

DEPARTMENT OF HIGHWAYS ONTARIO

MEMORANDUM

TO: Mr. A. M. Toye,
Bridge Engineer,
Bridge Division.

FROM: Mr. A. G. Stermac,
Principal Foundation Engr.,
Foundation Section,
Materials & Research Division.

Attention: Mr. B. R. Davis,
Bridge Design Engr.

DATE: December 27, 1963

OUR FILE REF.

IN REPLY TO

SUBJECT:

FOUNDATION INVESTIGATION REPORT

For

The Instability of the South-East
Retaining Wall of Hwy. 401 & 400
Overpass

W.J. 63-F-85 -- District No. 6
W.P. 233-60 ?

Attached, we are forwarding to you, a report on the
"Instability of the South-East Retaining Wall of Hwy. 401 and
400 Overpass".

The investigation has conclusively demonstrated that
the failure of the wall is due to the lack of drainage. The
water pressure built up behind the wall is solely responsible
for the cause of instability. It is our experience that the
majority of retaining wall failures are due to the same reason.
The importance of provision of a good drainage system for any
design of retaining walls cannot be overemphasized.

KYL/MdeF
Attach.

cc: Messrs. A. M. Toye (2)
H. A. Tregaskes
H. D. McMillan
C. K. Hunter (2)
C. Fraser
T. J. Kovich
A. Watt

KYL
K. Y. Lo,
SUPERVISING FOUNDATION ENGR.
For:
A. G. Stermac,
PRINCIPAL FOUNDATION ENGR.

Foundations Office
Gen. Files

FOUNDATION INVESTIGATION REPORT

For

The Instability of the South-East
Retaining Wall of Hwy. 401 & 400
Overpass

W.J. 63-F-85 -- District No.6

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FOUNDATION INVESTIGATION REPORT

For

The Instability of the South-East
Retaining Wall of Hwy. 401 & 400
Overpass

W.J. 63-F-85 -- District No.6

1. INTRODUCTION:

A verbal request was received from the Bridge Office during August 1963 for a foundation investigation to be carried out at the site of the South-East retaining wall of Hwy. 401 & 400 overpass where some structural movements have been observed. An investigation was subsequently carried out by this Section in order to determine the possible reason for movement of the retaining wall.

Presented in this report are the results of this investigation, together with our analysis of the stability of the retaining wall in question, and our findings as to the probable causes of movement. Since the particular wall is to be removed under the present reconstruction of Hwy. 401, no remedial measures are proposed. We believe, however, that the findings will be of help in future design of walls under similar conditions.

2. DESCRIPTION OF SITE:

The site is located at the South-East corner of the existing overpass bridge which carries Hwy. #400 over Hwy. #401. The retaining wall is adjacent to Hwy. #401 and the embankment fill for the South approach to Hwy. #400. The lengths of the straight and circular portion of the wall are 17 ft. and 30 ft., and the maximum height above the ground is 6.5 ft. Outward

cont'd. /2 ...

2. DESCRIPTION OF SITE: (cont'd.) ...

movements have been observed at different points along the wall up to a maximum of 5 inches at the top of the wall. Two vertical cracks have been observed in the face of the wall at the approximate locations of the straight and curved portion of the wall, as shown in Photos 1&3. The maximum height of fill retained by the wall is 6.5 ft., the surcharge angle being 20° .

3. FIELD INVESTIGATION PROCEDURE:

A total of six boreholes was carried out during the course of the field work. Boring was achieved by means of a conventional diamond drill adapted for soil sampling purposes. Samples were obtained in continuous frequency in most of the borings, the programme being so arranged as to obtain a complete picture of the subsoil stratigraphy both in front and behind the wall. Disturbed samples were obtained by means of a standard split-spoon sampler driven into the soil by a 140-lb. hammer delivering an energy of 350 ft.-lbs. per blow. Undisturbed samples were obtained by means of 2-inch I.D. Shelby tubes which were pushed into the soil. In B.H. #1-B, field vane tests were carried out at elevations 12 inches below the sample depths. Three Geonor piezometers were installed to determine the prevailing ground water conditions along a section approximately at right angles to the retaining wall and located near the centre.

The locations and elevations of all borings and piezometers are shown on Dwg. #63-F-85A and were established in the field by a D.H.O. survey crew from District #6 under the supervision of Mr. Marvin Smith.

cont'd. /3 ...

4. LABORATORY WORK:

A visual inspection of all samples was carried out in the laboratory for classification purposes. In addition, tests were carried out on selected samples in order to determine the following physical properties:

- 1) Atterberg Limits.
- 2) Natural Moisture Contents.
- 3) Bulk Densities.
- 4) Undrained Shear Strength in Unconfined Compression Test.
- 5) Undrained Shear Strengths in Unconsolidated Undrained Triaxial Test.
- 6) Shear Parameters in Terms of Effective Stresses.
- 7) Grain Size Distribution.
- 8) Specific Gravity.
- 9) Void Ratios.
- 10) Degree of Saturation.

The results of the tests are summarized in Appendix I which forms part of this report.

5. SOIL TYPES AND SOIL CONDITIONS:

5.1) General:

Subsoil at the site consists of a deposit of glacial origin which is overlain by the fill material used for the construction of the highway. The boundaries of these layers are shown on the borehole logs which are included in the Appendix of this report. The estimated stratigraphical profile shown on Dwg. #63-F85A is based upon this information. From ground level downward, the different soil types are as follows:

cont'd. /4 ...

5. SOIL TYPES AND SOIL CONDITIONS: (cont'd.) ...

5.2) Fill Material (Clayey Silt with Fine to Coarse Sand):

This material exists behind the retaining wall and forms the embankment of Hwy. #400. The depth varies due to the side slope from the roadway to the retaining wall, from an estimated maximum of 23 ft. to a minimum of about 11.0 ft. The material consists of a heterogeneous mixture of clayey silt and fine to coarse sand and exhibits a predominantly cohesive nature. The consistency may be described as very stiff to firm, the tendency being to decrease in strength with depth. The physical properties of the material as determined from the field and laboratory tests are summarized as follows:

TEST DESCRIPTION	<u>Minimum</u>	<u>Maximum</u>	<u>Average</u>
Liquid Limit	21%	38%	29%
Plastic Limit	14%	20%	17%
Moisture Content	13%	23%	18%
Bulk Density	130 p.c.f.	141 p.c.f.	133 p.c.f.
Degree of Saturation	94%	100%	97%
'N' Values	5	28	13
Undrained Shear Strength	750 p.s.f.	3360 p.s.f.	1870 p.s.f.
Effective Cohesion Intercept in Terms of Effective Stress (c')	-	-	0 p.s.f.
Effective Angle of Shearing Resistance in Terms of Effective Stress (Ø')	-	-	30°

cont'd. /5 ...

5. SOIL TYPES AND SOIL CONDITIONS: (cont'd.) ...

5.3) Fill Material (Sand and Gravel):

This material was encountered in front of the retaining wall and forms the road bed of Hwy. #401. It consists of well-graded sand and gravel in a dense to compact state, 'N' values ranging from 33 to 13 blows/ft. The depth of this layer was found to be about 4 ft.

5.4) Clayey Silt with Traces of Fine Sand (Glacial Till):

This deposit underlies the fill material on both sides of the wall and extends for a further depth of at least 14.0 ft. The material consists of a heterogeneous mixture of clayey silt and fine sand. The percentage of sand is in the order of 5%, the overall mixture being essentially cohesive. The consistency was found to be very stiff in the upper 4 ft., probably as a result of desiccation, and below that it was found to be stiff. In the lower portion, a tendency to increase in strength with depth was noted. The physical properties of the material as determined from the field and laboratory tests are summarized as:

cont'd. /6 ...

5. SOIL TYPES AND SOIL CONDITIONS: (cont'd.) ...

5.4) Clayey Silt with Traces of Fine Sand (Glacial Till):(cont'd.)

TEST DESCRIPTION	<u>Minimum</u>	<u>Maximum</u>	<u>Average</u>
Liquid Limit	25%	34%	31%
Plastic Limit	14%	23%	19%
Moisture Content	15%	31%	24%
Bulk Density	122 p.c.f.	130 p.c.f.	126 p.c.f.
'N' Values	7	29	17
Undrained Shear Strength	970 p.s.f.	3790 p.s.f.	1670 p.s.f.
Effective Cohesion Intercept in Terms of Effective Stress	-	-	0 p.s.f.
Effective Angle of Shearing Resistance in Terms of Effective Stress	-	-	35°

6. GROUND WATER CONDITIONS:

From observations of piezometers located near the centre of the wall, the ground water level prevailing at the time of the investigation, was found to be some 9 ft. higher behind the wall than in front. In front of the wall the ground water level was found to be at elev. 417.4 some 3.0 ft. below ground level. One piezometer was located in front of the wall. At the rear of the wall, two piezometers indicated identical water levels at elev. 426.4.

In the fill material behind the wall the average degree of saturation above elev. 426.4 was found to be 95%.

cont'd. /7 ...

