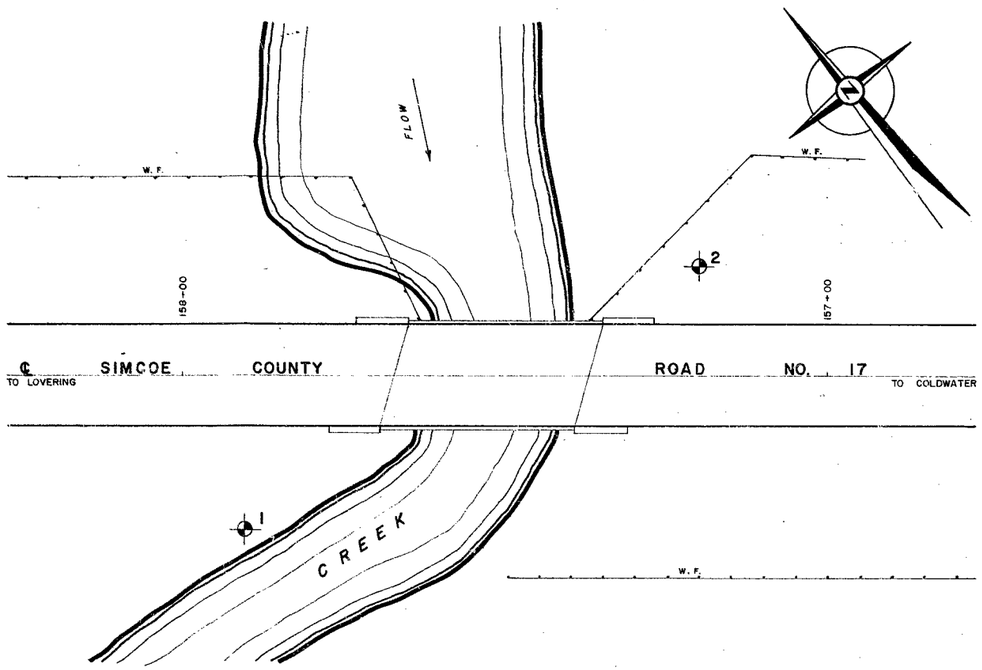
62-F-77

COUNTY ROAD #17

SIMCOE BRIDGE

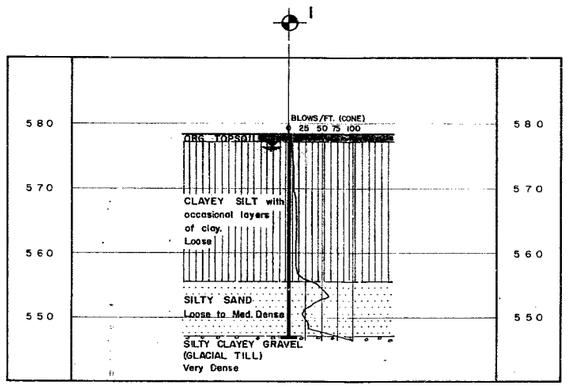
SITE #3



PLAN

SCALE IN FEET

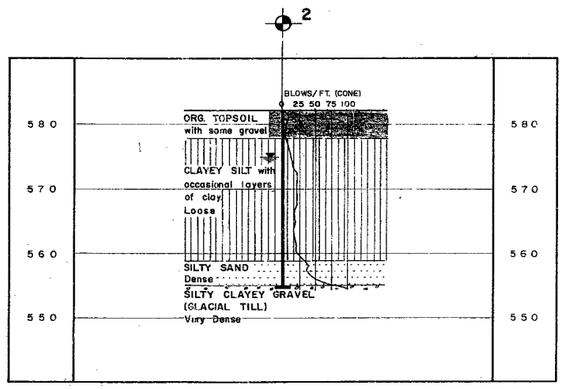
10 5 0 10 20



B. H. NO. 1

SCALE IN FEET

10 5 0 10 20



B. H. NO. 2

SCALE IN FEET

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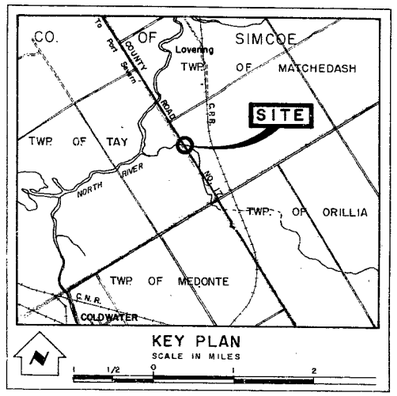


