

23-62-111-2

Mr. H. D. McMillan,  
Road Design Engineer.  
Materials & Research Section,  
(Foundations Office).

August 15, 1961.

D.R.O. FOUNDATION REPORT --  
(FILL STABILITY INVESTIGATION)  
W.P. 26-61 -- W.J. 61-V-56.

Re: Hwy. No. 65 - 3.5 Miles East of the Town  
of New Liskard, Dist. of Timiskaming,  
Twp. of Pyram, District No. 14.

Accompanying this memo, is our detailed report  
outlining the soil conditions at the above site, where it is  
proposed to raise the grade of Hwy. No. 65 between chainages  
56 + 60 and 63 + 00. The proposed vertical alignment will re-  
quire a fill of approx. 8 ft. above the existing grade at  
chainage 59 + 35.

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

If, however, further clarification is required  
please do not hesitate to contact our Office.

AGG/mdeP  
Attach.

cc: Messrs. H. D. McMillan (2)  
E. A. Tregaskes  
A. Mantle  
A. M. Teye  
G. E. Hunter  
H. S. Chapman  
D. B. Saint  
T. J. Kovich  
J. Ray  
J. E. Graspier  
F. Gorman

L. G. Anderson,  
PRINCIPAL FOUNDATION ENGR.  
Per:

*A. G. Sternes*  
(A. G. Sternes,  
SUPERVISING FOUNDATION ENGR.)

Foundations Office. -- Gen. Files.

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## FILL STABILITY INVESTIGATION

At Hwy. No. 65

3.5 Miles East of the Town of New Lisheard,  
District of Timiskaming, Twp. of Dymond,  
District No. 14.

W.P. 26-61

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W.J. 61-F-56.

### 1. INTRODUCTION:

At the above location it is proposed to raise the grade of Hwy. #65 between Stations 56 + 60 and 63 + 00. This will involve a maximum fill of about 8.0' at Station 59 + 35. A concrete culvert is at present, located at Station 59 + 35.

A field investigation was carried out by this Office in order to determine the subsoil conditions existing at the site. The results of this investigation, together with recommendations for the proposed construction, are given in this report.

### 2. DESCRIPTION OF THE SITE AND GEOLOGY:

The site is located approximately 3.5 miles east of New Lisheard on Hwy. #65. The surrounding area is fairly flat, but at the location of the proposed construction the highway crosses a natural ravine.

Physiographically, the site is located on the Timiskaming Clay Plain.

cont'd. /2 ...

### 3. FIELD AND LABORATORY WORK:

The field investigation was carried out using diamond drilling equipment adapted for soil sampling purposes. Two sampled boreholes and one dynamic cone penetration test were carried out. Undisturbed samples were recovered by means of Shelby Tubes, pushed by hand into the soil. Field vane tests were also carried out, where possible, at elevations 12" below the bottom of the samples. The locations of all boreholes, together with elevations, are shown on Eng. #61-P-56A.

Laboratory tests were carried out on a selection of samples to determine the following properties:-

- (1) Atterberg Limits.
- (2) Bulk Density.
- (3) Moisture Content.
- (4) Grain Size Distribution.
- (5) Undrained Shear Strength.
- (6) Consolidation Properties.

The results of these tests, together with a description of each sample, are given in appendix #1 of this report.

### 4. GEOSCIL CONDITIONS:

The stratigraphy of the site was found to be quite uniform and consisted of about 2.0' of topsoil underlain by deposits of varved clay extending to at least 61.0' in depth. The upper 6.0' of the varved clay deposit is oxidized and has a brownish colour. Down to about elev. 593.0 for a thickness of about 14', the varves

cont'd. /3 ...

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

consist of alternate layers of clay and clayey silt, about 1/8" thick. Below this elevation down to 61', the varves consist of layers of clay from 2" to 4" thick parted by layers of clayey silt 1/2" to 1-1/2" thick. Liquid limits for the clay layers varied from 54% to 76%, while plastic limits ranged from 21% to 29%. For the clayey silt layers, liquid limits averaged about 27%, and plastic limits about 22%. Moisture content determinations for the clay layers varied from about 45% to 72%, and for the clayey silt layers from about 28% to 31%. Bulk density determinations for the unseparated material gave values ranging from 104 p.c.f. to about 110 p.c.f.

Grain size distribution curves indicate the clay layers to contain 80% to 90% particles of clay size while the clayey silt layers contain only 25% particles of clay size. In-situ vane and undrained triaxial tests carried out in this material showed some disagreement, particularly where the sensitivity was high. In view of this, it was assumed that samples may have been disturbed somewhat; consequently, the vane results are considered to be more reliable. In view of this, it is estimated that the shear strength of this stratum varies from about 500 p.s.f. at the top to about 1900 p.s.f. at 66.0'. Based on these values the consistency of the stratum may be described as soft, becoming medium stiff to stiff with depth.

Consolidation tests carried out on the material from the clay layers show that the stratum is somewhat overconsolidated. The resulting curves obtained from this test are given in Appendix #1 of this report.

cont'd. /4 ...

5. GROUND WATER CONDITIONS:

Ground water elevation at the time of the investigation was estimated to be at elev. 611.3.

6. DISCUSSION AND RECOMMENDATIONS:

Proposals at this site involve the construction of a new embankment section about the existing Centre Line some 8.0' higher in elevation; also the installation of a new culvert to replace an existing one. The existing embankment consists of about 14.0' of rock fill.

A stability analysis based on total stresses, assuming a top width of 30', and side slopes of 2 horizontal to 1 vertical, was carried out to determine the factor of safety against a circular arc type of failure. Because of the stress strain properties of the clay layers, it has been assumed that little, if any, of the shear strength of the fill would be mobilized. For design purposes, therefore, the latter has been neglected. On the basis of this analysis it was concluded that berms would be required. The required height and lengths of berms for various embankment heights are given on Drawing #61-F-56B.

Based on the consolidation tests carried out, it is estimated that the maximum consolidation settlement would be in the order of 36" and because of the many drainage paths through the silt layers, this may occur fairly rapidly, possibly within 6 months. At Station 59 + 35 the existing culvert should be replaced by a flexible type culvert. In view of the predicted settlements, a stage construction



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

is recommended as follows:-

Temporary extensions of sufficient size to accommodate normal flow during the construction season should be added to the existing culvert for the full width of the proposed berms. The fill should then be completed to the full height of the berms. This should be left in place for as long a period as is possible. Excavations for the new culvert should then be carried out and the temporary and existing culverts removed. Care should be taken during this operation not to pile excavated material to an unsafe height on the sides of the trench. The new culvert should then be placed with the recommended camber of 18" as shown on Drawing #61-F-56B. This camber should be provided in order to take up additional settlements which will occur after the final completion of the fill to full height.

Because of the indicated settlements, a flexible type of pavement is recommended. Before final paving, it would be preferable to allow a period of about 12 months to elapse.

