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DIST. 6 REGION

W.P. No. 134-73-02
(W.O. 73-11108)

CONT. No. 84-45

W. O. No.

STR. SITE No. 24-343

HWY. No. 7N

LOCATION Brampton Bypass - from Queen St. Brampton to Hwy 10, including interchange

No. of PAGES - structure

OVERSIZE DRAWINGS TO BE INCLUDED WITH THIS REPORT.

REMARKS:

OVERSIZE DRAWING

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS, ONTARIO

MEMORANDUM 30M12-98

TO: Mr. G.C.E. Burkhardt, (3) Reg. Structural Planning Eng., Central Region, Toronto.

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

ATTENTION:

DATE: March 29th, 1974.

OUR FILE REF.

IN REPLY TO APR - 8 1974

SUBJECT:

FOUNDATION INVESTIGATION REPORT
For
Proposed Hwy. 410 Underpass at
Existing Hwy. 7, Site #24-343
Town of Brampton, County of Peel
District No. 6 (Toronto)

W.O. 73-11108 W.P. 134-73-02

Attached we are forwarding to you our detailed foundation investigation report on the subsoil conditions existing at the abovementioned 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.

M. Devata,
Supervising Engineer.

MD/mj
Attach.

c.c. E.J. Orr
B.R. Davis
R.S. Pillar
H. Greenland
B.J. Giroux
D. Gunther
G.A. Wrong
B.A. Singh
Giffels, Davis & Jorgenson Ltd.
Files
Documents

TABLE OF CONTENTS

FOUNDATION INVESTIGATION REPORT
For
Proposed Hwy. 410 Underpass at
Existing Hwy. 7, Site # 24-343
Town of Brampton, County of Peel
District No. 6 (Toronto)

W.O. 73-11108 W.P. 134-73-02

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1. INTRODUCTION:

The Soil Mechanics Section was requested to carry out a subsurface investigation for the abovementioned underpass structure in the Town of Brampton, County of Peel. The request was contained in a memo from Mr. G.C.E. Burkhardt, Regional Structural Planning Engineer, Central Region, dated January 14th, 1974. Subsequently, a foundation investigation was carried out by this section, to determine the subsoil, bedrock and groundwater conditions at the site.

The results of the investigation are presented in this report, together with our recommendations pertaining to design and construction of the structure foundations as well as the stability considerations associated with the approach fills and cuts.

2. DESCRIPTION OF SITE AND GEOLOGY:

The site is located immediately east of the intersection of Hwy. 7 and Heart Lake Road, in the Town of Brampton, County of Peel. The surrounding terrain is flat to gently undulating. Both Hwy. 7 and Heart Lake Road are two-lane paved roadways and there are traffic lights at the level crossing of these two roads. The area in the vicinity of site has been developed for light commercial, as well as aggricultural purposes.

..... /2

Physiographically, the site is located in the region of "Peel Plain". In this region, the general elevation is from 500 to 750 feet (152 to 229 m) above the sea level and there is a gradual and fairly uniform slope towards Lake Ontario. The characteristic deposit in this area is a ground moraine laid down during the Wisconsinian glacial age. Deposits of silt and sand are often found interbedded within the till.

3. FIELD INVESTIGATION AND LABORATORY WORK:

Six boreholes, four of which accompanied by a dynamic cone penetration test, were put down during the course of field investigation. The borings and the penetration tests were advanced by means of a continuous flight auger machine (commercially known as C.M.E. 55) adapted for soil sampling purposes.

Samples of the overburden were obtained at required depths by means of a 2" O.D. split spoon sampler. The sampler was driven into the soil with a driving energy in accordance with the specifications for Standard Penetration Test. The same method was used to advance the cone penetration test. Bedrock was proven at all boring locations by obtaining BXL size rock core samples. The groundwater conditions were observed by recording the water levels in the open borehole during the period of the field investigation.

The soil, bedrock and groundwater conditions encountered in the borings are presented on the Record of Borehole Sheets. The boring locations and elevations, together with estimated stratigraphical sections were shown on Drawing No. 73-11108 A. Field surveying was carried out by construction personnel from District #6. Elevations are referenced to a Geodetic Datum.

..... /3

All samples were subjected to careful inspection and classification both in the field and in the laboratory. Following this examination, various laboratory tests were carried out on representative samples to determine the physical properties of the overburden; namely:

Natural Moisture Contents
Atterberg Limits
Grain-size Distributions

The results of the laboratory testing are plotted on Record of Borehole Sheets and summarized on Figures No. 1 to 4, inclusive, all contained in the Appendix of this report.

4. SUBSOIL AND BEDROCK CONDITIONS:

4.1) General:

The predominant stratum encountered at the site is a cohesive deposit of stiff to hard clayey silt with sand and gravel. At three boring locations, this stratum is overlain by fill material of up to 5 feet (1.5 m) thick. The clayey silt is followed by a granular deposit ranging from silt to silty sand, which is in turn underlain by a heterogeneous mixture of clayey silt, sand and gravel of glacial origin. The overburden is followed by limestone bedrock.

The boundaries of the various deposits as determined in the boreholes are shown on the Record of Borehole Sheets. The stratigraphical sections, as shown on Drawing No. 73-11108 A, have been inferred from this data. From ground surface downward, the soil types and bedrock are described in the Subsections to follow.

..... /4

4.2) Fill Material:

Fill material was encountered at three boring locations (B.H.'s #2, #3 and #4). The fill material was composed of clayey silt with sand and gravel at two boreholes. At B.H. #3, it is a silty sand with traces of gravel. The thickness of the fill material was found to be 5 feet.(1.5 m) at all three boreholes. Standard Penetration Testing carried out within this stratum gave 'N' values ranging from 9 to 18 blows per foot. Based on these values, it is estimated that the fill material has been moderately compacted.

4.3) Clayey Silt, with Sand and Gravel:

This is the predominant stratum which was encountered immediately below the ground surface or directly under the fill material where it exists. The thickness of this deposit ranges from 7 feet (2.1 m) at B.H.#3 to 32 feet (9.8 m) at B.H. #4. Random thin seams of silt and sand are present within this deposit. At B.H.#4, the upper 7 feet (2.1 m) of this deposit consists of alternate layers of silty sand and clayey silt. A layer of slightly plastic silt with some sand and clay of 13.5 feet (4.1 m) thick was encountered at B.H.#5 within the lower portion of this stratum.

Grain-size distribution tests were performed on the samples obtained from the cohesive portion of this deposit. The results were summarized on Fig. #2 in an envelope form.

Atterberg Limit tests were carried out on the cohesive portion of the samples obtained. The results, which are plotted on the Record of Borehole Sheets and the Plasticity Chart (Fig.#1), are summarized in tabulated form as below.