7. DISCUSSION:

The purpose of this report is primarily to determine the causes for the observed movements of the aforementioned retaining wall. This wall is designed as a reinforced concrete cantilever and retains a fill about 6.5 ft. with a surcharge angle of 20° . Indications are that the entire wall has moved and tilted forward to distances of up to 5 inches at the top. It was observed during the investigation, that the weep holes were sealed with cement, thus not allowing free passage of water. It was further observed that no free-draining material existed behind the wall. Conditions such as these are likely to result in a build-up of a hydrostatic head behind the wall during the wet seasons of the year, thus greatly increasing the pressure acting on the wall. The high water level in the fill observed in the piezometers, together with the high degree of saturation determined in the laboratory, substantiate this point. With the above facts in mind, stability analyses in terms of effective stresses, have been carried out for various possible conditions of ground water level; these results are summarized as follows:

Assumptions for all Conditions:

Backfill behind the wall
(Clayey Silt with Sand)

$$\begin{aligned}c' &= 0, \quad \phi' = 30^{\circ} \\ \gamma &= 125 \text{ p.c.f.} \quad \gamma' = 65 \text{ p.c.f.} \\ \delta &= 20^{\circ} \quad (\text{angle of surcharge})\end{aligned}$$

Backfill in front of the wall
(well graded Sand & Gravel)

$$\begin{aligned}\phi &= 30^{\circ} \\ \gamma &= 125 \text{ p.c.f.} \quad \gamma' = 65 \text{ p.c.f.} \\ \delta &= 0^{\circ}\end{aligned}$$

Subsoil (Clayey Silt with
traces of Sand - Glacial Till)

$$\begin{aligned}c' &= 0, \quad \phi' = 35^{\circ} \\ \gamma &= 125 \text{ p.c.f.} \quad \gamma' = 65 \text{ p.c.f.}\end{aligned}$$

cont'd. /8 ...

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

The coefficient of active and passive pressure K_a and K_p respectively, have been calculated using the wedge theory.

Hence, K_a (coefficient of active pressure)

$$= \frac{\cos^2 \phi'}{\cos \alpha \left[1 + \sqrt{\frac{\sin(\phi' + \alpha) \sin(\phi' - \delta)}{\cos \alpha \cos \delta}} \right]^2}$$

and K_p (coefficient of passive pressure)

$$= \frac{\cos^2 \phi'}{\cos \alpha \left[1 - \sqrt{\frac{\sin(\phi' + \alpha) \sin(\phi' + \delta)}{\cos \alpha \cos \delta}} \right]^2}$$

where ϕ = effective angle of shearing resistance
 α = angle of friction between the backfill material and the wall (in our analyses this was assumed to be zero.)
 δ = angle of inclination of ground surface with the horizontal (surcharge angle)

$$\text{Hence, } K_a = \frac{\cos^2 30^\circ}{\cos 0^\circ \left[1 + \sqrt{\frac{\sin 30^\circ \sin(30^\circ - 20^\circ)}{\cos 0^\circ \cos 20^\circ}} \right]^2} = 0.441$$

$$K_p = \frac{\cos^2 30^\circ}{\cos 0^\circ \left[1 - \sqrt{\frac{\sin 30^\circ \sin(30^\circ + 0^\circ)}{\cos 0^\circ \cos 20^\circ}} \right]^2} = 3.00$$

Using the above-mentioned values, analyses have been carried out to determine the factor of safety against sliding and overturning of the retaining wall for various cases of assumed conditions of ground water levels.

cont'd. /9 ...

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

Case i) Ground water level assumed to be the same as the levels observed in the piezometers.

Case ii) Ground water level assumed to be at the ground surface everywhere behind the wall and 3.0 ft. below ground level in front of the wall. (This condition could occur during the wet seasons of the year since no drainage was provided.)

Case iii) Ground water level assumed to be at weep hole invert level behind the wall and 3.0 ft. below ground surface in front of the wall. (This condition would seem to be the condition for which the wall was designed.)

Case iv) Ground water assumed to be at the footing base level behind the retaining wall.

In all the above cases, the water level in front of the wall was taken as observed in the piezometer, i.e., approximately 3.0 ft. below ground surface. It is assumed that this will not vary greatly throughout the year since the road backfill material consists of free-draining sand and gravel.

The results of the analyses for the various cases are summarized as follows:

	<u>Factor of Safety Against</u>	
	<u>Sliding</u>	<u>Overturning</u>
Case i)	1.46	0.92
Case ii)	0.87	0.66
Case iii)	1.75	1.00
Case iv)	> 2.00	1.50

cont'd. /10 ...

8. CONCLUSIONS:

The above analyses show that the wall is in a state of critical equilibrium in all three cases with respect to overturning. It will be noted that even with the most favourable condition of ground water level behind the wall - i.e., at weep hole level, the safety factor against overturning is unity.

Calculations have shown that the provision of a free-draining medium behind the wall designed so as to permanently lower the water level to a satisfactory level would have prevented movement of the wall in question.

9. MISCELLANEOUS:

The field work was carried out by Mr. B. P. Kliem during August 12 - August 23, 1963, under the general supervision of Mr. M. Devata, Senior Foundation Engineer, who also prepared the report.

December 1963.

APPENDIX I.

DEPARTMENT OF HIGHWAYS - ONTARIO MATERIALS & RESEARCH DIVISION		RECORD OF BOREHOLE NO. 1B		FOUNDATION SECTION
JOB <u>63-F-85</u>	LOCATION <u>Hwy. 400, 53' Rt. Sta. 54+30.5</u>	ORIGINATED BY <u>B.K.</u>		
W.P. _____	BORING DATE <u>Aug. 12, 1963.</u>	COMPILED BY <u>B.K.</u>		
DATUM <u>420.4</u>	BOREHOLE TYPE <u>Washboring.</u>	CHECKED BY <u>M.D.</u>		

ELEV. DEPTH	SOIL PROFILE DESCRIPTION	STRAT. PLT	SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT	SHEAR STRENGTH P.S.F. ○ Triaxial ● Unconfined Compression + Field Vane	LIQUID LIMIT — WL PLASTIC LIMIT — WP WATER CONTENT — W WD — W — WL WATER CONTENT % 10 20 30	BULK DENSITY P.C.F.	REMARKS
			NUMBER	TYPE	BLOWS / FOOT						
420.4	Groundlevel					420					
0	Fill Mat'l (Mxt. of sand and gravel).										
416.4	Grey-brown clayey silt with traces of sand (Glacial Till).										WL 417.4 3'
4			1	TW	P					129.5	0'-0 0'-35
			2	TW	H					129.5	0'-0 0'-35
			3	TW	H	410	3790			125.0	
			4	TW	P					125.0	
			5	TW	P					127.0	
			6	TW	P						
								+ 1.5			
			7	TW	P					125.0	
								4.5 +			
			8	TW	P	400				122.0	
								+ 2.6			
			9	TW	P						
								+ 2.6			
395.4	Firm to very stiff.										
25	End of borehole.										
						390					

JOB 63-F-85

LOCATION Hwy. 400, 81' Rt. Sta. 54+25

ORIGINATED BY B.K.

W.D.

BORING DATE Aug. 15, 1963.

COMPILED BY B.K.

DATUM 435.5

BOREHOLE TYPE Washboring.

CHECKED BY M.D.

SOIL PROFILE		SAMPLES			ELEV SCALE	DYNAMIC PENETRATION RESISTANCE		LIQUID LIMIT — WL PLASTIC LIMIT — WP WATER CONTENT — W		BULK DENSITY PCF	REMARKS
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE		BLOWS / FOOT	SHEAR STRENGTH P.S.F.	WATER CONTENT % 10 20 30			
435.5	Groundlevel										
0	Fill Mat'l (Brown to grey clayey silt with fine to coarse sand).		1	SS	5	430					WLA30.5 5
			2	SS	12						
			3	SS	27						
			4	SS	28						
			5	SS	8						
			6	SS	6						
			7	SS	6						
			8	SS	8						
			9	SS	10						
417.7	Firm to very stiff.		10	SS	18	420					Gr 0% Si 77% Sa 4% Cl 19%
17.8	Grey clayey silt to silty clay (Glacial till).		11	SS	21						Gr 0% Si 71% Sa 3% Cl 26%
			12	SS	24						
			13	SS	22						
			14	SS	23						
			15	SS	21						
408.5	Very stiff.		16	SS	19						
27.0	End of borehole.		17	SS	20						

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & RESEARCH DIVISION

RECORD OF BOREHOLE NO. 20

FOUNDATION SECTION

JOB 63-F-85

LOCATION Hwy. 400, 81' Rt. Sta. 54+25

ORIGINATED BY B.K.

W P

BORING DATE Aug. 15, 1963.

COMPILED BY B.K.

DATUM 435.5

BOREHOLE TYPE Washboring.

CHECKED BY M.D.

SOIL PROFILE		SAMPLES		DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT		LIQUID LIMIT — WL PLASTIC LIMIT — WP WATER CONTENT — W		BULK DENSITY P C F.	REMARKS	
ELEV. DEPTH	DESCRIPTION	STRAT. PLT	NUMBER TYPE	BLOWS / FOOT	ELEV. SCALE	SHEAR STRENGTH P.S.F. ○ Unconfined Comp. ● Triaxial				
435.5	Groundlevel					500 1000 1500 2000 2500	10 20 30			
0	Fill Mat'l (Brown to grey clayey silt with fine to coarse sand).				430				WL 430.5 5'	
			1 TW P				3155 ○	○ ———	130.6	e=.38 Sr=94.8 G=2.75
			2 TW P				3360 ○ 5700 ●	○ ———	139.0	
			3 TW P				○	○ ———	133.8	e=.46 Sr=99.0 G=2.73
			4 TW P					○ ———		
			5 TW P					○		
			6 TW P					○		
			7 TW P		420	○		○ ———	129.7	Gr3% Si 22% Sa21% Cl44% e=.56 Sr=96.1 G=2.75
			8 TW P					○ ———		e=.58 Sr=100% G=2.71
			9 TW P					○		e=.56 Sr=98.5 G=2.72
417.0	Firm to very stiff.		10 TW P				○ ———			
18.5	End of borehole.									

