

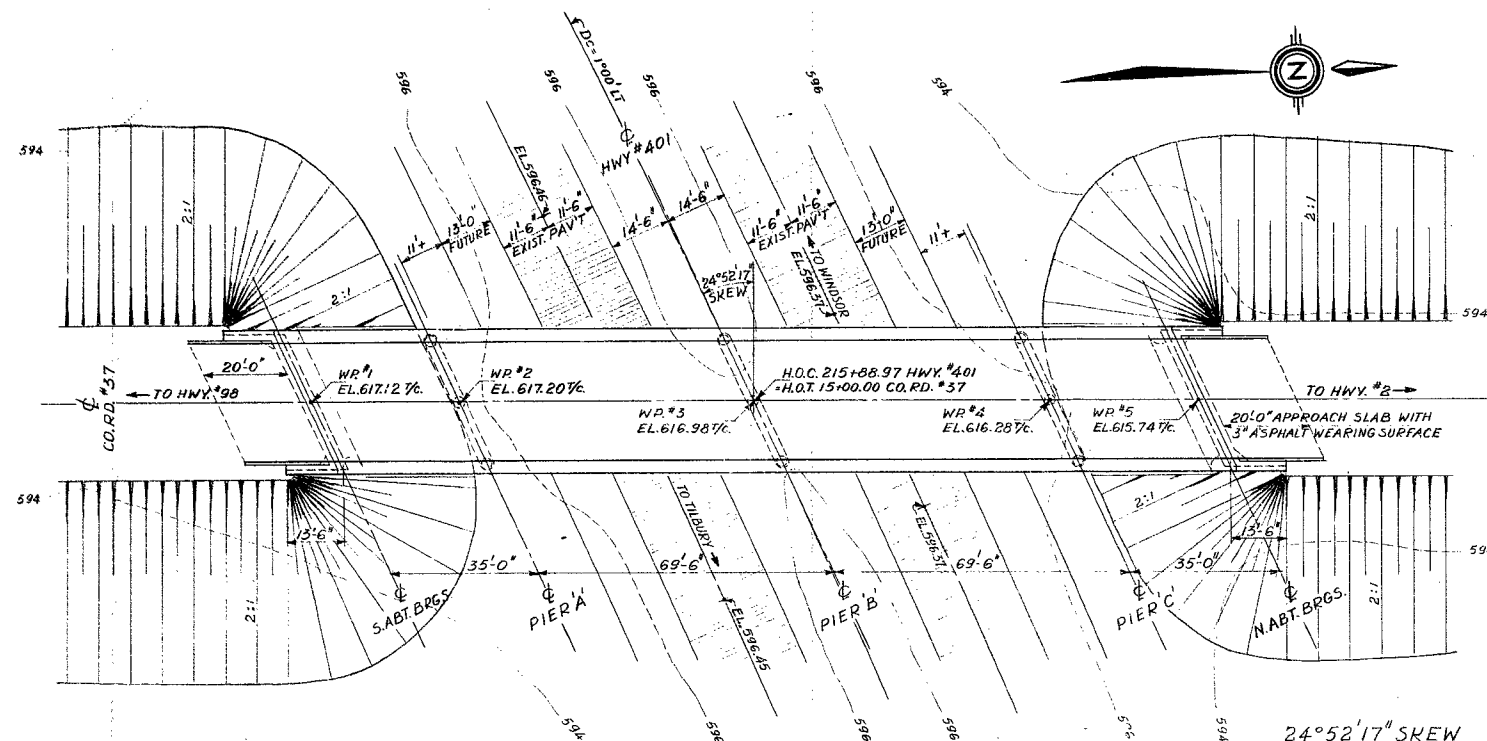
#67-F-104

W.P. #146-66-02

HWY. #401

COUNTY RD. 37

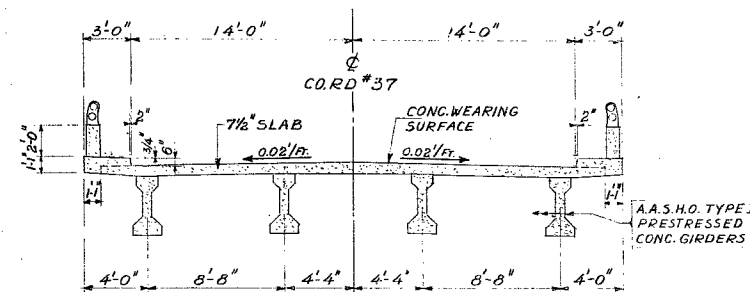




NOTE: \*% DENOTES ELEVATIONS ARE TO TOP OF CONCRETE WEARING SURFACE  
\*WP DENOTES WORKING POINT

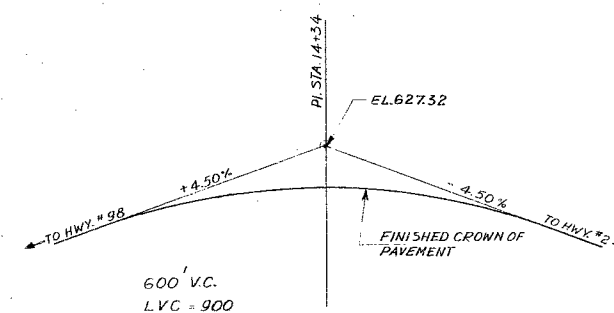
### PLAN

SCALE: 1" = 20'-0"



### TYPICAL DECK SECTION

SCALE: 1/16" = 1'-0"



### PROFILE OF COUNTY RD. #37

NOT TO SCALE

### NOTES

#### CLASS OF CONCRETE

DECK, CURBS AND PARAPET WALLS 4000 p.s.i.  
REMAINDER 3000 p.s.i. OR AS NOTED

#### CLEAR COVER ON REIN. STEEL

FOOTINGS, ABUTMENTS, PIERS, DECK: TOP, BOTTOM, 3" 2" 1 1/2"  
DIAPHRAGMS, CURBS, PARAPET WALLS, APP. SLABS, 1 1/2" 2" 1 1/2"  
AND/OR AS NOTED ON DRAWINGS

#### CONSTRUCTION NOTES

THE CONTRACTOR IS RESPONSIBLE FOR FINISHING THE BEARING SEATS DEAD LEVEL TO THE SPECIFIED ELEVATIONS WITH A TOLERANCE OF ± 1/8" INCH.  
NO CONCRETE SHALL BE PLACED ABOVE THE ABUTMENT BEARING SEATS UNTIL THE CONCRETE IN DECK HAS BEEN PLACED

