cc: Gen. Files

DEPARTMENT OF HIGHWAYS ONTARIO

23-66-129

MEMORANDUM

To: Mr. B. R. Davis,
Bridge Engineer,
Bridge Division.

Attention: Mr. S. McCombie

From: Foundation Section,
Materials and Testing Div.,
Room 107, Lab. Bldg.

Date: August 10, 1965

Our File Ref.

In reply to

Subject:

FOUNDATION INVESTIGATION REPORT
For
Proposed Crossing of Hwy. #401 and
County Road to Puce - Interchange #4,
District #1 (Chatham)
W.J. 65-F-75 -- W.P. 127-64

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

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

AGS/MceF
Attach.
cc: Messrs. B. R. Davis (2)
H. A. Tregaskes
D. W. Farren
A. Gater
F. C. Brown
J. Roy
A. Watt

Foundations Office
Gen. Files ✓

A. G. Stermac,
PRINCIPAL FOUNDATION ENGINEER

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FOUNDATION INVESTIGATION REPORT

For

Proposed Crossing of Hwy. #401 and
County Road to Puce - Interchange #4,
District #1 (Chatham)
W.J. 65-F-75 -- W.P. 127-64

1. INTRODUCTION:

A request dated June 17, 1965, to conduct a foundation investigation at the proposed crossing of the County Road to Puce and Highway #401, was received from Mr. G. Scott, Regional Bridge Location Engineer.

It is proposed to erect a four-span bridge to carry the County Road to Puce (Essex Road #8) over Highway #401. The site is 8.9 miles east of Highway #98 in the Township of Maidstone, County of Essex.

A foundation investigation was conducted by this Section at the proposed site to determine the soil conditions. Field and laboratory results, as well as discussion and recommendations for the foundation design, are reported herein.

2. SITE TOPOGRAPHY AND GEOLOGY:

The site is at present an open crossing of Highway #401 by the County Road to Puce. The surrounding area is quite flat, drained by ditches along the road-side and is under cultivation with field crops. The area is noted for its rich soil derived from the underlying clay.

cont'd. /2 ...

2. SITE TOPOGRAPHY AND GEOLOGY: (cont'd.) ...

The clay deposit is part of the Essex Clay Plain which is a glacial deposit consisting of a clayey-till underlain at a considerable depth by Paleozoic bedrock. The relatively soft nature of the Paleozoic sediments, which are believed to be the parent material of the till, may explain the general lack of gravel size and larger particles in the otherwise till-like deposits.

3. FIELD AND LABORATORY WORK:

Using conventional diamond drilling equipment adapted for soil sampling purposes, five sampled boreholes and five dynamic cone penetration tests were carried out at the site. A driving energy of 350 ft.-lbs. per blow was used for the dynamic cone penetration tests.

In cohesive materials, 2-inch I.D. Shelby tube samples were obtained by manually pushing the tubes into the soil if possible. Otherwise, samples of cohesive and non-cohesive materials were obtained using a 2-inch O.D. split-spoon sampler driven according to the specifications of the Standard Penetration Test. In addition, in-situ vane tests were conducted in the field to determine the shear strength of the cohesive materials.

Samples were visually examined and identified in the field and subsequently in the laboratory. Laboratory tests were conducted on selected representative samples to determine, where applicable:

cont'd. /3 ...

3. FIELD AND LABORATORY WORK: (cont'd.) ...

1) Atterberg Limits
2) Bulk Density
3) Grain-size Distribution
4) Natural Moisture Content
5) Undrained Shear Strength

Results of the above tests, field test results, together with the location and elevation of the boreholes, are presented in Appendix I of this report.

4. SOIL TYPES AND SUBSOIL CONDITIONS:

4.1) General:

Subsoil at the site consists mainly of a deposit of silty clay to clayey silt with some sand and occasional gravel (glacial till). The upper grey-brown crust extended to about 13 feet and was stiff to hard. Beneath 13 feet and extending to the full depth of the exploration, the deposit is grey in colour and is predominantly very stiff to stiff silty clay with layers of silty sand to sandy silt occurring irregularly between about 25 feet and 50 feet.

4.2) Silty Clay to Clayey Silt:

This material was encountered right below the 6 inches of topsoil in each borehole. The upper 4 to 6 feet, in general, was mottled grey and brown and appeared to be disturbed. The remainder of the material to a depth of 13 feet, was of a stiff to

cont'd. /4 ...

4. SOIL TYPES AND SUBSOIL CONDITIONS: (cont'd.) ...

4.2) Silty Clay to Clayey Silt: (cont'd.) ...

hard consistency ('N' values of 14 to 59), and was grey-brown in colour. At about 13 feet, the deposit became grey in colour.

Borehole 2 was sampled to 83 feet and washed to 101 feet all within this material, except for layers or pockets of silty sand to sandy silt encountered between about 25 and 50 feet. Except for these layers which were encountered irregularly in all boreholes, the deposit was fairly uniform, containing occasional small gravel, about 20% sand, 35% to 40% silt, and the remainder clay-sized particles (a till-like deposit).

The following is a summary of some properties of this material:

		Upper 15'	Below 13'
Moisture Content - W (%)	Max.	26.1	32.5
	Min.	16.2	16.6
	Avg.	19.3	19.8
Liquid Limit - W_L (%)	Max.	45.0	46.2
	Min.	31.6	27.0
	Avg.	36.0	32.5
Plastic Limit - Wp (%)	Max.	21.4	25.3
	Min.	17.3	14.2
	Avg.	18.8	17.6
Bulk Density - (pcf)	Avg.	130.	127.
Shear Strength - (psf)			
Unconfined Comp. Test		-	2,300 to 500
Field Vane Test		-	> 2,300 to 900

The shear strength varied from the maximum value at the top of the deposit to the minimum value at depth.

cont'd. /5 ...

4. SOIL TYPES AND SUBSOIL CONDITIONS: (cont'd.) ...

4.2) Silty Clay to Clayey Fill: (cont'd.) ...

The silty sand to sandy silt which was encountered at irregular intervals and thicknesses in all boreholes, appeared either to be layered with the main silty clay to clayey silt deposit or to occur in large pockets. The deposit varied from a single layer of silty sand 8 feet thick, in borehole 1 to at least three layers of sandy silt to silty sand and one layer of coarse to fine sand with some silt occurring between 24.5 feet and 51 feet in borehole 2.

5. GROUND WATER:

Ground water levels were observed during the period of the investigation. The most reliable data, from boreholes 2 and 3, indicate the water table was at about elevation 600.5'. This corresponds very closely with the level of the water observed in a drainage ditch north of the site. Borehole 1 indicated a water-level at elevation 602.3 feet; however, this hole had plugged at elevation 596' (i.e., 10.5 feet below ground surface) and had been filled by surface water when the casing was pulled. The water level was still decreasing in this hole after 8 days.

6. DISCUSSION AND RECOMMENDATIONS:

The proposed overpass which will carry the Puce Road over Highway 401 is to be a 4-span structure. For the piers, the upper clay crust is suitable for spread footing type foundations. An allowable design load of 2½ t.s.f. could be applied at elevation 600.

cont'd. /6 ...

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

Two proposals can be considered for the abutment supports:

i) Abutments can be supported on spread footings founded on a compacted granular fill using a safe bearing pressure of 2 t.s.f.

The fill should extend for a horizontal distance of at least 10 feet from the footing edges in the plane of the footing tops. This portion of the fill should be built with side slopes of 2:1 The remainder of the fill (not necessarily granular material) should be completed to about profile grade for a distance of about 50 feet behind the abutments before re-excavating for the abutment footings. The granular fill should be placed in 6-inch layers and compacted to at least 100% Proctor density.

ii) Abutments can be supported on 12¾" O.D. tubular steel piles driven to, but not beyond, elevation 595.0'. For piles driven to this depth, a design load of 20 tons per pile can be used.

Although some settlements are to be expected, it is difficult to estimate the probable differential settlements because of the variability of the subsoil. Since much of the settlement will be due to the imposed load of the embankments, it is recommended that the embankments be constructed at least 6 months prior to the construction of the piers. As well, a simply supported structure is recommended to provide for some differential settlement.

cont'd. /7 ...

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

No dewatering problems are expected during excavation because of the low permeability of the subsoil. When the desired excavated elevation is reached, a working slab should be cast immediately to prevent softening of the subsoil. Any seepage inflow should be handled adequately by low-capacity pumps.

Provided that standard side slopes of 2 horizontal to 1 vertical are used, no stability problems are anticipated for the proposed 20-foot approach embankments.

7. SUMMARY:

The subsoil consists generally of a deep deposit of silty clay to clayey silt with some sand and occasional gravel (glacial till).

Bridge piers should be supported on spread footings at elevation 600.0' where a safe bearing pressure of 2½ t.s.f. can be applied.

Abutments are recommended to be supported on spread footings on compacted granular fill where a safe bearing pressure of 2 t.s.f. can be applied. As an alternative, 12¾" Ø tubular steel piles may be driven to, but not beyond, elevation 595.0' with a design load of 20 tons per pile.

It is recommended that the approach fills be constructed at least 6 months prior to the construction of the piers.

No dewatering problems are anticipated for the excavations. Any seepage inflow should be handled readily by low-capacity pumps.

cont'd. /8 ...