7. SUMMARY:

- (1) Subsoil at the site consists of varved clay extending to at least 61' in depth. The consistency of this material is soft becoming medium stiff to stiff with depth.
- (2) Berms as shown on Dwg. #61-F-56B, should be constructed simultaneously with the embankment fill.

cont'd. /6 ...

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

(3) The existing concrete culvert should be removed and replaced by a flexible type culvert. Recommended procedure for this installation is given in (6) above.

(4) A flexible type of pavement is recommended. Before final paving, it would be preferable to allow a period of about 12 months to elapse.

8. MISCELLANEOUS:

The field work was carried out during the period June 17th to June 20th, 1961. Equipment used was owned and operated by Canadian Longyear, Ltd., under the supervision of W. W. Kulmickas of this Section.

REPORT PREPARED BY:

...B. M. Ghadiali...

for W. W. Kulmickas,  
PROJECT FOUNDATION ENGINEER.

August 1961.

REPORT APPROVED BY:

...K. G. Selby...

K. G. Selby,  
SENIOR PROJECT FOUNDATION ENGINEER.



APPENDIX I.

# SUMMARY OF FIELD & LABORATORY TESTS

JOB 61-F-56

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	19'-20.5'	Soft varved clay.	3	45.9	-	-	-	-	
	T2	24'-26'	Soft varved clay.	- Pushed	71.1 - 30.2	24.9 - -	65.7 - -	- TR=380 -	- 109.4 -	
	VANE	28'		-	-	-	-	560	-	Sens: 4.7
	T3	33'-35'	Med. stiff to stiff varved clay.	- Pushed	63.5 - 28.1	28.1 - -	76.0 - -	V= 384 TR=550 -	- 105.9 -	
	VANE	39.5'		-	-	-	-	960	-	Sens: 3.0
	T4	44'-46'	Med. stiff to stiff varved clay.	- Pushed	69.2 - 29.2	24.7 - 22.8	64.9 - 26.6	- TR=596 -	- 106.1 -	
	VANE	49.5'		-	-	-	-	960	-	Sens: 3.0
	T5	54'-56'	Med. stiff to stiff varved clay.	Pushed	-	-	-	-	-	
	VANE	60.5'		-	-	-	-	960	-	Sens: 3.0

Site 7

# SUMMARY OF FIELD & LABORATORY TESTS

JOB 61-F-56

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	T6	64'-66'	Med. stiff to stiff varved clay.	-	57.9	23.0	66.8	TR=550	-	
				Pushed	-	-	-	-	107.1	
				-	28.3	-	-	V= 565	-	
	VANE	71.5'		-	-	-	-	1200	-	Sens: 3.7
	T7	74'-75.5'	Med. stiff to stiff varved clay.	8	-	-	-	-	-	
	VANE	81.5'		-	-	-	-	1260	-	
2	T1	3'-4.8'	Soft varved clay.	Pushed	-	-	-	-	-	
	S2	3'-4.5'	Soft varved clay.	Pushed	56.3	-	-	-	-	
	VANE	6.5'	Soft varved clay.	-	-	-	-	480	-	Sens: 6.0
	T4	12'-13.8'	Soft varved clay.	-	69.1	23.3	60.0	V= 352	-	
				Pushed	-	-	-	-	104.1	
				-	30.2	-	-	TR=352	-	
	VANE	16.5'		-	-	-	-	560	-	Sens: 7.0
	T5	18'-19.8'	Med. stiff to stiff varved clay.	-	69.0	24.1	67.6	-	-	
				Pushed	-	-	-	-	102.5	
				-	30.6	-	-	TR=448	-	
	S6	23'-24.5'	Med. stiff to stiff varved clay.	3	72.5	-	-	-	-	
	VANE	26.5'	Med. stiff to stiff varved clay.	-	-	-	-	800	-	Sens: 5.0

Sig 7

# SUMMARY OF FIELD & LABORATORY TESTS

JOB 61-P-56

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
2	T7	30'-32'	Med. stiff to stiff varved clay.	-	70.8	25.2	65.8	V= 533	-	
		Pushed		-	-	-	-	105.7		
		-		29.4	-	-	TR=483	-		
	VANE	36.5'		-	-	-	-	800	-	Sens: 5.0
	T8	39'-41'	Med. stiff to stiff varved clay.	-	64.6	24.2	63.4	V= 533	-	
		Pushed		-	-	-	-	103.8		
		-		32.4	22.4	27.0	TR=640	-		
	VANE	46'		-	-	-	-	800	-	Sens: 2.5
	S9	50'-51.5'	Med. stiff to stiff varved clay.	5	61.3	-	-	-	-	
	VANE	56.5'		-	-	-	-	1760	-	
	S10	60'-61.5'	Med. stiff to stiff varved clay.	4	63.4	-	-	-	-	
	VANE	66.5'		-	-	-	-	1920	-	
			S denotes split spoon sample T   "   shelby tube V   "   lab. vane TR   "   triaxial test							

Site 7

Site 7

# DEPARTMENT OF HIGHWAYS - ONTARIO

## MATERIALS AND RESEARCH SECTION

W.P. 26-61

BORE HOLE NO. 1

JOB 61-F-56

STATION 59+31 (12' R.C.)

DATUM 625.6'

COMPILED BY B.K.

