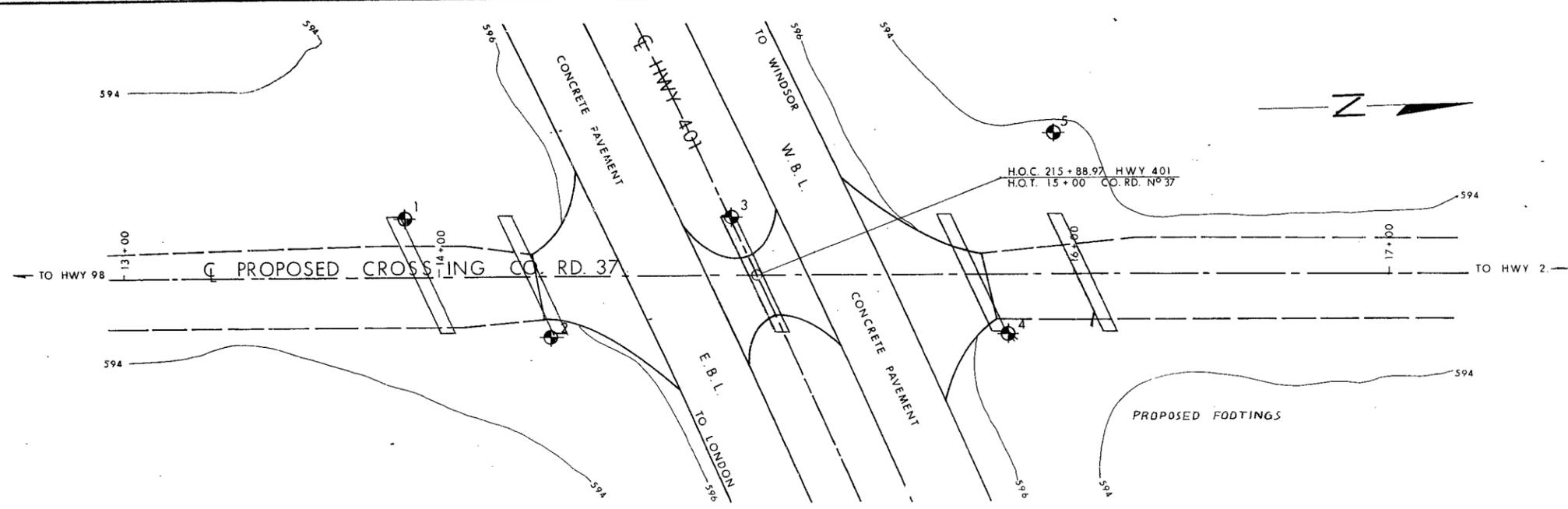


#67-F-104

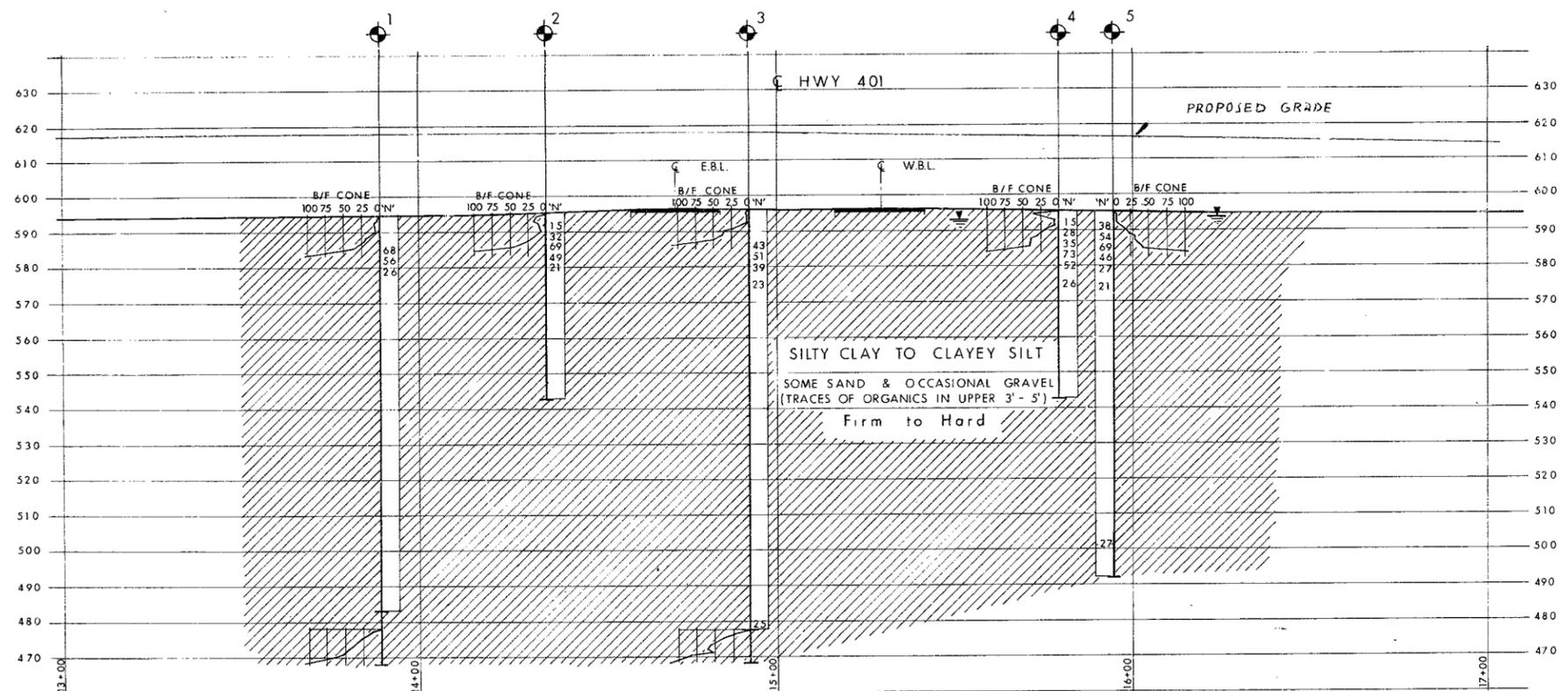
W.P. #146-66-02

HWY. #401

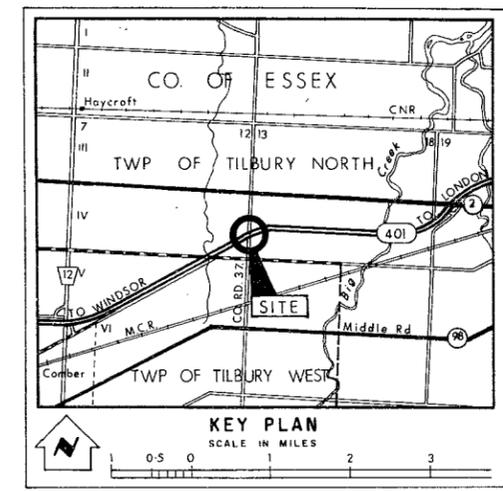
COUNTY RD. 37



PLAN  
SCALE  
20 10 0 20 40 FT



PROFILE  
SCALE  
20 10 0 20 40 FT



**LEGEND**

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

NO.	ELEVATION	STATION	OFFSET
1	594.7	13+89	18.5' LT
2	595.8	14+35	19.0' RT
3	595.6	14+92	18.5' LT
4	595.7	15+79	18.5' RT