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

With standard 2:1 side slopes, no stability problems are expected for the proposed approach embankments.

To provide for the possibility of differential settlement, a simply supported structure is recommended.

8. MISCELLANEOUS:

The field work was conducted in July 1965 using equipment owned and operated by Master Soil Investigations, Ltd., under the supervision of Mr. L. Palmer, Project Foundation Engineer, who subsequently prepared this report.

Mr. M. Devata, Senior Foundation Engineer, supervised the entire project, in general, and also reviewed this report.

August 1965.

APPENDIX 1.

FORM OB-ML-126-REVISED
64-3040

OFFICE REPORT ON SOIL EXPLORATION

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & TESTING DIVISION

RECORD OF BOREHOLE NO. 1

FOUNDATION SECTION

JOB 65-F-75 LOCATION Intersection Hwy 401 & Cty Road to Puce ORIGINATED BY L.P.

W.P. 127-64 BORING DATE July 6, 1965. COMPILED BY L.P.

DATUM Geodetic BOREHOLE TYPE Washboring CHECKED BY M.D.

ELEV. / DEPTH	DESCRIPTION	STRAT. PLOT	SAMPLES NUMBER	TYPE	BLOWS / FOOT	ELEV. SCALE
606.5	Ground Surface					
0	Silty clay to clayey silt, some sand, occasional gravel (Glacial Till) very stiff to hard grey-brown.		1	SS	17	
			2	SS	14	600
			3	SS	39	
593.5			4	SS	29	
13.0	Very stiff to stiff, grey.		5	SS	19	590
			6	TW	PM	
			7	TW	PM	
	Layer of silt.		8	TW	PH48", Drive 10"	
			9	TW	PM	580
			10	TW	PM	
			11	TW	PM	
			12	TW	PM	570
568.0						
38.5	Silty sand-compact to loose.		13	TW	Driven	
560.3			14	SS	10	560
46.2			15	TW	PM	
			16	TW	PM	
			17	TW	PM	550
			18	TW	PM	
544.0			19	TW	PM	
62.5	End of borehole.					540

DYNAMIC PENETRATION RESISTANCE
BLOWS / FOOT
20 40 60 80 100

SHEAR STRENGTH P.S.F.
+ - Field Vane Test
● - Unconf. Comp. Test
1000 2000 3000 4000 5000

LIQUID LIMIT ——— w_L
PLASTIC LIMIT ——— w_P
WATER CONTENT ——— w
w_P w w_L
WATER CONTENT %
10 20 30

BULK DENSITY
P.C.F.

135
137
132.5
131
130
125
1.6
46.2
117.5
121
41.4
125

REMARKS

602.3
Hole plugged at 596.1

Sa&Gr 16%
Si40%Cl 44%

Sa&Gr 19%
Si37%Cl 44%

Sa52%Si40%
Cl 8%

Gr2%Sa57%
Si30%Cl 11%

15 $\frac{0}{10}$ 5 Percent Strain at Failure

FORM OB-ML-126-REVISED
64-3040

OFFICE REPORT ON SOIL EXPLORATION

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & TESTING DIVISION

RECORD OF BOREHOLE NO. 2

FOUNDATION SECTION

JOB 65-F-75 LOCATION Intersection Hwy 401 & County Road to Puce. ORIGINATED BY L.P.

W.P. 127-64 BORING DATE July 7, 1965. COMPILED BY L.P.

DATUM Geodetic BOREHOLE TYPE Wash-boring CHECKED BY M.D.

ELEV. / DEPTH	DESCRIPTION	STRAT. PLOT	SAMPLES NUMBER	TYPE	BLOWS / FOOT	ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT 20 40 60 80 100 — SHEAR STRENGTH P.S.F. + - Field Vane Test ● - Unconf. Comp. Test 1000 2000 3000 4000 5000	LIQUID LIMIT W_L PLASTIC LIMIT W_P WATER CONTENT W — WATER CONTENT % 10 20 30	BULK DENSITY P.C.F.	REMARKS
606.5	Ground Surface									
	Silty clay to clayey silt, some sand, trace gravel, (glacial till) stiff to hard, grey brown.		1	TW	PM			45.0	115	▽ 600.4 (After 5 days)
			2	TW	PM	600			127	
			3	SS	57					
593.5 / 13.0			4	SS	29					
	Very stiff to firm. Grey.		5	TW	PM	590				
			6	TW	PM				128	
			7	TW	PM		+ 1.8			
582.0 / 24.5			8	TW	PM				139	Sa&Gr29%Si Cl 17% 54%
579.5 / 27.0	Silty sand		9	SS	36	580				Gr6%Sa42% Si33%Cl 9%
	Hard		10	SS	33					Sa91%Si&Cl 9%
576.1 / 30.4	18" coarse to fine sand		11	SS	22					
	Pockets and thin seams of fine sand.		12	TW	PM				128	Sa&Gr 20% Si51%Cl 29%
568.4 / 38.1	Silty sand.		13	TW	PM 9", Drive	570				Sa&Gr 61% Si33%Cl 6%
565.1 / 41.4			14	TW	PM				129	
	Silty sand, very dense.		15	SS	58	560				Gr2%Sa67% Si&Cl 31%
555.5 / 51.0			16	SS	12		+ 2.4			
			17	TW	PM	550	+ 2.0		123	
			18	G	-		+ 2.3			
						540				
			19	TW	PM		+ 2.2		122	
			20	G	-	530				
			21	TW	PM		+ 1.9		119	
						520	15 — 5 Percent Strain at Failure 10			
						510				
505.5 / 101.0										

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & TESTING DIVISION

RECORD OF BOREHOLE NO. 3

FOUNDATION SECTION

JOB 65-F-75 LOCATION Intersection Hwy 401 & County Road to Puce ORIGINATED BY L.P.
W.P. 127-64 BORING DATE July 12, 1965. COMPILED BY L.P.
DATUM Geodetic BOREHOLE TYPE Washboring CHECKED BY M.D.

ELEV. / DEPTH	DESCRIPTION	NUMBER	TYPE	BLOWS / FOOT	REMARKS
607.0	Ground Surface				
0.0	Clayey silt - some sand, occasional gravel stiff to hard grey-brown	1	TW	PH	
		2	SS	34	▼600.4 (After 3 days)
		3	SS	50	
593.5		4	SS	30	
13.5	Grey	5	TW	PH	Sa&Gr 21% Si40%Cl 39%
		6	TW	PH	
		7	TW	PH9" Driven 9"	
579.5					
27.5	Sandy silt, very dense.	8	SS	72	Sa36%Si55% Cl 9%
		9	SS	61	Gr3%Sa44% Si&Cl 53%
567.0					
40.0	Clayey silt	10	SS	41	
40.5	End of borehole.				

ELEV. SCALE: 600, 590, 580, 570, 560

DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT: 20, 40, 60, 80, 100

SHEAR STRENGTH P.S.F. ● Unconf Comp Test: 1000, 2000, 3000, 4000, 5000

LIQUID LIMIT w_L — PLASTIC LIMIT w_P — WATER CONTENT w

WATER CONTENT %: 10, 20, 30

BULK DENSITY P.C.F.: 121, 135, 129, 126, 131

15 (0 / 10) 5 Percent Strain at Failure

FORM OB-ML-126-REVISED
64-3040

OFFICE REPORT ON SOIL EXPLORATION

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & TESTING DIVISION

RECORD OF BOREHOLE NO. 4

FOUNDATION SECTION

JOB 65-F-75 LOCATION Intersection Hwy 401 & County Road to Puce ORIGINATED BY L.P.
W.P. 127-64 BORING DATE July 13, 1965 COMPILED BY L.P.
DATUM Geodetic BOREHOLE TYPE Washboring CHECKED BY M.D.

ELEV. / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES BLOWS / FOOT	ELEV. SCALE	BULK DENSITY γ P.C.F.	REMARKS
607.5	Ground Surface							
0.0	Silty clay to clayey silt some sand, trace gravel (glacial till) stiff to hard, grey brown.		1	G	-			
			2	TW	PH	600	126	▼ 601.5
			3	TW	Pu9", Driven 9"		131	(After 2 days) Sa18%Si41% Cl 41%
593.5			4	SS	35			
14.0	Grey		5	TW	PH	590	127	
			6	TW	PH		127.5	
584.0								
23.5	Sandy silt		7	SS	14			
582.3								
25.2			8	G	-	580		
579.0								
28.5	Sandy silt-very dense		9	SS	55			Sa&Gr36% Si49%Cl 15%
573.0								
34.5			10	SS	21	570		
566.8	15" Silty sand							Sa77%Si22% Cl 1%
40.7			11	SS	24			
561.0	18" Silty sand.							Sa&Gr70% Si25%Cl 5%
559.3			12	SS	13	560		
48.0	End of borehole.							
						550		

DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT — 20 40 60 80 100

SHEAR STRENGTH P.S.F.
+ - Field Vane Test
● - Unconf Comp Test
1000 2000 3000 4000 5000

