

MEMORANDUM

To: Mr. B. R. Davis,
Bridge Engineer,
Bridge Division,
Admin. Bldg.
Attention: Mr. S. McCombie

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

Date: April 8, 1968

Our File Ref.

In Reply To

SUBJECT:

FOUNDATION INVESTIGATION REPORT
For
Proposed Bridge Construction at the
Crossing of Chesapeake & Ohio Railway
And King's Hwy. #3
Proposed Rev. 'N' Line 'B'
District No. 1 (Chatham)
W.J. 68-F-5 -- W.P. 188-63-00

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

We believe that the factual data and recommendations contained therein, will prove adequate for your design requirements. Should additional information be required, please feel free to contact our Office.

AGS/MaeF
Attach.

cc: Messrs. B. R. Davis (2)
H. A. Tregaskes
D. W. Farren
W. Sonnenberg
F. C. Brown
A. P. Watt
J. Roy
B. A. Singh

Foundations Files
Gen. Files

A. G. Stermac
A. G. Stermac
PRINCIPAL FOUNDATION ENGINEER

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FOUNDATION INVESTIGATION REPORT
For
Proposed Bridge Construction at the
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Proposed Rev. 'N' Line 'B'
District No. 1 (Chatham)
W.J. 68-F-5 -- W.P. 188-63-00

1. INTRODUCTION:

A request for a foundation investigation at the site of the proposed new bridge at the crossing of Hwy. #3, proposed Rev. 'N' Line 'B', and Chesapeake & Ohio Railway, was received from Mr. A. P. Watt, Regional Bridge Location Engineer, in a memo dated January 18, 1968.

A field investigation was subsequently carried out by this Section to determine the subsoil conditions existing at the location of the proposed structure. Presented in this report are the results of this investigation, together with recommendations for the future structure foundations and approach embankments.

2. DESCRIPTION OF THE SITE:

The site is located on Hwy. #3, 1.5 miles east of Windsor, Ontario. The surrounding area is farmland with some buildings. The topography is flat.

Physiographically, the site is located in the region referred to as the St. Clair Clay Plain.

3. FIELD INVESTIGATION PROCEDURE:

A total of 6 borholes and 7 dynamic cone penetration tests, was carried out during the course of the field work. Boring was achieved by means of a Penn auger and diamond drilling equipment adapted for soil sampling purposes. Samples were recovered using a 2-inch O.D. split-spoon sampler driven according to the specifications of the Standard Penetration Test.

3. FIELD INVESTIGATION PROCEDURE: (cont'd.) ...

Samples were visually examined in the field and subsequently in the laboratory.

The locations and elevations of all boreholes were surveyed in the field by London Region Engineering Surveys Section, and are shown on Drawing 68-F-5A, which accompanies this report.

4. LABORATORY TESTS:

Laboratory tests were carried out on selected samples to determine Atterberg limits, natural moisture contents, grain-size distribution, bulk density, unconfined shear strength, consolidation characteristics, specific gravity, and chemical properties.

The results of tests carried out in the field and laboratory are plotted on the borehole logs which form part of this report.

5. SOIL TYPES AND SOIL CONDITIONS:

5.1) General:

The subsoil at the site consists of a stratum of clayey silt with sand and traces of gravel, some 125 ft. thick, underlain by limestone bedrock. The upper 15 - 20 ft. is generally harder than below, due to desiccation.

5.2) Clayey Silt with Sand and traces of Gravel (Till):

Below the topsoil, this deposit was encountered in all boreholes. The top 5 ft. of this material is brown in colour, being desiccated and oxidized.

Grain-size distribution tests have been run on samples of this material, indicating it to contain:

cont'd. /3 ...

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

Gravel	0	-	18%	Sand	25	-	48%
Silt	25	-	48%	Clay	8	-	35%

The physical properties of this layer are summarized as follows:

Liquid Limit	W_L	=	18.5 - 39.0%
Plastic Limit	W_P	=	11.5 - 18.6%
Moisture Content	W	=	9.4 - 29.0%
Specific Gravity	G	=	2.72 - 2.76
Bulk Density	δ	=	125 - 137 lb./ft. ³
pH Value		=	7.65 - 7.8
Organic Content		=	1.2%
Calcium Oxide Content		=	8.9 - 16.4%
Undrained Shear Strength:			
- Field Vane		=	960 - 1520 p.s.f.
- Sensitivity		=	1.2 - 2.1
- Unconfined Compression Test		=	900 - 2400 p.s.f.
- Triaxial Test		=	1100 - 2830 p.s.f.
- Standard Penetration 'N'		=	11 - 100 blows/ft.

Consolidation tests carried out on the undesiccated portion of the soil, indicate that the soil is preconsolidated. The estimated preconsolidation pressure is in the order of 3.5 t.s.f.

5.3) Bedrock:

Bedrock at this site was found to consist of generally sound limestone.

cont'd. /4 ...

6. GROUNDWATER CONDITIONS:

Groundwater observations were carried out in the boreholes during the field work. Based on these observations, the groundwater level is estimated to range between 622.7 and 624.4 at the time of investigation.

7. DISCUSSION AND RECOMMENDATIONS:

7.1) General:

It is proposed to construct a new bridge at this site to carry Hwy. #3, Line 'B' over the Chesapeake and Ohio Railway. The new bridge will be a three-span structure having equal spans of 46 ft. The proposed grade will be such that approach embankments some 32 ft. maximum height, will be required.

As described in the previous paragraphs of this report, the subsoil at the site consists of a deep deposit of clayey silt with sand and traces of gravel. The upper 15 - 20 feet of this deposit is desiccated and has a consequent very stiff to hard consistency. Below this zone the material decreases in shear strength and has a firm to very stiff consistency. In view of the foregoing, it is concluded that the most economical type of foundations for the new structure would be spread footings founded in the desiccated zone of the subsoil at elevations as high as is possible. Due to the fact that the subsoil is a compressible cohesive material, settlements are anticipated to occur over a long-term period. The structure must therefore be designed so as to withstand the resulting differential settlements. The various aspects of the proposed structure are outlined in detail below.

7.2) Piers:

It is recommended that the proposed piers be supported on spread footings founded within the upper desiccated subsoil layers. At or below the following elevations, a safe pressure of 2.5 t.s.f. may be assumed for design purposes.

East Pier	:	El. 619.0
West Pier	:	El. 619.0

cont'd. /5 ...

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

7.2) Piers: (cont'd.) ...

Assuming a design pressure of 2.5 t.s.f. and a long footing of width 8 ft., settlements have been calculated by conventional methods. The maximum calculated settlements at the footing centres are as follows:

Elastic (instantaneous)	: 1.5 inches
Consolidation	: <u>1.5 inches</u>
Total	3.0 inches

Based on experience with similar structures and similar subsoil conditions in the Windsor and Sarnia area, it is believed that the actual total settlement will not exceed 1-1/2 inches and will be about 50% complete within 2 years.

7.3) Abutments:

The proposed abutments may be supported on spread footings within the desiccated zone of the soil at the following elevations:

East Abutment	: El. 619.0
West Abutment	: El. 618.0

A safe pressure of 2.5 t.s.f. may be assumed for design purposes.

As an alternative, the abutments may be constructed within the approach fills and supported on 12-3/4 inch O.D. x 1/4 inch wall steel tube piles driven to el. 617.0. A design load of 30 tons per pile may be assumed in this case. Due to the fact that the subsoil decreases in strength below the desiccated zone, piles must not be driven lower than el. 617.0.

cont'd. /6 ...

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

7.3) Abutments: (cont'd.) ...

As a second alternative, the abutments may be supported on spread footings placed on well compacted granular fill material. The height of this granular fill will be dependent on the dimensions of the structure and may be any convenient height. The minimum requirements for the granular fill are detailed on Fig. 1 of this report. The granular material should consist of G.B.C. Class 'A' material and should be fully compacted according to the current D.H.C. method. A design pressure of 2.0 t.s.f. may be assumed for the abutment footings in this case.

