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W. O. No.

STR. SITE No.

HWY. No. 20

LOCATION Prop. Retaining Walls on Hwy 20 at Smithville

No. of Sheets -

OVERSIZE DRAWINGS TO BE INCLUDED WITH THIS REPORT.

REMARKS:

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS, ONTARIO

30M4-51

MEMORANDUM

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

FROM: Foundations Office,
Design Services Branch,
West Building.

ATTENTION:

DATE: June 20, 1973.

30M4-51
GEOCRES No.

OUR FILE REF.

IN REPLY TO JUL - 6 1973

SUBJECT:

FOUNDATION INVESTIGATION REPORT
For
Proposed Retaining Walls
On Highway 20
At Smithville
District No. 4 (Hamilton) 05
W.O. 73-11012 - W.P. 113-67-01

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
C. R. Robertson
B. J. Giroux
C. Mirza
G. A. Wrong
B. A. Singh

Foundations Files
Documents

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FOUNDATION INVESTIGATION REPORT
For
Proposed Retaining Walls
On Highway 20
At Smithville
District No. 4 (Hamilton)
W.O. 73-11012 - W.P. 113-67-01

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1. *INTRODUCTION:*

A request for a foundation investigation on Hwy. 20 at Smithville was received from Mr. G. C. E. Burkhardt, Regional Structural Planning Engineer, in a memo dated April 25, 1973.

Subsequently, a field investigation was carried out by the Foundations Office to determine the subsoil conditions at this location. This report contains the results of the investigation and our recommendations concerning the design of the proposed retaining wall foundations.

2. *SITE CONDITIONS:*

The site is located on Hwy. 20 at Smithville. The terrain in the immediate vicinity of the proposed retaining walls is hilly. This site is part of the Haldimand Clay Plain Physiographic Region of Southern Ontario. The subsoil in this part of the region is generally cohesive and is underlain by dolomite.

3. *FIELD AND LABORATORY WORK:*

The field work consisted of 17 sampled boreholes

....2

and 13 dynamic cone penetration tests. One sampled borehole from W.O. 71-11097 was added to this total.

The boreholes were advanced by washboring using diamond drilling equipment modified for soil sampling purposes. Disturbed samples were obtained using a 2-inch O.D. split spoon sampler driven according to the specifications for the Standard Penetration Test. A few undisturbed samples were taken using 2-inch I.D. Shelby tubes which were hammered into the ground.

Dynamic cone penetration tests were carried out adjacent to 11 sampled boreholes and at two other locations. Driving energy to advance the cones was 350 ft.-lbs. per blow.

Rock core samples were obtained at the bottom of three boreholes using BXL rock coring equipment.

The locations and elevations of the boreholes and cone tests are marked on Drawing #73-11012A accompanying this report.

Samples were examined visually in the field and again in the laboratory. Tests were performed on selected samples to determine the following physical properties:

(1) Natural Moisture Content
(2) Atterberg Limits
(3) Grain-size Distribution
(4) Unconfined Shear Strength

The results of the field and laboratory tests are given on the Record of Borehole sheets and Figures 1 to 3 which are contained in the Appendix of this report.

4. *SUBSOIL CONDITIONS:*

4.1) *General:*

The subsoil at this location consists of clayey silt and silty clay underlain by clayey silt till and dolomite bedrock. Layers of silt, clayey silt to silt, and varved clay were observed in the silty clay stratum. The site has been divided into two parts for purposes of describing the subsoil.

These parts consist of Retaining Walls #1 to #5 and Retaining Walls #6 to #9. The subsoil is described in each part from ground level downwards as follows:

4.2) Retaining Walls #1 to #5:

4.2.1) Silty Clay to Clayey Silt:

This 16 to 23-foot thick stratum consists of firm to hard silty clay and clayey silt. It is overlain by 1.5 feet of fill material consisting of clayey silt and some gravel and sand at Borehole 15. A 1.5 to 2.5-foot thick layer of compact silt and very stiff clayey silt to silt was observed near the bottom of this stratum at Retaining Walls #4 and #5. A 1 to 3-foot thick layer of varved clay occurs at the bottom of this stratum at Retaining Wall #5. The varved clay consists of 1/2-inch thick layers of brown clayey silt to silt and grey silty clay to clay.

The Atterberg limits and natural moisture content of the silty clay to clayey silt are as follows:

	Range of Values	*Average Value*
Natural Moisture Content (%)	22 - 28	25
Liquid Limit	36 - 54	46
Plasticity Index	17 - 28	23

This indicates that this stratum is of medium plasticity.

Unconfined compression tests performed on undisturbed samples taken in the very stiff to hard layers of this stratum gave unconfined shear strength values of 3780, 4660, and 5170 p.s.f. It is expected that these results represent a lower limit of the actual undrained shear strength in the very stiff to hard layers.

4.2.2) Clayey Silt Till:

This stratum, which was not encountered at all borehole locations, has a maximum thickness of 5 feet. It consists of hard clayey silt and some sand and gravel. This stratum has a natural moisture content of about 11 per cent. The clayey silt

portion has a liquid limit of about 22 and a plasticity index of about 11.

4.3) Retaining Walls #6 to #9:

4.3.1) Silty Clay to Clayey Silt:

This 6 to 15-foot thick stratum consists of firm to very stiff silty clay and clayey silt. The Atterberg limits and natural moisture content of this stratum are as follows:

	Range of Values	*Average Value*
Natural Moisture Content (%)	21 - 34	27
Liquid Limit	32 - 52	43
Plasticity Index	14 - 26	21

This indicates that this stratum is of medium plasticity.

4.3.2) Clayey Silt Till:

This stratum, which was not encountered at all borehole locations, has a maximum thickness of 1.8 feet. It consists of hard clayey silt and some sand and gravel. This stratum has a natural moisture content of about 12 per cent. The clayey silt portion has a liquid limit of about 24 and a plasticity index of about 10.

5. BEDROCK CONDITIONS:

The rock core samples obtained at this location were examined by Z. Koniuszy, Geologist, whose report is as follows:

Hole No. 1 Bedrock at 600.2

19.5 - 25.1 Dolomite; medium grey to brownish grey, fine grained, very dense, medium to thick bedded. From 20.5 to 21.0 ft. open vertical joint fracture, surfaces of fracture weathered.

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Hole No. 3 Bedrock at 598.6

10.2 - 10.7 Dolomite; yellowish grey, fine grained, dense.

10.7 - 16.3 Dolomite; medium grey to brownish grey, fine grained, very dense, medium to thick bedded. Vertical joint slightly open from 14.2 to 15.6 ft.

Hole No. 5 Bedrock at 595.8

15.9 - 20.4 Dolomite; medium grey to brownish grey, fine grained, very dense, medium to thick bedded.

6. *GROUNDWATER CONDITIONS:*

The groundwater level was established at some of the borehole locations, as follows:

Borehole	*Elevation (feet)*
1	614.8
3	605.3
5	601.7
6	607.7

7. *DISCUSSION AND RECOMMENDATIONS:*

7.1) *General:*

It is proposed to construct nine retaining walls. The visible faces will vary from 2 to about 12 feet in height. The subsoil is silty clay and clayey silt underlain by clayey silt till and dolomite bedrock.

7.2) *Retaining Walls #1 to #5:*

These retaining walls may be founded on either spread footings in the silty clay to clayey silt stratum or on piles driven to bedrock.

Spread footings should be placed at the following elevations in order to obtain the maximum possible allowable bearing pressure while maintaining the required amount of cover for frost protection.

Retaining Wall	*Location (Sta.)*	*Elevation (ft.)*
1	600+72 (600+75)	611
1	602+32 (602+23)	613
2	604+35	614
2	604+90	614
3	605+08 (605+04)	614
3	606+07 (606+00)	612
4	606+21 (606+26)	612
4	607+23 (606+77)	609
5	606+21 (606+17.5)	612
5	606+72 (606+75)	610

At intermediate locations the footings may be stepped in an appropriate manner. The maximum allowable bearing pressure for design purposes is 3 t.s.f. The minimum cover for frost protection is 4 feet. For computations of sliding resistance an adhesion of 2000 p.s.f. may be assumed between the footings and the subsoil.