6560

2.2

2.0

LIQUID LIMIT ——— w_L
PLASTIC LIMIT ——— w_P
WATER CONTENT ——— w
w_P w w_L
WATER CONTENT % 10 20 30

15 0 5 Percent Strain at Failure
10

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & TESTING DIVISION

RECORD OF BOREHOLE NO. 5

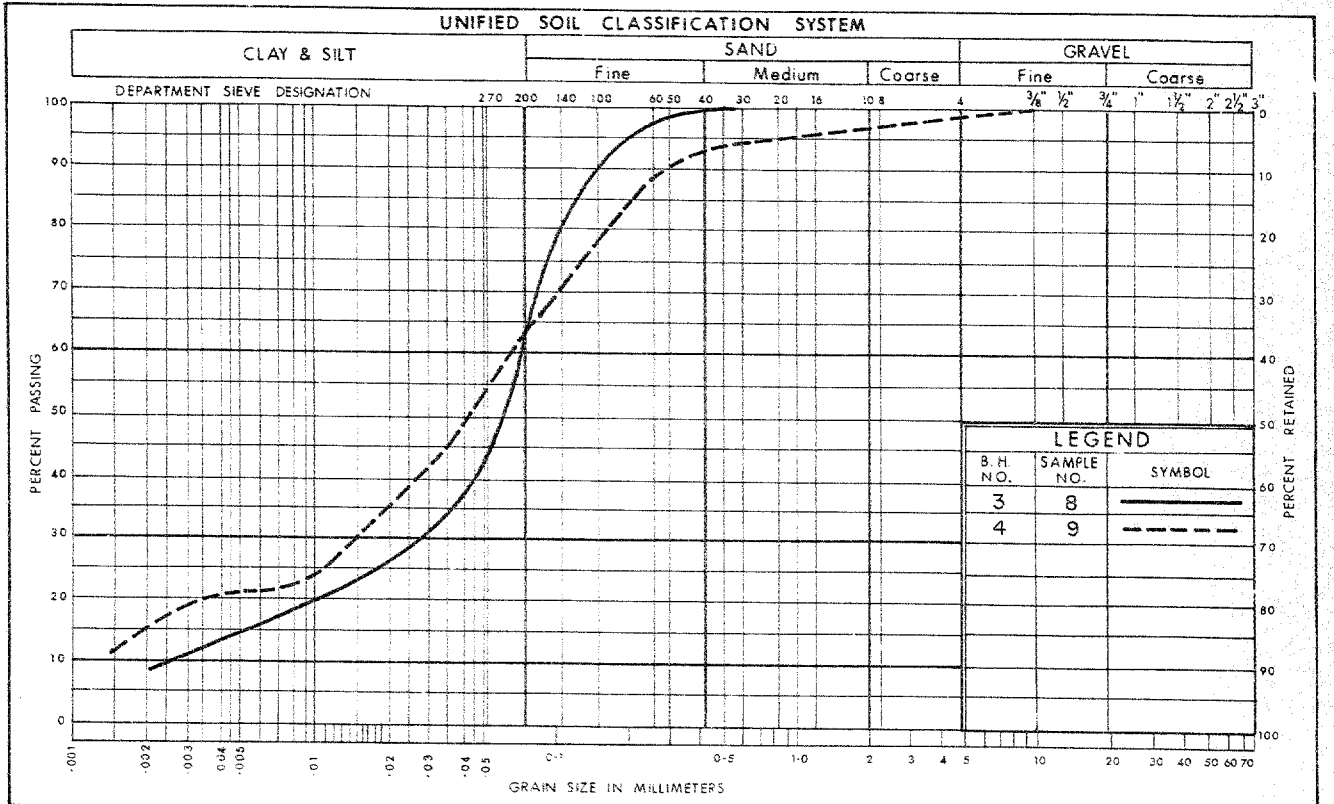
FOUNDATION SECTION

JOB 65-F-75 LOCATION Intersection Hwy 401 & County Road to Puce ORIGINATED BY L.P.
W.P. 127-64 BORING DATE July 13, 1965. COMPILED BY L.P.
DATUM Geodetic BOREHOLE TYPE Washboring CHECKED BY M.D. AL

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT 20 40 60 80 100 / SHEAR STRENGTH P.S.F.	LIQUID LIMIT w_L / PLASTIC LIMIT w_P / WATER CONTENT w — w_P w w_L / WATER CONTENT % 10 20 30	BULK DENSITY γ P.C.F.	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FOOT					
608.0	Ground Surface									
	Clayey silt some sand, occasional gravel (glacial till) very stiff to hard. Grey brown.		1	SS	20	600				Sa17%Si 40% Cl 43%
			2	SS	50					
			3	SS	59					
591.5	Grey		4	SS	29	590				
16.5	End of borehole.					580				

