

MEMORANDUM

To: Mr. G. K. Hunter,
Regional Road Design Engineer,
Central Region (Toronto),
Central Building.

FROM: Foundation Section,
Materials & Testing Office,
Room 107, Lab. Bldg.

DATE: January 7, 1970

ATTENTION:

IN REPLY TO

OUR FILE REF.

SUBJECT:

FOUNDATION INVESTIGATION REPORT
For
Proposed Storm Sewer
Bartlett Avenue Revision
Twp. of N. Grimsby - Co. of Lincoln
District No. 4 (Hamilton)
W.J. 69-F-96 -- W.P. 370-65-07

Enclosed please find our complete foundation report for the above mentioned project.

We believe that factual information pertaining to subsoil conditions at the site, and recommendations regarding the design and construction of the storm sewer, contained within the report, should be sufficient for your purposes.

If additional information is required, or should the report require further clarification, please contact this Office.

AGS/WieF
Attach.

cc: Messrs. H. A. Tregaskes

B. R. Davis

D. W. Farren

G. K. Hunter (2)

H. Greenland (2)

W. C. Friedmann

T. J. Kovich

W. S. Melinyshyn

Foundation of Canada Engineering Corp. Ltd.

B. A. Singh

Foundations Files

Gen. Files

A. G. Sterner
A. G. Sterner
PRINCIPAL FOUNDATION ENGINEER

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FOUNDATION INVESTIGATION REPORT
For
Proposed Storm Sewer
Bartlett Avenue Revision
Twp. of N. Grimsby - Co. of Lincoln
District No. 4 (Hamilton)
W.J. 69-F-96 -- W.P. 370-65-07

1. INTRODUCTION:

The Foundation Section was requested to carry out a subsurface investigation along the alignment for the proposed sewer. The request was contained in a memo from Mr. T. J. Kovich, Regional Materials Engineer, Central Region, dated October 21, 1969. The plan and profile (Drawing No. 3553-3T-1) was provided by Mr. R. S. Adachi, Supervising Engineer - Highways, Foundation of Canada Engineering Corporation Limited (correspondence dated October 30, 1969). Subsequently, an investigation was carried out by this Section at the above site in order to determine the subsoil conditions. This report contains all the factual data, together with our recommendations pertaining to the installation of the storm trunk sewer.

2. DESCRIPTION OF THE SITE AND GEOLOGY:

The site is located both north and south of the Q.E.W. - C.N.R. complex in Grimsby Beach, Ontario. In this area the existing Q.E.W. is located in a 8 to 10 foot deep cut, while the C.N.R. tracks, located to the south of the highway, are founded on the top of an embankment, which extends about 6 feet above existing ground surface. A drainage ditch, whose invert is 10 feet below the elevation of the tracks, is located south of the C.N.R.

Across the site the topography varies from about elevation 272, in the northern extremities, to 308 in the southern portion - i.e., increases in elevation towards the south.

2. DESCRIPTION OF THE SITE AND GEOLOGY: (cont'd.) ...

The northern portion is located in a built-up area; the southern part, however, will be in an area presently being utilized as a fruit orchard.

Physiographically, the site is located in the "Niagara Fruit Belt" subsection of the "Irbquois Plain Physiographic Region". In this subsection a shallow mantle of silt and sand overlies shale bedrock of the Queenston Formation, Ordovician Period.

3. FIELD AND LABORATORY WORK:

A total of 19 boreholes, 4 of which were accompanied by a dynamic cone penetration test, was carried out at the site by means of a standard diamond drill rig adapted for soil sampling purposes. In addition, 9 boreholes, put down previously during the investigations for the Bartlett Avenue structure crossings of:

- i) the Q.E.W. (W.J. 69-F-12) and
- ii) the C.N.R. (L.J. 69-F-13)

are in close proximity to the sewer alignment. These are incorporated in this report.

Samples of the surficial deposits and, in some cases the weathered portion of the bedrock, were obtained by means of a 2-inch O.D. split-spoon sampler, which was hammered into the ground in accordance with the specifications for the Standard Penetration Test. The same method was used to advance the dynamic cone penetration tests. It was often necessary to advance the boreholes through the weathered portion of the bedrock by using a tricone bit. AXT or BXL size rock core samples were obtained in all the borings.

Surveying was carried out by personnel from the Central Region Engineering Surveys Section. The elevations given in this report are referenced to a Geodetic datum. The

3. FIELD AND LABORATORY WORK: (cont'd.) ...

locations and elevations of all the boreholes are shown on Drawing 69-F-96A, together with a centre-line profile along the proposed sewer alignment.

All samples were subjected to careful visual examination in the field and subsequently in the laboratory. Following this examination, the stratigraphical boundaries were established at each borehole location, as shown on the Record of Borelog sheets in the Appendix to this report.

4. SUBSOIL CONDITIONS:

4.1) General:

The surficial mantle across the site varies from fill composed of a firm to stiff clayey silt to a very loose to compact silty sand. The thickness of the surficial deposits ranges from 1.0 foot to a maximum of 9 feet at the C.N.R. embankment. These deposits are underlain by shale bedrock, the upper 3 to 23 feet of which is in a weathered condition.

From ground surface downwards the overburden and bedrock sequence is as follows.

4.2) Surficial Deposits - Fill Material and Silty Sand:

Fill was encountered in the northern portion of the alignment, as well as in the vicinity of the existing A.E.W. and C.N.R. complex. The thickness of the fill varies from 2 to 4 feet in the former area, and up to 9 feet in the latter. In the northern area the fill is composed of a firm to stiff ('N' values between 5 and 17 blows/ft.) clayey silt, with a trace of sand and organic matter. In the vicinity of the C.N.R. the fill is composed of a loose brown silty sand.