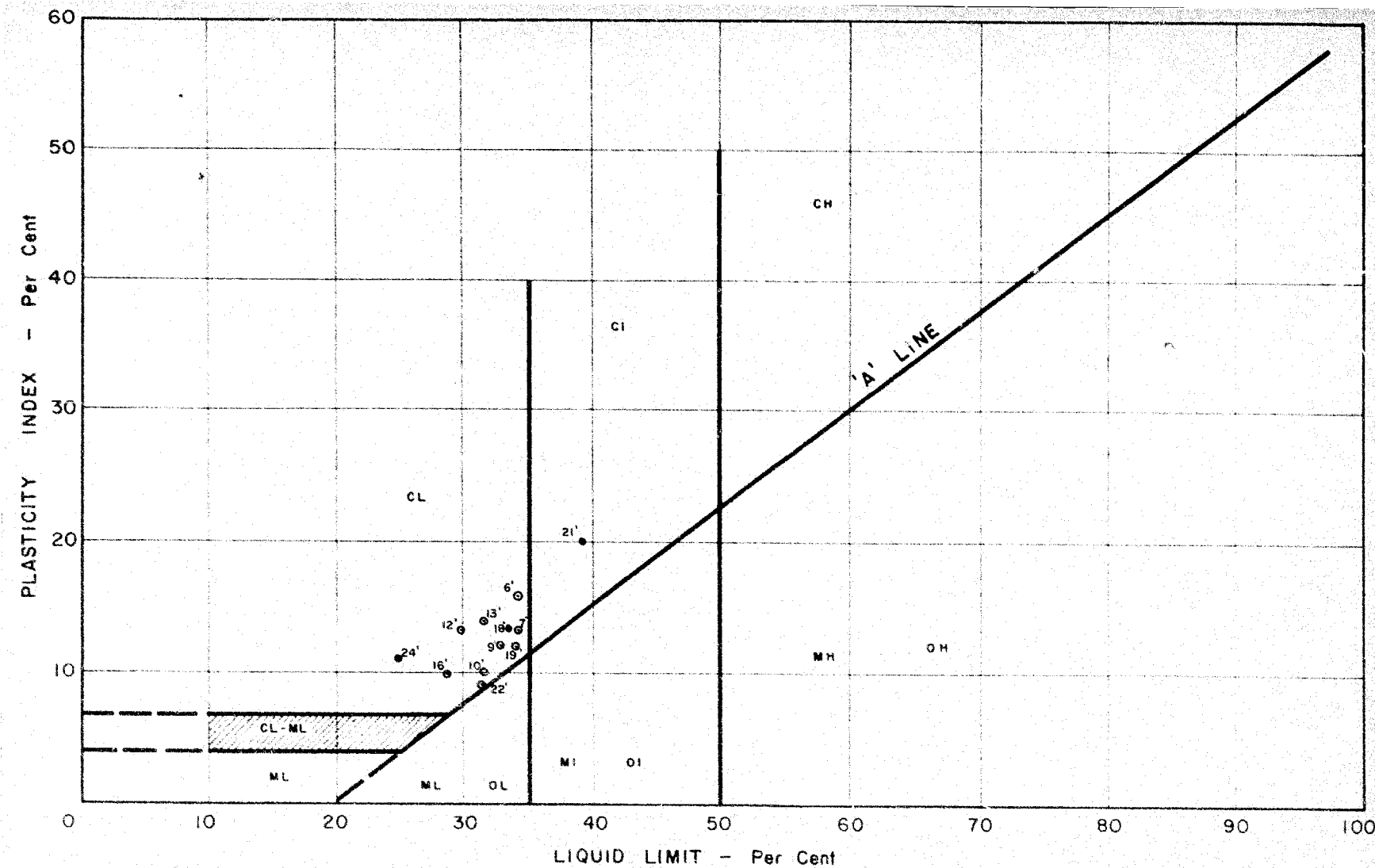
DEPARTMENT OF HIGHWAYS - ONTARIO MATERIALS & RESEARCH DIVISION		RECORD OF BOREHOLE NO. 3		FOUNDATION SECTION	
JOB <u>63-F-85</u>		LOCATION <u>Hwy. 400, 60' Rt. Sta. 54+25</u>		ORIGINATED BY <u>B.K.</u>	
W.P. _____		BORING DATE <u>AUG. 19, 1963.</u>		COMPILED BY <u>B.K.</u>	
DATUM <u>428.1</u>		BOREHOLE TYPE <u>Washboring.</u>		CHECKED BY <u>M.D.</u>	

SOIL PROFILE		SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE		LIQUID LIMIT — WL		BULK DENSITY	REMARKS	
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE		BLOWS / FOOT	SHEAR STRENGTH P.S.F.	PLASTIC LIMIT — WP	WATER CONTENT — W			P.C.F.
428.1	Groundlevel				430	500 1000 1500 2000 2500						
0	Fill Mat'l (Brown to grey clayey silt with fine to coarse sand).		1	SS	6							
			2	SS	20							
			3	SS	10							
			3A	TW	H							
			7	OS	P	420						
			8	OS	P							
			9	TW	H							
			10	TW	H							
415.6		Firm to very stiff.										
12.5		End of borehole.										
					410							

W.L. 425.6
2.5

130.8

DEPARTMENT OF HIGHWAYS - ONTARIO MATERIALS & RESEARCH DIVISION			RECORD OF BOREHOLE NO. 4				FOUNDATION SECTION			
JOB <u>63-F-85</u>		LOCATION <u>Hwy. 400 67' Lt. Sta. 52+07</u>		ORIGINATED BY <u>B.K.</u>						
W.P. _____		BORING DATE <u>Aug. 21, 1963.</u>		COMPILED BY <u>B.K.</u>						
DATUM <u>431.5</u>		BOREHOLE TYPE <u>Washboring</u>		CHECKED BY <u>M.D.</u>						
SOIL PROFILE		SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT	LIQUID LIMIT — WL PLASTIC LIMIT — WP WATER CONTENT — W WD — W — WL WATER CONTENT % 10 20 30	BULK DENSITY P.C.F.	REMARKS	
ELEV. DEPTH	DESCRIPTION	STRAT. PLT	NUMBER	TYPE						BLOWS / FOOT
431.5	Groundlevel									
0.0	Fill mat'l (mixt. of sand and gravel) Loose to compact.	0.0	1	SS	4	430				
		0.0	2	SS	11					
		0.0	3	SS	15				Gr2% Sa90%	
		0.0	4	SS	7				Cl & Si 8%	
		0.0	5	SS	6				Gr4% Sa83%	
		0.0	6	SS	4				Si & Cl 13%	
		0.0	7	SS	5					
		0.0	8	SS	12	420				
418.3		0.0	9	SS	7				WL 419.0 12.5	
13.2	Grey-brown clayey silt with traces of sand (Glacial Till) Stiff to very stiff.		10	TW	18					
			11	TW	23		3645		130.8	Gr 0% Sa2%
			12	TW	17				128.1	Si68% Cl30%
			13	TW	10					
			14	TW	9					
			15	TW	15	410			126.9	
			16	TW	10				124.5	
			17	TW	9					
406.0										
25.5	End of borehole.									
						400				



