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DIST. 6 REGION

W.P. No. 21-79-07

CONT. No. 86-86

W. O. No.

STR. SITE No. 24-145-474

HWY. No. 416

LOCATION Williams Parkway
Underpass

No of PAGES -

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OVERSIZE DRAWINGS TO BE INCLUDED WITH THIS REPORT.

REMARKS:

RETURN TO FILE

W.P. 21-79-07

FOUNDATION DESIGN SECTION

FOUNDATION INVESTIGATION REPORT

CONTRACT NO 86 - 80



Ontario

Ministry of
Transportation and
Communications

I N D E X

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3 - 47	Foundation Investigation Report for Williams Parkway Underpass W. P. 21-79-07, Site: 24-145-474 Hwy. 410, District #6, Toronto and Francheschini (Private) Drive U'Pass W. P. 21-79-08, Site: 24-145-473 Hwy. 410, District #6, Toronto

NOTE: FOR PURPOSES OF THIS CONTRACT, THIS REPORT SUPERSEDES ALL
OTHER FOUNDATION REPORTS PREPARED BY OR FOR THE MINISTRY IN
CONNECTION WITH THE ABOVE-MENTIONED PROJECTS.

EXPLANATION OF TERMS USED IN REPORT

2

N VALUE: THE STANDARD PENETRATION TEST (SPT) N VALUE IS THE NUMBER OF BLOWS REQUIRED TO CAUSE A STANDARD 51mm O.D. SPLIT BARREL SAMPLER TO PENETRATE 0.3m INTO UNDISTURBED GROUND IN A BOREHOLE WHEN DRIVEN BY A HAMMER WITH A MASS OF 63.5kg, FALLING FREELY A DISTANCE OF 0.76m. FOR PENETRATIONS OF LESS THAN 0.3m N VALUES ARE INDICATED AS THE NUMBER OF BLOWS FOR THE PENETRATION ACHIEVED. AVERAGE N VALUE IS DENOTED THUS \bar{N} .

DYNAMIC CONE PENETRATION TEST: CONTINUOUS PENETRATION OF A CONICAL STEEL POINT (51mm O.D. 60° CONE ANGLE) DRIVEN BY 475 J IMPACT ENERGY ON 'A' SIZE DRILL RODS. THE RESISTANCE TO CONE PENETRATION IS MEASURED AS THE NUMBER OF BLOWS FOR EACH 0.3m ADVANCE OF THE CONICAL POINT INTO THE UNDISTURBED GROUND.

SOILS ARE DESCRIBED BY THEIR COMPOSITION AND CONSISTENCY OR DENSENESS.

CONSISTENCY: COHESIVE SOILS ARE DESCRIBED ON THE BASIS OF THEIR UNDRAINED SHEAR STRENGTH (c_u) AS FOLLOWS:

c_u (kPa)	0 - 12	12 - 25	25 - 50	50 - 100	100 - 200	> 200
	VERY SOFT	SOFT	FIRM	STIFF	VERY STIFF	HARD

DENSENESS: COHESIONLESS SOILS ARE DESCRIBED ON THE BASIS OF DENSENESS AS INDICATED BY SPT N VALUES AS FOLLOWS:

N (BLOWS/0.3m)	0 - 5	5 - 10	10 - 30	30 - 50	> 50
	VERY LOOSE	LOOSE	COMPACT	DENSE	VERY DENSE

ROCKS ARE DESCRIBED BY THEIR COMPOSITION AND STRUCTURAL FEATURES AND/OR STRENGTH.

RECOVERY: SUM OF ALL RECOVERED ROCK CORE PIECES FROM A CORING RUN EXPRESSED AS A PERCENT OF THE TOTAL LENGTH OF THE CORING RUN.

MODIFIED RECOVERY: SUM OF THOSE INTACT CORE PIECES, 100mm+ IN LENGTH EXPRESSED AS A PERCENT OF THE LENGTH OF THE CORING RUN. THE ROCK QUALITY DESIGNATION (RQD), FOR MODIFIED RECOVERY, IS:

RQD (%)	0 - 25	25 - 50	50 - 75	75 - 90	90 - 100
	VERY POOR	POOR	FAIR	GOOD	EXCELLENT

JOINTING AND BEDDING:

	SPACING	50mm	50 - 300mm	0.3m - 1m	1m - 3m	> 3m
JOINTING		VERY CLOSE	CLOSE	MOD. CLOSE	WIDE	VERY WIDE
BEDDING		VERY THIN	THIN	MEDIUM	THICK	VERY THICK

ABBREVIATIONS AND SYMBOLS

FIELD SAMPLING

SS	SPLIT SPOON	TP	THINWALL PISTON
WS	WASH SAMPLE	OS	OSTERBERG SAMPLE
ST	SLOTTED TUBE SAMPLE	RC	ROCK CORE
BS	BLOCK SAMPLE	PH	TW ADVANCED HYDRAULICALLY
CS	CHUNK SAMPLE	PM	TW ADVANCED MANUALLY
TW	THINWALL OPEN	FS	FOIL SAMPLE

STRESS AND STRAIN

u_w	kPa	PORE WATER PRESSURE
r_u	1	PORE PRESSURE RATIO
σ	kPa	TOTAL NORMAL STRESS
σ'	kPa	EFFECTIVE NORMAL STRESS
τ	kPa	SHEAR STRESS
$\sigma_1, \sigma_2, \sigma_3$	kPa	PRINCIPAL STRESSES
ϵ	%	LINEAR STRAIN
$\epsilon_1, \epsilon_2, \epsilon_3$	%	PRINCIPAL STRAINS
E	kPa	MODULUS OF LINEAR DEFORMATION
G	kPa	MODULUS OF SHEAR DEFORMATION
μ	1	COEFFICIENT OF FRICTION

MECHANICAL PROPERTIES OF SOIL

m_v	kPa^{-1}	COEFFICIENT OF VOLUME CHANGE
C_c	1	COMPRESSION INDEX
C_s	1	SWELLING INDEX
C_α	1	RATE OF SECONDARY CONSOLIDATION
c_v	m^2/s	COEFFICIENT OF CONSOLIDATION
H	m	DRAINAGE PATH
T_v	1	TIME FACTOR
U	%	DEGREE OF CONSOLIDATION
σ'_{v0}	kPa	EFFECTIVE OVERBURDEN PRESSURE
σ'_p	kPa	PRECONSOLIDATION PRESSURE
τ_f	kPa	SHEAR STRENGTH
c'	kPa	EFFECTIVE COHESION INTERCEPT
ϕ'	-°	EFFECTIVE ANGLE OF INTERNAL FRICTION
c_u	kPa	APPARENT COHESION INTERCEPT
ϕ_u	-°	APPARENT ANGLE OF INTERNAL FRICTION
τ_R	kPa	RESIDUAL SHEAR STRENGTH
τ_r	kPa	REMOULDED SHEAR STRENGTH
S_f	1	SENSITIVITY = $\frac{c_u}{\tau_r}$

PHYSICAL PROPERTIES OF SOIL

ρ_s	kg/m^3	DENSITY OF SOLID PARTICLES	e	1, %	VOID RATIO	e_{min}	1, %	VOID RATIO IN DENSEST STATE
γ_s	kN/m^3	UNIT WEIGHT OF SOLID PARTICLES	n	1, %	POROSITY	I_D	1	DENSITY INDEX = $\frac{e_{max} - e}{e_{max} - e_{min}}$
ρ_w	kg/m^3	DENSITY OF WATER	w	1, %	WATER CONTENT	D	mm	GRAIN DIAMETER
γ_w	kN/m^3	UNIT WEIGHT OF WATER	S_r	%	DEGREE OF SATURATION	D_n	mm	n PERCENT - DIAMETER
ρ	kg/m^3	DENSITY OF SOIL	w_L	%	LIQUID LIMIT	C_u	1	UNIFORMITY COEFFICIENT
γ	kN/m^3	UNIT WEIGHT OF SOIL	w_p	%	PLASTIC LIMIT	h	m	HYDRAULIC HEAD OR POTENTIAL
ρ_d	kg/m^3	DENSITY OF DRY SOIL	w_s	%	SHRINKAGE LIMIT	q	m^3/s	RATE OF DISCHARGE
γ_d	kN/m^3	UNIT WEIGHT OF DRY SOIL	I_p	%	PLASTICITY INDEX = $w_L - w_p$	v	m/s	DISCHARGE VELOCITY
ρ_{sat}	kg/m^3	DENSITY OF SATURATED SOIL	I_L	1	LIQUIDITY INDEX = $\frac{w - w_p}{I_p}$	i	1	HYDRAULIC GRADIENT
γ_{sat}	kN/m^3	UNIT WEIGHT OF SATURATED SOIL	I_C	1	CONSISTENCY INDEX = $\frac{w_L - w}{I_p}$	k	m/s	HYDRAULIC CONDUCTIVITY
ρ'	kg/m^3	DENSITY OF SUBMERGED SOIL	e_{max}	1, %	VOID RATIO IN LOOSEST STATE	j	kN/m^3	SEEPAGE FORCE
γ'	kN/m^3	UNIT WEIGHT OF SUBMERGED SOIL						

FOUNDATION INVESTIGATION REPORT
For
Williams Parkway Underpass
W.P. 21-79-07, Site 24-145-474
Hwy. 410, District 6, Toronto

INTRODUCTION

This report summarizes the factual information obtained from a foundation investigation carried out between 83 05 18 and 83 05 30 at the above mentioned structure site. The fieldwork consisted 6 sampled boreholes advanced by means of hollow stem augers, solid stem augers or by wash boring BX casing. The boreholes ranged in depth from 12.6 m to 27.1 m below ground surface. Bedrock was proven in two borings by obtaining up to 2.8 m of BXL size rock core.

Subsequent to the initial investigation, an additional 4 boreholes (BH 7, 8, 9 and 10) were advanced at the site on 83 07 27. These four boreholes ranged in depth from 6.6 m to 11.1 m. The Record of Borehole sheets for these 4 boreholes are included in the Appendix for information. A brief description of the conditions at these boreholes included under the "Subsurface Conditions" section.

SITE DESCRIPTION

The site is located at the existing intersection of Heart Lake Road and Williams Parkway, in the City of Brampton, Municipality of Peel.

Land use in the area is predominantly residential subdivisions with a large mined out gravel pit to the north. Topography across the site is generally flat with the ground surface sloping gently toward the southeast.

The site is located in the physiographic region known as the "Peel Plain". This region is characterized by a level to undulating "till or boulder clay" plain underlain by shale or limestone bedrock. Locally, there is a partly buried esker which runs northwest and southwest of this site. The esker serves as a source of aggregate material and as an aquifer for wells.

Subsurface Conditions

General

The predominant deposit across the site consists of a very loose to very dense deposit of sand with varying proportions of silt, clay and gravel particles. This granular deposit, up to 14.4 m thick is underlain by shale bedrock. Overlying the sand stratum, the surficial deposits are quite variable, consisting of up to 3.4 m of silt, some sand, trace of clay, or up to 9.8 m of silty clay. Within the surficial silty clay deposit, a 3.1 m thick deposit of firm organic clay was encountered at the northeast corner of the site.

The boundaries between the various soil types, in situ and laboratory test results are shown on the attached Record of Borehole Sheets. The elevations and locations of the boreholes are shown on Drawing No. 2 of the contract drawings. along with four estimated stratigraphical sections based on borehole data.

The various soil types encountered are described in the following paragraphs:

Silt some Sand trace of Clay

The surficial deposit of silt some Sand traces of Clay extends to a maximum depth of 3.4 m in the southwest corner of the site and is not found in the most easterly areas.

Two grain size distribution tests completed on samples from this stratum indicate some variance in the sand content and a relatively uniform clay content. The results of these tests are plotted on Figure 1.

Atterberg limit testing was completed on samples from this deposit and results are plotted on Figure 5. The Atterberg limits indicate this deposit to be generally non-plastic silt to silt of slight plasticity (ML zone).

Based on interpretation of N values ranging from 11 to 50 blows per 0.3 m, the denseness of this generally non-cohesive stratum is assessed as compact to dense.

Sand with Silt some Gravel

This 2.1 m thick surficial deposit is only found on the north side of Williams Parkway in the middle of the site.

This material is similar to the underlying sands except it has a higher silt content. A grain size distribution test was conducted on a sample from this deposit and the result is plotted on Figure 4.

The N values of 31 and 36 blows per 0.3 m indicate this deposit is dense.

Silty Clay with Sand trace to some Gravel

This is the surficial deposit in the most easterly investigated section of the site and is overlain by the silt deposit to the west on the south side of Williams Parkway and sand to the north. This stratum is not found adjacent to Heart Lake Rd. The thickness of the deposit varies from 1.8 to 9.8 m.

The results of grain size distribution tests conducted on samples from this stratum are plotted in the form of an envelope on Figure 2.

Atterberg limit testing was conducted on samples taken from this deposit and results indicate the stratum is a silty clay of low plasticity (CL zone) to a silt of slight plasticity (CL-ML zone). The results of the Atterberg tests are plotted on Figure 5.

The consistency of this stratum is assessed as being stiff to hard based on N values ranging from 9 blows per 0.3 m to 106 blows per 10 cm.

Black Organic Clay

A 3.1 m layer of black organic clay was found sandwiched within the silty clay deposit in the northeast corner of the site.

Atterberg tests conducted on a sample taken from this layer indicate that the stratum is composed of highly plastic organic clay (OH zone). The results of an Atterberg limit test are plotted on Figure 5.

Organic matter content tests conducted on samples take from this stratum indicate an organic content varying from 6% to 35%.

Based on the Standard Penetration Test 'N' values varying from 4 to 9, the consistency of this cohesive deposit is assessed as firm.

Sand some Silt trace of Clay

This sand deposit overlies the bedrock and is present across the site. The stratum varies in thickness from 4.1 to 14.4 m, and is overlain by either silty clay or silt.

Grain size distribution curves completed on samples obtained from this stratum indicate that the silt and gravel contents vary throughout the deposit. A 1.3 m layer of gravel with sand some silt trace of clay was encountered directly overlying the bedrock on the north side of Williams Parkway, in the middle of the site. The results of grain size distribution tests are shown on Figure 3 in the form of an envelope. The grain size distribution test result for the localized zone of gravel with sand some silt is also plotted on this Figure.

Some cobbles or boulders were encountered while augering below elevation 229.3 adjacent to Heart Lake Road north of Williams Parkway.

The denseness of this stratum varies from very loose to very dense based on N values ranging from 3 blows per 0.3 m to 128 blows per 10 cm.

Additional Boreholes: BH 7, 8, 9, 10

As previously mentioned, four additional boreholes were advanced at this site subsequent to the initial investigation.

BH 7 was advanced to a depth of 8.1 m below the existing ground surface. Within this depth, the material consisted of a firm to stiff silty clay fill, with sand, trace gravel.

BH 8 and 9 were both advanced to a depth of 6.6 m. Within this depth the material encountered consisted of a firm to stiff silty clay fill, with sand, trace gravel.

BH 10 was advanced to a depth of 11.1 m below the existing ground surface. The upper 5 m consisted of a generally firm silty clay fill. Below this was a 4.4 m thick mixture of stiff organic silty clay and pieces of wood, also fill. Organic matter in this material ranged from 50% - 100%. From a depth of 9.4 m to the end of the borehole a compact sand deposit was encountered.

Shale Bedrock

Bedrock was encountered in two boreholes at a depth of 21.6 to 24.3 m below ground surface (i.e. elevation 214.3 to 212.4).

The bedrock was proven by obtaining up to 2.8 m of BXL size rock core. The bedrock is described as a grey shale of the Georgian Bay Formation with occasional layers of limestone 13 to 75 mm thick. The upper 0.4 to 1.4 m of the bedrock is in a slightly weathered state and below that is generally unweathered.

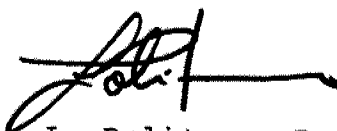
Rock core recovery rates varied from 89 to 97%. Based on the rock quality designation (RQD) values ranging from 0 to 39%, the quality of the bedrock is assessed as generally very poor to poor.

Groundwater Conditions

Groundwater was measured at depths of 13.0 to 12.2 m in two open boreholes indicating groundwater elevations of 222.9 to 224.5. In three additional boreholes, the groundwater elevation was assumed to be at the point of caving in of the borehole which occurred at depths of 8.8 to 13 m (elevation 224.2 to 228.5).

At the area of the site where the organic clay layer is sandwiched within the silty clay deposit, an observed groundwater elevation of 233.5 suggests the presence of a perched water table within the organic clay deposit.

The groundwater level was not established in BH 7, 8, 9 or 10.