Regardless of which of the above methods is used to support the abutments, settlement of the underlying cohesive subsoil is likely to occur due to the weight of the approach fill and the weight of the bridge. Assuming a bulk density of 130 p.c.f. for the fill material and the footing and pile loads as recommended above, the magnitudes of the maximum settlements have been calculated using conventional methods. The results of the calculations are as follows:

Elastic (instantaneous)	:	4 inches
Consolidation	:	<u>13 inches</u>
Total		17 inches

Based on experience with similar structures and similar subsoil conditions, it is believed that the actual total maximum settlement of the bridge abutments will be in the order of about 4 inches, 50% of which should occur during the first two years.

7.4) Structure Approaches:

No stability problems are anticipated with regard to the proposed structure approaches provided that they are constructed with 2:1 side slopes and according to the pertinent D.H.O. standards.

cont'd. /7 ...

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

7.4) Structure Approaches: (cont'd.) ...

Settlements of the subsoil below the embankments will occur over a long-term period and these are estimated to be in the order of 4 inches under the maximum fill height of 32 feet. 50% of this amount should occur within 2 years. This settlement should not be confused with the settlement which may occur within the fill itself and will be additional to it.

Excavations -

No dewatering problems are anticipated with regard to the excavations required for footings. It is recommended, however, that all footing bases be protected immediately after exposure by means of a suitable working slab, since the soil rapidly loses strength on contact with water.

7.5) General Recommendations for the Structure and Approaches:

Based on the foregoing, the following general recommendations are made with regard to the design and construction of the proposed structure:

(1) Embankments should be constructed as far in advance of the structure as is possible. This will result in the minimum differential settlements.

(2) The structure should be designed so as to be able to withstand differential settlements between piers and abutments of not less than 3 inches.

8. MISCELLANEOUS:

The field work for this project was carried out during the period February 21 - March 8, 1968, under the supervision of Mr. S. Nassif, Project Foundation Engineer, who also prepared this report. Equipment used was owned and operated by Canadian Longyear Ltd.

This report was reviewed by Mr. K. G. Selby, Supervising Foundation Engineer.

