MINISTRY OF TRANSPORTATION AND COMMUNICATIONS, ONTARIO

MEMORANDUM

30M12-88

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: July 16, 1973.

OUR FILE REF.

IN REPLY TO JUL 18 1973

SUBJECT:

FOUNDATION INVESTIGATION REPORT
For
The Proposed Ramp N-E Structure
At the Crossing of
Hwy. 401 and Hwy. 410 (Bridge #32)
Site No. 24-325
Town of Mississauga, County of Peel
District #6 (Toronto)
W.O. 73-11031 -- W.P. 127-66-23

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
Attach.
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

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FOUNDATION INVESTIGATION REPORT
For
The Proposed Ramp N-E Structure
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1. *INTRODUCTION:*

The present proposals for the construction program 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.

The Foundations Office was requested to carry out a subsurface investigation at the site of the proposed Bridge No. 32 (Ramp N-E over Hwy. #401 and Hwy. #410) of the above-mentioned interchange. The request was contained in a memo from Mr. G.C.E. Burkhardt, Regional Structural Planning Engineer, Central Region, dated April 25, 1973. Subsequently, an investigation was carried out by this Office to determine the subsoil, bedrock and groundwater conditions in this area.

This report presents the factual information obtained from this investigation together with recommendations pertaining to the foundation design of the proposed structure and stability considerations associated with the approaches.

2. *DESCRIPTION OF THE SITE AND GEOLOGY:*

The area under investigation is located approximately

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1 mile east of the existing Hwy. 401/Hwy. 10 interchange, in the Town of Mississauga, County of Peel. The terrain is flat to gently undulating in relief between about elevation 598 to 606. The land is developed for farming purposes.

The site is located in the physiographic region known as the "Peel Plain." The characteristic deposit in the vicinity of the area under investigation, is composed of a cohesive glacial till whose thickness is, in general, less than 10 feet. In this region, the Credit River, Oakville Creek and Etobicoke Creek have cut deep valleys into the overburden. There is, therefore, no large undrained depression, swamp or bog in this area, although in many of the interstream areas drainage is still imperfect.

The overburden is underlain by dark grey shale bedrock of the Meaford-Dundas Formation, Ordovician Period.

3. *FIELD AND LABORATORY WORK:*

Ten sampled boreholes were put down during the course of field investigation. The borings were advanced by means of two continuous flight auger machines adapted for soil sampling purposes.

Samples of the overburden were obtained in a 2" O.D. split-spoon sampler at required depths. The sampler was hammered into the soil with a driving energy of 350 ft. lb. per blow, in accordance with the specifications for the Standard Penetration Test. Bedrock was proven at all of the boring locations by obtaining BXL size rock core samples.

Groundwater level observations were carried out, during the period of the investigation, in the open boreholes.

The soil, bedrock and groundwater conditions encountered at the boring locations, are presented in the Record of Borehole sheets. The location and elevation of the various boreholes were surveyed by District #6 (Toronto), Construction personnel. The elevations in this report are referenced to a Geodetic Datum. Boring locations (referenced to a coordinate system) and elevations, together with estimated stratigraphical sections, are shown on

Drawing No. 73-11031A.

All the samples were subjected to a careful visual examination in the field and subsequently in the laboratory. Following this examination, various laboratory tests were carried out on selected representative samples to determine the physical properties of the overburden; namely,

Natural Moisture Content
Atterberg Limits
Grain-Size Distribution

The results of this testing are plotted on the Record of Borehole sheets and summarized on Figures No. 1 and 2, all of which are contained in the Appendix of this report.

4. *SUBSOIL AND BEDROCK CONDITIONS:*

4.1) *General:*

The predominant stratum across the site is a heterogeneous mixture of clayey silt to silty clay, some sand and gravel of glacial origin, the thickness of which varies from 3 to 8 feet. At B.H. #3, this cohesive deposit is underlain by a stratum of silty sand. The overburden is underlain by shale bedrock.

The boundary of the various deposits, as determined in the boreholes, are shown on the accompanying Record of Borehole sheets. The stratigraphical sections, shown on Drawing No. 73-11031A have been inferred from this data. From ground surface downwards, the soil and bedrock encountered are as follows.

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

This is the predominant stratum across the site. It is composed of a heterogeneous mixture of clayey silt to silty clay, some sand and traces of gravel (glacial till). The thickness of this deposit varies from 3 feet (B.H.'s #4 and #6) to 8 feet (B.H.'s #2 and #8).

Grain-size distribution curves, for samples of this cohesive stratum obtained with 2" O.D. sampling equipment, are

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shown on Figure No. 2 in the Appendix. Atterberg Limit tests were also performed on samples of the glacial till. The results, which are shown on the Record of Borehole sheets and on the Plasticity Chart (Figure No. 1), are tabulated below:

	Range	(Average)
Liquid Limit (W_L) %	31 - 40	(34)
Plastic Limit (W_p) %	19 - 27	(21)
Natural Moisture Content (W) %	11 - 24	(17)

Based on the above values, it is estimated that the cohesive deposit has a matrix, which is inorganic and of low to intermediate plasticity.

The standard penetration tests, carried out within this glacial deposit, are plotted on the Record of Borehole sheets. The testing gave 'N' values ranging from 25 blows per foot to 100 blows per 6 inches.