		Range
Liquid Limit (W_L)	%	16-34
Plastic Limit (W_p)	%	12-20
Natural Moisture Content (W)	%	8-18

..... /5

Based on these values, it may be estimated that the cohesive deposit is inorganic and of low plasticity.

Standard Penetration testing carried out within this deposit gave 'N' values ranging from 14 to in excess of 100 blows per foot. It is estimated that the consistency of this deposit varies between stiff to hard.

4.4) Granular Deposits - Silts and Sands:

Directly underlying the clayey silt is a granular deposit, whose composition ranges from silt with some sand to sand with some silt. The thickness of this granular deposit varies between 11 feet (3.4 m) (B.H. #1) and 27 feet (8.2 m) (B.H. #2). The results of the grain-size distribution testing carried out on samples recovered from this deposit are presented on Fig. #3. Standard Penetration Testing was carried out within this stratum. This testing gave 'N' values ranging from 46 to in excess of 100 blows per foot. The relative density of this deposit is therefore estimated to be varying from dense to very dense.

4.5) Heterogeneous Mixture of Clayey Silt, Sand and Gravel (Glacial Till):

This deposit of glacial origin was encountered at all boring locations except at B.H. #2. It is composed of a heterogeneous mixture of clayey silt, sand and gravel. Its thickness ranges from 3 feet (0.9 m) (B.H. #3) to 19.5 feet (5.9 m) (B.H. #1). Typical grain-size distribution curves are shown on Fig. #4. From a limited number of Atterberg limit tests, it is estimated that the glacial till has a matrix which is inorganic and of low plasticity. Standard Penetration testing gave 'N' values of in excess of 100 blows per foot. Based on these values, it is estimated that the consistency of the glacial till is hard.

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4.6) Bedrock:

Bedrock was proven at all boring locations by obtaining 3.5 feet (1.1 m) to 6.5 feet (2.0 m) of BXL size rock core samples. The bedrock is composed of limestone. The bedrock elevation at the various boreholes is as follows.

	Bedrock Elevation
B.H.#1	677.8
B.H.#2	678.5
B.H.#3	679.0
B.H.#4	675.0
B.H.#5	674.6
B.H.#6	676.2

The core samples revealed that the bedrock is generally sound with minor fracturing.

5. GROUNDWATER CONDITIONS:

Groundwater conditions were observed by recording the water levels in the open boreholes during the course of the field investigation. The observations indicated that the groundwater table within the overburden varied between elevations 718 and 723, corresponding to levels from 1.5 to 7 feet (0.5 to 2.1 m) below the existing ground surface.

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6. DISCUSSIONS AND RECOMMENDATIONS:

6.1) General:

It is proposed to construct a controlled access expressway between Hwy. 401 and Hwy. 7, following closely the alignment of the existing Heart Lake Road, in the County of Peel. This expressway will be designated as Hwy. 410 (Brampton Bypass). A number of interchange and structure crossings will be required. This report will deal with the proposed underpass structure at the crossing of Hwy. 410 and Hwy. 7 (Queen Street, Brampton) in the Town of Brampton, County of Peel.

It is understood that the structure at this site will be 100 feet (30.5 m) wide for the initial scheme. Ultimately the structure will be widened to approximately 170 feet (51.8 m). The structure is to have two spans. At the present time, two types of abutments are being considered, i.e., closed type (span length 115 feet or 35 m) and perched type (span length 130 feet or 40 m). The information available at time of the preparation of this report would indicate that the profile grade of Hwy. 410, in the vicinity of the structure, will be at about Elevation 707. At this grade, the Hwy. 410 will be in a cut section extending up to 19 feet (5.8 m) below the existing ground surface. In this area, the proposed grade of Hwy. 7 is to range from elevations 729 to 730. At these grades, the approaches will have a maximum height of 23 feet (7.0 m) in the longitudinal direction (combined fill and cut) and 6 feet (1.8 m) in the transverse direction (fill).

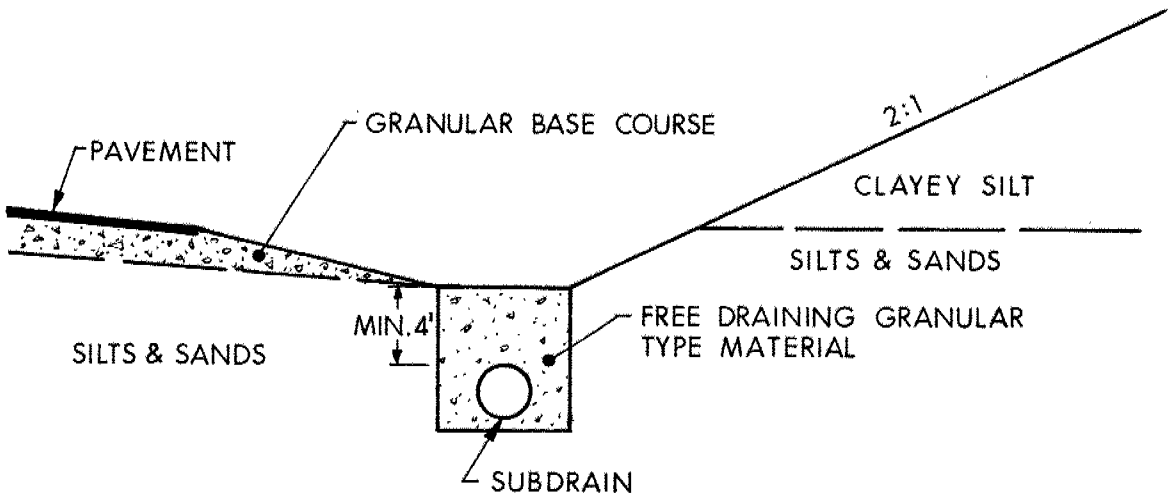
The predominant stratum across the site is a stiff to hard clayey silt with some sand and gravel which is underlain by up to 27 feet (8.2 m) of silts and sands. The granular deposit is underlain by a hard cohesive glacial till deposit which in turn, is followed by Limestone bedrock, at elevations ranging from 674 to 679.

..... /8

6.2) Cut and Fill Sections:

6.2.1) Hwy. 410 Cut Section:

As mentioned previously, the maximum depth of the cut section, in the vicinity of the proposed structure, will be of the order of 19 feet (5.8 m). The excavation will be carried out within the cohesive clay silt stratum. At certain locations, however, it would extend into the underlying granular deposit of silts and sands. The base of the cut will extend well below the groundwater level as recorded during the field investigation. To ensure the stability of the base of the excavation and the future performance of the pavement section, it will be necessary to lower the groundwater level permanently. This may be accomplished by installing at the toes of the cut slopes, a drainage system consisting of a perforated subdrain of adequate capacity. This subdrain should be located at least 4 feet below the finished grade and be connected to the nearby storm sewer, so that continuous flow can be maintained. In addition, the size of the subdrain should be such that it can handle the surficial runoff as well. Following is a sketch showing the details of this drainage system.