APPENDIX I

DEPARTMENT OF HIGHWAYS - ONTARIO

MATERIALS & TESTING DIVISION

JOB 68-F-5

LOCATION Hwy. #3 Sta. 541 + 15, 41' Rt. of C

FOUNDATION SECTION

W.P. 188-63-00

BORING DATE Feb. 22, 1968

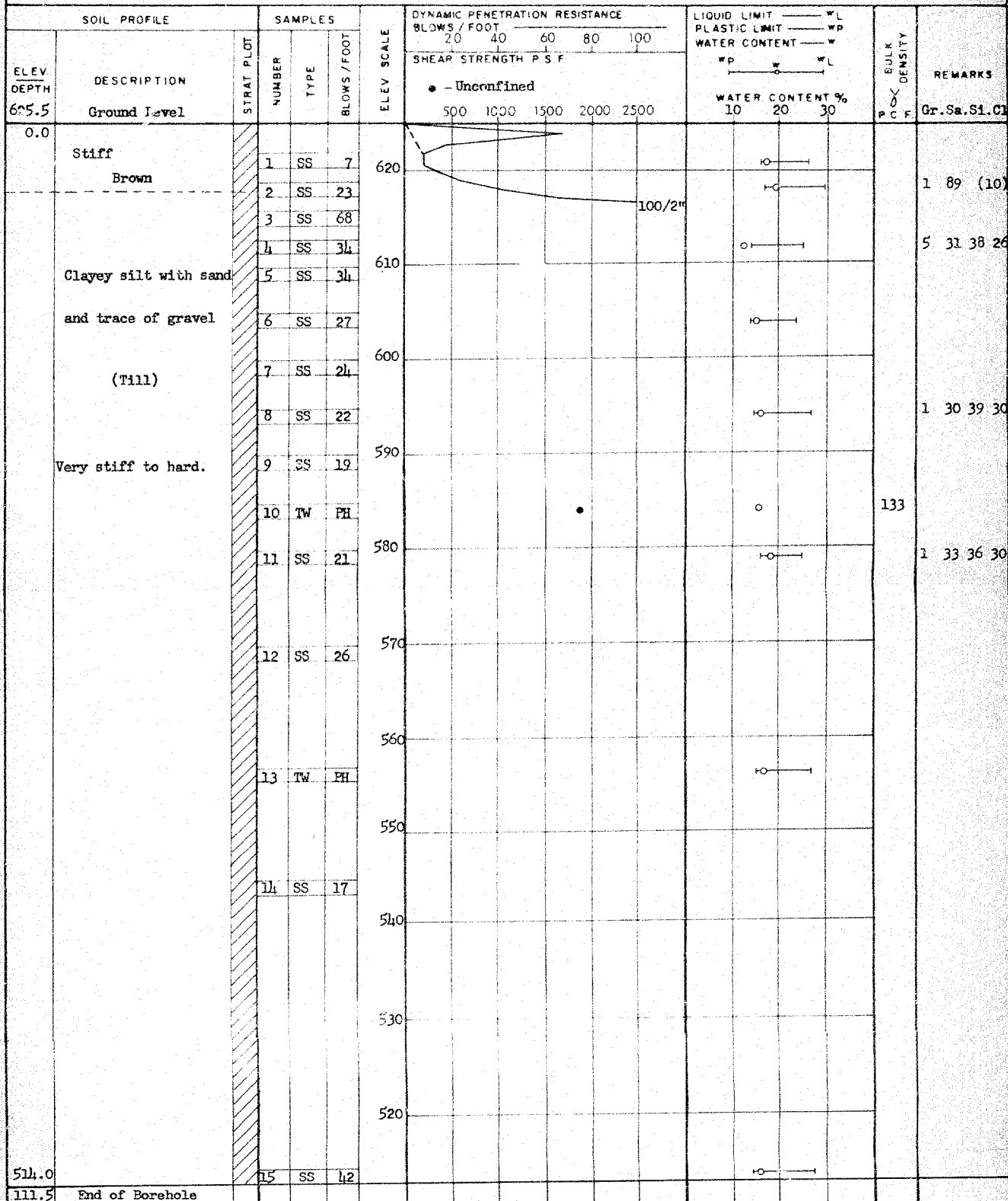
ORIGINATED BY SN

DATUM Geodetic

BOREHOLE TYPE Pendrill

COMPILED BY SN

CHECKED BY



DEPARTMENT OF HIGHWAYS - ONTARIO

RECORD OF BOREHOLE NO. 2

FOUNDATION SECTION

MATERIALS & TESTING DIVISION

108 68-F-5

LOCATION Hwy. #3 Sta. 540 + 81, 44' Lt. of E

ORIGINATED BY SN

W. P. 188-63-00

BORING DATE Feb. 26, 1968

COMPILED BY: _____ SN

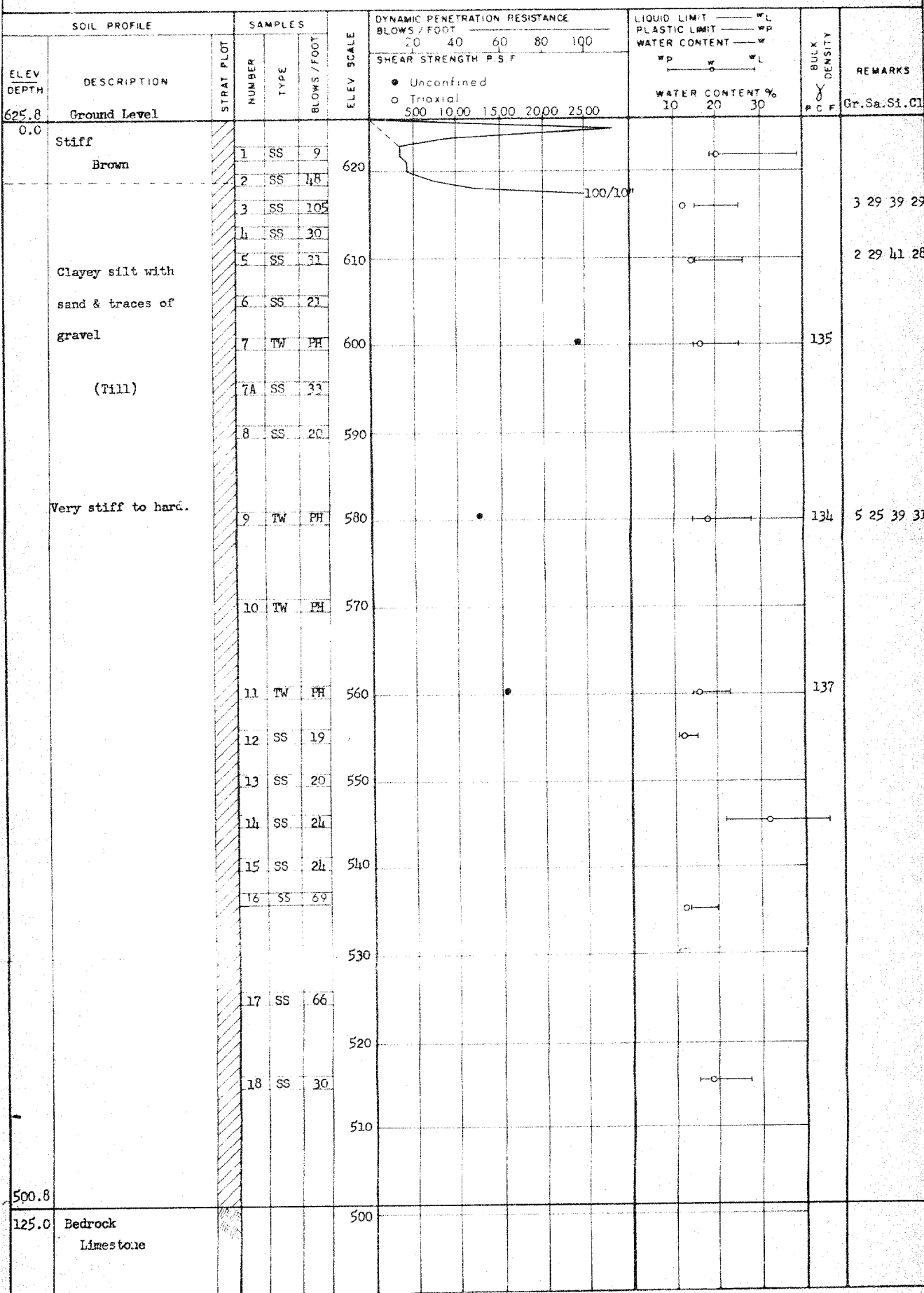
DATUM Geodetic

BOREHOLE TYPE Conc Penetration

CHECKED BY

[illegible]

DEPARTMENT OF HIGHWAYS - ONTARIO		RECORD OF BOREHOLE NO. 3		FOUNDATION SECTION	
MATERIALS & TESTING DIVISION		LOCATION Hwy. # 3 Sta. 540 + 71 2h' Lt. of G		ORIGINATED BY SN	
JOB 68-P-5		BORING DATE Feb. 26, 1968		COMPILED BY SN	
W.P. 188-63-00		BOREHOLE TYPE Pandrill		CHECKED BY	
DATUM Geodetic					



DEPARTMENT OF HIGHWAYS - ONTARIO

RECORD OF BOREHOLE NO. 4

FOUNDATION SECTION

MATERIALS & TESTING DIVISION

68-F-5

LOCATION Hwy. #3, Sta. 540 + 86 29' Rt. of E

ORIGINATED BY: SN

W P 188-63-00

BORING DATE Feb. 29, 1968

COMPILED BY SN

DATUM Geodetic

BOREHOLE TYPE Auger Pendrill

CHECKED BY

SOIL PROFILE		SAMPLES			DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT	LIQUID LIMIT ——— W _L PLASTIC LIMIT ——— W _P WATER CONTENT ——— W	BULK DENSITY	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FOOT	SHEAR STRENGTH P.S.F.	WATER CONTENT % 10 20 30	
625.5	Ground Level							
0.0	Clayey silt with sand & traces of gravel. (Till) Very stiff to hard.		1	SS	7			1 33 31 35
			2	SS	88			2 30 42 26
			3	SS	76			
			4	SS	76			
			5	SS	40			
			6	SS	42			
			7	SS	24			
			8	SS	22			
589.0			9	SS	18			
36.5	End of Borehole							

DEPARTMENT OF HIGHWAYS - ONTARIO

RECORD OF BOREHOLE NO. 5

FOUNDATION SECTION

JOB	68-F-5	LOCATION	Hwy. #3 Sta. 540 + 22 39' Rt. of Ø	ORIGINATED BY	SN
W.P.	188-63-00	BORING DATE	Feb. 2, 1968	COMPILED BY	SN
DATUM	Geodetic	BOREHOLE TYPE	NX & BX Casing with Diamond Drill	CHECKED BY	SL

[illegible]

FOUNDATION SECTION

ORIGINATED BY SN

COMPILED BY SN

CHECKED BY let

SOIL PROFILE		SAMPLES	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT	LQUID LIMIT — W _L PLASTIC LIMIT — W _P	BULK DENSITY	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT PLOT NUMBER TYPE BLOWS / FOOT	ELEV SCALE	SHEAR STRENGTH P.S.F.	WATER CONTENT %	Gr. Sa. Sl. Cl.
				o Triaxial • Unconfined	p L — p — L	
626.9	Ground Level					
0.0	Stiff	1 SS 11	620			3 26 39 32
	Brown	2 SS 16				
616.9		3 SS 71				G=2.76
10.0	Clayey silt with sand & traces of gravel.	4 SS 62	610			
	(Till)	5 SS 64				
		6 SS 25	600			
		7 SS 26				
		8 SS 37	590			135
	Very stiff to hard.	9 TW PM				132 G=2.72
		10 TW PM	580			133
		11 TW PM				
		12 TW PM	570			133
		13 SS 25				8 38 44 10
		14 SS 21	560			
		16 TW PM	550			125
		17 SS 77	540			
		18 SS 69	530			
		19 SS 72	520			
			510			
499.9			500			
127.0	Bedrock Limestone					

DEPARTMENT OF HIGHWAYS - ONTARIO		RECORD OF BOREHOLE NO. 8		FOUNDATION SECTION	
MATERIALS & TESTING DIVISION		LOCATION <u>Hwy. #3 Sta. 539 + 76 38' Rt. of R</u>		ORIGINATED BY <u>SN</u>	
JOB <u>68-F-5</u>		BORING DATE <u>March 5, 1968</u>		COMPILED BY <u>SN</u>	
W. P. <u>130-63-00</u>		BOREHOLE TYPE <u>Cone Penetration</u>		CHECKED BY <u>11</u>	
DATUM <u>Geodetic</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		
626.0	Ground Level													
0.0														
617.1						620								
8.9	End of Cone Test									100/11"				
						610								
						600								

Q ABUT BRG'S

Q PIER

46'

