

G.I.-30 SEPT. 1976

GEOCRES No. 40I14-103DIST. 2 REGION W.P. No. 40-66-22/23CONT. No. W. O. No. STR. SITE No. 19-530HWY. No. 402LOCATION CONCESSION 4 ROADOVERPASS EB/WB LANES, 3.1 MILES WEST
NO. 2 PAGES - OF Hwy 81

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OVERSIZE DRAWINGS TO BE INCLUDED WITH THIS REPORT.

REMARKS:

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS, ONTARIO

MEMORANDUM

40 I 14 - 103

GEOCREC No.

To: A.P. Watt (2)
Regional Structural Planning Engineer
Southwestern Region, London

FROM: Soil Mechanics Section
Geotechnical Office
West Bldg., Downsview

ATTENTION:

DATE: April 6, 1976

OUR FILE REF. W.P. 40-66-22 & 23

IN REPLY TO

APR 12 1976

SUBJECT:

FOUNDATION INVESTIGATION REPORT

For

W.P. 40-66-(22 & 23)
Hwy. 402 District 2 London
Concession 4 Road Overpass EB/WB Lanes
3.1 Miles West of Hwy 81

Attached we are forwarding to you our detailed Foundation Investigation Report on the subsoil conditions existing at the above mentioned site.

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

K. G. Selby

K.G. Selby
Supervising Engineer

KGS/bp

cc: R.S. Pillar
C.S. Grebski
B.J. Giroux
G.A. Wrong
A. Wittenberg
J.R. Roy
D.P. Collins
R. Hore
J. Anderson)
A. Crowley) Memo only
G. Sloan)
Files

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FOUNDATION INVESTIGATION REPORT

For

W.P. 40-66-(22 & 23)
Hwy. 402 District 2 London
Concession 4 Road Overpass EB/WB Lanes
3.1 Miles West of Hwy 81

1. INTRODUCTION

This report is to provide information for the design and construction of the proposed twin structures at the above mentioned site.

The subsoil information is based on eight sampled boreholes and six dynamic cone penetration tests. The boring operation was carried out using hollow stem augers which were advanced into the sand without the use of a plug. A split-spoon, from which the ball had been removed, was then washed down to just below the bottom of the augers, where it was driven in the conventional manner. In this way the disturbance of the sand layer to be sampled was kept to a minimum as it was not subjected to an unbalanced head during the removal of rods from the hollow stem augers.

2. SITE DESCRIPTION

The proposed location is in the Twp. of Caradoc two miles northeast of the Town of Mount Brydges. This area is a flat sand plain crossed by occasional low ridges. It is on the crest of one of these sand ridges which Hwy 402 crosses at an oblique angle that the structures will be located. A mile to the northeast the land rises sharply as a till moraine.

Numerous tobacco farms are situated in the area with the remainder of the cleared land being employed in mixed farming. The uncleared land is generally low and swampy. A typical example of this type of area is found 1000 ft. to the north of the site.

3. SUBSOIL

(3.1) General

The subsoil consists of an upper layer, up to 12 ft. in

thickness, of silt some sand overlying 50 to 60 ft. of sand with a trace of silt. These upper layers were layed down as a deltaic deposit at an early post glacial outlet of the Thames River and were then surficially reworked by wind action. Underlying them is at least 60 ft. of clayey silt. The deepest borehole was terminated in this layer some 120 ft. below the surface.

(3.2) Silt Some Sand

This upper layer varies in depth to a maximum of 12 ft. and has been partially removed where the concession road cuts through the crust of the ridge. It generally has a loose relative density increasing to compact in the lower portion. Moisture content varies from 15 to 20 percent.

(3.3) Sand

The sand layers varies from 50 to 60 ft. in thickness. It is primarily a deposit of fine sand containing less than 10% silt (grain size distribution shown as an envelope in Fig. 1). There are however occasional layers with higher silt contents. One layer between five and ten ft. in thickness consists of well graded sand with a trace of gravel. It was encountered in all boreholes between elevations 760 and 775.

The relative density of the sand deposit varies from compact to very dense with Standard Penetration 'N' values varying from 10 to in excess of 100 blows per foot. Moisture content above the groundwater level is approximately 5 percent while below the groundwater level it ranges from 14 to 21 percent.

(3.4) Clayey Silt

The clayey silt deposit extends from a depth of approximately 60 ft. to in excess of 120 ft. It has a stiff to hard consistancy with Standard Penetration 'N' values ranging from 14 to 70 blows per foot. The deposit has a low degree of plasticity with a moisture content of approximately 20%.

(3.5) Groundwater

Groundwater was encountered in the sand at elevation 786. This corresponds with the surface elevation of a nearby irrigation pond.

4. DISCUSSION AND RECOMMENDATIONS

(4.1) Discussion

It is proposed that Hwy 402 pass over Concession Road 4 on single span twin structures. The grade of Hwy 402 has been set at elevation 810, thereby requiring a cut of about eight ft. to lower the concession road to elevation 790. Two proposals are to be considered. The first is for structures with a single 90 ft. span and perched abutments. The second is to construct rigid frame structures with a span of 36 ft. It should be noted that this second proposal will require the construction of footings below the prevailing groundwater level.

(4.2) Perched Abutments on Spread Footings

Perched abutments may be constructed at or above elevation 794 by removing the existing soil above elevation 790. and replacing it with well compacted granular 'A'. A net safe design load of 2.5 tons per square foot may then be applied. For calculations of sliding resistance, a friction coefficient of .55 may be assumed to apply between the footing and the granular 'A'. A construction scheme is outlined in Fig. 2 in the Appendix. Settlements which will take place as the load is applied will not exceed 1½ inches with a differential settlement of less than 1 inch.