If the retaining walls are supported on piles, steel H-piles driven to bedrock should be used. The maximum load capacity of the pile section selected can be used for design purposes. The elevations of the surface of bedrock are as follows:

Retaining Wall	*Location (Sta.)*	*Elevation (ft.)*
1	600+72	601±
1	602+32	600±
2	604+35	598±
2	604+90	597±
3	605+08	597±
3	606+07	596±
4	606+21	595.5±
4	607+23	597.5±
5	606+21	597.5±
5	606+72	596.5±

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A minimum cover of 4 feet above the bottoms of pile caps should be provided for frost protection.

The backfill to the retaining walls should conform to the appropriate Ministry standard. The coefficient of active earth pressure can be assumed to be 0.33.

Due to the cohesive nature of the subsoil, no dewatering problems are anticipated.

7.3) Retaining Walls #6 to #9:

These retaining walls should be founded on spread footings keyed a minimum of 1 foot within the sound bedrock. The elevations of the surface of sound bedrock are as follows:

Retaining Wall	*Location (Sta.)*	*Elevation (Ft.)*
6	610+66 (610+80)	598±
6	611+15 (611+62)	597.5±
6	611+90 (611+97)	595.5±
7	611+42 (611+42)	597±
7	612+25 (612+40)	596.5± ?
8	612+62 (612+46)	595.5±
8	613+21 (612+81)	592.5±
8	613+69 (613+80)	594.5±
9	613+13 (612+85)	595±
9	613+92 (613+89)	591.5±

At intermediate locations the surface of sound bedrock may be interpolated. The footings may be stepped in an appropriate manner where the surface of sound bedrock is inclined. The maximum allowable bearing pressure for design purposes is 20 t.s.f.

For computations of sliding resistance a coefficient of friction of 0.5 may be assumed between the footings and the bedrock. The passive resistance to lateral movement of the sound bedrock may be calculated using a passive pressure of 7.5 t.s.f. The backfill to the retaining walls should conform to the appropriate Ministry standard. The coefficient of active earth pressure can be assumed to be 0.33.

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Due to the cohesive nature of the subsoil, no dewatering problems are anticipated.

8. MISCELLANEOUS:

The field work was carried out during the period of May 9 to 18, 1973, under the supervision of Mr. E. A. Wood, Project Foundations Engineer. The equipment was owned and operated by Canadian Longyear Limited.

This report was written by Mr. E. A. Wood and reviewed by Mr. K. G. Selby, Supervising Foundations Engineer.

E. A. Wood

K. G. Selby, P. Eng.

EAW/ao
June 19, 1973.

APPENDIX I

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS, ONTARIO

MEMORANDUM

TO: Mr. K. Selby,
Sup. Foundation Engineer.

FROM: Z. Koniuszy

ATTENTION:

DATE: May 25, 1973

OUR FILE REF.

IN REPLY TO

SUBJECT: Foundation Investigation 73-11012

The following is a brief description for three boreholes drilled at this site.

Hole No. 1 — Bedrock at 600.2

19.5 - 25.1	Dolomite; medium grey to brownish grey, fine grained, very dense, medium to thick bedded. From 20.5 to 21.0 ft. open vertical joint fracture, surfaces of fracture weathered.

Hole No. 3 — Bedrock at 598.6

10.2 - 10.7	Dolomite; yellowish grey, fine grained, dense.
10.7 - 16.3	Dolomite; medium grey to brownish grey, fine grained, very dense, medium to thick bedded. Vertical joint slightly open from 14.2 to 15.6 ft.

Hole No. 5 — Bedrock at 595.8

15.9 - 20.4	Dolomite; medium grey to brownish grey, fine grained, very dense, medium to thick bedded.

Z. Koniuszy

M. Koniuszy,
Geologist.

MK:mv

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS – ONTARIO

DESIGN SERVICES BRANCH — FOUNDATIONS OFFICE

RECORD OF BOREHOLE No 1

JOB 73-11012 — LOCATION Sta. 602 + 32 o/s 16' Lt. — ORIGINATED BY EW

W.P. 113-67-01 — BORING DATE May 10, 1973 — COMPILED BY EW

DATUM Geodetic — BOREHOLE TYPE Washboring & Cone Test — CHECKED BY

ELEV. / DEPTH	DESCRIPTION	STRAT. PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES BLOWS/FOOT	ELEV. SCALE
619.7	Ground Level					
0.0	Silty clay and clayey silt. Firm to Hard		1	SS	7	
			2	SS	42	
			3	SS	53	
			4	SS	55	610
			5	SS	25	
603.7			6	SS	41	
16.0 / 600.2	Clayey silt, some sand trace gravel. Hard					600
19.5 / 594.6	Sound Bedrock Dolomite		7	RC	95%	
25.1	End of Borehole					

DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT — 20 40 60 80 100

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 % — 20 40 60

BULK DENSITY γ P.C.F.

REMARKS — GR. SA. SI. CL.

0 1 91 8

3 16 61 20

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 2

JOB 73-11012 LOCATION Sta. 600 + 54 o/s 42' Lt. ORIGINATED BY EW

W.P. 113-67-01 BORING DATE May 10, 1973 COMPILED BY EW

DATUM Geodetic BOREHOLE TYPE Washboring & Cone Test CHECKED BY

SOIL PROFILE ELEV./DEPTH	DESCRIPTION	STRAT. PLOT	SAMPLES NUMBER	TYPE	BLOWS/FOOT	ELEV. SCALE
618.8	Ground Level					
0.0	Silty clay Stiff to Hard		1	SS	9	
			2	SS	29	
			3	SS	67	
			4	SS	37	610
			5	SS	26	
602.8			6	SS	53	
601.0	Clayey silt, some sand & gravel,		7	SS	50/3"	
17.8	Probable Bedrock End of Borehole					

DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT 20 40 60 80 100

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 % 20 40 60

BULK DENSITY γ P.C.F.

REMARKS GR. SA. SI. CL.

18 27 40 15

Note: Groundwater level not established

15 20 10 5 % STRAIN AT FAILURE

OFFICE REPORT SOIL EXPLORATION

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS – ONTARIO

DESIGN SERVICES BRANCH — FOUNDATIONS OFFICE

RECORD OF BOREHOLE Nº 3

JOB 73-11012 — LOCATION Sta. 610 + 66 o/s 35' Lt. — ORIGINATED BY EW

W.P. 113-67-01 — BORING DATE May 11, 1973 — COMPILED BY EW

DATUM Geodetic — BOREHOLE TYPE Washboring & Cone Test — CHECKED BY

SOIL PROFILE ELEV./DEPTH	DESCRIPTION	STRAT. PLOT	SAMPLES NUMBER	TYPE	BLOWS/FOOT	ELEV. SCALE	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 % 20 40 60	BULK DENSITY γ P.C.F.	REMARKS GR.SA.SI.CL.
608.8	Ground Level									
0.0	Silty clay.		1	SS	5					
	Firm to Very Stiff		2	SS	14					
599.8			3	SS	19					
598.6	Clayey silt, some sand & gravel		4	SS	100/3"	600				16 17 42 25
10.2			5	RC	90%					
592.5	Sound Bedrock Dolomite		6	RC	100%					
16.3	End of Borehole									

OFFICE REPORT – SOIL EXPLORATION

20 / 15 ◇ 5 / 10 % STRAIN AT FAILURE

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS – ONTARIO

DESIGN SERVICES BRANCH

FOUNDATIONS OFFICE

RECORD OF BOREHOLE No 4

JOB 73-11012 LOCATION Sta. 611 + 15 o/s 48' Lt. ORIGINATED BY EW

W.P. 113-67-01 BORING DATE May 14, 1973 COMPILED BY EW

DATUM Geodetic BOREHOLE TYPE Cone Test CHECKED BY

SOIL PROFILE			SAMPLES			ELEV. SCALE	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.
ELEV. / DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS/FOOT					
611.0	Ground Level									
0.0	Probably silty clay					610				
597.8						600				
13.2	Probable Bedrock End of Cone Test									

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 5

JOB 73-11012 — LOCATION Sta. 612 + 62 o/s 55' Lt. — ORIGINATED BY EW

W.P. 113-67-01 — BORING DATE May 14, 1973 — COMPILED BY EW

DATUM Geodetic — BOREHOLE TYPE Washboring & Cone Test — CHECKED BY

SOIL PROFILE ELEV./DEPTH	DESCRIPTION	STRAT. PLOT	SAMPLES NUMBER	TYPE	BLOWS/FOOT	ELEV. SCALE
611.7	Ground Level					
0.0	Silty Clay. Firm to Very Stiff		1	SS	6	610
			2	SS	18	
			3	SS	33	
			4	SS	14	600
			5	SS	14	
596.7						
595.8	Clayey si., some sa. & gravel		6	SS	100/5"	
15.9	Sound Bedrock		7	RC	95%	
591.3	Dolomite					
20.4	End of Borehole					

DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT — 20 40 60 80 100

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 % — 20 40 60

BULK DENSITY γ P.C.F.

