MINISTRY OF TRANSPORTATION AND COMMUNICATIONS, ONTARIO

MEMORANDUM

GEOCRES NO: 30M12-81

TO: Mr. G.C.E. Burkhardt, (3)
Regional Structural Planning Eng.,
Central Region,
3501 Dufferin St., Downsview.

FROM: Foundations Office,
Design Services Branch,
West Bldg., Downsview.

ATTENTION:

DATE: August 14, 1973.

OUR FILE REF.

IN REPLY TO AUG 17 1973

SUBJECT:

FOUNDATION INVESTIGATION REPORT
For
The Proposed Ramp E-S Structure
At The Crossing of
Hwy. #401 & Hwy. #403 (Bridge #25)
Town of Mississauga, County of Peel
District #6 (Toronto, Ont.)
W.O. 73-11033 - W.P. 127-66-~~80~~

127-66-39

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 design requirements. Should additional information be required, please do not hesitate to contact our Office.

A. G. Stermac,
PRINCIPAL FOUNDATIONS ENGINEER.

AGS/ao
Attch.
c.c. E. J. Orr
B. R. Davis
A. Rutka
R. S. Pillar
H. Greenland
B. J. Giroux
C. Mirza
G. A. Wrong
B. A. Singh

Foundations Files
Documents

TABLE OF CONTENTS

FOUNDATION INVESTIGATION REPORT
For
The Proposed Ramp E-S Structure
At The Crossing of
Hwy. #401 & Hwy. #403 (Bridge #25)
Town of Mississauga, County of Peel
District #6 (Toronto, Ont.)
W.O. 73-11033 - W.P. 127-66-~~39~~ 10

1. *INTRODUCTION:*

The present proposals for the construction programme of Hwy. #401-Hwy. #403 complex will require a major interchange in the vicinity of the intersection of Hwy. #401 and Heart Lake Road. This interchange, designated as 401/410/403 complex, will incorporate some twenty-one structures.

A request for a foundation investigation at the site of the proposed Bridge #25 (Ramp E-S, over reconstructed #401 core) was received from Mr. G. C. E. Burkhardt, Regional Structural Planning Engineer, in a memorandum dated May 8, 1973.

Following this request a field investigation was carried out by the Foundations Office to determine the subsoil, bedrock and groundwater conditions existing at the site.

This report contains the results of this investigation and our recommendations pertaining to the design of the proposed structure foundations and the stability of the approach fills and cuts.

2. *DESCRIPTION OF THE SITE AND GEOLOGY:*

The site of the proposed structure is located about 1 mile east of the existing Hwy. #401 & Hwy. #10 interchange, in the Town of Mississauga.

....2

Topographically, the general area is flat to gently undulating. The land is utilized for farming purposes.

Physiographically, the site is located in the region referred to as the "Peel Plain." Across this plain rivers and streams have cut deep valleys and consequently there are no large undrained depressions, swamps or bogs, although in many of the interstream areas the drainage is imperfect.

The characteristic geological material of this region is a glacial till containing large amounts of shale and limestone. The overburden is underlain by dark grey shale bedrock of the Meaford-Dundas Formation.

3. *FIELD AND LABORATORY INVESTIGATION PROCEDURES:*

A total of seven sampled boreholes and one dynamic cone penetration test was carried out during the course of the field work. Boring was achieved by means of a conventional diamond drilling equipment adapted for soil sampling purposes. During the field work, disturbed samples were obtained by means of a standard split-spoon sampler; the energy used in driving it conformed to the requirements of the Standard Penetration Test (SPT).

Dynamic cone penetration test was carried out adjacent to one borehole (B.H. #3). Driving energy to advance the cone was 350 ft.-lbs. per blow.

The bedrock was proven at all borehole locations using BXL rock coring equipment.

All boreholes were surveyed in the field by District #6 (Toronto) Construction Personnel. The locations referenced to a coordinate system and elevations referenced to Geodetic Datum and are shown on Drawing No. 73-11033A which accompanies this report.

All samples were visually examined and classified at the site as well as in the laboratory. Following this inspection laboratory tests were carried out on selected samples to determine the following engineering properties:

.....3

Natural Moisture Content
Atterberg Limits
Grain-Size Distribution

The test results are summarized on the Record of Borehole sheets contained in the Appendix of this report.

4. *SOIL TYPES AND SOIL CONDITIONS:*

4.1) *General:*

Generally uniform subsoil conditions were found to prevail over the site area. The subsoil consists of a relatively shallow deposit ranging in thickness from 2 to 7 ft. of glacial till which is a heterogeneous mixture of clayey silt to silty clay, some sand and trace of gravel, followed by shale bedrock.

The boundaries of the different deposits are shown on the Record of Borehole sheets attached to the Appendix. The estimated stratigraphical profile of Drawing #73-11033A is based upon this information.