NOT TO SCALE

..... /9

A cut of the depth contemplated will be inherently stable with respect to a deep seated failure within the subsoil, provided 2:1 shopes are employed. The cut slopes will have to be protected against erosion caused by uncontrolled surficial runoff. This may be accomplished by sodding the slopes.

6.2.2) Hwy. 7 Fill Sections:

Up to 6 feet (1.8 m) of fill will be required along the approaches to the structure (along Hwy. #7). The approaches will be inherently stable both in the longitudinal and transverse directions provided that

i) 2:1 slopes are employed

ii) The fill is properly compacted.

6.3) Structure Foundations:

6.3.1) Central Pier:

The overburden is competent. It is therefore recommended that the centre pier be supported on spread footings within the overburden. A minimum of 4 feet of cover should be provided above the base of the footing for frost protection purposes. Considering the grade of Hwy. 410 at the proposed pier location this would place the base of the footing at approximate elevation 700. At this elevation, the foundation subsoil consists of very dense silts and sands (the southern portion of the pier) or hard clayey silt with some sand and gravel (the northern portion). A footing so founded may be designed using an allowable bearing pressure of up to 4 t.s.f.

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The base of the footing will be located well below the groundwater level recorded during the period of the investigation. In this regard it is recommended that the foundation elements be constructed only after the Hwy. #410 cut has been made and the permanent drainage system installed. This provision would lower the prevailing groundwater level at this location. The excavation will then be some 4 feet (1.2 m) below the ground surface. Any surficial runoff and in flow eminating from the granular subsoil could be controlled using techniques such as pumping from sumps.

The settlement of the footing will be negligible in magnitude provided the foundation subsoil is not loosened or softened by the construction operations or uncontrolled surface runoff. In this regard it would be advantageous to cover the foundation subsoil with a working mat of lean concrete as soon as the footing level is reached.

6.3.2) Abutments:

i) Closed Type:

The abutments can be founded on spread footings located in the granular deposit of silts and sands. Taking the frost protection requirements into consideration the base of the footings could be located at or below elevation 703. Under these conditions the abutment foundations could be designed using an allowable bearing value of up to 4 t.s.f.

Recommendations pertaining to the dewatering and settlement considerations as discussed under 6.3.1) are applicable.

If the structure is designed as a rigid frame, then a coefficient of earth pressure at rest (K_o) of 0.5 should be assumed for the granular fill placed behind the wall, when designing the abutments. However, if some movement of the wall is permitted, then a coefficient of active earth pressure (K_a) of 0.33 can be used.

..... /11

The granular backfill behind the wall should be allowed to drain in order to prevent the buildup of excess hydrostatic groundwater pressure in this area. This can be accomplished by providing weep holes at the base of the walls. The location and spacing of these weep holes should be determined in accordance with current M.T.C. practices.

For spread footing supported abutments it is recommended a coefficient of friction of 0.6 be used in the computations to determine the sliding resistance between the concrete base of the footing and the underlying granular deposit of silts and sands.

ii) Perched Type:

The perched type abutments may be supported on spread footings within the parent clayey silt deposit at or below elevation 720. The front face of the footings should be at least 10 feet (3 m) behind the forward slope surface. Footings so founded may be designed using an allowable bearing pressure of up to 3.5 t.s.f. In determining the slide resistance between the concrete base of the footing and the underlying clayey silt, an adhesion value of 2,500 p.s.f. may be used.

The excavation for the footings will be carried out within the cohesive clayey silt. No major dewatering problems are anticipated since the clayey silt is relatively impervious. Any minor inflow into the excavation from sources such as water bearing granular seams within the clayey silt deposit, can be handled using techniques such as pumping from sumps.

Recommendations pertaining to settlement considerations, horizontal earth pressure, etc. will be similar to those given for closed type abutment footings.

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7. MISCELLANEOUS:

This project was carried out between January 29th and February 13th, 1974, under the supervision of Mr. V. Korlu, Project Engineer.

The drilling equipment used was owned and operated by P.V.K. and Sons Drilling Co. Ltd., Burford, Ontario.

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

C.S. Poon, P. Eng.

M. Devata, P. Eng.

CSP/mj
March, 1974.

APPENDIX I

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS–ONTARIO

DESIGN SERVICES BRANCH — FOUNDATIONS OFFICE

RECORD OF BOREHOLE No 1

JOB 73-11108 — LOCATION Co-ord's. 15,880,530 N; 936, 902E — ORIGINATED BY VK

W.P. 134-73-02 — BORING DATE January 29, 1974 — COMPILED BY VK

DATUM Geodetic — BOREHOLE TYPE Auger and sample with C.M.E. - 55 — CHECKED BY SP

m	ELEV. / DEPTH ft.	DESCRIPTION	STRAT. PLOT	SAMPLES NUMBER	TYPE	BLOWS/FOOT (0.3 m)	ELEV. SCALE ft/m	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT (0.3 m) 20 40 60 80 100	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.
221.1	725.3	Ground Level						SHEAR STRENGTH P.S.F. ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE			
0.0	0.0	Clayey Silt with sand and gravel		1	SS	17	720				22 25 41 12
				2	SS	47	219.5				▼ w.l. (219.0) el. 718.3
				3	SS	128					
				4	SS	146/11"					0 31 55 14
		Brown Grey		5	SS	100/5"	710				
215.9	708.3	V. stiff to hard		6	SS	150/6"	216.4				
5.2	17.0	Silt with some sand Grey		7	SS	100/5"					0 23 76 1
212.6	697.3	V. Dense		8	SS	106	700 213.4				
8.5	28.0	Het. mix. of clayey silt, sand and gravel. (glacial till) Grey		9	SS	100/3"					
				10	SS	100/6"	690 210.3				
				11	SS	100/2"					14 35 41 10
		Hard		12	SS	100/2"	680 207.3				
206.6	677.8										
14.5	47.5	Limestone		13	RC. BXL	92%					
204.6	671.3	Sound bedrock									
16.5	54.0	End of Borehole					670 204.2				