REMARKS — GR. SA. SI. CL.

OFFICE REPORT — SOIL EXPLORATION

20 / 15 5 / 10 % STRAIN AT FAILURE

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS – ONTARIO

DESIGN SERVICES BRANCH — FOUNDATIONS OFFICE

RECORD OF BOREHOLE Nº 6

JOB 73-11012 — LOCATION Sta. 611 + 67 o/s 50' Lt. — ORIGINATED BY EW

W.P. 113-67-01 — BORING DATE May 14, 1973 — COMPILED BY EW

DATUM Geodetic — BOREHOLE TYPE Washboring and Cone Test — CHECKED BY

SOIL PROFILE			SAMPLES				DYNAMIC PENETRATION RESISTANCE	LIQUID LIMIT w_L		
ELEV. / DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS/FOOT	ELEV. SCALE	BLOWS / FOOT 20 40 60 80 100	PLASTIC LIMIT w_P	BULK DENSITY γ P.C.F.	REMARKS GR.SA.SI.CL.
611.9	Ground Level						SHEAR STRENGTH P.S.F. o UNCONFINED + FIELD VANE • QUICK TRIAXIAL × LAB VANE	WATER CONTENT w w_P w w_L		
								WATER CONTENT % 20 40 60		
0.0	Silty clay. Firm to Very Stiff		1	SS	21	610				
			2	SS	8					
			3	SS	38					
			4	SS	22	600				
597.4			5	SS	19					
14.5	Probable Bedrock End of Borehole									

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 73-11012 LOCATION Sta. 613 + 21 o/s 30' Lt. ORIGINATED BY EW

W.P. 113-67-01 BORING DATE May 14, 1973 COMPILED BY EN

DATUM Geodetic BOREHOLE TYPE Cone Test CHECKED BY

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT 20 40 60 80 100	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 + FIELD VANE ● QUICK TRIAXIAL × LAB VANE	w_P — w — w_L WATER CONTENT %	γ P.C.F.	GR. SA. SI. CL.
604.6	Ground Level									
0.0	Probably Clayey silt to silty clay.					600				
592.8										
11.8	Probable Bedrock End of Cone Test									

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 8

JOB 73-11012 — LOCATION Sta. 613 + 69 o/s 29' Lt. — ORIGINATED BY EW

W.P. 113-67-01 — BORING DATE May 15, 1973 — COMPILED BY EW

DATUM Geodetic — BOREHOLE TYPE Washboring & Cone Test — CHECKED BY

SOIL PROFILE			SAMPLES			ELEV. SCALE	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 % 20 40 60	BULK DENSITY γ P.C.F.	REMARKS GR.SA.SI.CL.
ELEV. / DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS/FOOT					
604.2	Ground Level									
0.0	Clayey silt. Firm to Stiff		1	SS	4	600				
			2	SS	8					
			3	SS	10					
594.8			4	SS	100/5"					
9.4	Probable Bedrock End of Borehole									

Note: Groundwater level not established

OFFICE REPORT — SOIL EXPLORATION

15 20 10 5 % STRAIN AT FAILURE

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS – ONTARIO

DESIGN SERVICES BRANCH

FOUNDATIONS OFFICE

RECORD OF BOREHOLE Nº 9

JOB 73-11012 LOCATION Sta. 611 + 42 o/s 29' Rt. ORIGINATED BY EW

W.P. 113-67-01 BORING DATE May 15, 1973 COMPILED BY EW

DATUM Geodetic BOREHOLE TYPE Washboring 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 % 20 40 60	γ P.C.F.	GR. SA. SI. CL.
604.8	Ground Level									
0.0	Clayey silt. Firm to Stiff		1	SS	5	600				
			2	SS	21					
598.8 / 597.2	Gravelly clayey silt, some sand		3	SS	126					44 18 28 10
7.6	Probable Bedrock End of Borehole									

Note: Groundwater level not established.

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 10

JOB 73-11012 LOCATION Sta. 613 + 13 o/s 54' Rt. ORIGINATED BY EW

W.P. 113-67-01 BORING DATE May 15, 1973 COMPILED BY EW

DATUM Geodetic BOREHOLE TYPE Washboring & Cone Test CHECKED BY

SOIL PROFILE			SAMPLES			ELEV. SCALE	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 % 20 40 60	BULK DENSITY γ P.C.F.	REMARKS GR.SA.SI.CL.
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS/FOOT					
611.7	Ground Level									
0.0	Silty Clay.		1	SS	4	610				
			2	SS	19					
	Firm to Very Stiff		3	SS	11					
			4	SS	15	600				
			5	SS	15					
596.7										
595.6	Gravelly clayey silt, some sand.		6	SS	116/7"					37 17 30 16
16.1	Probable Bedrock End of Borehole									

Note: Groundwater level not established.

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 11

JOB 73-11012 — LOCATION Sta. 613 + 92 o/s 31' Rt. — ORIGINATED BY EW

W.P. 113-67-01 — BORING DATE May 15, 1973 — COMPILED BY EW

DATUM Geodetic — BOREHOLE TYPE Washboring & Cone Test — CHECKED BY

SOIL PROFILE ELEV./DEPTH	DESCRIPTION	STRAT. PLOT	SAMPLES NUMBER	TYPE	BLOWS/FOOT	ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT (20 40 60 80 100) / 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 % (20 40 60)	BULK DENSITY γ P.C.F.	REMARKS GR.SA.SI.CL.
605.3	Ground Level									
0.0	Silty clay. Stiff		1	SS	10	600				
			2	SS	15					
			3	SS	15					
593.8			4	SS	13					
592.0	Clayey silt with gravel, some sand.		5	SS	69/9"					36 15 38 11
13.3	Probable Bedrock End of Borehole									

Note: Groundwater level not established.

OFFICE REPORT — SOIL EXPLORATION

20 / 15 ◇ 5 / 10 % STRAIN AT FAILURE

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RECORD OF BOREHOLE Nº 12

JOB 73-11012 — LOCATION Sta. 606 + 32 o/s 30' Lt. — ORIGINATED BY EW

W.P. 113-67-01 — BORING DATE May 16, 1973 — COMPILED BY EW

DATUM Geodetic — BOREHOLE TYPE Washboring — CHECKED BY

ELEV. / DEPTH	DESCRIPTION	STRAT. PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES BLOWS/FOOT
620.0	Ground Level				
0.0	Silty Clay. Stiff to Hard		1	SS	10
			2	SS	33
			3	SS	50
			4	SS	31
605.5			5	SS	30
603.0	Silt. Compact		6	SS	27
17.0	Silty clay. Stiff		7	SS	21
597.5			8	SS	22
595.6	Clayey silt, some sand & gravel				
24.4	Probable Bedrock End of Borehole				

Note; Groundwater level not established.

ELEV. SCALE: 610, 600

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 % 20 40 60

BULK DENSITY γ P.C.F.