(4.3) Tube Piles

The footings for both structural alternatives may be supported on steel tube piles (12-3/4" X 1/4") driven to elevation 755. For design purposes a safe design load of 40 tons per pile may be assumed.

(4.4) Franki Piles

Either structural alternative may be supported on Franki type displacement caissons. The elevation at which the bulb of the pile is formed will vary from one scheme to the other due to the difference in elevation of the pile caps. In the case of the rigid frame structure they should be formed below elevation 778, while the structure with perched abutments the pile bulbs may be formed below elevation 783.

Piles with the following shaft diameters (inside diameter of the drive tube) will develop the following design bearing capacities.

14 in.	-	70 tons
18 in.	-	125 tons
22 in.	-	150 tons

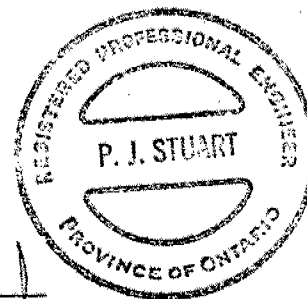
The cost of installing these piles complete with all material other than reinforcing steel may be estimated assuming \$25.00, \$28.00 and \$32.00 per lineal foot for the 14 inch, 18 inch and 22 inch types, respectively. Settlement not exceeding one inch could be expected.

(4.5) Dewatering

No dewatering problems are to be expected if perched abutments are employed as the footings or pile caps will be above groundwater level. If the rigid frame structure is adopted the pile caps will be founded several feet below the groundwater level. The groundwater level may be depressed sufficiently to allow construction in dry conditions by pumping from sumps located beyond the area of the pile caps. It should, however, be noted that the volume of water required to be pumped will be relatively large as ponds excavated in the immediate vicinity are used as water sources to irrigate tobacco crops.

(4.6) Frost Protection

All pile caps or spread footings should be protected against frost action by a minimum four feet of cover.



A handwritten signature in black ink, appearing to read "Peter Stuart".

Peter Stuart, P. Eng.
Project Engineer

A handwritten signature in black ink, appearing to read "K.G. Selby".

K.G. Selby, P. Eng.
Supervising Engineer

APPENDIX

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS-ONTARIO
ENGINEERING SERVICES BRANCH-GEOTECHNICAL OFFICE-SOIL MECHANICS SECTION

RECORD OF BOREHOLE NO 1

WP 40-66-22/23 LOCATION Co-ords. 15,601,648 N; 1,272,265 E. ORIGINATED BY PJS
 DIST 2 HWY 402 BORING DATE February 4, 1976 COMPILED BY PJS
 DATUM Geodetic BOREHOLE TYPE Hollow Stem Auger & Cone Test CHECKED BY [Signature]

SOIL PROFILE			SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT					LIQUID LIMIT <u>W_L</u> PLASTIC LIMIT <u>W_P</u> WATER CONTENT <u>W</u>			UNIT WEIGHT <u>γ</u>	REMARKS
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	'N' VALUES		20	40	60	80	100	W _P	W	W _L		
799.5	Ground Level															
0.0	Silt, some sand															
	Loose		1	SS	7											
792.5			2	SS	26											
7.0	Fine sand, trace of silt		3	SS	24											0 91 (9)
			4	SS	30											0 93 (7)
			5	SS	23											
	Compact to Very Dense		6	SS	43											
			7	SS	53											
	Well graded sand trace of gravel		8	SS	34											7 88 (5)
			9	SS	107											
			10	SS	30											
			11	SS	42											0 95 (5)
748.0			12	SS	32											
51.5	End of Borehole															

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS-ONTARIO
ENGINEERING SERVICES BRANCH-GEOTECHNICAL OFFICE-SOIL MECHANICS SECTION

RECORD OF BOREHOLE NO 2

WP 40-66-22/23

LOCATION Co-ords. 15,601,697 N; 1,272,276 E.

ORIGINATED BY PJS

DIST 2 HWY 402

BORING DATE February 5, 1976

COMPILED BY PJS

DATUM Geodetic

BOREHOLE TYPE Hollow Stem Auger

CHECKED BY

SOIL PROFILE			SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT					LIQUID LIMIT w_L PLASTIC LIMIT w_p WATER CONTENT w			UNIT WEIGHT γ	REMARKS % GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	'N' VALUES		20	40	60	80	100	w_p	w	w_L		
799.0	Ground Level															
0.0	Silt, some sand, trace of clay															
792.0	Loose		1	SS	9											0 18 74 8
7.0	Fine sand, trace of silt		2	SS	34	790										
			3	SS	17											
			4	SS	19											0 93 (7)
			5	SS	22											0 92 (8)
	Compact to Very Dense		6	SS	22	780										
			7	SS	30											
	Well graded sand trace of gravel		8	SS	35	770										
			9	SS	28											2 93 (5)
			10	SS	24	760										
			11	SS	41	750										
742.5			12	SS	24											
56.5	End of Borehole															

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS-ONTARIO
ENGINEERING SERVICES BRANCH-GEOTECHNICAL OFFICE-SOIL MECHANICS SECTION

RECORD OF BOREHOLE NO 3

WP 40-66-22/23 LOCATION Co-ords. 15,601,737 N; 1,272,311 E. ORIGINATED BY PJS
DIST 2 HWY 402 BORING DATE February 9 1976 COMPILED BY PJS
DATUM Geodetic BOREHOLE TYPE Hollow Stem Auger & Cone Test CHECKED BY *ef.*