KEY PLAN

SCALE IN MILES

1 1/2 0 1 2

LEGEND

- Bore Hole
- Cone Penetration Hole
- Bore & Cone Penetration Hole
- Water Levels established at time of field investigation

NO.	ELEVATION	STATION	OFFSET
1	578.5	157+90	24' LT.
2	582.4	157+20	17' RT.

- NOTE -

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

DEPARTMENT OF HIGHWAYS - ONTARIO

MATERIALS & RESEARCH SECTION

SIMCOE COUNTY ROAD NO. 17

BRIDGE SITE NO. 3

STATION 157+52

ORIGINATED W. KUI-MATICKAS	DISTRICT NO. 11	DATE 23 JULY 1962
DRAWN D. MUNFORD	W.P. NO.	JOB NO. 62 - F - 77
CHECKED	CONTRACT NO.	DRAWING NO. 62 - F - 77A
APPROVED R. L. Bell		

28-6.

Mr. A. M. Toye,
Bridge Engineer.
Materials & Research Division,
(Foundation Section)

July 24, 1962.

D.H.O. FOUNDATION INVESTIGATION REPORT.
W.J. 62-F-77 -- W.P. (Nil).
Municipal Job.

Attention: Mr. K. L. Kleinsteiber,
Municipal Bridge Liaison Engr.

Re: Proposed New Bridge - (Bridge Site No. 3) -
on Simcoe County Rd. No. 17 - Chainage 157+52,
District No. 6.

Attached, we are forwarding to you, our detailed foundation investigation report on the subsoil conditions existing at the above structure site.

We believe you will find the factual data and recommendations contained therein, adequate for your future design work. Should further information be required, please do not hesitate to contact our Office.

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

KYL/MdeF
Attach.

cc: Messrs. A. M. Toye (3)
J. P. Howard
L. E. Clark
J. C. Tillcock
T. J. Kovich
McCormick & Rankin, Ltd.
A. Watt

Foundations Office
Gen. Files.

TABLE OF CONTENTS

FOUNDATION INVESTIGATION

For

Proposed New Bridge - (Bridge Site No. 3) -
on Simcoe County Rd. No. 17, at Chainage 157+52,
District No. 6,
W.J. 62-F-77 -- W.P. (Nil)

1. INTRODUCTION:

A request for a bridge foundation investigation on the Simcoe County Road No. 17 at chainage 157+52 was received from the Toronto Regional Soils Engineer, Mr. T. J. Kovich, dated May 9, 1962.

It is proposed to erect a new bridge to carry Simcoe County Road No. 17 over a creek. The site of the proposed bridge is located in the Township of Tay.

In order to determine the soil properties and decide on the type of foundations, an investigation was carried out by this Section. Results and the discussion of the field and laboratory investigations, as well as conclusions and recommendations for the future design work, are contained in the following paragraphs of this report.

2. DESCRIPTION OF SITE:

The area in which the structure is located is generally flat terrain.

Physiographically, the site is located in the so-called Simcoe Uplands.

cont'd. /2 ...

3. FIELD AND LABORATORY WORK:

In order to obtain sufficient information on the type and properties of the subsoil, two sampled boreholes, and two dynamic cone penetration tests, were carried out at this site.