PROPOSED GRADE

FILL

AS PER D.H.C. STANDARDS

20' MIN

10' MIN

COMPACTED FILL

G.B.C. CLASS 'A' MATERIAL

2:1

TOPSOIL REMOVED

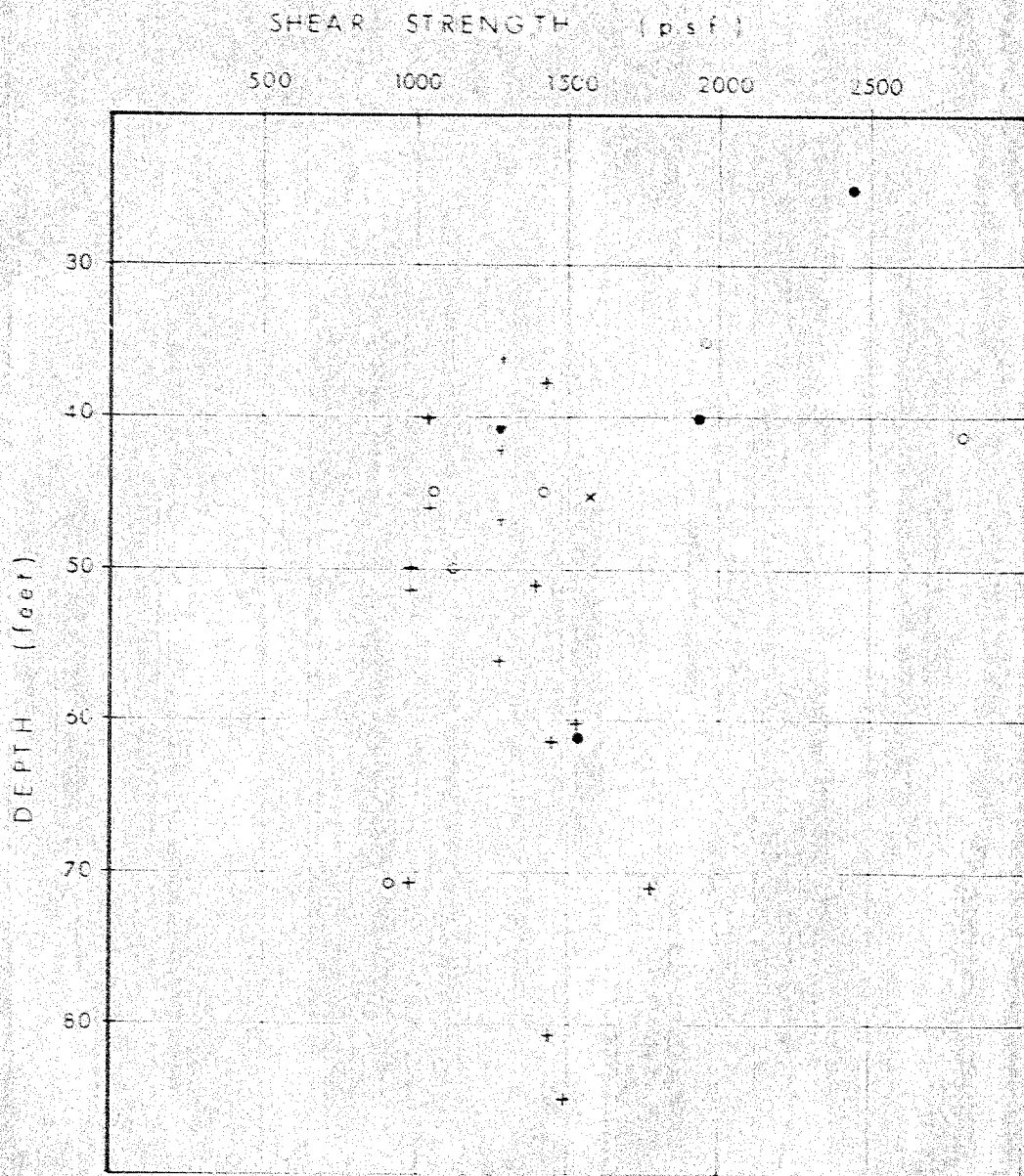
SPREAD FOOTINGS ON COMPACTED FILL

WP No 188-63-00

JOB No 68-F-5

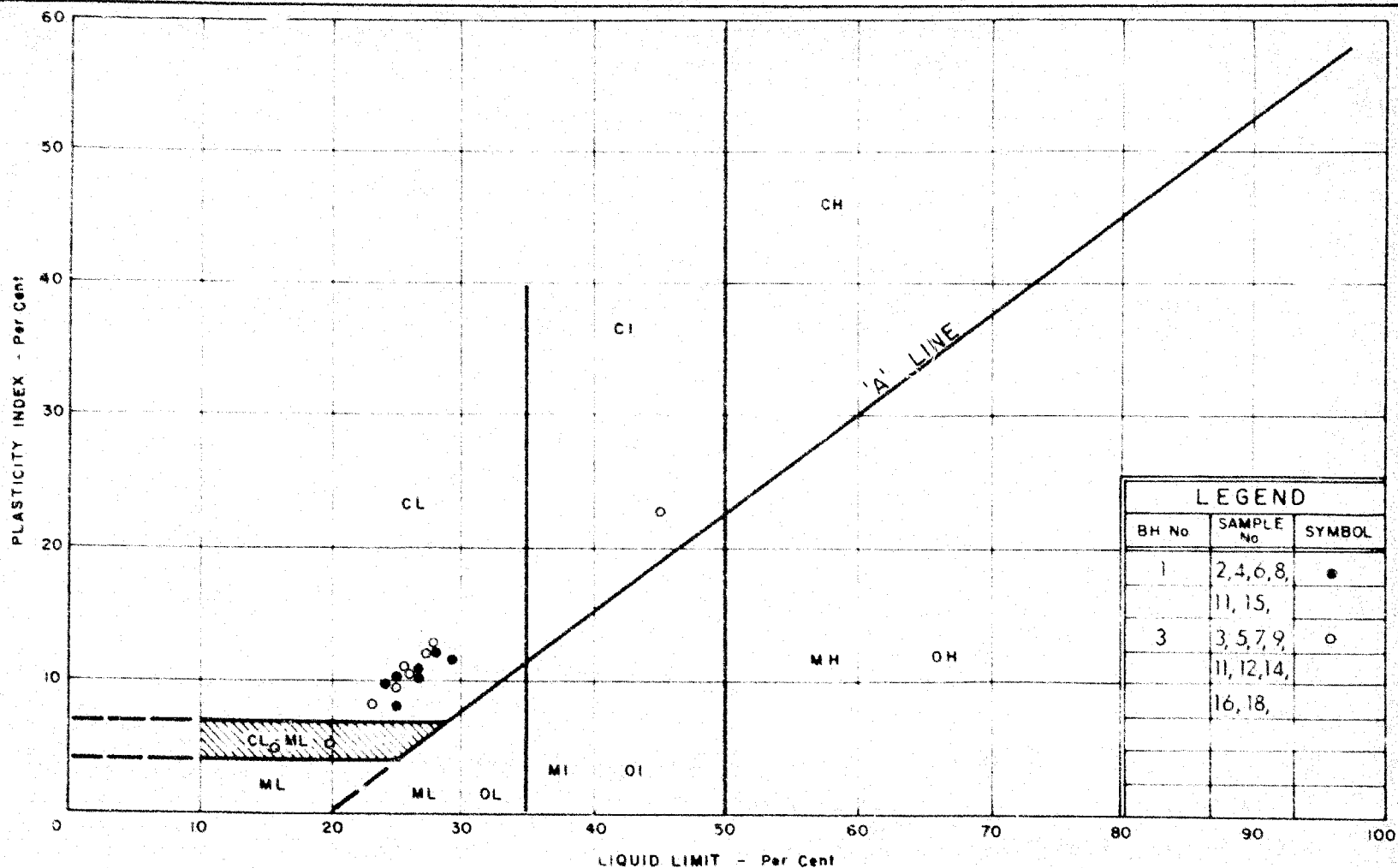
FIG No 1

SHEAR STRENGTH v.s. DEPTH



- o Triaxial Shear Strength
- Unconfined Shear Strength
- + Field Vane
- x Lab Vane