From ground level downward, the various strata are described in some detail with regard to soil types and physical properties as follows:

4.2) *Heterogeneous Mixture of Clayey Silt to Silty Clay Some Sand and Trace of Gravel (Glacial Till):*

This deposit was intersected in all borings and extends from immediately below a thin layer of topsoil down to the bedrock surface. The thickness of the zone ranges from 2 to 7 ft. The lower boundary was found to vary between elevation 582.2 (B.H. #3) and elevation 571.4 (B.H. #7).

The material in the stratum consists of clayey silt to silty clay, some sand and trace of gravel.

Laboratory tests carried out on a limited number of samples indicate the following physical properties:

	Min. - *Max.*	*Average*
Natural Moisture Content (%)	12 - 21	16
Liquid Limit (%)	28 - 36	33
Plastic Limit (%)	20 - 24	23

...4

Grain-size distribution curves are included in the Appendix of this report (Fig. 1).

Standard penetration tests carried out within this cohesive deposit gave "N" values ranging from 41 to over 100 blows per foot.

The consistency of the overall deposit is estimated to be hard.

4.3) Bedrock - Shale:

The glacial till deposit is underlain by a shale bedrock at all of the boring locations. The upper boundary of the bedrock varies between elevation 582± and elevation 571±.

The core recovery ranged from 30% to 100% at the borehole locations. Based on the core recovery and inspection of the core samples the upper 1 to 7 ft. portion of the bedrock is weathered. The shale was found to be sound immediately below the overburden without any signs of weathering at the location of B.H. #1.

The bedrock is composed of dark grey interbedded shale and limestone.

5. *GROUNDWATER CONDITIONS:*

Groundwater level observations were carried out during the period of the field investigation (June), in open boreholes. The observed water levels are presented on the individual Record of Borehole sheets as well as on Drawing No. 73-11033A. The results indicate that the groundwater level varies between elevation 582± and elevation 574±, which correspond to levels ranging from 1 to 10 ft. below the existing ground surface.

No artesian or downward drainage conditions were encountered.

6. *DISCUSSION AND RECOMMENDATIONS:*

6.1) General:

It is proposed to build a four-span (63'-105'-111'-66') underpass structure at this location. This structure (Bridge #25)

or Ramp E-S will carry the traffic over the reconstructed Hwy. #401 core.

Bridge #25 will be part of the proposed Hwy. #401 and Hwy. #403 interchange complex.

The proposed profile grade of Hwy. #401 in the vicinity of the structure will be at approximate elevation 574.5. The proposed profile grade of Ramp E-S varies between elevation 599 and elevation 600. The elevation of the existing ground level ranges from elevation 592± to elevation 576±. In order to accommodate these grades fills up to 22' and cuts up to 16' will be required.

As described in the previous paragraphs of this report, the subsoil at the site consists of a relatively shallow deposit (2 - 7 ft.) of glacial till, followed by shale bedrock.

6.2) *Foundations - Ramp E-S Structure:*

6.2.1) *Abutments:*

The abutments of the proposed structure may be supported on spread footings placed on well compacted, suitable granular material within the approach fills. A safe design load of 2.5 t.s.f. may be assumed. The granular material should consist of Granular 'A' and should be fully compacted according to current standards. A detailed construction scheme is outlined on Figure 2 of the Appendix.

As an alternative the abutments for this structure may be perched within the approach fills and supported on end-bearing steel 'H' piles driven to bedrock. The allowable capacity of a pile will be dependent on the pile section chosen. For example, 12 BP 74 steel 'H' piles may be designed for a safe design load of 95 tons. For estimating purposes, it can be assumed that the piles will meet the bedrock surface at the following elevations:

South Abutment: El. 581± - El. 582± (B.H.'s #1 & #2)
North Abutment: El. 571± - El. 574± (B.H.'s #6 & #7)

....6

Since the pile caps of the perched abutments will be formed within the approaches, no dewatering problems are anticipated.

No boulder or rock fill material should be placed in that portion of the approaches through which piles are to be driven.

6.2.2) Piers:

The excavation for the reconstructed Hwy. #401 core in the vicinity of the pier locations will be carried out into the shale bedrock.

The footings of the proposed piers may be founded on the sound bedrock. The base of the footing excavations should be carefully inspected to ensure that all the probable weathered or fractured part of the shale bedrock is removed. Frost protection (min. 4 ft.) should be provided for the underside of the footings, since the shale is considered susceptible to frost action. To prevent the shale from being softened by uncontrolled surface runoff water at foundation level it may be advantagecus that a concrete working slab be poured immediately after the excavation reached the required foundation level. If these procedures are followed, safe design loads up to 10 t.s.f. may be used for design purposes.

A coefficient of friction of 1.0 between the rough concrete surface and sound shale may be assumed in order to compute the horizontal resistance of the footings.

The settlement of the footings will be negligible in magnitude.

The level of the groundwater in the overburden as established during the field investigation is well above the footing excavation bases. This condition, however, should not present any major dewatering problems, due to the relatively impervious nature of the subsoil. Any seepage into the excavations could be easily handled by employing conventional techniques, such as pumping from sumps.