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

1. Natural Moisture Content
2. Grain Size Distribution
3. Liquid Limits
4. Plastic Limits
5. Undrained Shear Strength
6. Consolidation Curves

4. SUBSOIL CONDITIONS:

4.1) General:

The stratigraphy of the soil at the site was found to be generally uniform. A detailed description of various soil types encountered during the investigation, is shown in Appendix I of this report, and is also given in subsequent paragraphs. The estimated stratigraphical profile shown on Dwg. No. 62-F-77A is based upon this information.

4.2) Soft Clayey Silt with Occasional Layers of Clay:

This stratum, which extends to approx. El. 555.0 for a depth of about 20'-0" to 22'-0", was found below the topsoil. It may be classified as loose with an average "N" value of 3 blows/foot.

cont'd. /3

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

4.2) Soft Clayey Silt with Occasional Layers of Clay: (cont'd.)

A layer of clay was encountered at 7'-0" below ground elevation in B.H. #1 and at approx. 4'-6" below ground level in B.H. #2. The percentage of silt in this layer is 49%, clay 48% and the rest of 3% is formed by sand. To determine the shear strength of the clay stratum, undrained triaxial compression tests were carried out. The shear strengths obtained in the laboratory gave an average value of about 1500 p.s.f. The field vane tests carried out in the clayey silt layers gave an average value of about 600 p.s.f.

4.3) Loose to Med. Dense Silty Sand:

This stratum which extends to approx. El. 547.0 for a depth of about 7'-0" to 8'-0", may be classified as loose to med. dense, with an average "N" value of 18 blows/foot.

The percentage of sand in this layer is 51%, silt forms 46% and the rest of 3% is gravel.

4.4) Very Dense Silty Clayey Gravel (Glacial Till):

Following the stratum of loose to med. dense silty sand is a layer of very dense silty clayey gravel (glacial till). The overall stratum is in a very dense state with an average "N" value in excess of 170 blows/foot.

cont'd. /4 ...

5. GROUND WATER CONDITIONS:

The ground water level, at the time of the investigation, was found at El. 576.5 in B.H. #1 and at El. 575.0 in B.H. #2.

No artesian water conditions were encountered.

6. DISCUSSION AND RECOMMENDATIONS:

As can be seen from the previously described soil stratigraphy, the soil consists of soft clayey silt with occasional layers of clay, underlain by loose to med. dense silty sand, followed by very dense silty, clayey gravel (glacial till). The upper layers cannot provide adequate support for spread footings. The future structure should be supported on piles. End bearing timber piles are recommended. For timber piles (treated if not completely below the lowest established water table), a design load of 20 tons per pile may be used. It is estimated that the piles should reach practical refusal at or below El. 547.0 on the west shore and at El. 555.0 on the east shore, within one or two feet. A dewatering scheme will be necessary as excavations will be carried out below creek or ground water table levels. The bottom of the footing should be placed 5'-0" below creek bed to provide sufficient cover for frost protection and should be at approx. Elev. 571.0.

Footings for falsework may be placed on the surface of the loose clayey silt. A safe load of 0.5 tons per sq. ft. may be employed.

cont'd. /5 ...

7. SUMMARY:

(1) The stratification of the soil is quite uniform. The relative density of the materials encountered varies from loose to very dense.

(2) Because of the loose density of the upper layers, piled footings are recommended for the structure. End bearing timber piles should be driven down to approx. El. 547.0 on the west shore and down to approx. El. 555.0 on the east shore. The design load for timber piles should be 20 tons/pile.

(3) Bottom of the footings should be at approx. Elev. 571.0 to provide sufficient cover for frost protection.

(4) A dewatering scheme will be necessary as excavations will be carried out below creek or ground water table levels.

(5) Footings for falsework may be placed on the surface of the loose clayey silt. A safe load of 0.5 tons per sq. ft. may be employed.

8. ACKNOWLEDGEMENTS:

The field work, performed on June 29 and 30, 1962, together with the preparation of this report, was undertaken by Mr. W. W. Kulmatickas. The investigation was carried out under the general supervision of Mr. K. G. Selby, who reviewed this report.

July 1962.

APPENDIX I.