20
15 ⊹ 5 % STRAIN AT FAILURE
10

OFFICE REPORT ON SOIL EXPLORATION

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS – ONTARIO

DESIGN SERVICES BRANCH — FOUNDATIONS OFFICE

RECORD OF BOREHOLE No 2

JOB 73-11108 — LOCATION Co-ord's. 15,880, 623N; 936, 812E — ORIGINATED BY VK

W.P. 134-73-02 — BORING DATE February 11, 1974 — COMPILED BY VK

DATUM Geodetic — BOREHOLE TYPE Auger and sample with C.M.E. - 55 — CHECKED BY SR

m	ELEV. / DEPTH ft.	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS/FOOT (0.3 m)	ELEV. SCALE ft/m	REMARKS / GR.SA.SI.CL.
221.4	726.5	Ground Level						
0.0	0.0	Clayey silt with sand and gravel & trace of organics (fill) (stiff)		1	SS	14		
219.9	721.5			2	SS	46	720	19 24 47 10
1.5	5.0	Clayey Silt with Sand Brown Hard		3	SS	82	219.5	w.l. el. 719.5 (219.3)
				4	SS	105		0 38 52 10
				5	SS	150/10"	710	
215.0	705.5			6	SS	128/11"	216.4	0 28 54 18
6.4	21.0	Silty Sand, with occasional gravel		7	SS	124	700	
				8	SS	163	213.4	0 81 (19)
				9	SS	175/8"	690	
				10	SS	191/9"	210.3	17 59 (24)
206.8	678.5	Grey Very Dense Limestone partly fractured bedrock		11	BXL RC	75%	680 207.3	
204.8	672.0			12	BXL RC	76%		
16.6	54.5	End of Borehole					670 204.2	

DYNAMIC PENETRATION RESISTANCE — BLOWS / FOOT (0.3 m) — 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 % — 10 20 30

BULK DENSITY γ P.C.F.

20 / 15 ◇ 5 / 10 % STRAIN AT FAILURE

OFFICE REPORT ON SOIL EXPLORATION

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS-ONTARIO

DESIGN SERVICES BRANCH — FOUNDATIONS OFFICE

RECORD OF BOREHOLE No3

JOB 73-11108 — LOCATION Co-ord's. 15,880,616N; 937,005E — ORIGINATED BY VK

W.P. 134-73-02 — BORING DATE February 7, 1974 — COMPILED BY VK

DATUM Geodetic — BOREHOLE TYPE Auger and sample with C.M.E. - 55 — CHECKED BY SR

m	ELEV. / DEPTH ft.	DESCRIPTION	STRAT. PLOT	SAMPLES NUMBER	TYPE	BLOWS/FOOT	ELEV. SCALE ft/m	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.
220.8	724.5	Ground Level									
0.0	0.0	Silty sand with trace of gravel (fill compact)		1	SS	18	720				w.l. el.722.0 (220.1)
219.3	719.5										
1.5	5.0	Clayey silt with some sand and gravel stiff to hard		2	SS	14	219.5		○ ⊢		16 31 38 15
				3	SS	44					
217.1	712.5	Brown		4	SS	93			○ ⊢		0 22 53 25
3.7	12.0			5	SS	57	710				
		Silty sand with occasional layers of silt		6	SS	98	216.4		○		0 5 95 0
				7	SS	119			○		0 64 (36)
				8	SS	142/11"	700				
							213.4				
		grey very dense		9	SS	46					
211.0	692.5										
9.8	32.0	Het. mix. of clayey silt, sand and gravel - (glacial till)		10	SS	100/5"	690		○		
							210.3				
				11	SS	100/4"			○		47 36 (17)
206.9	679.0	grey Hard					680				
13.9	45.5	Limestone		12	BXL RC	70% Rec	207.3				
205.1	673.0	Sound Bedrock		13	BXL RC	100%					
15.7	51.5	End of Borehole					670				
							204.2				

20 15 ○ 5 10 % STRAIN AT FAILURE

OFFICE REPORT ON SOIL EXPLORATION

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS - ONTARIO

DESIGN SERVICES BRANCH — FOUNDATIONS OFFICE

RECORD OF BOREHOLE No 4

JOB 73-11108 — LOCATION Co-ord's. 15,880,712N; 936, 912E — ORIGINATED BY VK

W.P. 134-73-02 — BORING DATE February 13, 1974 — COMPILED BY VK

DATUM Geodetic — BOREHOLE TYPE Auger and sample with C.M.E. - 55 — CHECKED BY SR

m	ELEV. / DEPTH ft.	DESCRIPTION	STRAT. PLOT	SAMPLES NUMBER	TYPE	BLOWS/FOOT	ELEV. SCALE ft/m	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	BULK DENSITY γ P.C.F.	REMARKS GR. SA. SI. CL.
221.0	725.0	Ground Level							WATER CONTENT % 10 20 30		
0.0	0.0	Clayey silt with seams of sand & gr. (fill) (stiff)									w.l. ▽el.723.5 (220.5)
219.5	720.0			1	SS	9	720				
1.5	5.0	(with layers of silty sand) brown		2	SS	43	219.5				0 57 (43)
				3	SS	77					
				4	SS	124					0 42 45 13
				5	SS	145/9"	710				
							216.4				
				6	SS	88					
		Clayey silt with sand and gravel grey		7	SS	172/8"	700				37 18 29 16
							213.4				
				8	SS	100/6"					
				9	SS	100/6"	690				14 30 42 13
209.7	688.0	Hard					210.3				
11.3	37.0	Silty sand, with trace of gravel		10	SS	172/10"					
				11	SS	100/6"	680		OH		0 52 42 6
206.7	678.0	Very dense					207.3				
14.3	47.0	Het. mix. of clayey silt, sand & gr. (gl. till) Hard		12	SS	100/4"					
205.8	675.0			13	BXL RC	70%					
15.2	50.0	Limestone partly fractured bedrock		14	BXL RC	80%	670				
204.2	670.0										
16.8	55.0	End of Borehole					204.2				
							660				
							201.2				

20 15 ◇ 5 10 % STRAIN AT FAILURE

OFFICE REPORT ON SOIL EXPLORATION

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS – ONTARIO

DESIGN SERVICES BRANCH — FOUNDATIONS OFFICE

RECORD OF BOREHOLE No 5

JOB 73-11108 — LOCATION Co-ord's. 15,880,732N; 937, 064E — ORIGINATED BY VK

W.P. 134-73-02 — BORING DATE January 29, 1974 — COMPILED BY VK

DATUM Geodetic — BOREHOLE TYPE Auger and sample with C.M.E. - 55 — CHECKED BY SR

m / ELEV. ft.	DEPTH ft.	DESCRIPTION	STRAT. PLOT	SAMPLES NUMBER	TYPE	BLOWS/FOOT	ELEV. SCALE ft/m
220.2	722.6	Ground Level					
0.0	0.0	Clayey silt with sand and gravel					720
				1	SS	45	219.5
				2	SS	117	
				3	SS	100/6"	
		brown Hard		4	SS	135/10"	710
		Silt with some sand and clay. (slightly plastic)		5	SS	118/10"	216.4
				6	SS	159/10"	
				7	SS	37	700
		Dense to very Dense					213.4
211.4	693.6	grey		8	SS	113	
8.8	29.0	Silty sand with gravel		9	SS	166	690
							210.3
208.3	683.6	grey Very Dense		10	SS	100/6"	
11.9	39.0	Het. mix. of clayey silt, sand and gravel (glacial till)		11	SS	100/3"	680
205.6	674.6	grey Hard					207.3
14.6	48.0	Limestone partly fractured Bedrock		12	BXL RC	67% Rec.	
203.7	668.6			13	BXL RC	67% Rec.	670
							204.2
16.5	54.0	End of Borehole					660
							201.2

DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT (0.3 m) — 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 % — 10 20 30

BULK DENSITY γ P.C.F.