FORM 08 MT-17
REV. APR. 1965
85-214

UNIFIED SOIL CLASSIFICATION SYSTEM

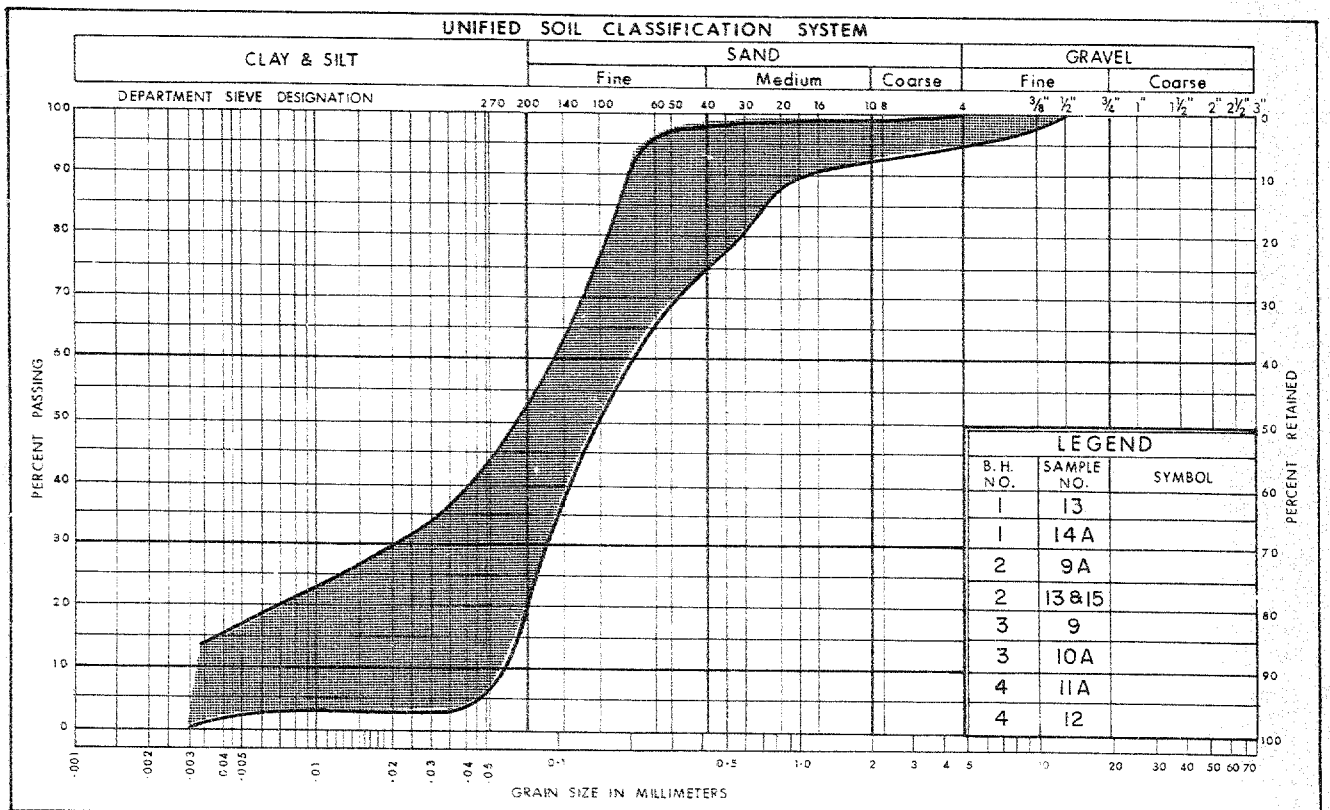


DEPARTMENT OF HIGHWAYS
MATERIALS and TESTING DIVISION
ONTARIO

GRAIN SIZE DISTRIBUTION
SANDY SILT

W.P. No. 127-64
JOB No. 65-F-75

FORM CS MT-17
REV. APR. 1965



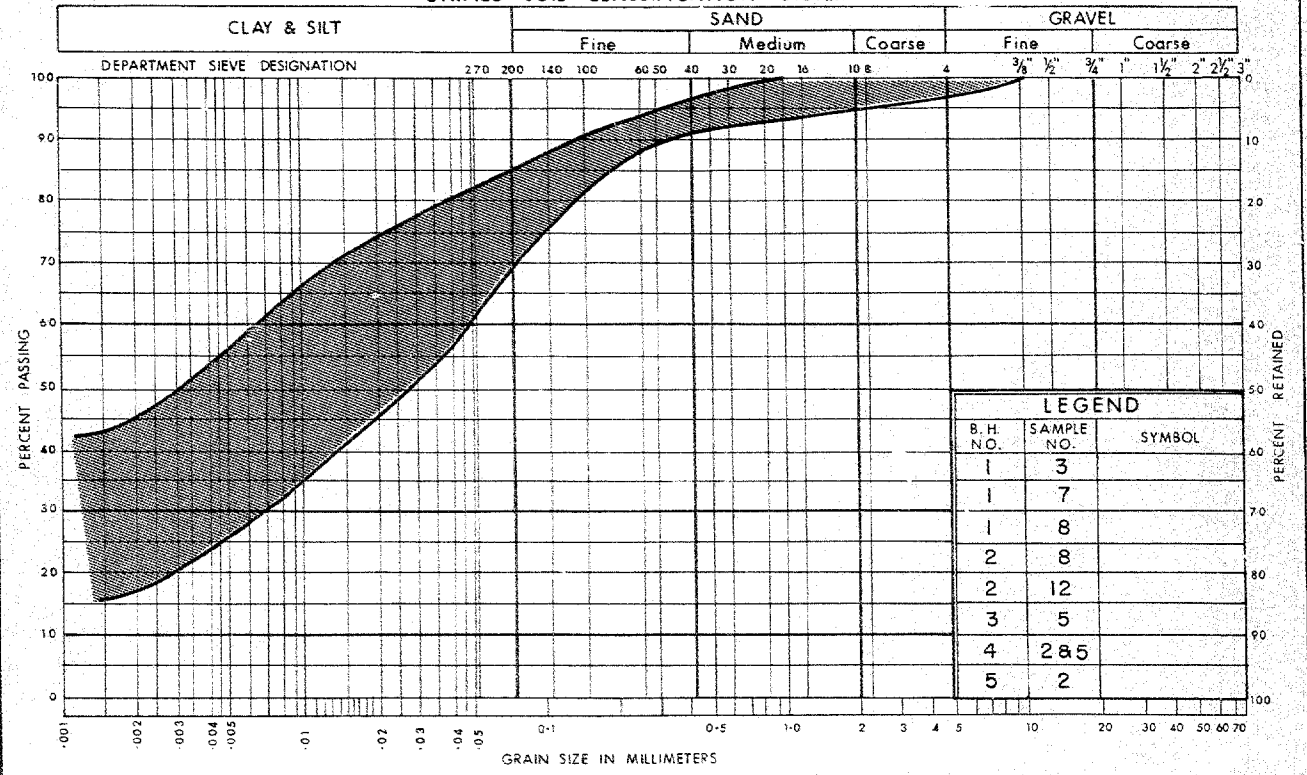
DEPARTMENT OF HIGHWAYS
MATERIALS and TESTING DIVISION
ONTARIO

GRAIN SIZE DISTRIBUTION
SILTY SAND
ENVELOPE for SAMPLES

W.P. No. 127-64
JOB No. 65-F-75

FORM OB MT-17
REV. APR. 1965
65-414

UNIFIED SOIL CLASSIFICATION SYSTEM



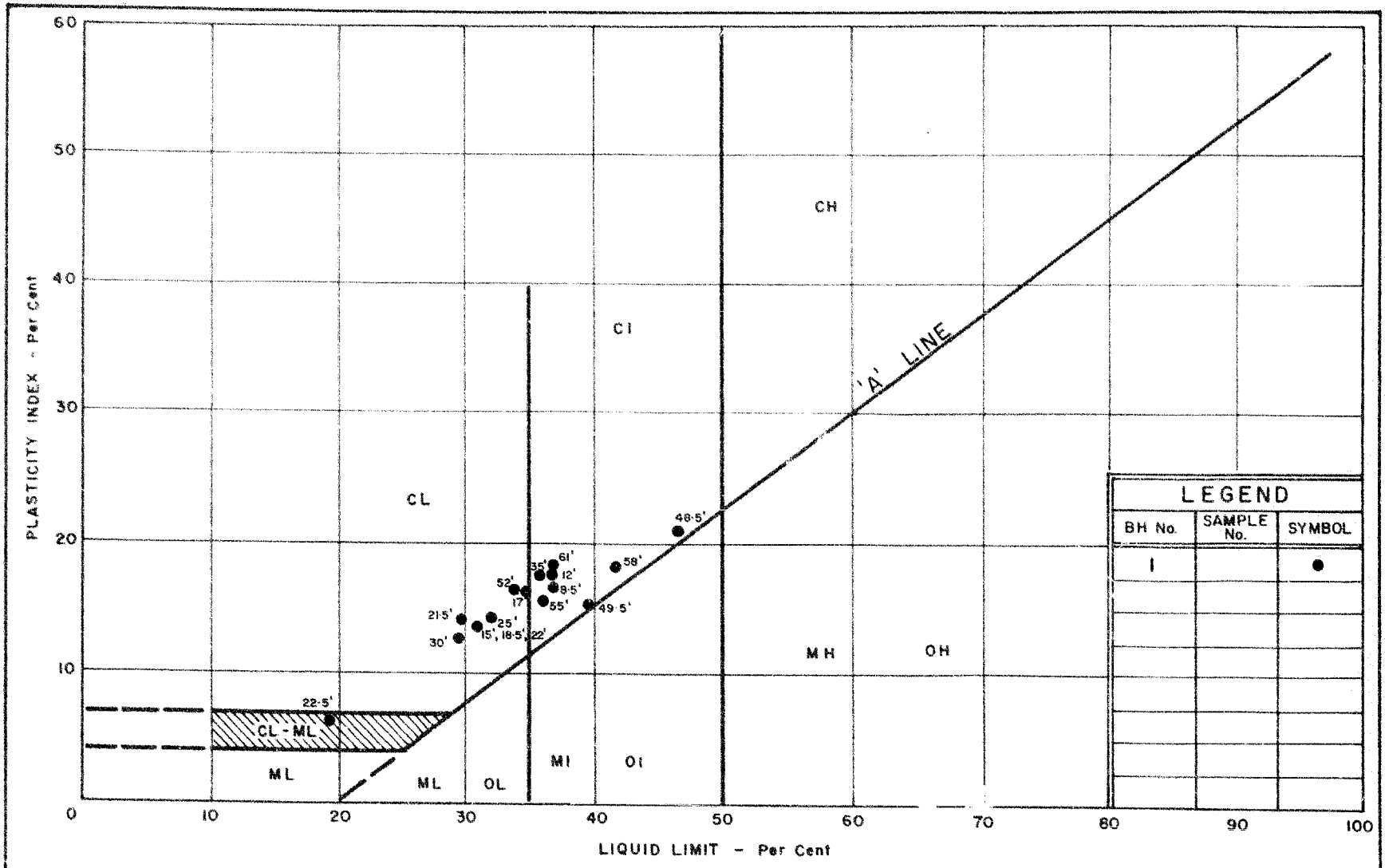
LEGEND		
B. H. NO.	SAMPLE NO.	SYMBOL
1	3	
1	7	
1	8	
2	8	
2	12	
3	5	
4	2&5	
5	2	