FORM 08-ML-126 REV. 1961 OFFICE REPORT ON SOIL EXPLORATION

61-4391

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & RESEARCH DIVISION

RECORD OF BOREHOLE NO. 1

FOUNDATION SECTION

JOB 62-F-77 LOCATION Simcoe County Road No. 17 Bridge at Ch. 157+52 ORIGINATED BY W.W.K.

W.P. Nil BORING DATE July 3, 1962. COMPILED BY H.S.

DATUM 578.5 BOREHOLE TYPE Wash Boring - BX Casing. CHECKED BY W.W.K.

ELEV. / DEPTH	DESCRIPTION	STRAT. PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES BLOWS / FOOT	ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT 20 40 60 80 100 / SHEAR STRENGTH P.S.F. Field Vane Test + 200 400 600 800 1000	LIQUID LIMIT w_L / PLASTIC LIMIT w_P / WATER CONTENT w ; w_P w w_L ; WATER CONTENT % 20 40 60	BULK DENSITY P.C.F.	REMARKS
578.5	Ground Elevation					580.0				
577.3	Organic Topsoil									▽ W.T. El. 576.5 Observed in casing.
1.2	Soft clayey silt with occasional layers of clay.		1	SS	3	570.0				Sand 3% Clay 38% Silt 59%
			2	TW	P		s.o			
			3	SS	4	560.0				
555.5			4	SS	3					
23.0	Loose to medium dense silty sand.		5	SS	7	550.0	For 9"			
547.0										Silt 50% Sand 50%
31.5			6	SS	100 For 1"					
546.9	Very dense silty clayey gravel (Till)									
31.6	End of borehole.					540.0				

FORM 08-ML-126 REV. 1961 OFFICE REPORT ON SOIL EXPLORATION

61-4391

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & RESEARCH DIVISION

RECORD OF BOREHOLE NO. 2

FOUNDATION SECTION

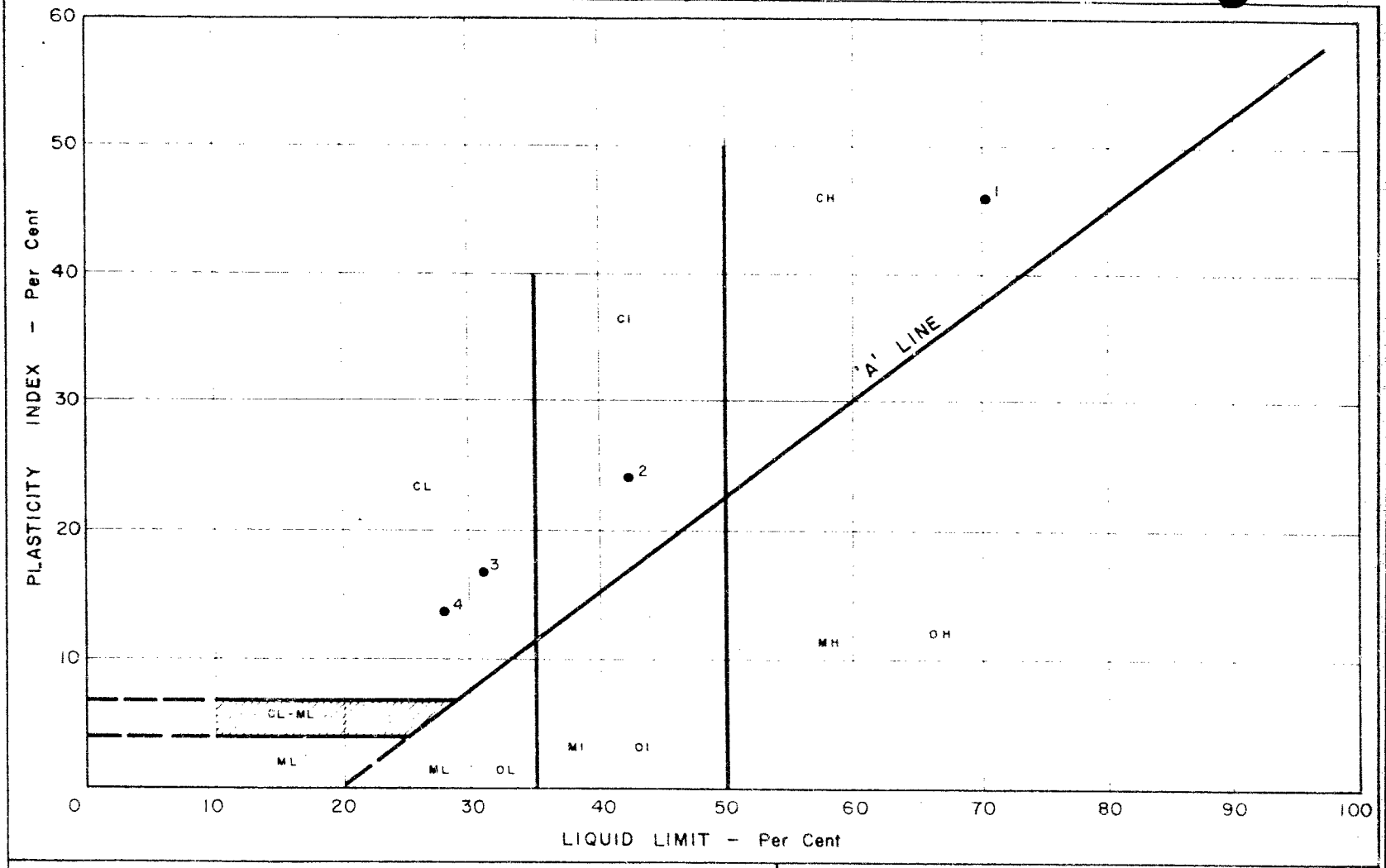
JOB 62-F-77 LOCATION Simcoe County Road No. 17 Bridge at Ch. 157/55 ORIGINATED BY W.W.K.

