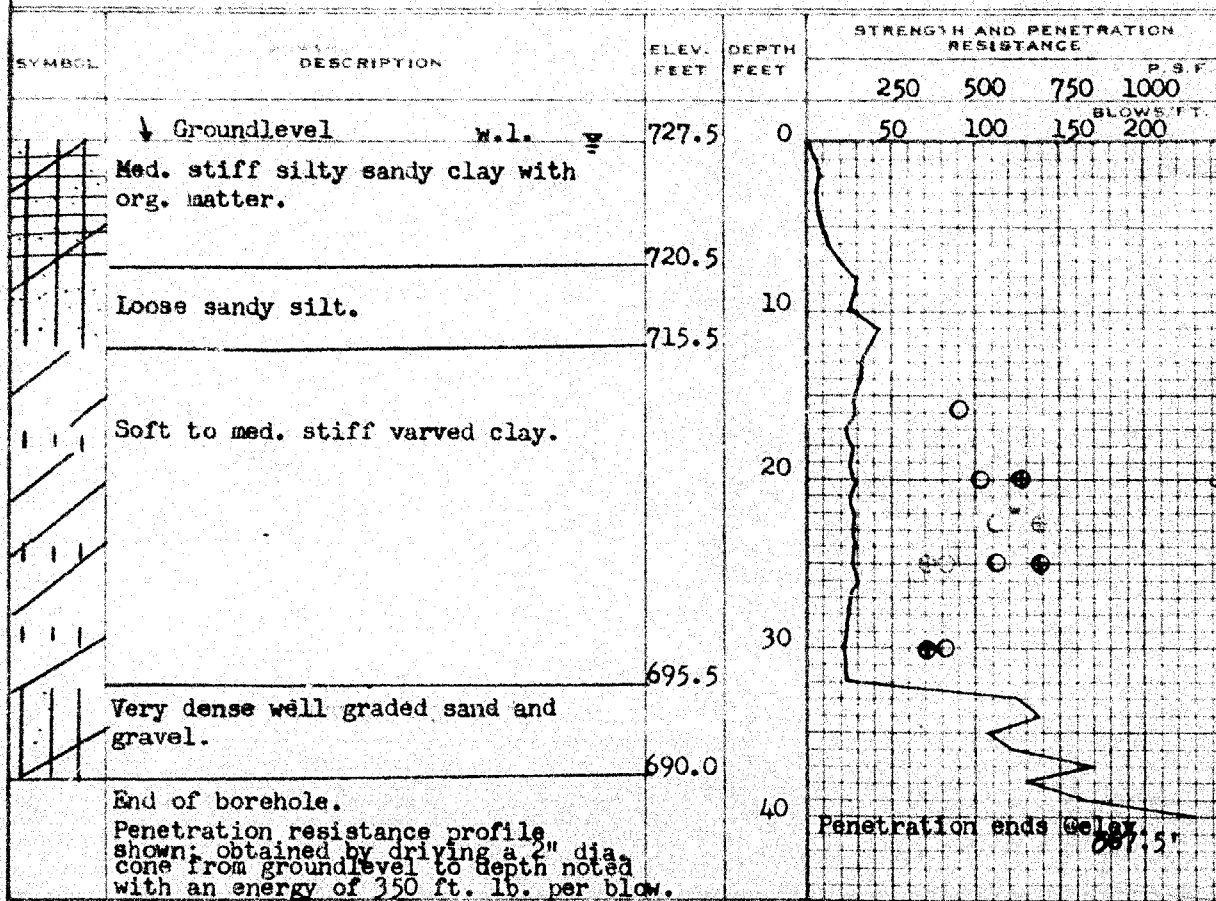
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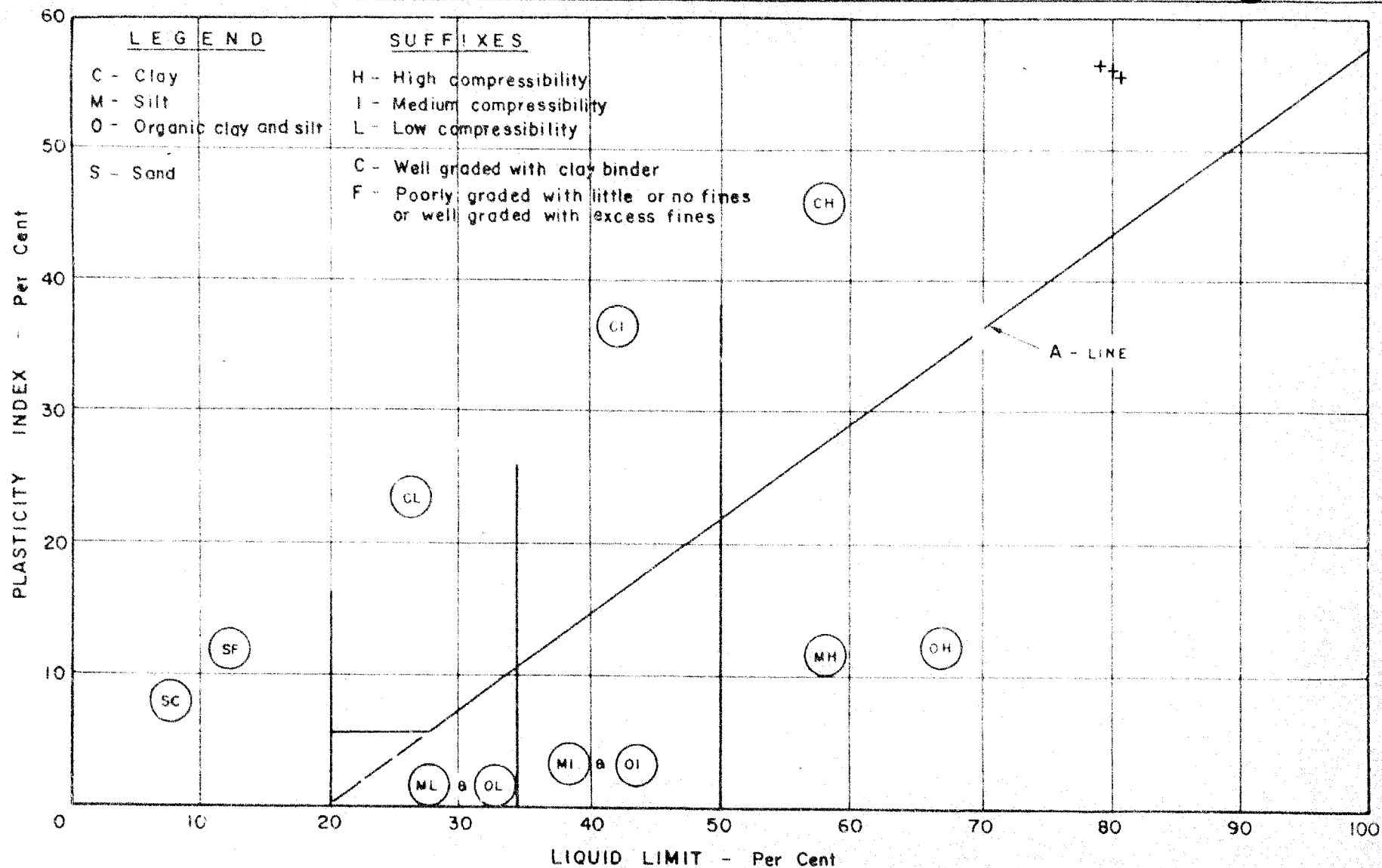
W.P. 26-61 BORE HOLE NO. 1  
 JOB 61-F-61 STATION 317+60 E  
 DATUM 727.5' COMPILED BY B.K.  
 BORING DATE June 23/61. CHECKED BY W.W.K.