L. Politano, P. Eng.,
Project Foundations Engineer



M. Devata, P. Eng.,
Chief Foundations Engineer
(East)

APPENDIX

RECORD OF BOREHOLE No 1

METRIC

W P 21-79-07 LOCATION Co-ords N 4 841 516.5 E 284 467.5 ORIGINATED BY R.M.
DIST 6 HWY 410 BOREHOLE TYPE Hollow Stem Auger COMPILED BY H.S.
DATUM Geodetic DATE 83 05 18, 19 CHECKED BY *so*

SOIL PROFILE		STRAT PLOT	SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION		NUMBER	TYPE	'N' VALUES			20	40	60	80	100					
237.2	Ground Surface																GR SA SI CL
0.0	Silt some Sand trace of Clay		1	SS	50		236										0 not plastic
			2	SS	42												
			3	SS	40												0 not plastic
233.8	Dense		4	SS	41		234										0 28 66 6
3.4	Sand some Silt trace of Clay		5	SS	33		232										0 83 10 7
			6	SS	31												
			7	SS	26		230										
			8	SS	26		228										0 72 25 3
			9	SS	25		226										0 90 8 2
	Compact to dense		10	SS	37		224										
			11	SS	54												
	trace of Gravel		12	SS	64		222										8 76 14 2
			13	SS	103		220										
219.4	very dense		14	SS	170												10 81 8 1
17.8	End of Borehole Refusal to Augering																
	*Groundwater Elevation assumed to be at the elevation of caving in of the open Borehole																

RECORD OF BOREHOLE No 2

METRIC

W P 21-79-07 LOCATION Co-ords N 4 841 540.5 E 284 485.0 ORIGINATED BY R.M.
 DIST 6 HWY 410 BOREHOLE TYPE Solid Stem Auger and Dynamic Cone COMPILED BY H.S.
 DATUM Geodetic DATE 83 05 19-20 CHECKED BY [Signature]

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100		
236.7	Ground Surface													
0.0	Silt some Sand trace of Clay Compact to Dense		1	SS	32		236							0 16 74 10
234.6			2	SS	15									
2.1	Silty Clay with Sand trace Gravel		3	SS	39		234							4 30 51 15
			4	SS	45									
			5	SS	36		232							
	Very Stiff to Hard													
230.3			6	SS	114		230							11 46 35 8
6.4	Sand some Silt trace of Clay		7	SS	41									
			8	SS	52		228							0 79 18 3
			9	SS	56	*	226							
	Dense to Very Dense													
224.1			10	SS	54									0 86 11 3
12.6	End of Borehole													
	* Groundwater elevation assumed to be at the elevation of cave in of the open Borehole													

RECORD OF BOREHOLE No 3

METRIC

W P 21-79-07 LOCATION Co-ords N 4 841 567.0 E 284 513.0 ORIGINATED BY R.M.
 DIST 6 HWY 410 BOREHOLE TYPE Hollow Stem Auger COMPILED BY H.S.
 DATUM Geodetic DATE 83 05 20, 24, 25 CHECKED BY [Signature]

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100					
235.9	Ground Surface																
0.0																	
	Silty Clay with Sand some Gravel		1	SS	22		234										19 36 31 15
			2	SS	22												7 47 35 11
			3	SS	17												6 30 47 17
			4	SS	51												
			5	SS	106	10 cm											
			6	SS	45		230										
	Very Stiff to Hard		7	SS	49		228										9 35 42 14
227.4			8	SS	34		226										
8.5	Sand some Silt trace of Clay trace to some Gravel		9	SS	58												18 64 14 4
			10	SS	14		224										
			11	SS	17		222										0 90 9 1
	Compact to Very Dense		12	SS	15		220										
			13	SS	47		218										
			14	SS	38		216										19 64 14 3
			15	SS	42												
214.3							214										
21.6	Shale (90%) with occasional Limestone layers		16	RC. BXL			212										
211.9																	
24.0	End of Borehole																

+³, x⁵: Numbers refer to
Sensitivity

20
15 \div 5 (%) STRAIN AT FAILURE
10

RECORD OF BOREHOLE No 4

METRIC

W P 21-79-07 LOCATION Co-ords N 4 841 587.0 E 284 492.5 ORIGINATED BY R.M.
DIST 6 HWY 410 BOREHOLE TYPE Solid Stem Auger COMPILED BY H.S.
DATUM Geodetic DATE 83 05 25 CHECKED BY 10

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100					
235.7	Ground Surface																GR 5A 51 CL
0.0	Silty Clay with Sand some Gravel Stiff		1	SS	12												12 20 45 23
233.9			2	SS	8												
1.8	Organic Clay BLACK		3	SS	4												
	Firm		4	SS	8												
230.8			5	SS	9												
4.9	Silty Clay with Sand trace Gravel		6	SS	16												1 20 54 25
	Very Stiff		7	SS	22												
227.2			8	SS	51												
8.5	Sand some Silt trace of Clay some Gravel Very Dense		9	SS	110/25cm												20 62 15 3
223.1			10	SS	51												
12.6	End of Borehole																
* O.M. indicates percentage of organic matter																	

OFFICE REPORT ON SOIL EXPLORATION

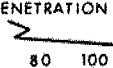
+3, x5 : Numbers refer to Sensitivity

20
15 ϕ 5 (%) STRAIN AT FAILURE
10

RECORD OF BOREHOLE No 5

METRIC

W P 21-79-07 LOCATION Co-ords N 4 841 544.0 E 284 441.0 ORIGINATED BY R.M.
 DIST 6 HWY 410 BOREHOLE TYPE Solid Stem Auger COMPILED BY H.S.
 DATUM Geodetic DATE 83 05 25 CHECKED BY So

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 					UNIT WEIGHT Y	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100		
237.3	Ground Surface													GR SA SI CL
0.0	Silt some Sand trace of Clay Compact		1	SS	11		236							
235.2			2	SS	12									
2.1	Sand some Silt trace of Clay		3	SS	3		234							0 80 8 12
			4	SS	7									
			5	SS	12		232							
	Very Loose to Dense		6	SS	44		230							0 85 13 2
			7	SS	90/23cm		228							
	Cobbles to Boulders		8	SS	117/15cm									26 52 16 6
	Very Dense		9	SS	185/10cm		226							
224.7			10	SS	128									0 60 33 7
12.6	End of Borehole													
	* Groundwater Elevation assumed to be at the Elevation of Caving in of the Open Borehole													

OFFICE REPORT ON SOIL EXPLORATION

5. CL clay
C2 silty clay
C4 clay

RECORD OF BOREHOLE No 6

METRIC

W P 21-79-07 LOCATION Co-ords N 4 841 560.5 E 284 467.0 ORIGINATED BY R.M.
DIST 6 HWY 410 BOREHOLE TYPE Solid Stem Auger and Wash Boring COMPILED BY H.S.
DATUM Geodetic DATE 83 05 26, 27, 30 CHECKED BY

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT Y	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100		
236.7	Ground Surface													
0.0	Sand with Silt some Gravel Dense		1	SS	31		236							15 51 34 0
234.6			2	SS	36									
2.1	Silty Clay with Sand some Gravel		3	SS	9		234							15 45 29 11
			4	SS	12									
			5	SS	22		232							
			6	SS	38		230							
			7	SS	25									15 19 48 18
			8	SS	33		228							
	Stiff to Hard		9	SS	30		226							12 46 25 17
224.8			10	SS	38		224							4 57 29 10
11.9	Sand some Silt some Gravel trace of Clay		11	SS	65		222							23 67 9 1
			12	SS	30									
			13	SS	40		220							21 59 18 2
			14	SS	62		218							20 66 12 2
	Compact to Very Dense		15	SS	23		216							13 64 20 3
			16	SS	62									
	Limestone Boulders		17	RC. BXL			214	REC 38% RQD 15% Weathering Unweathered						
	Gravel with Sand some Silt trace Clay		18	RC.				88% 0%						50 24 17 9
212.4			19	SS	39		212							
24.3	Shale (80% Grey with randomly interbedded Limestone (20%) layers 13 to 75 mm thick		20	RC. BXL				94% 39% Slight						
209.6			21	RC. BXL				97% 39% Unweathered						
27.1	End of Borehole						210							

RECORD OF BOREHOLE No 7

METRIC

W P 21-79-07 LOCATION Co-ords. N 4 841 609.5; E 284 517.0 ORIGINATED BY RM
 DIST 6 HWY 410 BOREHOLE TYPE Solid Stem Auger COMPILED BY HS
 DATUM Geodetic DATE 1983 07 27 CHECKED BY EP

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			20	40	60	80	100		
234.9	Ground Surface												
0.0													
	Very Stiff		1	SS	29								
			2	SS	18	*							13 30 42 15
	Silty Clay (Fill) with sand trace gravel Firm to Stiff		3	SS	6								
			4	SS	9								
			5	SS	7								3 22 48 27
226.8	End of Borehole		6	SS	11								
8.1	* Groundwater elevation not established												

+³, x⁵: Numbers refer to
Sensitivity

20
15
10

5 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 8

METRIC

W P 21-79-07 LOCATION Co-ords. N 4 841 599.0; E 284 506.0 ORIGINATED BY RM
 DIST 6 HWY 410 BOREHOLE TYPE Solid Stem Auger COMPILED BY HS
 DATUM Geodetic DATE 83 07 27 CHECKED BY [Signature]

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100	PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT Y	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES								
235.0	Ground Surface												
0.0													
	Silty Clay (Fill) with sand trace gravel	Very Stiff Firm	1	SS	25	*	234						9 28 42 21
			2	SS	18								
			3	SS	6		232						
			4	SS	7		230						
228.4			5	SS	9								
6.6	End of Borehole												
	* Groundwater elevation not established												

+3, x5: Numbers refer to
Sensitivity

20
15 5 (%) STRAIN AT FAILURE
10

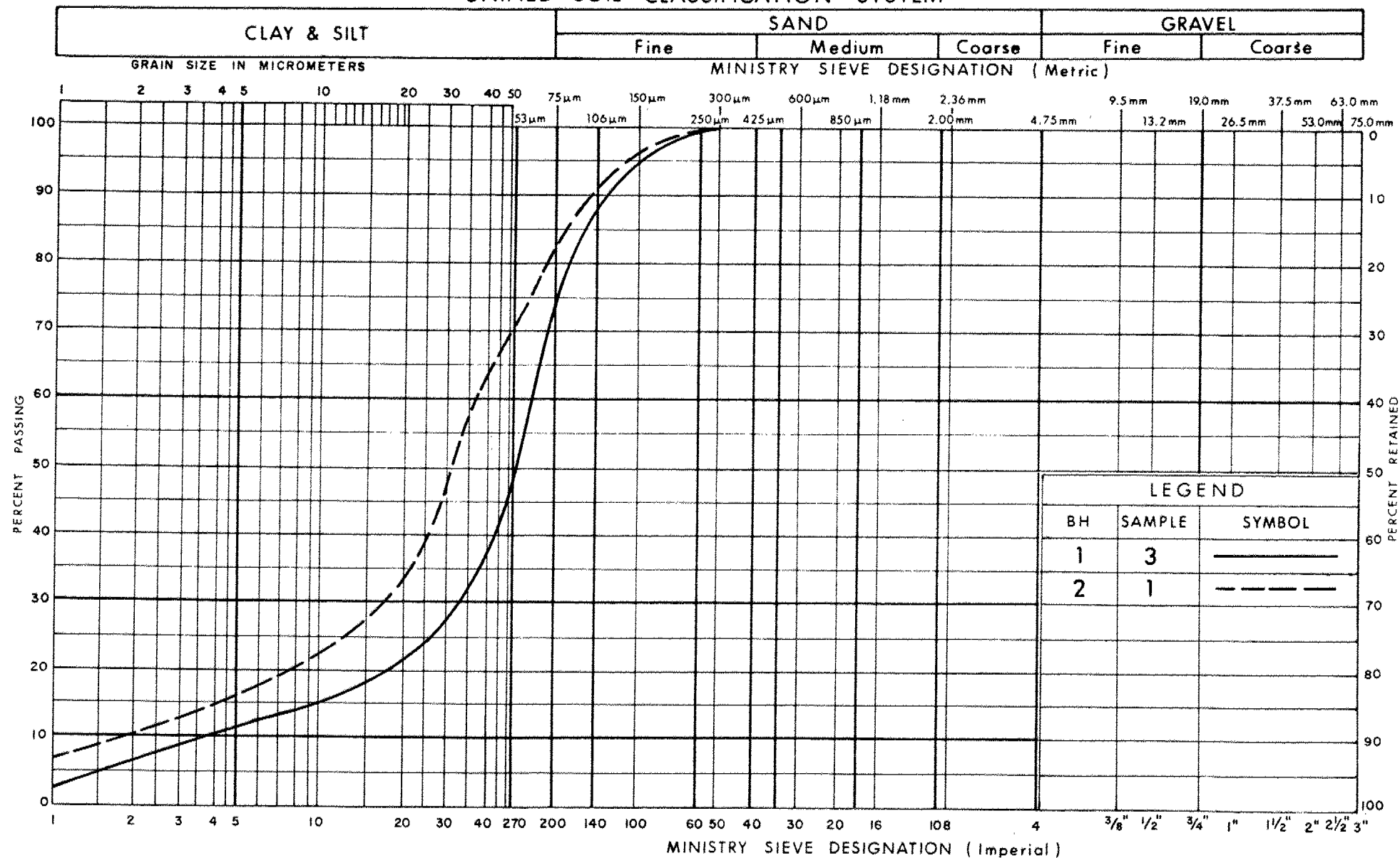
RECORD OF BOREHOLE No 9

METRIC

W P 21-79-07 LOCATION Co-ords. N 4 841 593.5; E 284 500.5 ORIGINATED BY RM
 DIST 6 HWY 410 BOREHOLE TYPE Solid Stem Auger COMPILED BY HS
 DATUM Geodetic DATE 83 07 27 CHECKED BY CP

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100		
235.3	Ground Surface													
0.0	Sand (Fill) some gravel trace silt dense		1	SS	38		234							27 62 11 0
1.2	Silty Clay (Fill) with sand trace gravel Firm to Stiff		2	SS	9	*								
			3	SS	7		232							
			4	SS	9		230							4 24 48 24
228.7	End of Borehole		5	SS	12									
6.6	* Groundwater elevation not established													

UNIFIED SOIL CLASSIFICATION SYSTEM



Ontario

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Transportation and
Communications