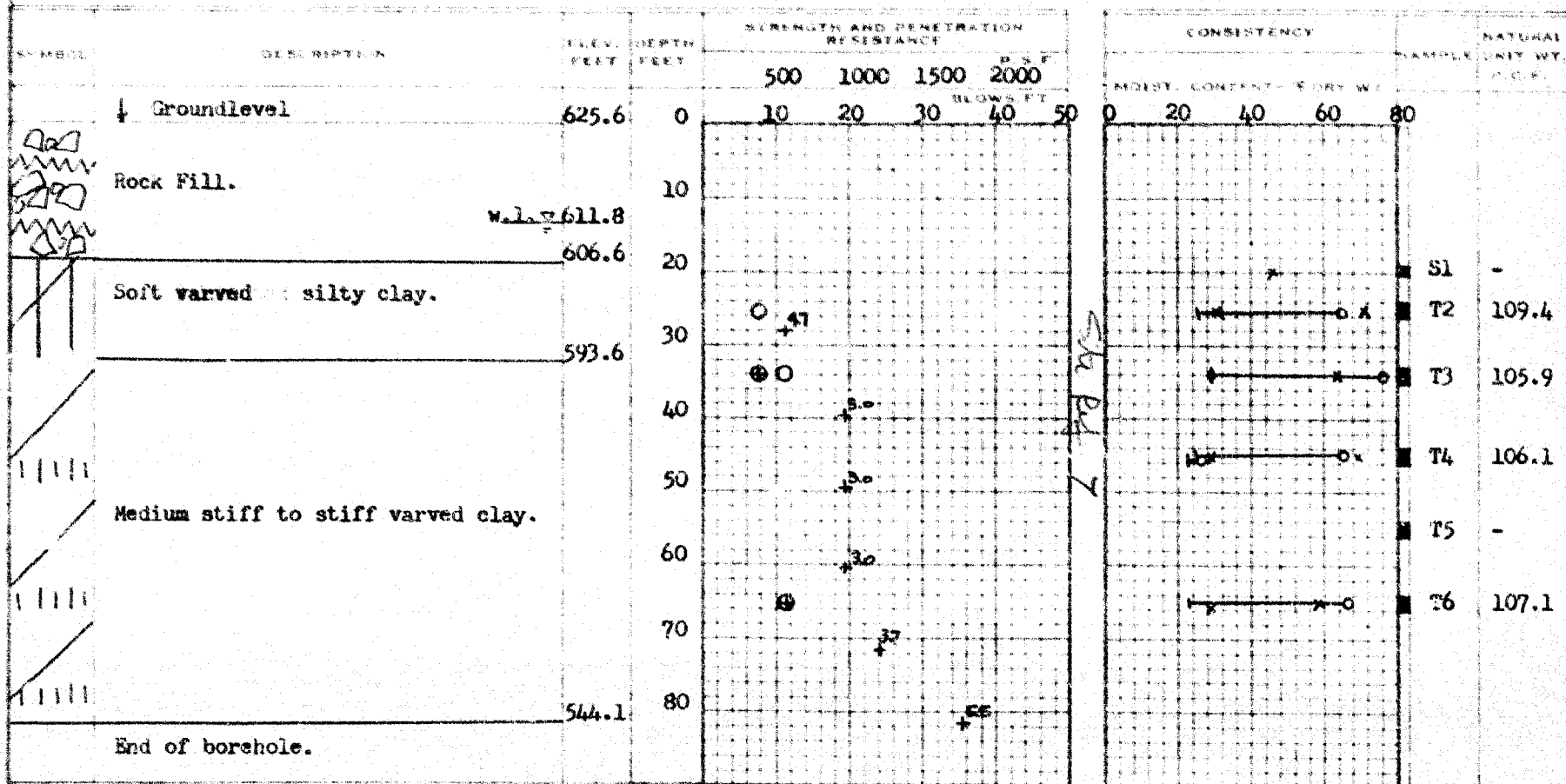
BORING DATE June 16/61

CHECKED BY R.W.K.

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

## LEGEND

Lab vane - - - - - ⊕  
 1/2 UNCONFINED COMPRESSION (QU) - ○  
 VANE TEST (C) AND SENSITIVITY (S) - +  
 NATURAL MOISTURE AND LIQUIDITY INDEX - X  
 LIQUID LIMIT - ○  
 PLASTIC LIMIT - +



# DEPARTMENT OF HIGHWAYS - ONTARIO

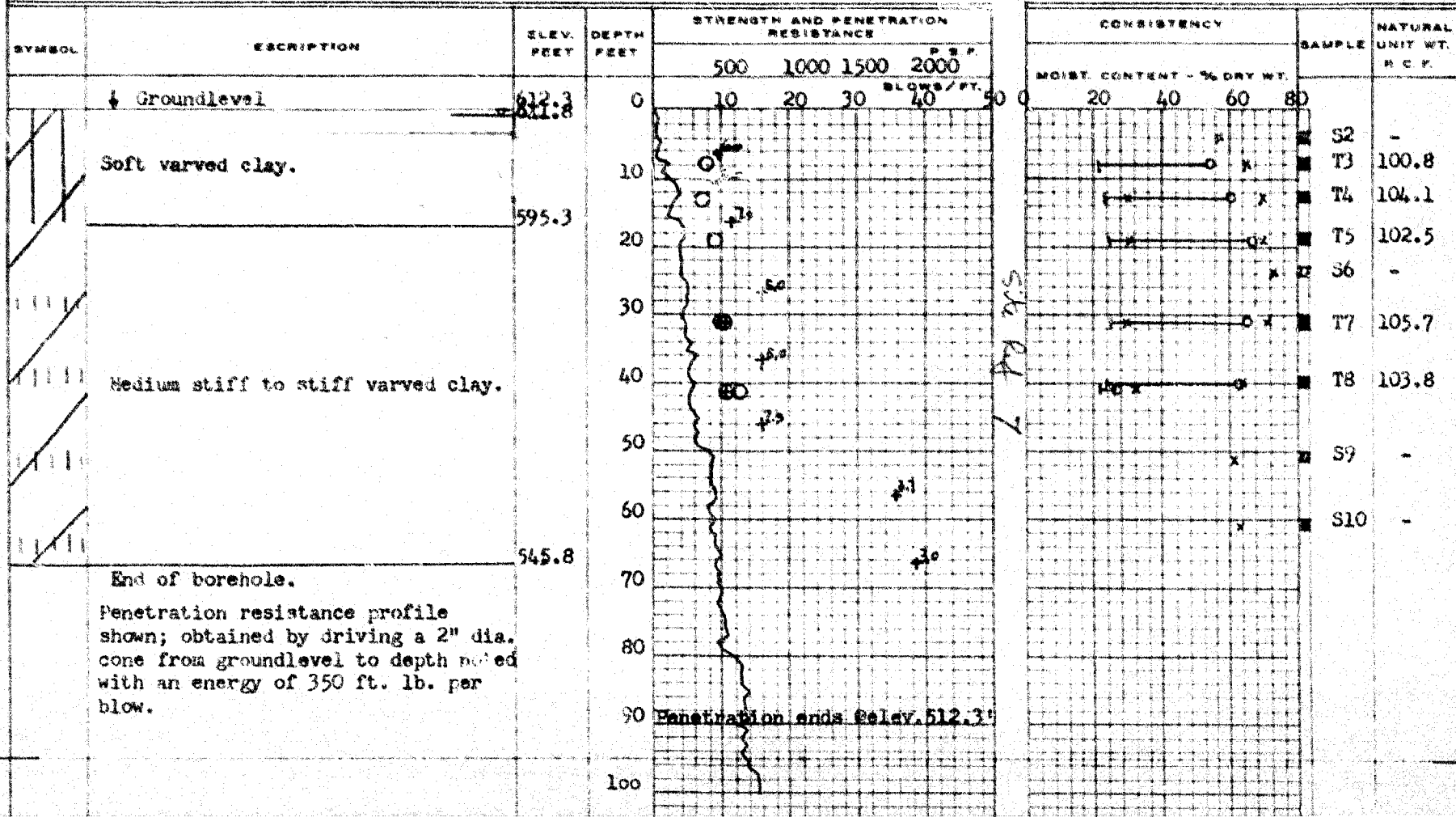
## MATERIALS AND RESEARCH SECTION

W.P. 24-61 BORE HOLE NO. 2  
 JOB 61-F-56 STATION 59+31 (35' Rt.)  
 DATUM 612.3' COMPILED BY B.K.  
 BORING DATE JUNE 17/61 CHECKED BY W.W.K.