REMARKS GR.SA.SI.CL

OFFICE REPORT SOIL EXPLORATION

20
15 ◇ 5 % STRAIN AT FAILURE
10

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RECORD OF BOREHOLE Nº 13

JOB 73-11012 LOCATION Sta. 607 + 02 o/s 20' Lt. ORIGINATED BY EW

W.P. 113-67-01 BORING DATE May 16, 1973 COMPILED BY EW

DATUM Geodetic BOREHOLE TYPE Washboring and Cone Test CHECKED BY

SOIL PROFILE ELEV. / DEPTH	DESCRIPTION	STRAT. PLOT	SAMPLES NUMBER	TYPE	BLOWS/FOOT	ELEV. SCALE
616.4	Ground Level					
0.0	Silty clay. Firm to Very Stiff		1	SS	4	
			2	SS	27	
			3	SS	27	610
604.4			4	SS	21	
602.4	Clayey silt to silt		5	SS	28	
14.0 599.4	Silty clay. Very Stiff		6	SS	18	600
597.5	Clayey silt, some sand & gravel.		7	SS	30/5"	
18.9	Probable Bedrock End of Borehole					

Note: Groundwater level not established.

DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT 20 40 60 80 100

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 % 20 40 60

BULK DENSITY γ P.C.F.

REMARKS GR. SA. SI. CL.

9 26 47 18

OFFICE REPORT SOIL EXPLORATION

20 15 5 10 % STRAIN AT FAILURE

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RECORD OF BOREHOLE Nº 14

JOB 73-11012 — LOCATION Sta. 606+21 o/s 19' Rt. — ORIGINATED BY EW

W.P. 113-67-01 — BORING DATE May 16, 1973 — COMPILED BY EW

DATUM Geodetic — BOREHOLE TYPE Washboring and Cone Test — CHECKED BY [illegible]

ELEV. / DEPTH	DESCRIPTION	STRAT. PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES BLOWS/FOOT	ELEV. SCALE
616.6	Ground Level					
0.0	Silty Clay		1	SS	12	
	Stiff to Hard		2	SS	48	
			3	SS	40	610
605.1			4	SS	33	
603.6	Clayey silt to silt		5	SS	29	
602.1	Silty clay					
14.5	Varved Clay		6	SS	13	600
599.1						
597.4	Clayey silt, some sand & gravel;		7	SS	20/8"	
19.2	Probable Bedrock					
	End of Borehole					

Note: Groundwater level not established

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 % 20 40 60

BULK DENSITY γ P.C.F.

REMARKS GR.SA.SI.CL.

OFFICE REPORT SOIL EXPLORATION

20
15 ⊹ 5 % STRAIN AT FAILURE
10

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RECORD OF BOREHOLE No 15

JOB 73-11012 — LOCATION Sta. 606 + 75 o/s 39' Rt. — ORIGINATED BY EW

W.P. 113-67-01 — BORING DATE May 16, 1973 — COMPILED BY EW

DATUM Geodetic — BOREHOLE TYPE Washboring & Cone Test — CHECKED BY

SOIL PROFILE ELEV. / DEPTH	DESCRIPTION	STRAT. PLOT	SAMPLES NUMBER	TYPE	BLOWS/FOOT	ELEV. SCALE
616.5	Ground Level					
615.0	Clayey silt some grav. & sand (Fill)		1	SS	12	
1.5	Silty clay		2	SS	22	
	Very stiff to hard		3	SS	27	610
			4	SS	22	
603.5			5	SS	26	
602.0	Clayey silt to silt.					
14.5	Silty clay. Stiff to Very Stiff		6	SS	22	600
597.5						
596.5	Varved clay		7	SS	16	
20.0	Probable Bedrock End of Borehole					

Note: Groundwater level not established

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 % 20 40 60

BULK DENSITY γ P.C.F.

REMARKS GR.SA.SI.CL.

20
15 ◇ 5 % STRAIN AT FAILURE
10

OFFICE REPORT SOIL EXPLORATION

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS – ONTARIO

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RECORD OF BOREHOLE Nº 16

JOB 73-11012 LOCATION Sta. 604 + 48 o/s 42' Lt. ORIGINATED BY EW

W.P. 113-67-01 BORING DATE May 17, 1973 COMPILED BY EW

DATUM Geodetic BOREHOLE TYPE Washboring 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) 1000 2000 3000 4000 5000	LIQUID LIMIT w_L, PLASTIC LIMIT w_P, WATER CONTENT w (w_P — w — w_L); WATER CONTENT % 20 40 60	BULK DENSITY γ P.C.F.	REMARKS GR.SA.SI.CL.
619.6	Ground Level									
0.0	Silty clay. Stiff to Hard		1	SS	18			o		58 22 (16)
			2	SS	21					
			3	TW	-		o		127	
			4	SS	51					
			5	TW	-	610	•	o	126	
			6	SS	22					
			7	SS	23					
602.1										
17.5	Claycy silt, some grav & sand.		8	SS	60	600		o		26 15 43 16
598.2			9	SS	75					
			10	SS	30/7"					
21.4	Probable Bedrock End of Borehole									

Note: Groundwater level not established.

OFFICE REPORT – SOIL EXPLORATION

20
15 ◇ S % STRAIN AT FAILURE
10

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS – ONTARIO

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RECORD OF BOREHOLE No 17

JOB 73-11012 — LOCATION Sta. 605 + 46 o/s 41' Lt. — ORIGINATED BY EW

W.P. 113-67-01 — BORING DATE May 17, 1973 — COMPILED BY EW

DATUM Geodetic — BOREHOLE TYPE Washboring — CHECKED BY [illegible]

SOIL PROFILE ELEV./DEPTH	DESCRIPTION	STRAT. PLOT	SAMPLES NUMBER	TYPE	BLOWS/FOOT	ELEV. SCALE
622.7	Ground Level					
0.0	Silty clay to clay. Firm to Hard		1	SS	6	620
			2	SS	32	
			3	SS	26	
			4	TW	11	610
			5	SS	38	
			6	SS	25	
			7	SS	20	
			8	SS	24	
601.7						
21.0	Clayey silt with sand, some gravel.		9	SS	98	600
546.9			10	SS	79	
25.8	Probable Bedrock End of Borehole					

Note: Groundwater level not established

DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT

SHEAR STRENGTH P.S.F.
o UNCONFINED + FIELD VANE
● QUICK TRIAXIAL × LAB VANE
1000 2000 3000 4000 5000

LIQUID LIMIT W_L
PLASTIC LIMIT W_P
WATER CONTENT W
W_P W W_L
WATER CONTENT %
20 40 60

BULK DENSITY γ P.C.F.

REMARKS	GR. SA. SI. CL.
	13 30 43 14
	22 31 36 11

OFFICE REPORT SOIL EXPLORATION

15 20 10 5 % STRAIN AT FAILURE

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RECORD OF BOREHOLE No 18

JOB 73-11012 LOCATION Sta. 604 + 93 o/s 58' Lt. ORIGINATED BY EW

W.P. 113-67-01 BORING DATE May 17, 1973 COMPILED BY EW

DATUM Geodetic BOREHOLE TYPE Washboring 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 P.C.F.	REMARKS
ELEV. / DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS/FOOT		SHEAR STRENGTH P.S.F. ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE	WATER CONTENT % 20 40 60		GR.SA.SI.CL
622.8	Ground Level									
0.0	Silty clay.					620				
	Very Stiff to Hard		1	SS	33					
			2	SS	45					
612.3			3	SS	28					
10.5	End of Borehole									

Note: Groundwater level not established

OFFICE REPORT / SOIL EXPLORATION

20
15 ◇ 5 % STRAIN AT FAILURE
10

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS – ONTARIO

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RECORD OF BOREHOLE No 19

JOB 73-11012 LOCATION Sta. 601 + 72 o/s 8' Lt. ORIGINATED BY EW

W.P. 113-67-01 BORING DATE May 17, 1973 COMPILED BY EW

DATUM Geodetic BOREHOLE TYPE Washboring CHECKED BY CF

SOIL PROFILE			SAMPLES				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	ELEV. SCALE	SHEAR STRENGTH P.S.F. ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE	WATER CONTENT % 20 40 60	γ P.C.F.	GR.SA.SI.CL.
617.7	Ground Level									
0.0	Silty clay. Very Stiff		1	SS	28	610				
			2	SS	24					
607.2			3	SS	22					
10.5	End of Borehole									