DEPARTMENT OF HIGHWAYS
MATERIALS and TESTING DIVISION
ONTARIO

GRAIN SIZE DISTRIBUTION
CLAYEY SILT to SILTY CLAY (Glacial Till)
ENVELOPE for SAMPLES

W.P. No. 127-64
JOB No. 65-F-75

FORM CB-MT-252
(REV. JUNE 1965)
65-3624

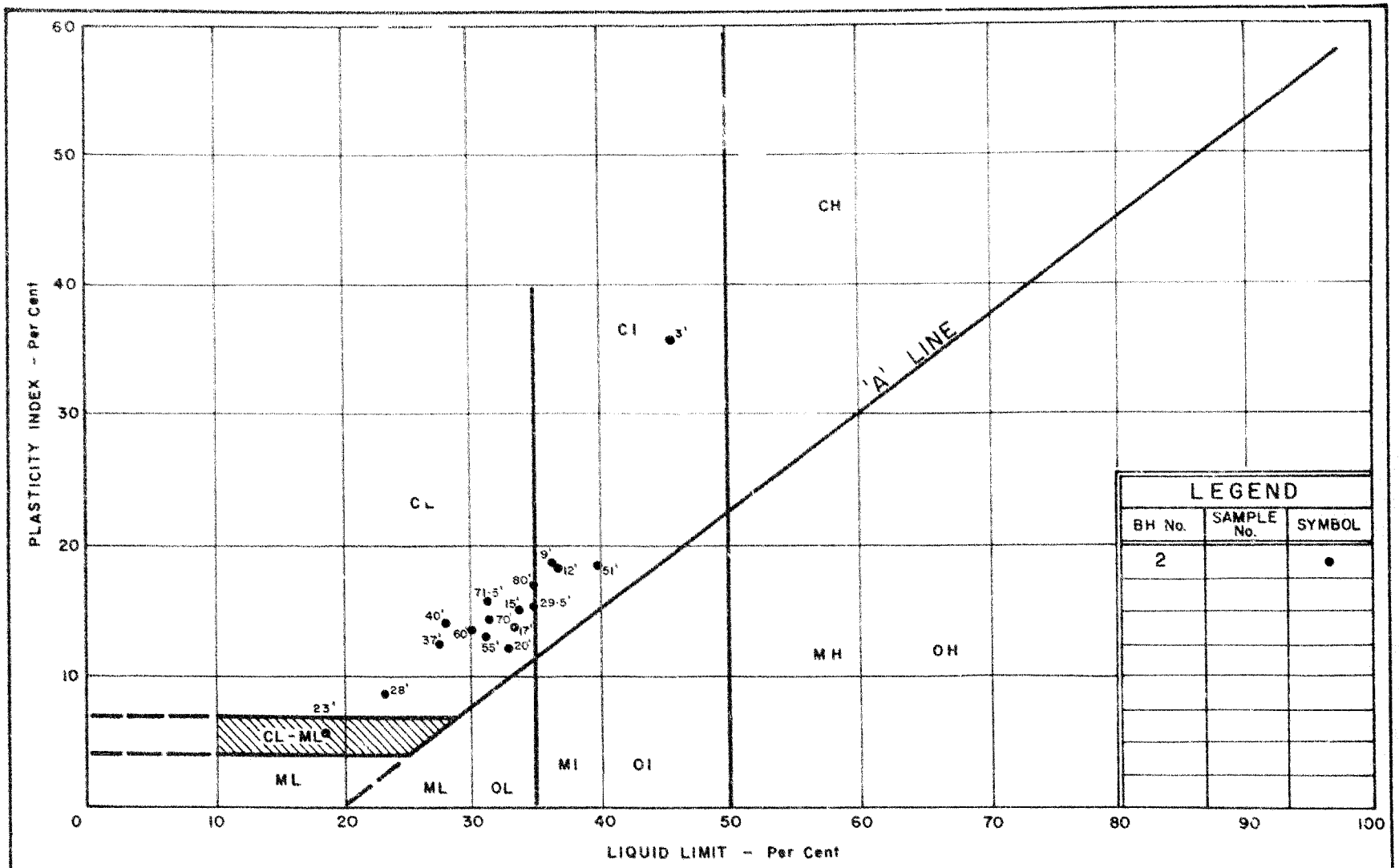


DEPARTMENT OF HIGHWAYS
MATERIALS and TESTING DIVISION
ONTARIO

PLASTICITY CHART

W.P. No. 127-64
JOB No. 65-F-75

FORM CB-MT-252
(REV. JUNE 1965)
85-1624

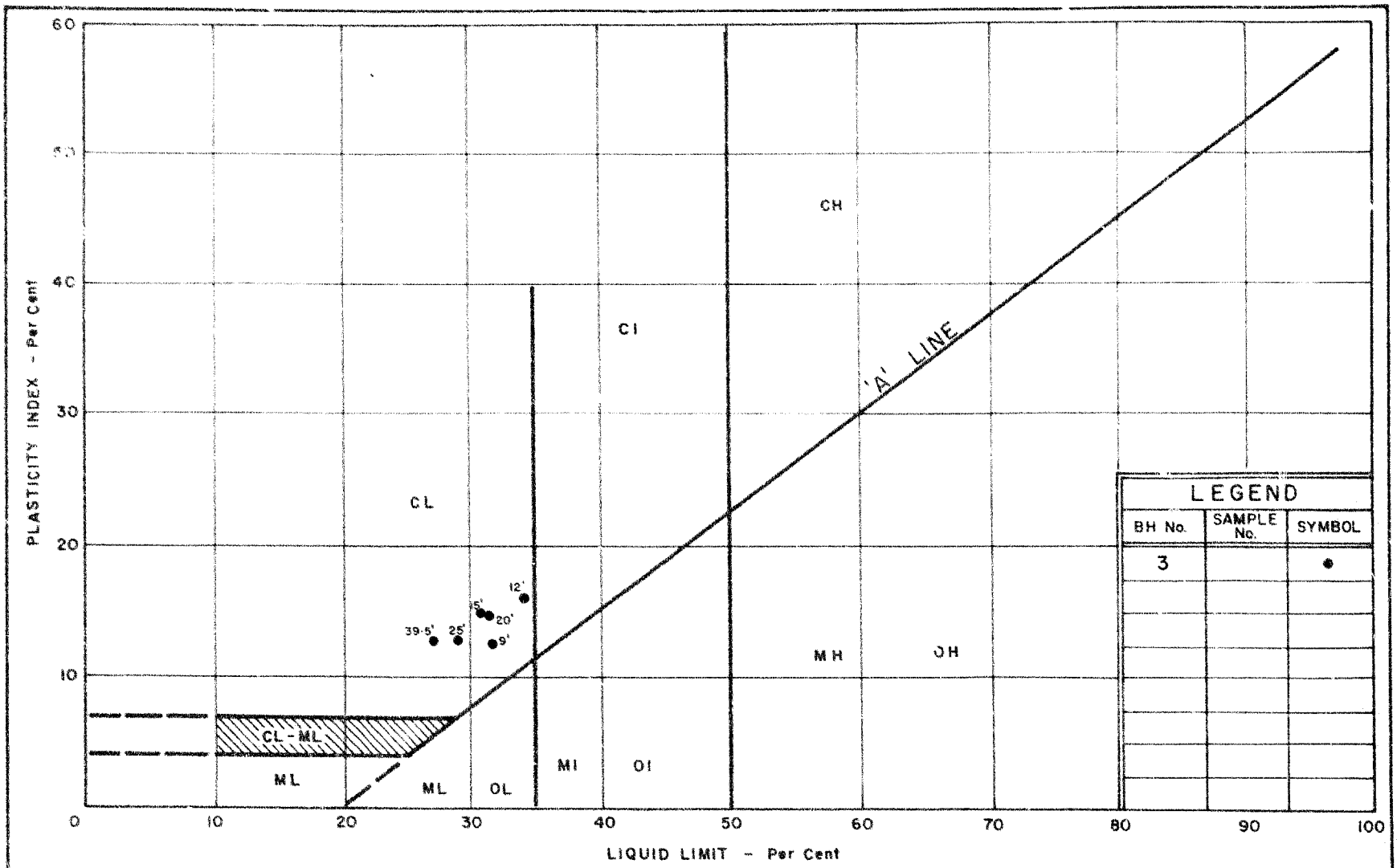


DEPARTMENT OF HIGHWAYS
MATERIALS and TESTING DIVISION
ONTARIO

PLASTICITY CHART

W.P. No. 127-64
JOB No. 65-F-75

FORM OB-MT-252
(REV JUNE 1965)
65-1624

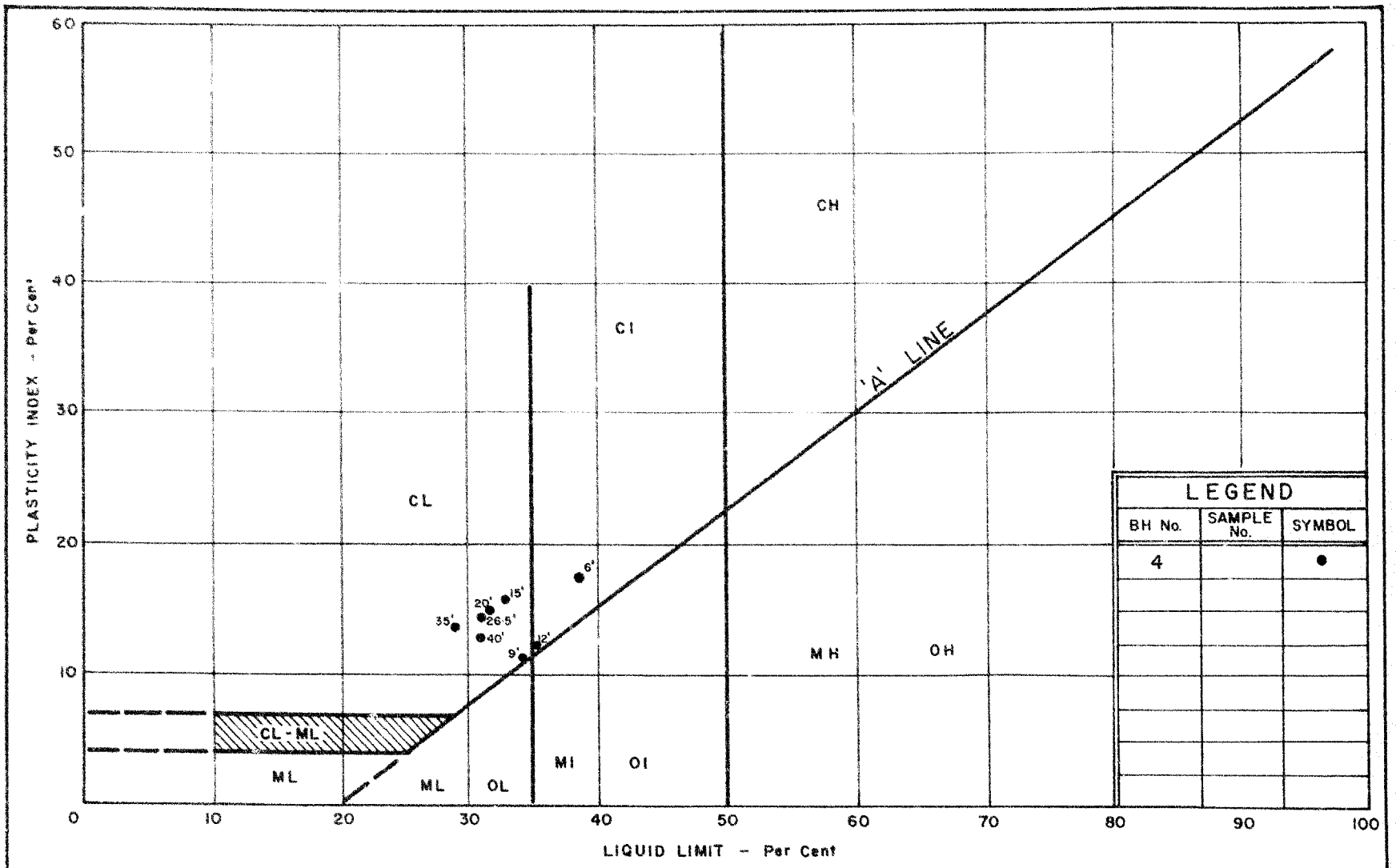


DEPARTMENT OF HIGHWAYS
MATERIALS and TESTING DIVISION
ONTARIO

PLASTICITY CHART

W.P. No. 127-64
JOB No. 65-F-75

FORM OD-MT-252
(REV JUNE 1965)
65-1624

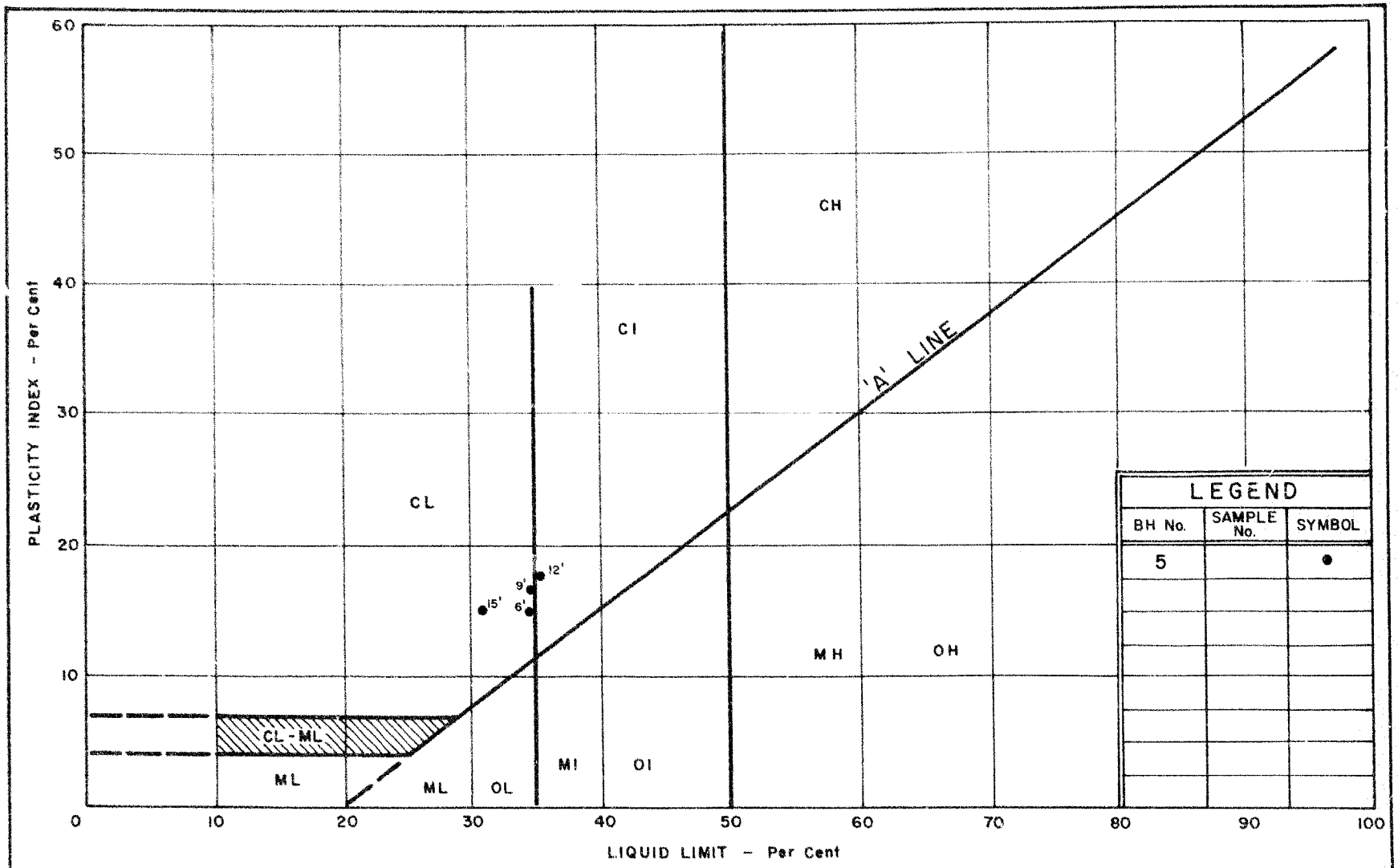


DEPARTMENT OF HIGHWAYS
MATERIALS and TESTING DIVISION
ONTARIO

PLASTICITY CHART

W.P. No. 127-64
JOB No. 65-F-75

FORM OB-MT-252
(REV. JUNE 1965)
65-1624



DEPARTMENT OF HIGHWAYS
ONTARIO
MATERIALS and TESTING DIVISION

PLASTICITY CHART

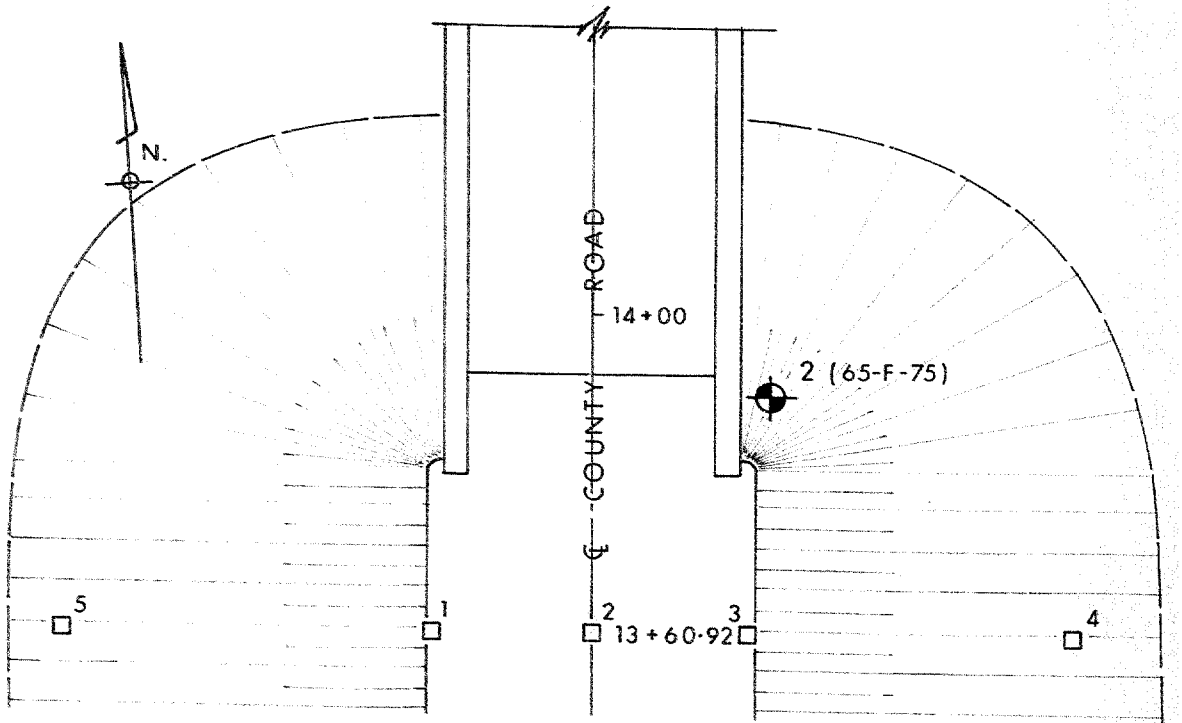
W.P. No. 127-64

JOB No. 65-F-75

INSTRUMENTATION OF APPROACH

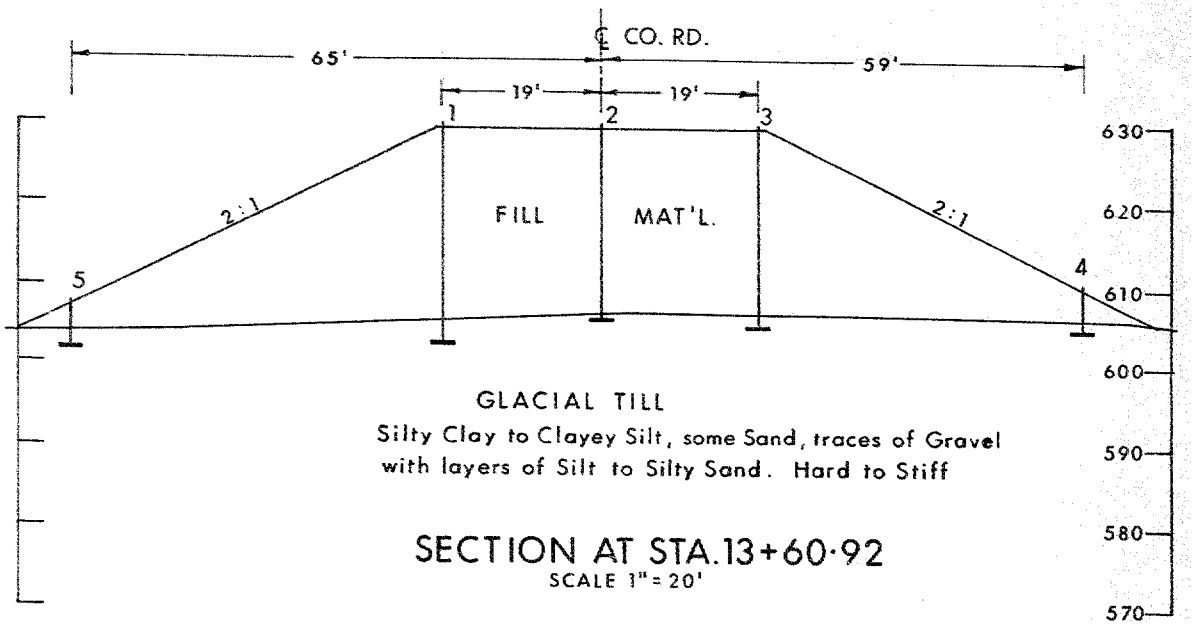
COUNTY ROAD TO PUCE INTERCHANGE NO. 4

5 SETTLEMENT PLATES



PLAN

SCALE 1" = 20'



GLACIAL TILL

Silty Clay to Clayey Silt, some Sand, traces of Gravel with layers of Silt to Silty Sand. Hard to Stiff

SECTION AT STA. 13+60·92

SCALE 1" = 20'

NOTE: PLATES INSTALLED
FILL STARTED
FILL COMPLETED
RODS TO PLATES INSTALLED

65-F-75

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

IN TERMS OF EFFECTIVE STRESS $\tau_f = c' + \sigma' \tan \phi'$

c'	EFFECTIVE COHESION INTERCEPT
ϕ'	EFFECTIVE ANGLE OF SHEARING RESISTANCE, OR FRICTION

IN TERMS OF TOTAL STRESS $\tau_f = c_u + \sigma \tan \phi$

c_u	APPARENT COHESION
ϕ_u	APPARENT ANGLE OF SHEARING RESISTANCE, OR FRICTION

μ	COEFFICIENT OF FRICTION
S_t	SENSITIVITY

GENERAL

π	= 3·1416
e	BASE OF NATURAL LOGARITHMS 2·7183
$\log_e \sigma$ OR $\ln \sigma$	NATURAL LOGARITHM OF σ
$\log_{10} \sigma$ OR $\log \sigma$	LOGARITHM OF σ 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

DEPARTMENT OF HIGHWAYS ONTARIO

MEMORANDUM

65-F-75
WP 127-64

To: Mr. K.Y. Lo,
Supervising Foundation Engineer,
Room 107, Lab. Building.

From: Bridge Division,
Downsview, Ontario.

Date: June 17, 1965.

Our File Ref.

In reply to

Subject: W.P. 127-64
Site 6-232
County Road to Puce
Interchange # 4,
Highway #401 District # 1.

We are sending to you herewith two prints of Bridge Site Plan E-4353-1 on which we have marked in red the proposed location of the above structure.