REMARKS — GR. SA. SI. CL.

w.l. el. 717.6 (218.7)

0 41 46 13

0 23 65 12

3 27 54 16

0 85 (15)

22 54 (24)

20
15 ⊹ 5 % STRAIN AT FAILURE
10

OFFICE REPORT ON SOIL EXPLORATION

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS – ONTARIO

DESIGN SERVICES BRANCH — FOUNDATIONS OFFICE

RECORD OF BOREHOLE No 6

JOB 73-11108 — LOCATION Co-ord's. 15,880,816N; 936,983E — ORIGINATED BY VK

W.P. 134-73-02 — BORING DATE February 14, 1974 — COMPILED BY VK

DATUM Geodetic — BOREHOLE TYPE Auger and sample with C.M.E. - 55 — CHECKED BY SR

m	ELEV. / DEPTH ft.	DESCRIPTION	STRAT. PLOT	SAMPLES NUMBER	TYPE	BLOWS/FOOT (0.3m)	ELEV. SCALE ft/m
220.7	724.2	Ground Level					
0.0	0.0	Clayey Silt with layers of silt and sand Brown Grey		1	SS	47	720
				2	SS	47	219.5
				3	SS	62	
				4	SS	142	
				5	SS	190	710
214.6	704.2	Hard		6	SS	172	216.4
6.1	20.0	Silty Sand		7	SS	150	700
				8	SS	163/10"	213.4
				9	SS	173	690
		Grey Very Dense		10	SS	160/9"	210.3
207.9	682.2						
12.8	42.0	Het. mix. of clayey silt, sand and gravel (glacial till) grey hard		11	SS	100/5"	680 207.3
206.4	676.2						
14.3	48.0	Limestone partly fractured bedrock		12	RC BXL	60%	
205.0	672.7						
15.7	51.5	End of Borehole					670 204.2

DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT (0.3m) 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 % 10 20 30

BULK DENSITY γ P.C.F.

REMARKS — GR.SA.SI.CL.

w.l. el. 721.7 (220.0)

0 5 85 10

20 36 36 8

0 16 52 32

0 75 (25)

45 36 (19)