It is estimated that the consistency of the glacial till varies from stiff to hard.

4.3) Silty Sand, Some Gravel:

This granular deposit was found underlying the glacial till stratum at B.H. #3 only. It consists of silty sand with some gravel. The thickness of this granular deposit was found to be 6.5 feet. Standard penetration testing carried out within this deposit gave 'N' values ranging from 31 to 40 blows per foot, indicating the granular deposit is in a dense state.

4.4) Bedrock:

The overburden is underlain by bedrock which was proven at all of the boring locations by obtaining up to 17 feet of BXL size core samples. Over the site, the bedrock surface was found to vary between elevation 593 (B.H. #3) and elevation 598 (B.H. #7). The bedrock is composed of a dark grey interbedded shale and limestone - the upper 1 to 4 feet of which is, in general, in a weathered condition.

5. *GROUNDWATER CONDITIONS:*

The groundwater level conditions across the site, during the period of field investigation (May and June 1973), were observed by taking readings in the open boreholes. The results of the readings are shown on the Record of Borehole sheets, as well as on Drawing No. 73-11031A.

The observations indicate that the groundwater level varies between elevations 596 and 601, which corresponds to levels ranging from 1 to 6 feet below existing ground surface. It should be noted that the overburden is relatively impermeable in nature and therefore, the figures quoted above may not represent the true groundwater level existing at the site.

6. *DISCUSSION AND RECOMMENDATIONS:*

6.1) *General:*

In conjunction with the construction program of Hwy. 401 and Hwy. 403, the existing Hwy. 401 from Hwy. 27 westerly to Hwy. 10, is to be developed as a 16-lane basic core-collector. A number of interchanges are proposed for this portion of Hwy. 401, specifically:

i) Hwy. 401/Hwy. 403/Hwy. 410 Complex
ii) Hwy. 401/Dixie Road Interchange
iii) Hwy. 401/Airport Entrance/Little Etobicoke Creek Complex
iv) Hwy. 401/First Line Interchange

This report will deal with the proposed Bridge No. 32, at the tri-level crossing of Ramp N-E (highest level), Hwy. 401 (middle level) and Hwy. 410 (lowest level), in the 401/403/410 complex. The 55-foot wide structure is to have seven spans (91'-137'-152'-161'-126'-135'-81'). The proposed profile grade of the Ramp N-E, in the vicinity of the structure, will vary from elevation 625 to elevation 603. To reach these grades, fill up to 21 feet high will have to be placed at the west approach location.

The proposed profile grade of Hwy. 410 N.B.L. and S.B.L.

will be at elevations 568 and 572 respectively. Therefore, cuts up to 35 feet deep though the cohesive glacial till into shale bedrock will be required to reach these grades. The profile grade of the centre cores and W.B. collector of Hwy. 401 ranges from elevation 597 to elevation 601. Only nominal cuts within the glacial till will be necessary.

The predominant stratum across the site is composed of a 3 to 8 feet thick cohesive glacial till which is underlain by shale bedrock.

In the subsections to follow the foundation support for the underpass structure will be discussed. In addition, the stability and settlement considerations associated with the approaches will be presented.

6.2) Foundations - Ramp N-E Structure:

6.2.1) Piers:

In the vicinity of the pier locations, the bedrock surface is only several feet (max. 8 feet) below the existing ground surface. It is, therefore, recommended that the piers be supported on spread footings founded on sound shale bedrock. A minimum of 4 feet of earth cover should be provided to the underside of the footings since the shale is considered susceptible to frost action. Taking this into consideration, the footings for the various piers should be founded at the following elevations.

Location	*Station*	*Recommended Founding Elevation*	*Refer to B.H.*
Pier #1	146+18	593	3
Pier #2	144+81	593	4
Pier #3	143+29	593	5
Pier #4	141+70	567	6
Pier #5	140+44	564	7
Pier #6	139+10	562	8

An allowable bearing value of up to 10 t.s.f. may be used in designing the footings, founded as recommended. The

horizontal resistance of the footings may be computed using a coefficient of friction of 1.0 between rough concrete surface and sound shale.

In order to minimize the depth of excavations for the pier footings, it may be advantageous to carry out the approach cuts for Hwy. 401 and Hwy. 410 prior to the construction of the pier footings. If this procedure is followed, the depth of excavations will be in the order of 4 to 6 feet. The footing excavations will be carried out through the cohesive glacial till into the shale bedrock. Thr groundwater table established during the field investigation is well above the footing founding level. In view of the relatively impervious nature of the subsoil, no major dewatering problems are anticipated. The subsurface investigation indicates that at B.H. #3 (Pier #1), a layer of granular deposit is located immediately above the shale bedrock. Excess groundwater seepage into the footing excavation for Pier #1 can be anticipated. This, however, could be handled by using ordinary pumping methods.

The settlement of the footings will be negligible in magnitude, provided that measures are exercised to prevent the shale from being softened by groundwater seepage or uncontrolled surface runoff. It may be advantageous to protect the shale, at the footing foundation level, by covering it with a lean concrete working slab immediately after the completion of the excavation.