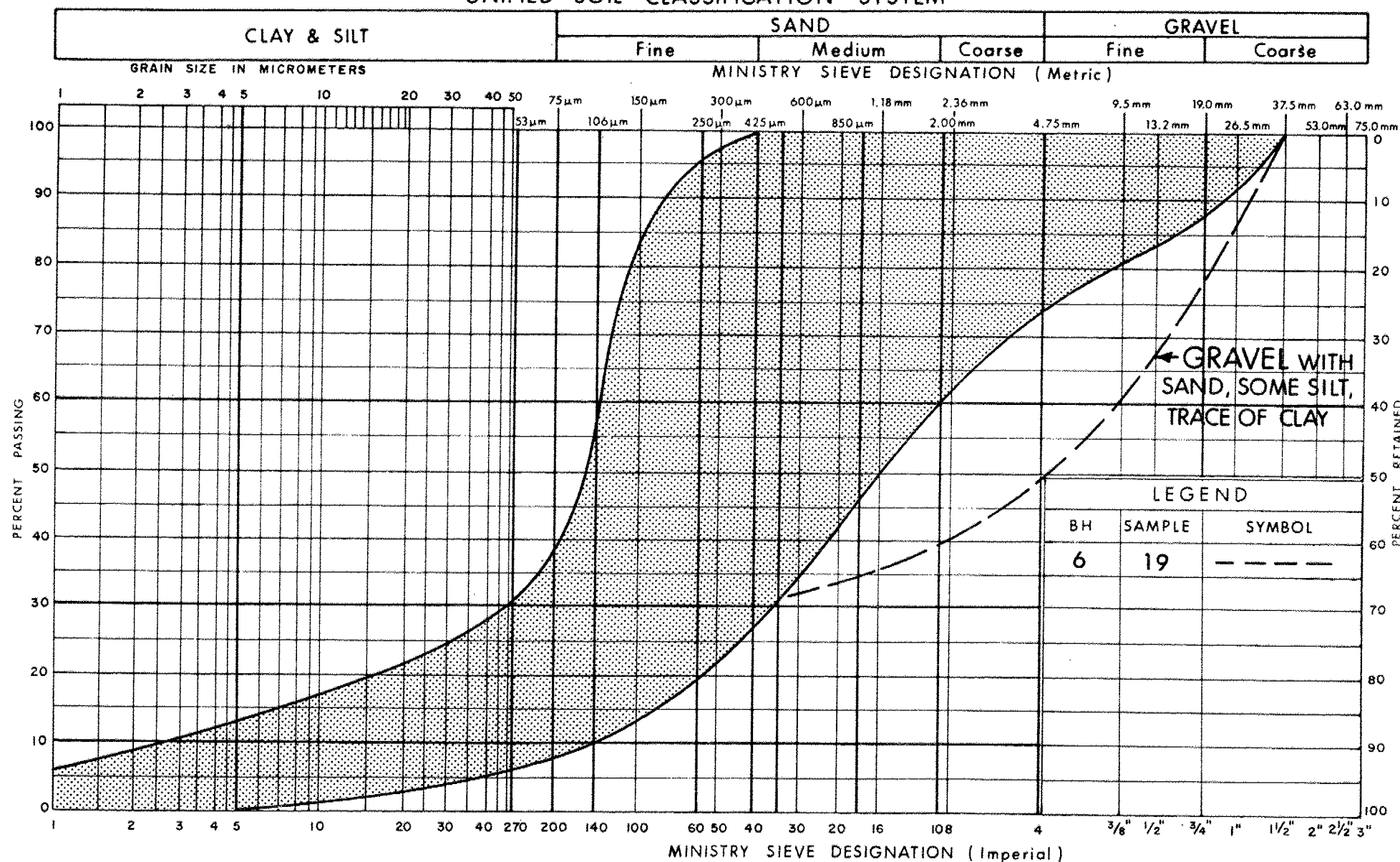
GRAIN SIZE DISTRIBUTION

SILT SOME SAND, TRACE OF CLAY

FIG No 1

W P 21-79-07

UNIFIED SOIL CLASSIFICATION SYSTEM



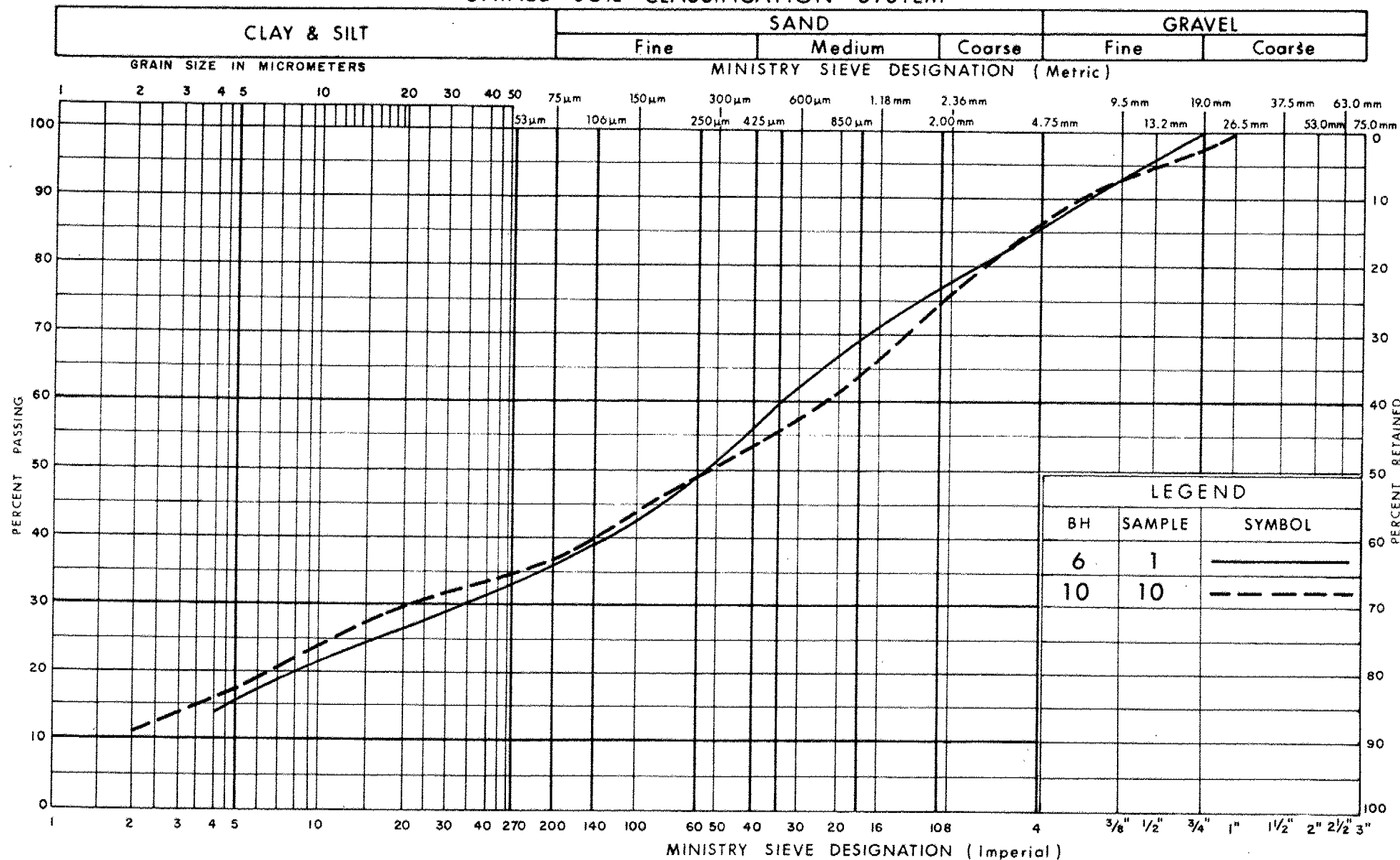
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Communications

GRAIN SIZE DISTRIBUTION
SAND SOME SILT, TRACE OF CLAY

FIG No 3

W P 21-79-07

UNIFIED SOIL CLASSIFICATION SYSTEM

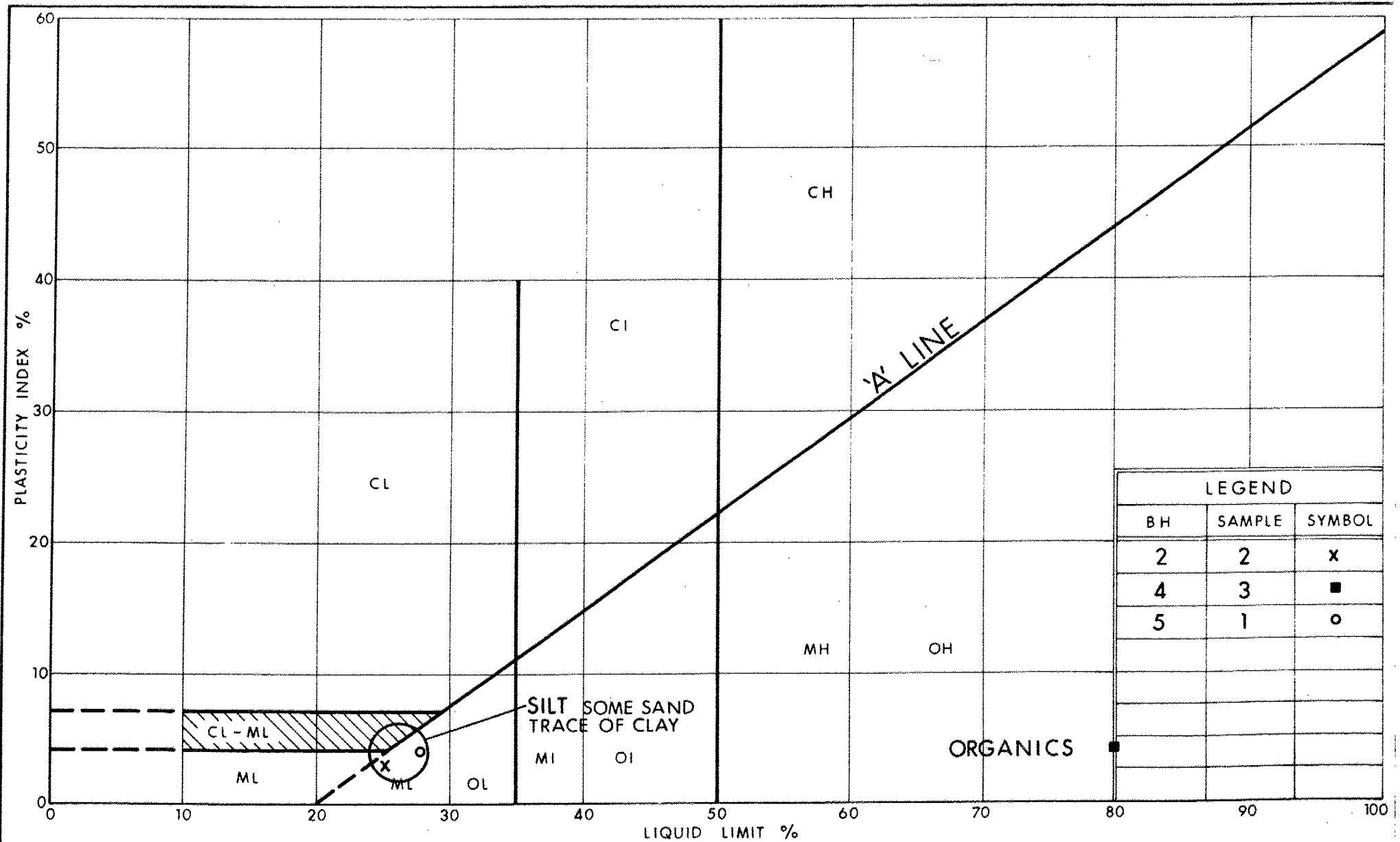


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Communications

GRAIN SIZE DISTRIBUTION
SAND WITH SILT, SOME GRAVEL

FIG No 4

W P 21-79-07

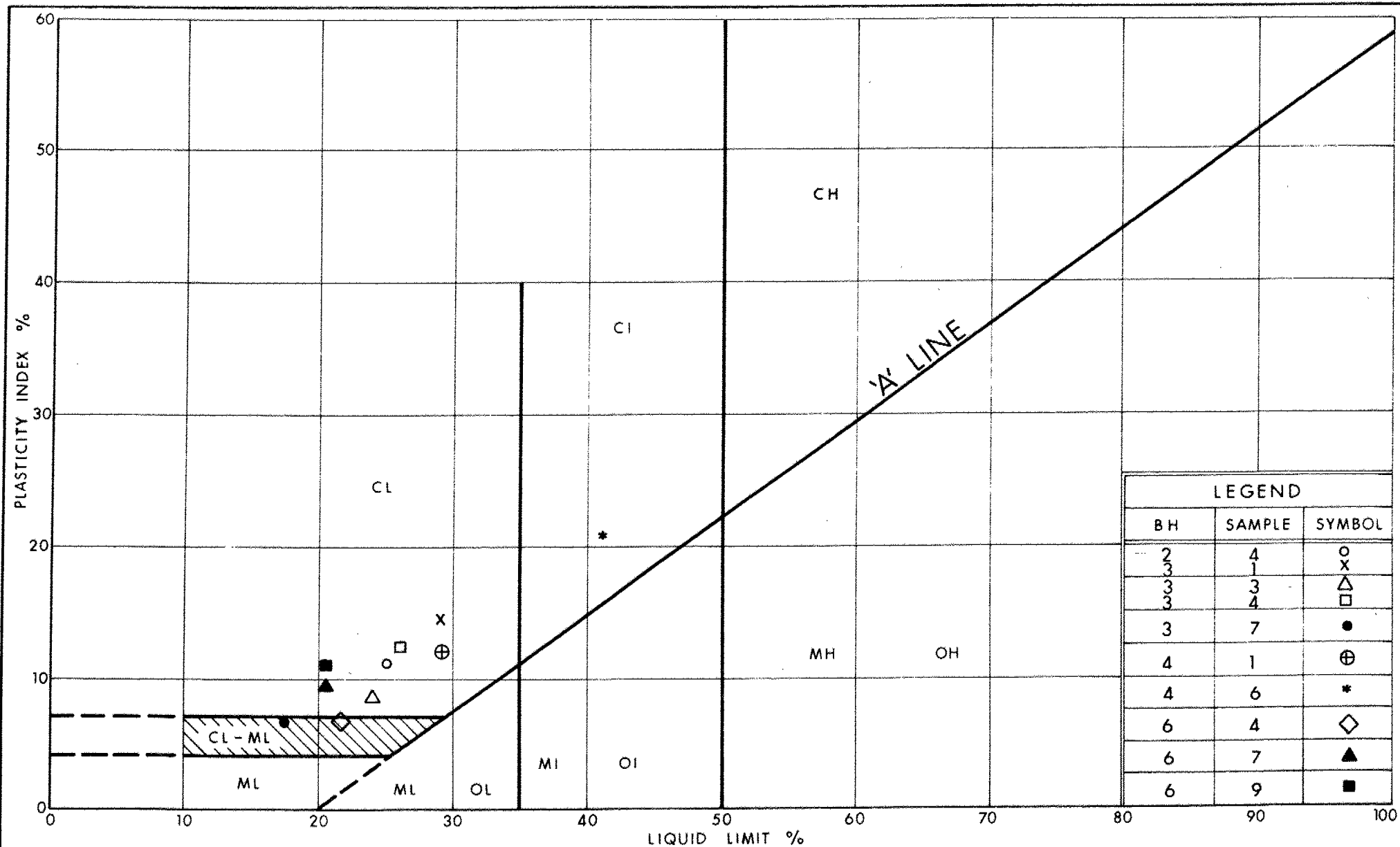
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Communications

PLASTICITY CHART

FIG No 5

W P 21-79-07

23

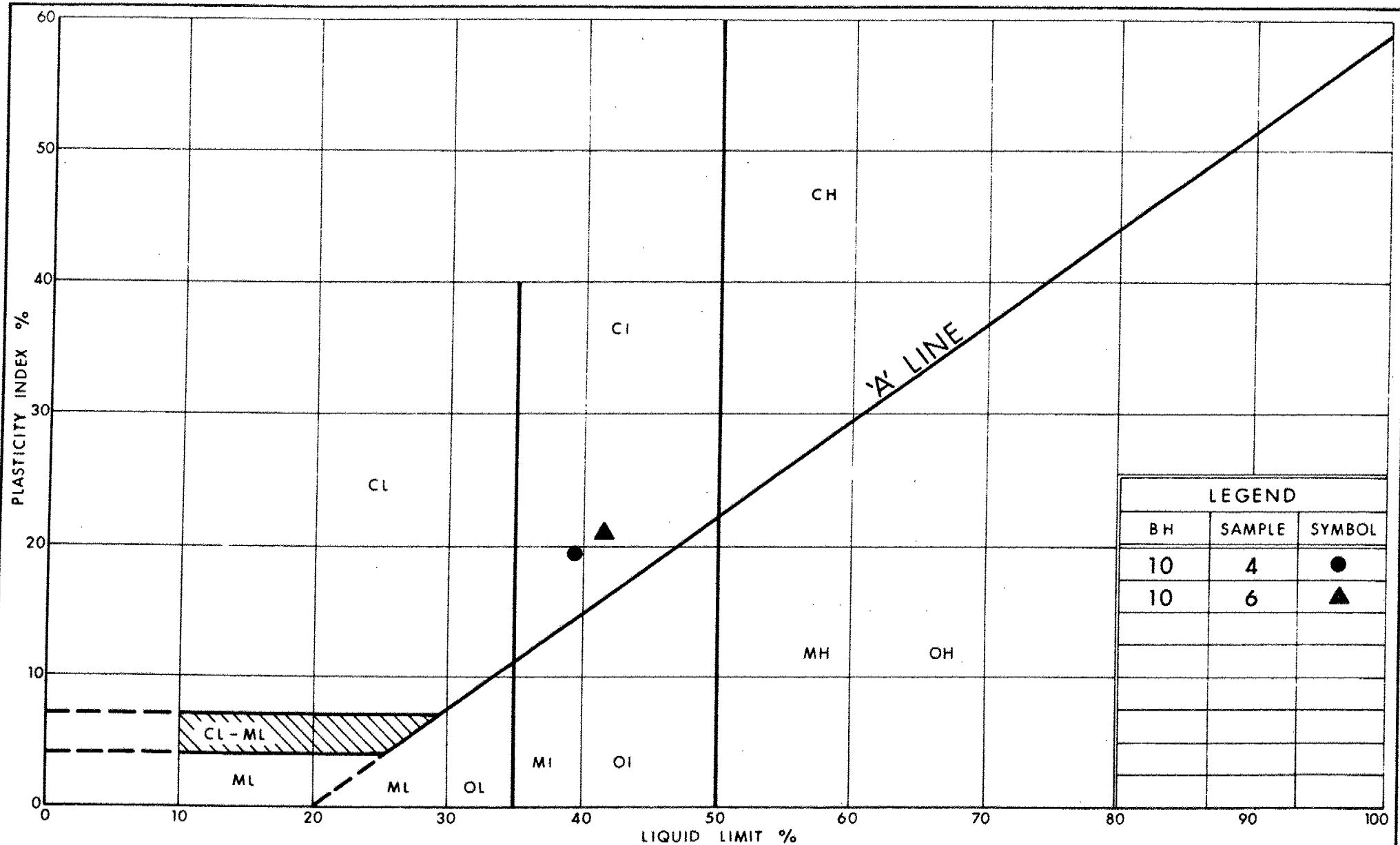


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PLASTICITY CHART SILTY CLAY WITH SAND TRACE TO SOME GRAVEL

FIG No 6

W P 21-79-07

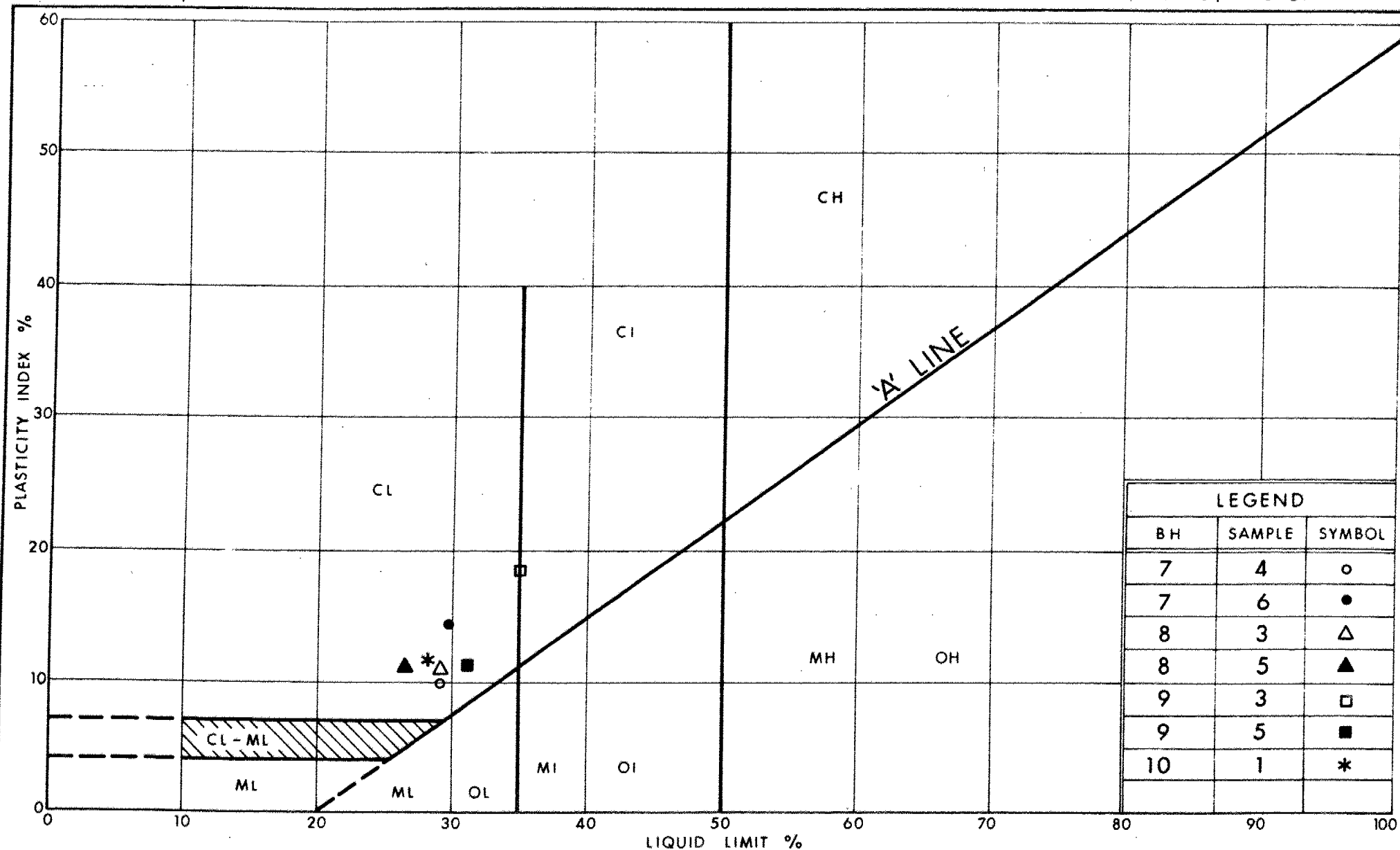


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PLASTICITY CHART MIXTURE OF SILTY CLAY AND PIECES OF WOOD (FILL)