W.P. Nil BORING DATE July 4, 1962. COMPILED BY H.S.

DATUM 582.4 BOREHOLE TYPE Wash Boring - BX Casing. CHECKED BY W.W.K.

ELEV. / DEPTH	DESCRIPTION	STRAT. PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES BLOWS/FOOT	ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS/FOOT 20 40 60 80 100 / SHEAR STRENGTH P.S.F. Vane Field Test 200 400 600 800 1000	LIQUID LIMIT w_L / PLASTIC LIMIT w_P / WATER CONTENT w — WATER CONTENT % 20 40 60	BULK DENSITY P.C.F.	REMARKS
582.4	Ground Elevation									
0.00 / 578.2	Organic topsoil with some gravel.					580.0				
4.2	Soft clayey silt with occasional layers of clay.		1	SS	9					▽ W.T. El. 575.0 Observed in casing.
			2	TW	3	570.0	26			
			3	TW	P		3.0			Sand 2% Silt 38% Clay 60%
			4	SS	2	560.0				
558.9 / 23.5	Dense to very dense silty sand.		5	SS	112		For 5"			Gravel 7% Silt 42% Sand 51%
555.1 / 27.3			6	SS	80 For 1"					
555.0 / 27.4	Very dense silty clayey gravel (Till) End of borehole.					550.0				

FORM 08-ML 252 (REV MARCH 62)



NOTES **BOREHOLE NO. 1**

SAMPLE NO. 1 FROM 5' to 6'-6"
SAMPLE NO. 2 FROM 10' to 12'
SAMPLE NO. 3 FROM 15' to 16'-6"
SAMPLE NO. 4 FROM 20' to 21'-6"