6.2.2) Abutments:

The east abutment for this structure may be supported on spread footing type of foundation located within the sound shale bedrock. The appropriate founding elevation is 590. Recommendations pertaining to the bearing pressure and footing excavations were discussed in detail under Subsection 6.2.1).

The west abutment for this structure can be perched within the approach fill and supported on end-bearing piles driven to shale bedrock at approximately elevation 595. The design load for the piles will depend on the pile section chosen, for example, 12 BP 74 steel H-piles could be designed using

an allowable load of 95 tons/pile.

No bouldery or rock fill should be placed in areas where piles are to be drivne.

6.3) Approaches:

As mentioned previously, up to 21 feet of fill will be placed to form the west approach embankment for this structure. The glacial till is competent, therefore, no stability problems are anticipated provided

i) 2:1 slopes are employed, and
ii) fills are properly compacted.

The natural subsoil will settle under the approach embankment loading. The glacial till has been heavily over-consolidated and its thickness in the vicinity of the approach embankment is in general, less than 10 feet. It is, therefore, estimated that the magnitude of this settlement should not exceed 1 inch and the major portion of this settlement will be realized immediately following the completion of the fill placement.

As mentioned previously, Hwy. 401 and Hwy. 410 are in cut sections in the vicinity of this structure. The stability and related considerations for the approach cuts were discussed in detail in our Foundation Report W.O. 72-11166 for Bridge No. 29 (Hwy. 401 E.B. Collector and Subcollector over Hwy. 410). Recommendations pertaining to approach cuts, contained in that report, are considered applicable for this project.

7. MISCELLANEOUS:

The field work was carried out between May 24 and June 6, 1973, under the supervision of Mr. V. Korlu, Project Foundations Engineer.

Drilling equipment was owned and operated by Dominion Soil Investigation Ltd., Toronto, and Canadian Longyear Ltd., Toronto.

This report was prepared by Mr. C. S. Poon, Project Foundations Engineer, and reviewed by Mr. M. Devata, Supervising Foundations Engineer.

C. S. Poon, P. Eng.

M. Devata, P. Eng.

CSP/ao
July 13, 1973.

APPENDIX I

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS – ONTARIO

DESIGN SERVICES BRANCH — FOUNDATIONS OFFICE

RECORD OF BOREHOLE No 1

JOB 73-11031 — LOCATION Co-ords. 15,856,477 N; 956,986 E. — ORIGINATED BY VK

W.P. 127-66-23 — BORING DATE May 24, 1973 — COMPILED BY SB

DATUM Geodetic — BOREHOLE TYPE Cont. Flight Auger; BXL Rock Coring — CHECKED BY

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT	LIQUID LIMIT W_L / PLASTIC LIMIT W_P / WATER CONTENT W	BULK DENSITY	REMARKS
ELEV. / DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS/FOOT		SHEAR STRENGTH P.S.F. o UNCONFINED + FIELD VANE • QUICK TRIAXIAL × LAB VANE	WATER CONTENT % 10 20 30	γ P.C.F.	GR.SA.SI.CL
602.6	Ground Level									
0.0	Het.mix.of clayey silt,sand and gravel (Glacial Till)		1	SS	70	600				▼599.1
595.6	Hard		2	SS	100/6"			o		9 12 52 2
7.0	weathered									
589.3	Sound Shale Bedrock		3	RC BXL	100%	590				
13.3	End of Borehole					580				

OFFICE REPORT SOIL EXPLORATION

20
15 ☼ 5 % STRAIN AT FAILURE

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS – ONTARIO

DESIGN SERVICES BRANCH

FOUNDATIONS OFFICE

RECORD OF BOREHOLE No 2

JOB 73-11031 LOCATION Co-ords. 15,856,528 N; 957,010 E. ORIGINATED BY VK

W.P. 127-66-23 BORING DATE May 24, 1973 COMPILED BY BB

DATUM Geodetic BOREHOLE TYPE Cont. Flight Auger, BXL Rock Coring 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.
604.2	Ground Level									
0.0	Het.mix.of clayey silt,sand & gravel (Glacial Till)		1	SS	25	600		H		▼ 598.4 5 42 43 10
596.2	Very Stiff to Hard		2	SS	68					
8.0	Weathered									
589.2	Sound Shale Bedrock		3	RC BXL	100%	590				
15.0	End of Borehole					580				

OFFICE REPORT · SOIL EXPLORATION

15 20 5 % STRAIN AT FAILURE

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS – ONTARIO

DESIGN SERVICES BRANCH — FOUNDATIONS OFFICE

RECORD OF BOREHOLE No 3

JOB 73-11031 — LOCATION Co-ords. 15,856,465 N; 957,080 E. — ORIGINATED BY VK

W.P. 127-66-23 — BORING DATE May 25, 1973 — COMPILED BY SR

DATUM Geodetic — BOREHOLE TYPE Cont. Flight Auger; BXL Rock Coring — 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, ● 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.
604.5	Ground Level									
0.0	Het.mix.of clayey silt,sand & gravel (Glac.Till) Hard		1	SS	35	600		o		▼601.1
599.5										
5.0	Silty sand and fine gravel.		2	SS	31			HO		1 54 40 5
593.0	Dense		3	SS	40			HO		
11.5	Shale Bedrock		4	RC BXL	75%	590				
584.5			5	RC BXL	80%					
20.0	End of Borehole					580				