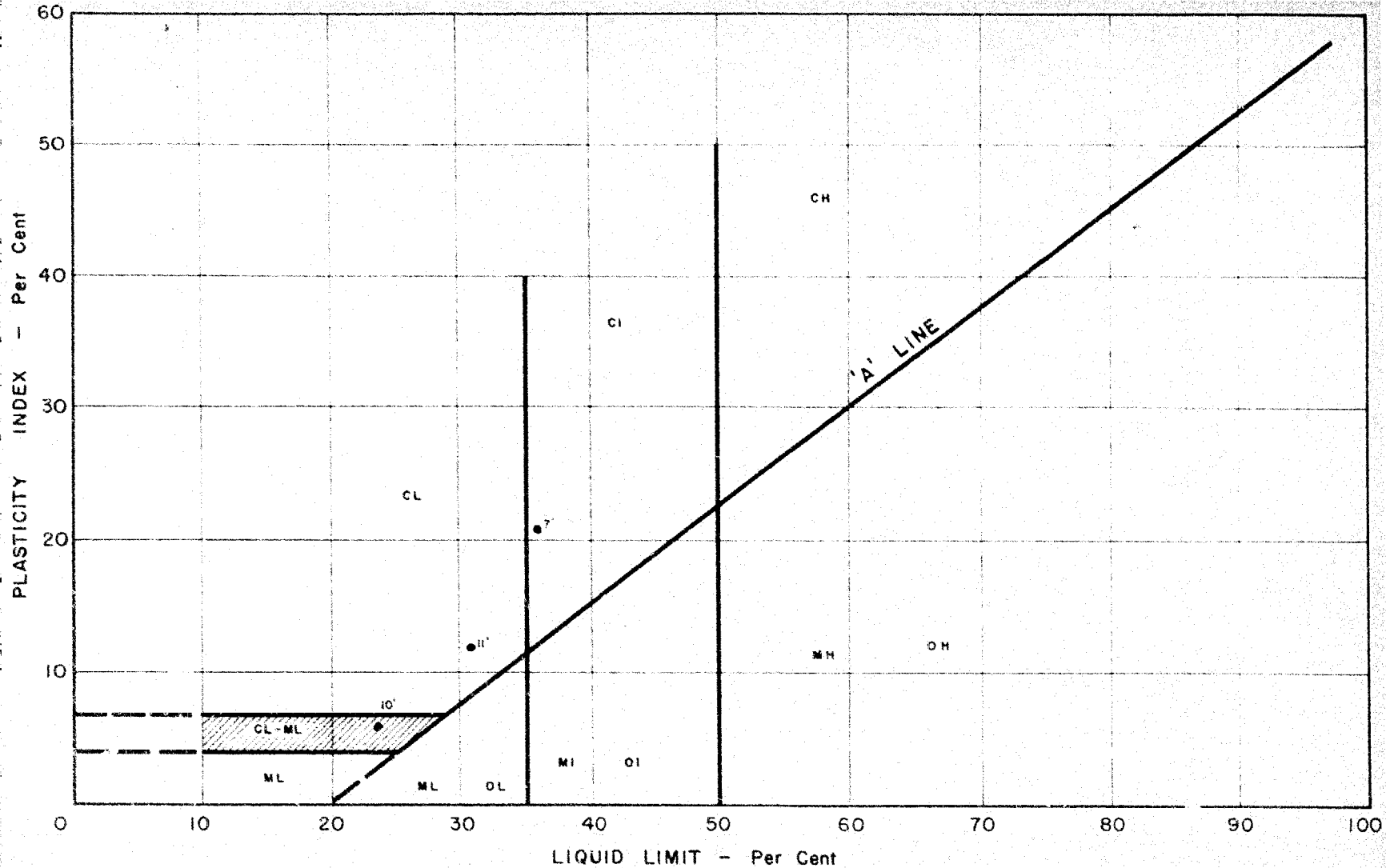
NOTES

- - BH 1A
- ◊ - BH 1B

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & RESEARCH DIVISION
PLASTICITY CHART

Job No. 63-F-85 W.P. No.

Location HWY. 400 & HWY 401



NOTES * - BH. 3

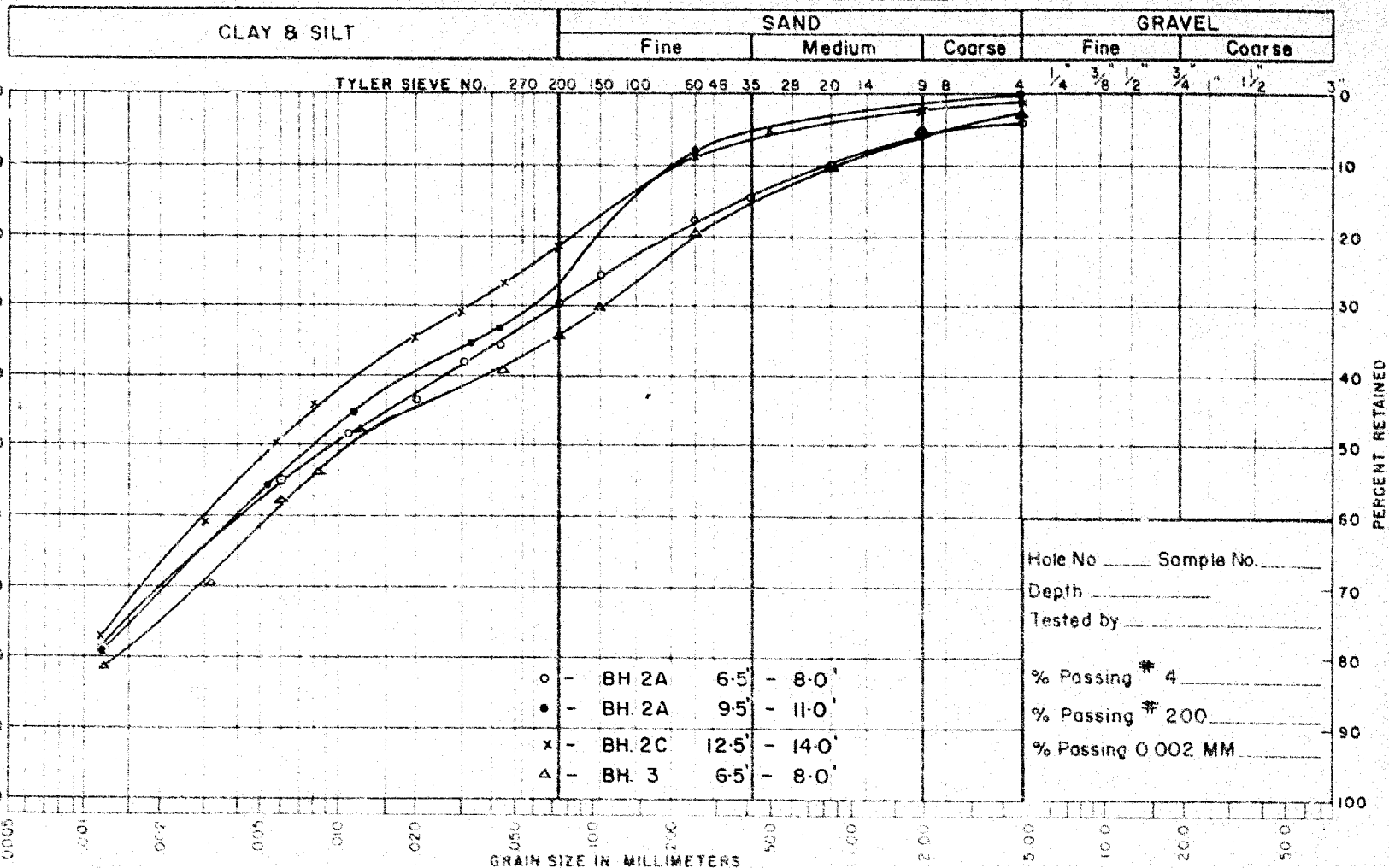
DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & RESEARCH DIVISION
PLASTICITY CHART

Job No. 63-F-85

W.P. No.

Location HWY. 400 & HWY. 401

UNIFIED SOIL CLASSIFICATION SYSTEM



NOTES FILL MATERIAL (Brown to Grey CLAYEY SILT with fine to co. Sand)

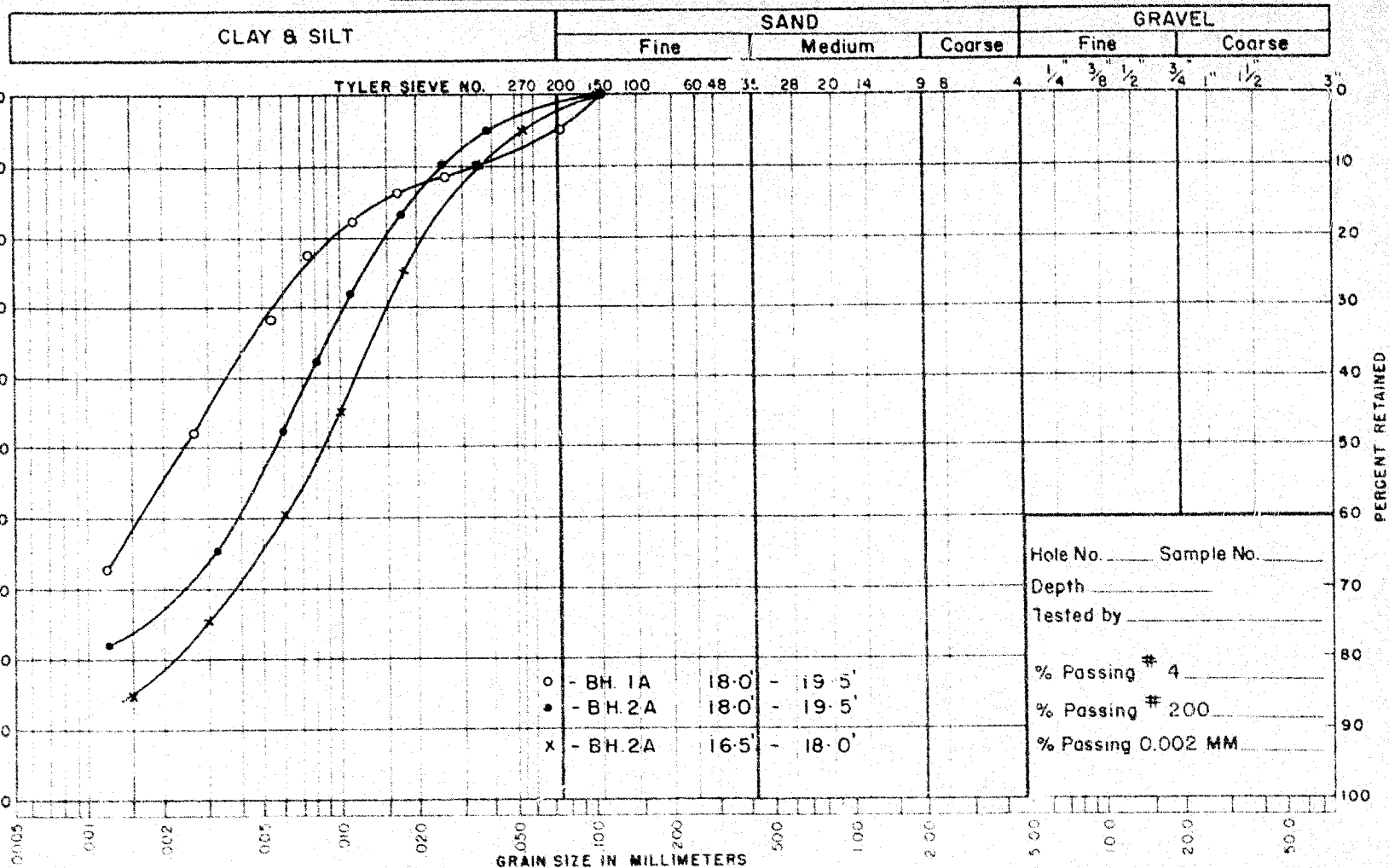
DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & RESEARCH SECTION
GRAIN SIZE DISTRIBUTION