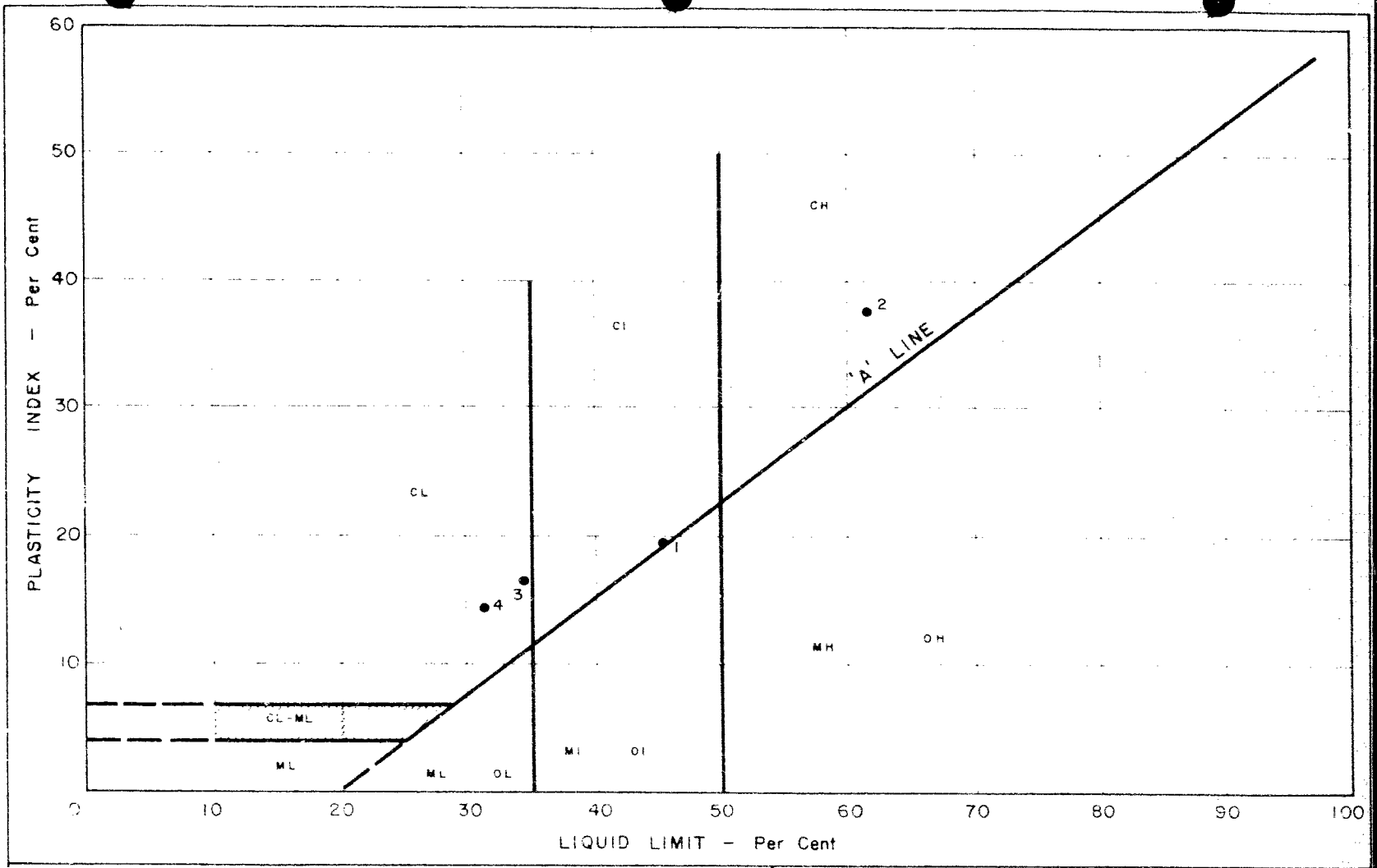
DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & RESEARCH DIVISION

PLASTICITY CHART

Job No. 62-F-77 W.P. No. ——

Location SIMCOE COUNTY RD. NO. 17 STA. 157+52

FORM 08-ML 252 (REV MARCH 62)



NOTES **BOREHOLE NO. 2**

SAMPLE NO 1 FROM 5' to 6'-6"
SAMPLE NO. 2 FROM 10' to 11'-6"
SAMPLE NO. 3 FROM 15' to 16'-6"
SAMPLE NO 4 FROM 20' to 21'-6"