2" DIA. SPLIT TUBE  
 2" SHELBY TUBE  
 2" SPLIT TUBE  
 2" DIA. CONE  
 2" SHELBY  
 CASING

### LEGEND

1/2 UNCONFINED COMPRESSION (Q<sub>u</sub>)  
 VANE TEST (C) AND SENSITIVITY (S)  
 NATURAL MOISTURE AND LIQUIDITY INDEX  
 LIQUID LIMIT  
 PLASTIC LIMIT





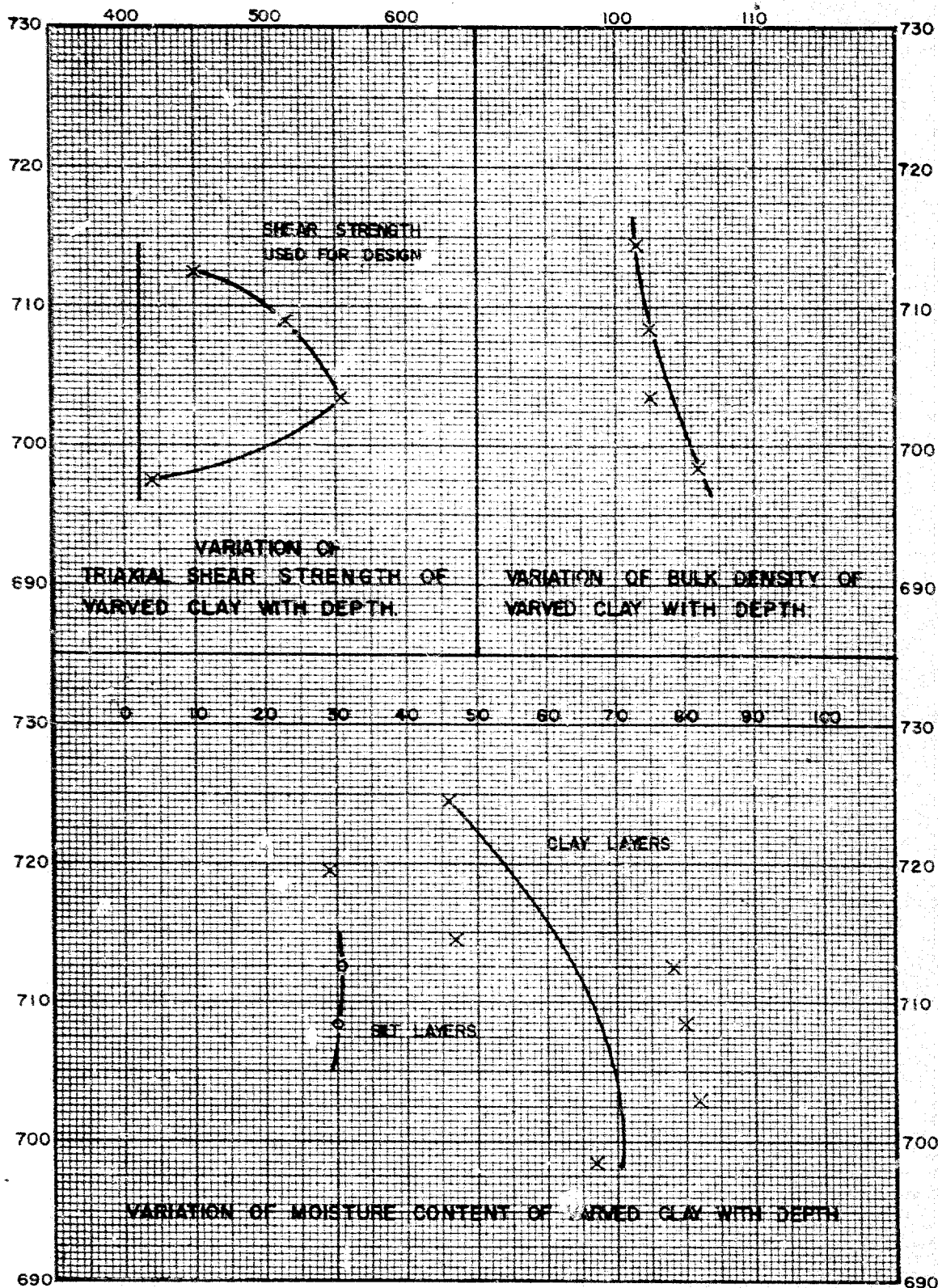
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DEPARTMENT OF HIGHWAYS - ONTARIO  
MATERIALS & RESEARCH SECTION  
PLASTICITY CHART