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

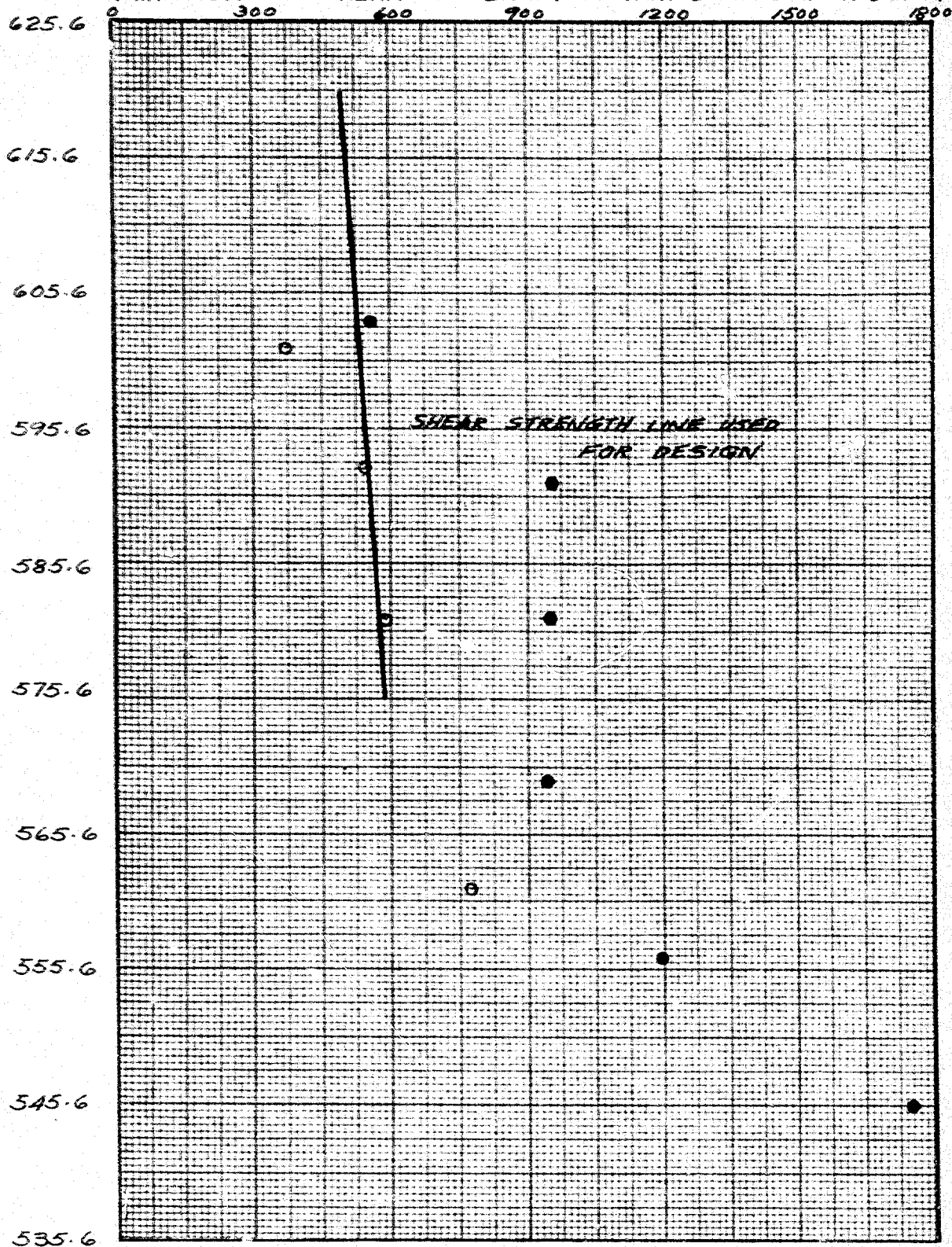
### LEGEND

Lab Vane  
 1/2 UNCONFINED COMPRESSION (Qu)  
 VANE TEST (C) AND SENSITIVITY (S)  
 NATURAL MOISTURE AND  
 LIQUIDITY INDEX  
 LIQUID LIMIT  
 PLASTIC LIMIT