....7

6.3) Approaches:

As described previously the approaches will consist of partial fill and cut sections. The maximum fill height is about 22 ft. and the deepest portion of the cut is in the order of 16 ft.

6.3.1) Fills:

The underlying subsoil (Glacial Till) is competent to support the proposed 22 ft. high embankment constructed with 2:1 standard forward and side slopes.

The settlement due to consolidation of the subsoil caused by embankment loading will be negligible in magnitude and it is assumed that major portion of the settlement will take place immediately following the completion of the fill placement.

The fill should consist of well compacted acceptable material.

The topsoil and any soft surficial material should be removed in accordance with the pertinent standards within the construction area.

6.3.2) Cuts:

The cuts for Hwy. #401, up to 16 ft. deep will be made through the glacial till and into the shale bedrock. Since the shale when it is exposed to air, frost action and weathering tends to erode and disintegrate quickly, should be treated as earth cut.

It is recommended, therefore, that the cut slopes be protected with an adequate cover of topsoil and sodded.

7. MISCELLANEOUS:

The field investigation was carried out during the period of June 4 to 11, 1973, under the supervision of Mr. V. Korlu, Project Foundations Engineer.

Equipment was owned and operated by Canadian Longyear Ltd.

....8

This report was written by Mr. P. Payer, Senior Foundations Engineer.

The entire project was under the general supervision of Mr. M. Devata, Supervising Foundations Engineer, who also reviewed this report.

P. Payer

P. Payer, P. Eng.

M. Devata

M. Devata, P. Eng.

PP/ao
Aug. 13, 1973.

APPENDIX I

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS – ONTARIO

DESIGN SERVICES BRANCH — FOUNDATIONS OFFICE

RECORD OF BOREHOLE Nº 1

JOB 73-11033 — LOCATION Co-ords. 15,856,986 N; 958,683 E. — ORIGINATED BY VK

W.P. 127-66-~~390~~ 10 — BORING DATE June 6, 1973 — COMPILED BY VK

DATUM Geodetic — BOREHOLE TYPE Drill with tricone and BXL Bit — CHECKED BY [illegible]

SOIL PROFILE: ELEV. / DEPTH	DESCRIPTION	STRAT. PLOT	SAMPLES: NUMBER	TYPE	BLOWS/FOOT	ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE: BLOWS / FOOT; SHEAR STRENGTH P.S.F. (○ UNCONFINED, ● QUICK TRIAXIAL, + FIELD VANE, × LAB VANE)	LIQUID LIMIT W_L, PLASTIC LIMIT W_P, WATER CONTENT W (W_P — W — W_L); WATER CONTENT %	BULK DENSITY γ P.C.F.	REMARKS: GR. SA. SI. CL.
583.3	Ground Level									
581.3	Glacial Till									▽ 582.2
2.0	Shale Bedrock		1	BXL	100%	580				
571.3	Sound		2	BXL	100%					
12.0	End of Borehole					570				

OFFICE REPORT · SOIL EXPLORATION

20
15 ⊹ 5 % STRAIN AT FAILURE
10

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS – ONTARIO

DESIGN SERVICES BRANCH — FOUNDATIONS OFFICE

RECORD OF BOREHOLE Nº 2

JOB 73-11033 — LOCATION Co-ords. 15,856,971 N; 958,732 E. — ORIGINATED BY VK

W.P. 127-66-390 10 — BORING DATE June 4, 1973 — COMPILED BY VK

DATUM Geodetic — BOREHOLE TYPE Drill with tricone and BXL Bit — CHECKED BY

SOIL PROFILE ELEV. / DEPTH	DESCRIPTION	STRAT. PLOT	SAMPLES NUMBER	TYPE	BLOWS/FOOT	ELEV. SCALE
588.8	Ground Level					
0.0	Het.mix of silty clay, some sand, trace of gravel		1	SS	146	
			2	SS	130	
581.8	(Glac.Till) Hard					
7.0	weathered		3	BXL	30%	580
	sound					
	Shale Bedrock		4	BXL	95%	
						570
566.9			5	BXL	100%	
21.9	End of Borehole					560

DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT

SHEAR STRENGTH P.S.F.
○ UNCONFINED + FIELD VANE
● QUICK TRIAXIAL × LAB VANE

LIQUID LIMIT W_L
PLASTIC LIMIT W_P
WATER CONTENT W
W_P — W — W_L
WATER CONTENT % 10 20 30

BULK DENSITY γ P.C.F.

REMARKS GR.SA.SI.CL.