W P No 188-63-00
 JCB No 68-F-5
 FIG No *2



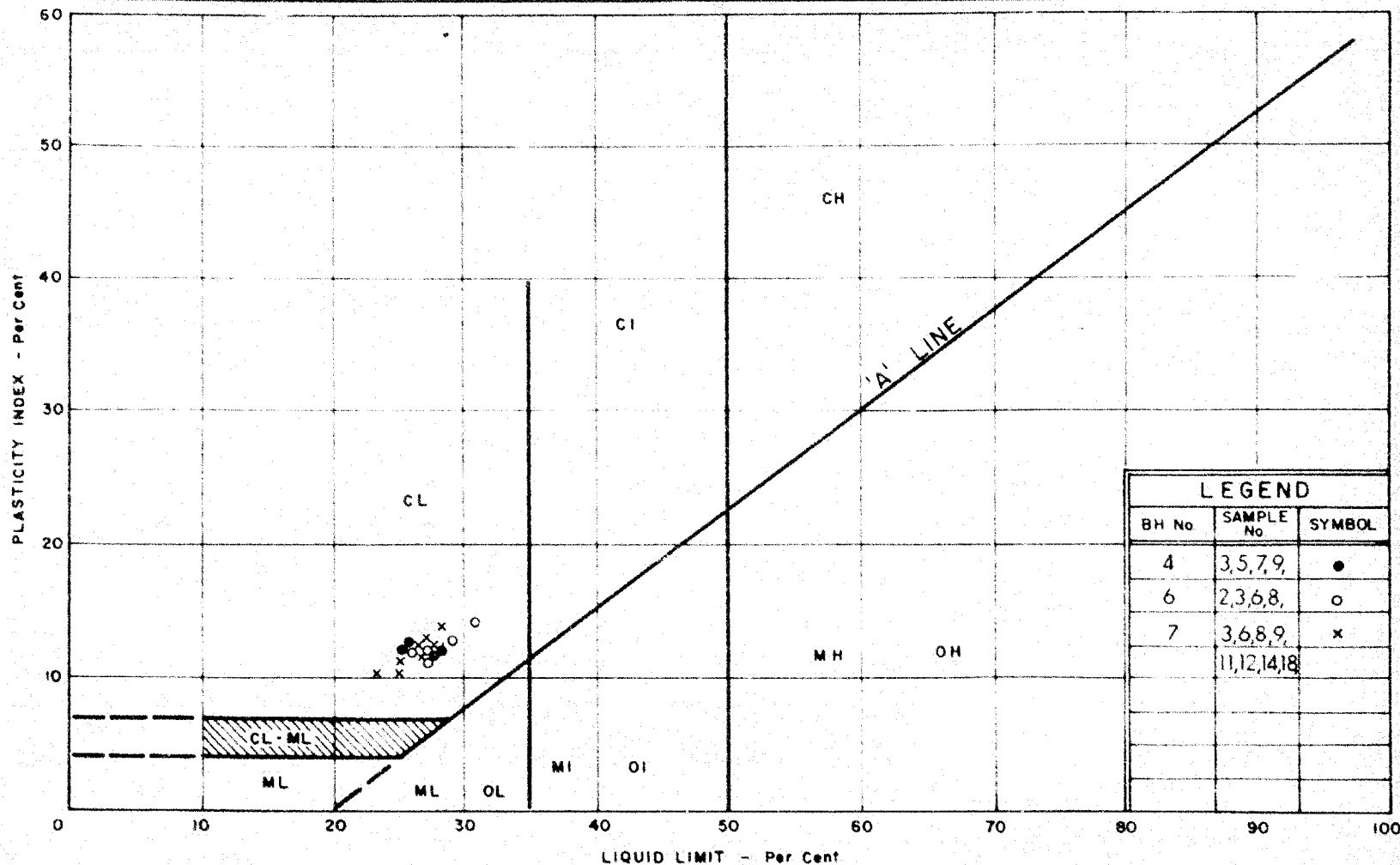
DEPARTMENT OF HIGHWAYS
MATERIALS and
TESTING
DIVISION

PLASTICITY CHART
CLAYEY SILT
(GLACIAL TILL)

WP No. 188 - 63 - 00

JOB No. 68 - F - 5

FIG. No. 3



DEPARTMENT OF HIGHWAYS
MATERIALS and
TESTING
DIVISION

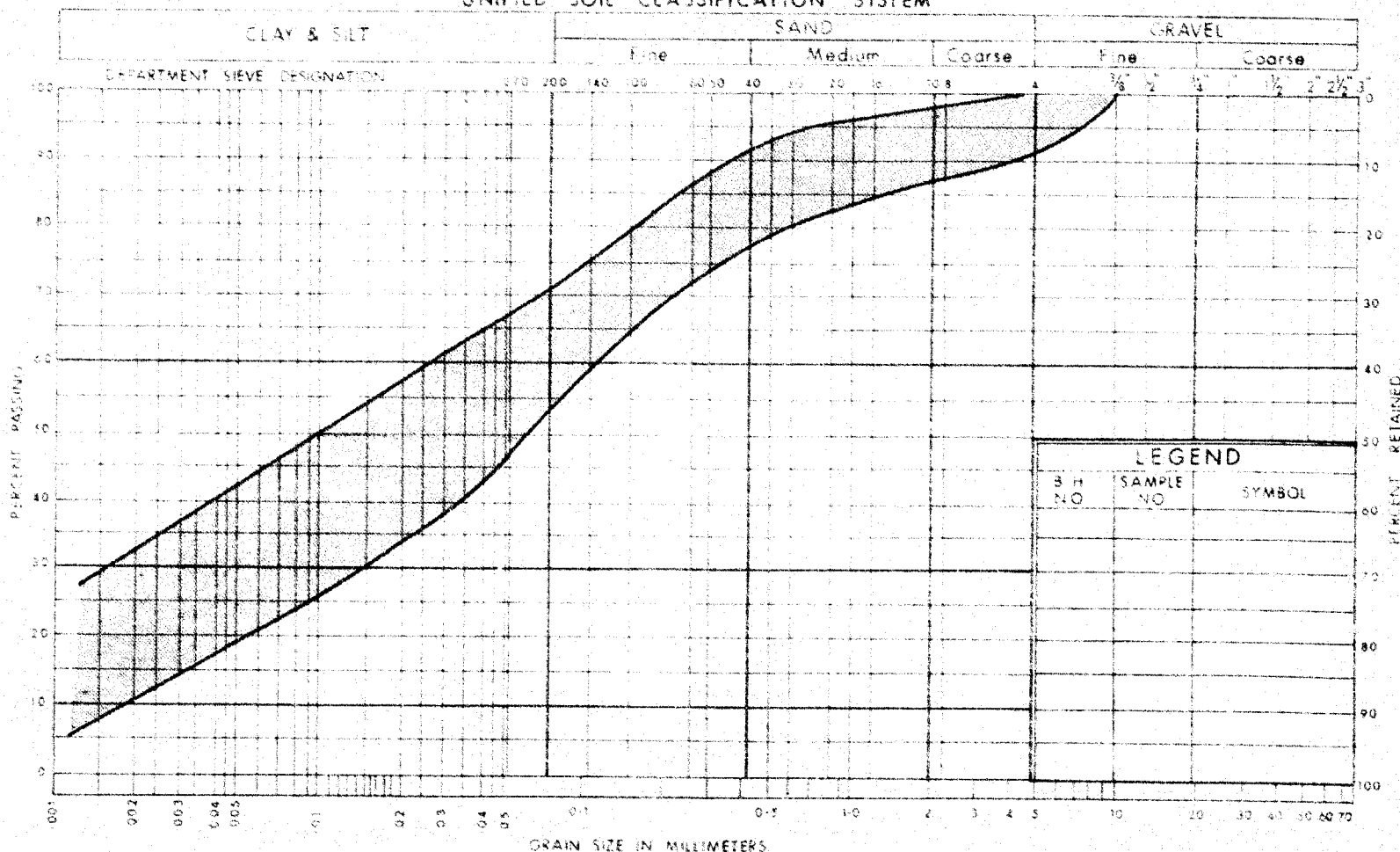
PLASTICITY CHART CLAYEY SILT (GLACIAL TILL)

WP No. 188-63-00

JOB No. 68-F-5

FIG. No. 4

UNIFIED SOIL CLASSIFICATION SYSTEM



DEPARTMENT OF HIGHWAYS
MATERIALS and
TESTING
DIVISION

GRAIN SIZE DISTRIBUTION
CLAYEY SILT
WITH SAND & TRACES OF GRAVEL
(GLACIAL TILL)

WP No. 188-63-00

JOB No. 68-F-5

FIG No. 5

VOID RATIO
VS
PRESSURE

JOB 68-F-5
BORE HOLE 5
SAMPLE 11
DEPTH 40'