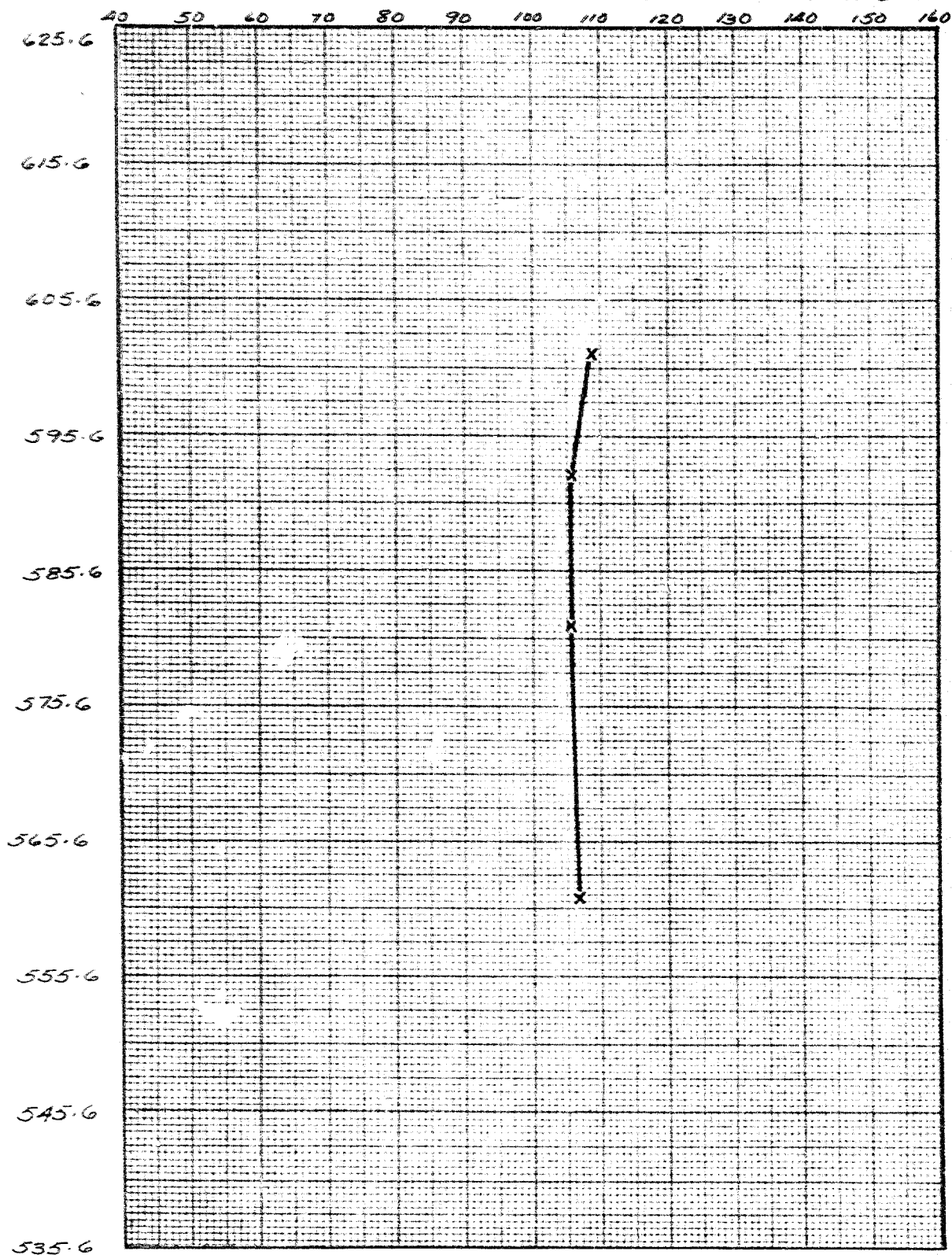
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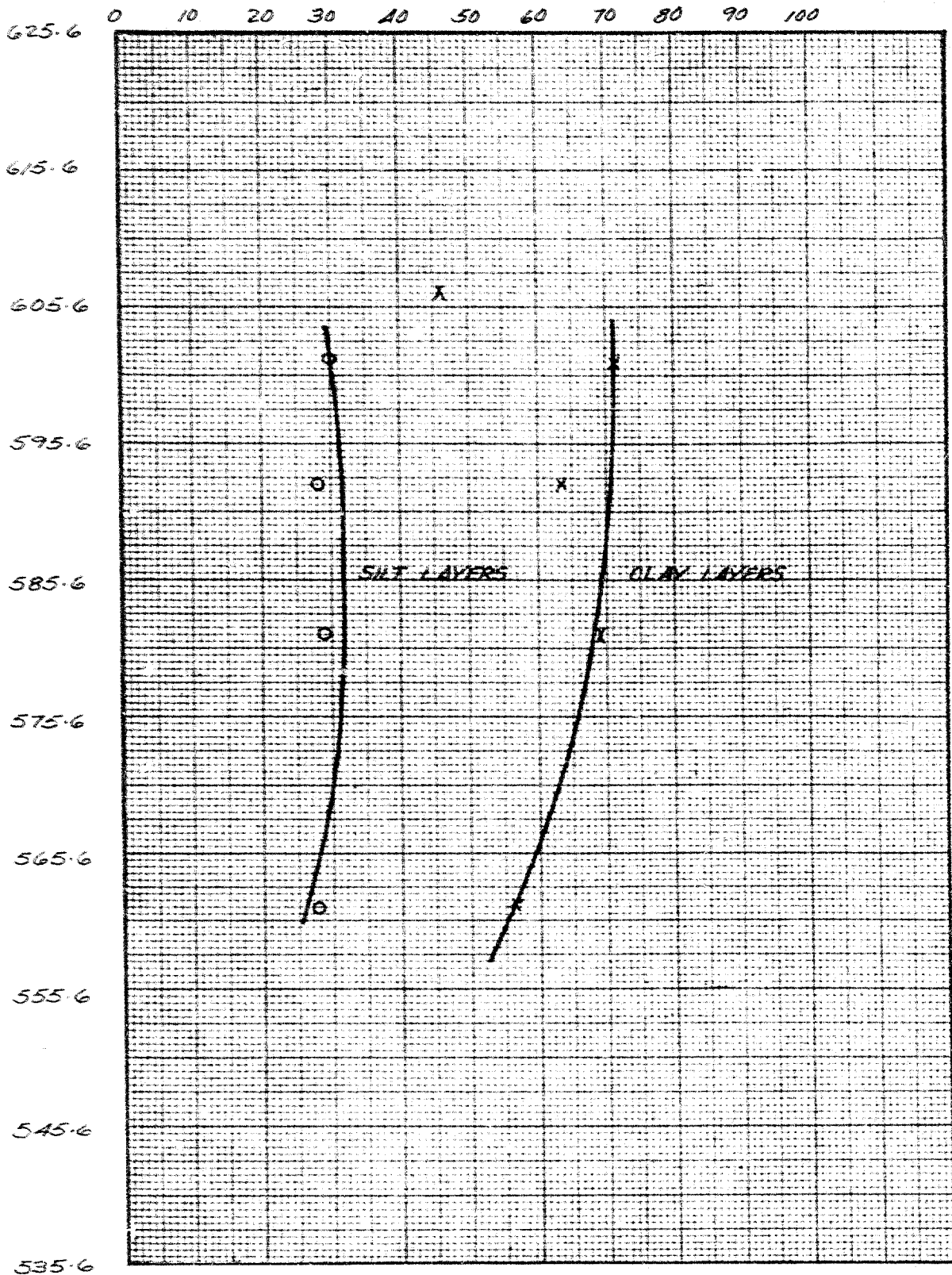
● IN SITU VANE