1 7 50 42

▽ 1 7 50 42

582.0

OFFICE REPORT SOIL EXPLORATION

20
15 ⊹ 5 % STRAIN AT FAILURE
10

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS - ONTARIO

DESIGN SERVICES BRANCH — FOUNDATIONS OFFICE

RECORD OF BOREHOLE No 3

JOB 73-11033 — LOCATION Co-ords. 15,857,037 N; 958,728 E. — ORIGINATED BY VK

W.P. 127-66-~~390~~ 10 — BORING DATE June 4, 1973 — COMPILED BY VK

DATUM Geodetic — BOREHOLE TYPE Drill with tricone and BXL Bits — CHECKED BY [illegible]

SOIL PROFILE ELEV./DEPTH	DESCRIPTION	STRAT. PLOT	SAMPLES NUMBER	TYPE	BLOWS/FOOT	ELEV. SCALE
584.7	Ground Level					
582.7	Glacial Till					
2.0	weathered					580
	sound		1	BXL	100%	
	Shale Bedrock					
570.7			2	BXL	100%	570
14.0	End of Borehole					

DYNAMIC PENETRATION RESISTANCE
BLOWS / FOOT — 20 40 60 80 100
SHEAR STRENGTH P.S.F.
○ UNCONFINED + FIELD VANE
● QUICK TRIAXIAL × LAB VANE

LIQUID LIMIT —— w_L
PLASTIC LIMIT —— w_P
WATER CONTENT — w
w_P — w — w_L
WATER CONTENT %

BULK DENSITY γ P.C.F.

REMARKS — GR.SA.SI.CL.

▽ 574.7

20
15 ☼ 5 % STRAIN AT FAILURE
10

OFFICE REPORT SOIL EXPLORATION

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS – ONTARIO

DESIGN SERVICES BRANCH — FOUNDATIONS OFFICE

RECORD OF BOREHOLE No 4

JOB 73-11033 — LOCATION Co-ords. 15,857,136 N; 958,764 E. — ORIGINATED BY VK

W.P. 127-66-390 10 — BORING DATE June 6, 1973 — COMPILED BY VK

DATUM Geodetic — BOREHOLE TYPE Drill with tricone and BXL Bits — CHECKED BY

SOIL PROFILE			SAMPLES				DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT	LIQUID LIMIT W_L / PLASTIC LIMIT W_P / WATER CONTENT W	BULK DENSITY γ P.C.F.	REMARKS
ELEV. / DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS/FOOT	ELEV. SCALE	SHEAR STRENGTH P.S.F. ○ UNCONFINED ⊕ QUICK TRIAXIAL + FIELD VANE × LAB VANE	WATER CONTENT %		GR. SA. SI. CL.
583.2	Ground Level									
581.2	Glacial Till					580				
2.0	weathered / sound		1	BXL	100%					▽ 577.2
	Shale Bedrock									
569.2			2	BXL	95%	570				
14.0	End of Borehole					560				

20 / 15 ◇ 5 / 10 % STRAIN AT FAILURE

OFFICE REPORT ' SOIL EXPLORATION

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS – ONTARIO

DESIGN SERVICES BRANCH — FOUNDATIONS OFFICE

RECORD OF BOREHOLE No 5

JOB 73-11033 — LOCATION Co-ords. 15,857,238 N; 958,809 E. — ORIGINATED BY VK

W.P. 127-66-~~390~~ 10 — BORING DATE June 8, 1973 — COMPILED BY VK

DATUM Geodetic — BOREHOLE TYPE Drill with tricone and BXL Bits — CHECKED BY

SOIL PROFILE ELEV./DEPTH	DESCRIPTION	STRAT. PLOT	SAMPLES NUMBER	TYPE	BLOWS/FOOT	ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS/FOOT / SHEAR STRENGTH P.S.F. (o UNCONFINED, ● QUICK TRIAXIAL, + FIELD VANE, × LAB VANE)	LIQUID LIMIT W_L / PLASTIC LIMIT W_P / WATER CONTENT W — WATER CONTENT % (10 20 30)	BULK DENSITY γ P.C.F.	REMARKS GR. SA. SI. CL.
581.5	Ground Level									
0.0	Het.mix.of silty clay, some sand (Glacial Till)		1	SS	41	580		o		0 17 58 25
575.5	Hard		2	SS	~~100~~/2"					▽575.3
6.0	weathered									
	sound		3	BXL	100%	570				
	Shale Bedrock		4	BXL	100%					
562.5										
19.0	End of Borehole					560				

OFFICE REPORT ' SOIL EXPLORATION

20
15 ⊹ 5 % STRAIN AT FAILURE
10

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS – ONTARIO

DESIGN SERVICES BRANCH — FOUNDATIONS OFFICE

RECORD OF BOREHOLE No 6

JOB 73-11033 — LOCATION Co-ords. 15,857,287 N; 958,861 E. — ORIGINATED BY VK

W.P. 127-66-390 10 — BORING DATE June 11, 1973 — COMPILED BY VK

DATUM Geodetic — BOREHOLE TYPE Drill with tricone and BXL Bits — CHECKED BY

SOIL PROFILE ELEV./DEPTH	DESCRIPTION	STRAT. PLOT	SAMPLES NUMBER	TYPE	BLOWS/FOOT	ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS/FOOT — SHEAR STRENGTH P.S.F. o UNCONFINED + FIELD VANE @ QUICK TRIAXIAL × LAB VANE	LIQUID LIMIT W_L — PLASTIC LIMIT W_P — WATER CONTENT W — WATER CONTENT % 10 20 30	BULK DENSITY γ P.C.F.	REMARKS GR. SA. SI. CL.
578.5	Ground Level									
0.0	Het. mix. of clayey silt, sand & gravel									
574.5	(Glac. Till) Hard		1	SS	100/6"			o		▽575.0 5 21 45 29
4.0			2	SS	100/1"	570				
	weathered									
	sound		3	BXL	100%					
	Shale Bedrock									
558.0			4	BXL	100%	560				
20.5	End of Borehole					550				