15 20 5 10 % STRAIN AT FAILURE

OFFICE REPORT ON SOIL EXPLORATION

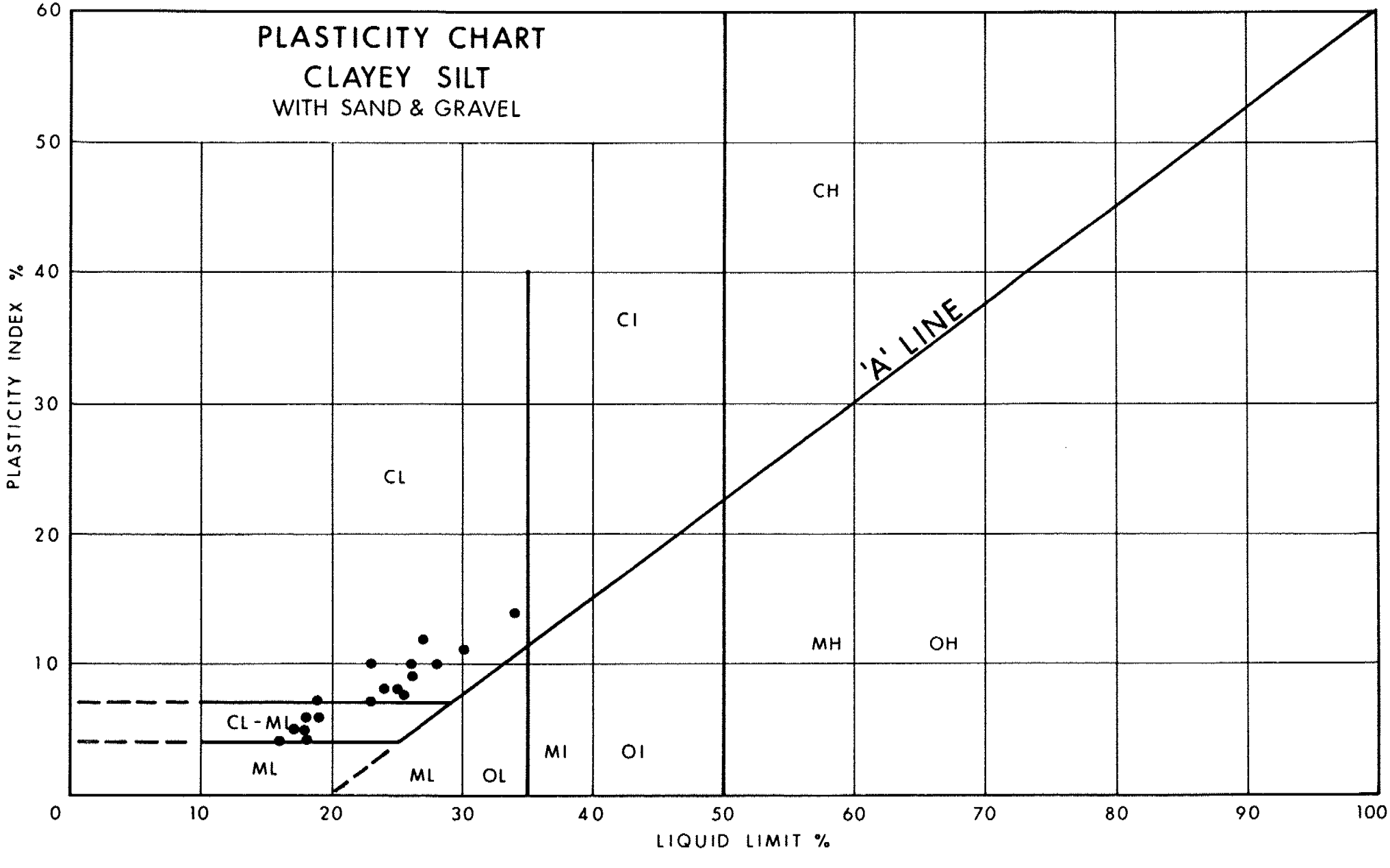


FIG. 1

W.O. 73-11108

GRAIN SIZE DISTRIBUTION

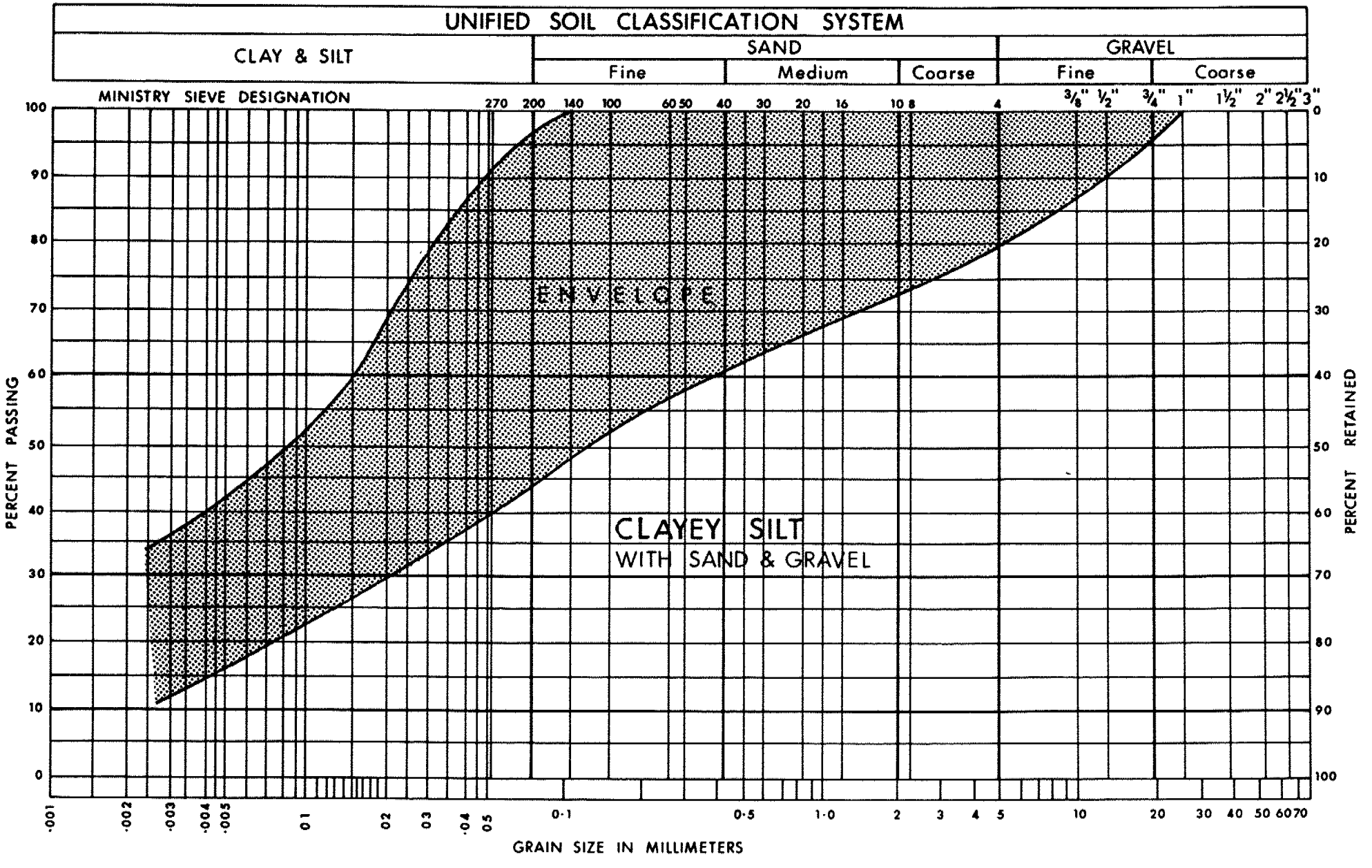


FIG. 2

W.O. 73-11108

GRAIN SIZE DISTRIBUTION

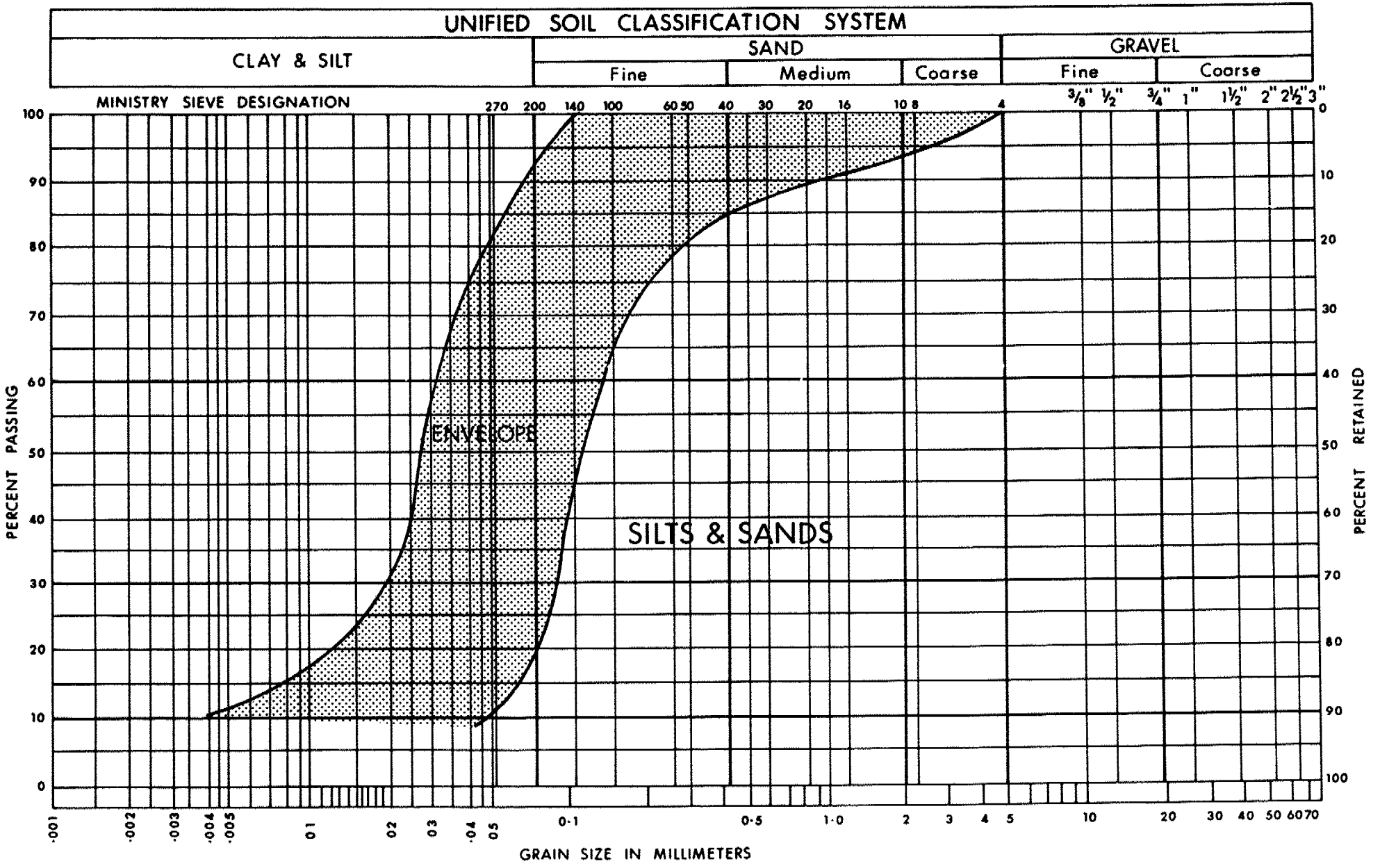


FIG. 3

W.O. 73 - 11108

GRAIN SIZE DISTRIBUTION

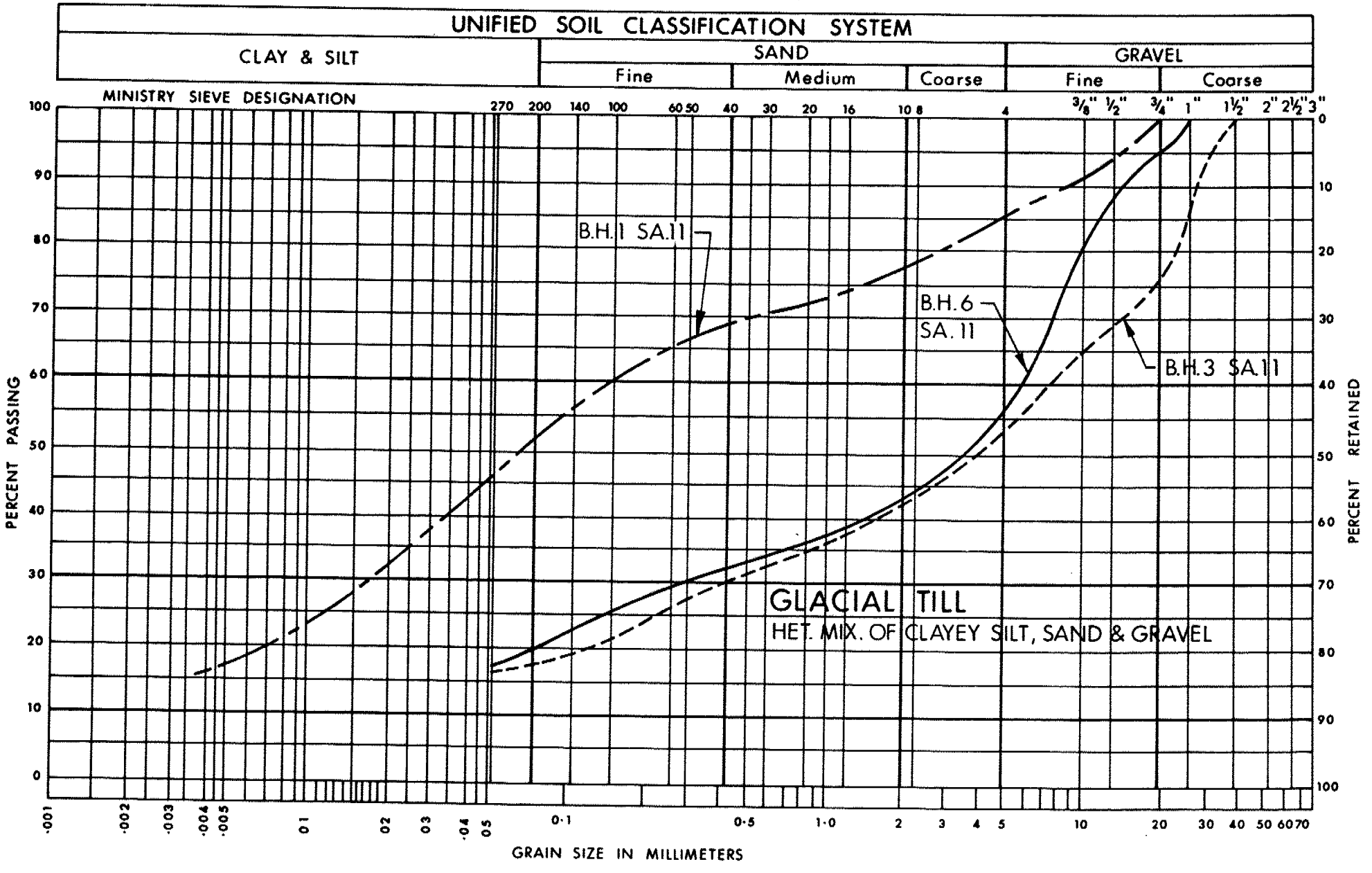


FIG. 4

W.O. 73-11108

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
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

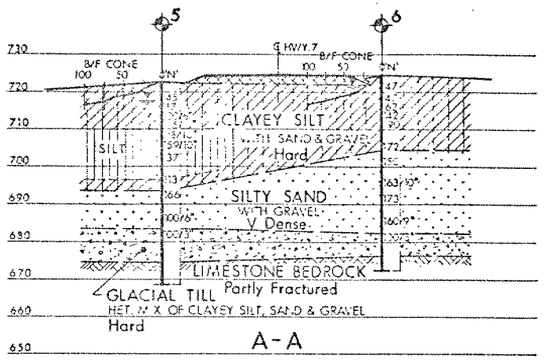