B.M. ELEV. 593.64  
GEODETIC DATUM: CUT + ON W. EDGE OF C.B.  
ON & AT STA. 212+30.00 HWY. #401

REVISIONS	DATE	BY	DESCRIPTION
1			

DEPARTMENT OF HIGHWAYS ONTARIO  
BRIDGE DIVISION

### COUNTY ROAD #37 UNDERPASS

2.5 MILES EAST OF HIGHWAY #77 - INTERCHANGE #7

KING'S HIGHWAY No. 401 (M.C. FREEWAY) DIST. No. 1  
CO. ESSEX  
TWP. TILBURY NORTH LOT 12 & 13 CON. 4

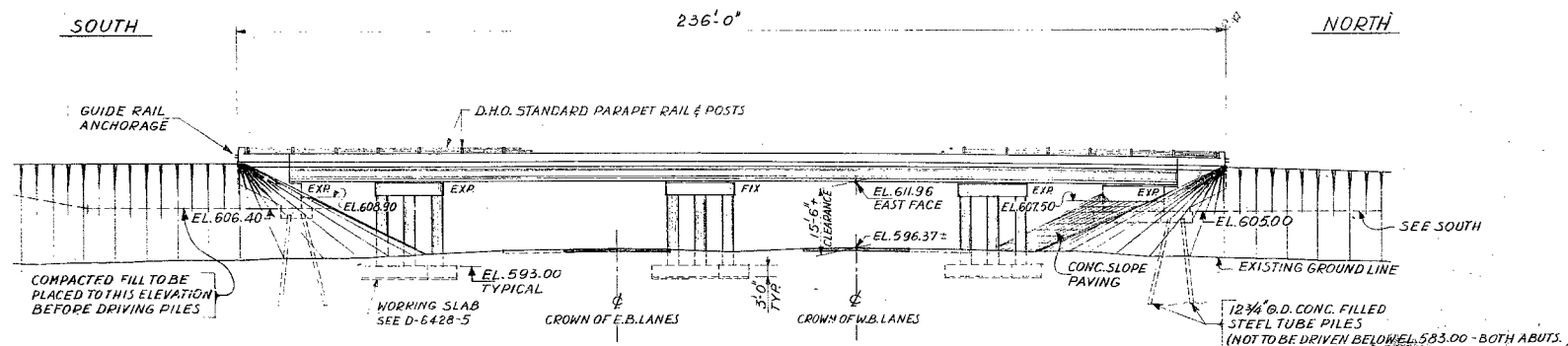
### GENERAL LAYOUT

APPROVED	BRIDGE ENGINEER	SITE No. 6-257	W.P. No. 146-66-02
DESIGN J.Sz./J.L.R.	CHECK J.L.R.	CONTRACT Nos.	
DRAWING J.Sz.	CHECK J.Sz.	DRAWING No.	D-6428-1
DATE JUL 7/68	LOADING HS20-44		

### LIST OF DRAWINGS

- D-6428-1 GENERAL LAYOUT
- 2 BORE HOLE LOCATIONS & SOIL STRATA
- 3 FOUNDATION LAYOUT
- 4 ABUTMENTS
- 5 PIERS
- 6 PRESTRESSED GIRDERS & BEARINGS
- 7 DECK
- 8 PARAPET WALL DETAILS
- 9 APPROACH SLABS
- 10 STANDARD STEEL PARAPET RAILS
- 11 STANDARD DETAILS
- 12 DETAILS OF CONC. SLOPE PAVING

PRINT RECORD  
No. FOR DATE

### ELEVATION

SCALE: 1" = 20'-0"





## MEMORANDUM

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

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

Attention: Mr. S. McCombie

DATE: December 20, 1967

Our File Ref.

IN REPLY TO

JAN - 9 1968

SUBJECT:

FOUNDATION INVESTIGATION REPORT  
For  
Proposed Underpass at the Crossing of  
County Rd. 37 and Hwy. 401  
District No. 1 (Chatham)  
W.J. 67-F-104 -- W.P. 146-66-02

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/MdeF

Attach.

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

Foundations Files  
Gen. Files ✓

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

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1. INTRODUCTION.
  2. DESCRIPTION OF SITE AND GEOLOGY.
  3. FIELD AND LABORATORY WORK.
  4. SOIL TYPES AND CONDITIONS:
    - 4.1) General.
    - 4.2) Silty Clay to Clayey Silt.
  5. GROUNDWATER CONDITIONS.
  6. DISCUSSION AND RECOMMENDATIONS:
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    - 6.2) Approach Embankments.
  7. SUMMARY.
  8. MISCELLANEOUS.
-

**FOUNDATION INVESTIGATION REPORT**  
**For**  
**Proposed Underpass at the Crossing of**  
**County Rd. 37 and Hwy. 401**  
**District No. 1 (Chatham)**  
**W.J. 67-F-104 -- W.P. 146-66-02**

---

**1. INTRODUCTION:**

The Foundation Section was requested to carry out an investigation for the proposed underpass at the crossing of Hwy. 401 and County Rd. 37 in the Township of Tilbury N., County of Essex. The request was contained in a memo from the Bridge Location Section (Mr. A. P. Watt, Regional Bridge Location Engineer), dated October 26, 1967. An investigation was subsequently carried out by this Section to determine the subsoil conditions existing at the site.

This report contains the results of the investigation, together with recommendations pertaining to the foundations of the new structure and the stability of the approach embankment.

**2. DESCRIPTION OF SITE AND GEOLOGY:**

The site is located about 2.5 miles east of Hwy. 77, Interchange #7, on Hwy. 401. At this location, the 401 grade is about 3 to 4 ft. above the surrounding ground surface elevation. The highway consists of four paved lanes with a median strip and associated gravel shoulders. Along each side of the highway there is a drainage ditch, 2 to 3 ft. below the surrounding ground surface elevation. The grade of the existing county road is at about the same elevation as the surrounding ground level. The immediate area is generally flat farmland with some farm buildings along the county road.

Geological information available indicates that the site is located within the physiographic region known as the "St. Clair Clay Plains". The overburden in this area is composed

cont'd. /2 ...



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

of cohesive glacial till sheets deposited during the most recent periods of glaciation; this till has been encountered for depths varying from 120 to 200 ft. At localized areas the till sheets have been smoothed by shallow deposits of lacustrine clay which settled in the depressions. The overburden is underlain by either limestone or black shale bedrock of the Devonian Period, Palaeozoic Era.

3. FIELD AND LABORATORY WORK:

Five sampled boreholes and seven dynamic cone penetration tests were carried out during the course of the recent field work.

Boring was achieved by means of a Penn. Drill adapted for soil sampling purposes. Samples were recovered at required depths in 2-inch O.D. split-spoon samplers which were hammered into the soil, or in 2-inch I.D. Shelby tubes.

The Shelby tubes were pushed manually or hydraulically into the cohesive deposit wherever possible. The method of driving the split-spoon sampler conformed to the requirements of the Standard Penetration Test. The same method was used to advance the cone in the dynamic cone penetration test. Where possible, field vane tests were carried out at various depth intervals in order to determine the undrained shear strength of the cohesive strata. During sampling and drilling operations, detailed logs of the borings were made which described drilling and sampling techniques, soil types encountered, and groundwater conditions.