15 20 5 % STRAIN AT FAILURE

OFFICE REPORT SOIL EXPLORATION

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS – ONTARIO

DESIGN SERVICES BRANCH

FOUNDATIONS OFFICE

RECORD OF BOREHOLE No 4

JOB 73-11031 LOCATION Co-ords. 15,856,415 N; 957,208 E. ORIGINATED BY VK

W.P. 127-66-23 BORING DATE May 28, 1973 COMPILED BY SB

DATUM Geodetic BOREHOLE TYPE Cont. Flight Auger; BXL Rock Core CHECKED BY

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT	LIQUID LIMIT W_L / PLASTIC LIMIT W_P / WATER CONTENT W	BULK DENSITY	REMARKS
ELEV. / DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS/FOOT		SHEAR STRENGTH P.S.F. ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE	WATER CONTENT % 10 20 30	γ P.C.F.	GR.SA.SI.CL.
600.1	Ground Level									
0.0	Wet mix of clayey silt, sand & gravel (Till) Hard		1	SS	100/1"			C		▽ 598.6 27 19 36 18
597.1										
3.0	Weathered Sound			RC						
			2	BXL	90%	590				
	Shale Bedrock		3	BXL	50%					
			4	BXL	80%					
580.1			5	BXL	100%	580				
20.0	End of Borehole					570				

OFFICE REPORT SOIL EXPLORATION

20
15 ⊹ 5 % STRAIN AT FAILURE

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS – ONTARIO

DESIGN SERVICES BRANCH — FOUNDATIONS OFFICE

RECORD OF BOREHOLE No 5

JOB 73-11031 — LOCATION Co-ords. 15,856,380 N; 957,357 E. — ORIGINATED BY VK

W.P. 127-66-23 — BORING DATE June 6, 1973 — COMPILED BY SR

DATUM Geodetic — BOREHOLE TYPE Cont. Flight Auger; BXL Rock Core — CHECKED BY

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT	LIQUID LIMIT W_L / PLASTIC LIMIT W_P / WATER CONTENT W	BULK DENSITY	REMARKS
ELEV. / DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS/FOOT		SHEAR STRENGTH P.S.F. o UNCONFINED + FIELD VANE • QUICK TRIAXIAL × LAB VANE	W_P — W — W_L WATER CONTENT %	γ P.C.F.	GR.SA.SI.CL
602.1	Ground Level									
0.0	Het.mix.of clayey silt,sand & gravel (Glac.Till) Hard		1	SS	54	600				▼ 598.4
596.3										
5.8	Shale Bedrock		2	RC BXL	100%	590				
586.3			3	RC BXL	100%					
15.8	End of Borehole					580				

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 6

JOB 73-11031 LOCATION Co-ords. 15,856,358 N; 957,516 E. ORIGINATED BY VK

W.P. 127-66-23 BORING DATE May 29, 1973 COMPILED BY SR

DATUM Geodetic BOREHOLE TYPE Cont. Flight Auger; BXL Rock Core 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 ● 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.
599.8	Ground Level									
0.0 / 596.8	Het. mix. of clayey silt, sand & gravel Till Hard		1	SS	100/4"			○		▽ 599.1 28 13 43 16
3.0	Weathered			RC						
	Sound		2	BXL	75%	590				
	Shale Bedrock		3	BXL	100%					
582.0			4	BXL	100%					
17.8	End of Borehole					580				

OFFICE REPORT SOIL EXPLORATION

20
15 ◇ 5 % STRAIN AT FAILURE

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS – ONTARIO

DESIGN SERVICES BRANCH

FOUNDATIONS OFFICE

RECORD OF BOREHOLE No 7

JOB 73-11031 LOCATION Co-ords. 15,856,457 N; 957,642 E. ORIGINATED BY VK

W.P. 127-66-23 BORING DATE May 30, 1973 COMPILED BY SR

DATUM Geodetic BOREHOLE TYPE Cont. Flight Auger; BXL Rock Core CHECKED BY

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT	LIQUID LIMIT W_L / PLASTIC LIMIT W_P / WATER CONTENT W	BULK DENSITY	REMARKS
ELEV. / DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS/FOOT		SHEAR STRENGTH P.S.F. ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE	WATER CONTENT % 10 20 30	γ P.C.F.	GR. SA. SI. CL
604.7	Ground Level									
0.0	Het.mix.of clayey silt,sand & gravel									
598.2	(Glacial Till) Hard		1	SS	62	600		○	598.4 ▼	31 14 44 11
6.5	Weathered		2	SS	100/5"			○		
	Sound		3	RC BXL	80%					
			4	BXL	80%	590				
	Shale Bedrock		5	BXL	100%					
			6	BXL	100%					
583.5			7	BXL	100%					
21.2	End of Borehole					580				