FIG No 7

W P 21-79-07



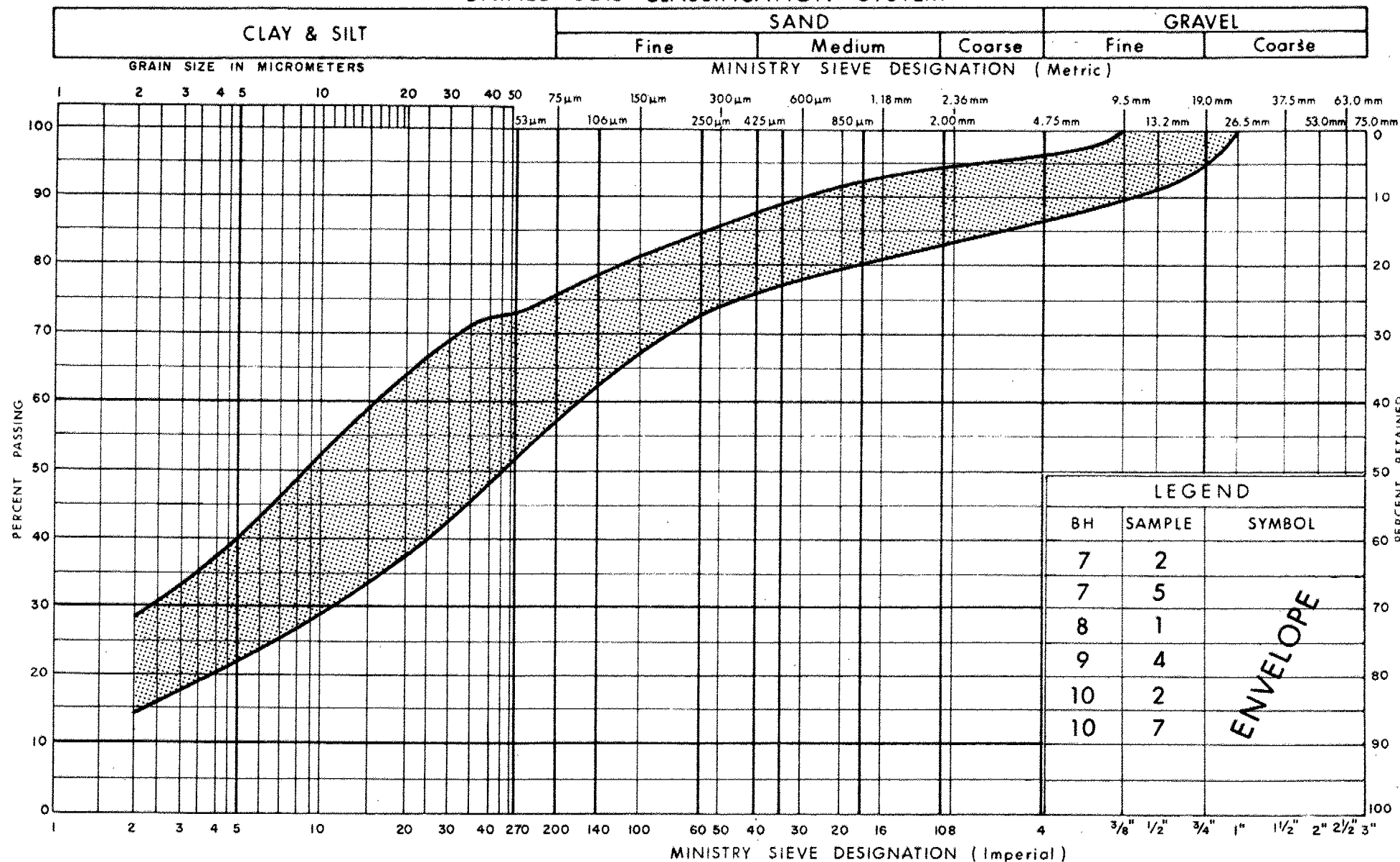
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PLASTICITY CHART SILTY CLAY WITH SAND TRACE OF GRAVEL (FILL)

FIG No 8

W P 21-79-07

UNIFIED SOIL CLASSIFICATION SYSTEM



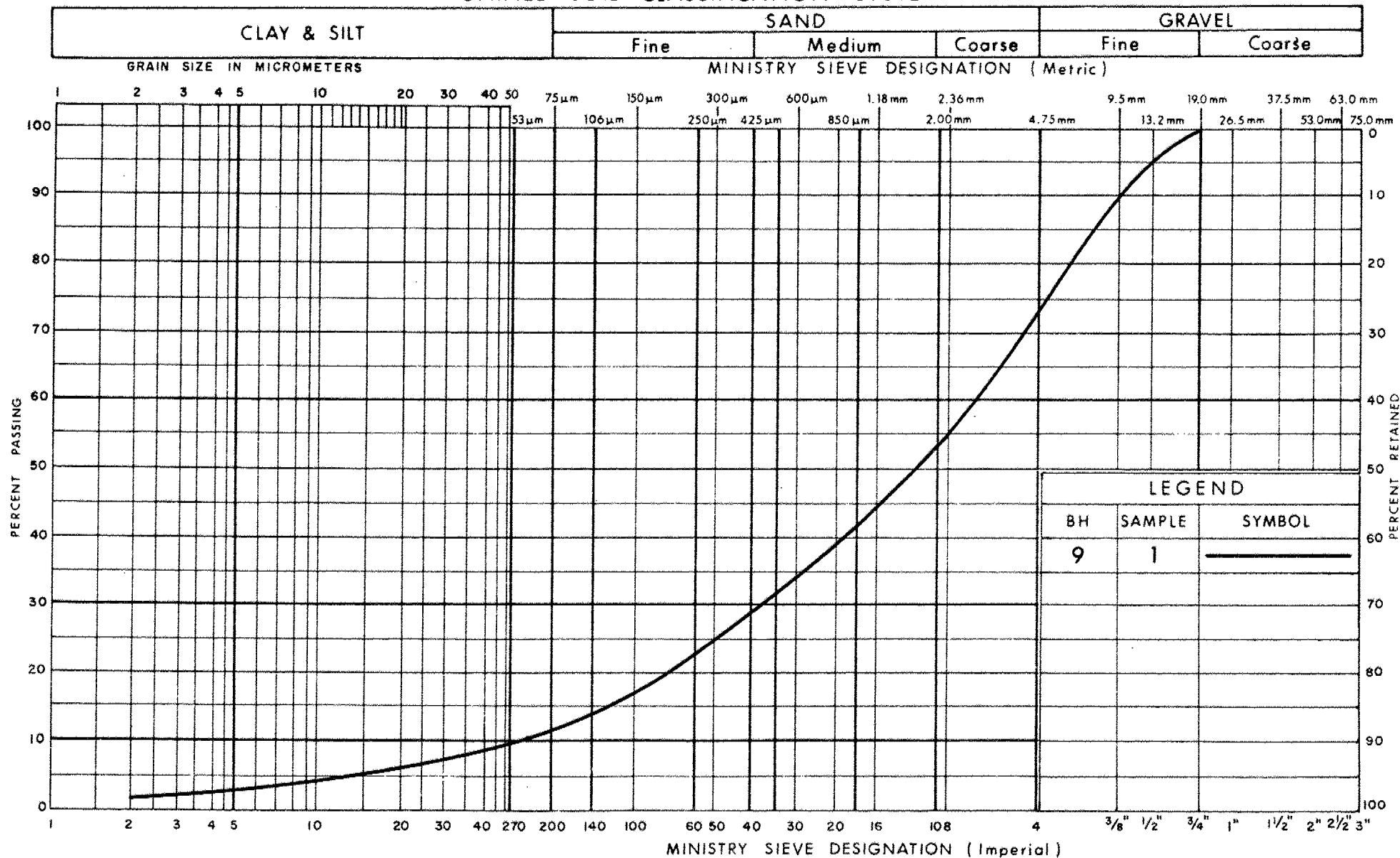
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GRAIN SIZE DISTRIBUTION
SILTY CLAY WITH SAND TRACE OF GRAVEL (FILL)

FIG No 9

WP 21-79-07

UNIFIED SOIL CLASSIFICATION SYSTEM



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GRAIN SIZE DISTRIBUTION

SAND, SOME GRAVEL TRACE OF SILT (FILL)

FIG No 10

WP 21-79-07

FOUNDATION INVESTIGATION REPORT

For

Francheschini (Private) Drive Underpass

W.P. 21-79-08; Site 24-145-473

Hwy. #410, District 6, TorontoINTRODUCTION:

This report summarizes the factual information obtained from a foundation investigation carried out between 83-07-19 and 83-08-09 at the above mentioned structure site. The fieldwork consisted of 8 sampled boreholes advanced by means of hollow stem augers, solid stem augers, or by washing casing. The boreholes ranged in depth from 4.2 to 32.0 m below ground surface. Bedrock was sampled in one borehole by obtaining 2.9 m of BQ rock core.

SITE DESCRIPTION AND GEOLOGY

The site is located at the existing intersection of Heart Lake Rd. and the private drive into Franceschini Gravel Pit, in the City of Brampton, Municipality of Peel.

Land use in the area is dominated by gravel pits with the Franceschini Pit to the west of Heart Lake Road and a large abandoned gravel pit to the east. Residential subdivisions are enclosing on these pits from the south and east. Topography across the site is generally very gently rolling, with the overall ground surface sloping to the south.

The site is located in the physiographic region known as the "Peel Plain". This region is characterized by a level to undulating "till or boulder clay" plain underlain by shale or limestone bedrock. Locally there is a partly buried esker which runs to the east of the site. The esker serves as a source of aggregate material and as an aquifer for wells.

SUBSURFACE CONDITIONSGeneral

The predominant deposit across the site consists of a compact to very dense sand some silt, trace of clay, trace of gravel. This deposit was investigated to a maximum depth of 30.2 m with occasional 0.9 to 2.1 m zones of sand and gravel being encountered throughout the deposit. The sand is underlain by shale bedrock. A firm to hard silty clay was found overlying the sand in the central section of the site, just below the surface in the southwest corner and approximately in the middle of the sand deposit at both locations.

The eastern portion of the site is located on the edge of a 17 m deep abandoned gravel pit, the bottom of which is covered by 1.8 to 3.5 m of water. Beneath the water is a 0.5 to 4.1 m thick deposit of very soft to hard silty clay which is underlain by very dense sand.

The boundaries between the various soil types, in situ and laboratory test results are shown on the attached Record of Borehole Sheets. The elevations and locations of the boreholes are shown on Dwg. 2 of the Str. Dwg. along with one profile and one cross-section indicating the estimated stratigraphical sections based on borehole data.

The various soil types encountered are described in the following paragraphs.

Silty Clay, with Sand, some Gravel

The deposit of silty clay with sand, some gravel is the surficial deposit in the central and eastern sections of the site and is found just below the surface in the southwest corner. A thin zone is also found in the middle of the sand layer in the western and central portions of the site. The silty clay lying on the bottom of the abandoned gravel pit generally becomes silty at the interface with the sand stratum. The deposit varies in thickness from 0.5 to 5.2 m.

Three grain size distribution tests were conducted on samples taken from this stratum and they indicate some variability in the distribution of grain sizes. The results of these tests are plotted on Figure 3.

Results of atterberg limit testing completed on samples from this deposit are plotted on Figure 4. Testing indicates a wide range in the plasticity of this material varying from the borderline silty clay to silt of low plasticity zone (CL-ML) to a clay of intermediate plasticity (CI). Atterberg limit test results, completed on samples from the silty zones at the bottom of the silty clay in the pond indicates a silt of low plasticity (ML). Results are plotted on Figure 5.

The consistency of the silty clay in the deep boreholes varied from firm to hard based on "N" values ranging from 2 blows per 0.3 m to 100 blows per 10 cm. The upper zone of the silty clay lying on the bottom of the abandoned gravel pit has a consistency ranging from very soft to firm as indicated by field vane shear strength values varying from 4 to 38 kPa.

This soft consistency may be a result of previous pit operations. The consistency of the silty clay changes close to the sand interface and is generally hard where the silty material lies. The hard consistency is indicated by "N" values varying from 68 blows per 0.3 m to 100 blows per 5 cm.

Sand, some Silt, trace Clay, trace Gravel

This deposit of sand with silt, trace of clay, trace of gravel was found across the entire investigated area and was explored to a maximum extent of 30.2 m. Occasional 0.9 to 2.1 m seams of sand and gravel were encountered throughout the deposit. A 1.4 to 2.4 m zone of cobbles and/or boulders was encountered at approximately elevation 224 in the central and eastern sections of the site.

The results of grain size distribution tests conducted on samples from this stratum indicate an average sand content of 80% with results plotted in the form of an envelope on Figure 1. A number of grain size distribution tests were conducted on samples from the interbedded sand and gravel zones and the results are shown on Figure 2. The gravel content varies from 32 to 68 percent in these zones.

Interpretation of N values ranging from 12 blows per 0.3 m to 100 blows per 10 cm indicate the denseness of the deposit to vary from compact in the upper half of the deposit to very dense in the lower regions.

Shale Bedrock

Bedrock encountered in two boreholes at depths of 25.9 and 30.2 m below the surface (i.e. elevation 215.3 and 213.1).

Bedrock was proven in one borehole by obtaining 2.9 m of BQ rock core. The bedrock is a grey shale of the Georgian Bay Formation with occasional layers of limestone 15 to 90 mm thick. The upper 1.1 m of the shale is moderately weathered with 1.1 m of slightly weathered bedrock underlying and generally unweathered material below this. Rock core recovery rates varied from 25% to 100%. Based on rock quality designation (RQD) values ranging from 0 to 27 percent the quality of the bedrock is assessed as generally very poor to poor in the lower 0.7 m.

Groundwater Conditions

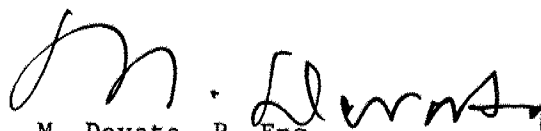
The groundwater table was encountered at an elevation of approximately 227.5 in the two deep boreholes which closely corresponds to the water level of 228.1 in the abandoned gravel pit.

Closure

The Foundation Investigation and Design Reports for these two sites were prepared by H. Sturm, P. Eng., of the MTC Foundation Design Section. Only the factual soils information from the original reports is included under this cover.