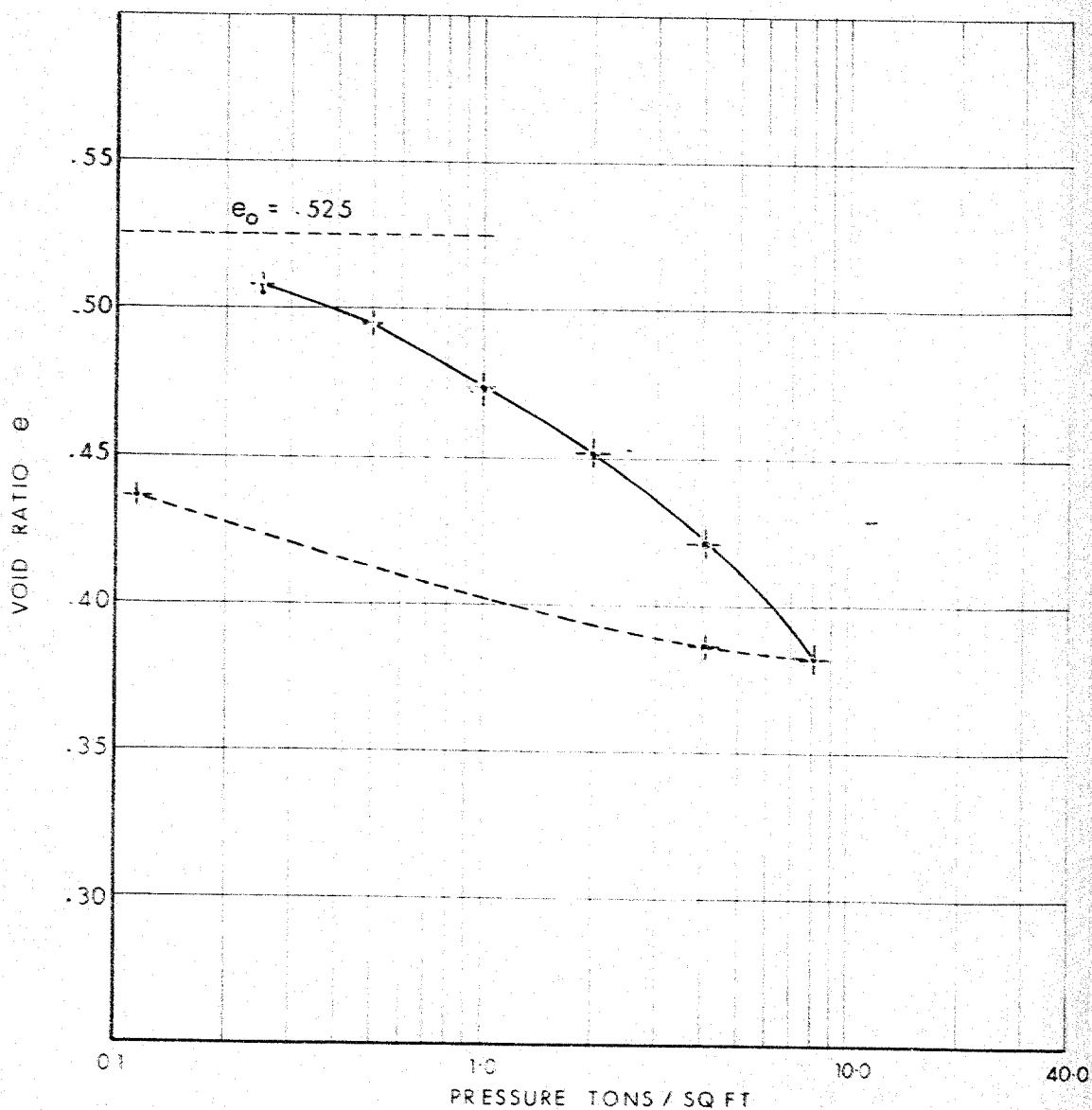


FIG 6

VOID RATIO
VS
PRESSURE

JOB 68-F-5
BORE HOLE 7
SAMPLE 16
DEPTH 75'11"

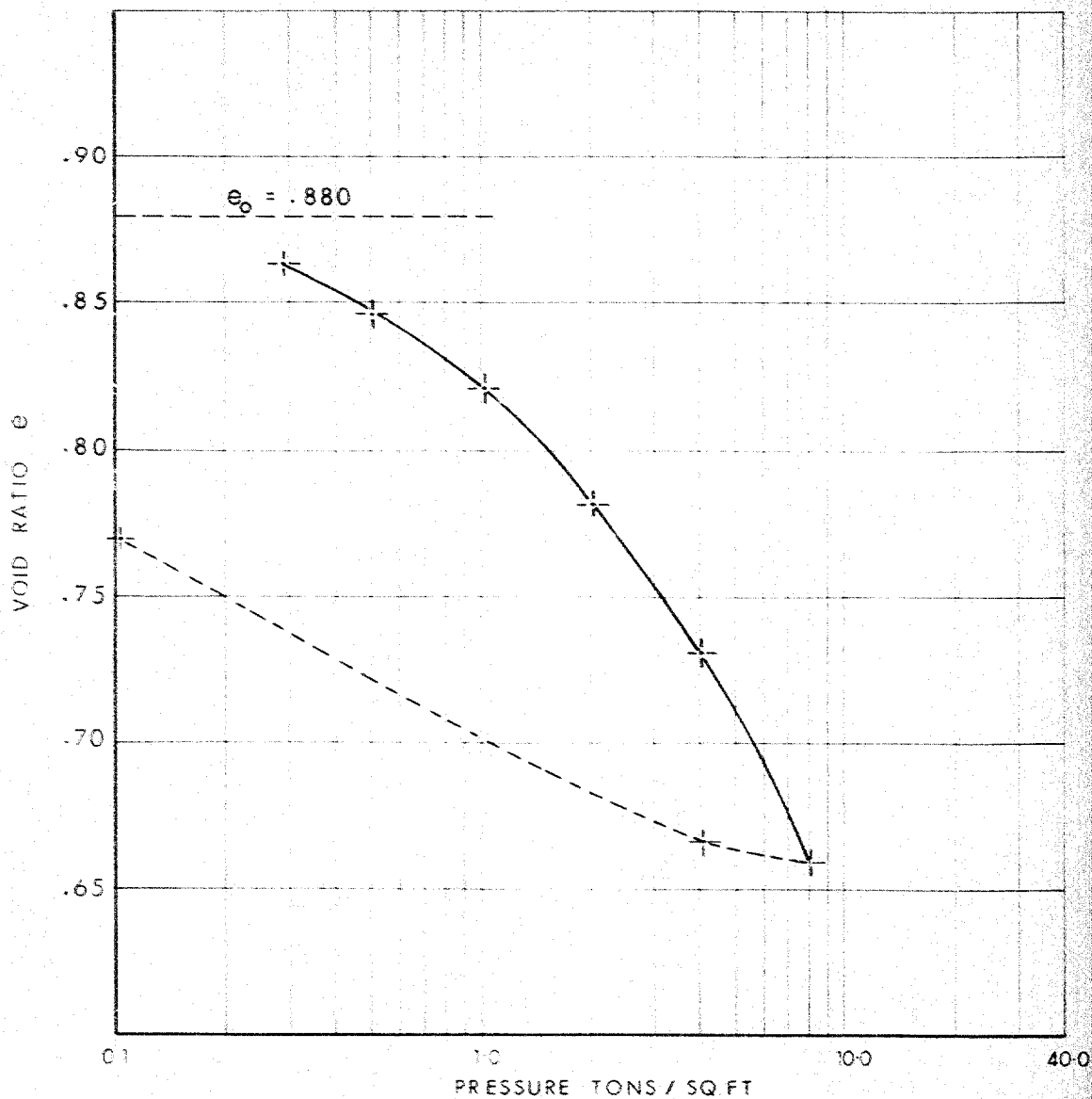


FIG 7

VOID RATIO
VS
PRESSURE

JOB 68-F-5
BORE HOLE 7
SAMPLE 11
DEPTH 45' 11"