In the southern portion of the alignment the surficial mantle is composed of a very loose to compact ('N' values between 3 and 15 blows/ft.) silty sand with a trace of gravel. The thickness of this deposit varies from 1 to 4 feet.

4. SUBSOIL CONDITIONS: (cont'd.) ...

4.3) Shale Bedrock:

The surficial deposits are directly underlain by shale bedrock, the upper portion of which is in a weathered condition.

4.3.1) Upper Weathered Zone -

The zone of weathering extends for depths of between 3 and 23 feet below the surface of the bedrock; it is greatest between Station 31+00 and 34+00 - i.e., in the vicinity of the Q.E.W. and C.N.R. complex (refer to B.H.'s #4 to 9, inclusive). The weathered zone consists essentially of horizontally oriented shale fragments embedded in a clayey silt matrix, which has been derived by the "in-situ" weathering of the bedrock. Standard penetration resistance testing, carried out within this area, gave 'N' values which range from a low of 11 blows/ft. near the surface, increasing to as many as 100 blows per inch with depth, being on the average greater than 75 blows/ft.

4.3.2) Lower Sound Zone -

Sound shale bedrock was encountered at elevations between 264 (northern portion) and 303 (southern portion). The rock is reddish-brown in colour with grey seams and mottlings occurring randomly throughout. Occasional gypsum inclusions were observed in the shale.

The core recoveries, in general, range between 70 and 100 percent. The lower percentage recoveries occur within areas where the shale was relatively soft and was, therefore, subjected to grinding during the drilling operations.

5. GROUNDWATER CONDITIONS:

Groundwater level observations were carried out in the open boreholes upon completion of the field work. These observations are shown on the individual Borelog sheets as well as on Drawing 69-F-96A. The results of these readings indicate that the groundwater level varies from as high as elevation 302, in

5. GROUNDWATER CONDITIONS: (cont'd.) ...

the most southerly portion of the alignment, to elevation 264 in the most northerly. The phreatic surface so obtained closely parallels the existing ground surface - i.e., there is a seepage gradient extending from the high ground to the south towards the lower northern area. These elevations correspond to depths below ground surface of between 3 and 11 feet, in general, being closer to the surface in the southern area.

The aforementioned pattern indicates that the groundwater level across the site is, in general, located at or in close proximity to the point of transition between the weathered and sound zones of the shale. In two areas, however, namely:

- i) Station 28+00 to 34+00 (B.H.'s 1 to 9, inclusive); and
- ii) Station 37+00 to 41+00 (B.H.'s 37 to 40, inclusive)

the groundwater level is located within the weathered portion of the bedrock.

6. DISCUSSION AND RECOMMENDATIONS:

It is proposed to construct a storm sewer at the Bartlett Avenue Revision and Q.E.W. in the Town of Grimsby Beach. The sewer will consist of different diameter sizes ranging from 51 inches (south end) to 72 inches (north end) and the details are shown on Dwg. 62-F-96A. The invert elevation of the proposed sewer will be situated in the sound bedrock, except in limited areas at the contact of weathered and sound zones of the bedrock. At the time of writing this report, it is not known whether the sewer construction will be carried out by open cut methods or tunnelling through the bedrock. In view of these facts, the two methods of constructing the proposed sewer are discussed separately under the appropriate heading.

6. DISCUSSION AND RECOMMENDATIONS: (cont'd.) ...

6.1) General:

Subsoil over the site area consists of 1 to 9 ft. of overburden overlying shale bedrock, the upper 3 to 23 ft. of which is in a weathered condition. The overburden consists mainly of either fill material (firm to stiff clayey silt with a trace of sand and organic matter), or a deposit of loose to compact silty sand with traces of gravel.

The groundwater level is generally parallel to the existing ground surface and is located at or in close proximity to the point of transition between the weathered and sound zones of the shale. This indicates that there is a seepage gradient extending from the high ground to the south towards the lower northern area and eventually into the lake.

6.2) Sewer Constructed by Open Cut Within the Shale Bedrock:

If the roadway excavations for Bartlett Ave. are carried out prior to the installation of the storm sewer, it may be beneficial to adopt open cut construction methods. In this event, it may be necessary to protect the excavation sides within the weathered shale zones by means of suitably placed sheeting to comply with the Trench Excavators Act. It is possible that substantial quantities of water may enter the excavations, but it is believed that this water can be handled by pumping methods.

With regard to the pipe bedding, it is recommended that the current standards of the Department for Class 'B' Bedding and for Bedding on an Unyielding Foundation, be adhered to. Any granular material used for bedding should be of Granular Base Course Class 'A'.

6. DISCUSSION AND RECOMMENDATIONS: (cont'd.) ...

6.3) Sewer Constructed by Tunnelling Through the Bedrock:

If the sewer has to be constructed by tunnelling through the bedrock, the following comments should be noted:

The bedrock is shale, the upper 3 to 23 ft. of which is in a weathered condition. The weathered zone is relatively thicker between Sta. 31+00 and Sta. 34+00 - i.e., in the vicinity of the Q.E.W. and C.N.R. complex. The weathered shale consists essentially of horizontally oriented shale fragments embedded in a clayey silt matrix. Since the sewer will be constructed below the groundwater level, it may be necessary to lower the groundwater to a level below the tunnel base, or to construct the tunnel using air pressure greater than the prevailing hydrostatic pressure. This also applies to the construction of the manhole shafts. Contractors who consider using air pressure, should be advised that they would be responsible for determining the air pressure to be used, and also, that they would be responsible for preventing leakage through the large number of boreholes that have been drilled at the site.