○ UNDISTURBED TRIAXIAL

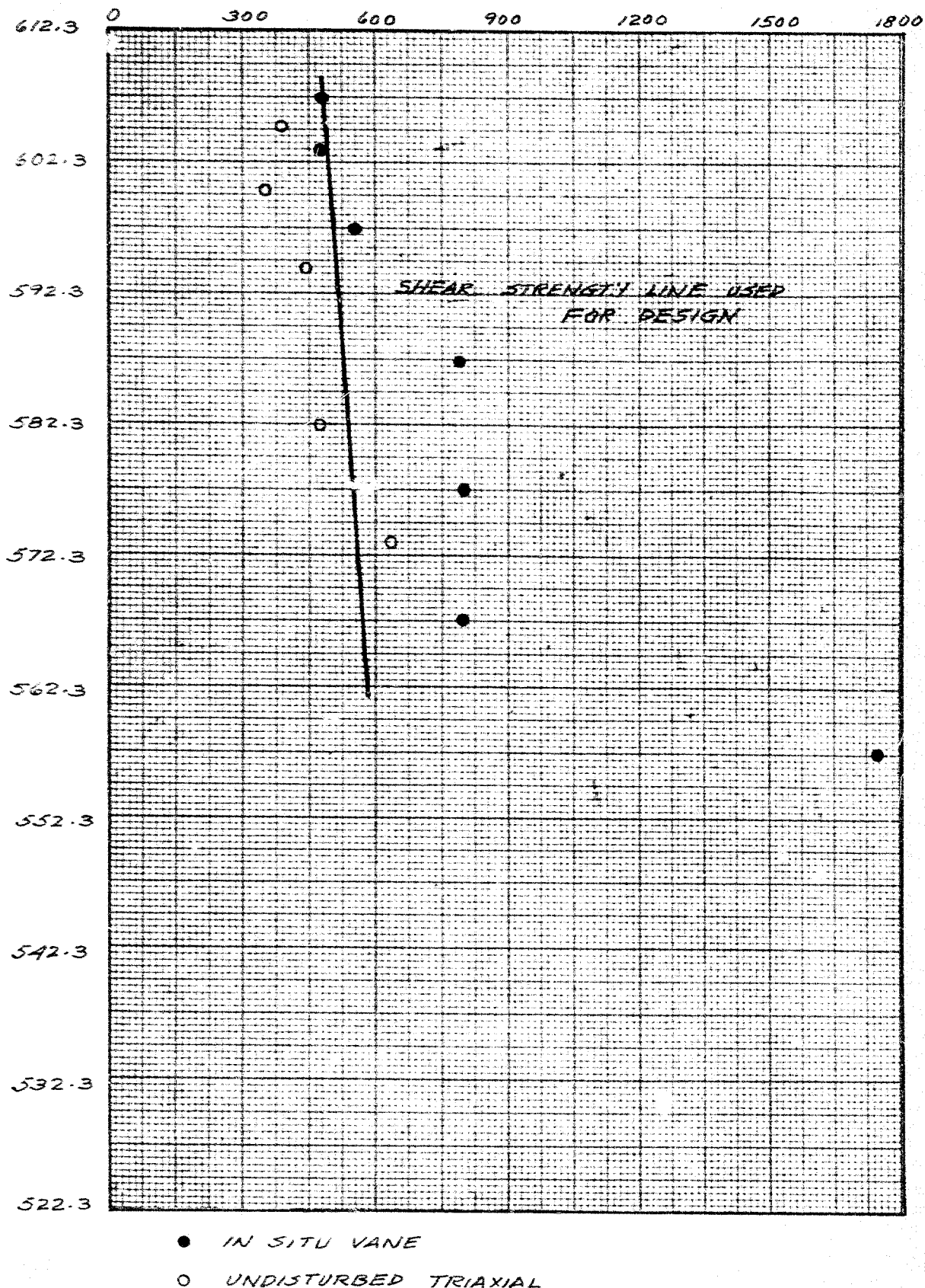
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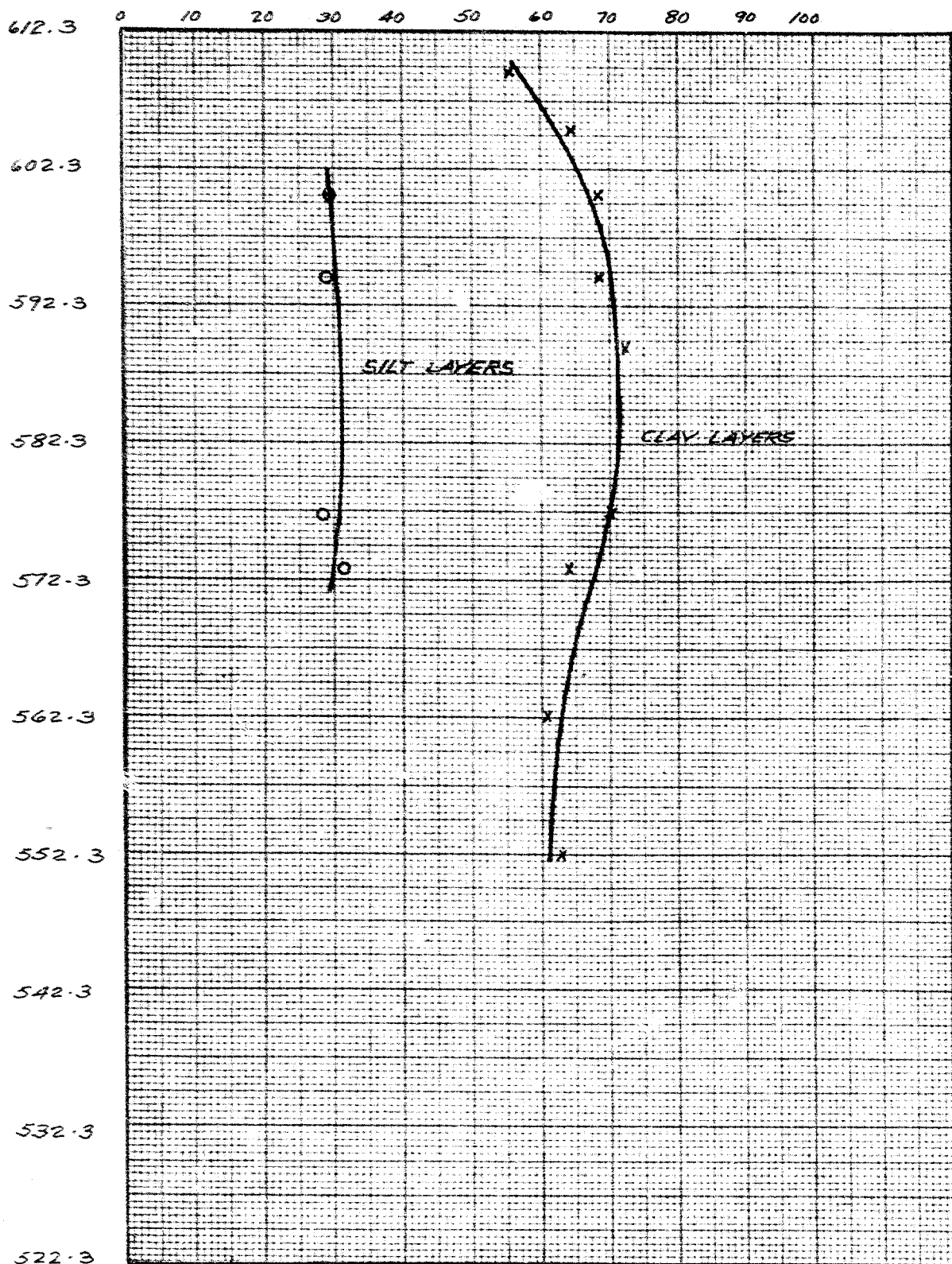
## VARIATION OF NATURAL MOISTURE CONTENT OF VARVED CLAY WITH DEPTH