SOIL PROFILE			SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT					LIQUID LIMIT w_L PLASTIC LIMIT w_p WATER CONTENT w			UNIT WEIGHT Y	REMARKS
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	'N' VALUES		20	40	60	80	100	w_p	w	w_L		
796.0	Ground Level															
0.0	Silt, trace of sand and clay.		1	SS	7	790										
	Loose to Dense		2	SS	39											0 2 93 5
784.0			3	SS	30											
12.0			4	SS	23											0 93 (7)
	Well graded sand		5	SS	33	780										
	trace of gravel		6	SS	26											
			7	SS	65											
	Fine sand, trace of silt		8	SS	37	770										8 88 (4)
			9	SS	28											
	Compact to Very Dense		10	SS	92	760										
			11	SS	100	750										
	some silt		12	SS	42											
			13	SS	26	740										0 67 25 8
			14	SS	18	730										
726.0																
70.0	Clayey Silt					720										
	Very Stiff to Hard		15	SS	39	710										
			16	SS	30	700										
692.0																
104.0																

20
15-5 % STRAIN AT FAILURE
10

Continued

OFFICE REPORT ON SOIL EXPLORATION

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS-ONTARIO

ENGINEERING SERVICES BRANCH-GEOTECHNICAL OFFICE-SOIL MECHANICS SECTION

RECORD OF BOREHOLE NO 3 Continued

WP 40-66-22/23

LOCATION Co-ords. 15,601,737 N; 1,272,311 E.

ORIGINATED BY PJS

DIST 2 HWY 402

BORING DATE February 9, 1976

COMPILED BY PJS

DATUM Geodetic

BOREHOLE TYPE Hollow Stem Auger

CHECKED BY *[Signature]*

SOIL PROFILE			SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT					LIQUID LIMIT W_L PLASTIC LIMIT W_P WATER CONTENT W			UNIT WEIGHT γ	REMARKS
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	'N' VALUES		20	40	60	80	100	W_P	W	W_L		
692.0	continued															
104.0	Clayey silt Very Stiff to Hard					690										
						680										
677.0			17	SS	25											
119.0	End of Borehole															

RECORD OF BOREHOLE NO 4

WP 40-66-22/23

LOCATION Co-ords. 15,601,741 N; 1,272,356 E.

ORIGINATED BY PJS

DIST 2 HWY 402

BORING DATE February 10, 1976

COMPILED BY PJS

DATUM Geodetic

BOREHOLE TYPE Hollow Stem Auger & Cone Test

CHECKED BY

SOIL PROFILE			SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT				LIQUID LIMIT — w_L PLASTIC LIMIT — w_p WATER CONTENT — w			UNIT WEIGHT γ	REMARKS
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	'N' VALUES		20	40	60	80	100	w_p	w	w_L	
798.9	Ground Level														
0.0	Silt, some sand, trace of clay.														
791.9	Loose		1	SS	4										0 92 (8)
7.0			2	SS	9										
			3	SS	32										0 44 51 5
	Silt		4	SS	69										
			5	SS	32										
	Fine sand, trace of silt		6	SS	64										0 86 (14)
			7	SS	44										
	Loose to Very Dense		8	SS	70										
			9	SS	65										2 92 (6)
	Well graded sand trace of gravel		10	SS	33										
			11	SS	82										
			12	SS	100	7"									
			13	SS	116										
			14	SS	48										
740.9															
58.0	Clayey silt														
737.4	Hard		15	SS	36										
61.5	End of Borehole														

RECORD OF BOREHOLE NO 5

WP 40-66-22/23
DIST 2 HWY 402
DATUM Geodetic

LOCATION Co-ords. 15,601,712 N; 1,272,194 E.
BORING DATE February 12, 1976
BOREHOLE TYPE Hollow Stem Auger & Cone Test

ORIGINATED BY PJS
COMPILED BY PJS
CHECKED BY *EP*

SOIL PROFILE			SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT				LIQUID LIMIT w_L PLASTIC LIMIT w_p WATER CONTENT w			UNIT WEIGHT γ	REMARKS % GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	'N' VALUES		20	40	60	100	w_p	w	w_L		
799.4	Ground Level														
0.0	Silt, some sand, trace of clay														
792.4	Compact		1	SS	13										0 88 (12)
7.0	Fine sand		2	SS	32										0 92 (8)
	trace of silt		3	SS	34										
			4	SS	23										
			5	SS	19										
	Compact to Very Dense		6	SS	34										2 91 (7)
			7	SS	50										
			8	SS	39										
	Well graded sand trace of gravel		9	SS	42										
			10	SS	39										
			11	SS	74										
			12	SS	132										
			13	SS	15										
741.4															
58.0	Clayey Silt		14	SS	55										
	Hard														
732.9			15	SS	70										
66.5	End of Borehole														

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS-ONTARIO
ENGINEERING SERVICES BRANCH-GEOTECHNICAL OFFICE-SOIL MECHANICS SECTION

RECORD OF BOREHOLE NO 6

WP 40-66-22/23 LOCATION Co-ords. 15,601,718 N; 1,272,244 E. ORIGINATED BY PJS
DIST 2 HWY 402 BORING DATE February 11, 1976 COMPILED BY PJS
DATUM Geodetic BOREHOLE TYPE Hollow Stem Auger CHECKED BY *[Signature]*

SOIL PROFILE			SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT					LIQUID LIMIT — w_L PLASTIC LIMIT — w_p WATER CONTENT — w			UNIT WEIGHT γ	REMARKS
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	'N' VALUES		20	40	60	80	100	w_p	w	w_L		
796.3	Ground Level															
0.0	Fine sand, trace of silt		1	SS	11	790										0 91 (9)
			2	SS	26											
			3	SS	26											
			4	SS	18											
	Compact to Very Dense		5	SS	34	780										0 94 (6)
			6	SS	46											
			7	SS	42											
	Well graded sand		8	SS	50	770										11 84 (5)
	Trace of gravel															
761.3			9	SS	40											
35.0	End of Borehole															

RECORD OF BOREHOLE NO 7

WP 40-66-22/23

LOCATION Co-ords. 15,601,757 N; 1,272,279 E.