5	594.0	15+94	45.0' 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.

NO.	DATE	BY	DESCRIPTION

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

**COUNTY ROAD 37**

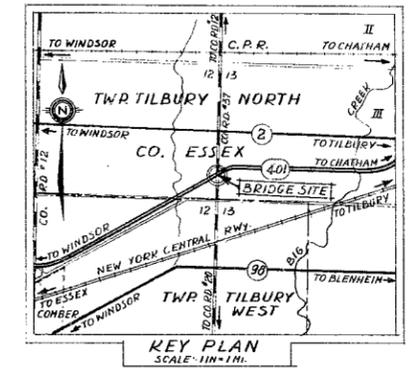
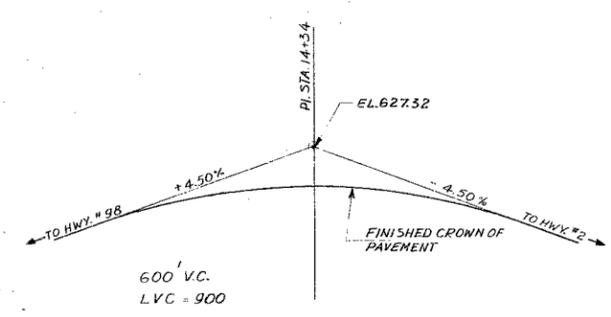
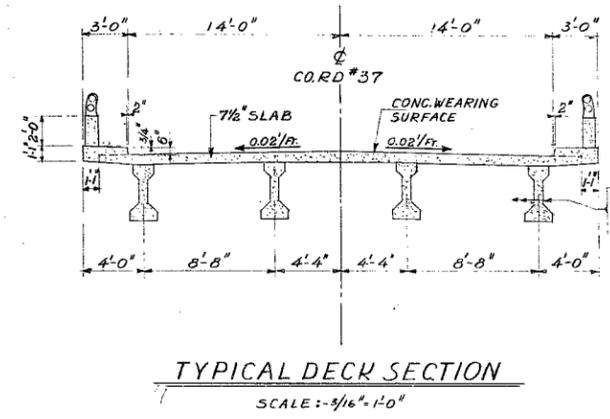
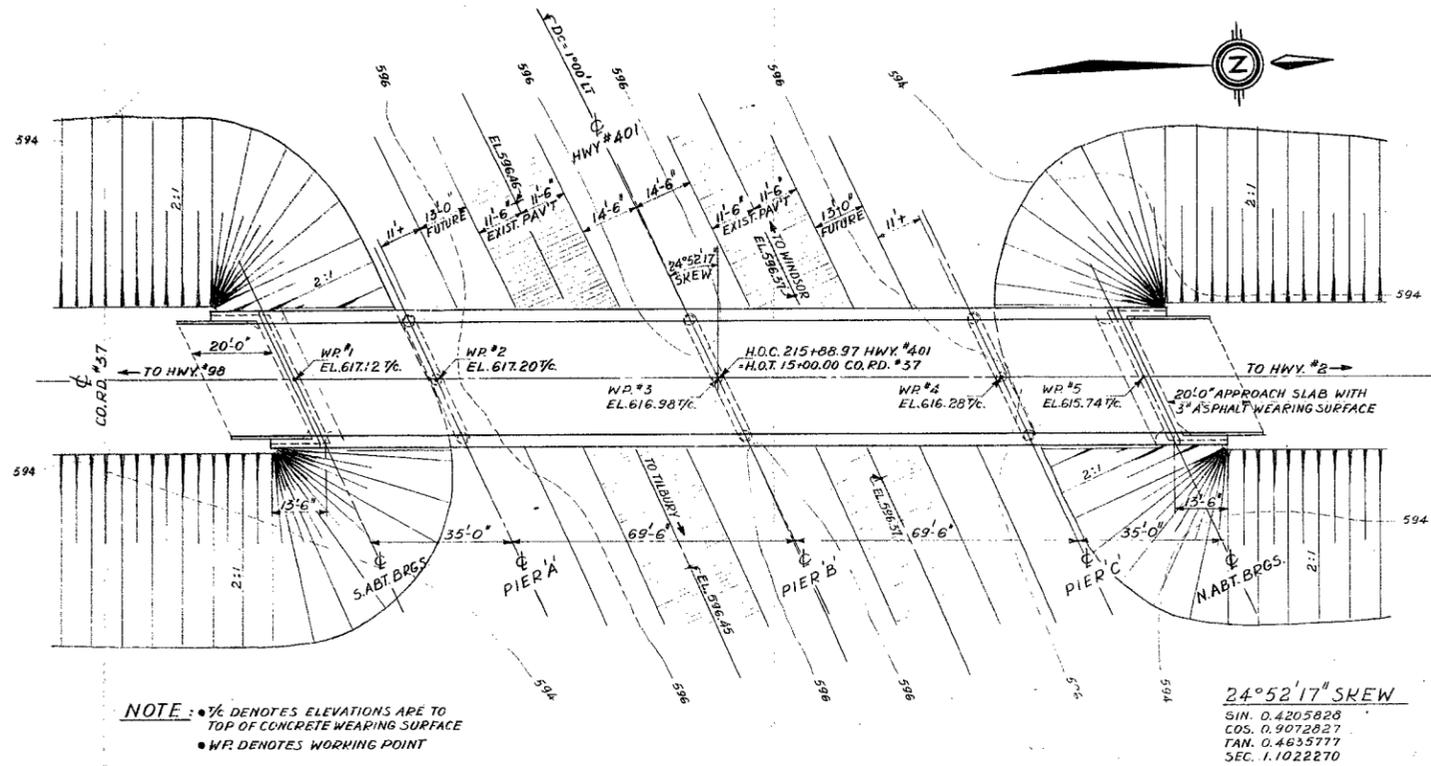
KING'S HIGHWAY NO. 401 DIST. NO. 1  
CO. ESSEX  
TWP. TILBURY NORTH LOT 12 & 13 CON. 4