Note: Groundwater Level not established

OFFICE REPORT SOIL EXPLORATION

20
15 5 % STRAIN AT FAILURE
10

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RECORD OF BOREHOLE Nº 20 (B.H.# 6 W.O. 71-11097)

JOB 73-11012 LOCATION Sta. 612 + 25 o/s 54' Rt. of ℄ ORIGINATED BY PP

W.P. 113-67-01 BORING DATE Sept. 28, 1971 COMPILED BY PP

DATUM Geodetic BOREHOLE TYPE Cont. Flight Auger CHECKED BY [illegible]

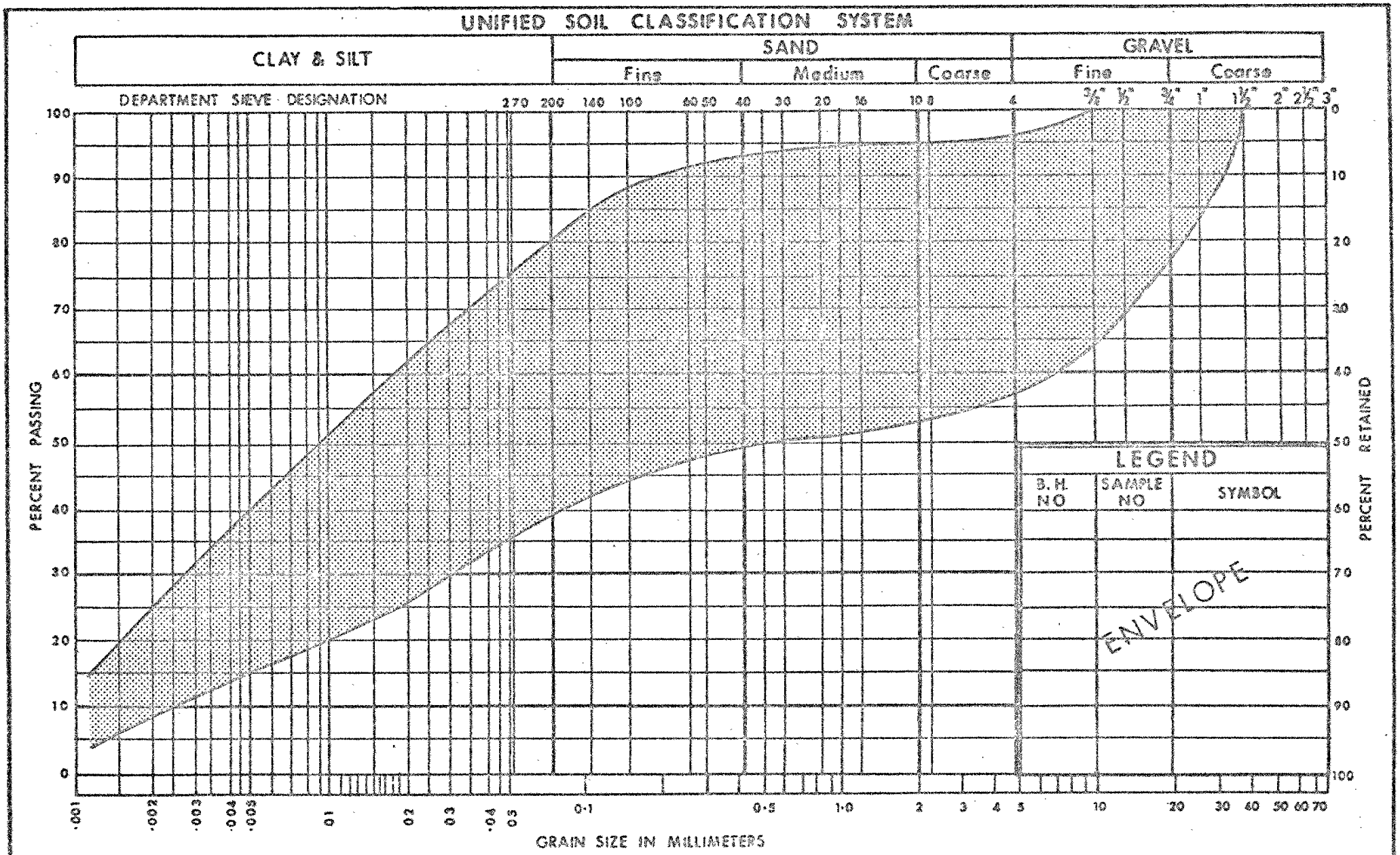
SOIL PROFILE ELEV./DEPTH	DESCRIPTION	STRAT. PLOT	SAMPLES NUMBER	TYPE	BLOWS/FOOT	ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS/FOOT / SHEAR STRENGTH P.S.F. ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE	LIQUID LIMIT W_L / PLASTIC LIMIT W_P / WATER CONTENT W / WATER CONTENT % 20 40 60	BULK DENSITY γ P.C.F.	REMARKS GR. SA. SI. CL.
610.8	Ground Level									
0.0	Silty clay & clayey silt.		1	SS	33	610		○		
	Very Stiff to Hard		2	SS	28			○		0 0 70 30
			3	SS	16	600		○		
598.1										
597.4	Clayey sl., some sa & gr.		4	SS	10/8"			○		8 14 51 27
13.4	End of Borehole									