7. MISCELLANEOUS:

The field work for this project was carried out during the period November 3 to 14, 1969, under the supervision of Mr. V. Korlu, Project Foundation Engineer, who also prepared this report.

The equipment used was owned and operated by P.V.K. & Sons.

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

January 1970

APPENDIX I

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No. 1 (BH 8, 69F-12) FOUNDATION SECTION

 JOB 69-F-96 LOCATION Co-ords: 692, 710N, 993, 666E
 W.P. 370-65-07 BORING DATE April 24, 1969
 DATUM Geodetic BOREHOLE TYPE Washboring - NX Casing; Cone

 ORIGINATED BY VK
 COMPILED BY WH & CM
 CHECKED BY

SOIL PROFILE		STRAT PLOT	SAMPLES		ELEV SCALE	DYNAMIC PENETRATION RESISTANCE					LIQUID LIMIT ——— w_L PLASTIC LIMIT ——— w_p WATER CONTENT ——— w			BULK DENSITY γ P C F	REMARKS		
ELEV DEPTH	DESCRIPTION		NUMBER	TYPE		BLOWS / FOOT	BLOWS / FOOT					SHEAR STRENGTH P S F				WATER CONTENT %	
							20	40	60	80	100	○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE					
292.1	Ground Level																
0.0	Topsoil & Fill																
289.1	Material		1	SS 150													
3.0	Weathered		2	SS 100/3"													
283.0			3	SS 100/1"													
9.1			4	AXT 82%	280												
			5	AXT 90%													
	Shale Bedrock		6	AXT 100%	270												
	Sound		7	AXT 100%													
258.1			8	AXT 100%	260												
34.0	End of Borehole																
					250												

 285.8
 Apr. 30/69

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No. 2 (Bh 6, 69F-12) FOUNDATION SECTION

JOB 69-F-96 LOCATION Co-ords; 692, 754 N, 993, 609 E ORIGINATED BY VK
 W.P. 370-65-07 BORING DATE April 29, 1969 COMPILED BY WH & CM
 DATUM Geodetic BOREHOLE TYPE Washboring - NX Casing; Cone CHECKED BY

SOIL PROFILE			SAMPLES			ELEV SCALE	DYNAMIC PENETRATION RESISTANCE					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		BLOWS / FOOT					SHEAR STRENGTH P.S.F.					WATER CONTENT %
							20	40	60	80	100	○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE					
293.8	Ground Level																
291.8	Topsoil & Fill Materl																
2.0	Weathered		1	SS	90	290											
			2	SS	100/6"												
284.6			3	SS	100/2"												
9.2	Shale Bedrock		4	AXT	83%	280											
			5	AXT	80%												
			6	AXT	100%	270											
			7	AXT	100%												
259.8			8	AXT	100%	260											
34.0	End of Borehole																

▼ 287.3
 Apr. 30/69

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No. 3 (Bh 74, 69F12 FOUNDATION SECTION)

JOB 69-F-96

LOCATION Co-ords; 692, 662N, 993, 641E

ORIGINATED BY VK

W.P. 370-65-07

BORING DATE April 23, 1969

COMPILED BY WH & CM

DATUM Geodetic

BOREHOLE TYPE Washboring - NX Casing

CHECKED BY *4/2*

SOIL PROFILE		STRAT. PLOT	SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE		LIQUID LIMIT ——— w_L		BULK DENSITY	REMARKS
ELEV. DEPTH	DESCRIPTION		NUMBER	TYPE	BLOWS / FOOT		BLOWS / FOOT	RESISTANCE	PLASTIC LIMIT ——— w_p	WATER CONTENT ——— w		
291.5	Ground Level											
0.0	Fill Material					290						
1.0	Weathered		1	SS 100/6"								289.1
			2	SS 100/3"								Apr. 30/69
282.3			3	SS 100/2"								
9.2	Shale Bedrock		4	AXT 50%		280						
	Sound		5	AXT 100%								
			6	AXT 100%		270						
262.5			7	AXT 100%								
29.0	End of Borehole					260						

SHEAR STRENGTH P.S.F.

○ UNCONFINED + FIELD VANE
● QUICK TRIAXIAL x LAB VANE

WATER CONTENT %
 w_p ——— w ——— w_L

P.C.F. GR. SA. SI. CL.

DEPARTMENT OF HIGHWAYS- ONTARIO

MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No. 4 (Bh 7, 69F12) FOUNDATION SECTION

JOB 69-F-96 LOCATION Co-ords; 692, 568N, 993, 610E ORIGINATED BY VK
 W.P. 370-65-07 BORING DATE April 22, 1969 COMPILED BY WH & CM
 DATUM Geodetic BOREHOLE TYPE Washboring - NX Casing CHECKED BY /

SOIL PROFILE		STRAT PLOT	SAMPLES		ELEV SCALE	DYNAMIC PENETRATION RESISTANCE		LIQUID LIMIT		BULK DENSITY	REMARKS
ELEV DEPTH	DESCRIPTION		NUMBER	TYPE		BLOWS/FOOT	BLOWS / FOOT	SHEAR STRENGTH PS F	PLASTIC LIMIT		
292.0	Ground Level										
0.0	Fill Material										
1.0	Weathered		1	SS 100/6"	290						288.7
			2	SS 100/5"							June 19/69
292.9			3	SS 100/1"							
	Shale Bedrock		4	BYL 81%	280						
	Sound		5	AXT 100%							
			6	AXT 100%	270						
263.0			7	AXT 100%							
29.0	End of Borehole				260						

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No. 5(Bh 5, 69F12) FOUNDATION SECTION