The locations and elevations for all borings were surveyed in the field by personnel from the London Region Engineering Surveys, and are shown on Dwg. #67-F-104A, together with the estimated stratigraphical profile.

All samples were subjected to a careful visual inspection in the laboratory prior to any tests being carried out. Following this inspection, tests were carried out on certain samples to

cont'd. /3 ...

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

determine the following physical properties of the various soil types:

Atterberg Limits  
Natural Moisture Contents  
Bulk Densities  
Grain-Size Distributions  
Consolidation Characteristics  
Undrained Shear Strengths

The results of these tests are summarized and plotted on the Record of Borelog sheets contained in the Appendix of the report.

On completion of laboratory testing, the various soil samples were classified as to soil type and consistency, or relative density, in general, according to the Unified Soil Classification System (Oct. 1963).

4. SOIL TYPES AND CONDITIONS:

4.1) General:

The predominant stratum across the site is a hard to firm silty clay to clayey silt; this stratum is greater than 100 ft. in thickness. The subsoil conditions are shown on the Record of Borelog sheets contained in the Appendix of the report. The estimated stratigraphical profile shown on Dwg. #67-F-104A is inferred from this information.

4.2) Silty Clay to Clayey Silt:

The site is covered by a surficial mantle of silty clay topsoil some 6 to 8 inches thick. Directly underlying the topsoil, an extensive deposit of silty clay to clayey silt was encountered, extending at least 118 ft., which was the maximum depth sampled. In B.H.'s #1 and #3, dynamic cone penetration tests were performed

cont'd. /4 ...

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

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

from 118 ft. to 127 ft. The results of these tests indicate the cohesive stratum extends at least to this depth. The deposit was found to be generally uniform as evidenced by the fact that the Atterberg limits are relatively constant with minor variations with depth. The material in the deposit is classified as silty clay to clayey silt with minor percentages of sand and gravel. The upper 3 to 5 ft. of the stratum has a trace of organic matter throughout.

The desiccated crust was found to be in a very stiff to hard preconsolidated state down to 30 ft. Physical properties of the overall deposit are as follows:

	Upper Zone <u>Desiccated Crust</u> (Approximately 30 ft.)	Lower Zone (30 - 118 ft.)
Bulk Density ( $\gamma$ ) (p.c.f.)	129 - 131	124 - 126
Liquid Limit ( $W_L$ ) (%)	33 - 42	30 - 39
Sensitivity ( $S_t$ )	-	1.5 - 2.5
Standard Penetration Tests ( $N$ ) (blows/ft.)	15 - 73	25 - 27
Plastic Limit ( $W_p$ ) (%)	18 - 22	17 - 21
Moisture Content ( $W$ ) (%)	16 - 21	16 - 27
Undrained Shear Strength ( $C_u$ ) (p.s.f.)	1900 - 3200	600 - 1800

Atterberg limits are plotted on the Plasticity Chart and indicate that the stratum is predominantly inorganic and of low to intermediate plasticity. The results of the undrained

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

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

shear strength in the laboratory as well as in situ tests in the field, indicate that the consistency of the stratum varies from firm to stiff immediately below the crust and changing mainly to stiff with depth. A graph showing a relationship between shear strength vs. depth indicates that the clay deposit is pre-consolidated to a depth of some 60 ft. below the ground surface. Below this depth the deposit appears to be normally consolidated.

Typical grain-size distribution curves obtained from the samples of this deposit are shown in the Appendix of this report. In addition, the results of the consolidation test performed on 3 representative samples of the clay obtained from B.H.'s #1 and #5, are also shown in the Appendix.

5. GROUNDWATER CONDITIONS:

Groundwater levels were observed during the period of the field investigation. It is estimated that the water level is at about elevation 592 which corresponds with the water level observed in a drainage ditch southwest of the site. The exact water levels observed at the time of investigation are shown on the borelogs included in the Appendix of this report.

6. DISCUSSION AND RECOMMENDATIONS:

6.1) General:

It is proposed to construct an underpass structure to carry County Rd. 37 over Hwy. 401. Present proposals call for a four-span (35'-69'-69'-35') structure with approach fills having a maximum height about 21 ft. above the existing Hwy. 401 grade.

Subsoil at the site consists of an extensive deposit of firm to hard silty clay to clayey silt covered by a thin layer of topsoil.

cont'd. /6 ...

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

6.1) General: (cont'd.) ...

Since the upper 30 ft. of subsoil consists of a very stiff to hard silty clay to clayey silt, conditions are favourable for spread footing support and, in the case of the proposed piers, it is recommended that the footings be placed at elevation 590 - i.e., some 4 to 6 ft. below the existing ground surface - with an allowable bearing pressure of 2.5 t.s.f.

The proposed abutments may be constructed within the approach fills; two alternative methods are given for the foundation support of the abutments:

I) Abutments can be founded on spread footings founded on a compacted granular (G.B.C. Class 'A') material using a safe bearing pressure of 2.0 t.s.f. The granular fill should extend for a horizontal distance of at least 10 ft. 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 should be completed to about profile grade for a distance of about 50 ft. behind the abutments before re-excavating for the abutment footing. Prior to the construction of granular fills, all organic topsoil within this area should be removed.

II) Abutments can be supported on 12-3/4" O.D. closed-end tubular piles driven about 10 ft. into the upper desiccated zone - i.e., to about elevation 583. For piles driven to this depth, a design load of 20 tons per pile can be used.

Care should be taken to ensure that no bouldery fill is placed at the locations through which piles have to be driven.

cont'd. /7 ...

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

6.1) General: (cont'd.) ...

In the past, several structures have been constructed in this area by the Department, with similar subsoil conditions. These structures were designed to tolerate a maximum differential settlement between abutments within the approach fills and end piers in the order of 1 to 1-1/2 inches, and the maximum differential settlement between the centre and end piers in the order of 1/2 to 1 inch. According to available information, the structures built in this area, designed for these differential movements, appear to be in a satisfactory condition. At the proposed structure location, it is estimated that the differential settlements will also be of the same order and we, therefore, recommend that the proposed structure be designed to tolerate the aforementioned differential settlements.

No major dewatering problems are anticipated during the construction of the pier footings, in view of the low permeable nature of the subsoil; however, care should be taken to prevent softening of the subsoil of the foundation levels by the surface run-off. In this regard, it is recommended that the foundation base be protected by pouring a mat of lean concrete as soon as subgrade level is reached.

6.2) Approach Embankments:

The proposed approach embankments will be some 21 to 23 ft. above existing ground surface. No stability problems are anticipated for embankments constructed of properly compacted fill, and with standard 2:1 slopes.

7. SUMMARY:

A foundation investigation for the proposed structure at the crossing of County Rd. 37 and Hwy. 401 is reported.

Subsoil at the site consists of a thin topsoil deposit

cont'd. /8 ...

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

underlain by a deep deposit of firm to hard silty clay to clayey silt.