ORIGINATED BY PJS

DIST 2 HWY 402

BORING DATE February 11, 1976

COMPILED BY PJS

DATUM Geodetic

BOREHOLE TYPE Hollow Stem Auger & Cone Test

CHECKED BY

SOIL PROFILE			SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT					LIQUID LIMIT w_L PLASTIC LIMIT w_p WATER CONTENT w			UNIT WEIGHT γ	REMARKS % GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	N' VALUES		20	40	60	80	100	w_p	w	w_L		
796.3	Ground Level															
0.0			1	SS	19											
			2	SS	23											
	Silt		3	SS	60											0 2 91 7
	Fine sand, trace of silt		4	SS	28											0 94 (6)
	Compact to Very Dense		5	SS	33											
			6	SS	52											4 90 (6)
			7	SS	61											
	Well graded sand		8	SS	49											
	Trace of gravel		9	SS	52											
760.8			10	SS	43											
759.4	End of Borehole					760										
36.9	End of Cone Test															

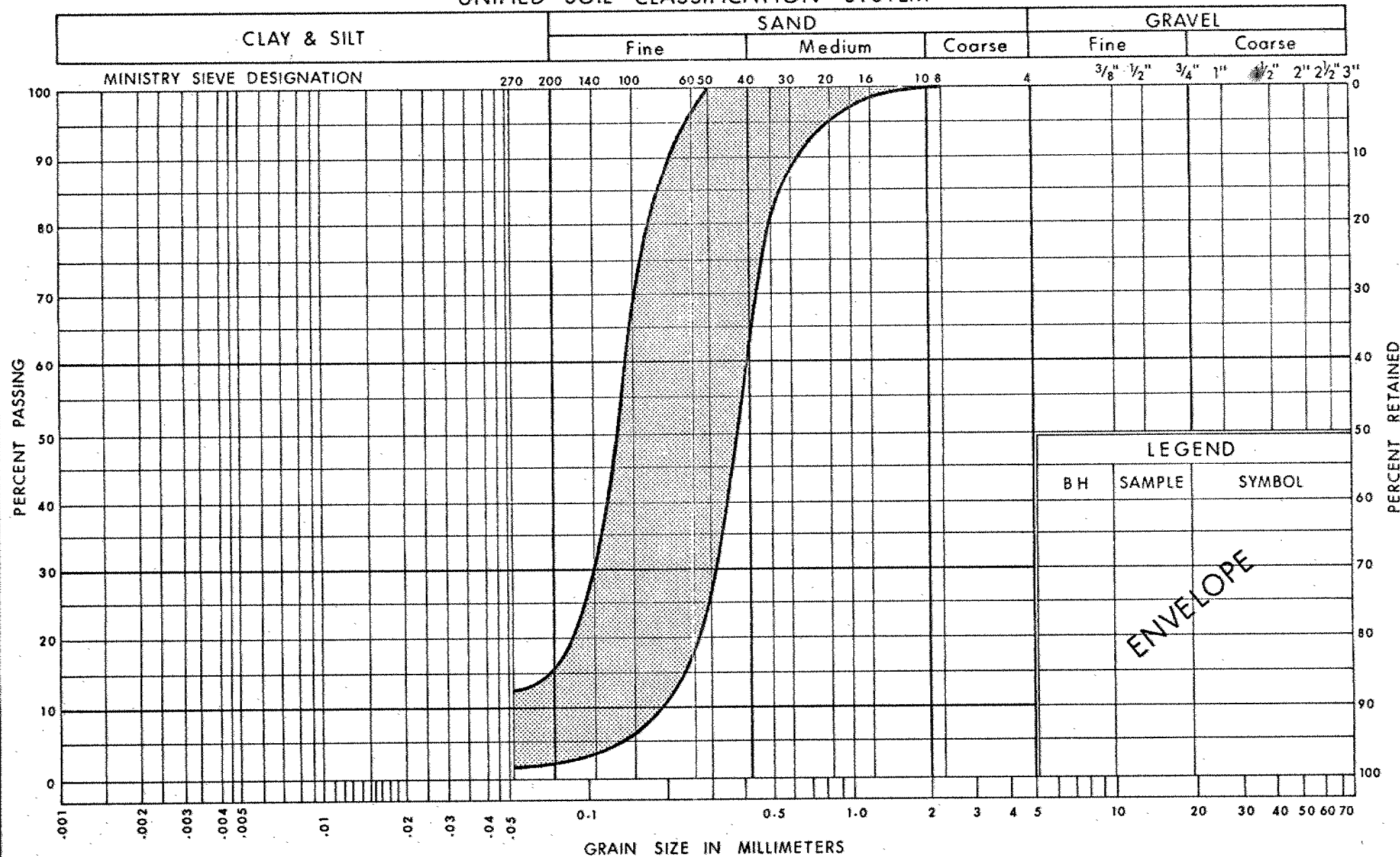
MINISTRY OF TRANSPORTATION AND COMMUNICATIONS-ONTARIO
ENGINEERING SERVICES BRANCH-GEOTECHNICAL OFFICE-SOIL MECHANICS SECTION

RECORD OF BOREHOLE NO 8

WP 40-66-22/23 LOCATION Co-ords. 15,601,809 N; 1,272,288 E. ORIGINATED BY PJS
DIST 2 HWY 402 BORING DATE February 13, 1976 COMPILED BY PJS
DATUM Geodetic BOREHOLE TYPE Hollow Stem Auger & Cone Test CHECKED BY *[Signature]*