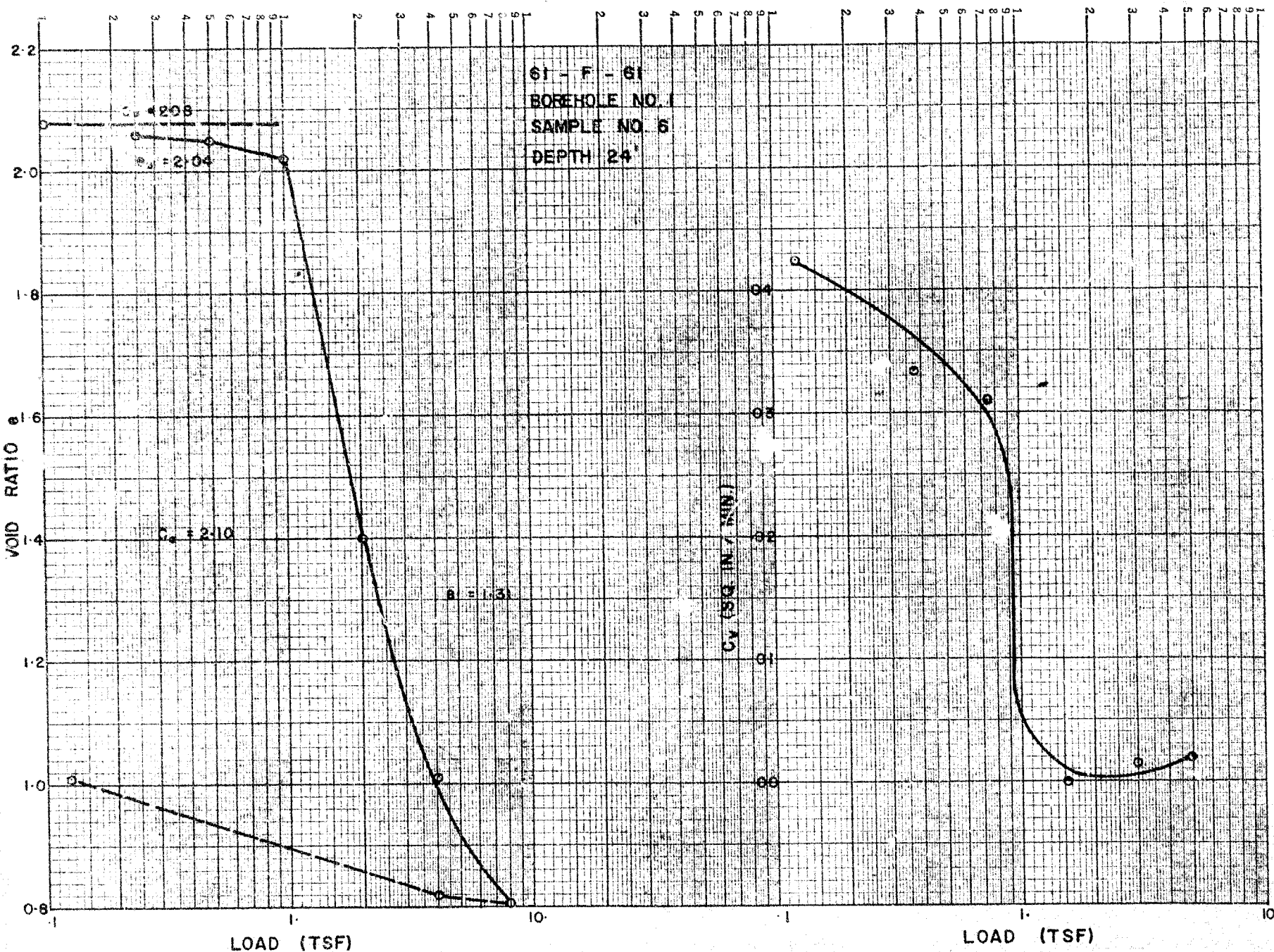
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W.P. No. 26 - 61