Pier foundations for the structure should be supported on spread footings at elevation 590 where a safe bearing pressure of 2.5 t.s.f. can be applied.

The abutments can be founded: 1) within a zone composed of properly compacted granular fill using an allowable bearing pressure of 2.0 t.s.f., or 11) on 12-3/4" O.D. closed-end pipe piles driven about 10 ft. below surface.

The anticipated settlements of the structure foundations and approach fills are discussed in the section "Discussion and Recommendations".

No major dewatering problems are anticipated for the pier footing excavations.

No stability problems are anticipated for the approach fills with standard 2:1 slopes.

8. MISCELLANEOUS:

The field work, performed during the period November 6 to 20, 1967, was undertaken by Mr. P. B. Schnabel, Project Foundation Engineer, who also prepared this report.

The equipment was owned and operated by Dominion Soil Investigation Ltd.

The work was carried out under the general supervision of Mr. M. Devata, Supervising Foundation Engineer, who also reviewed this report.

December 1967

APPENDIX I



DEPARTMENT OF HIGHWAYS - ONTARIO  
MATERIALS & TESTING DIVISION

RECORD OF BOREHOLE NO. 1

FOUNDATION SECTION

JOB 67-F-104 LOCATION 401 & County Rd. 37 ORIGINATED BY PBS  
W.P. 146-66-02 BORING DATE Nov. 9, 1967 COMPILED BY PBS  
DATUM Geodetic BOREHOLE TYPE Auger CHECKED BY HL

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT					LIQUID LIMIT — WL PLASTIC LIMIT — WP WATER CONTENT — W			BULK DENSITY Y P.C.F.	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FOOT		20	40	60	80	100	WP	W	WL		
							SHEAR STRENGTH P.S.F. + Field Vane									
							o Unconfined									
							500	1000	1500	2000	2500	WATER CONTENT %				
							20	40	60				20	40		
594.7	Ground Level															
593.9	Topsoil															
	Silty clay to clayey  silt with some sand  & occasional gravel.  (traces of organics in upper 4 to 5 ft.)  Firm to hard.		1	TW	PM	590									125	1.7% Org.
			2	TW	PH						3210				128.5	
			3	SS	68											
			4	SS	56											
			5	SS	26	580										
			6	TW	PM										130	
			7	TW	PM	570										
			8	TW	PM										128	
			9	TW	PM	560										
			10	TW	PM				+1.8							
			11	TW	PM	550			+1.7							
			12	TW	PM				+2.1							
			13	TW	PM	540			+2						124	Gr.2, Sa.15 Sl.43, Cl.40
			14	TW	PM				+1.6							
			15	TW	PM	530			+2							
			16	TW	PM				+1.3						125	
			17	TW	PM	520			+1.8							
			18	TW	PM				+1.7							
			19	TW	PM	510			+1.8						126	
			20	TW	PM				+2.4							
			21	TW	PM	500			+1.8							
483.2			22	TW	PH	490									125	
111.5	End of sampled borehole.					480										
468.1						470										
126.6	End of Borehole															

DEPARTMENT OF HIGHWAYS - ONTARIO

MATERIALS & TESTING DIVISION

RECORD OF BOREHOLE NO. 2

FOUNDATION SECTION

JOB 67-F-104 LOCATION 401 & County Rd. 37 ORIGINATED BY FBS  
W.P. 146-66-02 BORING DATE Nov. 9, 1967 COMPILED BY FBS  
DATUM Geodetic BOREHOLE TYPE Auger CHECKED BY [Signature]

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT					LIQUID LIMIT — WL PLASTIC LIMIT — WP WATER CONTENT — W			BULK DENSITY P.C.F.	REMARKS			
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FOOT		20	40	60	80	100	500	1000	1500			2000	2500	20
595.8	Ground Level																		
595.1	Topsoil																		
	Silty clay to clayey silt with some sand and occasional gravel  (traces of organics in upper 4 to 5 ft.)  Hard to Stiff		1	SS	15														
			2	SS	32														
			3	SS	69														
			4	SS	49														
			5	SS	21														
			6	TW	PH														
			7	TW	FM														
			8	TW	FM														
			9	TW	FM														
			10	TW	FM														
			11	TW	FM														
542.8				12	TW	FM													
53.0	End of borehole																		

590  
580  
570  
560  
550  
540

0  
15  
10

% Strain

5 18 ( 77 )

129

125

SUPERIMPOSED DOCUMENT MAY APPEAR AS MULTI-FEED ON FILM

DEPARTMENT OF HIGHWAYS - ONTARIO  
MATERIALS & TESTING DIVISION

RECORD OF BOREHOLE NO. 3

FOUNDATION SECTION

JOB 67-F-104 LOCATION 401 & Co. Rd. 37 ORIGINATED BY PBS  
W.P. 146-66-02 BORING DATE Nov. 16 - 20, 1967 COMPILED BY PBS  
DATUM Geodetic BOREHOLE TYPE Auger CHECKED BY AK

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT					LIQUID LIMIT — WL PLASTIC LIMIT — WP WATER CONTENT — W			BULK DENSITY P.C.F.	REMARKS	
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FOOT		SHEAR STRENGTH P.S.F. + Field Vane      x Lab. Vane o Unconfined      • Quick Triax.					WATER CONTENT %					
595.6	Ground Level						20	40	60	80	100						
595.0	Topsoil						500	1000	1500	2000	2500						
	Silty clay to clayey silt with some sand & occasional gravel.  (traces of organics in upper 2 to 3 ft.)  Hard to firm.		1	TW	PM	590										131	
			2	TW	PM												
			3	SS	43												
			4	SS	51												
			5	SS	39	580											
			6	SS	23												
			7	TW	PM	570											129
			8	TW	PM												
			9	TW	PM	560											
			10	TW	PM												126
			11	TW	PM	550											124
			12	TW	PM												127
						540											
			13	TW	PM												123
						530											
			14	TW	PM												
						520											
			15	TW	PM												
						510											
		16	TW	PM												127	
					500												
		17	TW	PM													
					490												
		18	TW	PM													
					480											134	
477.6			19	TW	PH												
118.0	End of sampled borehole.		20	SS	25												
468.9						470											
126.7	End of Borehole																