SOIL PROFILE			SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT					LIQUID LIMIT w_L PLASTIC LIMIT w_p WATER CONTENT w			UNIT WEIGHT γ	REMARKS
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	N' VALUES		20	40	60	80	100	w_p	w	w_L		
796.2	Ground Level															
0.0	Silt with sand, trace of clay.															
	Loose to Compact		1	SS	9	790										0 36 63 1
787.2			2	SS	17											
9.0	Fine sand, trace of silt		3	SS	28											0 97 (3)
	Compact to Very Dense		4	SS	20											
			5	SS	30											0 98 (2)
			6	SS	25											
	Well graded sand		7	SS	41	770										
	Trace of gravel		8	SS	124											
			9	SS	68	760										0 86 (14)
			10	SS	35											
			11	SS	65	750										
			12	SS	51											
738.2						740										
58.0	Clayey silt. Stiff															
734.7			13	SS	14											
61.5	End of Borehole															

UNIFIED SOIL CLASSIFICATION SYSTEM



GRAIN SIZE DISTRIBUTION
FINE SAND, TRACE OF SILT

FIG No 1

W P 40-66-22 & 23

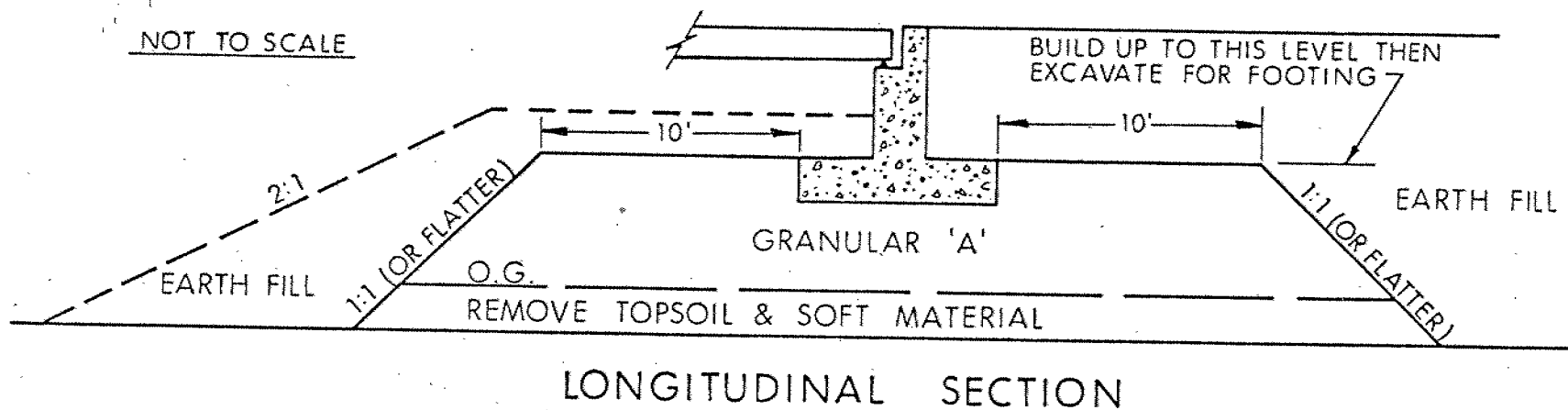
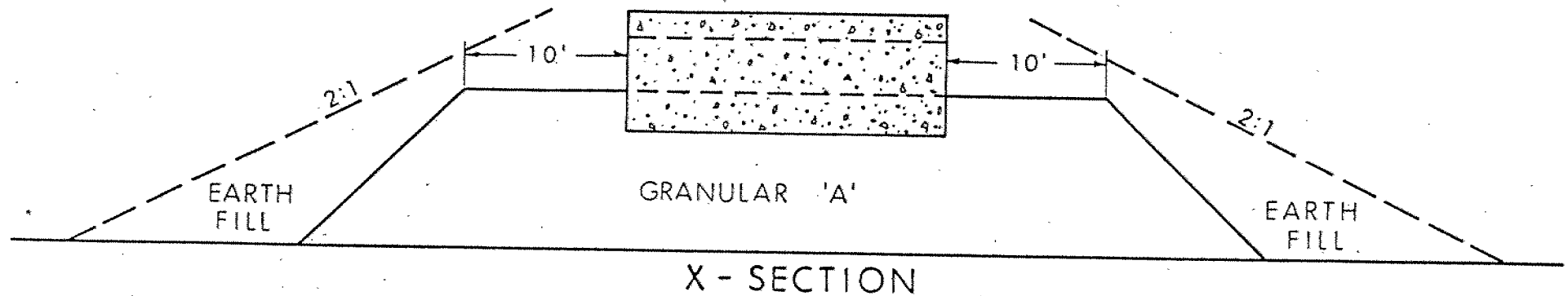


Ontario

Ministry of
Transportation and
Communications

ENGINEERING SERVICES BRANCH

ABUTMENT ON COMPACTED FILL SHOWING GRANULAR 'A' CORE



NOTES

- 1 - REMOVE TOPSOIL &/OR SOFT SUBSOIL UNDER AREA OF COMPACTED GRANULAR 'A'.
- 2 - PLACE GRANULAR 'A' TO TOP OF FOOTING LEVEL, COMPACTED ACCORDING TO CURRENT M.T.C. STANDARDS.
- 3 - EXCAVATE COMPACTED GRANULAR 'A' MATERIAL FOR FOOTING.