Note: Groundwater Level not established

OFFICE REPORT SOIL EXPLORATION

20
15 ◇ 5 % STRAIN AT FAILURE
10

FORM OD-MT-17
REV. AUG. 1971



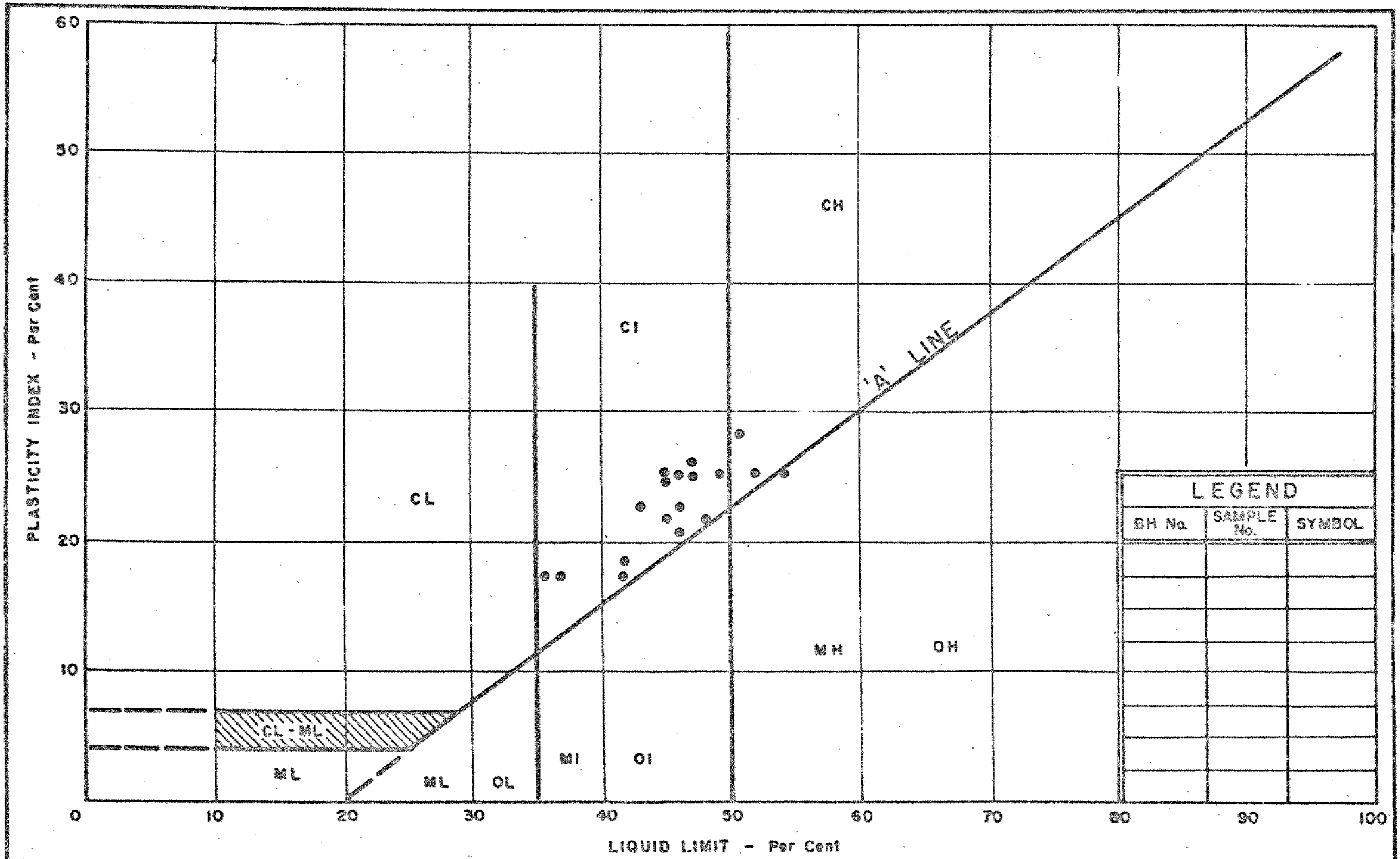
DEPARTMENT OF TRANSPORTATION AND COMMUNICATIONS
ONTARIO
DESIGN SERVICES BRANCH

GRAIN SIZE DISTRIBUTION

CLAYEY SILT, SOME SAND & GRAVEL

W.P. No. 113-67-01
JOB No. 73-11012
FIG. NO. 1

REVISED JULY 1966



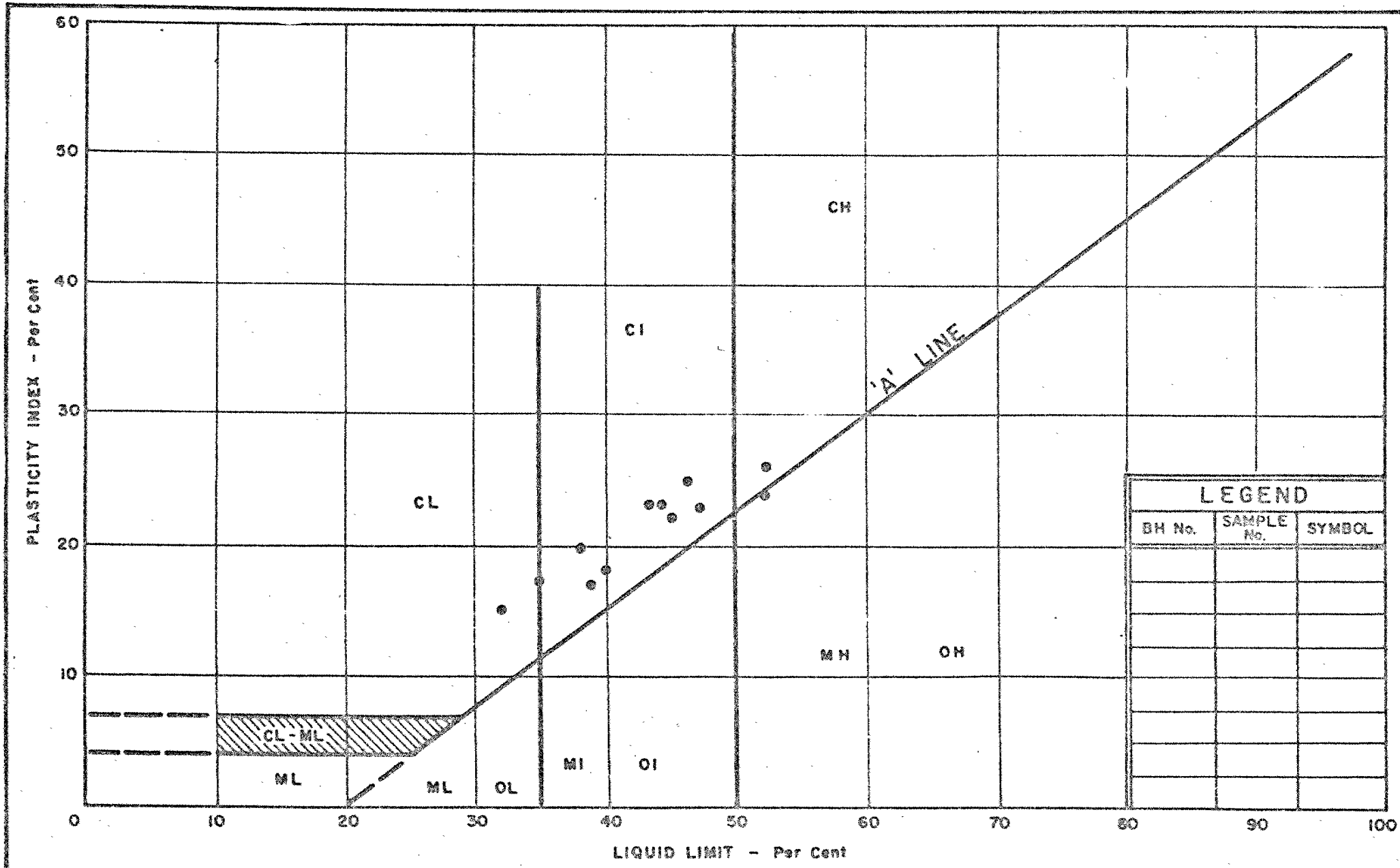
DEPARTMENT OF HIGHWAYS
MATERIALS and TESTING DIVISION

PLASTICITY CHART
SILTY CLAY TO CLAYEY SILT
(RETAINING WALLS 1 to 5)

W.P. No. 113-67-01
JOB No. 73-11012
FIG. NO. 2

FORM CD-MT-252

REVISED JUL[illegible]1966



DEPARTMENT OF HIGHWAYS
MATERIALS and TESTING DIVISION

PLASTICITY CHART

SILTY CLAY TO CLAYEY SILT

(RETAINING WALLS 6 to 9)

W.P. No. 113 - 67 - 01

JOB No. 73 - 11012

FIG. NO. 3

FD-9 (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-96 (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

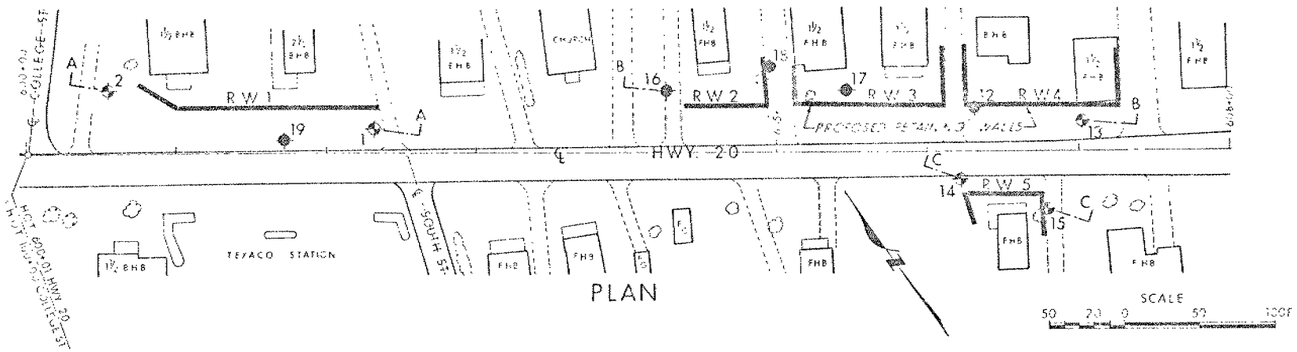
d	DISTANCE FROM TOP OF WALL TO POINT OF APPLICATION OF PRESSURE
δ	ANGLE OF WALL FRICTION
K	DIMENSIONLESS COEFFICIENT TO BE USED WITH VARIOUS SUFFIXES IN EXPRESSIONS REFERRING TO NORMAL STRESS ON WALLS
K_o	COEFFICIENT OF EARTH PRESSURE AT REST