DEPARTMENT OF HIGHWAYS - ONT.
MATERIALS & RESEARCH DIVISION

PLASTICITY CHART

Job No **62-F-77** W P No ——

Location **SIMCOE COUNTY RD. NO. 17 STA. 157+52**

ABBREVIATIONS USED IN THIS REPORT

PENETRATION RESISTANCE

STANDARD PENETRATION RESISTANCE 'N' :- THE NUMBER OF BLOWS REQUIRED TO ADVANCE A STANDARD SPLIT SPOON SAMPLER 12 INCHES INTO THE SUBSOIL, DRIVEN BY MEANS OF A 140 POUND HAMMER FALLING FREELY A DISTANCE OF 30 INCHES.

DYNAMIC PENETRATION RESISTANCE :- THE NUMBER OF BLOWS REQUIRED TO ADVANCE A 2 INCH, 60 DEGREE CONE, FITTED TO THE END OF DRILL RODS, 12 INCHES INTO THE SUBSOIL, THE DRIVING ENERGY BEING 350 FOOT POUNDS PER BLOW.

DESCRIPTION OF SOIL

THE CONSISTENCY OF COHESIVE SOILS AND THE RELATIVE DENSITY OR DENSENESS OF COHESIONLESS SOILS ARE DESCRIBED IN THE FOLLOWING TERMS :-

CONSISTENCY	'N' BLOWS / FT.	c LB. / SQ. FT.	DENSENESS	'N' BLOWS / FT.
VERY SOFT	0 - 2	0 - 250	VERY LOOSE	0 - 4
SOFT	2 - 4	250 - 500	LOOSE	4 - 10
FIRM	4 - 8	500 - 1000	COMPACT	10 - 30
STIFF	8 - 15	1000 - 2000	DENSE	30 - 50
VERY STIFF	15 - 30	2000 - 4000	VERY DENSE	> 50
HARD	> 30	> 4000		

TYPE OF SAMPLE

S.S.	SPLIT SPOON	T.W.	THINWALL OPEN
W.S.	WASHED SAMPLE	T.P.	THINWALL PISTON
S.B.	SCRAPER BUCKET SAMPLE	O.S.	OESTERBERG SAMPLE
A.S.	AUGER SAMPLE	F.S.	FOIL SAMPLE
C.S.	CHUNK SAMPLE	R.C.	ROCK CORE
S.T.	SLOTTED TUBE SAMPLE		
	P.H. SAMPLE ADVANCED HYDRAULICALLY		
	P.M. SAMPLE ADVANCED MANUALLY		

SOIL TESTS

Qu	UNCONFINED COMPRESSION	L.V.	LABORATORY VANE
Q	UNDRAINED TRIAXIAL	F.V.	FIELD VANE
Qcu	CONSOLIDATED UNDRAINED TRIAXIAL	C	CONSOLIDATION
Qd	DRAINED TRIAXIAL	S	SENSITIVITY