d	DISTANCE FROM TOP OF WALL TO POINT OF APPLICATION OF PRESSURE
δ	ANGLE OF WALL FRICTION
K	DIMENSIONLESS COEFFICIENT TO BE USED WITH VARIOUS SUFFIXES IN EXPRESSIONS REFERRING TO NORMAL STRESS ON WALLS
K_o	COEFFICIENT OF EARTH PRESSURE AT REST

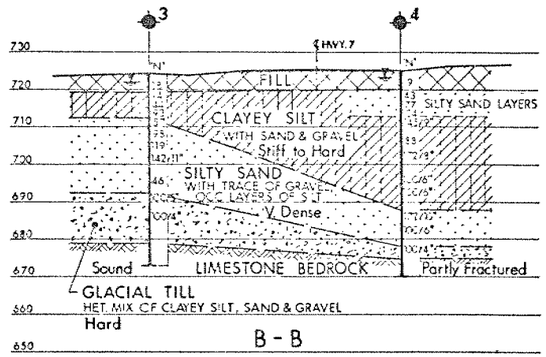
FOUNDATIONS

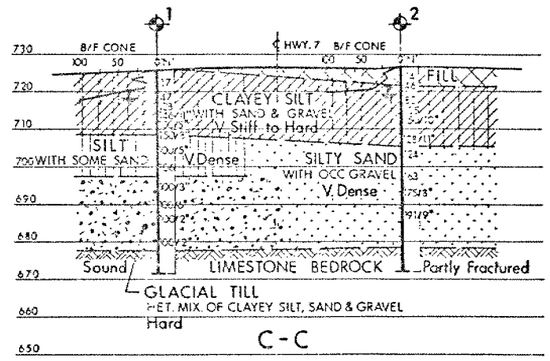
B	BREADTH OF FOUNDATION
L	LENGTH OF FOUNDATION
D	DEPTH OF FOUNDATION BENEATH GROUND
N	DIMENSIONLESS COEFFICIENT USED WITH A SUFFIX APPLYING TO SPECIFIC GRAVITY, DEPTH AND COHESION ETC. IN THE FORMULA FOR BEARING CAPACITY
k_s	MODULUS OF SUBGRADE REACTION