OFFICE REPORT | SOIL EXPLORATION

15 20 5 10 % STRAIN AT FAILURE

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS–ONTARIO

DESIGN SERVICES BRANCH — FOUNDATIONS OFFICE

RECORD OF BOREHOLE No 8

JOB 73-11031 — LOCATION Co-ords. 15,856,369 N; 957,778 E. — ORIGINATED BY VK

W.P. 127-66-23 — BORING DATE May 30, 1973 — COMPILED BY SR

DATUM Geodetic — BOREHOLE TYPE Cont. Flight Auger; BXL Rock Core — CHECKED BY

ELEV. / DEPTH	DESCRIPTION	STRAT. PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES 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 %	BULK DENSITY γ P.C.F.	REMARKS GR.SA.SI.CL
603.0	Ground Level									
0.0	Het.mix.of clayey silt,sand & gravel (Glacial Till) Hard		1	SS	100/6"	600		o		▼ 599.7 2 21 47 30
595.0										
8.0	Weathered									
	Sound Shale Bedrock		2	RC BXL	100%	590				
			3	BXL	100%					
584.0			4	BXL	100%					
19.0	End of Borehole					580				

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 9

JOB 73-11031 LOCATION Co-ords. 15,856,354 N; 957,864 E. ORIGINATED BY VK

W.P. 127-66-23 BORING DATE May 31, 1973 COMPILED BY SR

DATUM Geodetic BOREHOLE TYPE Cont. Flight Auger; BXL Rock Core CHECKED BY

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT	LIQUID LIMIT W_L / PLASTIC LIMIT W_P / WATER CONTENT W	BULK DENSITY γ	REMARKS
ELEV. / DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS/FOOT		SHEAR STRENGTH P.S.F. o UNCONFINED + FIELD VANE • QUICK TRIAXIAL × LAB VANE	WATER CONTENT % 10 20 30	P.C.F.	GR.SA.SI.CL.
602.2	Ground Level									
0.0	Het.mix.of clayey silt to silty clay, sand & gravel (Till)					600				▼596.4
			1	SS	26					8 44 36 12
594.3	Very Stiff to Hard		2	SS	30					
7.9	Weathered									
	Sound		3	RC BXL	70%	590				
	Shale Bedrock		4	BXL	30%					
581.4			5	BXL	75%					
20.8	End of Borehole					580				

OFFICE REPORT SOIL EXPLORATION

20
15 ⊹ 5 % STRAIN AT FAILURE

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS – ONTARIO

DESIGN SERVICES BRANCH — FOUNDATIONS OFFICE

RECORD OF BOREHOLE No 10

JOB 73-11031 — LOCATION Co-ords. 15,856,409 N; 957,853 E. — ORIGINATED BY VK

W.P. 127-66-23 — BORING DATE June 1, 1973 — COMPILED BY BR

DATUM Geodetic — BOREHOLE TYPE Cont. Flight Auger; BXL Rock Core — CHECKED BY

SOIL PROFILE ELEV./DEPTH	DESCRIPTION	STRAT. PLOT	SAMPLES NUMBER	TYPE	BLOWS/FOOT	ELEV. SCALE
600.9	Ground Level					
0.0	Het.mix.of clayey silt to silty clay, sand & gravel (Till)		1	SS	65	600
594.4	Hard		2	SS	100/6"	
6.5	Weathered		3	RC BXL	60%	590
	Sound					
584.9	Shale Bedrock		4	BXL	60%	
16.0	End of Borehole					580

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
W_P W W_L
WATER CONTENT % 10 20 30

BULK DENSITY γ P.C.F.

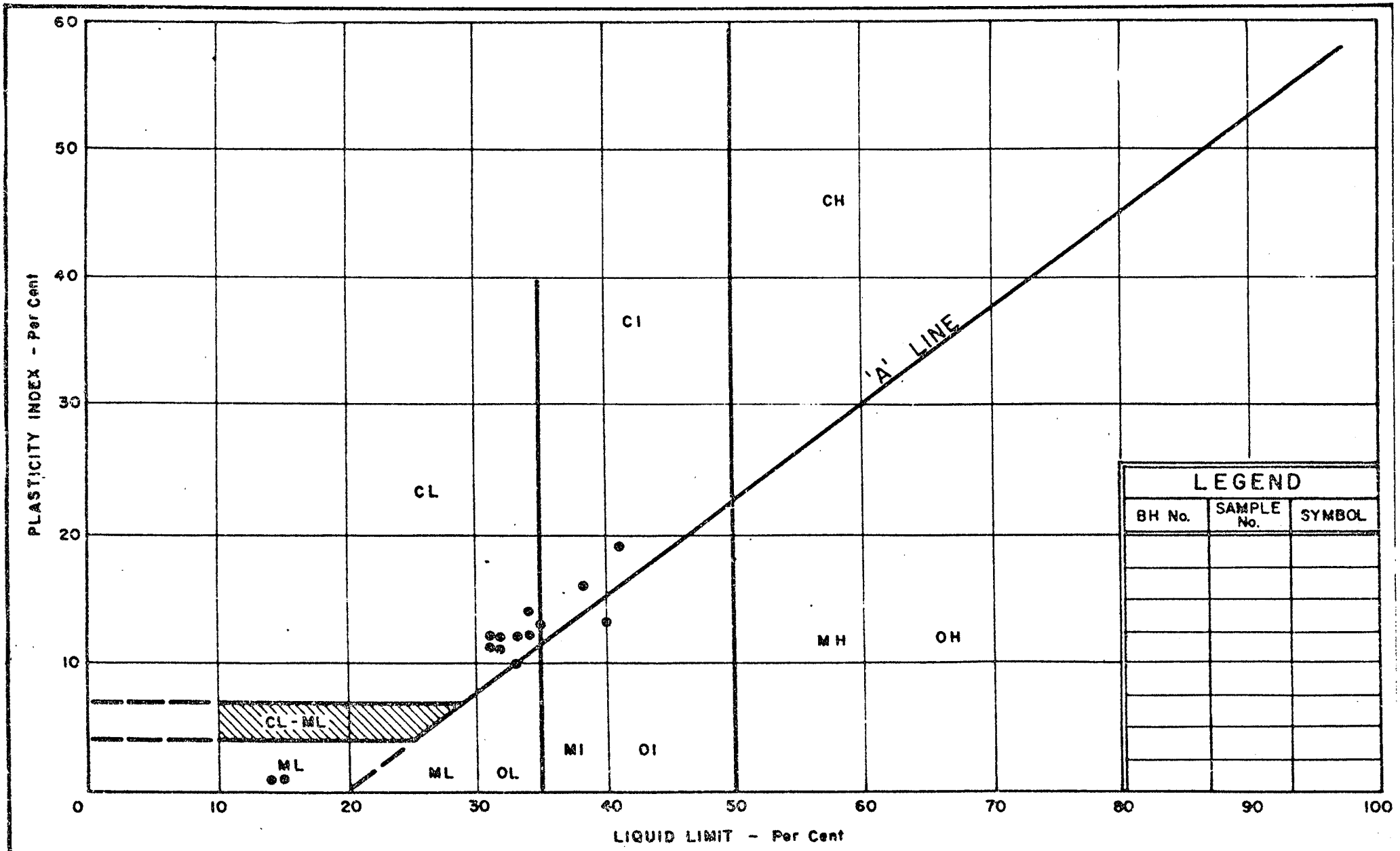
REMARKS GR.SA.SI.CL.