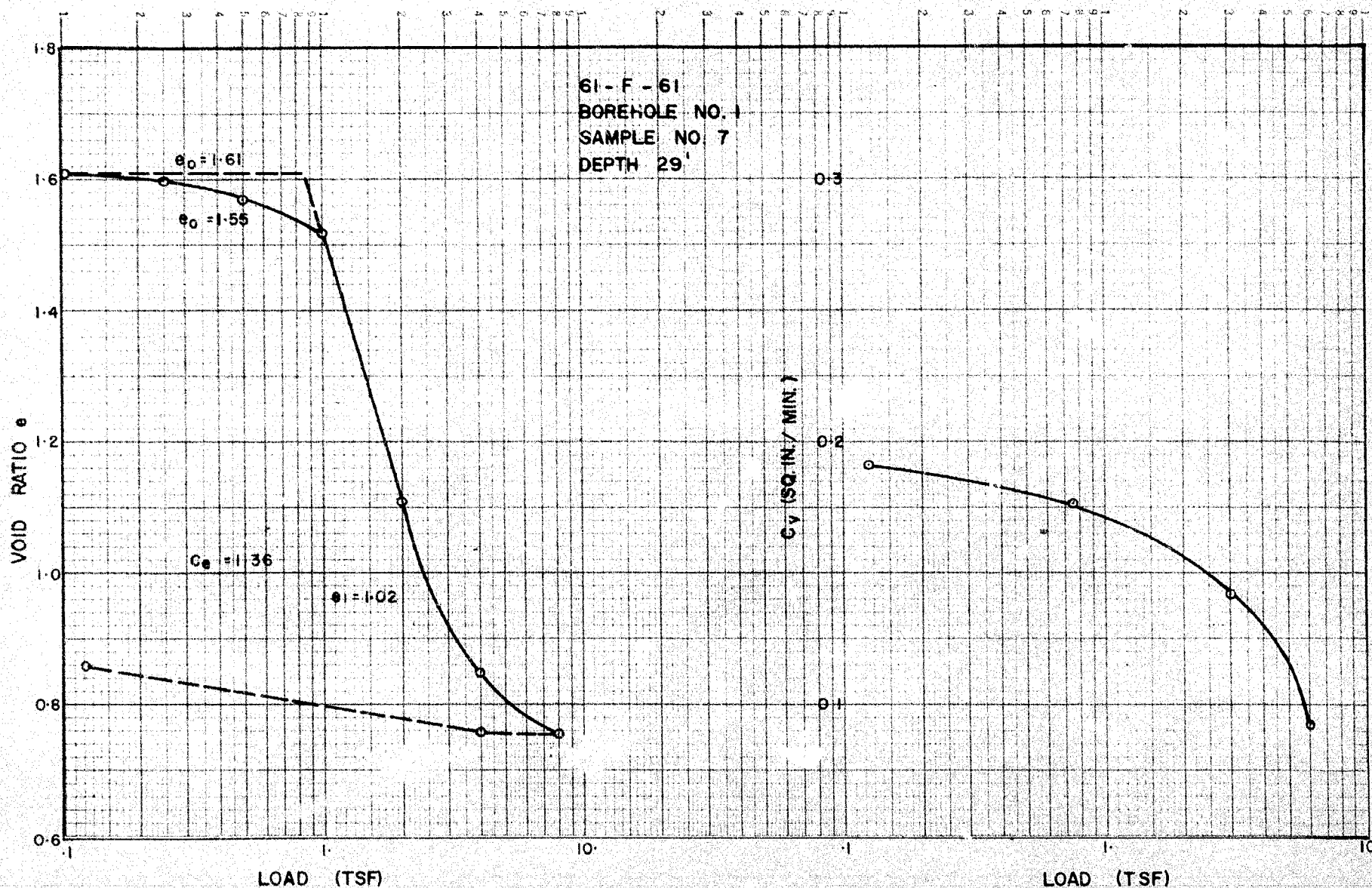
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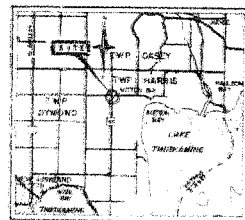
61 - F - 61  
 BOREHOLE NO. 1  
 SAMPLE NO. 6  
 DEPTH 24'



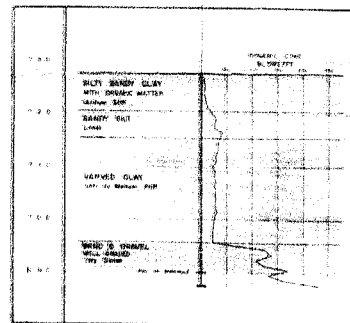






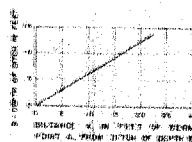
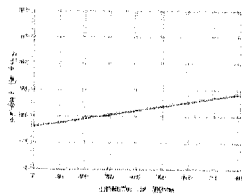