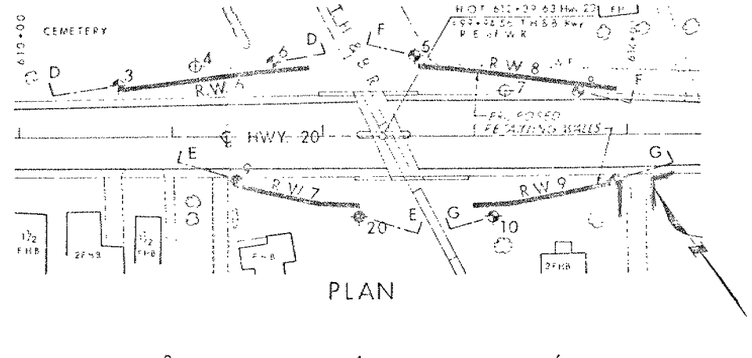
FOUNDATIONS

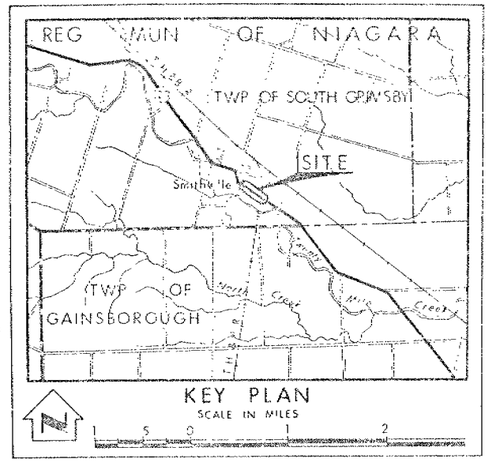
B	BREADTH OF FOUNDATION
L	LENGTH OF FOUNDATION
D	DEPTH OF FOUNDATION BENEATH GROUND
N	DIMENSIONLESS COEFFICIENT USED WITH A SUFFIX APPLYING TO SPECIFIC GRAVITY, DEPTH AND COHESION ETC. IN THE FORMULA FOR BEARING CAPACITY
k_s	MODULUS OF SUBGRADE REACTION

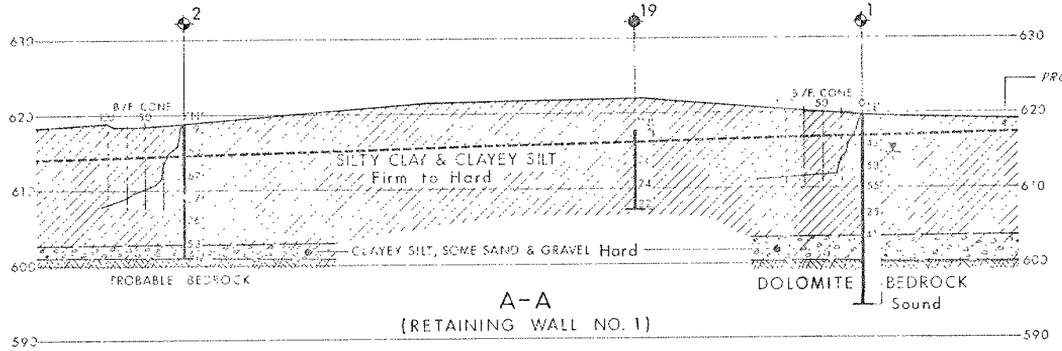
SLOPES

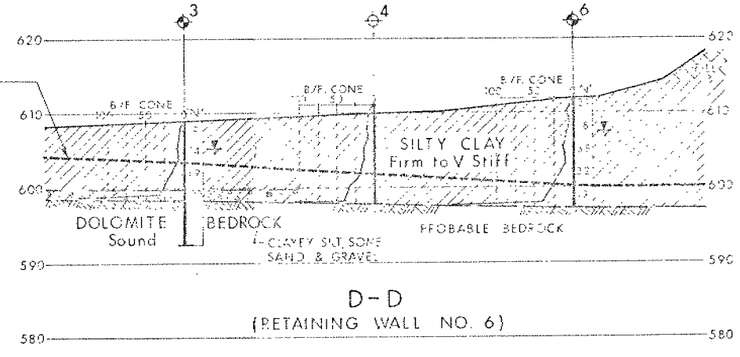
H	VERTICAL HEIGHT OF SLOPE
D	DEPTH BELOW TOE OF SLOPE TO HARD STRATUM
β	ANGLE OF SLOPE TO HORIZONTAL