▼ 596.7
0 1 74 25

20
15 ⊹ 5 % STRAIN AT FAILURE
10

OFFICE REPORT — SOIL EXPLORATION

REVISED JUL` 1966



DEPARTMENT OF HIGHWAYS
MATERIALS and TESTING DIVISION

PLASTICITY CHART

GLACIAL TILL

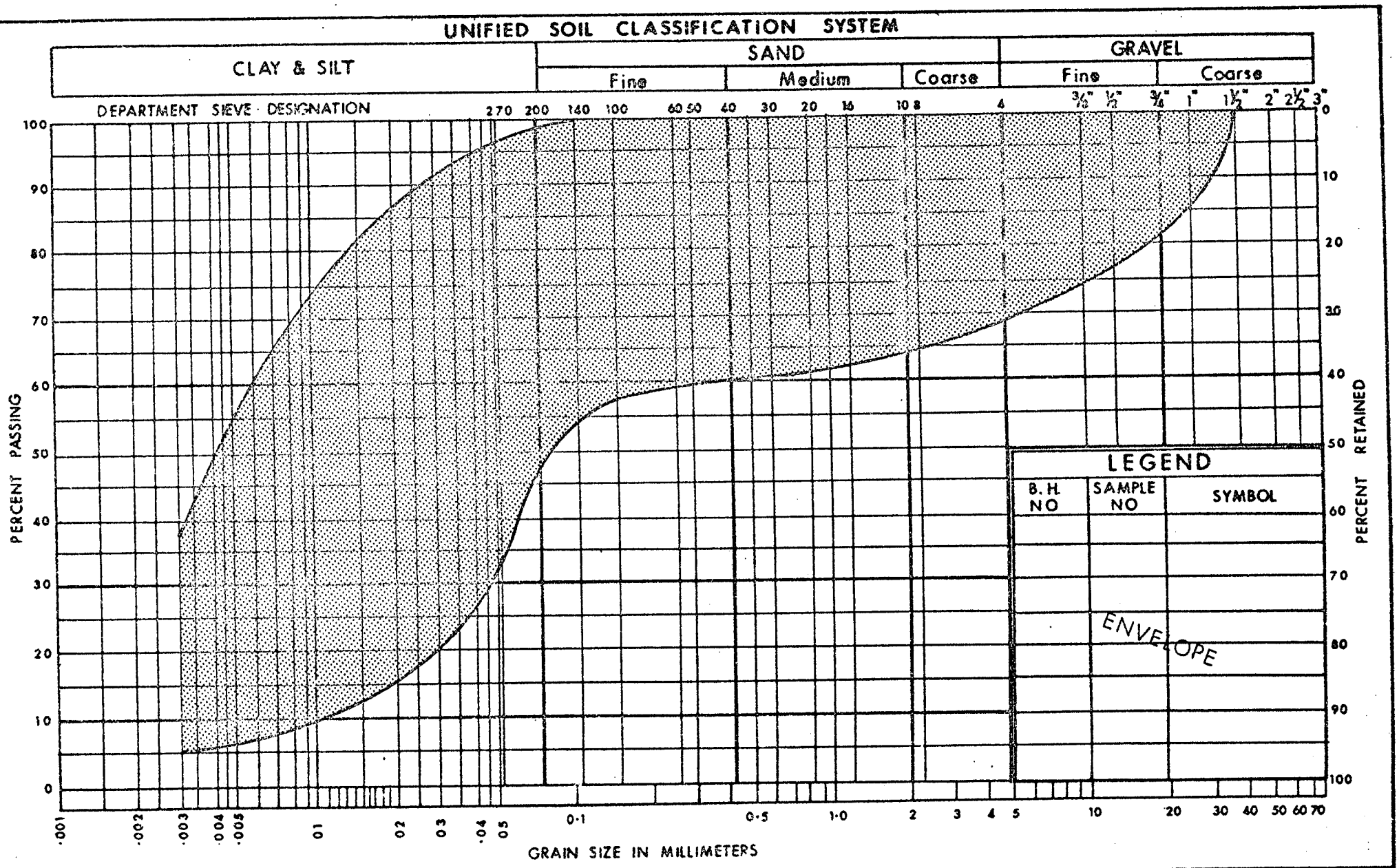
HET. MIX. OF CLAYEY SILT TO SILTY CLAY, SAND & GRAVEL

W.P. No. 127 - 66 - 23

JOB No. 73 - 11031

FIG. 1

FORM OD - MT - 17
REV. AUG. 1971



DEPARTMENT OF TRANSPORTATION AND COMMUNICATIONS
ONTARIO
DESIGN SERVICES BRANCH

GRAIN SIZE DISTRIBUTION

GLACIAL TILL

HET. MIX. OF CLAYEY SILT TO SILTY CLAY, SAND & GRAVEL

W.P. No. 127 - 66 - 23