ABBREVIATIONS & SYMBOLS USED IN THIS REPORT

PENETRATION RESISTANCE

'N' = STANDARD PENETRATION RESISTANCE : - 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>c LB./SQ. FT.</u>	<u>DENSENESS</u>	<u>'N' BLOWS / FT.</u>
VERY SOFT	0 - 250	VERY LOOSE	0 - 4
SOFT	250 - 500	LOOSE	4 - 10
FIRM	500 - 1000	COMPACT	10 - 30
STIFF	1000 - 2000	DENSE	30 - 50
VERY STIFF	2000 - 4000	VERY DENSE	> 50
HARD	> 4000		

TERMS TO BE USED IN DESCRIBING SOILS :-

TRACE < 10% , SOME 10-25% , WITH 25-40% , > 40% SILTY, SANDY, GRAVELLY, CLAYEY ETC.

TYPE OF SAMPLE

S.S.	SPLIT SPOON	T.W.	THINWALL OPEN
W.S.	WASHED SAMPLE	T.P.	THINWALL PISTON
S.T.	SLOTTED TUBE SAMPLE	O.S.	OESTERBERG SAMPLE
A.S.	AUGER SAMPLE	F.S.	FOIL SAMPLE
C.S.	CHUNK SAMPLE	R.C.	ROCK CORE

P.H. SAMPLE ADVANCED HYDRAULICALLY

P.M. SAMPLE ADVANCED MANUALLY

SOIL TESTS

U	UNCONFINED COMPRESSION	L.V.	LABORATORY VANE
UU	UNCONSOLIDATED UNDRAINED TRIAXIAL	F.V.	FIELD VANE
CIU	CONSOLIDATED ISOTROPIC UNDRAINED TRIAXIAL	C	CONSOLIDATION
CID	" " DRAINED "	S	SENSITIVITY
CAU	" ANISOTROPIC UNDRAINED "		
CAD	" " DRAINED "		

ABBREVIATIONS & SYMBOLS USED IN THIS REPORT

SOIL PROPERTIES

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

GENERAL

π	= 3.1416
e	BASE OF NATURAL LOGARITHMS 2.7183
$\log_e \sigma$ OR $\ln \sigma$	NATURAL LOGARITHM OF σ
$\log_{10} \sigma$ OR $\log \sigma$	LOGARITHM OF σ TO BASE 10
t	TIME
g	ACCELERATION DUE TO GRAVITY
V	VOLUME
W	WEIGHT
M	MOMENT
F	FACTOR OF SAFETY

STRESS AND STRAIN

u	PORE PRESSURE
σ	NORMAL STRESS
$\bar{\sigma}$	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