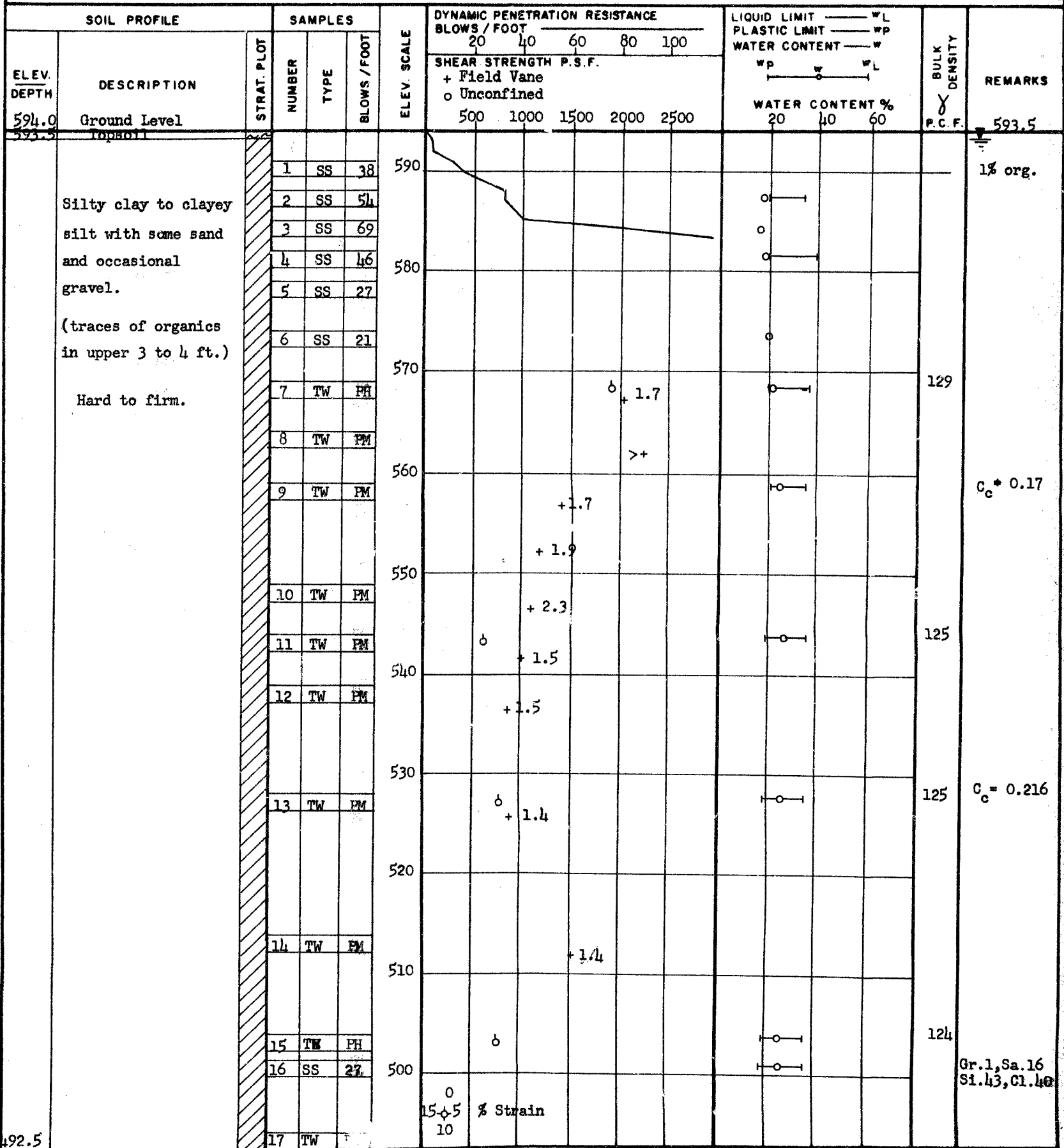
DEPARTMENT OF HIGHWAYS - ONTARIO

MATERIALS & TESTING DIVISION

RECORD OF BOREHOLE NO. 5

FOUNDATION SECTION

JOB 67-F-104 LOCATION 401 & County Rd. 37 ORIGINATED BY PBS  
W.P. 146-66-02 BORING DATE Nov. 6 - 8, 1967 COMPILED BY PBS  
DATUM Geodetic BOREHOLE TYPE Auger CHECKED BY [Signature]



101.5 End of Borehole

SUPER IMPOSED DOCUMENT MAY  
APPEAR AS MULTI-FEED ON FILM.