JOB No. 73 - 11031

FIG. 2

FD-9c (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
ϕ'	EFFECTIVE ANGLE OF SHEARING RESISTANCE, OR FRICTION
	IN TERMS OF EFFECTIVE STRESS $\tau_f = c' + \sigma' \tan \phi'$
c_u	APPARENT COHESION
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

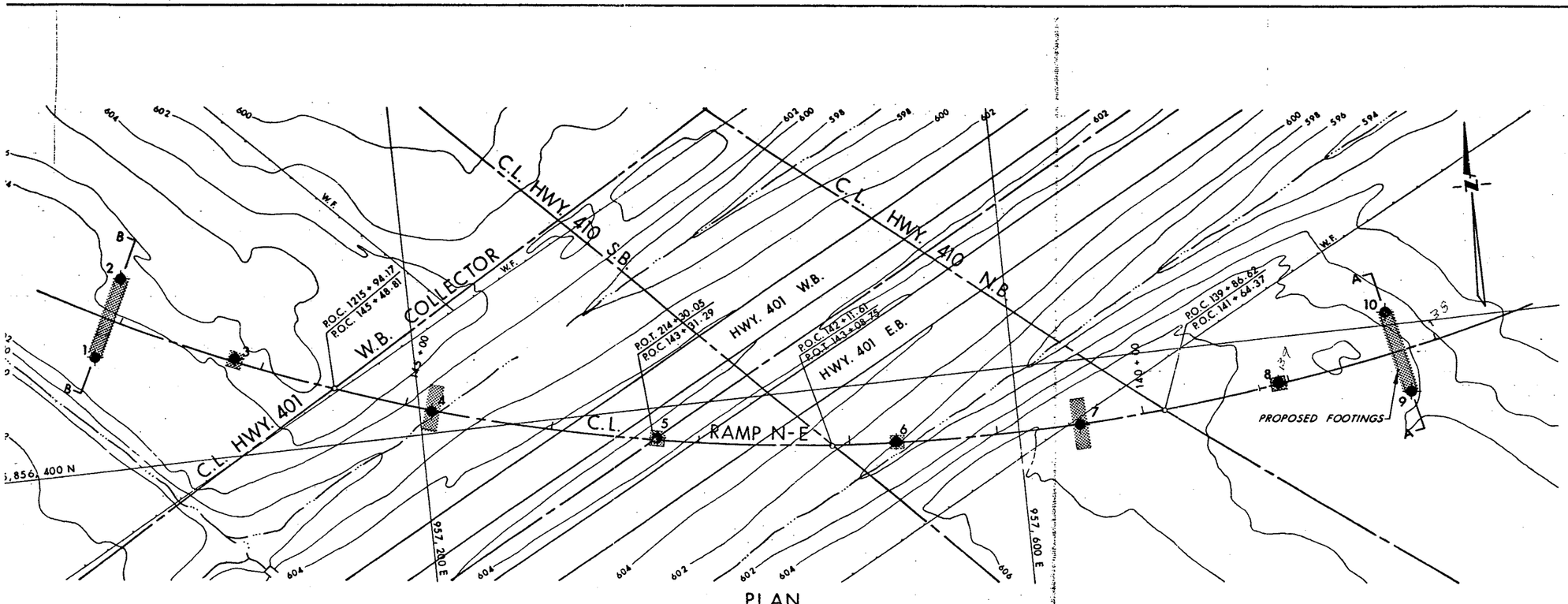
d	DISTANCE FROM TOP OF WALL TO POINT OF APPLICATION OF PRESSURE
δ	ANGLE OF WALL FRICTION
K	DIMENSIONLESS COEFFICIENT TO BE USED WITH VARIOUS SUFFIXES IN EXPRESSIONS REFERRING TO NORMAL STRESS ON WALLS
K_o	COEFFICIENT OF EARTH PRESSURE AT REST