Job No. 63-F-85

W.P. No. _____

Location HWY. 400 & HWY. 401

UNIFIED SOIL CLASSIFICATION SYSTEM



NOTES GREY BROWN CLAYEY SILT with traces of Sand. (GLACIAL TILL)

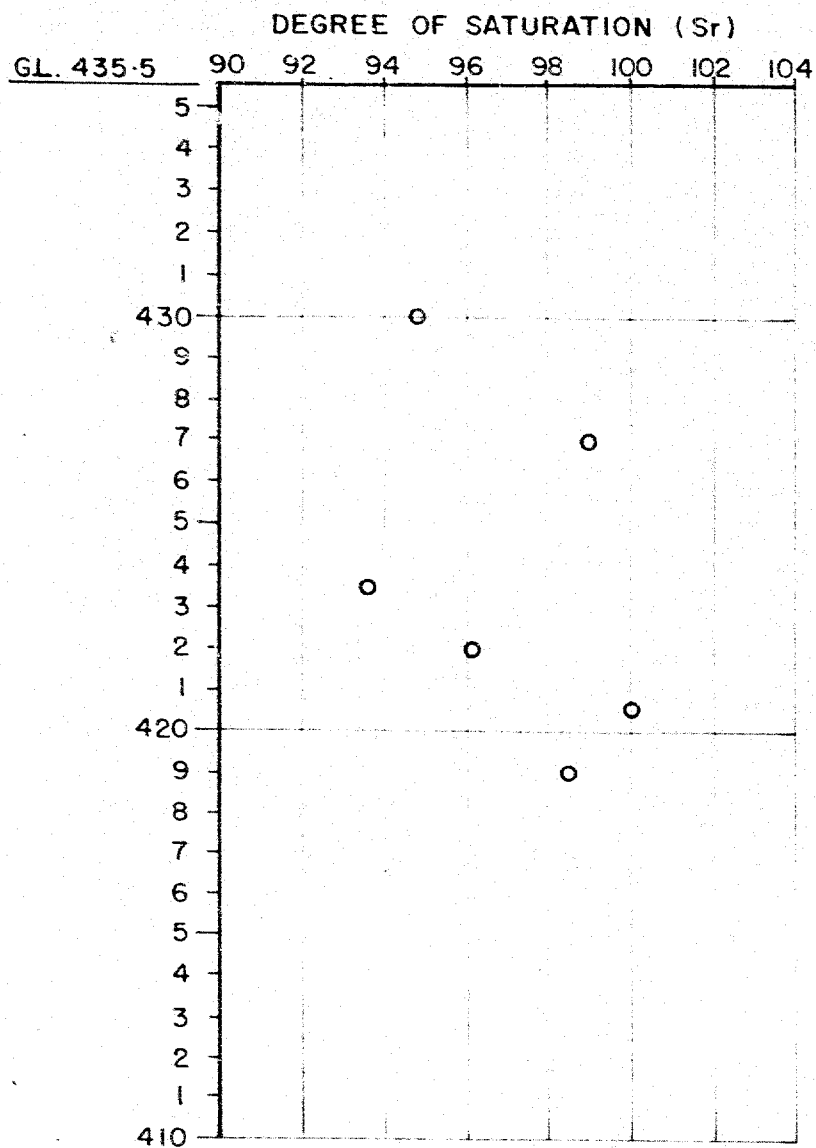
DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & RESEARCH SECTION
GRAIN SIZE DISTRIBUTION