**BORE HOLE LOCATIONS & SOIL STRATA**

SUBM'D. P.S.	CHECKED <i>[Signature]</i>	W.P. NO. 146-66-02	M.B.T. DRAWING NO.
DRAWN A.B.	CHECKED <i>[Signature]</i>	JOB NO. 67-F-104	<b>67-F-104 A</b>
DATE JAN. 4, 1968	SITE NO.	BRIDGE DRAWING NO.	
APPROVED <i>[Signature]</i>	PRINCIPAL FOUNDATION ENGINEER	CONT. NO.	

PRINT RECORD

NO.	FOR	DATE

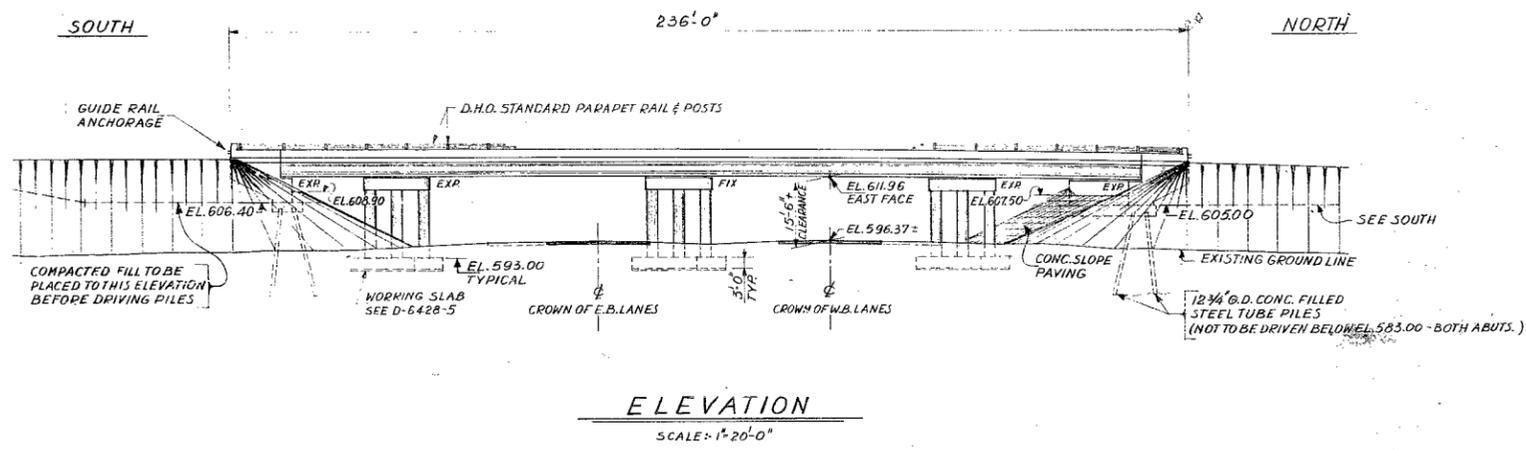


**NOTES**

**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"  
DIAPHRAGMS, CURBS, PARAPET WALLS, APP. SLABS, 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