L. Politano, P. Eng.,
Project Foundations Engineer




M. Devata, P. Eng.,
Chief Foundations Engineer
(East)

APRIL 1986

APPENDIX

RECORD OF BOREHOLE No 1

METRIC

W P 21-79-08 LOCATION Co-ords N 4 841 864.2; E 284 129.2 ORIGINATED BY HS
DIST 6 HWY 410 BOREHOLE TYPE Hollow Stem Auger, Wash Bore, BQ Rock Core COMPILED BY HS
DATUM Geodetic DATE 1983 07 19, 22 CHECKED BY 

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			SHEAR STRENGTH								
								20 40 60 80 100				10 20 30				
241.2	Ground Surface															GR SA SI CL
0.0	Sand															
240.0			1	SS	33		240									18 55 16 11
1.2	Silty Clay With Sand Some Gravel Stiff to Firm		2	SS	13											19 44 23 14
238.2			3	SS	2											
3.0			4	SS	12		238									0 78 18 4
			5	SS	16											
			6	SS	17		236									
			7	SS	29											
			8	SS	36		234									1 91 7 1
			9	SS	20		232									
			10	SS	27		230									
			11	SS	18		228									12 71 15 2
			12	SS	3		226									35 61 3 1
			13	SS	19											
			14	SS	70		224									32 55 11 1
			15	SS	85		222									5 80 12 3
			16	SS	87		220									
			17	SS	81											7 81 10 2
			18	SS	114	23 cm	218									
			19	SS	100	10 cm	216									5 80 13 2
215.3			20	SS	150	3 cm										
25.9			21	RC				REC	RQD	Weathering						
			22	RC				71%	0							
			23	RC				25%	0	Moderately						
			24	RC				53%	0							
			25-27	RC				78%	0	Slightly						
			28	RC				83%	0							
212.3								83%	27%	Unweathered						
28.9	End of Borehole															

+3, x5: Numbers refer to
Sensitivity

20
15 ϕ 5 (%) STRAIN AT FAILURE
10



RECORD OF BOREHOLE No 2

METRIC

W P 21-79-08 LOCATION Co-ords N 4 841 872.2; E 284 124.3 ORIGINATED BY HS
DIST 6 HWY 410 BOREHOLE TYPE Solid Stem Augers COMPILED BY HS
DATUM Geodetic DATE 1983 07 25 CHECKED BY *EP*

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES		20	40	60	80	100					
242.1	Ground Surface															
0.0	Sand and Gravel															
240.0			1	SS	37											50 41 6 3
2.1			2	SS	27											
			3	SS	14											
			4	SS	21											4 73 18 5
			5	SS	27											2 66 30 2
			6	SS	46											
			7	SS	45											4 76 16 4
			8	SS	62											
			9	SS	46											31 52 13 4
227.9																
14.2	End of Borehole															
	* NOTE: No water table encountered															

+3, x5: Numbers refer to
Sensitivity

20
15 5 (%) STRAIN AT FAILURE
10

RECORD OF BOREHOLE No 3

METRIC

W P 21-79-08 LOCATION Co-ords N 4 841 890.5; E 284 142.5 ORIGINATED BY HS
DIST 6 HWY 410 BOREHOLE TYPE Hollow Stem Auger, Wash Bore COMPILED BY HS
DATUM Geodetic DATE 1983 07 25, 27 CHECKED BY *CP*

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20 40 60 80 100						
243.3	Ground Surface													
0.0	Silty Clay With Sand Some Gravel		1	SS	32		242							
			2	SS	6									
	Clay		3	SS	13									
			4	SS	33		240							
	Firm to Very Stiff		5	SS	29									6 29 44 21
238.1			6	SS	31									
5.2							238							
	Sand and Gravel		7	SS	20									61 25 10 4
			8	SS	23		236							1 90 7 2
	Sand Some Silt Trace Clay Trace Gravel		9	SS	42		234							
	Sand and Gravel		10	SS	100		232							68 27 4 1
	Compact to Very Dense		11	SS	22									2 91 6 1
							230							46 47 6 1
	Sand and Gravel		12	SS	30									
			13	SS	15		228							
226.1			14	SS	26		226							5 71 20 4
17.2	Silty Clay With Sand Some Gravel	Hard	15	SS	100	10 cm								
224.4							224							
18.9	Cobbles or Boulders		16	SS	72									5 85 9 1
			17	SS	83		222							
	Sand and Gravel		18	SS	89		220							56 36 8 0
			19	SS	60									0 73 25 2
	Sand Some Silt Trace of Clay Trace of Gravel Very Dense		20	SS	95		218							
			21	SS	96	15 cm	216							
			22	SS	105	15 cm	214							0 52 45 3
213.1														
30.2														

Continued

+3, x5: Numbers refer to
Sensitivity

20
15-5 (%) STRAIN AT FAILURE
10

Continued

RECORD OF BOREHOLE No 3 Continued METRIC

W P 21-79-08 LOCATION Co-ords N 4 841 890.5; E 284 142.5 ORIGINATED BY HS
 DIST 6 HWY 410 BOREHOLE TYPE Hollow Stem Auger, Wash Bore COMPILED BY HS
 DATUM Geodetic DATE 1983 07 25, 27 CHECKED BY GP.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100					
213.1	Continued																
30.2	Highly Weathered Grey Shale		23	SS	150	13 cm	212										
211.3																	
32.0	End of Borehole																

OFFICE REPORT ON SOIL EXPLORATION

+³, x⁵: Numbers refer to
Sensitivity

20
15
10
5 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 4

METRIC

W P 21-79-08 LOCATION Co-ords N 4 841 913.3; E 284 178.2 ORIGINATED BY RM
DIST 6 HWY 410 BOREHOLE TYPE Wash Bore COMPILED BY HS
DATUM Geodetic DATE 1983 08 02 to 04 CHECKED BY *OP*

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)				
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40						60	80	100	WATER CONTENT (%)
								SHEAR STRENGTH										
							○ UNCONFINED + FIELD VANE											
							● QUICK TRIAXIAL x LAB VANE											
228.1	Water Level													GR SA SI CL				
0.0	Water						228											
225.4							226											
2.7	Silty Clay Very Soft		1	SS	1													
223.2	Silt Hard		2	SS	100	5 cm	224							16 44 30 10				
4.9			3	SS	100	10 cm												
			4	SS	120	15 cm	222											
	Sand Some Silt Trace Clay Trace Gravel Very Dense		5	SS	123		220							0 86 12 2				
			6	SS	162		218											
			7	SS	100	10 cm												
215.5			8	SS	109		216							0 67 32 1				
12.6	End of Borehole																	

RECORD OF BOREHOLE No 5

METRIC

W P 21-79-08 LOCATION Co-ords N 4 841 920.8; E 284 174.3 ORIGINATED BY RM
 DIST 6 HWY 410 BOREHOLE TYPE Wash Bore COMPILED BY HS
 DATUM Geodetic DATE 1983 08 04, 05 and 08 CHECKED BY [Signature]

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100					
228.1	Water Level																
0.0	Water																
226.3																	
1.8																	
	Silty Clay With Sand Some Gravel Very Soft to Soft		1	TW	PM												
223.0			2	SS	106												19 35 41 5
5.1			3	SS	133	15 cm											
			4	SS	133												1 87 11 1
	Sand Some Silt Trace Clay Trace Gravel Very Dense		5	SS	120												18 65 15 2
			6	SS	100	10 cm											
215.6			7	SS	100	5 cm											0 83 16 1
12.5	End of Borehole																

OFFICE REPORT ON SOIL EXPLORATION

+³, x⁵: Numbers refer to
Sensitivity

20
15 5 (%) STRAIN AT FAILURE
10

RECORD OF BOREHOLE No 6

METRIC

W P 21-79-08 LOCATION Co-ords N 4 841 926.8; E 284 186.5 ORIGINATED BY RM
DIST 6 HWY 410 BOREHOLE TYPE Wash Bore COMPILED BY HS
DATUM Geodetic DATE 1983 08 08 CHECKED BY *[Signature]*

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100					
228.1	Water Level						228										
0.0	Water						226										
224.6							224										
224.1	Silty Clay Soft		1	SS	74												
223.5	Sand Very Dense		2	SS	100	13 cm											
4.6	End of Borehole																
	* Vane sank while taking remolded shear strength																

OFFICE REPORT ON SOIL EXPLORATION

+³, x⁵: Numbers refer to
Sensitivity

20
15 5 (%) STRAIN AT FAILURE
10

RECORD OF BOREHOLE No 7

METRIC

W P 21-79-08 LOCATION Co-ords N 4841939.4; E 284 199.3 ORIGINATED BY RM
 DIST 6 HWY 410 BOREHOLE TYPE Wash Bore COMPILED BY HS
 DATUM Geodetic DATE 1983 08 08 and 09 CHECKED BY SP

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40						60	80	100
								SHEAR STRENGTH							WATER CONTENT (%)		
							○ UNCONFINED + FIELD VANE										
							● QUICK TRIAXIAL x LAB VANE										
228.1	Water Level																
0.0	Water						228										
							226										
224.8																	
3.3	Sand to Silt		1	SS	145												
223.9	Very Dense		2	SS	100												
4.2	End of Borehole					10 cm	224										
									</								

+³, x⁵: Numbers refer to Sensitivity.

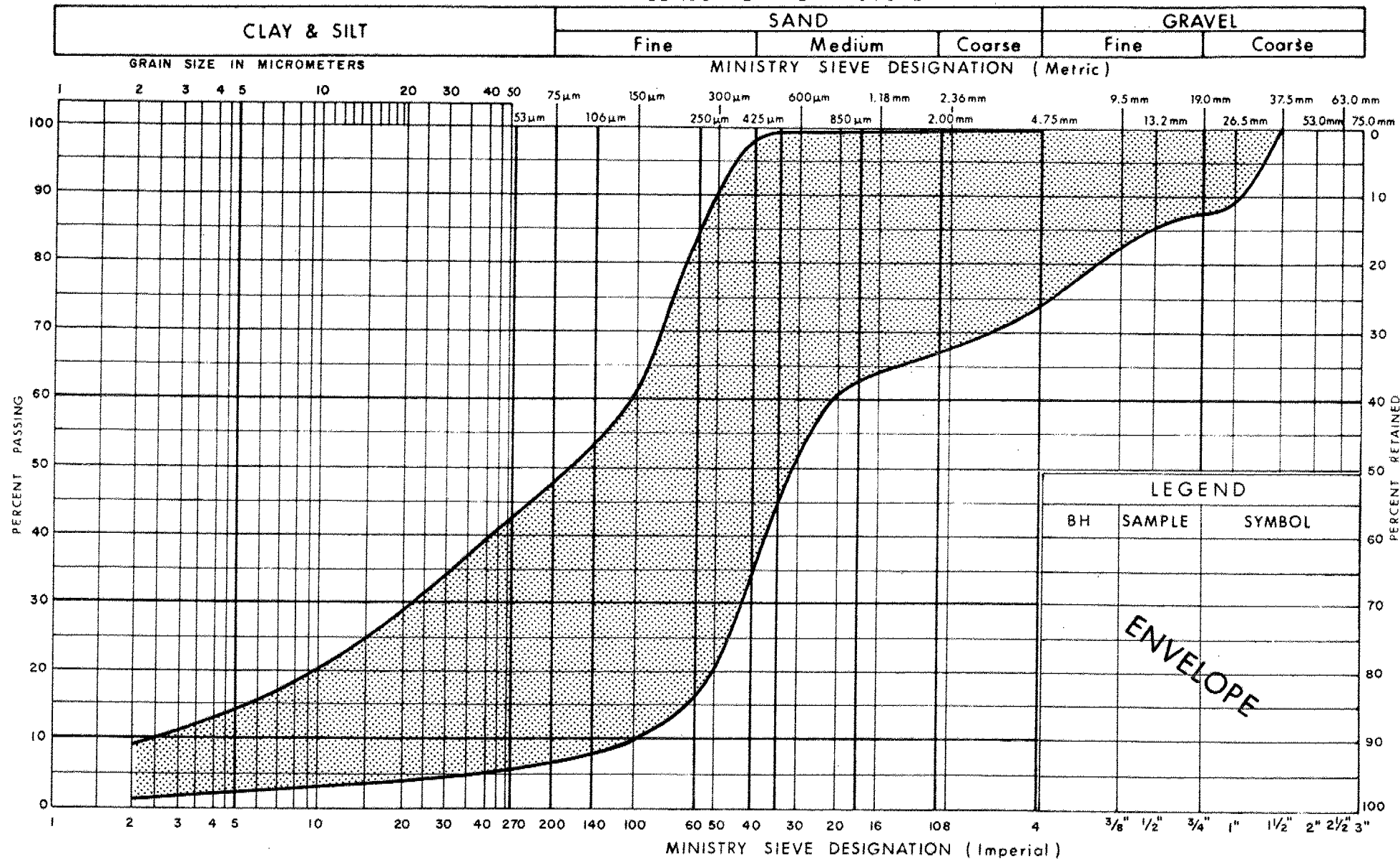
20
15 ϕ 5 (%) STRAIN AT FAILURE
10

METRIC

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT	PLASTIC LIMIT	NATURAL MOISTURE CONTENT	LIQUID LIMIT	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20 40 60 80 100	W _p	W	W _L		
								SHEAR STRENGTH kPa O UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE	WATER CONTENT (%)				
228.1	Water Level												
0.0	Water						228						
226.3							226	+1					
1.8	very soft		1	TW	PM								
	Silty Clay with Sand some Gravel Firm		2	SS	10								
			3	TW	PM								
							224	+2					
								+2					
								+3					
222.1	Silt Hard		4	SS	68			+6 Vane only advanced					
5.9	End of Borehole							25 cm					

+3, x5: Numbers refer to Sensitivity

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LEGEND		
BH	SAMPLE	SYMBOL

ENVELOPE

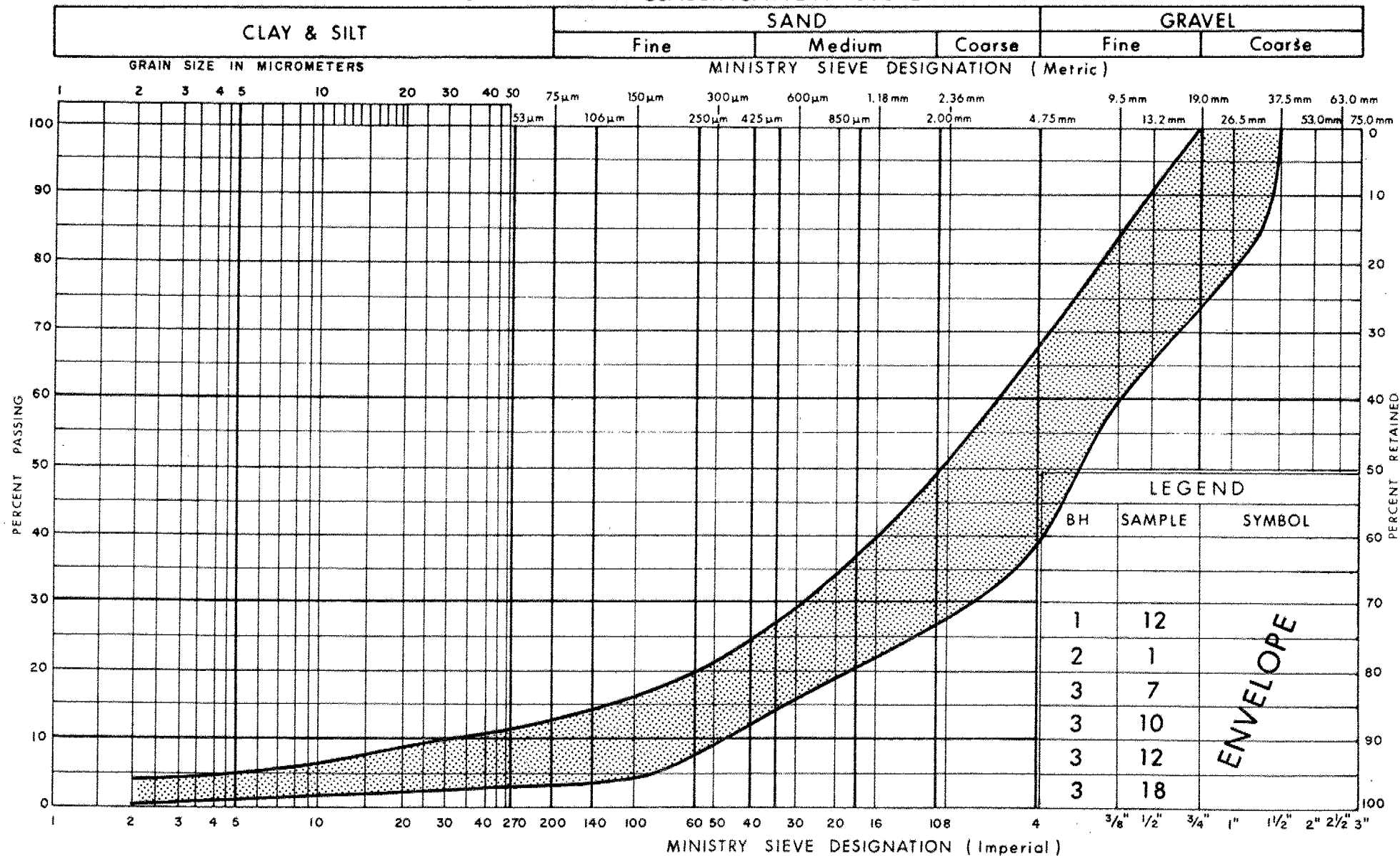


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GRAIN SIZE DISTRIBUTION
SAND SOME SILT, TRACE OF CLAY & GRAVEL

FIG No 1
W P 21-79-08

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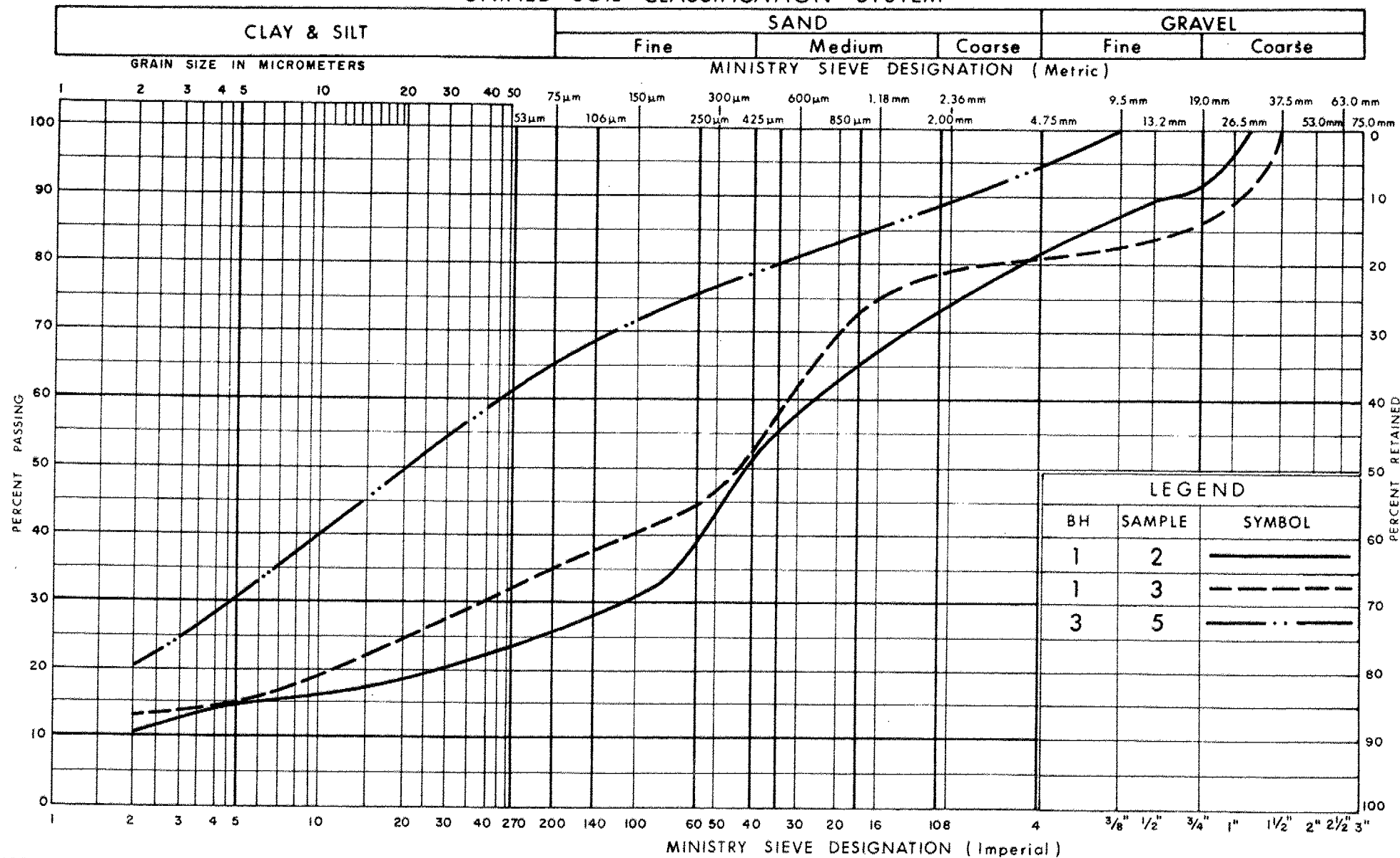
GRAIN SIZE DISTRIBUTION