DEPARTMENT OF HIGHWAYS - ONTARIO

## MATERIALS &amp; TESTING DIVISION

JOB 67-F-104

W.P. 146-66-02

DATUM Geodetic

LOCATION 401 &amp; County Rd. 37

BORING DATE November 8, 1967

BOREHOLE TYPE Auger

## RECORD OF BOREHOLE NO. 4

FOUNDATION SECTION

ORIGINATED BY PBS

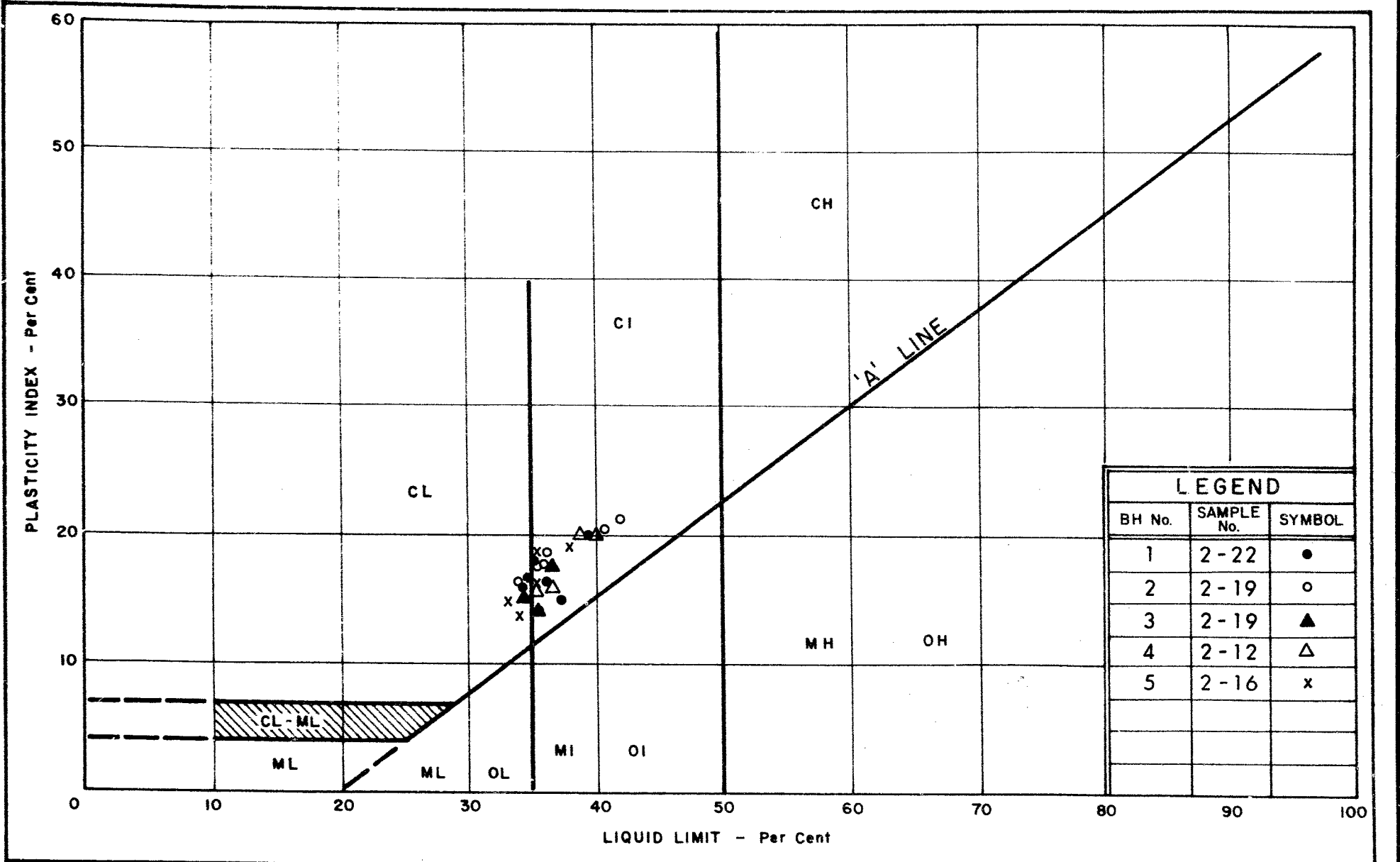
COMPILED BY PBS

CHECKED BY *HL*

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE		LIQUID LIMIT — WL PLASTIC LIMIT — WP WATER CONTENT — W		BULK DENSITY Y P.C.F.	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLT	NUMBER	TYPE	BLOWS / FOOT		BLOWS / FOOT	SHEAR STRENGTH P.S.F.	WATER CONTENT %			
595.7	Ground Level											
595.0	Topsoil											
	Silty clay to clayey silt with some sand and occasional gravel		1	SS		15						
			2	SS		28						
			3	SS		35						
			4	SS		73						
	(traces of organics in upper 3 to 4 ft.)		5	SS		52						
			6	SS		26						
	Hard to stiff		7	TW		PM						
			8	TW		PM						
			9	TW		PM						
			10	TW		PM						
			11	TW		PM						
			12	TW		PM						
542.7												
53.0	End of Borehole											

0  
15-5 % Strain  
10

SUPERIMPOSED DOCUMENT MAY APPEAR AS MULTI-FEED ON FILM.