- 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 CONG. SLOPE PAVING

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

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

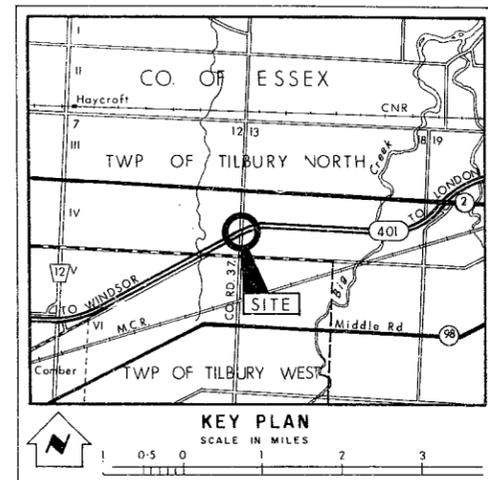
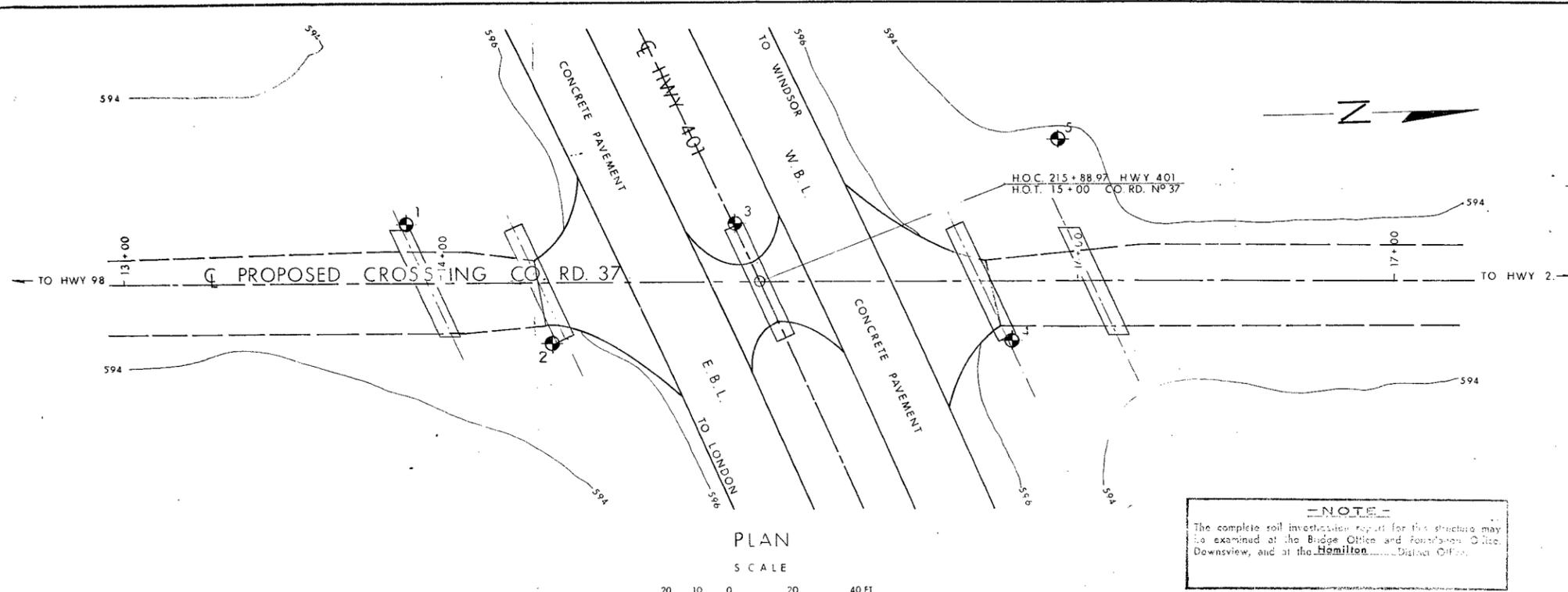
**GENERAL LAYOUT**

APPROVED: \_\_\_\_\_ SITE No. 6-257 W.P. No. 146-66-02

DESIGN: J.Sz./J.L.K. CHECK: J.L.K. CONTRACT No. \_\_\_\_\_  
 DRAWING: J.Sz. CHECK: \_\_\_\_\_ DRAWING No. D-6428-1  
 DATE: JUL 7/68 LOADING: HS20-44

PRINT RECORD	No.	FOR	DATE

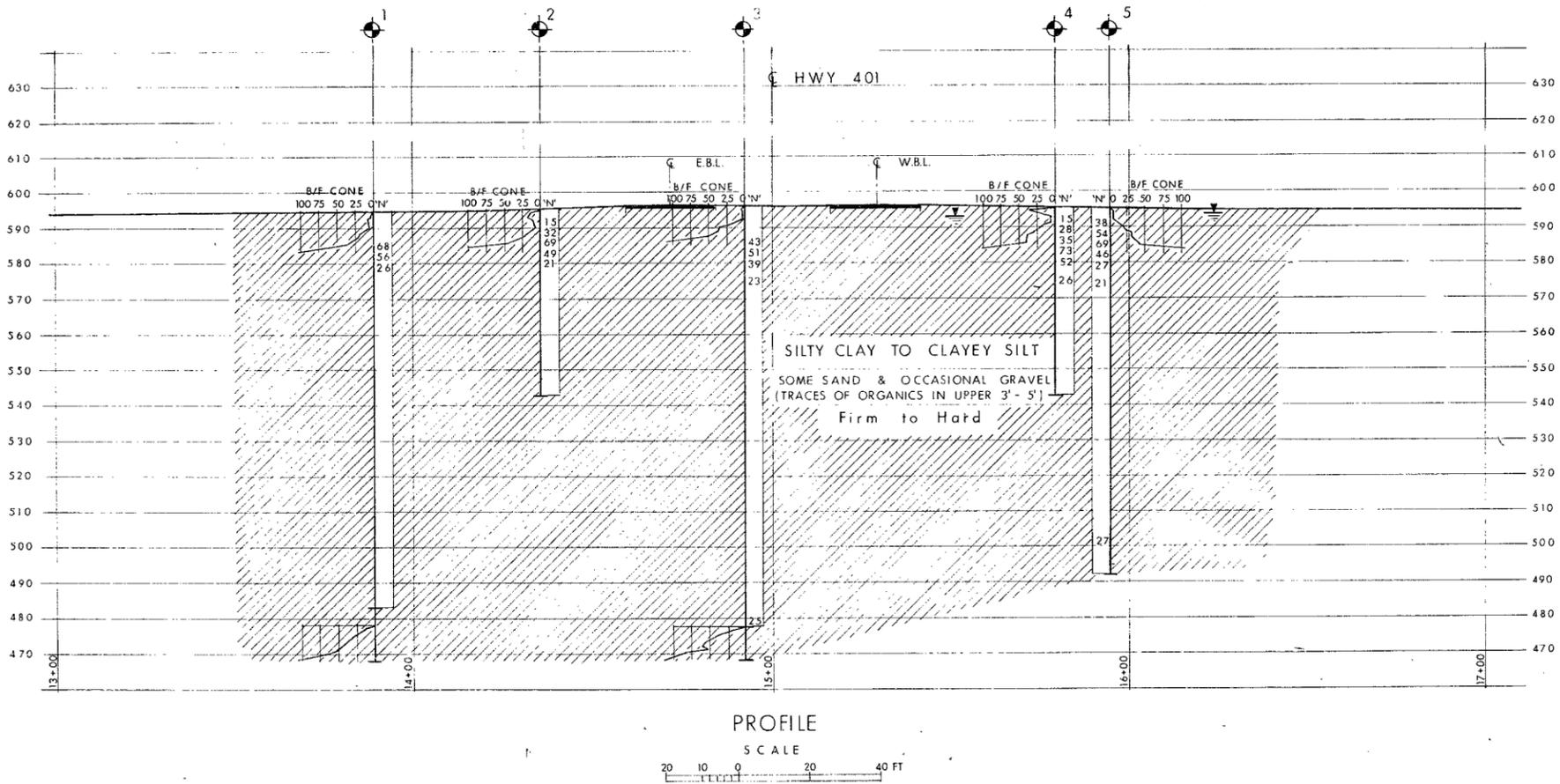




**LEGEND**

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

NO.	ELEVATION	STATION	OFFSET
1	594.7	13+89	18.5' LT
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**- 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**