Job No. 63-F-85 W.P. No. _____

Location HWY. 400 & HWY. 401

BOREHOLE NO.2

63-F-85

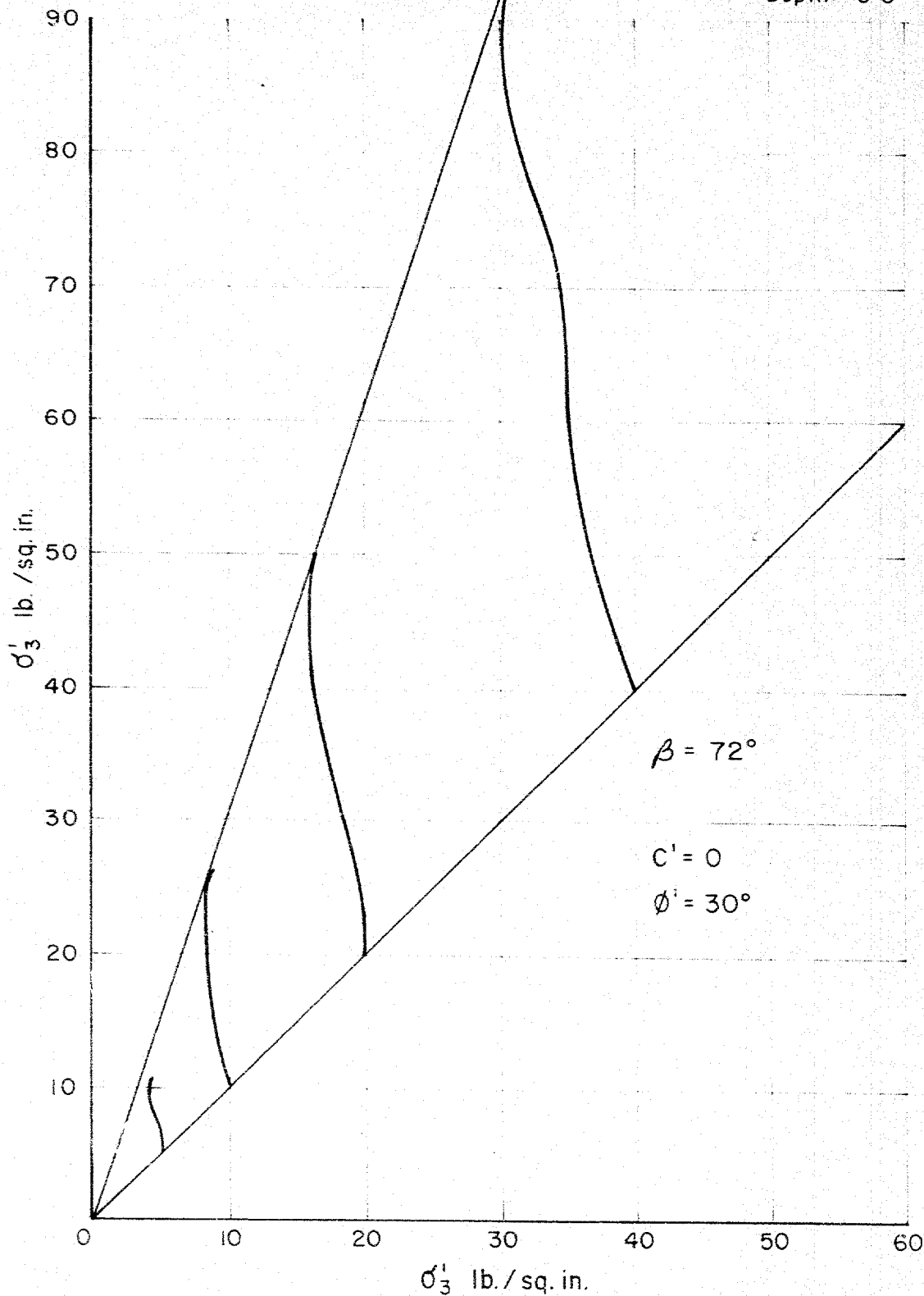


BOREHOLE NO. 2B

63-F-85

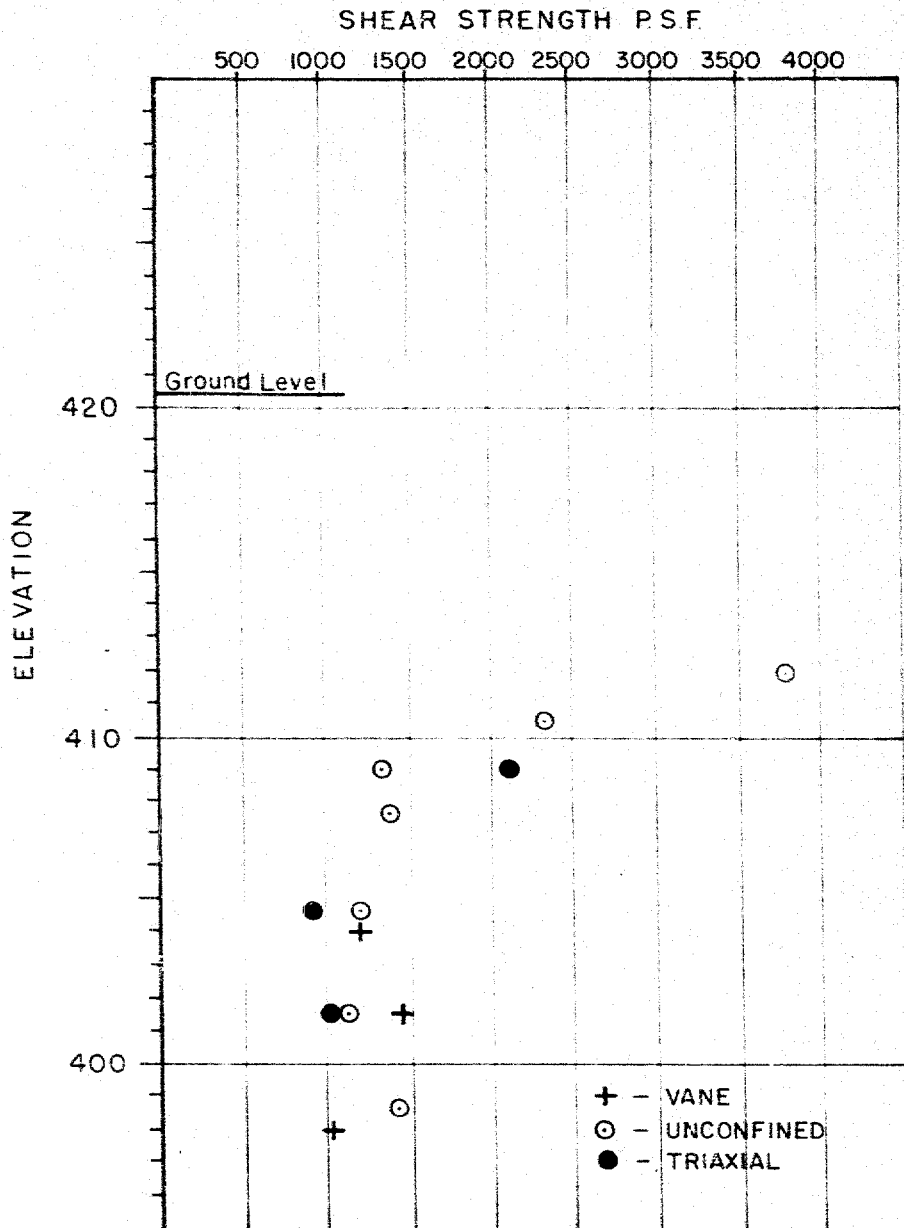
Sample No. 1

Depth - 6.5'