DEPARTMENT OF HIGHWAYS  
MATERIALS and  
TESTING  
DIVISION

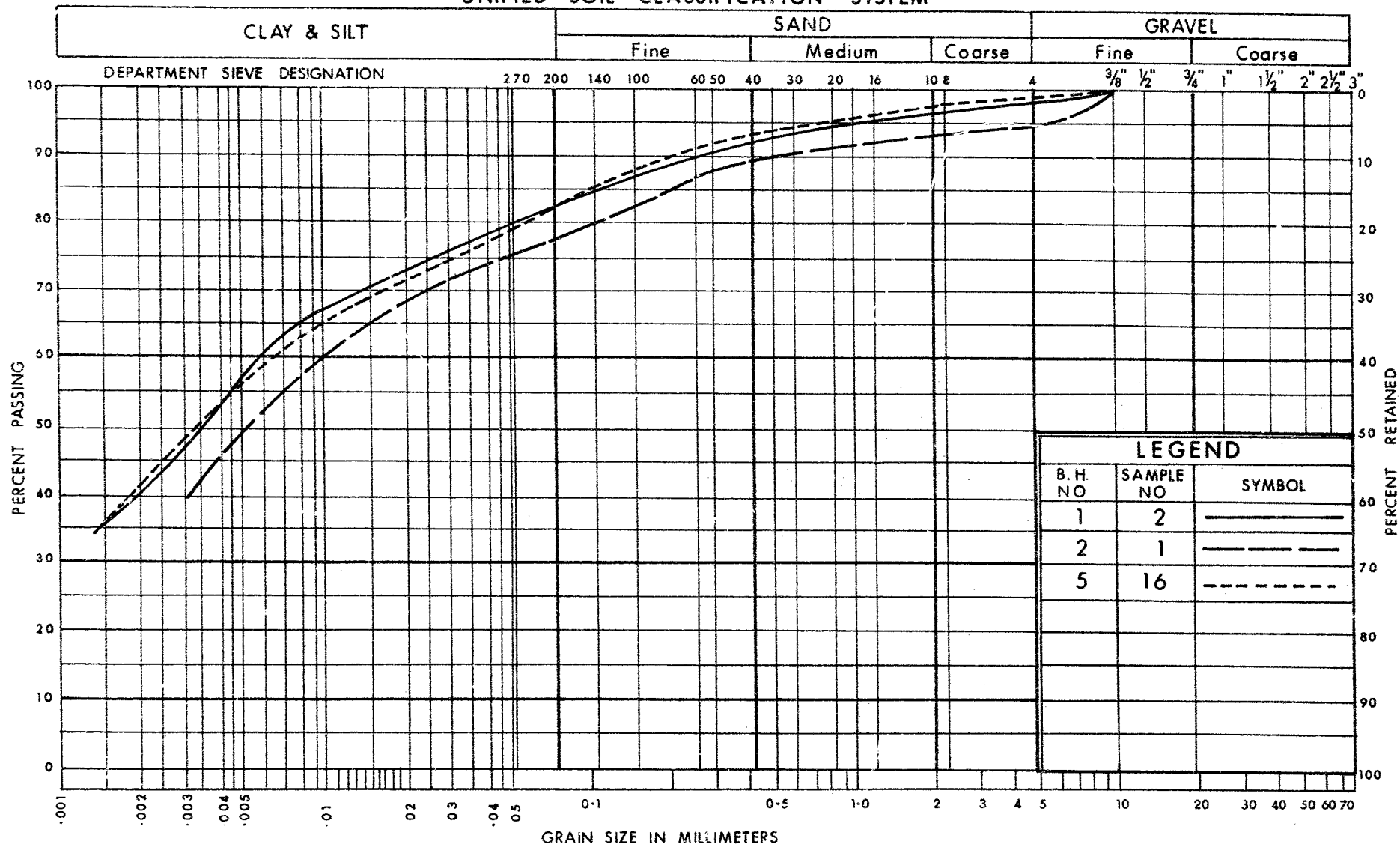
# PLASTICITY CHART

## SILTY CLAY TO CLAYEY SILT

W.P. No. 146-66-02

JOB No. 67-F-104

# UNIFIED SOIL CLASSIFICATION SYSTEM



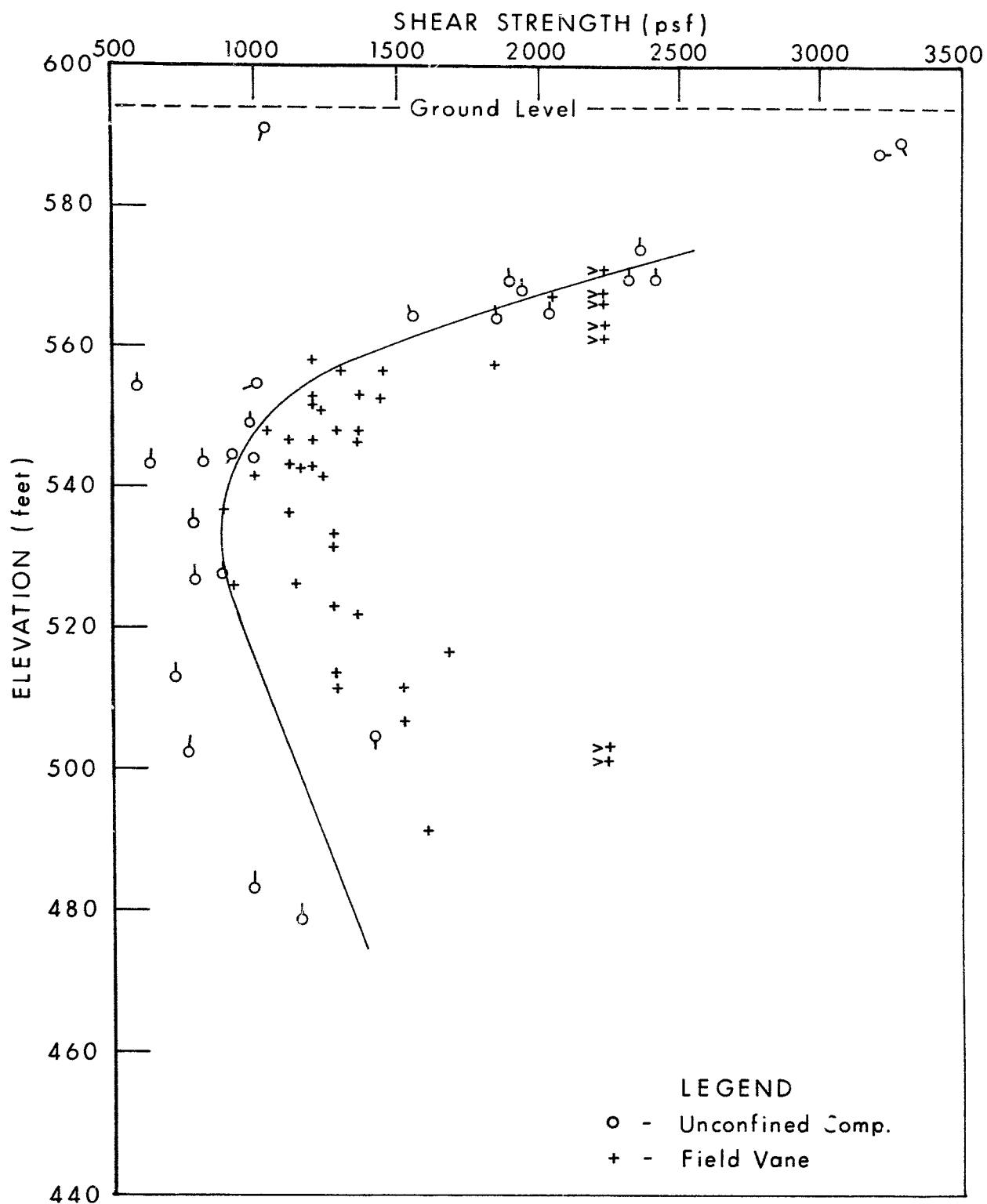
DEPARTMENT OF HIGHWAYS  
MATERIALS and  
TESTING  
DIVISION

GRAIN SIZE DISTRIBUTION  
SILTY CLAY TO CLAYEY SILT

W.P. No. 146-66-02

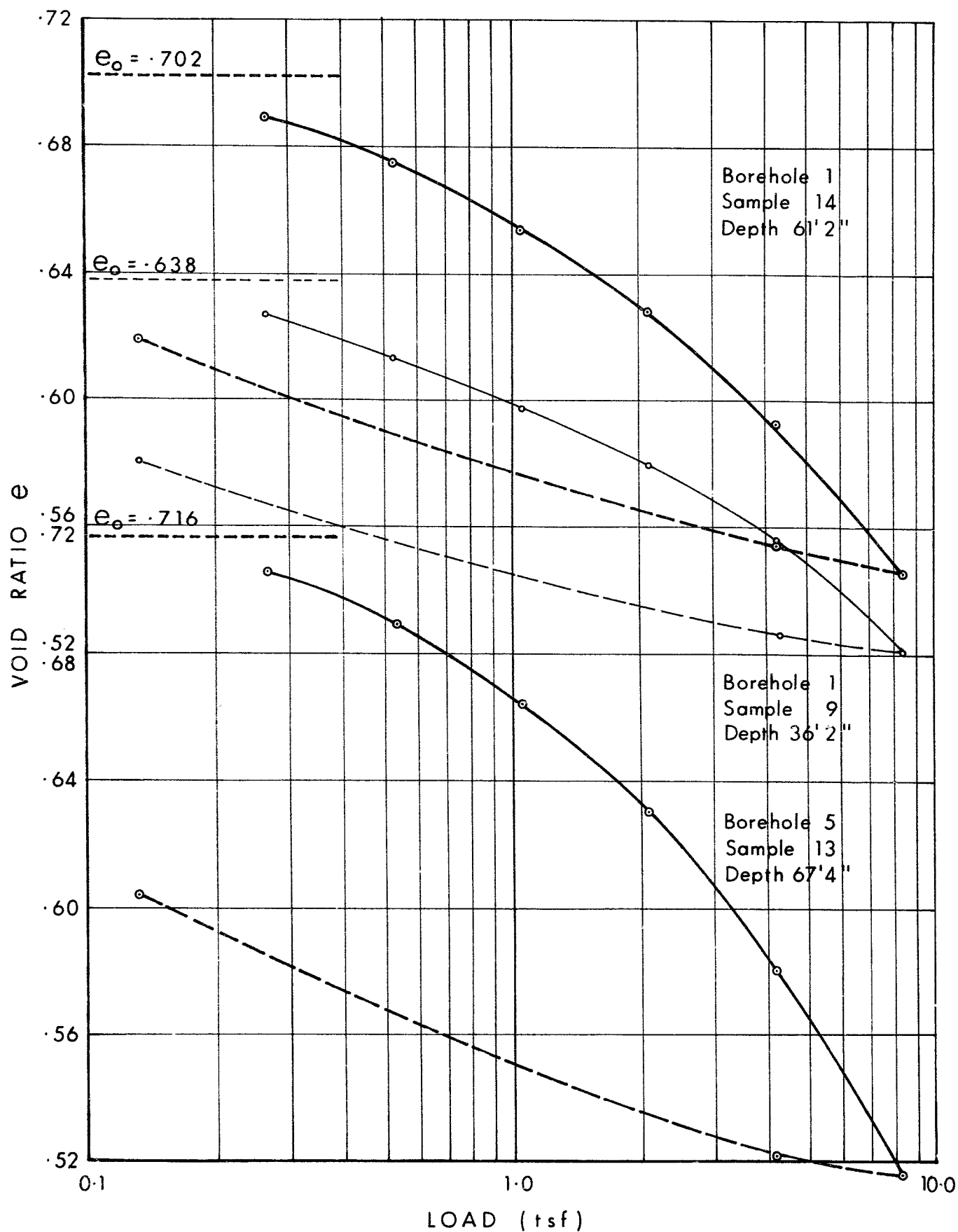
JOB No. 67-F-104

# SHEAR STRENGTH vs DEPTH





# CONSOLIDATION CURVES



## 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

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

$\gamma$	UNIT WEIGHT OF SOIL (BULK DENSITY)
$\gamma_s$	UNIT WEIGHT OF SOLID PARTICLES
$\gamma_w$	UNIT WEIGHT OF WATER
$\gamma_d$	UNIT DRY WEIGHT OF SOIL (DRY DENSITY)
$\gamma'$	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
$\tau_f$	SHEAR STRENGTH
$c'$	EFFECTIVE COHESION
	INTERCEPT
$\phi'$	EFFECTIVE ANGLE OF SHEARING RESISTANCE, OR FRICTION
	IN TERMS OF EFFECTIVE STRESS $\tau_f = c' + \sigma' \tan \phi'$
$c_u$	APPARENT COHESION
$\phi_u$	APPARENT ANGLE OF SHEARING RESISTANCE, OR FRICTION
	IN TERMS OF TOTAL STRESS $\tau_f = c_u + \sigma \tan \phi$
$\mu$	COEFFICIENT OF FRICTION
$S_i$	SENSITIVITY

## GENERAL

$\pi$	= 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
$\sigma$	NORMAL STRESS
$\sigma'$	NORMAL EFFECTIVE STRESS ( $\bar{\sigma}$ IS ALSO USED)
$\tau$	SHEAR STRESS
$\epsilon$	LINEAR STRAIN
$\gamma$	SHEAR STRAIN
$\nu$	POISSON'S RATIO ( $\mu$ IS ALSO USED)
E	MODULUS OF LINEAR DEFORMATION (YOUNG'S MODULUS)
G	MODULUS OF SHEAR DEFORMATION
K	MODULUS OF COMPRESSIBILITY
$\eta$	COEFFICIENT OF VISCOSITY

## EARTH PRESSURE

d	DISTANCE FROM TOP OF WALL TO POINT OF APPLICATION OF PRESSURE
$\delta$	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
$\beta$	ANGLE OF SLOPE TO HORIZONTAL

## MEMORANDUM

67-F-104

To: Mr. A. G. Sternac  
Principal Foundation Engineer  
Lab Building  
D O W N S V I E W

From: A. P. Watt

Date: October 26, 1967

Our File Ref.

IN REPLY TO

## SUBJECT:

W.P. 146-66-02, Bridge Site 6-257,  
Township Road Underpass,  
2.5 miles east of Hwy. 77, Interchange 7,  
Highway 401,  
District 1, Chatham.

-----

Would you kindly arrange to have a foundation investigation conducted at the above location.

I have enclosed two copies of the site plan number E-4812-1 with the probable footing locations marked in red.

Attached please find a copy of the preliminary structure site report for your use.

Accommodations are available in Tilbury, Ontario.

o



A. P. WATT  
REGIONAL BRIDGE LOCATION ENGINEER

APW:gp  
ENCL.

c.c. Mr. S. McCombie  