JOB 69-F-96

LOCATION Co-ords; 692, 582N, 993, 553E

ORIGINATED BY VK

W.P. 370-85-07

BORING DATE April 23, 1969

COMPILED BY WH & CM

DATUM Geodetic

BOREHOLE TYPE Washboring - NX Casing

CHECKED BY

SOIL PROFILE		STRAT PLOT	SAMPLES			ELEV SCALE	DYNAMIC PENETRATION RESISTANCE		LIQUID LIMIT		BULK DENSITY	REMARKS
ELEV DEPTH	DESCRIPTION		NUMBER	TYPE	BLOWS / FOOT		BLOWS / FOOT	SHEAR STRENGTH P S F	PLASTIC LIMIT	WATER CONTENT		
291.3	Ground Level											
289.0	Fill Material	X	1	SS	100/6"	290						289.3 Apr. 30/69
2.3	Weathered		2	SS	100/5"							
281.3			3	SS	100/2"							
10.0	Shale Bedrock		4	BXL	90%	280						
	Sound		5	BXL	90%							
			6	BXL	40%	270						
261.3			7	BXL	100%							
30.0	End of Borehole					260						

RECORD OF BOREHOLE No. 6 (BH6, 69F-13) FOUNDATION SECTION

ORIGINATED BY VK

COMPILED BY CM

CHECKED BY *[Signature]*

SOIL PROFILE			SAMPLES			ELEV SCALE	DYNAMIC PENETRATION RESISTANCE	Liquid Limit ———— w_L	BULK DENSITY	REMARKS	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	BLOWS / FOOT		BLOWS / FOOT	PLASTIC LIMIT ———— w_p			WATER CONTENT ———— w
							20 40 60 80 100	SHEAR STRENGTH PSF			WATER CONTENT %
							○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB. VANE	w_p ———— w ———— w_L			
303.0	Ground Level										
0.0	Fill Material		1	SS	12	300					
295.5	Loose Brown		2	SS	4						
7.5			3	SS	100/6"						
			4	SS	70	290					
	Weathered		5	SS	100/4"						
			6	SS	100/5"						
277.9			7	SS	100/1"	280					
255.1											
	Shale Bedrock		8	BXL	82%						
			9	BXL	100%	270					
	Sound										
263.0			10	BXL	100%						
40.0	End of Borehole					260					

RECORD OF BOREHOLE No. 7 (Bh 8, 69F-13) FOUNDATION SECTION

SOIL PROFILE		STRAT PLOT	SAMPLES			ELEV SCALE	DYNAMIC PENETRATION RESISTANCE	LQUID LIMIT ——— w _L	BULK DENSITY	REMARKS	
ELEV DEPTH	DESCRIPTION		NUMBER	TYPE	BLOWS / FOOT		BLOWS / FOOT	PLASTIC LIMIT ——— w _p			WATER CONTENT ——— w
							20 40 60 80 100				
						SHEAR STRENGTH PSF		w _p ——— w _L			
						○ UNCONFINED + FIELD VANE					
						● QUICK TRIAXIAL x LAB. VANE					
								WATER CONTENT %			
304.2	Ground Level										
0.0	Fill Material										
	Sand with trace silt & gravel		1	SS	5	300					
			2	SS	5						
295.0	Loose Brown		3	SS	150						
9.2			4	SS	100/6"						
	Weathered		5	SS	100/4"	290					
	Shale Bedrock		6	SS	100/3"						
279.1			7	SS	100/1"	280					
25.1											
274.2	Sound		8	BXL	60%						
30.0	End of Borehole					290					

DEPARTMENT OF HIGHWAYS- ONTARIO
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No. 8 (Bh 7, 69P-13) FOUNDATION SECTION


JOB 69-F-96 LOCATION Co-ords; 692, 325N, 993, 529E ORIGINATED BY VK
W.P. 370-65-07 BORING DATE April 16, 1969 COMPILED BY CM
DATUM Geodetic BOREHOLE TYPE Washboring, NX Casing, Cone CHECKED BY

SOIL PROFILE		STRAT PLOT	SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE					LIQUID LIMIT ——— w_L PLASTIC LIMIT ——— w_P WATER CONTENT ——— w			BULK DENSITY γ P.C.F.	REMARKS	
ELEV. DEPTH	DESCRIPTION		NUMBER	TYPE	BLOWS/FOOT		BLOWS / FOOT					SHEAR STRENGTH P.S.F.					WATER CONTENT %
							20	40	60	80	100	○ UNCONFINED	+ FIELD VANE	● QUICK TRIAXIAL			
299.0	Ground Level																
0.0	Topsoil														DR. SA. SI. CL.		
296.0																	
3.0	Shale Bedrock Weathered		1	SS	38										▼ 294.0		
			2	SS	126												
			3	SS	100/6"	290											
			4	SS	100/4"												
			5	SS	100/4"												
			6	SS	100/6"	280											
			7	SS	100/3"												
268.9			8	SS	100/1"	270											
30.1	End of Borehole																
						260											

294.0

RECORD OF BOREHOLE No. 9 (3h 5, 69F-13) FOUNDATION SECTION

JOB	69-F-96	LOCATION	Co-ords; 692, 343N, 993, 473 E	ORIGINATED BY	VK
W.P.	370-65-07	BORING DATE	April 14, 1969	COMPILED BY	WH & CM
DATUM	Geodetic	BOREHOLE TYPE	Washboring NX Casing; Cone	CHECKED BY	