ABBREVIATIONS USED IN THIS REPORT

SOIL PROPERTIES

γ	UNIT WEIGHT OF SOIL (BULK DENSITY)
γ_s	UNIT WEIGHT OF SOLID PARTICLES
γ_w	UNIT WEIGHT OF WATER
γ_d	UNIT DRY WEIGHT OF SOIL (DRY DENSITY)
γ'	UNIT WEIGHT OF SUBMERGED SOIL
G	SPECIFIC GRAVITY OF SOLID PARTICLES $G = \frac{\gamma_s}{\gamma_w}$
e	VOID RATIO
n	POROSITY
w	WATER CONTENT
S_r	DEGREE OF SATURATION
w_L	LIQUID LIMIT
w_P	PLASTIC LIMIT
I_P	PLASTICITY INDEX
s	SHRINKAGE LIMIT
I_L	LIQUIDITY INDEX $= \frac{w - w_P}{I_P}$
I_C	CONSISTENCY INDEX $= \frac{w_L - w}{I_P}$
e_{max}	VOID RATIO IN LOOSEST STATE
e_{min}	VOID RATIO IN DENSEST STATE
I_D	DENSITY INDEX $= \frac{e_{max} - e}{e_{max} - e_{min}}$
	RELATIVE DENSITY D_r IS ALSO USED
h	HYDRAULIC HEAD OR POTENTIAL
q	RATE OF DISCHARGE
v	VELOCITY OF FLOW
i	HYDRAULIC GRADIENT
k	COEFFICIENT OF PERMEABILITY
j	SEEPAGE FORCE PER UNIT VOLUME
m_v	COEFFICIENT OF VOLUME CHANGE $= \frac{-\Delta e}{(1+e)\Delta \sigma'}$
c_v	COEFFICIENT OF CONSOLIDATION
C_c	COMPRESSION INDEX $= \frac{\Delta e}{\Delta \log_{10} \sigma'}$
T_v	TIME FACTOR $= \frac{c_v t}{d^2}$ (d, DRAINAGE PATH)
U	DEGREE OF CONSOLIDATION
τ_f	SHEAR STRENGTH
c'	EFFECTIVE COHESION INTERCEPT — IN TERMS OF EFFECTIVE STRESS $\tau_f = c' + \sigma' \tan \phi'$
ϕ'	EFFECTIVE ANGLE OF SHEARING RESISTANCE, OR FRICTION — IN TERMS OF EFFECTIVE STRESS $\tau_f = c' + \sigma' \tan \phi'$
c_u	APPARENT COHESION — IN TERMS OF TOTAL STRESS $\tau_f = c_u + \sigma \tan \phi$
ϕ_u	APPARENT ANGLE OF SHEARING RESISTANCE, OR FRICTION — IN TERMS OF TOTAL STRESS $\tau_f = c_u + \sigma \tan \phi$
μ	COEFFICIENT OF FRICTION
S_t	SENSITIVITY

GENERAL

π	= 3·1416
e	BASE OF NATURAL LOGARITHMS 2·7183
$\log_e a$ OR $\ln a$	NATURAL LOGARITHM OF a
$\log_{10} a$ OR $\log a$	LOGARITHM OF a TO BASE 10
t	TIME
g	ACCELERATION DUE TO GRAVITY
V	VOLUME
W	WEIGHT
M	MOMENT
F	FACTOR OF SAFETY

STRESS AND STRAIN

u	PORE PRESSURE
σ	NORMAL STRESS
σ'	NORMAL EFFECTIVE STRESS ($\bar{\sigma}$ IS ALSO USED)
τ	SHEAR STRESS
ε	LINEAR STRAIN
γ	SHEAR STRAIN
ν	POISSON'S RATIO (μ IS ALSO USED)
E	MODULUS OF LINEAR DEFORMATION (YOUNGS MODULUS)
G	MODULUS OF SHEAR DEFORMATION
K	MODULUS OF COMPRESSIBILITY
η	COEFFICIENT OF VISCOSITY

EARTH PRESSURE

d	DISTANCE FROM TOP OF WALL TO POINT OF APPLICATION OF PRESSURE
δ	ANGLE OF WALL FRICTION
K	DIMENSIONLESS COEFFICIENT TO BE USED WITH VARIOUS SUFFIXES IN EXPRESSIONS REFERRING TO NORMAL STRESS ON WALLS
K_o	COEFFICIENT OF EARTH PRESSURE AT REST

FOUNDATIONS

B	BREADTH OF FOUNDATION
L	LENGTH OF FOUNDATION
D	DEPTH OF FOUNDATION BENEATH GROUND
N	DIMENSIONLESS COEFFICIENT USED WITH A SUFFIX APPLYING TO SPECIFIC GRAVITY, DEPTH AND COHESION ETC. IN THE FORMULA FOR BEARING CAPACITY
k_s	MODULUS OF SUBGRADE REACTION

SLOPES

H	VERTICAL HEIGHT OF SLOPE
D	DEPTH BELOW TOE OF SLOPE TO HARD STRATUM
β	ANGLE OF SLOPE TO HORIZONTAL