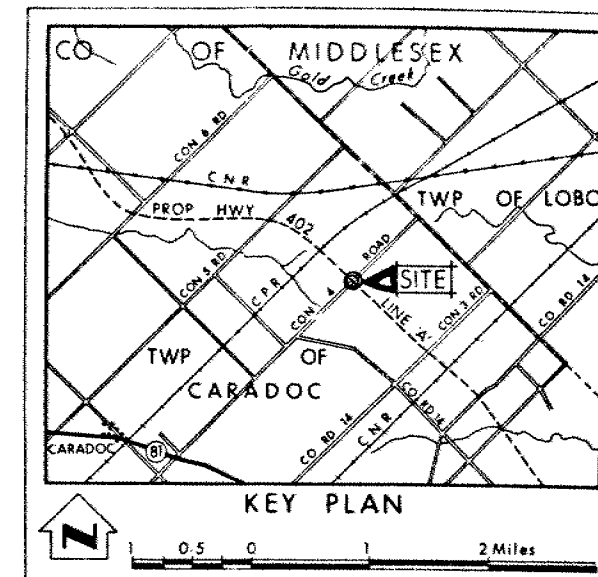
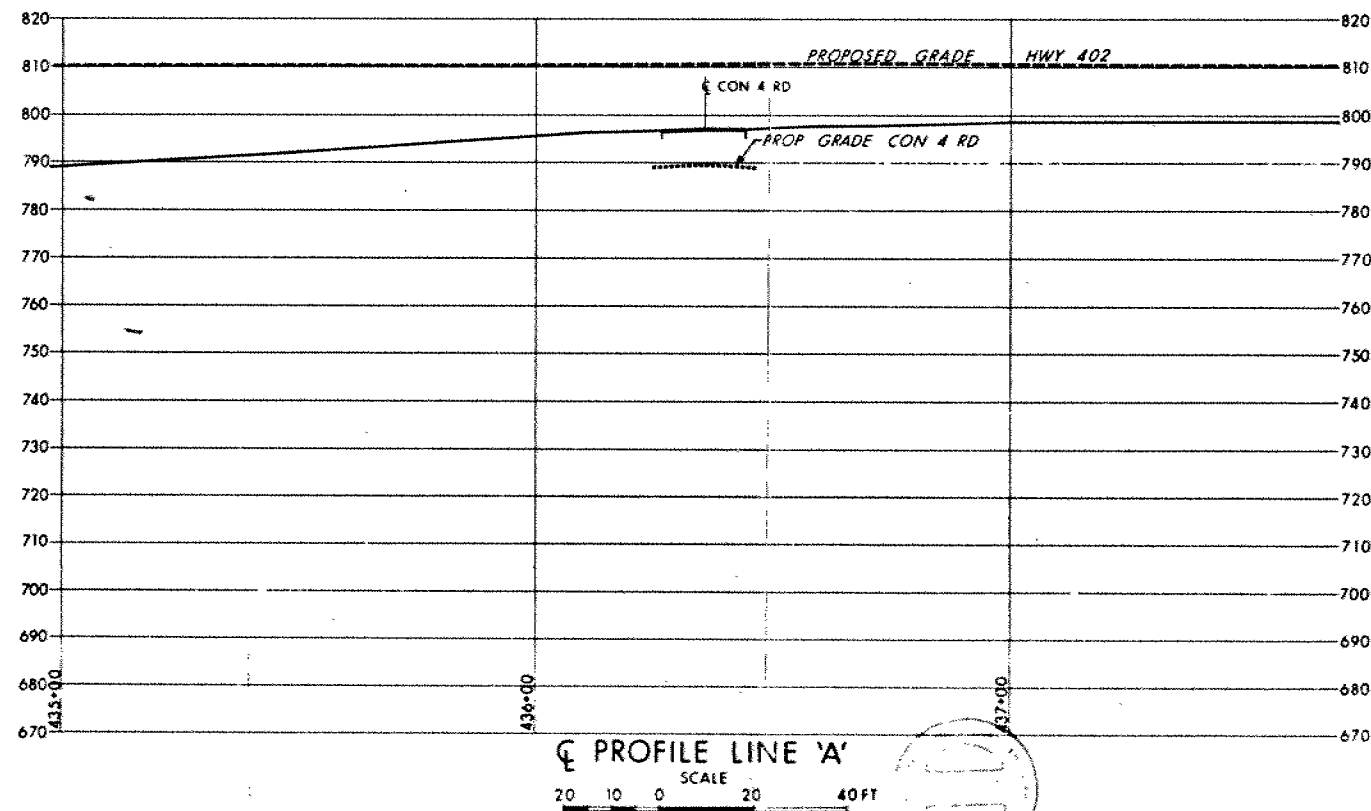
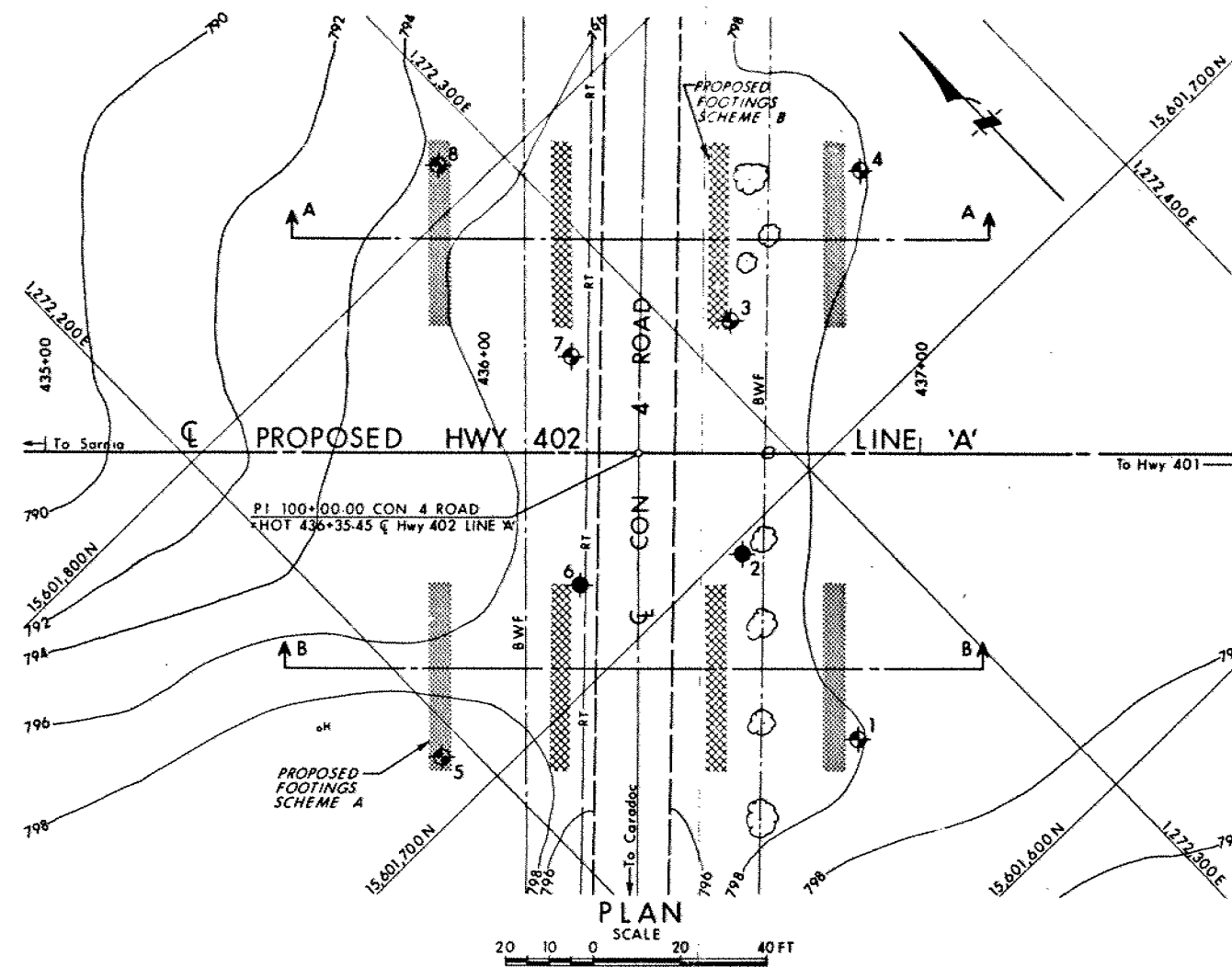
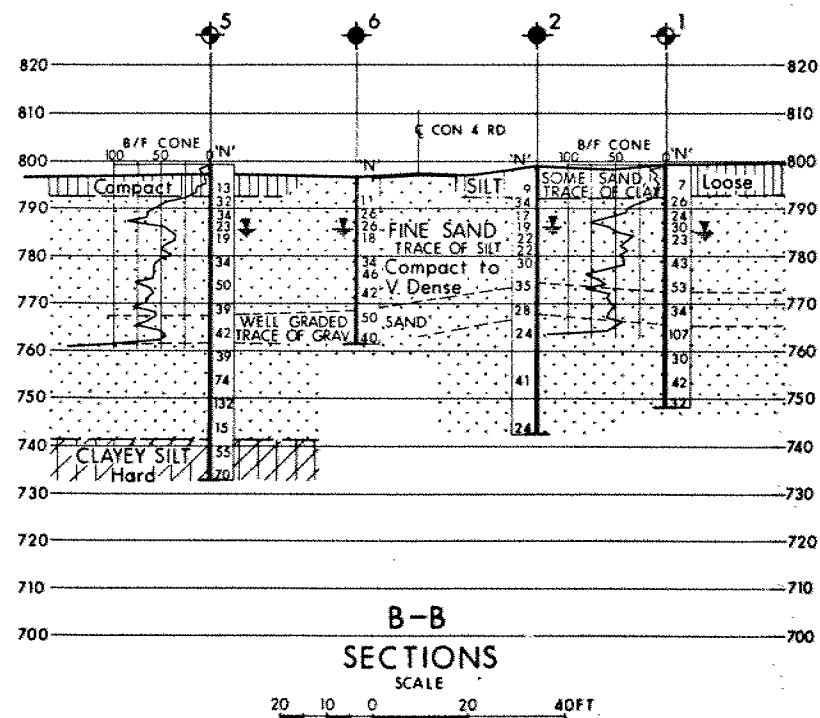
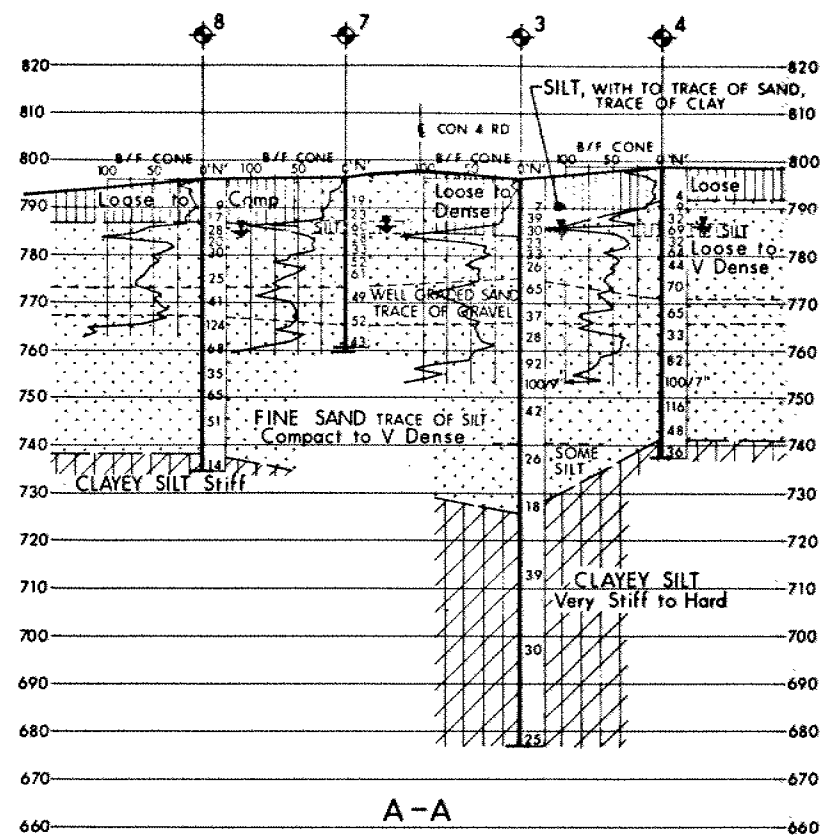
d	DISTANCE FROM TOP OF WALL TO POINT OF APPLICATION OF PRESSURE
δ	ANGLE OF WALL FRICTION
K	DIMENSIONLESS COEFFICIENT TO BE USED WITH VARIOUS SUFFIXES IN EXPRESSIONS REFERRING TO NORMAL STRESS ON WALLS
K_0	COEFFICIENT OF EARTH PRESSURE AT REST