Interbedded SAND & GRAVEL Layers

FIG No 2

W P 21-79-08

UNIFIED SOIL CLASSIFICATION SYSTEM



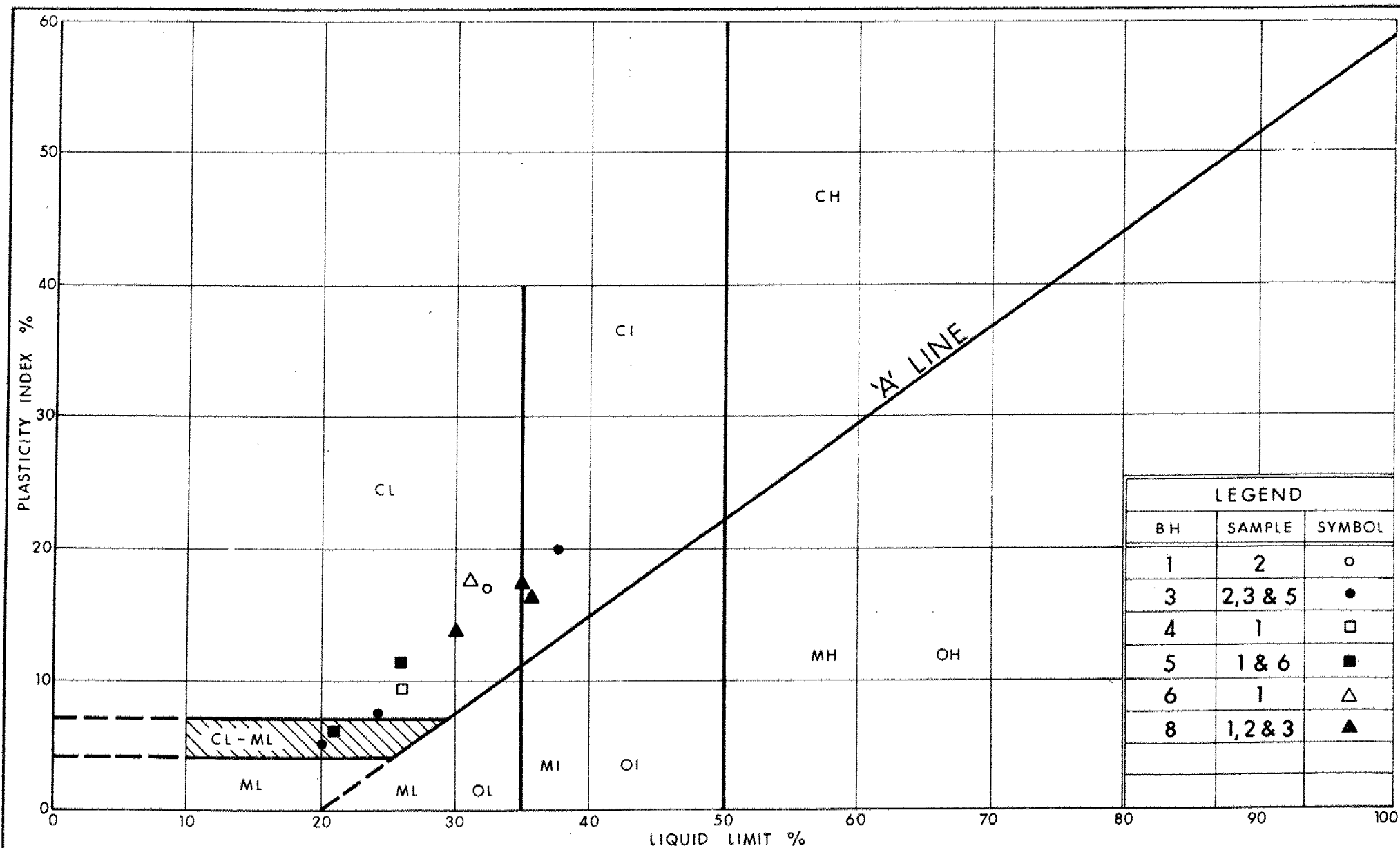
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GRAIN SIZE DISTRIBUTION
SILTY CLAY WITH SAND SOME GRAVEL

FIG No 3

W P 21-79-08

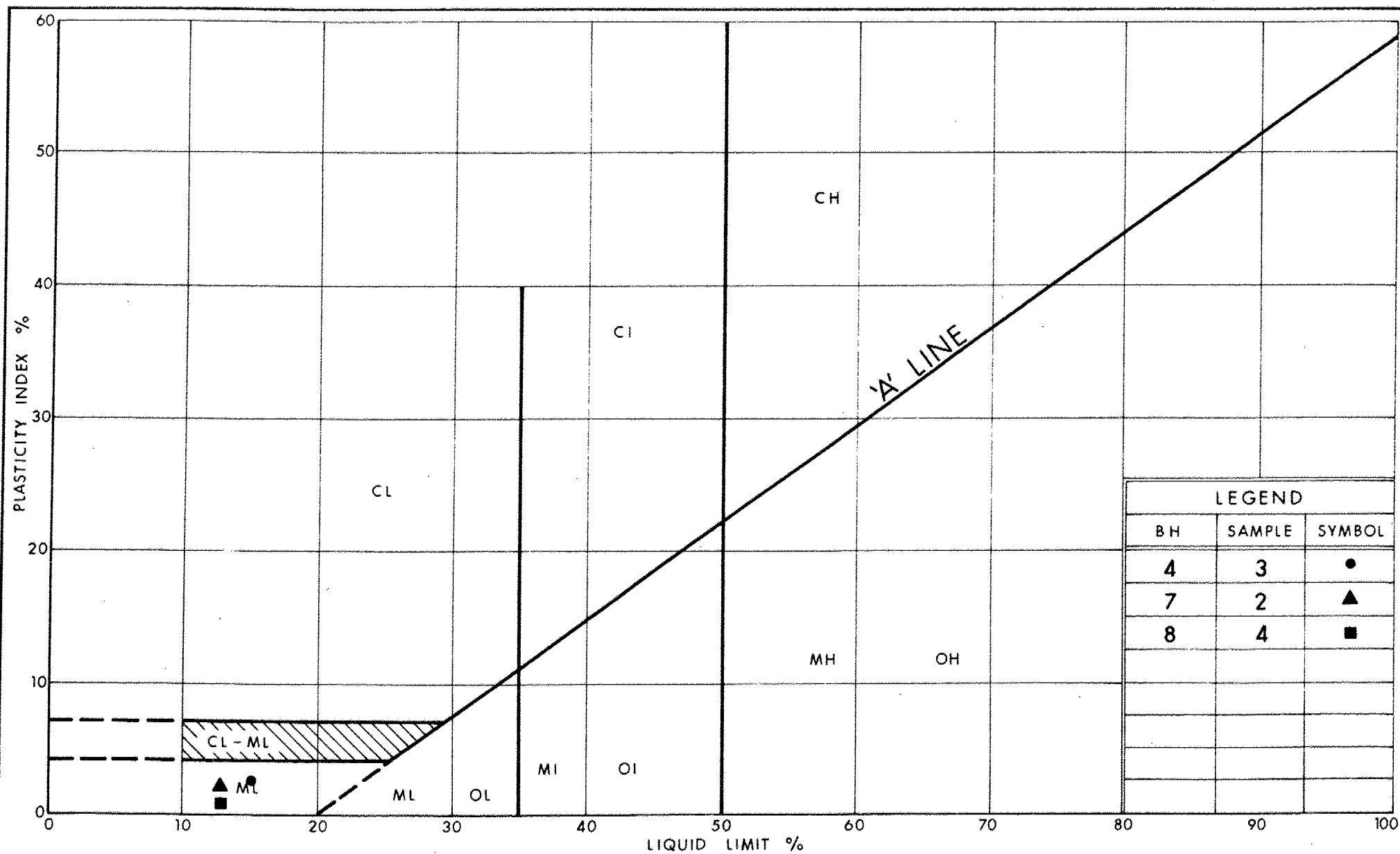


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PLASTICITY CHART SILTY CLAY WITH SAND, SOME GRAVEL

FIG No 4

W P 21-79-08



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PLASTICITY CHART SILT

FIG No 5

W P 21-79-08

Proj. Supervisor
Joe La Scala

454-1242

Don Gmitir



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NOTE:

THIS REPORT DOES NOT CONTAIN THE
RESULTS OF BH 7, 8, 9 & 10 WHICH WERE
DRILLED ON 83-07-27, SUBSEQUENT TO
THE INITIAL INVESTIGATION. FOR LOG SHEETS
AND REVISED DRWG, SEE FILE.

foundation investigation and design report

ENGINEERING MATERIALS OFFICE
PAVEMENT & FOUNDATION DESIGN SECTION

WP 21-79-07

DIST 6

HWY 401

STR SITE 24-145-474

Williams Parkway Underpass

DISTRIBUTION

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Files

FOUNDATION INVESTIGATION REPORT

For

Williams Parkway Underpass
W.P. 21-79-07, Site 24-145-474
Highway 410, District 6, Toronto

INTRODUCTION

This report summarizes the factual information obtained from a foundation investigation carried out between 83 05 18 and 83 05 30 at the above mentioned structure site. The fieldwork consisted of 6 sampled boreholes advanced by means of hollow stem augers, solid stem augers or by wash boring BX casing. The boreholes ranged in depth from 12.6 m to 27.1 m below ground surface. Bedrock was proven in two borings by obtaining up to 2.8 m of BXL size rock core.

SITE DESCRIPTION AND GEOLOGY

The site is located at the existing intersection of Heart Lake Road and Williams Parkway, in the City of Brampton, Municipality of Peel.

Land use in the area is predominantly residential subdivisions with a large mined out gravel pit to the north. Topography across the site is generally flat with the ground surface sloping gently toward the southeast.

The site is located in the physiographic region known as the "Peel Plain". This region is characterized by a level to undulating "till or boulder clay" plain underlain by shale or limestone bedrock. Locally, there is a partly buried esker which runs northwest and southwest of this site. The esker serves as a source of aggregate material and as an aquifer for wells.

Subsurface Conditions

General

The predominant deposit across the site consists of a very loose to very dense deposit of sand with varying proportions of silt, clay and gravel particles. This granular deposit, up to 14.4 m thick is underlain by shale bedrock. Overlying the sand stratum, the surficial

deposits are quite variable, consisting of up to 3.4 m of silt, some sand, trace of clay, or up to 9.8 m of silty clay. Within the surficial silty clay deposit, a 3.1 m thick deposit of firm organic clay was encountered at the northeast corner of the site.

The boundaries between the various soil types, in situ and laboratory test results are shown on the attached Record of Borehole Sheets. The elevations and locations of the boreholes are shown on Drawing No. 217906-A, along with three estimated stratigraphical sections based on borehole data.

The various soil types encountered are described in the following paragraphs.

Silt some Sand trace of Clay

The surficial deposit of silt some Sand traces of Clay extends to a maximum depth of 3.4 m in the southwest corner of the site and is not found in the most easterly areas.

Two grain size distribution tests completed on samples from this stratum indicate some variance in the sand content and a relatively uniform clay content. The results of these tests are plotted on Figure 1.

Atterberg limit testing was completed on samples from this deposit and results are plotted on Figure 5. The Atterberg limits indicate this deposit to be generally non-plastic silt to silt of slight plasticity (ML zone).

Based on interpretation of N values ranging from 11 to 50 blows per 0.3 m, the denseness of this generally non-cohesive stratum is assessed as compact to dense.

Sand with Silt some Gravel

This 2.1 m thick surficial deposit is only found on the north side of Williams Parkway in the middle of the site.

This material is similar to the underlying sands except it has a higher silt content. A grain size distribution test was conducted on a sample from this deposit and the result is plotted on Figure 4.

The N values of 31 and 36 blows per 0.3 m indicate this deposit is dense.

Silty Clay with Sand trace to some Gravel

This is the surficial deposit in the most easterly investigated section of the site and is overlain by the silt deposit to the west on the south side of Williams Parkway and sand to the north. This stratum is not found adjacent to Heart Lake Rd. The thickness of the deposit varies from 1.8 to 9.8 m.

The results of grain size distribution tests conducted on samples from this stratum are plotted in the form of an envelope on Figure 2.

Atterberg limit testing was conducted on samples taken from this deposit and results indicate the stratum is a silty clay of low plasticity (CL zone) to a silt of slight plasticity (CL-ML zone). The results of the Atterberg tests are plotted on Figure 5.

The consistency of this stratum is assessed as being stiff to hard based on N values ranging from 9 blows per 0.3 m to 106 blows per 10 cm.

Black Organic Clay

A 3.1 m layer of black organic clay was found sandwiched within the silty clay deposit in the northeast corner of the site.

Atterberg tests conducted on a sample taken from this layer indicate that the stratum is composed of highly plastic organic clay (OH zone). The results of an Atterberg limit test are plotted on Figure 5.

Organic matter content tests conducted on samples taken from this stratum indicate an organic content varying from 6% to 35%.

Based on the Standard Penetration Test 'N' values varying from 4 to 9, the consistency of this cohesive deposit is assessed as firm.

Sand some Silt trace of Clay

This sand deposit overlies the bedrock and is present across the site. The stratum varies in thickness from 4.1 to 14.4 m, and is overlain by either silty clay or silt.

Grain size distribution curves completed on samples obtained from this stratum indicate that the silt and gravel contents vary throughout the deposit. A 1.3 m layer of gravel with sand some silt trace of clay was encountered directly overlying the bedrock on the north side of Williams Parkway, in the middle of the site. The results of grain size distribution tests are shown on Figure 3 in the form of an envelope. The grain size distribution test result for the localized zone of gravel with sand some silt is also plotted on this figure.

Some cobbles or boulders were encountered while augering below elevation 229.3 adjacent to Heart Lake Rd. north of Williams Parkway.

The denseness of this stratum varies from very loose to very dense based on N values ranging from 3 blows per 0.3 m to 128 blows per 10 cm.

Shale Bedrock

Bedrock was encountered in two boreholes at a depth of 21.6 to 24.3 m. below ground surface (i.e. elevation 214.3 to 212.4).

The bedrock was proven by obtaining up to 2.8 m of BXL size rock core. The bedrock is described as a grey shale of the Georgian Bay Formation with occasional layers of limestone 13 to 75 mm thick. The upper 0.4 to 1.4 m of the bedrock is in a slightly weathered state and below that is generally unweathered.

Rock core recovery rates varied from 89 to 97%. Based on the rock quality designation (RQD) values ranging from 0 to 39%, the quality of the bedrock is assessed as generally very poor to poor.

Groundwater Conditions

Groundwater was measured at depths of 13.0 to 12.2 m in two open boreholes indicating groundwater elevations of 222.9 to 224.5.

In three additional boreholes, the groundwater elevation was assumed to be at the point of caving in of the borehole which occurred at depths of 8.8 to 13 m (elevation 224.2 to 228.5).

At the area of the site where the organic clay layer is sandwiched within the silty clay deposit, an observed groundwater elevation of 233.5 suggests the presence of a perched water table within the organic clay deposit.

DISCUSSION & RECOMMENDATIONS

General

In order to accommodate Williams Parkway over the proposed Highway 410, a two span (31 m, 38 m) underpass structure is contemplated. Design considerations necessitate a slight shift in the alignment of existing Williams Parkway to the south. The proposed profile grades will require earth cuts in the order of 6 m deep for the Highway 410 as well as raising the Williams Parkway grade by up to 2.0 m.