OFFICE REPORT ' SOIL EXPLORATION

20
15 ☼ 5 % STRAIN AT FAILURE
10

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS – ONTARIO

DESIGN SERVICES BRANCH — FOUNDATIONS OFFICE

RECORD OF BOREHOLE No 7

JOB 73-11033 — LOCATION Co-ords. 15,857,310 N; 958,814 E. — ORIGINATED BY VK

W.P. 127-66-390 10 — BORING DATE June 12, 1973 — COMPILED BY VK

DATUM Geodetic — BOREHOLE TYPE Drill with tricone and BXL Bits — CHECKED BY

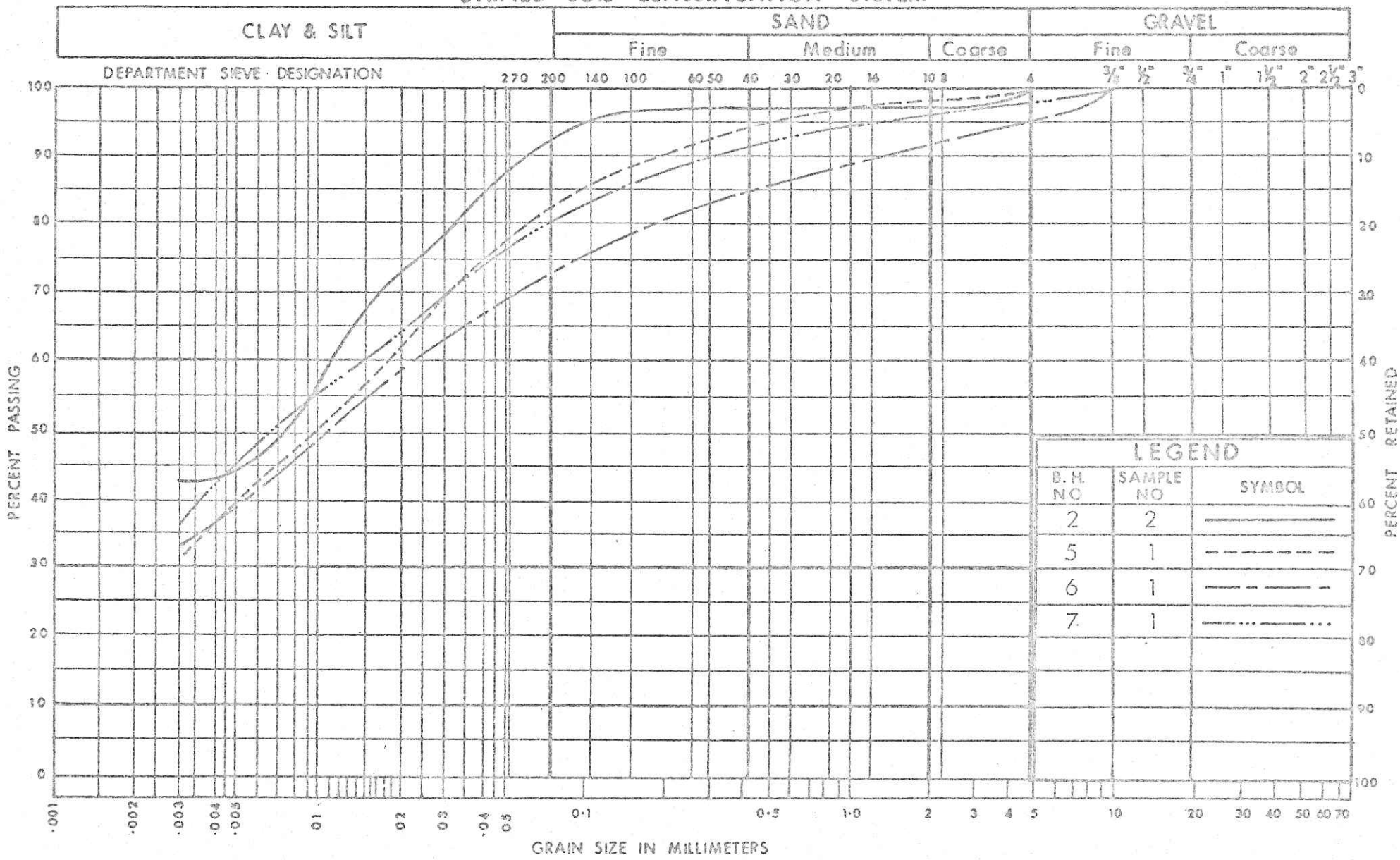
SOIL PROFILE ELEV./DEPTH	DESCRIPTION	STRAT. PLOT	SAMPLES NUMBER	TYPE	BLOWS/FOOT	ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT; SHEAR STRENGTH P.S.F. ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE	LIQUID LIMIT w_L PLASTIC LIMIT w_P WATER CONTENT w WATER CONTENT % 10 20 30	BULK DENSITY γ P.C.F.	REMARKS GR. SA. SI. CL.
577.4	Ground Level									
0.0	Het.mix.of clayey si. sand and gravel. (Glacial Till) Hard		1	SS	100/3"			○		▽574.4 2 17 53 28
571.4						570				
6.0	weathered / sound Shale Bedrock		2	BXL	90%					
563.0										
14.4	End of Borehole					560				