NO.	DATE	BY	DESCRIPTION

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

**COUNTY ROAD 37**  
2.5 MILES EAST OF HIGHWAY #77 INTERCHANGE #7  
KING'S HIGHWAY NO. 401 DIST. NO. 1  
CO. ESSEX  
TWP. TILBURY NORTH LOT 12 & 13 CON. 4

**BORE HOLE LOCATIONS & SOIL STRATA**

SUBM'D. P.S.	CHECKED <i>[Signature]</i>	W.P. NO. 146-66-02	M.B.T. DRAWING NO.
DRAWN A.B.	CHECKED <i>[Signature]</i>	JOB NO. 67-F-104	67-F-104 A
DATE JAN. 4, 1968	SITE NO. 6-257	BRIDGE DRAWING NO.	
APPROVED <i>[Signature]</i>	CONT. NO.	D-6428-2	



## 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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  2. DESCRIPTION OF SITE AND GEOLOGY.
  3. FIELD AND LABORATORY WORK.
  4. SOIL TYPES AND CONDITIONS:
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    - 4.2) Silty Clay to Clayey Silt.
  5. GROUNDWATER CONDITIONS.
  6. DISCUSSION AND RECOMMENDATIONS:
    - 6.1) General.
    - 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

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

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:

	<u>Upper Zone</u> <u>Desiccated Crust</u> (Approximately 30 ft.)	<u>Lower Zone</u> (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 1i) 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 [Signature]

SOIL PROFILE		SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT					LIQUID LIMIT — WL PLASTIC LIMIT — WP WATER CONTENT — W			BULK DENSITY γ <sub>B</sub> P.C.F.	REMARKS	
ELEV. DEPTH	DESCRIPTION	NUMBER	TYPE	BLOWS / FOOT		20	40	60	80	100	WP	W	WL			
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											128.5	
		3	SS	68												
		4	SS	56												
		5	SS	26												
		6	TW	PM											130	
		7	TW	PM												
		8	TW	PM											128	
		9	TW	PM												
		10	TW	PM												
		11	TW	PM												
		12	TW	PM											124	Gr. 2, Sa. 15 Sl. 43, Cl. 40
		13	TW	PM												
		14	TW	PM												
		15	TW	PM											125	
		16	TW	PM												
		17	TW	PM												
		18	TW	PM											126	
		19	TW	PM												
		20	TW	PM												
		21	TW	PM												
483.2			22	TW	PH										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		STRAT. PLOT	SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT					LIQUID LIMIT — WL PLASTIC LIMIT — WP			BULK DENSITY P.C.F.	REMARKS
ELEV. DEPTH	DESCRIPTION		NUMBER	TYPE	BLOWS / FOOT		20	40	60	80	100	WATER CONTENT — W				
						SHEAR STRENGTH P.S.F. + Field Vane o Unconfined					WATER CONTENT %					
						500	1000	1500	2000	2500	20	40	60			
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										129	
			9	TW	FM											
			10	TW	FM											
			11	TW	FM											
542.8			12	TW	FM										125	
53.0	End of borehole															

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  
W.P. 146-66-02  
DATUM Geodetic

LOCATION 401 & County Rd. 37  
BORING DATE Nov. 16 - 20, 1967  
BOREHOLE TYPE Auger

ORIGINATED BY PBS  
COMPILED BY PBS  
CHECKED BY [Signature]

SOIL PROFILE		SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT					LIQUID LIMIT — WL PLASTIC LIMIT — WP WATER CONTENT — W			BULK DENSITY γ P.C.F.	REMARKS	
ELEV. DEPTH	DESCRIPTION	NUMBER	TYPE	BLOWS / FOOT		20	40	60	80	100	WP	WL	W			
595.6	Ground Level															
595.0	Topsoil															
	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											
		2	TW	PM												
		3	SS	43												
		4	SS	51												
		5	SS	39												
		6	SS	23												
		7	TW	PM												
		8	TW	PM												
		9	TW	PM												
		10	TW	PM												
		11	TW	PM												
		12	TW	PM												
		13	TW	PM												
		14	TW	PM												
		15	TW	PM												
		16	TW	PM												
		17	TW	PM												
		18	TW	PM												
477.6			19	TW	PH	480										
118.0		End of sampled borehole.	20	SS	25											
468.9					470											
126.7	End of Borehole															

IF PER IMPROVED DOCUMENT MAY APPEAR AS MULTIFED ON FILM.

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]

ELEV. DEPTH	SOIL PROFILE DESCRIPTION	STRAT. PLOT	SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT					LIQUID LIMIT — WL PLASTIC LIMIT — WP WATER CONTENT — W			BULK DENSITY P.C.F.	REMARKS	
			NUMBER	TYPE	BLOWS / FOOT		20	40	60	80	100	20	40	60			
594.0	Ground Level															593.5	
593.5	Topsoil																
	Silty clay to clayey silt with some sand and occasional gravel. (traces of organics in upper 3 to 4 ft.) Hard to firm.		1	SS	38	590										1% org.	
		2	SS	54	580												
		3	SS	69													
		4	SS	46													
		5	SS	27													
		6	SS	21													
		7	TW	PH												129	
		8	TW	FM													
		9	TW	FM													C <sub>c</sub> * 0.17
		10	TW	FM													
		11	TW	FM													125
		12	TW	FM													
		13	TW	FM													125
		14	TW	FM													
		15	TW	PH													124
		16	SS	27													Gr.1, Sa.16 Si.43, Cl.40
492.5				17	TW												