The predominant overburden across this site is a 4.1 to 14.4 m deposit of very loose to very dense sands, overlain by silty clays or silts. A 3.1 m pocket of black organic clay was encountered in the northeast corner of the site. Underlying the overburden is grey shale bedrock.

The following recommendations pertain to the design and construction of the structure foundations and related earthworks.

Structure Foundations

West Abutment

The west abutment can be founded by means of spread footings located at or below elevation 230.0 for a factored bearing capacity at the U.L.S. of 600 kPa, and a bearing capacity of 290 kPa at the S.L.S. Type II. The use of piles at this abutment is not recommended because of the numerous boulders and cobbles encountered in the sand stratum at this location.

East Abutment and Pier

The variable nature of the soil at the proposed pier location and the less competent subsoil at the east abutment will require that end bearing piles driven to bedrock be used for the foundation at this location. An estimated pile tip elevation of 212.0 for the pier and 213.0 for the east abutment can be used for estimating purposes. A steel HP 310 X 110 pile may be designed for a load of 1,600 kN for the factored axial capacity, and a load of 1150 kN for the bearing capacity at the S.L.S. Type II.

The pile tips should be reinforced because of the presence of boulders in the sand stratum.

No dewatering difficulties are anticipated for the footing and pile cap excavations. The water inflow from the perched water table within the organic clay layer can be handled by normal pumping methods.

Earth pressures against the abutment wall should be computed as per Subsection 6.6.1.2.2 of the O.H.B.D.C. Manual.

The underside of all footing elements should be provided with a minimum of 1.3 m of earth cover for frost protection purposes.


Stability of Embankments


The 3.1 m layer of organic material encountered at the north corner of the east abutment must be completely subexcavated and backfilled with a non-cohesive granular material below the abutment and in the area of the approaches.

No stability problems are anticipated for fill heights of 2 m and cuts of 6 m constructed with 2:1 slopes, provided the organic clay is subexcavated as outlined above.

Miscellaneous

The fieldwork for this investigation was carried out under the supervision of Mr. R. Matthys, Student Specialist, utilizing equipment owned and operated by Atcost Soil Investigation, Toronto. This report was written by Mr. H. Sturm, Project Foundation Engineer and reviewed by Mr. M. Devata, Senior Foundations Engineer.

for 
H. J. Sturm
Project Foundations Engineer


M. S. Devata, P. Eng.
Senior Foundations Engineer

HJS:gm

RECORD OF BOREHOLE No 1

METRIC

W P 21-79-07 LOCATION Co-ords N 4 841 516.5 E 284 467.5 ORIGINATED BY R.M.
DIST 6 HWY 410 BOREHOLE TYPE Hollow Stem Auger COMPILED BY H.S.
DATUM Geodetic DATE 83 05 18, 19 CHECKED BY *so*

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES		20	40	60	80	100					
237.2 0.0	Ground Surface															
	Silt some Sand trace of Clay		1	SS	50	236										
			2	SS	42											
			3	SS	40											
233.8 3.4	Dense		4	SS	41	234										
	Sand some Silt trace of Clay		5	SS	33											
			6	SS	31	232										
			7	SS	26	230										
			8	SS	26	228										
			9	SS	25	226										
	Compact to dense		10	SS	37	224										
			11	SS	54											
	trace of Gravel		12	SS	64	222										
			13	SS	103	220										
219.4 17.8	very dense		14	SS	170.08cm											
	End of Borehole Refusal to Augering															
	*Groundwater Elevation assumed to be at the elevation of caving in of the open Borehole															

+3, x5: Numbers refer to
Sensitivity

20
15
10
(%) STRAIN AT FAILURE



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RECORD OF BOREHOLE No 2

METRIC

W P 21-79-07 LOCATION Co-ords N 4 841 540.5 E 284 485.0 ORIGINATED BY R.M.
DIST 6 HWY 410 BOREHOLE TYPE Solid Stem Auger and Dynamic Cone COMPILED BY H.S.
DATUM Geodetic DATE 83 05 19-20 CHECKED BY

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 SHEAR STRENGTH ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE	PLASTIC LIMIT W _p NATURAL MOISTURE CONTENT W LIQUID LIMIT W _L WATER CONTENT (%) 10 20 30	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES							
236.7	Ground Surface											
0.0	Silt some Sand trace of Clay Compact to Dense		1	SS	32		236					0 16 74 10
234.6			2	SS	15		234					4 30 51 15
2.1	Silty Clay with Sand trace Gravel		3	SS	39		232					
			4	SS	45							
	Very Stiff to Hard		5	SS	36							
230.3			6	SS	114		230					11 46 35 8
6.4	Sand some Silt trace of Clay		7	SS	41		228					0 79 18 3
			8	SS	52		226					
			9	SS	56							
	Dense to Very Dense		10	SS	54							0 86 11 3
224.1	End of Borehole											
12.6	* Groundwater elevation assumed to be at the elevation of cave in of the open Borehole											

+3, x5: Numbers refer to
Sensitivity

20
15
10
5
0
5
10
15
20
(%) STRAIN AT FAILURE

OFFICE REPORT ON SOIL EXPLORATIONS

RECORD OF BOREHOLE No 3

METRIC

W P 21-79-07 LOCATION Co-ords N 4 841 567.0 E 284 513.0 ORIGINATED BY R.M.
DIST 6 HWY 410 BOREHOLE TYPE Hollow Stem Auger COMPILED BY H.S.
DATUM Geodetic DATE 83 05 20, 24, 25 CHECKED BY

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					NATURAL MOISTURE CONTENT	LIQUID LIMIT	UNIT WEIGHT	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100	W _p	W	W _L	
235.9	Ground Surface															
0.0	Silty Clay with Sand some Gravel		1	SS	22		234									19 36 31 15
			2	SS	22											7 47 35 11
			3	SS	17											6 30 47 17
			4	SS	51											
	Very Stiff to Hard		5	SS	106/10cm											
			6	SS	45											
			7	SS	49		228									9 35 42 14
227.4	Sand some Silt trace of Clay trace to some Gravel		8	SS	34		226									
8.5			9	SS	58											18 64 14 4
			10	SS	14		224									
	Compact to Very Dense		11	SS	17		222									0 90 9 1
			12	SS	15		220									
			13	SS	47		218									
			14	SS	38		216									19 64 14 3
			15	SS	42											
214.3	Shale (90%) with occasional Limestone layers						214									
21.6			16	RC. BXL			212									
211.9	End of Borehole															
24.0																

+3, x5: Numbers refer to
Sensitivity

20
15-0-5 (%) STRAIN AT FAILURE
10

OFFICE REPORT ON SOIL EXPLORATION



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RECORD OF BOREHOLE No 4

METRIC

W P 21-79-07 LOCATION Co-ords N 4 841 587.0 E 284 492.5 ORIGINATED BY R.M.
DIST 6 HWY 410 BOREHOLE TYPE Solid Stem Auger COMPILED BY H.S.
DATUM Geodetic DATE 83 05 25 CHECKED BY *SO*

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100					
235.7	Ground Surface																GR SA SI CL
0.0	Silty Clay with Sand some Gravel Stiff		1	SS	12		234										12 20 45 23
233.9			2	SS	8												
1.8	Organic Clay BLACK		3	SS	4		232										
	Firm		4	SS	8												
230.8			5	SS	9		230										
4.9	Silty Clay with Sand trace Gravel		6	SS	16												
	Very Stiff		7	SS	22		228										
227.2			8	SS	51		226										
8.5	Sand some Silt trace of Clay some Gravel Very Dense		9	SS	110/25 cm		224										
223.1			10	SS	51												
12.6	End of Borehole																
	* O.M. indicates percentage of organic matter																

+3, x5: Numbers refer to
Sensitivity

20
15
10
5 (%) STRAIN AT FAILURE

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RECORD OF BOREHOLE No 5

METRIC

W P 21-79-07 LOCATION Co-ords N 4 841 544.0 E 284 441.0 ORIGINATED BY R.M.
DIST 6 HWY 410 BOREHOLE TYPE Solid Stem Auger COMPILED BY H.S.
DATUM Geodetic DATE 83 05 25 CHECKED BY *Lo*

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	NUMBER	TYPE	'N' VALUES			20	40	60	80	100				
237.3	Ground Surface														GR SA SI CL
0.0	Silt some Sand trace of Clay Compact	1	SS	11		236									
235.2		2	SS	12											
2.1	Sand some Silt trace of Clay	3	SS	3		234									0 80 8 12
		4	SS	7											
	Very Loose to Dense	5	SS	12		232									
		6	SS	44											0 85 13 2
		7	SS	90/23cm		230									
	Cobbles to Boulders	8	SS	137/25cm		228									26 52 16 6
	Very Dense	9	SS	185/10cm		226									
224.7		10	SS	128											0 60 33 7
12.6	End of Borehole														
	* Groundwater Elevation assumed to be at the Elevation of Caving in of the Open Borehole														

+3, x5: Numbers refer to
Sensitivity

20
15 5 (%) STRAIN AT FAILURE
10

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RECORD OF BOREHOLE No 6

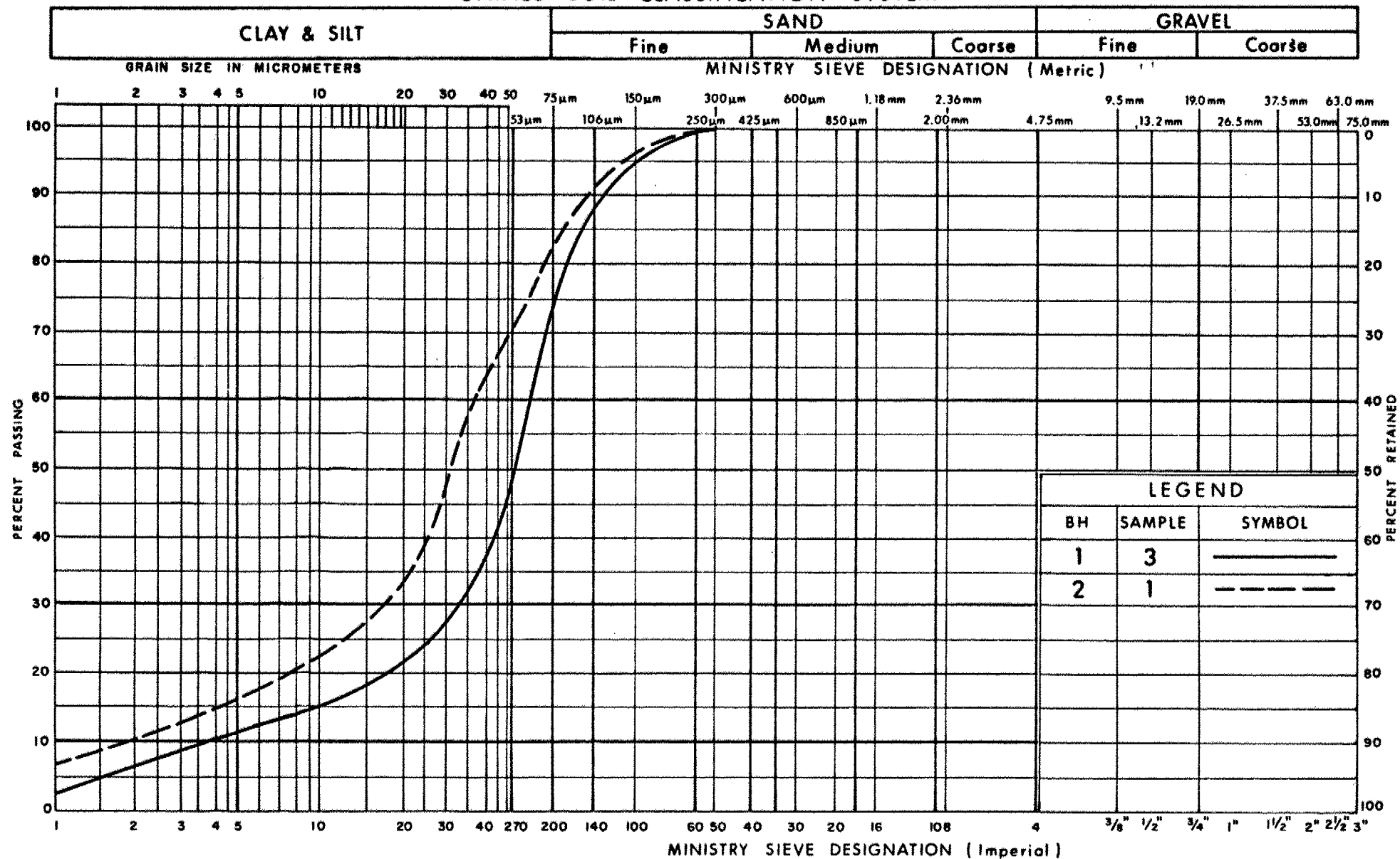
METRIC

W P 21-79-07 LOCATION Co-ords N 4 841 560.5 E 284 467.0 ORIGINATED BY R.M.
DIST 6 HWY 410 BOREHOLE TYPE Solid Stem Auger and Wash Boring COMPILED BY H.S.
DATUM Geodetic DATE 83 05 26, 27, 30 CHECKED BY *LD*

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100				
236.7	Ground Surface															GR SA SI CL
0.0	Sand with Silt some Gravel Dense		1	SS	31		236									15 51 34 0
234.6			2	SS	36											
2.1	Silty Clay with Sand some Gravel		3	SS	9		234									15 45 29 11
			4	SS	12											
			5	SS	22		232									
			6	SS	38		230									
			7	SS	25											15 19 48 18
			8	SS	33		228									
	Stiff to Hard		9	SS	30		226									12 46 25 17
224.8			10	SS	38		224									4 57 29 10
11.9	Sand some Silt some Gravel trace of Clay		11	SS	65											23 67 9 1
			12	SS	30		222									
			13	SS	40		220									21 59 18 2
			14	SS	62		218									20 66 12 2
	Compact to Very Dense		15	SS	23		216									13 64 20 3
			16	SS	62											
	Limestone Boulders		17	RC.			214	REC	RQD	Weathering						
			18	BXL				38%	15%	Unweathered						
	Gravel with Sand some Silt trace Clay		19	SS	39			88%	0%							50 24 17 9
212.4							212									
24.3	Shale (80% Grey with randomly interbedded Limestone (20%) layers 13 to 75 mm thick		20	RC. BXL				94%	39%	Slight						
			21	RC. BXL						Unweathered						
209.6							210	97%	39%							
27.1	End of Borehole															

+3, x⁵: Numbers refer to 20
Sensitivity 15 ± 5 (%) STRAIN AT FAILURE
10

UNIFIED SOIL CLASSIFICATION SYSTEM



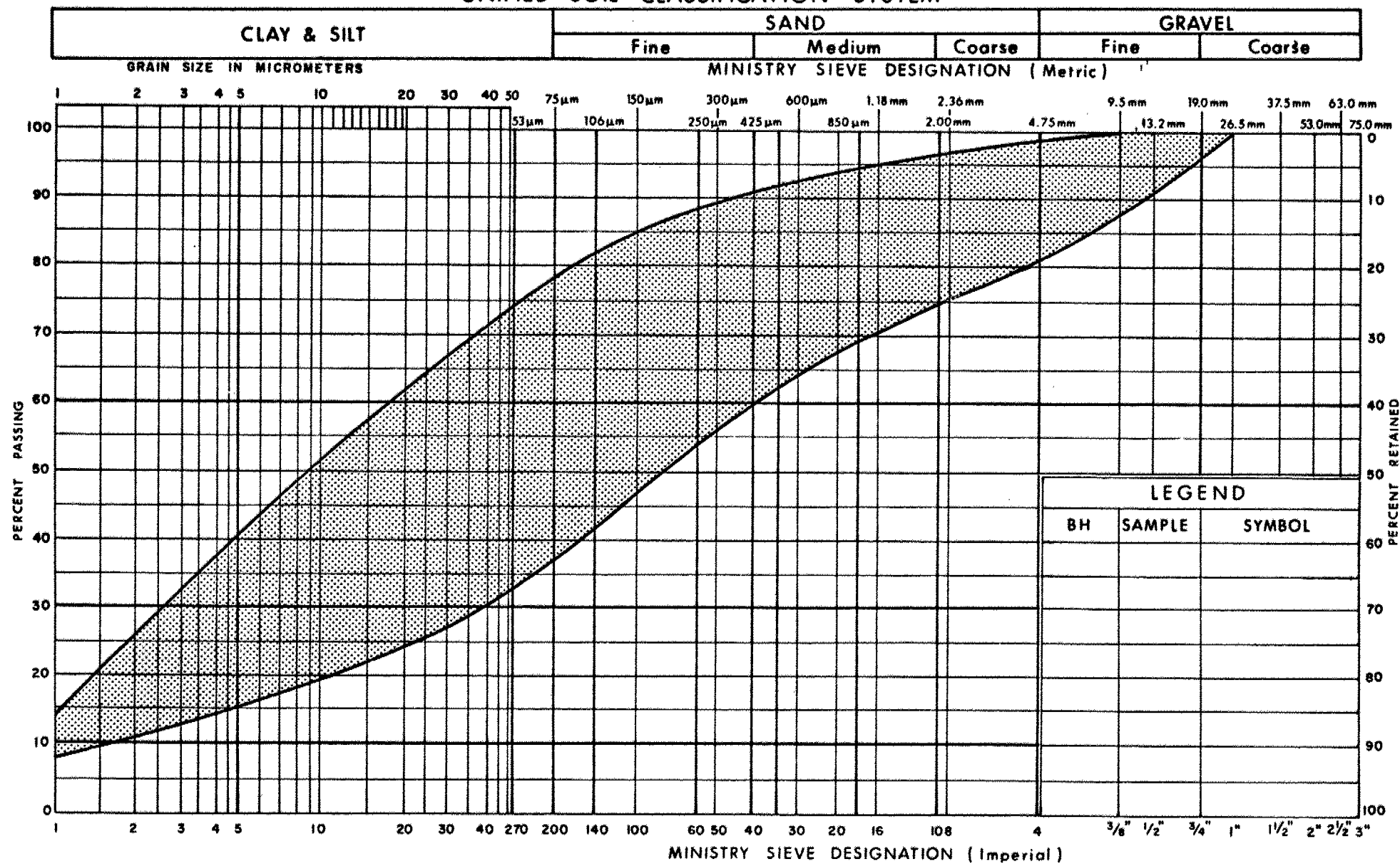
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GRAIN SIZE DISTRIBUTION
SILT SOME SAND, TRACE OF CLAY