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE		LIQUID LIMIT ——— w_L		BULK DENSITY	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FOOT		BLOWS / FOOT	RESISTANCE	PLASTIC LIMIT ——— w_p	WATER CONTENT ——— w		
300.0	Ground Level						20 40 60 80 100					
0.0	Topsoil											
297.0			1	SS	59							
			2	SS	100/6"							
			3	SS	100/4"	290						
			4	SS	122/10"							
			5	SS	100/5"							
			6	SS	100/2"	280						
			7	SS	100/2"							
273.0			8	BXL	25%							
27.0	Shale Bedrock		9	BXL	80%	270						
	Sound		10	BXL	25%							
261.0		11	BXL	100%								
39.0	End of Borehole				260							

FOUNDATION SECTION

ORIGINATED BY VIC

COMPILED BY GHS

CHECKED BY *[Signature]*


SOIL PROFILE			SAMPLES			DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT		LIQUID LIMIT ——— w_L PLASTIC LIMIT ——— w_p WATER CONTENT ——— w		BULK DENSITY γ P.C.F.	REMARKS
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	BLOWS / FOOT	ELEV SCALE	SHEAR STRENGTH PS F ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE	WATER CONTENT % w_p ——— w ——— w_L			
272.1	Ground Level										
0.0	Fill Material: (Clayey, silt with some sand & tr. gravel) Stiff-Hard	X	1	SS	12	270					
268.1		X	2	SS	52						
4.0	Shale Bedrock										
264.1	Weathered		3	BXL	98%						
8.0				RC	Rec						
261.1	Sound		4	BXL	100%						
11.0	End of Borehole					260					

FOUNDATION SECTION

ORIGINATED BY: VK

COMPILED BY CJ

CHECKED BY *[Signature]*

SOIL PROFILE		STRAT PLOT	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		NUMBER	TYPE	BLOWS / FOOT		SHEAR STRENGTH P.S.F. ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE		WATER CONTENT % w_p ——— w ——— w_L					
274.5	Ground Level													
271.5	Fill Material		1	SS	17	270								
3.0	Shale Bedrock Weathered		2	SS	120									
6.5			3	BXL RC	80% Rec									
264.0	Sound		4	BXL	95%								W.L. 266.0	
10.5	End of Borehole					260								

DEPARTMENT OF HIGHWAYS - ONTARIO		RECORD OF BOREHOLE No. 19		FOUNDATION SECTION	
MATERIALS & TESTING OFFICE					
JOB	69-F-96	LOCATION	Co-ords; 693, 716N, 993, 911 E	ORIGINATED BY	VK
W.P.	370-65-07	BORING DATE	November 13, 1969	COMPILED BY	CM
DATUM	Geodetic	BOREHOLE TYPE	Washboring - BX Casing	CHECKED BY	<i>[Signature]</i>

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. PLT	NUMBER	TYPE	BLOWS / FOOT		SHEAR STRENGTH P.S.F. ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE		WATER CONTENT %			
276.9	Ground Level											
274.9	Fill Material	X	1	SS	15							
270.0	Shale Bedrock	X	2	SS	34							
	Weathered		3	SS	130							
	(upper 2' extensively weathered)		4	BXL RC	90% Rec	270						
267.9				BXL								
10.0	Sound		5	RC	100%							
263.9												
13.0	End of Borehole					260						

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No. 20

FOUNDATION SECTION

JOB 69-F-96

LOCATION

Co-ords; 693, 621N, 993, 879E

ORIGINATED BY

VK

W.P. 370-65-07

BORING DATE

November 13, 1969

COMPILED BY

CM

DATUM Geodetic

BOREHOLE TYPE Washboring - BK Casing

CHECKED BY

W.A.

SOIL PROFILE		STRAT. PL. OT	SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE		LIQUID LIMIT		BULK DENSITY	REMARKS	
ELEV. DEPTH	DESCRIPTION		NUMBER	TYPE	BLOWS / FOOT		BLOWS / FOOT	PLASTIC LIMIT	WATER CONTENT	W _L			W _P
279.5	Ground Level						SHEAR STRENGTH PSF		WATER CONTENT %				
							○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB. VANE						
277.5	Fill Material	⊗	1	SS	5	270					P.C.F. Y	GR. SA. SI. CL.	
	<u>Weathered</u>	⊗	2	SS	11								
	(upper 2' extensively weathered)	⊗	3	SS	156								
271.5					BXL 95%								
8.0	Shale Bedrock		4	RC	Rec	260						W.L. 270.5	
	<u>Sound</u>												
264.0	(occ. weathered zones to elev. 266.0)		5	BXL 100% RC Rec									
15.5	End of Borehole					260							

DEPARTMENT OF HIGHWAYS - ONTARIO

MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No. 21

FOUNDATION SECTION

JOB 69-F-96

LOCATION Co-ords: 693, 520N, 993, 865E

ORIGINATED BY

VK

W.P. 370-65-07

BORING DATE November 13, 1969

COMPILED BY

CM

DATUM Geodetic

BOREHOLE TYPE Washboring, BX Casing

CHECKED BY

LA

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.		w_p ——— w ——— w_L WATER CONTENT %					
282.2	Ground Level													
0.0	Topsoil		1	SS	12	280							GR. SA. SI. CL.	
1.0	Weathered (upper 3' extensively weathered, with some sand and trace of gravel)		2	SS	90									
273.2			3	BXL 95% RC Rec		270								W.L. 271.2
9.0	Shale Bedrock Sound (occ. weathered zones)		4	BXL 100% RC Rec										
266.2														
15.0	End of Borehole					260								


DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No. 22

FOUNDATION SECTION

JOB 69-F-96 LOCATION Co-ords; 693, 427N 993, 840E
 W.P. 370-65-07 BORING DATE November 13, 1969
 DATUM Geodetic BOREHOLE TYPE Washboring - BX Casing