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



LEGEND			
	Bore Hole		
	Dynamic Cone Penetration Resistance Test B/F CONE - Blows/ft. Cone Test (350 ft. lbs. energy/blow)		
	Bore Hole & Cone Test		
	Water Levels established at time of field investigation, Feb 1976		
NO.	ELEVATION	CO-ORDINATES NORTH	EAST
1	799.5	15,601,648	1,272,265
2	799.0	15,601,697	1,272,276
3	796.0	15,601,737	1,272,311
4	798.9	15,601,741	1,272,356
5	799.4	15,601,712	1,272,194
6	796.3	15,601,718	1,272,244
7	796.3	15,601,757	1,272,279
8	796.2	15,601,809	1,272,288

NOTE

The boundaries between soil strata have been established only at Bore Hole locations. Between Bore Holes the boundaries are assumed from geological evidence.

REVISIONS	DATE	BY	DESCRIPTION

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS—ONTARIO
ENGINEERING SERVICES BRANCH—GEOTECHNICAL OFFICE—SOIL MECHANICS SECTION

CON 4 ROAD

HIGHWAY NO Proposed 402 LINE 'A' DIST NO 2
CO MIDDLESEX
TWP CARADOC LOT 22 CON III & IV

BORE HOLE LOCATIONS & SOIL STRATA

SUBNO PJS CHECKED AP NO 40-66-22 & 23 DRAWING NO 406622 & 23-A
DRAWN CHECKED AND NO
DATE March 15, 1976 SITE NO 19-530 BRIDGE DRAWING NO
APPROVED CONT NO