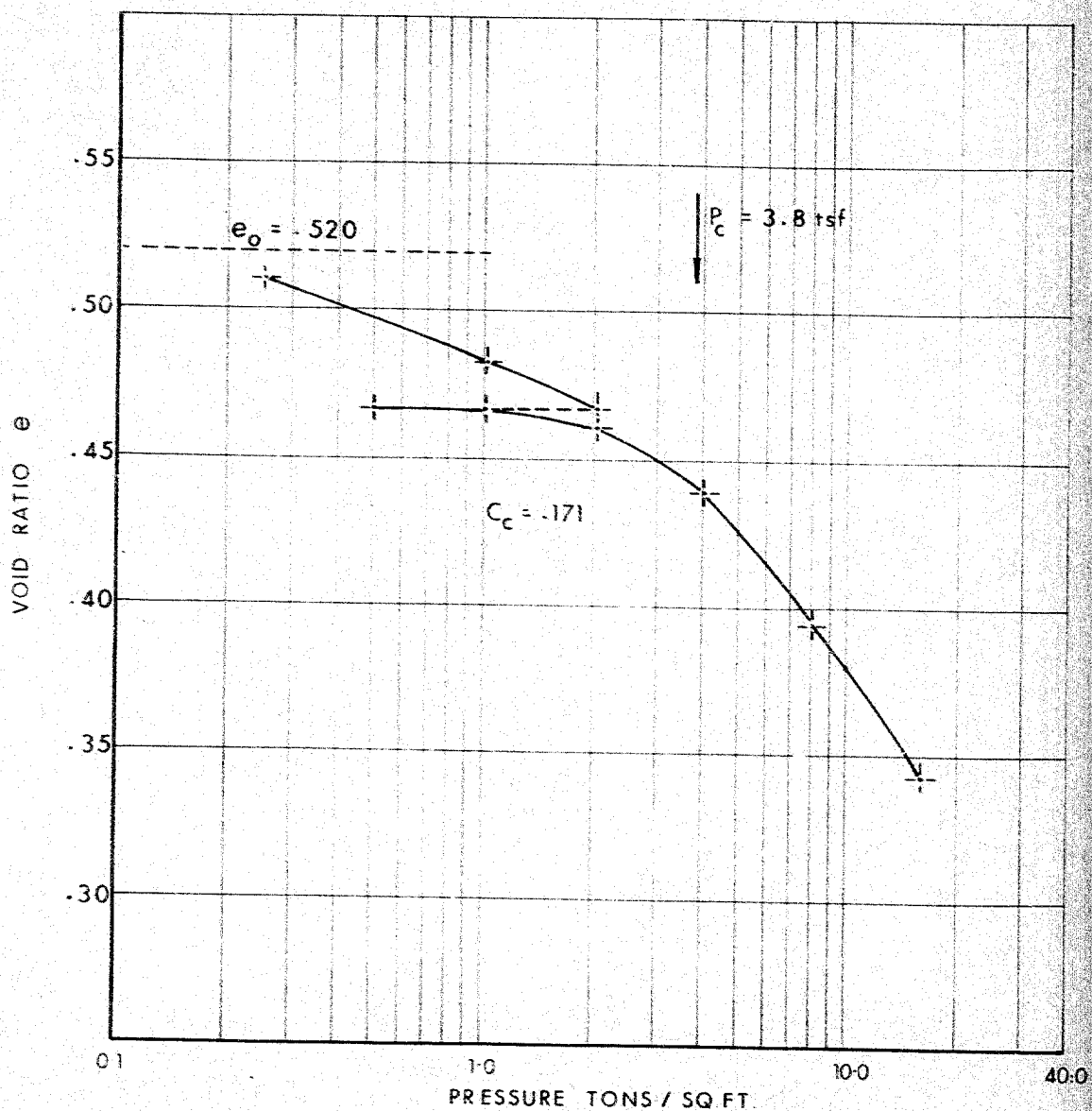


FIG. 8

VOID RATIO
VS
PRESSURE

JOB 68-F-5
BORE HOLE 3
SAMPLE 10
DEPTH 56' 4"

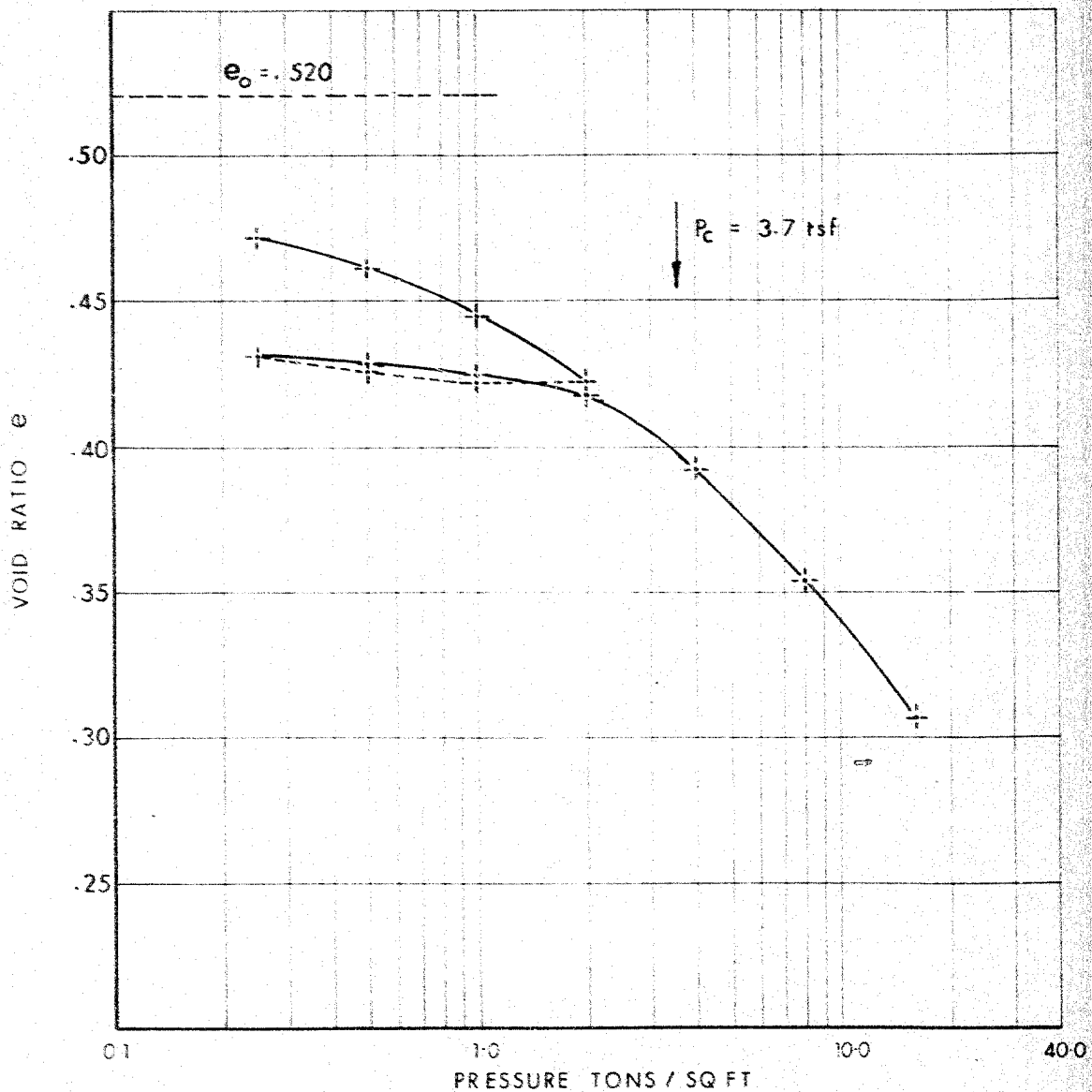


FIG 9

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:-

<u>CONSISTENCY</u>	<u>'N' BLOWS / FT.</u>	<u>c LB. / SQ. FT.</u>	<u>DENSENESS</u>	<u>'N' BLOWS / FT.</u>
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

SS	SPLIT SPOON	TW	THINWALL OPEN
WS	WASHED SAMPLE	TP	THINWALL PISTON
SB	SCRAPER BUCKET SAMPLE	CS	OESTERBERG SAMPLE
AS	AUGER SAMPLE	FS	FOIL SAMPLE
CS	CHUNK SAMPLE	RC	ROCK CORE
ST	SLOTTED TUBE SAMPLE		
	P.H. SAMPLE ADVANCED HYDRAULICALLY		
	P.M. SAMPLE ADVANCED MANUALLY		