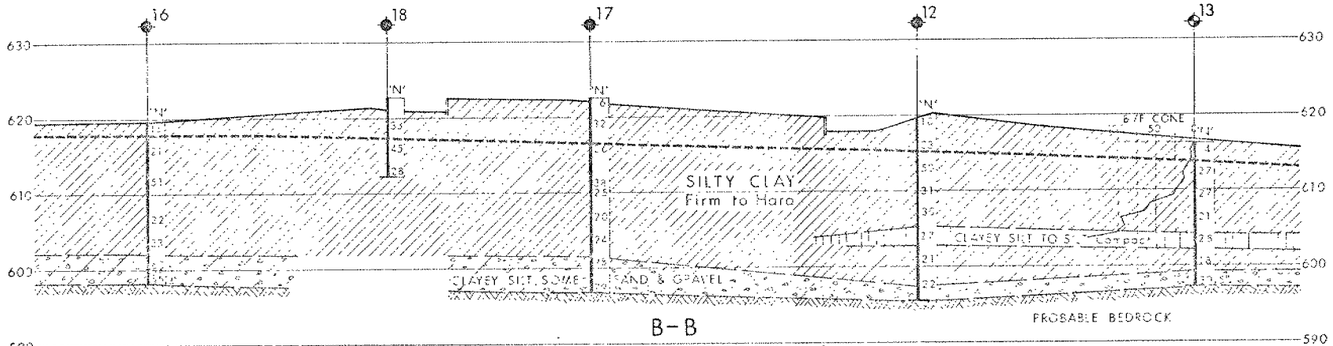


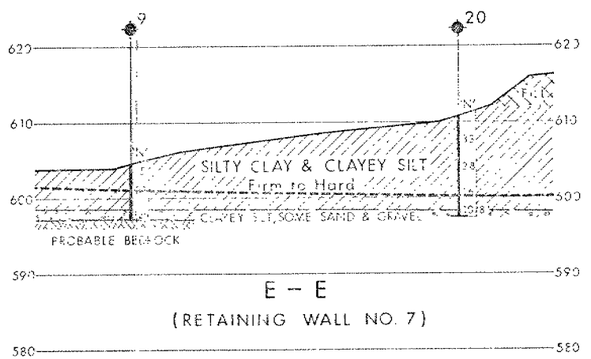


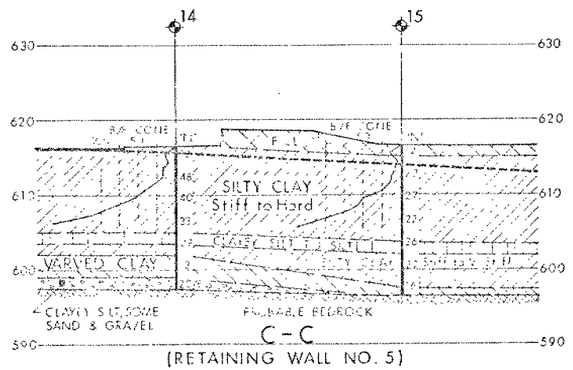


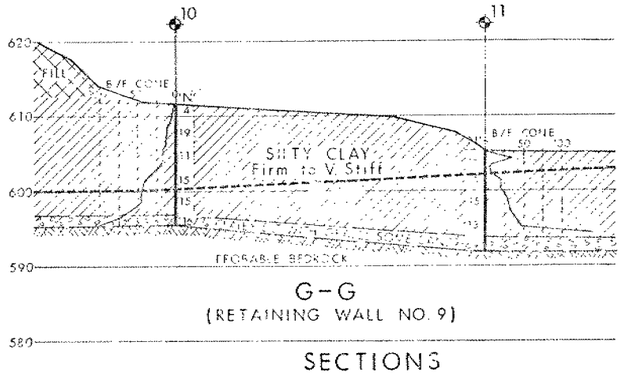


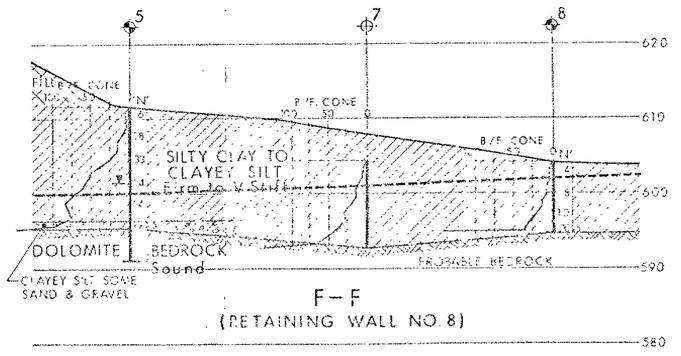


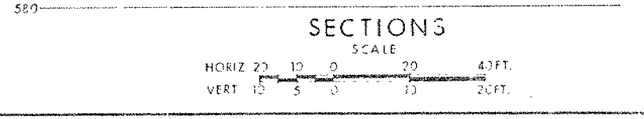












LEGEND

- Bore Hole
- Cone Penetration Test
- Bore Hole & Cone Test
- Water Levels established at time of field investigation May 1973
  W.L. not established in Borehole 2 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19 & 20

NO.	ELEVATION	STATION	OFFSET
1	619.7	602+32	16' LT.
2	618.8	600+54	42' LT.
3	608.9	610+66	35' LT.
4	611.0	611+15	48' LT.
5	611.7	612+62	55' LT.
6	611.9	611+67	50' LT.
7	604.6	613+21	30' LT.
8	604.2	613+69	29' LT.
9	604.8	611+42	29' RT.
10	611.7	613+13	54' RT.
11	606.3	613+92	31' RT.
12	620.0	606+32	30' LT.
13	616.4	607+02	20' LT.
14	616.6	606+21	19' RT.
15	616.5	606+75	39' RT.
16	619.6	604+28	42' LT.
17	622.7	605+66	41' LT.
18	622.8	604+93	56' LT.
19	617.7	603+72	5' LT.
20	610.5	612+25	54' RT.

— 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
DESIGN SERVICES BRANCH — FOUNDATIONS OFFICE

RETAINING WALLS (1, 2, 3, 4, 5, 6, 7, 8 & 9)

HIGHWAY NO. 20 DIST NO. 4
REGIONAL MUNICIPALITY OF NIAGARA
TWP SOUTH GRIMSBY LOT 6 & 7 CON IX

BORE HOLE LOCATIONS & SOIL STRATA

SUBMD E.W.	CHECKED	W.P. NO. 11-67-01	DRAWING NO. 73-11012A
DRAWN	CHECKED	W.O. NO. 73-11012	
DATE June 27 1973		SITE NO.	BRIDGE DRAWING NO.
APPROVED		CONT NO.	

CONSULTANTS

totten sims hubicki associates limited

G. L. TOTTEN B.Sc., P.Eng.
R. E. SIMS B.A.Sc., P.Eng.
J. M. HUBICKI B.A.Sc., P.Eng.
R. L. WINDOVER M.Sc., P.Eng.
P.C. EBERLEE B.A.Sc., P.Eng.

1500 HOPKINS STREET, L1N 2C3
WHITBY, ONTARIO, (416) 668-9363

April 11th, 1975

Mr. J. P. Cullen
Senior Project Design Engineer
Central Region
Ministry of Transportation
and Communications
Downsview 464, Ontario

Attention: Mr. A. Sulavella

Re: Slope Stability and Culvert Extension,
W.P. 113-67-01, Highway 20, Smithville

Dear Sir:

In accordance with instructions received from Mr. J. Cullen, on April 8th, 1975, please find enclosed one (1) copy of the plan of the C.S.P. culvert, Station 564+29, for the above noted project. This plan has been revised to indicate the 6" Granular 'A' cushion under the concrete bedding, Detail A on Sheet 56A, in order to provide a continuous drainage path as recommended in a Memorandum dated March 27th, 1975 from Mr. B. L. Ly to Mr. A. Sulavella.

If you have any comments or questions, please contact this office at your convenience.

Yours very truly,

D. R. Woods

D. R. Woods, P. Eng.

DRW/an
Encl:
C.C. Mr. B. L. Ly

No Comment.

Apr. 28th, 75

Mr. J. P. Cullen,
Area Manager,
Planning and Design Office,
Central Region.

Mr. A. Sulavella

Materials and Testing Office,
Central Region.

April 7, 1975

Treatment of South Slope
Sta. 560+50± to Sta. 564+40±
Hwy. 20, W.P. 113-67-01
Hamilton District

This is in reply to your memo of March 21, 1975. As requested, we have reviewed the contract drawing sheet #56 of the above noted project and found that the recommended remedial measures shown on the typical section are in accordance with our mutual agreement reached at the meeting held on February 13, 1975.

No further comments are to be made re this matter.

P. Penev,
Project Soils Engineer.

PP/PFW/nr

c.c. K. Selby ✓

For: P. F. Weber,
Senior Soils Supervisor.

B. Ing Apr. 8th, 1975

W.P. 113-67-01

Mr. A. Sulavella
Planning & Design Office
Central Region

Soil Mechanics Section
Geotechnical Office
West Building, Downsview

March 27, 1975

SLOPE STABILITY & CULVERT EXTENSION
HIGHWAY 20, W.P. 113-67-01
SMITHSVILLE, DISTRICT 4
****

We have reviewed the design drawings of the above-mentioned project, shown in Sheet 56 and Sheet 56A.

We feel that a 6" granular 'A' cushion should be placed under the concrete pad (Detail 'A' in Sheet 56A) to provide a continuous drainage path.

We have no other comments.

B. L. Ly, Proj. Engineer

for

K. G. Selby
Supervising Engineer

cc: P. Webber
Totten, Sims, Hubicki Ass. Ltd.

Files
Record Services

/sah

Mr. G.C.E. Burkhardt,
Regional Structural Planning Eng.,
Central Region,
3501 Dufferin St., Downsview.

Mr. W. M. Killin.

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

August 20, 1973.

Foundation Investigation Report
Retaining Walls - Smithville
Hwy. #20, District #4 (Hamilton)
W.O. 73-11012 ✓ -- W.P. 113-67-01

This memo confirms recommendations given to Mr. J. Eleong, Totten, Sims & Hubicki by telephone on August 17, 1973, regarding Wall #9 on the above-mentioned project.

The retaining walls adjacent to Wall #9 which will be constructed to retain the private drive at the south-east end may be founded on spread footings assuming a net safe pressure of 1.5 t.s.f. The base of footings should be in original ground below elevation 600 and must have a minimum cover of 4 ft. for frost protection.

K. G. Selby

KGS/ao

K. G. Selby,
SUPERVISING FOUNDATIONS ENGINEER.

c.c. C. S. Grebski
R. G. Burnfield
J. Eleong (Totten, Sims & Hubicki)

Foundations Files
Documents

73-11012

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS, ONTARIO

MEMORANDUM

TO: Mr. G.C.E. Burkhardt,
Reg. Structural Planning Eng.,
Central Region.

FROM: R.G. Burnfield,
Regional Systems Design.

ATTENTION:

DATE: July 10, 1973.

OUR FILE REF.

IN REPLY TO

SUBJECT:

Re: Foundation Investigation Report,
Retaining Walls - Smithville,
W.P. 113-67-01, Highway 20.

I am in receipt of our copy of above report.

The report notes that retaining walls 1 to 5 may be founded on either spread footings or on piles driven to bedrock. In view of the proximity of a number of houses to the construction site, I recommend that spread footings be selected.

J.P. Cullen
For:
R.G. Burnfield
Regional Highway Design Engineer

JPC/ACW