The bridge site is readily accessible. It is 8.9 miles east of Highway #98. No problems are anticipated regarding the accommodation.

Please make the necessary arrangement for foundation investigation. We will be pleased to have your report in due course.

N. Zoltay.

NZ/kp
c.c. S. McCombie
G. Scott
N.D. Smith
W. Kinnear
R. Fitzgibbon

N. Zoltay,
for G. Scott,
Regional Bridge Location Engineer.

Rush

25/8/65

Bridge Division,
Downview, Ontario,
November 1, 1965.

MEMORANDUM:

To File

RE: Proposed structures on Hwy. 402, located 0.6 miles to 0.9 miles East of Hwy. 90.
District No. 1, Chatham.
W.P. 127-64, 128-64, 129-64, 131-64, 132-64, 309-64, 310-64, 669-64 and 670-64.

At a meeting between Mr. M. Devata of Foundations Branch and K. Emsi of Bridge Division, concerning the above structures held on October 28, 1965 at the Bridge Office, it was agreed that:

1. The spread footings for all the piers can be designed for a bearing capacity of 2½ tons/ft.^{2}.

2. The abutment piles for all the structures if driven in accordance with the recommendations given in the individual Foundation Reports, can be designed to carry 30 Tons/pile.

3. The structures should be designed to tolerate a maximum differential settlement between the abutments and shoulder piers in the order of ¼ to 1½ inches.

MEE/ag
c.c. A. G. Stermac
G. Scott

K. G. Emsi,
Bridge Project Engineer.

file

DEPARTMENT OF HIGHWAYS ONTARIO

MEMORANDUM

To: Mr. A. Stermac,
Principal Foundation Engineer,
Room 107,
Lab. Bldg.

From: Bridge Division,
Downsview, Ontario.

Date: August 30, 1965.

Our File Ref.

In reply to

Subject: W.P. 127-64, Site #6-232,
County Road to Puce Interchange,
Hwy. 401, District 1.

This will confirm the discussion between the Bridge Design Engineer and yourself concerning the foundations for the subject structure.

I understand that it has been agreed to design the bridge using simply supported spans and therefore it will not be necessary to place the approach fills 6 months prior to construction of the bridge.

Gavin Scott

GS/ds
c.c. S. McCombie
C. Grebski
F. C. Brown
W. G. Wigle
A. Gater

G. Scott,
Regional Bridge Location Engineer.

DEPARTMENT OF HIGHWAYS ONTARIO

65-F-75
W.P 127-64

MEMORANDUM

To: Mr. K.Y. Lo,
Supervising Foundation Engineer,
Room 107, Lab. Building.

From: Bridge Division,
Downsview, Ontario.

Date: June 17, 1965.

Our File Ref.

In reply to

Subject: W.P. 127-64
Site 6-232
County Road to Puce
Interchange # 4,
Highway #401 District # 1.

We are sending to you herewith two prints of Bridge Site Plan E-4353-1 on which we have marked in red the proposed location of the above structure.