OFFICE REPORT ON SOIL EXPLORATION

20
15 ⊹ 5 % STRAIN AT FAILURE
10

FORM CD - MT - 17
REV. AUG. 1971

UNIFIED SOIL CLASSIFICATION SYSTEM



DEPARTMENT OF TRANSPORTATION AND COMMUNICATIONS
ONTARIO
DESIGN SERVICES BRANCH

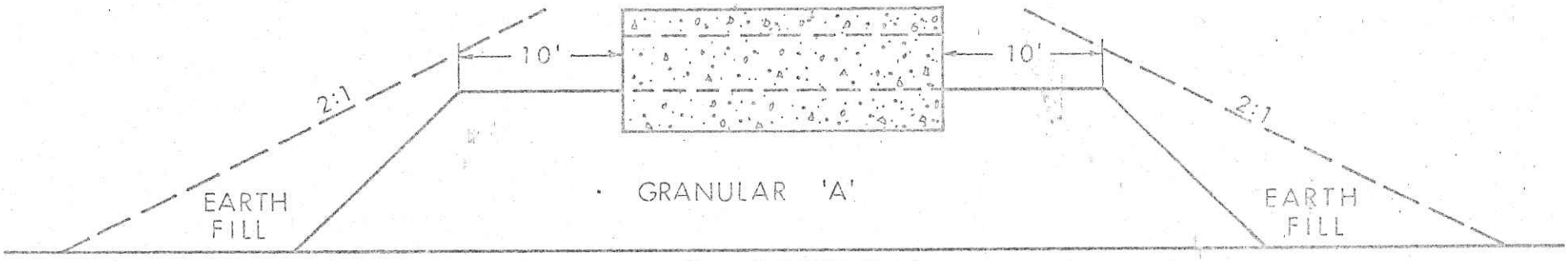
GRAIN SIZE DISTRIBUTION

GLACIAL TILL

HET. MIX. OF CLAYEY SILT, SAND & GRAVEL

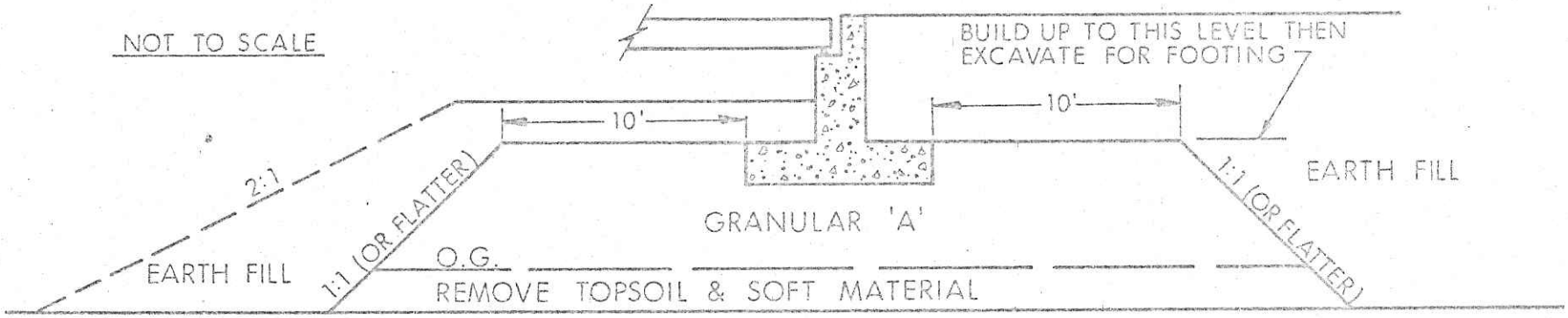
W.P. No. 127 - 66 - ~~390~~ 28
JOB No. 73 - 11033
FIG. 1

ABUTMENT ON COMPACTED FILL SHOWING GRANULAR 'A' CORE



X - SECTION

NOT TO SCALE



LONGITUDINAL SECTION

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.