DEPARTMENT OF HIGHWAYS - ONTARIO  
MATERIALS & TESTING DIVISION

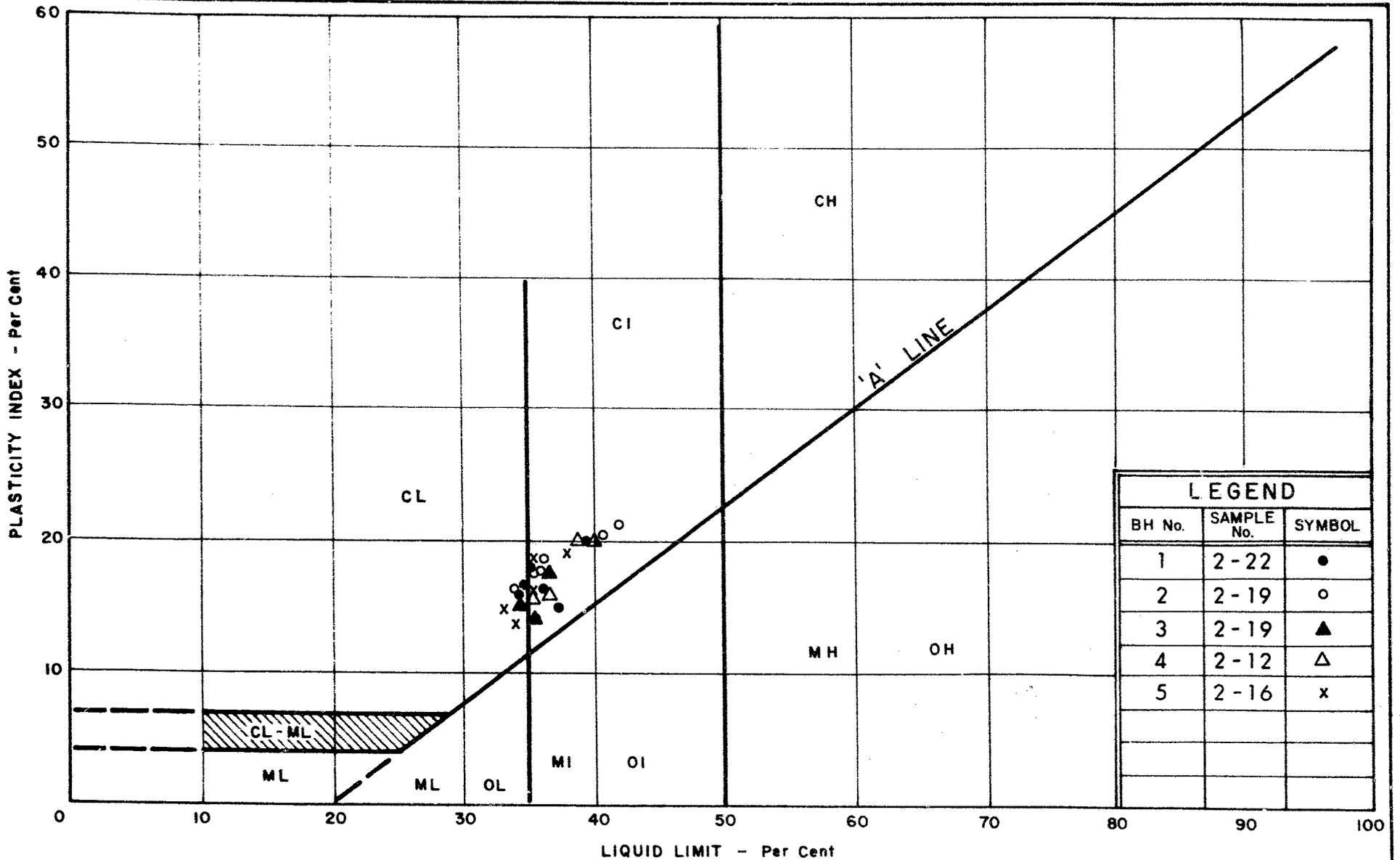
RECORD OF BOREHOLE NO. 4

FOUNDATION SECTION

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

SOIL PROFILE		SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE					LIQUID LIMIT — WL PLASTIC LIMIT — WP WATER CONTENT — W			BULK DENSITY γ <sub>p.c.f.</sub>	REMARKS	
ELEV. DEPTH	DESCRIPTION	NUMBER	TYPE	BLOWS / FOOT		BLOWS / FOOT	20	40	60	80	100	WP	W			WL
595.7	Ground Level															
595.0	Topsoil															
	Silty clay to clayey silt with some sand and occasional gravel  (traces of organics in upper 3 to 4 ft.)  Hard to stiff	1	SS	15												
		2	SS	28												
		3	SS	35												
		4	SS	73												
		5	SS	52												
		6	SS	26												
		7	TW	PM											129	
		8	TW	PM											130	
		9	TW	PM											128	
		10	TW	PM											123	
		11	TW	PM											123	
542.7			12	TW	PM											
53.0	End of Borehole															

SUPERIMPOSED DOCUMENT MAY APPEAR AS MULTI-FEED ON FILM.