## VARIATION OF SHEAR STRENGTH OF VARVED CLAY WITH DEPTH

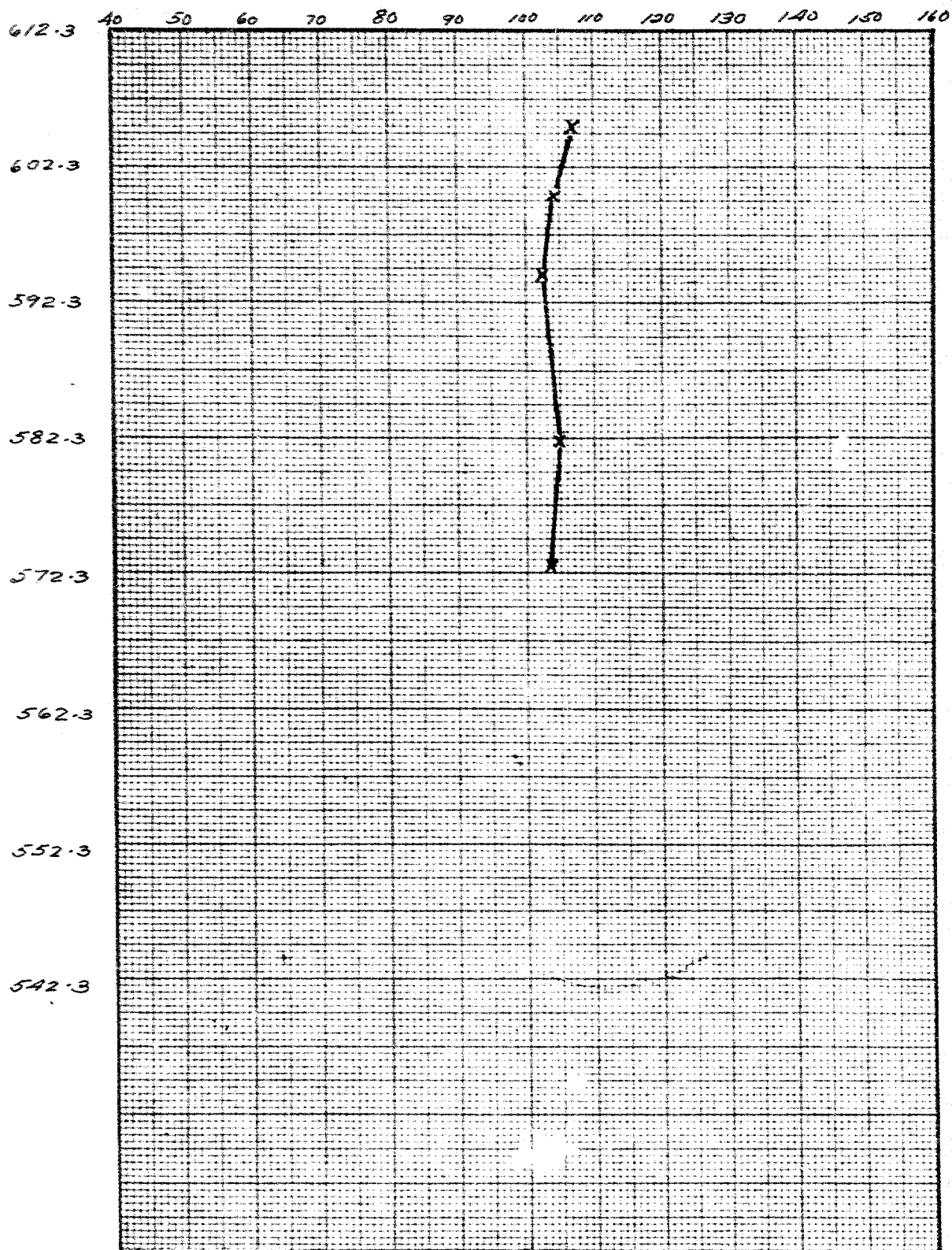


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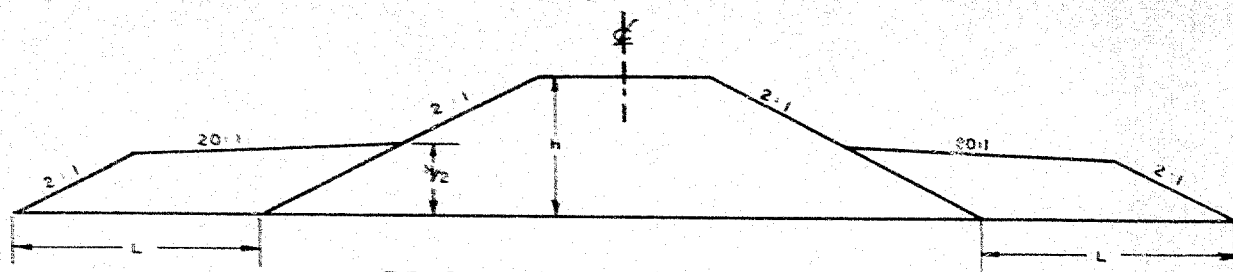




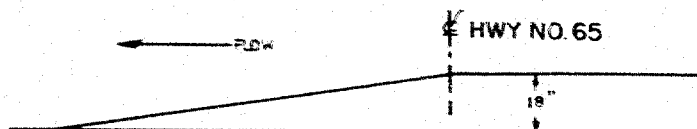
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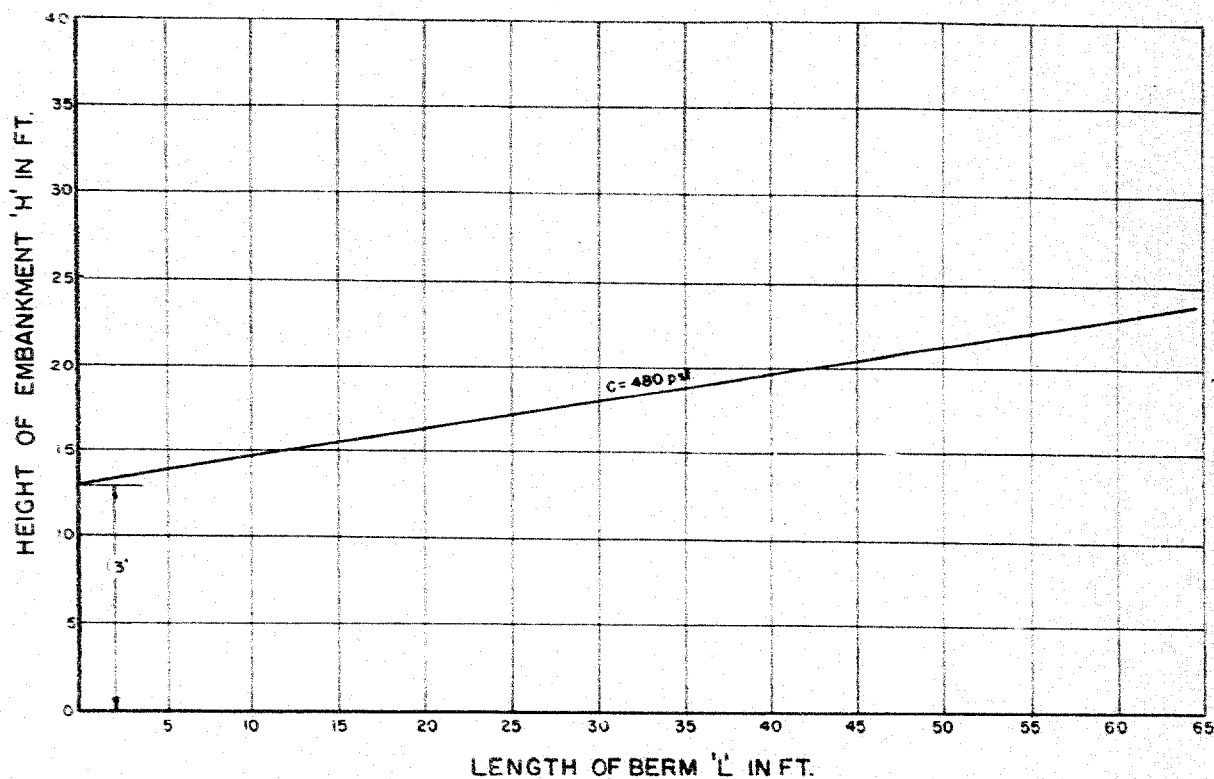