The bridge site is readily accessible. It is 8.9 miles east of Highway #98. No problems are anticipated regarding the accommodation.

Please make the necessary arrangement for foundation investigation. We will be pleased to have your report in due course.

N. Zoltay,
for G. Scott,
Regional Bridge Location Engineer.

NZ/kp
c.c. S. McCombie
G. Scott
N.D. Smith
W. Kinnear
R. Fitzgibbon

Rush

W.P. 127-64 65-F-75

Note:
Query by Chester Grebski:
Can the proposed stage construction be dispensed with? If so causing serious planning problems.

Answer by phone August 25. 1965.

Yes! It is proposed to construct simply supported spans (AASHO prestressed concrete beams). By pouring the deck the structure becomes semi-continuous. Many bridges in that area are built the same way and no problems were encountered. Since the soil conditions are considered to be comparable it is believed that the settlements (predicted) may be on the high side.

For the completion of our records it would be advisable to have plates reinstated prior to full construction so that settlements could be recorded.

August 27. 1965 [illegible]

cc: Foundations Office(Rm. 110)

Mr. S. McCombie,
Bridge Planning Engineer,
Bridge Division.

Foundation Section,
Materials & Testing Div.,
Room 107, Lab. Bldg.

Attn: Mr. G. Scott

December 1., 1965

Preliminary Review of the Bridge Plans for the Proposed Structures on Hwy. 401, located 0.6 miles to 8.9 miles East of Hwy. 98, Hwy. 401, District No. 1 (Chatham) - W.P. 127-64, 128-64, 129-64, 309-64, 310-64, 669-64, and 670-64.

We have reviewed the preliminary bridge drawings for the above-mentioned structures. The foundation design for each structure appears to comply with recommendations contained in our foundation reports.

MD/MdeF

M. Devata,
SENIOR FOUNDATION ENGINEER
For:
A. G. Stermac,
PRINCIPAL FOUNDATION ENGINEER

cc: Foundations Office ✓

Gen. Files

DEPARTMENT OF HIGHWAYS ONTARIO

MEMORANDUM

To: Mr. A. Stermac,
Principal Foundation Engineer
Room 107, Lab. Bldg.

From: Bridge Division,
Downsview, Ontario.

Date: December 3, 1965.

Our File Ref.

In reply to

Subject:

W.P. 127-64, Site 6-232,
County Rd. to Puce Interchange No. 4,
8.9 miles east of Hwy. 98,
Hwy. 401, District 1.

We are sending to you herewith one print of Preliminary Plan D 5815-P1 of the above structure.

Would you please let us have your written comments.

N Zoltay.

NZ/ag
c.c. S. McCombie
G. Scott

N. Zoltay,
for G. Scott,
Regional Bridge Location Engineer.

Foundations Office

Mr. F. C. Brown,
District Engineer,
Chatham, Ontario.

Attn: Mr. P. Peacock.

Materials & Testing Division.

April 5, 1966.