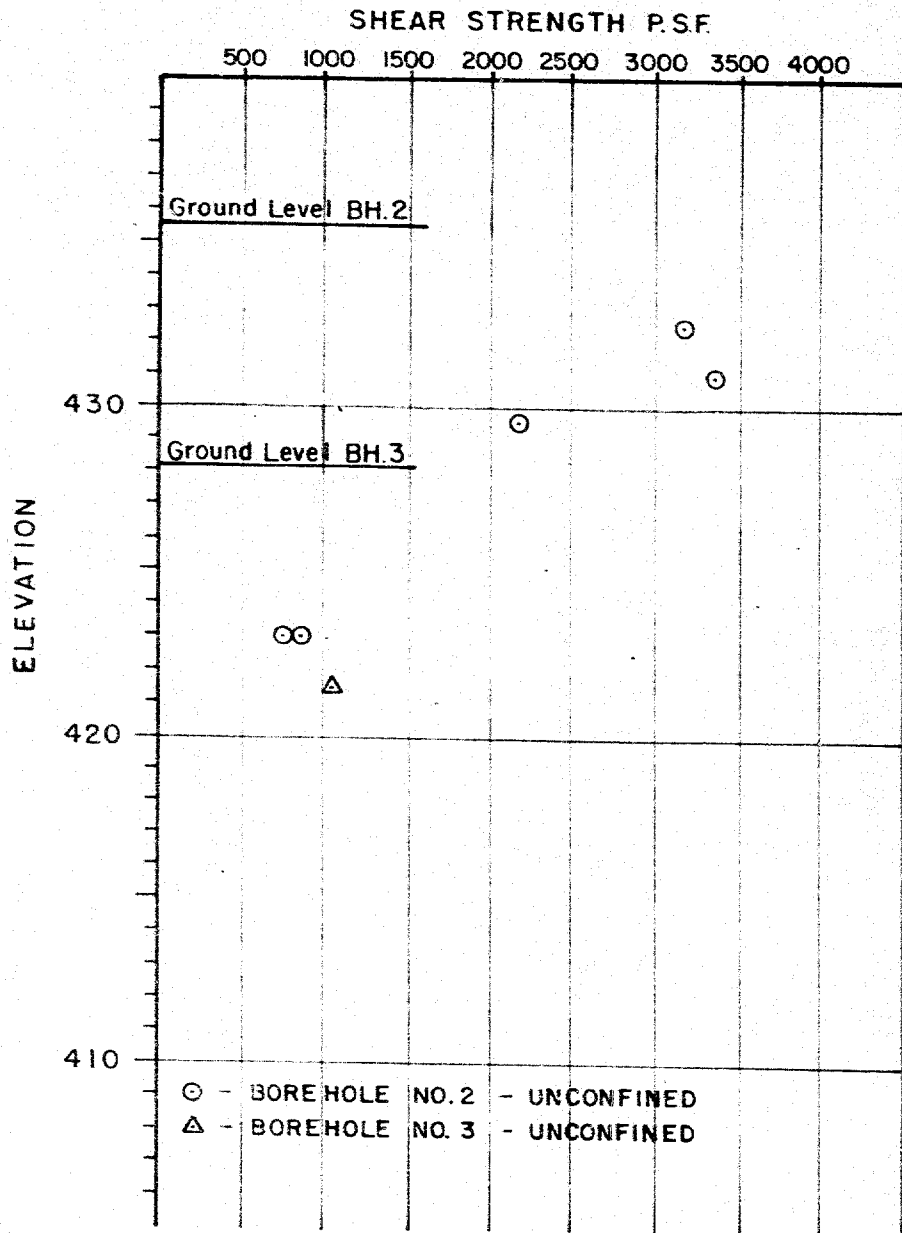
BOREHOLE NO. 1

63-F-85

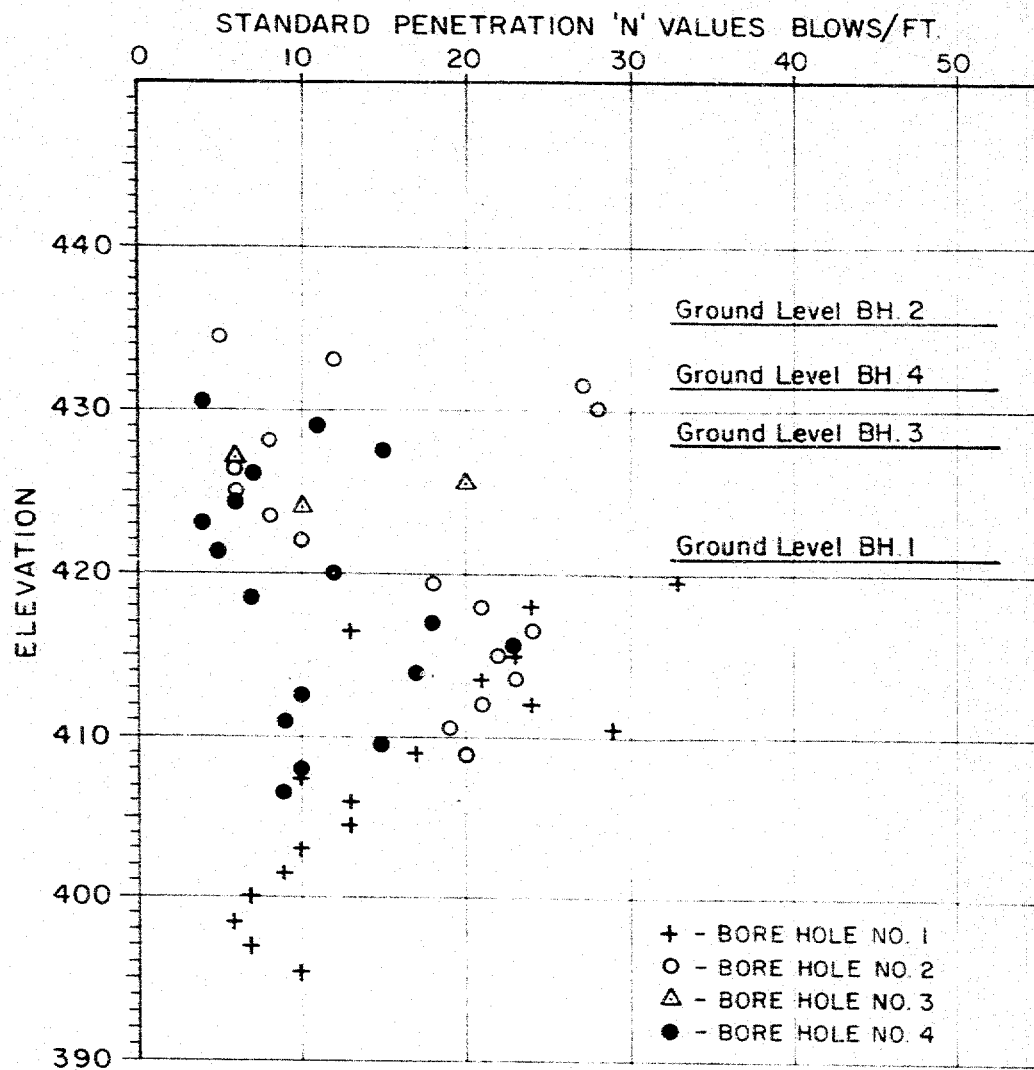


BOREHOLES NO. 2 & 3

63-F-85



BOREHOLES NO. 1, 2, 3 & 4
63-F-85

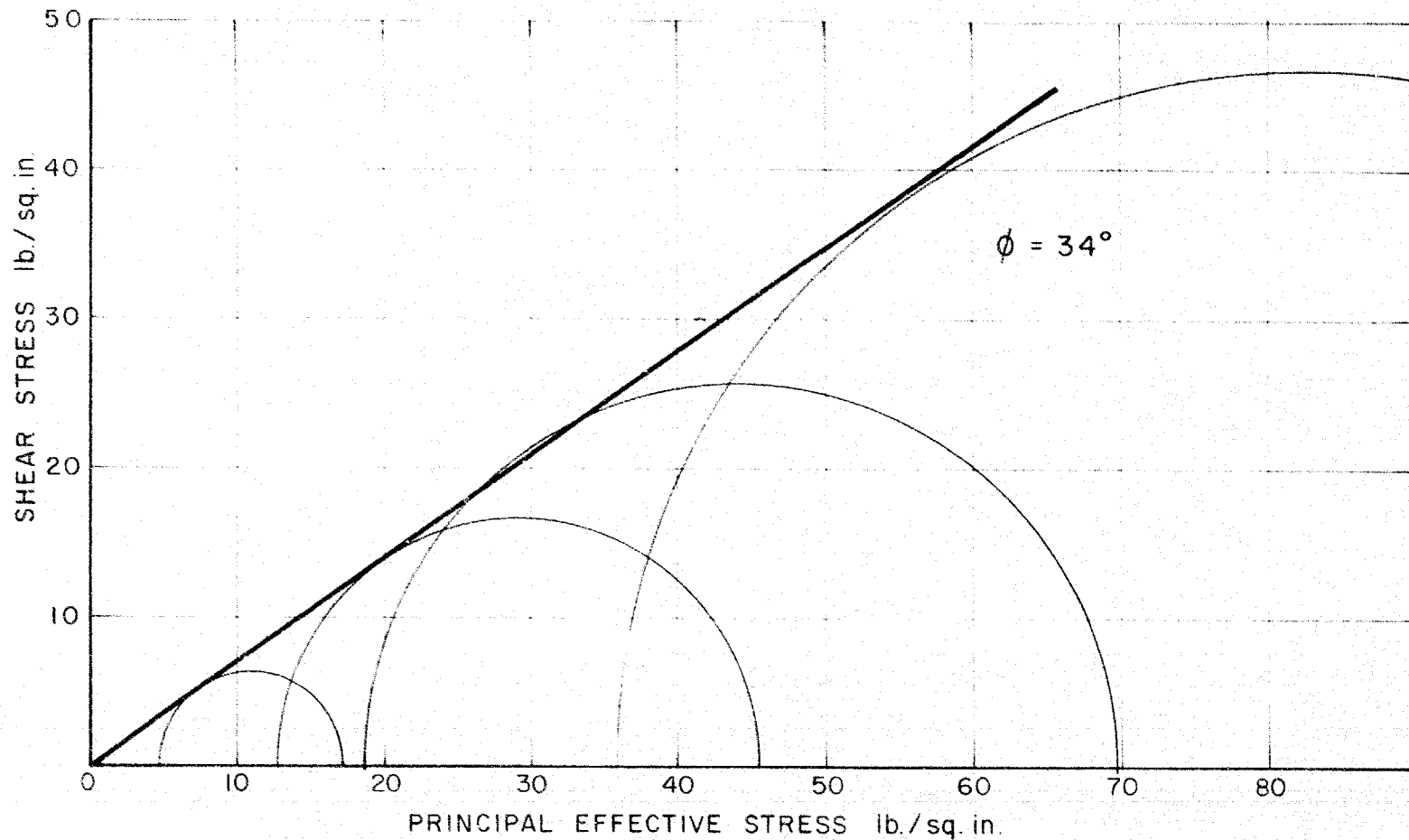


BOREHOLE NO. 1B

63-F-85

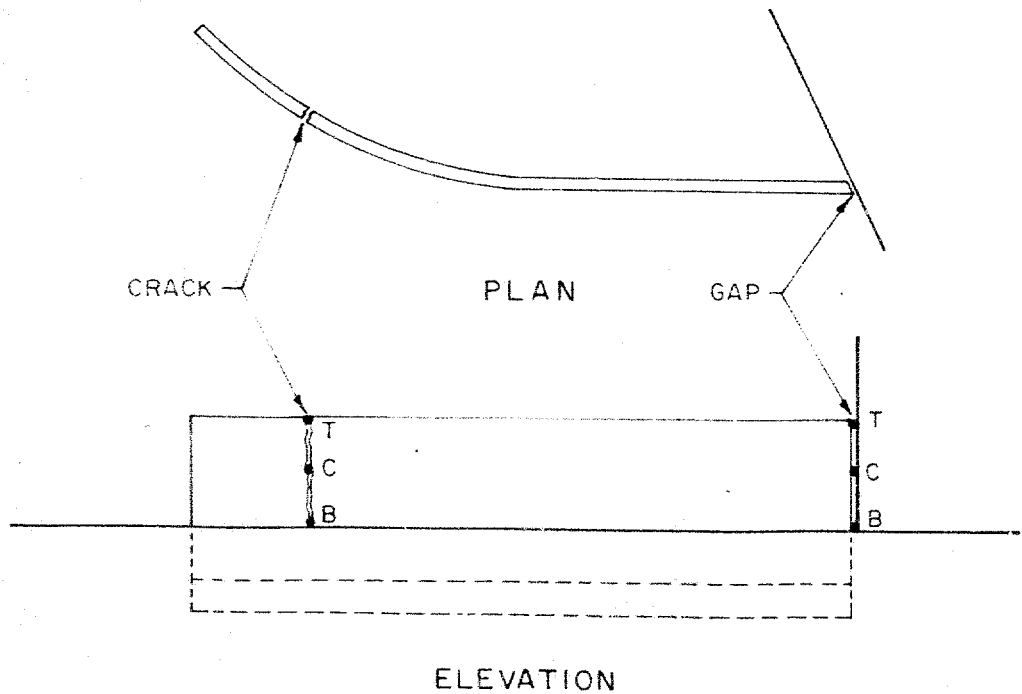
Sample No. 2 & 3

Depth - 7.5' - 9.5'



RETAINING WALL MOVEMENT

63-F-85



CRACK						
DATE	WIDTH			OUTWARD MOVEMENT		
	T	C	B	T	C	B
16 AUG. 63	1.937"	1.250"	0.812"	0.187"	0.125"	0.125"
23 AUG. 63	2.000"	1.250"	0.812"	0.187"	0.125"	0.125"
10 OCT. 63	2.000"	1.250"	0.800"	0.187"	0.125"	0.125"
4 DEC. 63	4.450"	3.500"	2.500"	0.250"	0.250"	0.125"
GAP						
16 AUG. 63	2.375"	2.000"	1.500"	5.125"	4.250"	3.250"
23 AUG. 63	2.500"	1.937"	1.500"	5.125"	4.250"	3.250"
10 OCT. 63	2.500"	1.937"	1.500"	5.000"	4.200"	3.000"
4 DEC. 63	4.125"	2.437"	2.000"	9.500"	8.000"	5.500"

PHOTOS



PHOTO NO. 1

View along Bridge Abutment showing lateral displacement of Retaining Wall.

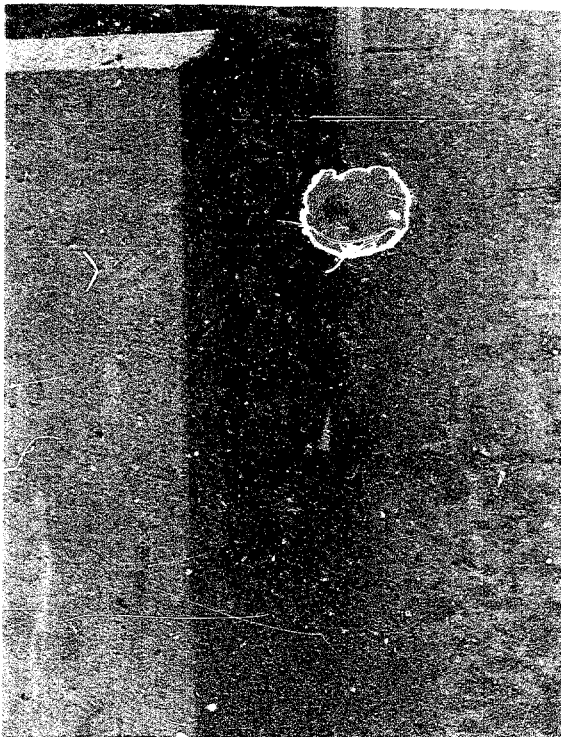


PHOTO NO. 2

View of separation between Abutment and Retaining Wall.

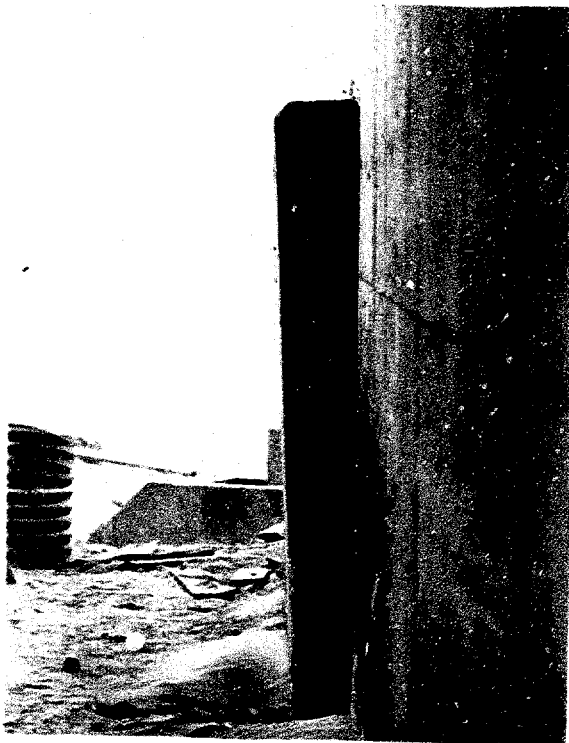


PHOTO NO. 1

View along Bridge Abutment showing lateral displacement of Retaining Wall.