RECOMMENDED BERM SECTION



ARRANGEMENT OF CULVERT



ORIGINATED W. KULMATICAS

DRAWN *T. Szegvary*

CHECKED *[Signature]*

APPROVED

DATE 29 AUGUST 1961

DEPARTMENT OF HIGHWAYS - ONTARIO  
MATERIALS & RESEARCH SECTION  
FILL STABILITY AT HWY NO. 65

AT CHAINAGE 59 + 35

SCALE

W. P. NO. 26-61

JOB NO. 61-F-56

DWG NO. 61-F-56 B

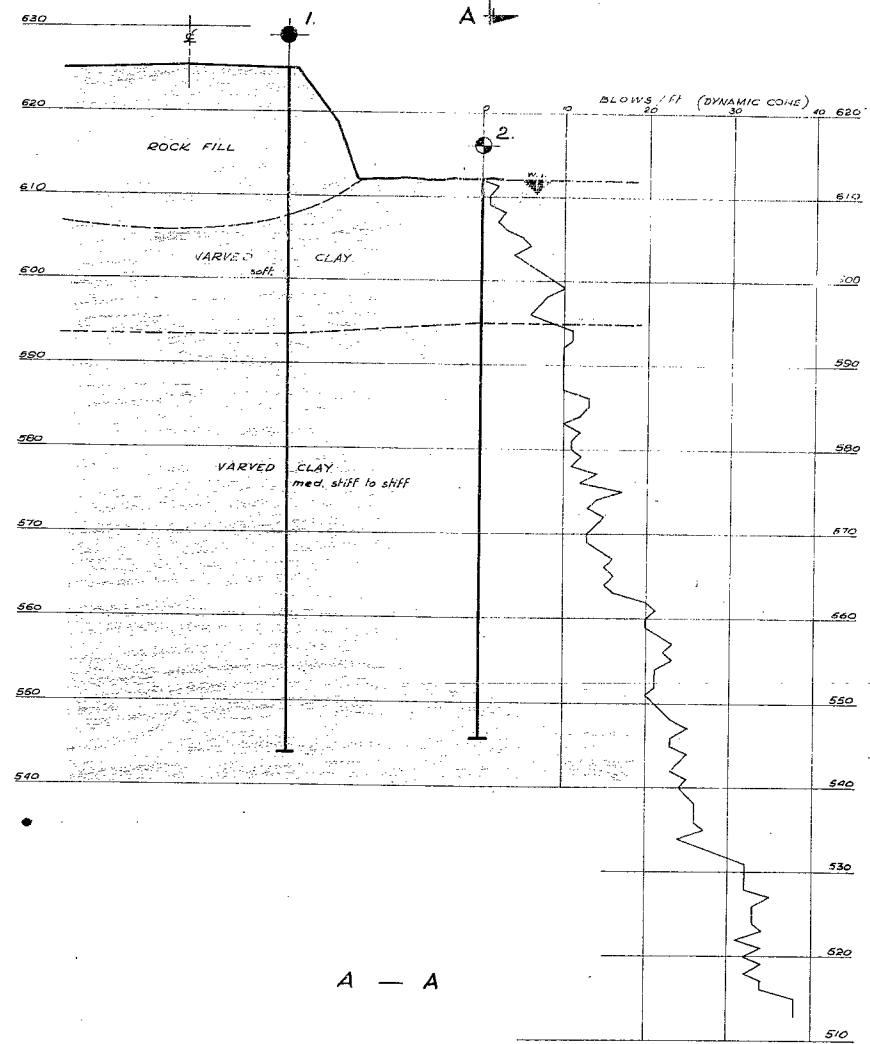
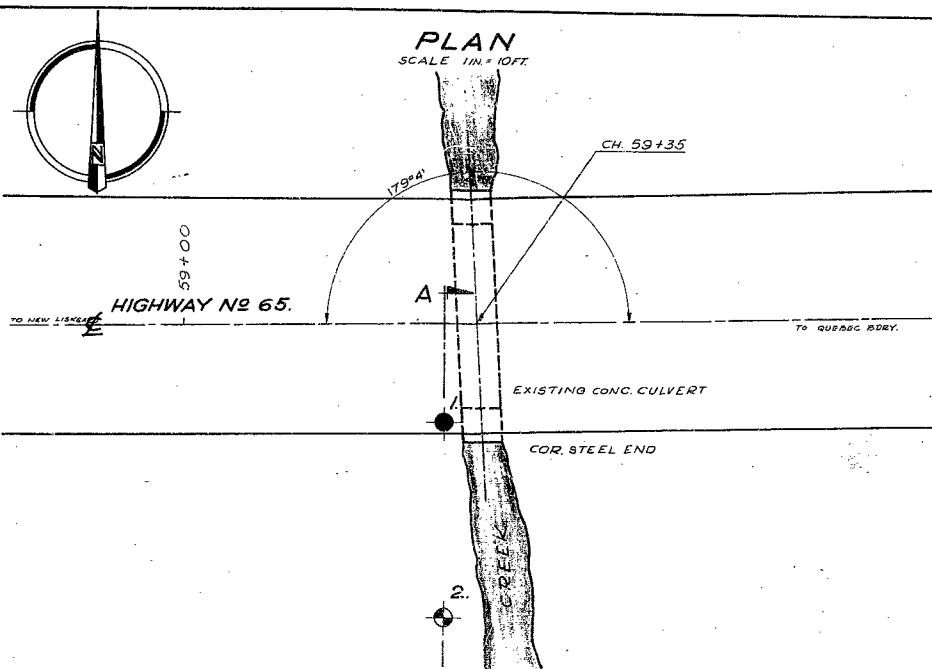
#61-F-56

W.P. #26-61

Hwy. #65

3.5 MILES E. OF

NEW LISKEARD T.



LEGEND			
	BORE HOLE		
	BORE AND PENETRATION HOLE		
HOLE	ELEVATION	STATION	OFFSET
1	625.6	59+31	12' RT.
2	612.3	59+31	35' RT.

5 59601400  
5264000  
17  
31M 12 IE

DEPARTMENT OF HIGHWAYS - ONTARIO MATERIALS & RESEARCH SECTION			
FILL STABILITY AT HWY No 65 CHAINAGE 59+31			
ORIGINATED BY KULMATICAS	DISTRICT NO. 14	DATE 31 AUG 1961	
DRAWN T. K. (10/11)	W.P. NO. 26-61	JOB NO. 61-F-56	
CHECKED <i>[Signature]</i>	SCALE 1/4" = 1' SHOWN	DRAWING NO.	
APPROVED <i>[Signature]</i>		61-F-56 A	