SOIL TESTS

Qu	UNCONFINED COMPRESSION	LV	LABORATORY VANE
Q	UNDRAINED TRIAXIAL	FV	FIELD VANE
Qcu	CONSOLIDATED UNDRAINED TRIAXIAL	C	CONSOLIDATION
Qd	DRAINED TRIAXIAL	S	SENSITIVITY

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 SUBMERSED 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_s	SHEAR STRENGTH
c'	EFFECTIVE COHESION INTERCEPT
ϕ'	EFFECTIVE ANGLE OF SHEARING RESISTANCE OR FRICTION
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
$\log_e a$ 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
$\bar{\sigma}$	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 (YOUNG'S 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_0	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

68-F-5

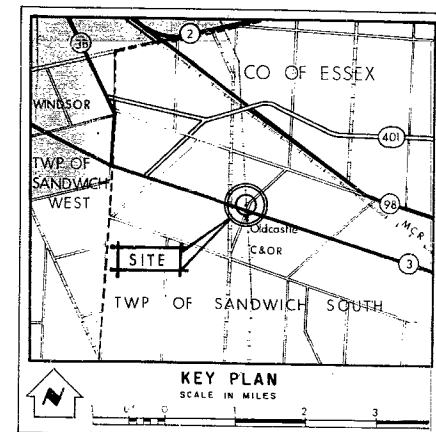
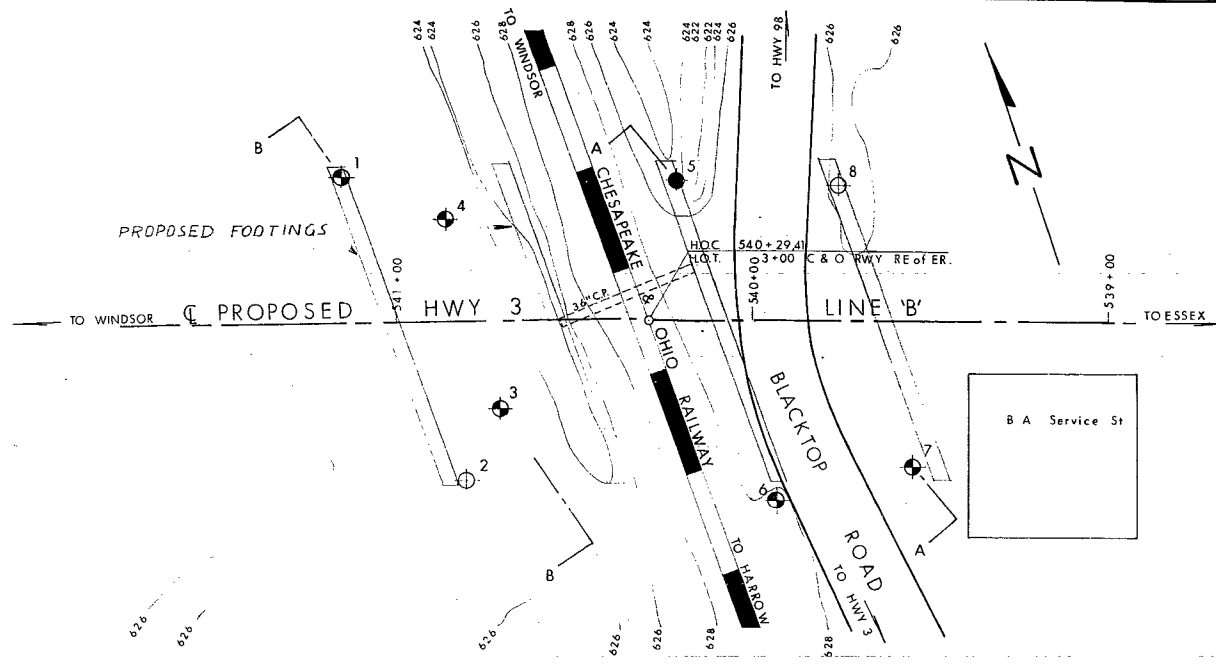
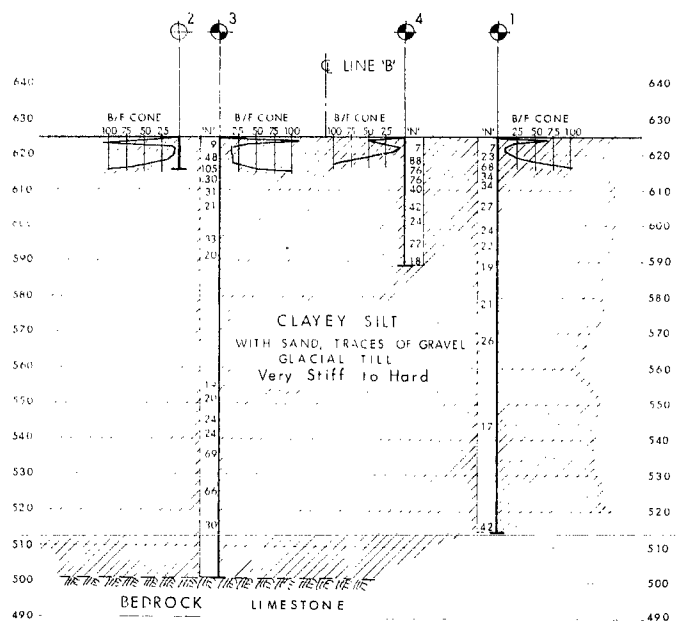
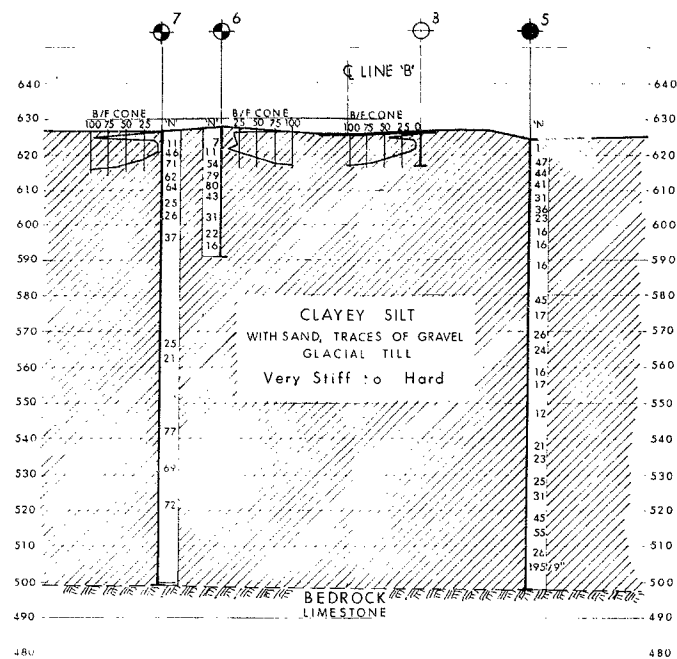
W.P. # 188-63-00

HWY # 3 LINE 'B'

CHESAPEAKE

& OHIO

RAILWAY



LEGEND			
	Bore Hole		
	Cone Penetration Hole		
	Bore & Cone Penetration Hole		
	Water Levels established at time of field investigation, FEB. 1968		

NO.	ELEVATION	STATION	OFFSET
1	625.5	541+15	41' RT
2	626.0	540+81	44' LT
3	625.8	540+71	24' LT
4	625.5	540+86	29' RT
5	624.5	540+22	39' RT
6	628.1	539+93	50' LT
7	626.9	539+55	41' LT
8	626.0	539+76	38' 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.

DATE	BY	DESCRIPTION

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

CHESAPEAKE & OHIO RAILWAY

KING'S HIGHWAY NO. 3 LINE 'B' DIST. NO. 1
CO. ESSEX
TWP. SANDWICH SOUTH LOT 302 CON. N. TALBOT RD.

BORE HOLE LOCATIONS & SOIL STRATA

SUBM'D. S.N.	CHECKED	W.P. NO. 188-63-00	M.S.T. DRAWING NO.
DRAWN A.B.	CHECKED	JOB NO. 68-F-5	68-F-5 A
DATE MARCH 27, 1968	SITE NO.	BRIDGE DRAWING NO.	
APPROVED <i>[Signature]</i>	CONT. NO.		

REF. NO. E-4815-1