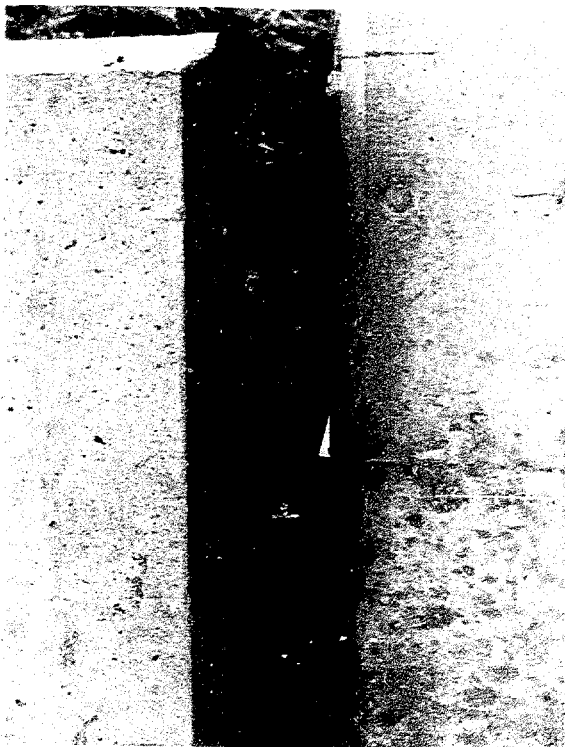


PHOTO NO. 2

View of separation between Abutment and Retaining Wall.



PHOTO NO. 3

Crack in Face of Retaining Wall.



PHOTO NO. 2

Crack in Face of Retaining Wall.

TO: Mr. A. Stermac,
Principal Foundations
Engineer,
Room 107, Lab. Bldg.

FROM: C. S. Grebski

DATE: August 2, 1963.

OUR FILE REF.

IN REPLY TO

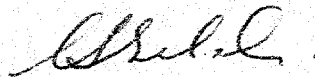
SUBJECT: Retaining Wall Movement at
Intersection of Hwys. 400 and 401,
District #6

Enclosed is one print D-3063-1, as you requested by phone.

As discussed, we would like to have an investigation of the S.E. retaining wall, which has been slowly moving forward over the last three years. No movement was noticed prior to this. We would like you to tell us why the wall is moving.

This structure is to be demolished under Contract 63-216, which is now out for tender.

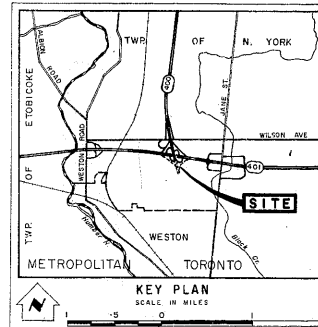
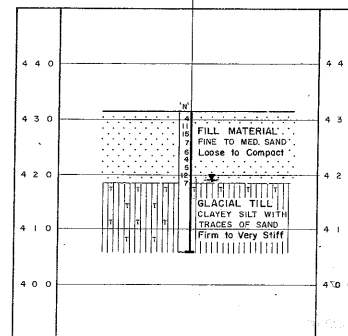
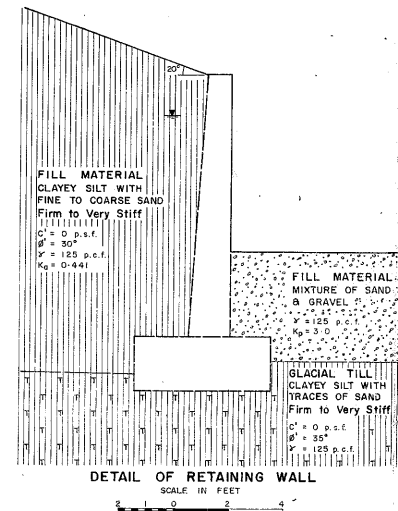
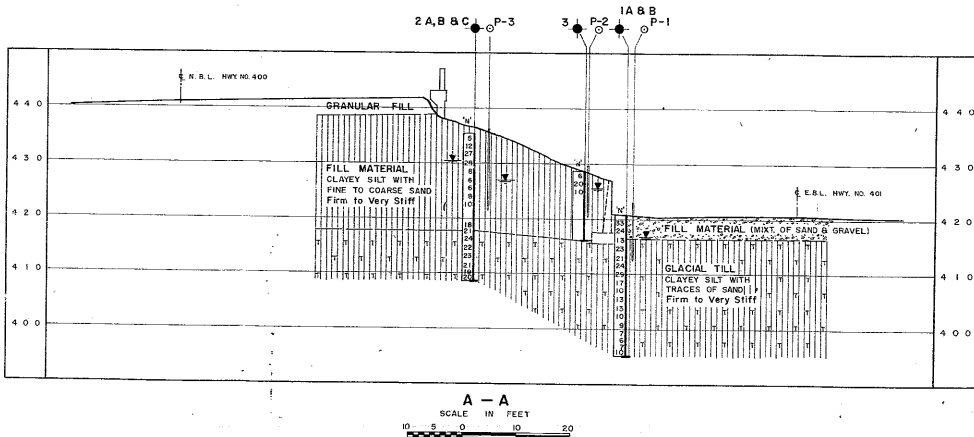
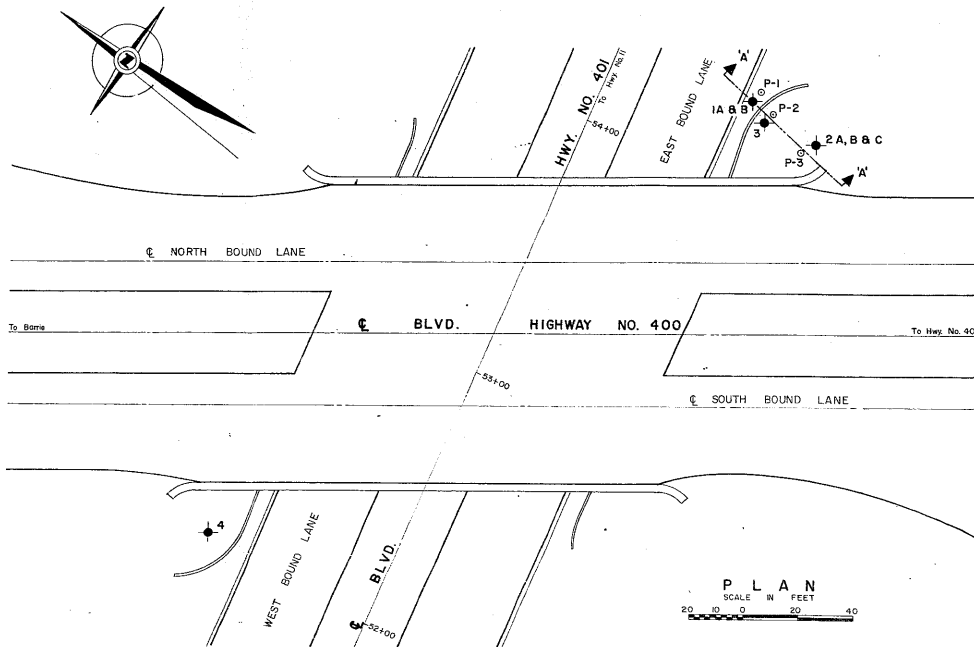
CSG:ah



C. S. Grebski,
for B. Davis,
Bridge Design Engineer.

OK (Photo) Friday 9.8.63

#63-F-B5
W.P. #233-60
S.E. RET. WALL
OF HWY. #401 &
400, OVERPASS



LEGEND				
	Bore Hole 1			
	Cone Penetration Hole			
	Bore & Cone Penetration Hole			
	Water Levels established at time of field investigation (Oct. 1963)			
	Piezometer			
NO.	ELEVATION	STATION	OFFSE ¹	
IA & B	4 2 0 . 35	54+30.5	53' RT.	
2A & B & C	4 35 . 46	54+25	81' RT.	
3	4 26 . 14	54+25	60' RT.	
4	4 31 . 46	52+07	67' LT.	
TYP. ELEV.				
P-1	4 12 . 35	54+35	54.5 RT.	
P-2	4 20 . 14	54+29	62' RT.	
P-3	4 21 . 46	54+20.5	77' RT.	

NOTE
The boundaries between soil strata have been established only of Bore Hole locations. Between Bore Holes the boundaries are assumed from geological evidence and may be subject to considerable error.

REVISION	DATE	BY	DESCRIPTION

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & RESEARCH DIVISION - FOUNDATION SECTION

RETAINING WALL INVESTIGATION

KING'S HIGHWAY NO. 400 & 401 DIST. NO. 6
CO. YORK M. TO ONT. METROPOLITAN TORONTO
TWP. NORTH YORK LOT CON.

SHOWING BORE HOLE & PIEZOMETER LOCATIONS

SUB'D M. D. CHECKED h/j W.P. NO. 233-60 M.S.R. DRAWING NO.
DRAWN D. M. CHECKED h/j JOB NO. 63-F-85
DATE 29 NOV. 1963 SITE NO. BRIDGE DRAWING NO.
APPROVED A. B. Brown CONT. NO. **63-F-85 A**
PRINCIPAL CONSULTING ENGINEER