KEY PLAN  
1:10000 - 1:25000



BOREHOLE NO. 1

St. A. 2000-01-10-1000



FILED - JANUARY 27 1968  
FBI - NEW YORK

## MATERIALS & RESEARCH SECTION

FILL STABILITY INVESTIGATION  
HIGHWAY NO. 65

1. NAME (Last, first, middle initial) JAMES EARL RAY	2. DATE OF BIRTH (MM/DD/YYYY) 05/19/28	3. SEX M	4. RACE W	5. HEIGHT (inches) 5' 11"	6. WEIGHT (pounds) 175	7. EYES B	8. HAIR B	9. COMPLEXION F	10. BIRTHPLACE (City, State) ALABAMA	11. SOCIAL SECURITY NUMBER [REDACTED]	12. MARITAL STATUS S	13. OCCUPATION [REDACTED]	14. EDUCATION [REDACTED]	15. RELIGION [REDACTED]	16. SIGNATURE [REDACTED]	17. DATE 05/28/68	18. AGENT [REDACTED]	19. OFFICE [REDACTED]	20. DIVISION [REDACTED]	21. FILE NUMBER 61-8-10
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61-F-21

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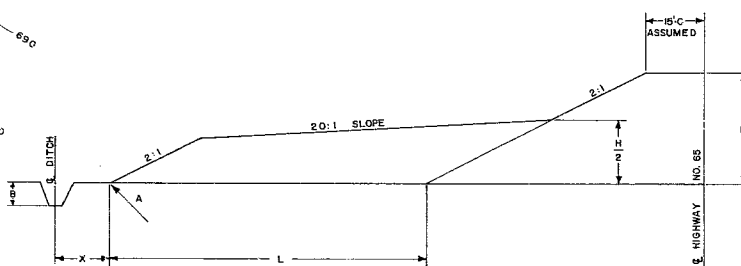
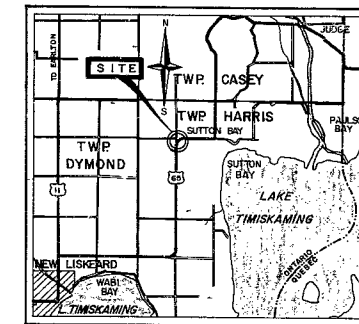
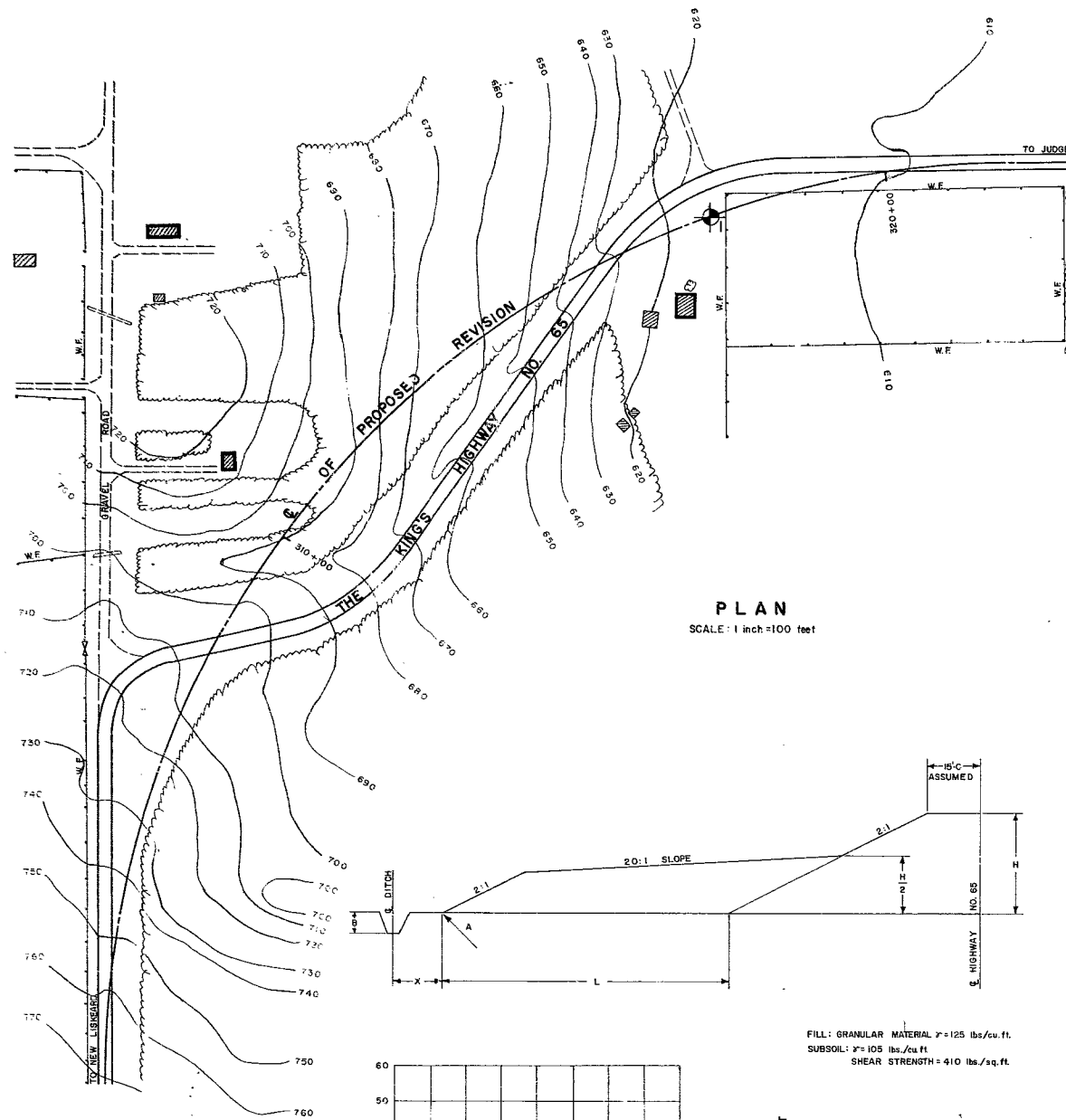
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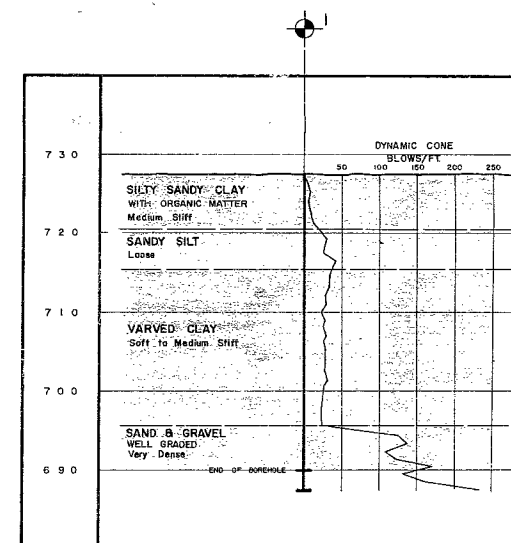
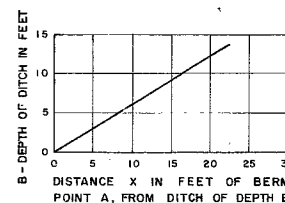
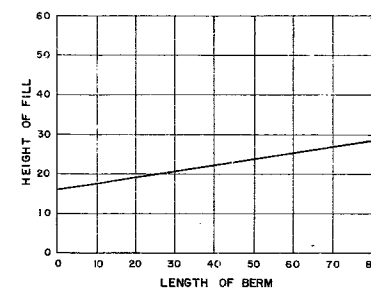
W.P. 26-61

HWY # 65

FILL STABILITY



FILL: GRANULAR MATERIAL  $\gamma = 125$  lbs./cu. ft.  
SUBSOIL:  $\gamma = 105$  lbs./cu. ft.  
SHEAR STRENGTH = 410 lbs./sq. ft.



DEPARTMENT OF HIGHWAYS - ONTARIO MATERIALS & RESEARCH SECTION		
<b>FILL STABILITY INVESTIGATION HIGHWAY NO. 65</b>		
ORIGINATED W. KULMATICAS	DISTRICT NO. 14	25 SEPT 19
DRAWN D. MUMFORD	W.P. NO. 26-61	61-F-6
CHECKED <i>[Signature]</i>	SCALE	VS NO.
APPROVED <i>[Signature]</i>	AS SHOWN	<b>1-F-61A</b>