Installation of Settlement Plates at the Approach fill locations on Hwy. 401, Dist. #1.

F Further to our telephone conversation, we are enclosing the list of various structure which are scheduled to be built in your district. We may wish to instrument some of these projects and request you to advise us at least two weeks prior to the commencement of approach fill construction of each project.

WP127-64 County Rd. to Puce Interchange No. 4 8.9 Miles East of Hwy. 98. 66-F-70

WP131-64 Sandwich S. Twp. Rd., Concession XI, Underpass 3.2 Miles East of Hwy. 98.

WP132-64 Essex County Rd. 27 Underpass 1.5 Miles East of Hwy. 98.

WP309-64 Maidstone Twp. Rd. Concession VII Underpass 7.1 Miles East of Hwy. 98.

WP310-64 Maidstone Twp. Rd. Concession IX Underpass 5.4 Miles East of Hwy. 98.

WP128-64 Maidstone Twp. Rd. Concession VI Underpass 8.0 Miles East of Hwy. 98.

WP129-64 Maidstone Twp. Rd. Concession XII Underpass 6.3 Miles East of Hwy. 98.

WP669-64 Sandwich S. Twp. Rd. Concession X Underpass 2.3 Miles East of Hwy. 98.

WP670-64 Sandwich S. Twp. Rd. Concession XII Underpass 0.6 Miles East of Hwy. 98.

M. Devata

MD/tt
cc: Foundations Office
Gen. Files

M. Devata
SENIOR FOUNDATION ENGINEER

For: A. G. Stermac
PRINCIPAL FOUNDATION ENGINEER

401 & Keele Street
Downsview, Ontario

October 4, 1967

Master Soil Investigation
104 Kenbar Drive
Weston, Ontario

Dear Sirs:

This is to confirm our request of Sept. 28, 1967 for the supply of a Diamond Drill together with all necessary equipment, as specified under the terms of our Contract Agreement, at County Rd. to Sheddon and Hwy. 401 near London, Ontario, on October 2, 1967.

This project bears Job Number 67-F-48, and 65-F-75.

Yours truly,

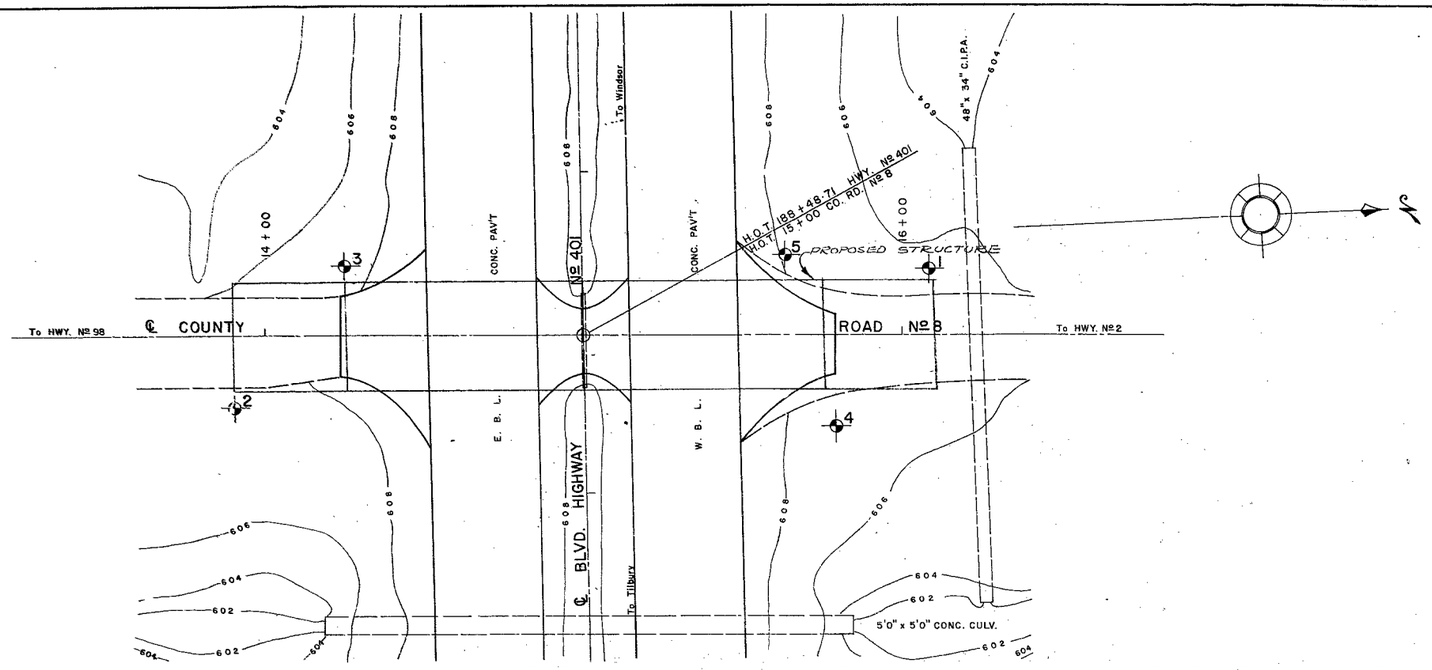
M. Devata

MD:mt

M. Devata
Supervising Foundation Engineer
for: A. G. Sterman
Principal Foundation Engineer

cc: E. Konings
Foundation Files
General File

#65-F-75
W.P.#127-64
HWY.#401 &
CTY. RD. TO
PUCE



PLAN

SCALE IN FEET

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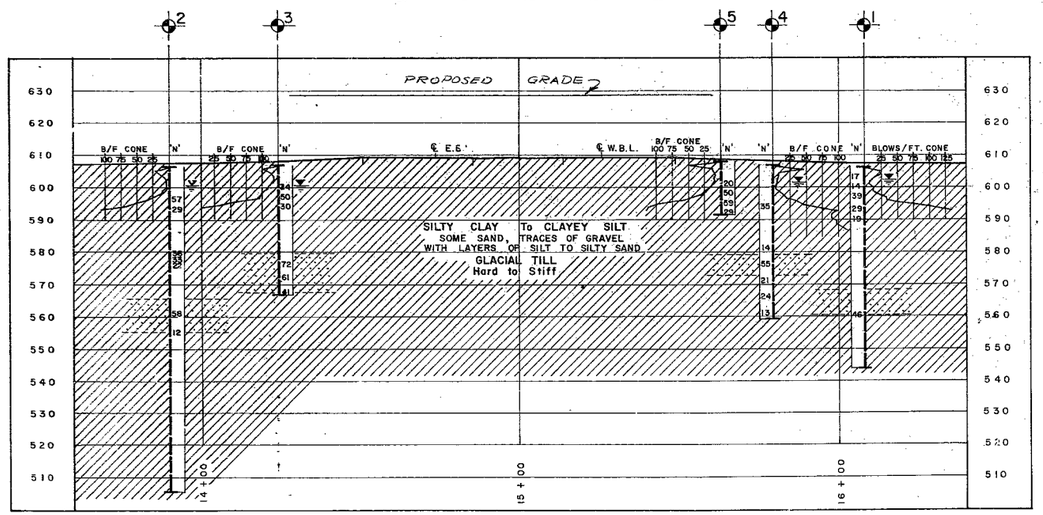

℄ PROFILE CO. RD. Nº8

SCALE IN FEET

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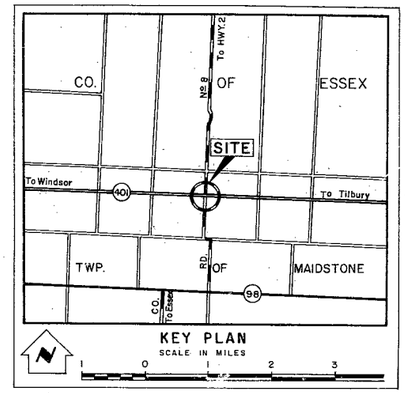

LEGEND

- Bore Hole
- Cone Penetration Hole
- Bore & Cone Penetration Hole
- Water Levels established at time of field investigation. July 1965

NO.	ELEVATION	STATION	OFFSET
1	606·5	16+08	21'LT.
2	606·5	13+90	22'RT.
3	606·0	14+25	22'LT.
4	607·5	15+79	28'RT.
5	608·0	15+63	25'LT.

– 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.

PRINT RECORD		
NO	FOR	DATE

REVISIONS		
DATE	BY	DESCRIPTION

DEPARTMENT OF HIGHWAYS – ONTARIO

MATERIALS & TESTING DIVISION – FOUNDATION SECTION

COUNTY ROAD Nº 8

KING'S HIGHWAY NO. 401 DIST. NO. 1

CO. ESSEX

TWP. MAIDSTONE LOT 17 CON. V – VI

BORE HOLE LOCATIONS & SOIL STRATA

SUBM'D L.P.	CHECKED	W.P. NO. 127 – 64	M.B.T. DRAWING NO. 65 – F – 75A
DRAWN D.G.H	CHECKED	JOB NO. 65-F-75	
DATE 17 AUG. /65		SITE NO	BRIDGE DRAWING NO.
APPROVED (PRINCIPAL FOUNDATION ENGINEER)		CONT. NO.	

REF. Nº E-4353-1