ORIGINATED BY VK
 COMPILED BY CM
 CHECKED BY AR

SOIL PROFILE		STRAT PLOT	SAMPLES		ELEV SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT	LIQUID LIMIT ——— w_L PLASTIC LIMIT ——— w_p WATER CONTENT ——— w		BULK DENSITY γ P.C.I.	REMARKS	
ELEV DEPTH	DESCRIPTION		NUMBER	TYPE			BLOWS / FOOT	SHEAR STRENGTH — PS F ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE			WATER CONTENT %
283.5	Ground Level		1	SS	12	280				W.L. = 273.0	
0.0	Topsoil										
1.0	Weathered (upper 3' extensively weathered with trace of roots)		2	SS	81						
275.5			3	BXL 90% RC Rec							
8.0	Shale Bedrock		4	BXL 100% RC Rec		270					
268.5	Sound										
15.0	End of Borehole										
						260					

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No. 23

FOUNDATION SECTION

JOB 69-F-96

LOCATION

Co-ords: 693, 326N, 993, 812E

ORIGINATED BY

VK

W.P. 370-65-07

BORING DATE

November 12, 1969

COMPILED BY

CM

DATUM Geodetic

BOREHOLE TYPE

Washboring, BX Casing

CHECKED BY

JF

SOIL PROFILE			SAMPLES		ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE		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 ± 5 F.		WATER CONTENT %			
282.7	Ground Level						<input type="radio"/> UNCONFINED + FIELD VANE <input checked="" type="radio"/> QUICK TRIAXIAL x LAB VANE					
0.0	Topsoil	OK	1	SS	13	280						GR. SA. SI. CL.
1.0	Weathered (upper 4' extensively weathered with trace roots)		2	SS	121							
275.0			3	BXL 98% RC Rec								
7.7	Shale Bedrock <u>Sound</u>		4	BXL 100% RC Rec								
268.7						270						W.L. 275.2
14.0	End of Borehole											
						260						

W.L.
275.2

FOUNDATION SECTION

ORIGINATED BY VK
COMPILED BY CM
CHECKED BY

SOIL PROFILE		STRAT. PT.	SAMPLES		ELEV. SCALE	DYNAMIC PENETRATION BLOWS / FOOT	RESISTANCE	LIQUID LIMIT ——— w_L PLASTIC LIMIT ——— w_p WATER CONTENT ——— w * w_p ——— w ——— w_L WATER CONTENT %	BULK DENSITY Y P.C.F.	REMARKS
ELEV. DEPTH	DESCRIPTION		NUMBER	TYPE						
282.4	Ground Level									
0.0	Topsoll	X	1	SS	10	280				W.L. 274.4
1.0	Weathered (upper 1' extensively weathered with trace of roots)		2	SS	123					
275.4	Shale Bedrock		3	BXL RC	95% Rec					
7.0	Sound		4	BXL RC	98% Rec					
269.4	(occ. weathered zones)									
13.0	End of Borehole									
						260				

FOUNDATION SECTION

VK

CM

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 Y P.C.F.	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLT.	NUMBER	TYPE	BLOWS / FOOT		SHEAR STRENGTH P.S.F. ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE		WATER CONTENT % w _o w _p L _p				
287.3	Ground Level												
0.0	Top Soil		1	SS	13								
1.0	Weathered		2	SS	89								
281.3	(upper 2' extensively weathered)		3	BXL RC	95% Rec	280							
6.0	Shale bedrock												
	Sound												
	(Occ. weathered zones throughout)		4	RC	Rec								
268.3			5	BXL RC	100% Rec	270							
19.0	End of Borehole					260							

DEPARTMENT OF HIGHWAYS- ONTARIO
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No. 27

FOUNDATION SECTION

JOB 69-F-96

LOCATION

Co-ords: 692, 941N, 993, 705E

ORIGINATED BY

VK

W.P. 370-65-07

BORING DATE

November 10, 1969

COMPILED BY

CM

DATUM Geodetic

BOREHOLE TYPE

Washboring, BX Casing

CHECKED BY

VK

SOIL PROFILE		STRAT. PLT	SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE		LIQUID LIMIT w_L PLASTIC LIMIT w_p WATER CONTENT w		BULK DENSITY Y P.C.F.	REMARKS
ELEV. DEPTH	DESCRIPTION		NUMBER	TYPE	BLOWS / FOOT		SHEAR STRENGTH P.S.F.		w_p w w_L WATER CONTENT %			
290.3	Ground Level											
0.0	Topsoil		1	SS	7	290						
1.0	Weathered (upper 3' extensively weathered with trace of sand & gravel)		2	SS	45							
			3	SS	179							
280.3			4	BXL 98% RC Rec								
10.0	Shale Bedrock Sound (occ. weathered zones to elev 271)		5	BXL 100% RC Rec		280						
			6	BXL 100% RC Rec								
266.3			7	BXL 100% RC Rec		270						
24.0	End of Borehole											
						260						

W.L.
280.8

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No. 34

FOUNDATION SECTION

JOB	69-F-96	LOCATION	Co-ords; 692, 276N, 993, 486E
W.P.	370-65-07	BORING DATE	November 3, 1969
DATUM	Geodetic	BOREHOLE TYPE	Washboring - BX Casing; Cone

ORIGINATED BY VK
COMPILED BY CM
CHECKED BY

[illegible]

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No. 35

FOUNDATION SECTION

JOB 69-F-96 LOCATION Co-ords: 692, 182N 993, 453E
 W.P. 370-65-07 BORING DATE November 4, 1969
 DATUM Geodetic BOREHOLE TYPE Washboring, BX Casing; cone