LEGEND		
BH No.	SAMPLE No.	SYMBOL
1	2-22	●
2	2-19	○
3	2-19	▲
4	2-12	△
5	2-16	x



DEPARTMENT OF HIGHWAYS  
**MATERIALS and  
 TESTING  
 DIVISION**

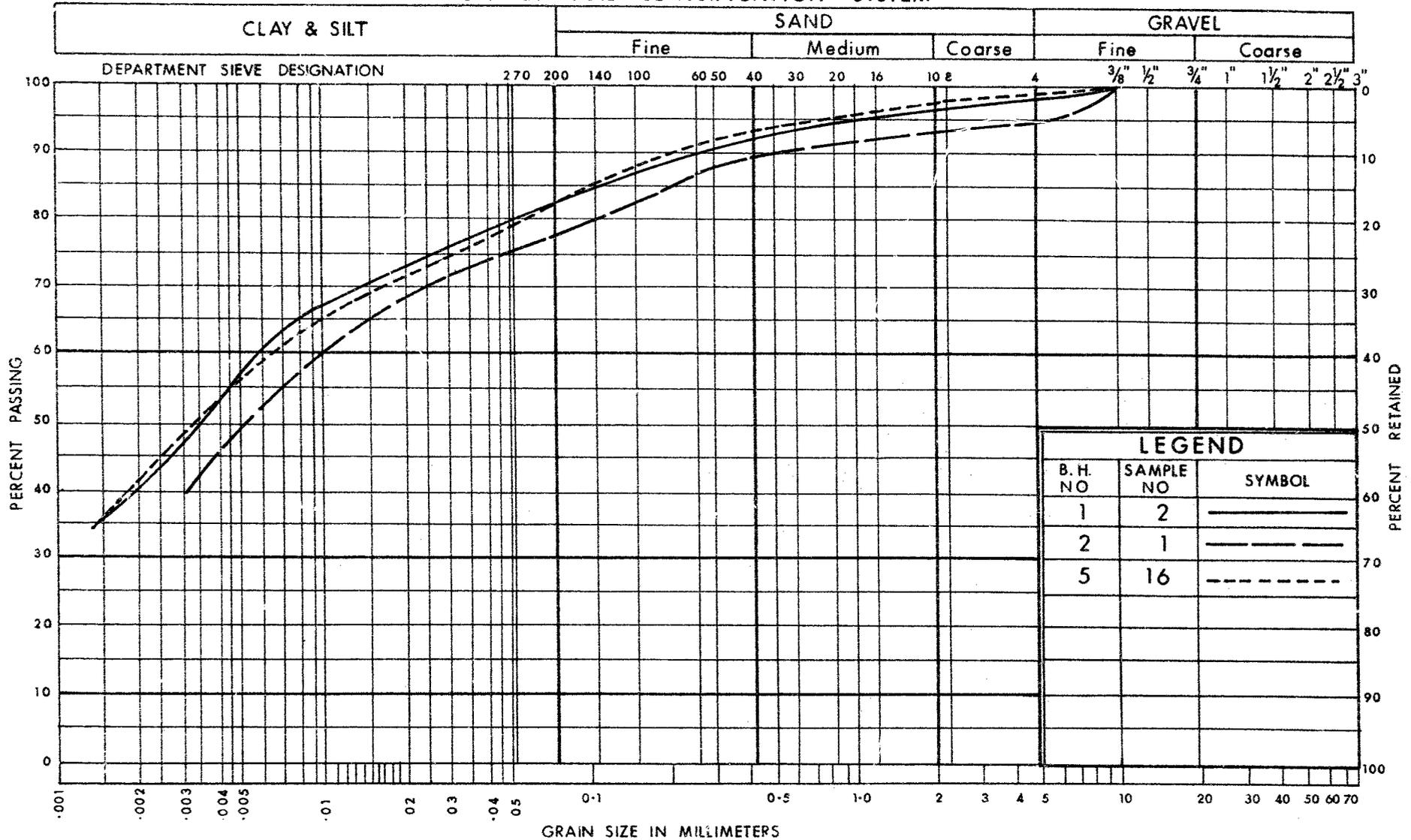
ONTARIO

**PLASTICITY CHART**  
 SILTY CLAY TO CLAYEY SILT

W.P. No. 146-66-02

JOB No. 67-F-104

UNIFIED SOIL CLASSIFICATION SYSTEM



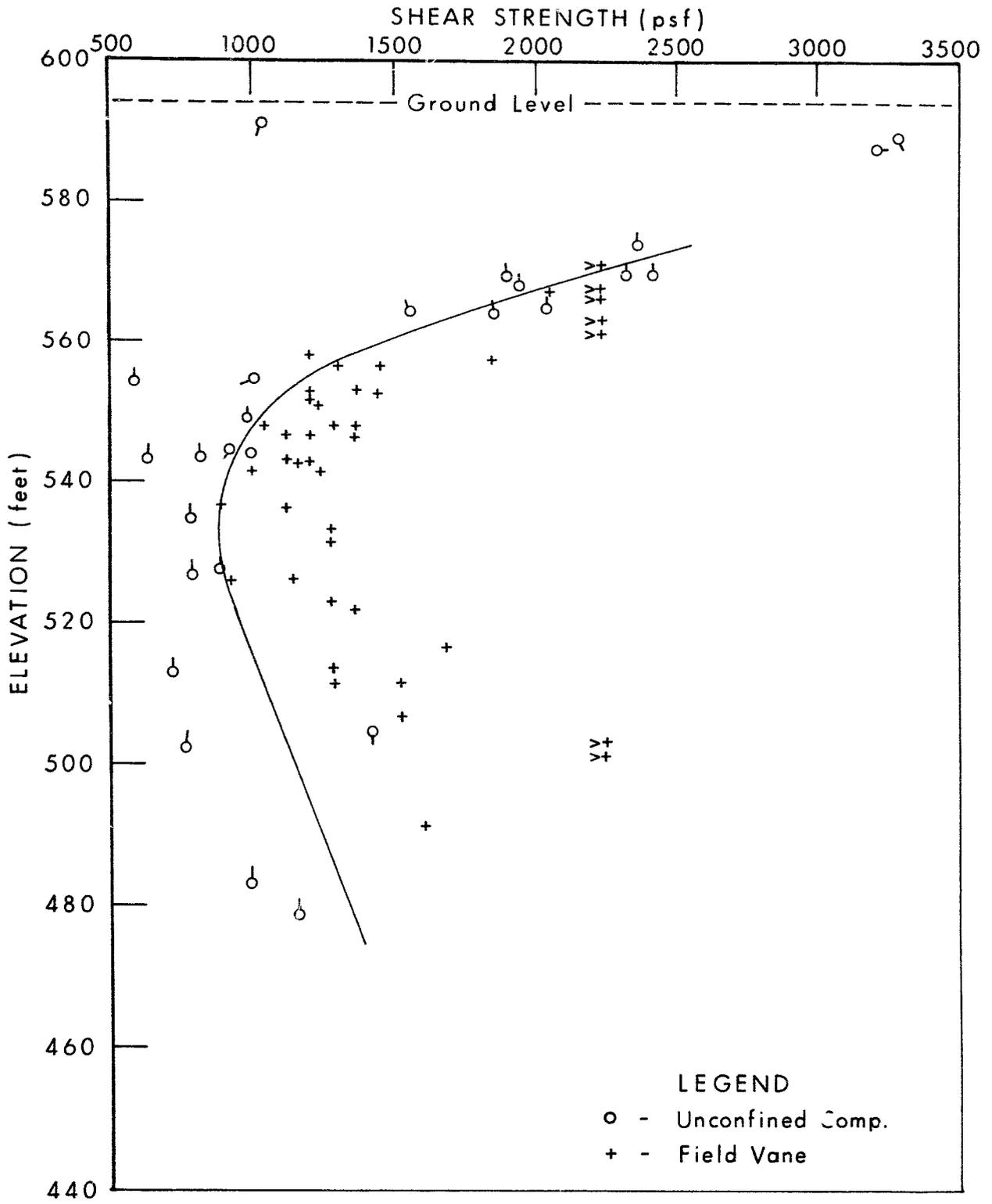
DEPARTMENT OF HIGHWAYS  
MATERIALS and  
TESTING  
DIVISION

GRAIN SIZE DISTRIBUTION  
SILTY CLAY TO CLAYEY SILT

W.P. No. 146-66-02

JOB No. 67-F-104

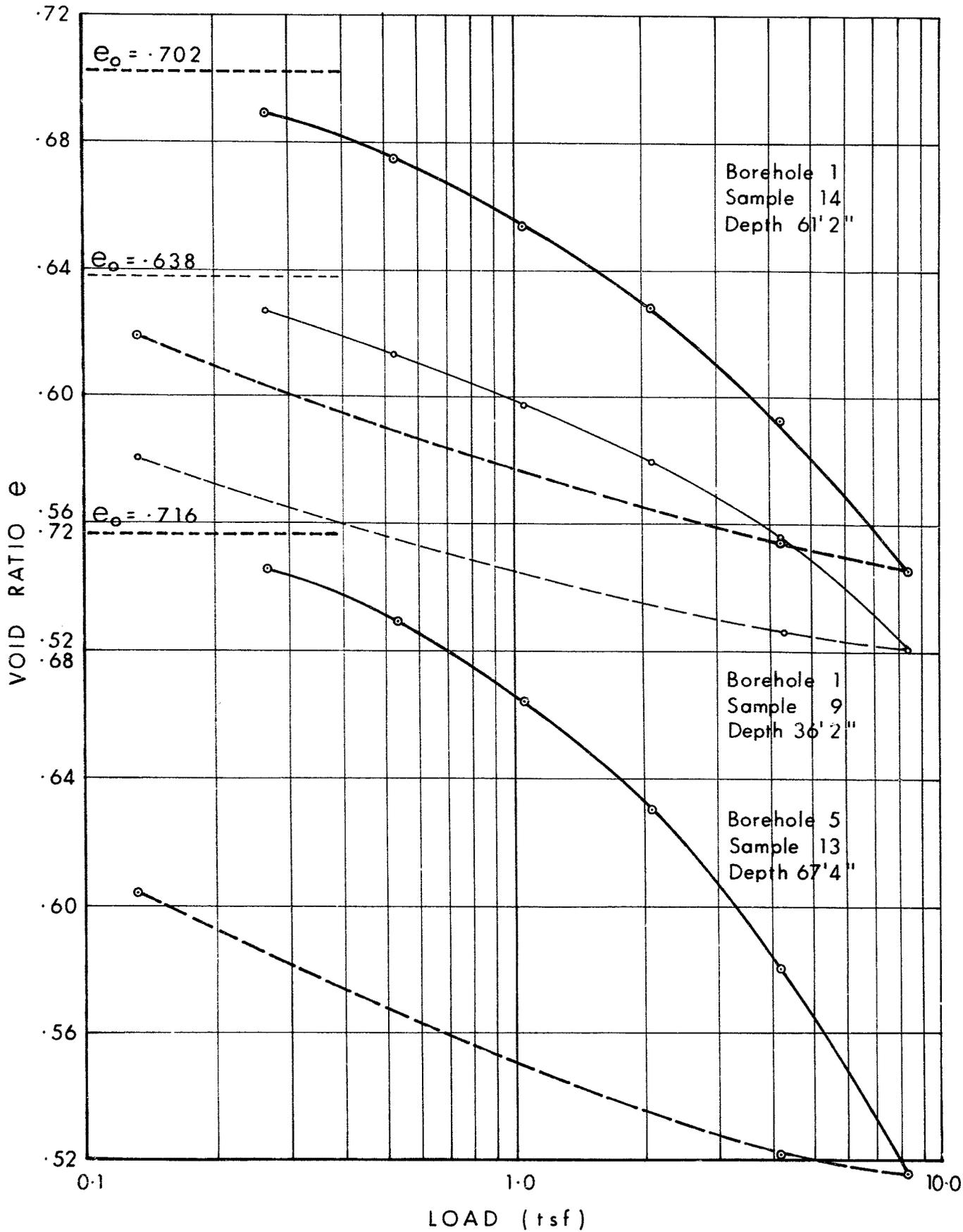
# SHEAR STRENGTH vs DEPTH



### LEGEND

- - Unconfined Comp.
- + - Field Vane

# 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
$c_u$	APPARENT COHESION
$\phi_u$	APPARENT ANGLE OF SHEARING RESISTANCE, OR FRICTION
$\mu$	COEFFICIENT OF FRICTION
$S_t$	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
$K_o$	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
$\beta$	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.

*A. P. Watt*

A. P. WATT  
REGIONAL BRIDGE LOCATION ENGINEER

APW:gp  
ENCL.

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

RECEIVED BY DATE NOV 14/67  
DISTRIBUTION DATE JAN 10/67

67-F-104

1967 NOV 3 AM 11:23

00134

00135

EX 200N NOV 3/67 1130A VR

CMAT 1 R PILLAR NICE ENGR

LONG 3 J ROY RGN MAT ENGR

RE 101-66-02 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.

N DEVATED MAT 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 770  
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 B-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-104

*No comments  
J. Dewata  
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:

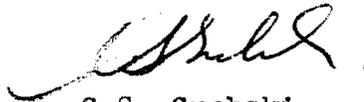
IN REPLY TO

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 comments

11/1/68

14th Dec 68