FIG. 2

JOB No: 73 - 11033

FD-9a (Rev. Jan. 73)

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 :-

CONSISTENCY	c LB./SQ.FT.
VERY SOFT	0 - 250
SOFT	250 - 500
FIRM	500 - 1000
STIFF	1000 - 2000
VERY STIFF	2000 - 4000
HARD	> 4000

DENSENESS	'N' BLOWS / FT.
VERY LOOSE	0 - 4
LOOSE	4 - 10
COMPACT	10 - 30
DENSE	30 - 50
VERY DENSE	> 50

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 "		

FD-9b (Rev. Jan. 73)

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 — IN TERMS OF EFFECTIVE STRESS $\tau_f = c' + \sigma' \tan \phi'$
ϕ'	EFFECTIVE ANGLE OF SHEARING RESISTANCE, OR FRICTION — IN TERMS OF EFFECTIVE STRESS $\tau_f = c' + \sigma' \tan \phi'$
c_u	APPARENT COHESION — IN TERMS OF TOTAL STRESS $\tau_f = c_u + \sigma \tan \phi$
ϕ_u	APPARENT ANGLE OF SHEARING RESISTANCE, OR FRICTION — IN TERMS OF TOTAL STRESS $\tau_f = c_u + \sigma \tan \phi$
μ	COEFFICIENT OF FRICTION
S_t	SENSITIVITY

GENERAL

π	= 3·1416
e	BASE OF NATURAL LOGARITHMS 2·7183
$\log_e a$ OR $\ln a$	NATURAL LOGARITHM OF a
$\log_{10} a$ OR $\log a$	LOGARITHM OF a TO BASE 10
t	TIME
g	ACCELERATION DUE TO GRAVITY
V	VOLUME
W	WEIGHT
M	MOMENT
F	FACTOR OF SAFETY

STRESS AND STRAIN

u	PORE PRESSURE
σ	NORMAL STRESS
σ'	NORMAL EFFECTIVE STRESS ($\bar{\sigma}$ IS ALSO USED)
τ	SHEAR STRESS
ε	LINEAR STRAIN
γ	SHEAR STRAIN
ν	POISSON'S RATIO (μ IS ALSO USED)
E	MODULUS OF LINEAR DEFORMATION (YOUNGS MODULUS)
G	MODULUS OF SHEAR DEFORMATION
K	MODULUS OF COMPRESSIBILITY
η	COEFFICIENT OF VISCOSITY

EARTH PRESSURE

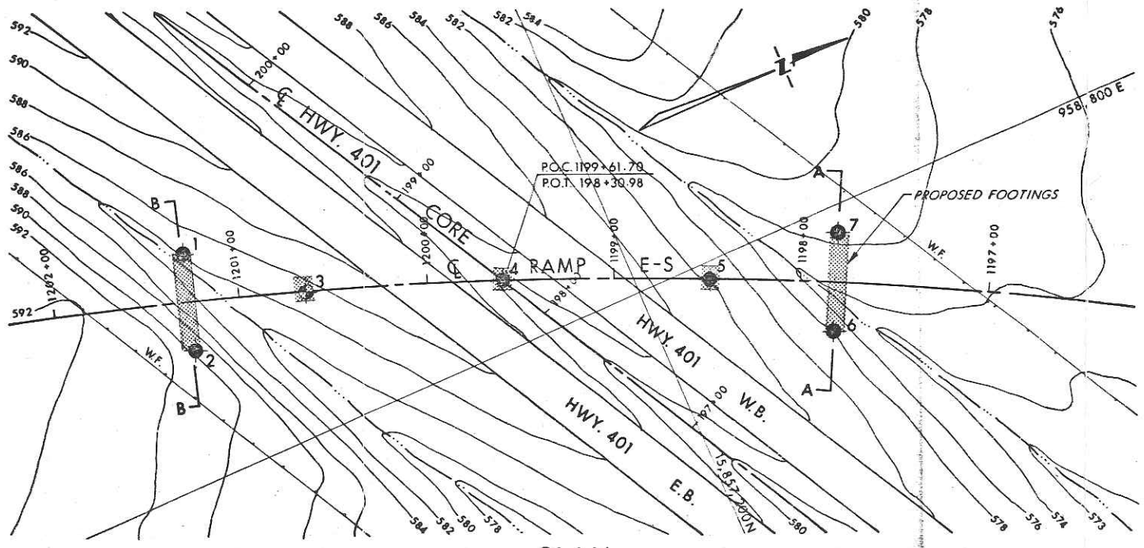
d	DISTANCE FROM TOP OF WALL TO POINT OF APPLICATION OF PRESSURE
δ	ANGLE OF WALL FRICTION
K	DIMENSIONLESS COEFFICIENT TO BE USED WITH VARIOUS SUFFIXES IN EXPRESSIONS REFERRING TO NORMAL STRESS ON WALLS
K_o	COEFFICIENT OF EARTH PRESSURE AT REST

FOUNDATIONS

B	BREADTH OF FOUNDATION
L	LENGTH OF FOUNDATION
D	DEPTH OF FOUNDATION BENEATH GROUND
N	DIMENSIONLESS COEFFICIENT USED WITH A SUFFIX APPLYING TO SPECIFIC GRAVITY. DEPTH AND COHESION ETC. IN THE FORMULA FOR BEARING CAPACITY
k_s	MODULUS OF SUBGRADE REACTION