ORIGINATED BY VK
 COMPILED BY CM
 CHECKED BY

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE					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		BLOWS/FOOT					SHEAR STRENGTH P.S.F.					WATER CONTENT % w_p — w — w_L
							20	40	60	80	100	○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB. VANE					
302.0	Ground Level																
0.0	Silty sand with trace gravel V. Loose-Compt.	...	1	SS	3	300									Elev. 294.5		
298.0		...	2	SS	12												
4.0	Weathered (upper 2' extensively weathered)	...	3	SS	17												
294.0		...	4	BXL	50%												
8.0	Shale Bedrock Sound (occ. weathered zones throughout)	...	5	RC	Rec	290											
			6	BXL	85% RC Rec												
				BXL	90%												
289.0			7	RC	Rec	280											
23.0	End of Borehole					270											

Elev.
294.5

DEPARTMENT OF HIGHWAYS- ONTARIO
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No. 36

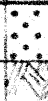
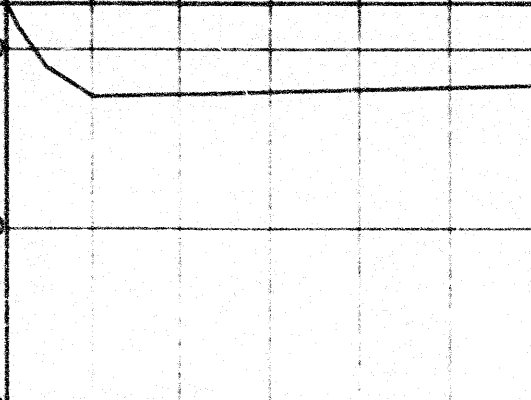
FOUNDATION SECTION

JOB 69-F-96 LOCATION Co-ords: 692, 087N, 993, 420E
 W.P. 370-65-07 BORING DATE November 5, 1969
 DATUM Geodetic BOREHOLE TYPE Washboring, BX Casing; Cone

ORIGINATED BY VK

COMPILED BY CM

CHECKED BY /

SOIL PROFILE			SAMPLES			ELEV SCALE	DYNAMIC PENETRATION RESISTANCE					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		BLOWS / FOOT	20	40	60	80	100	SHEAR STRENGTH PS F ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB. VANE				WATER CONTENT % w_p ——— w ——— w_L
302.1	Ground Level																
0.0	Silty sand		1	SS	3												
299.1	V. Loose - Loose		2	SS	7												
3.0	Weathered		3	SS	173												
296.6			4	BXL	98%												
5.5	Shale Bedrock				BXL		100%										
	Sound		5	RC	Rec												
	(occ. weathered zones throughout; fractured below elev. 285)		6	BXL	100%												
				RC	Rec												
				BXL	100%												
280.1			7	RC	Rec												
22.0	End of Borehole																

W.I.
295.6

FOUNDATION SECTION

VK

CM

CHECKED BY

SOIL PROFILE		STRAT PLOT	SAMPLES			ELEV SCALE	DYNAMIC PENETRATION RESISTANCE		LIQUID LIMIT		BULK DENSITY	REMARKS	
ELEV DEPTH	DESCRIPTION		NUMBER	TYPE	BLOWS/FOOT		BLOWS / FOOT	20	40	60			80
300.5	Ground Level												
298.0	Silty sand Loose	•••	1	SS	10	300							
2.5	Extensively weathered	▨ ▨ ▨	2	SS	65								
4.0	Shale Bedrock Sound (occ. weathered zones throughout)		3	BXL RC	100% Rec	290							
283.5			4	BXL RC	100% Rec								
17.0	End of Borehole		5	BXL	67%	280							

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No. 38

FOUNDATION SECTION

JOB 69-P-96

LOCATION

Co-ords: 691, 900N, 993, 352E

ORIGINATED BY

VK

W.P. 370-65-07

BORING DATE

November 7, 1969

COMPILED BY

CM


DATUM Geodetic

BOREHOLE TYPE

Washboring - BX Casing

CHECKED BY

LH

SOIL PROFILE		STRAT PLOT	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		NUMBER	TYPE	BLOWS / FOOT		SHEAR STRENGTH P S F. ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE				w_p ——— w ——— w_L WATER CONTENT %				
300.7	Ground Level														
0.0	Silty sand with		1	CS	-	300									WL 296.2
297.7	tr. gravel & clay		2	CS	-										
3.0	Shale Bedrock			BXL											
	Weathered		3	RC	50%										
	(upper 2' extensively weathered)		4	BXL	80%										
11.0	Sound			BXL	100%	290									
285.7			5	RC	Rec.										
15.0	End of Borehole					280									

WL
296.2

FOUNDATION SECTION

ORIGINATED BY VK

COMPILED BY CM

CHECKED BY *[Signature]*

SOIL PROFILE			SAMPLES			ELEV SCALE	DYNAMIC PENETRATION RESISTANCE		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 + FIELD VANE ● QUICK TRIAXIAL x LAB. VANE		WATER CONTENT % w_p ——— w ——— w_L			
301.1	Ground Level											
0.0	Shale Bedrock <u>Weathered</u> (upper 4' extensively weathered)					300						
291.1			1	RC	Rec							
10.0												
288.1	<u>Sound</u>		2	RC	Rec	290						
13.0	End of Borehole		3	BXL	95%							
						260						