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

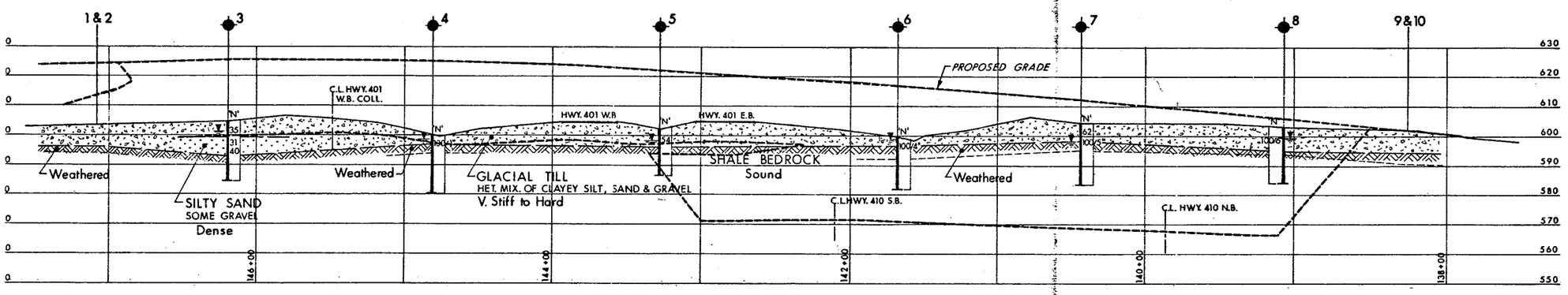
SLOPES

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



PLAN

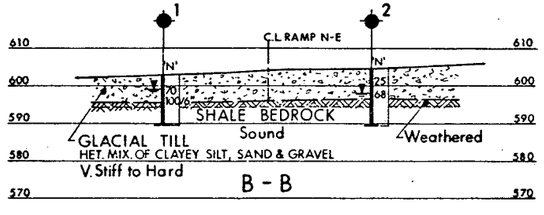
40 20 0 SCALE 40 80 FT.



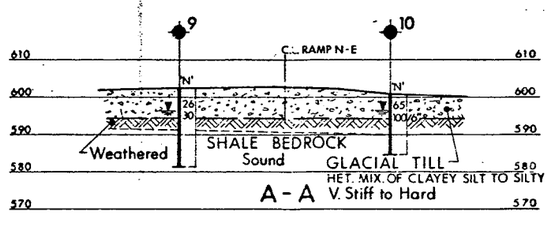
PROFILE

HORIZ. 40 20 0 SCALE 40 80 FT.

VERT. 20 10 0 20 40 FT.



B - B

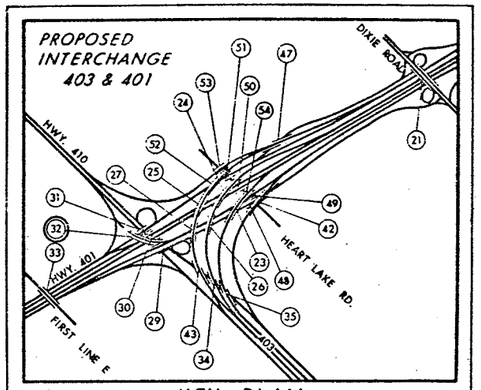


A - A

SECTIONS

20 10 0 SCALE 20 40 FT.

REF. No: Plan B 81 - 93 &
Fenco No. 3983 - 3K - 8



KEY PLAN

LEGEND

- Bore Hole
- Cone Penetration Test
- Bore Hole & Cone Test
- Water Levels established at time of field investigation. May & June 73.

NO.	ELEVATION	CO-ORDINATES NORTH	CO-ORDINATES EAST		
1	602.6	15,856,477	956,986	854.1	689.3
2	604.2	15,856,528	957,010	069.7	696.7
3	604.5	15,856,465	957,080	050.5	718.0
4	600.1	15,856,415	957,208	035.2	757.0
5	602.1	15,856,380	957,357	024.6	802.4
6	599.8	15,856,358	957,516	017.9	850.9
7	604.7	15,856,357	957,642	017.2	889.3
8	603.0	15,856,369	957,778	021.2	930.7
9	602.2	15,856,354	957,864	016.7	957.0
10	600.9	15,856,409	957,853	033.5	953.6

— 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

REGISTERED PROFESSIONAL ENGINEER — CIVIL — V. KORLU — PROVINCE OF ONTARIO

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

BRIDGE No. 32
RAMP N-E

HIGHWAY NO. 410 DIST. NO. 6
CO. PEEL
TOWN OF MISSISSAUGA LOT CON.

BORE HOLE LOCATIONS & SOIL STRATA

SUBMD V. K.	CHECKED	W.P. NO. 127 - 66 - 230	DRAWING NO. 73 - 11031 A
DRAWN S. R	CHECKED	W.O NO. 73 - 11031	
DATE JULY 9, 1973		SITE NO.	BRIDGE DRAWING NO.
APPROVED PRINCIPAL FOUNDATION ENGINEER		CONT. NO.	