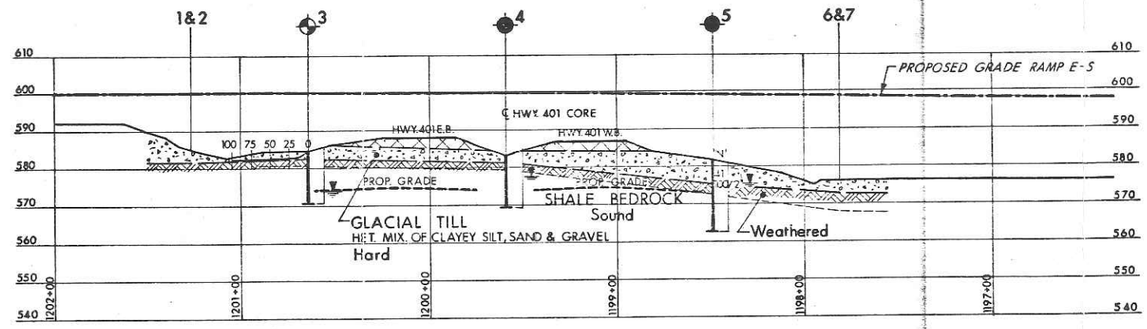
SLOPES

H	VERTICAL HEIGHT OF SLOPE
D	DEPTH BELOW TOE OF SLOPE TO HARD STRATUM
β	ANGLE OF SLOPE TO HORIZONTAL



PLAN

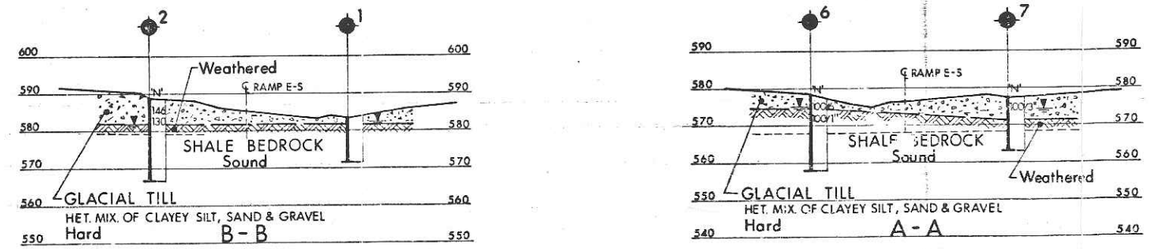
40 20 0 SCALE 40 80 FT.



PROFILE

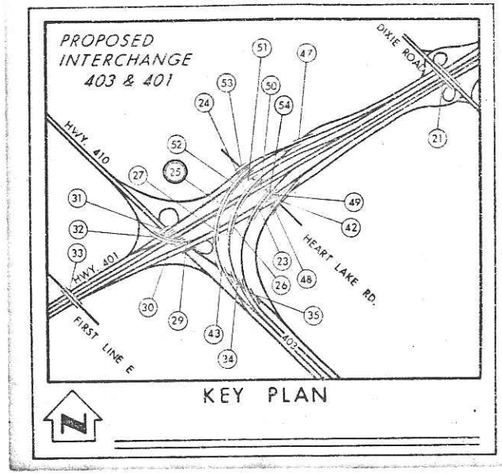
HORIZ. 40 20 0 SCALE 40 80 FT.

VERT. 20 10 0 20 40 FT.



SECTIONS

20 10 0 SCALE 20 40 FT.



LEGEND

- Bore Hole
- Cone Penetration Test
- Bore Hole & Cone Test
- Water Levels established at time of field investigation. June 1973.

NO.	ELEVATION	CO-ORDINATES	
		NORTH	EAST
1	583.3	15,856,986	958,683
2	588.8	15,856,971	958,732
3	584.7	15,857,037	958,728
4	583.2	15,857,136	958,764
5	581.5	15,857,238	958,809
6	578.5	15,857,287	958,861
7	577.4	15,857,310	958,814

4883 08 29 2246.5

— 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

REF. No: 3983 - 3K - 3

REGISTERED PROFESSIONAL ENGINEER CIVIL V. KORLU PROVINCE OF ONTARIO

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS—ONTARIO
DESIGN SERVICES BRANCH—FOUNDATIONS OFFICE

BRIDGE No. 25
(HWY. 403 RAMP E-S)

HIGHWAY NO. 401 & 403 DIST. NO. 6

CO. PEEL

TOWN OF MISSISSAUGA LOT CON.

BORE HOLE LOCATIONS & SOIL STRATA

SUBMD. V.K.	CHECKED	W.P. NO. 127-66-390	DRAWING NO. 73-11033 A
DRAWN S.R.	CHECKED	W.O. NO. 73-11033	
DATE JULY 30, 1973.		SITE NO.	BRIDGE DRAWING NO.
APPROVED PRINCIPAL FOUNDATION ENGINEER		CONT. NO.	

SNO-TRACE 300-8-72