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No. 40

FOUNDATION SECTION

JOB 69-F-96

LOCATION

Co-ords. 691, 711N, 993, 284E

ORIGINATED BY

VK

W.P. 370-65-07

BORING DATE

November 10, 1969

COMPILED BY

CM

DATUM Geodetic

BOREHOLE TYPE

Washboring - BX Casing

CHECKED BY

✓

SOIL PROFILE		STRAT PLOT	SAMPLES		ELEV SCALE	DYNAMIC PENETRATION RESISTANCE		LIQUID LIMIT ——— w_L		BULK DENSITY	REMARKS
ELEV DEPTH	DESCRIPTION		NUMBER	TYPE		BLOWS / FOOT	SHEAR STRENGTH PSF	PLASTIC LIMIT ——— w_p	WATER CONTENT ——— w		
303.5	Ground Level						○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB. VANE				
0.0	Silty Sand-Loose-Comp.		1	SS		9					
300.5	occ. cl. silt seams		2	SS		26					
298.0	Weathered		3	BXL		95%					
5.5	Shale Bedrock sound		4	BXL		100%					
290.5	(occ. Fractured zones)		5	BXL		100%					
				RC		Rec					
19.0	End of Borehole										

P.C.F. GR. SA. SI. CL.

W.L.
299.5

SOIL PROFILE			SAMPLES			ELEV SCALE	DYNAMIC PENETRATION RESISTANCE		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 + FIELD VANE ● QUICK TRIAXIAL x LAB. VANE		WATER CONTENT % w_p ——— w ——— w_L			
305.8	Ground Level											
303.3	Silty sand. Loose	...	1	SS	7	300						W.L. 300.8
302.5			2	SS	24							
300.8	Weathered			BXL	98%							
5.0	Shale Bedrock Sound (occ. weathered & fractured zones throughout)		3	RC	Rec							
292.8				BXL	98%	290						
13.0	End of Borehole		4	RC	Rec							

FOUNDATION SECTION

JOB	69-F-96	LOCATION	Coords: 691, 525N 993, 211E	ORIGINATED BY	VK
W.P.	370-65-07	BORING DATE	November 7, 1969	COMPILED BY	OM
DATUM	Geodetic	BOREHOLE TYPE	Washboring, BX Casing	CHECKED BY	/

SOIL PROFILE			SAMPLES			ELEV SCALE	DYNAMIC PENETRATION RESISTANCE		LIQUID LIMIT ——— w_L		BULK DENSITY	REMARKS
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	BLOWS/FOOT		BLOWS/FOOT	BLANK	PLASTIC LIMIT ——— w_p	WATER CONTENT ——— w		
307.1	Ground Level											
0.0	Silty Sand - Loose	•••••	1	SS	6							
304.1	Extensively weathered	▨▨▨▨▨	2	SS	7							
3.0	Shale bedrock											
4.5	Sound											
297.6	(occ. weathered zones)		3	BXL RC	100% Rec	300						
9.5	End of Borehole											
						290						

ABBREVIATIONS USED IN THIS REPORT

PENETRATION RESISTANCE

STANDARD PENETRATION RESISTANCE 'N' - THE NUMBER OF BLOWS REQUIRED TO ADVANCE A STANDARD SPLIT SPOON SAMPLER 12 INCHES INTO THE SUBSOIL, DRIVEN BY MEANS OF A 140 POUND HAMMER FALLING FREELY A DISTANCE OF 30 INCHES.

DYNAMIC PENETRATION RESISTANCE - THE NUMBER OF BLOWS REQUIRED TO ADVANCE A 2 INCH, 60 DEGREE CONE, FITTED TO THE END OF DRILL RODS, 12 INCHES INTO THE SUBSOIL. THE DRIVING ENERGY BEING 350 FOOT POUNDS PER BLOW.

DESCRIPTION OF SOIL

THE CONSISTENCY OF COHESIVE SOILS AND THE RELATIVE DENSITY OR DENSENESS OF COHESIONLESS SOILS ARE DESCRIBED IN THE FOLLOWING TERMS:-

<u>CONSISTENCY</u>	<u>'N' BLOWS/FT.</u>	<u>c LB./ SQ. FT.</u>	<u>DENSENESS</u>	<u>'N' BLOWS/ FT.</u>
VERY SOFT	0 - 2	0 - 250	VERY LOOSE	0 - 4
SOFT	2 - 4	250 - 500	LOOSE	4 - 10
FIRM	4 - 8	500 - 1000	COMPACT	10 - 30
STIFF	8 - 15	1000 - 2000	DENSE	30 - 50
VERY STIFF	15 - 30	2000 - 4000	VERY DENSE	> 50
HARD	> 30	> 4000		

TYPE OF SAMPLE

S.S.	SPLIT SPOON	T.W.	THINWALL OPEN
W.S.	WASHED SAMPLE	T.P.	THINWALL PISTON
S.B.	SCRAPER BUCKET SAMPLE	O.S.	OESTERBERG SAMPLE
A.S.	AUGER SAMPLE	F.S.	FOIL SAMPLE
C.S.	CHUNK SAMPLE	R.C.	ROCK CORE
S.T.	SLOTTED TUBE SAMPLE		
	P.H. SAMPLE ADVANCED HYDRAULICALLY		
	P.M. SAMPLE ADVANCED MANUALLY		

SOIL TESTS

Q _u	UNCONFINED COMPRESSION	L.V.	LABORATORY VANE
Q	UNDRAINED TRIAXIAL	F.V.	FIELD VANE
Q _{cu}	CONSOLIDATED UNDRAINED TRIAXIAL	C	CONSOLIDATION
Q _d	DRAINED TRIAXIAL	S	SENSITIVITY

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

EARTH PRESSURE

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

FOUNDATIONS

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

SLOPES

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

69-F-96

W.P. 370-65-07

Q.E.W. (REVISION)

BARTLETT AVE. REVISION

STORM SEWER.