Mr. A. Crowley  
Mr. R. Forrest

RECEIVED BY DESK NOV 1/67  
SUBMITTED ON DATE JAN 10/67

67-F-104

1967 NOV 3 AM 11:23

00134

00135

CL

RE JMWV NOV 3/67 1130A VR

CHAT 1 R PILLAR BTCE ENGR

LONG 3 J ROY RGN NAT ENGR

RE 1966-66-62 BRIDGE SITE 6-257 TWP ROAD UNDERPASS 2.5 MILES EAST

HWY 77 INTERCHANGE 7 HWY 401 DIST 1 CHATHAM

THE FOUNDATION INVESTIGATION WORK FOR THE ABOVE MENTIONED PROJECT  
WILL COMMENCE ON MONDAY NOV 6/67. THIS IS FOR YOUR INFORMATION.

RE DEVATED NAT AND TEST FOR A G STERNAC

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401 & Keele Street  
Downsview, Ontario

~~October~~ November 6, 1967

Dominion Soil Investigation Ltd.  
77 Crockford Blvd.  
Scarborough, Ontario

Dear Sirs:

This is to confirm our request of November 3, 1967 for the supply of a Penn Drill together with all necessary equipment, as specified under the terms of our Contract Agreement, at County Rd. #37 and Hwy 401 (west of interchange #8).

This project bears Job Number 67-F-104.

Yours truly,



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

MD:mt

cc: H. Konings  
Foundation Files / 100  
General File

Department of Highways Ontario

Copy for the information of

A. Stermac

**Mr. A. Watt,  
Reg. Bridge Location Engineer,  
London Regional Office,  
London, Ontario.**

**Bridge Division,  
Downsview, Ontario.**

**April 3, 1968.**

**County Road #37 Underpass  
2.5 Mi. E. of Hwy. #77 - Interchange #7  
W.P. 146-66-02, Site 6-257  
Hwy. 401, Dist. 1**

**Attached herewith are prints of the Preliminary Bridge  
Plan Drawing D-6428-P1 for the above-mentioned structure.**

**The estimated cost of the proposed structure is \$97,900.  
This cost includes tender, materials, engineering and sundry  
construction.**

**Any comments or revisions you may have should be submitted  
within three weeks.**

**CSG:ts  
Attach.**

**C.S. Grebaki,  
Bridge Design Engineer.**

**c.c. S. McCombie  
A. Stermac (2)  
J. Anderson**

67-F-154

*No comments  
J. Lewata  
April 17/68*

DEPARTMENT OF HIGHWAYS ONTARIO

MEMORANDUM

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

FROM: Bridge Division,  
Downsview, Ontario

ATTENTION:

DATE: August 8, 1968

OUR FILE REF:

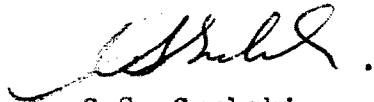
IN REPLY TO

SUBJECT: County Road #37 Underpass  
W.P. 146-66-02, Site 6-257  
Highway 401 (M.C.F.), District 1

67-F-104

Attached herewith we are submitting the final bridge drawings which show the foundation design for this structure.

Kindly give us your comments at your earliest convenience.



C.S. Grebski,  
Bridge Design Engineer

CSG:rd

Attach.

*No comment*

*1/10/68*

*14th Dec 68*