SLOPES

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



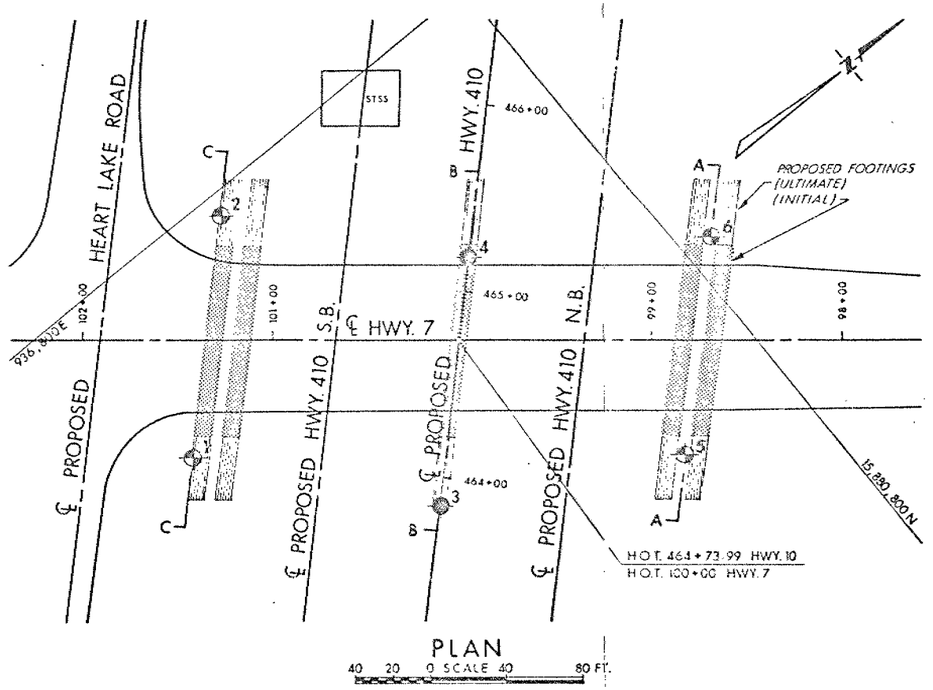




SECTIONS

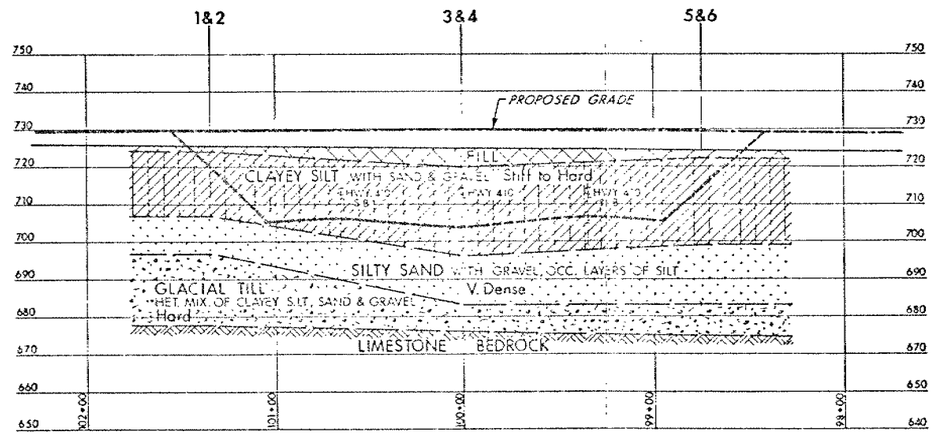
HORIZ. 40 20 0 SCALE 40 80 FT.

VERT. 20 10 0 20 40 FT.



PLAN

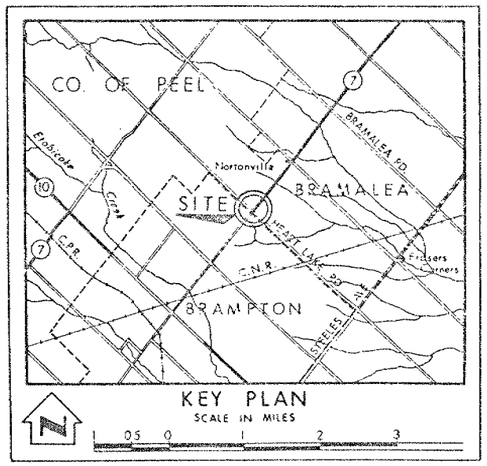
40 20 0 SCALE 40 80 FT.



PROFILE - HWY. 7

HORIZ. 40 20 0 SCALE 40 80 FT.

VERT. 20 10 0 20 40 FT.



KEY PLAN

SCALE IN MILES

0.5 0 1 2 3

LEGEND

- Bore Hole
- Cone Penetration Test
- Bore Hole & Cone Test
- Water Levels established at time of field investigation Jan & Feb. 1974

NO.	ELEVATION	CO-ORDINATES NORTH	CO-ORDINATES EAST
1	725.3	15,880,530	936,902
2	726.5	15,880,623	936,812
3	724.5	15,880,616	937,005
4	725.0	15,880,712	936,912
5	722.6	15,880,732	937,064
6	724.2	15,880,816	936,983

NOTE FOR CONTRACT DOCUMENT :
The complete foundation investigation report for this structure may be examined at the Structural Office and Foundations Office, Downsview, and at the TORONTO District Office.

— NOTE —

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

REVISIONS	DATE	BY	DESCRIPTION

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS—ONTARIO
ENGINEERING SERVICES BRANCH – GEOTECHNICAL OFFICE

HWY. 410 UNDERPASS AT HWY. 7

HIGHWAY NO. 410 DIST. NO. 6

CO. PEEL

TOWN OF BRAMPTON LOT CON

BORE HOLE LOCATIONS & SOIL STRATA

SUBMD V.K.	CHECKED	W.P. NO. 134-73-02	DRAWING NO. 73-11108 A
DRAWN S.R.	CHECKED	W.O. NO. 73-11108	
DATE FEB. 28, 1974		SITE NO.	BRIDGE DRAWING NO.
APPROVED		CONT NO.	

PHOTOTRACE 210-0-73