FIG No 1

W P 21-79-07

UNIFIED SOIL CLASSIFICATION SYSTEM



Ontario

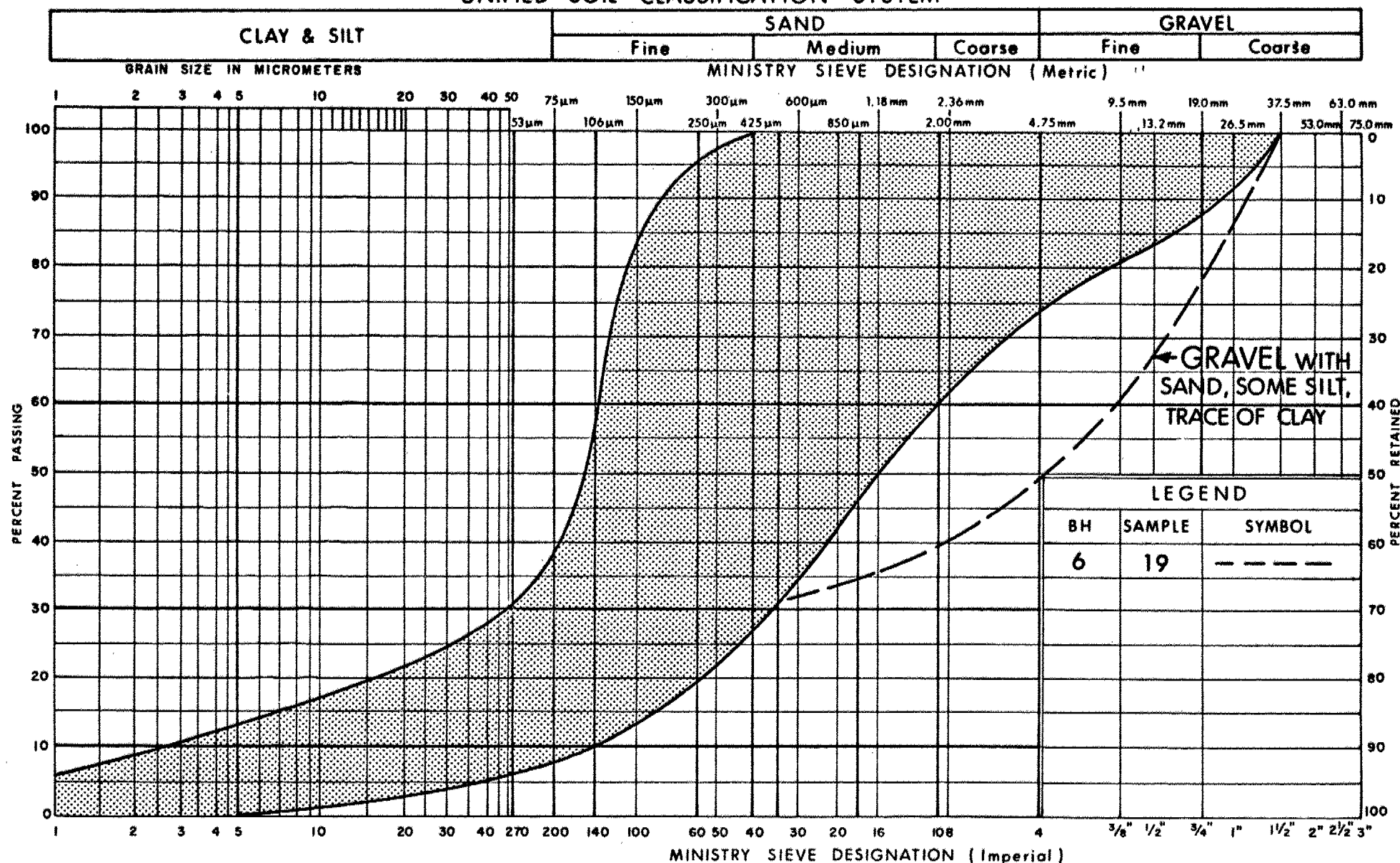
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Communications

GRAIN SIZE DISTRIBUTION
SILTY CLAY WITH SAND, TRACE TO
SOME GRAVEL

FIG No 2

W P 21-79-07

UNIFIED SOIL CLASSIFICATION SYSTEM



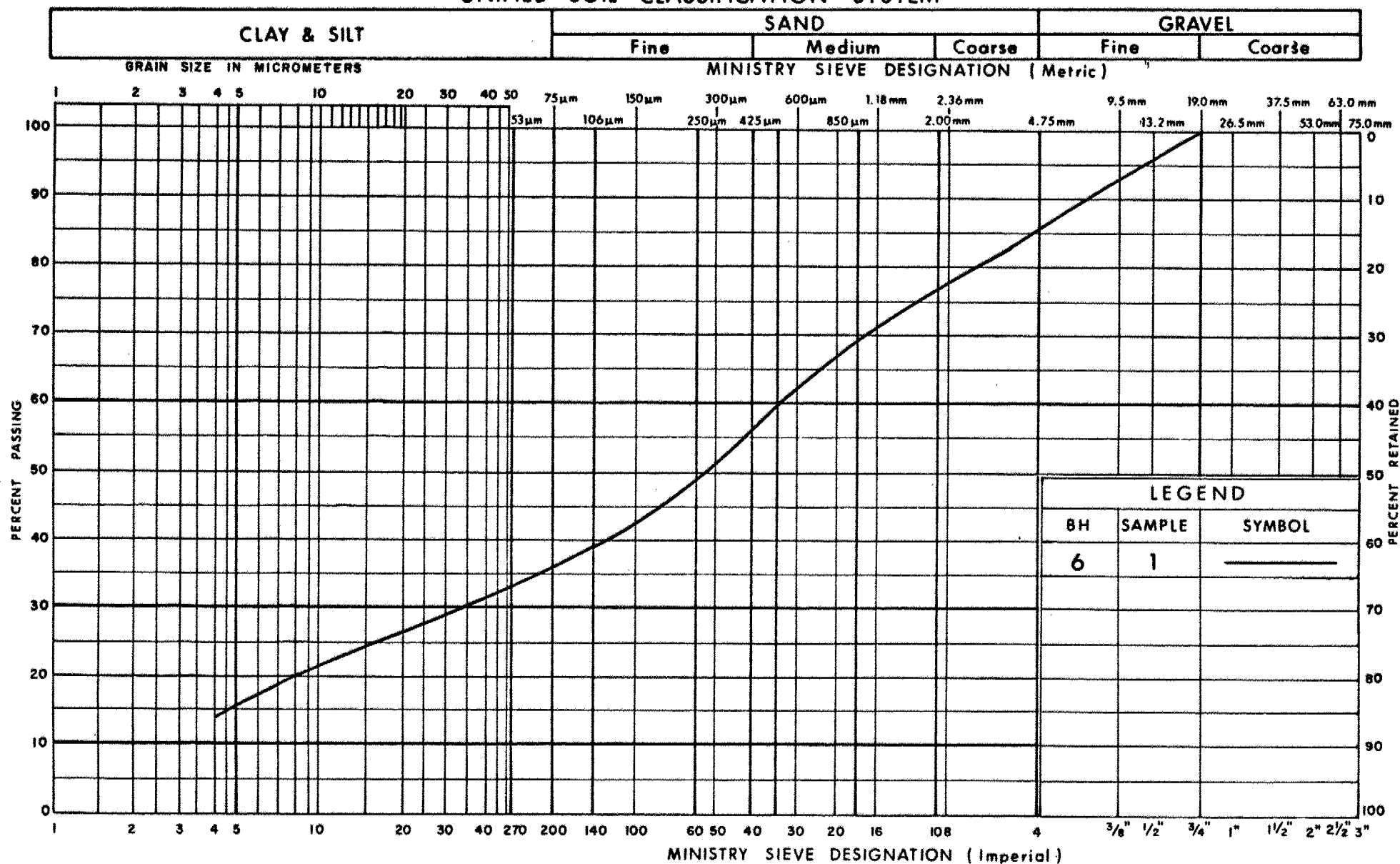
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GRAIN SIZE DISTRIBUTION
SAND SOME SILT, TRACE OF CLAY

FIG No 3

W P 21-79-07

UNIFIED SOIL CLASSIFICATION SYSTEM

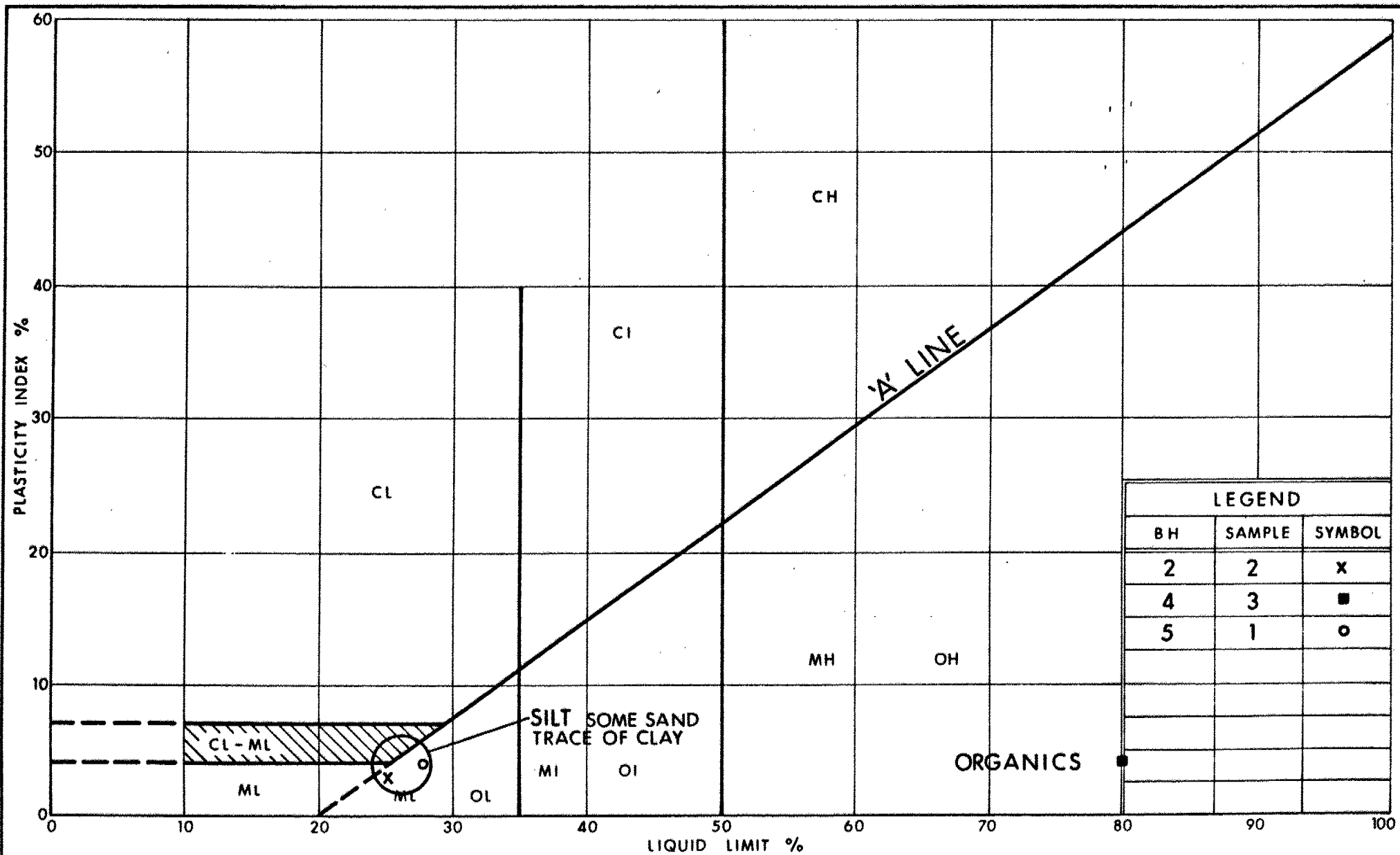


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GRAIN SIZE DISTRIBUTION
SAND WITH SILT, SOME GRAVEL

FIG No 4

W P 21-79-07

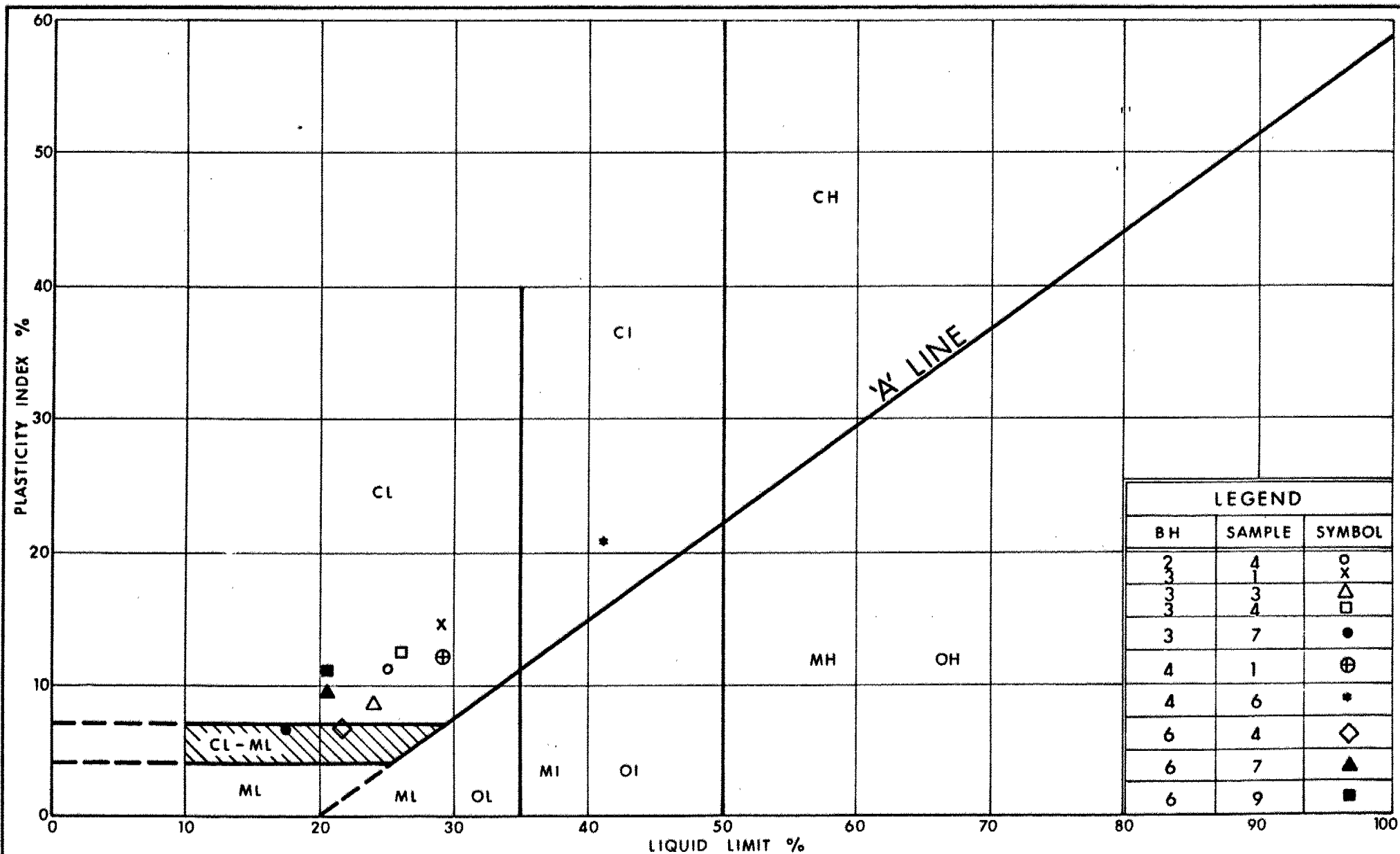


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Communications

PLASTICITY CHART

FIG No 5

W P 21-79-07



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Communications

PLASTICITY CHART
SILTY CLAY WITH SAND
TRACE TO SOME GRAVEL

FIG No 6

W P 21-79-07

EXPLANATION OF TERMS USED IN REPORT

N VALUE: THE STANDARD PENETRATION TEST (SPT) N VALUE IS THE NUMBER OF BLOWS REQUIRED TO CAUSE A STANDARD 51mm O.D. SPLIT BARREL SAMPLER TO PENETRATE 0.3m INTO UNDISTURBED GROUND IN A BOREHOLE WHEN DRIVEN BY A HAMMER WITH A MASS OF 63.5kg, FALLING FREELY A DISTANCE OF 0.76m. FOR PENETRATIONS OF LESS THAN 0.3m N VALUES ARE INDICATED AS THE NUMBER OF BLOWS FOR THE PENETRATION ACHIEVED. AVERAGE N VALUE IS DENOTED THUS \bar{N} .

DYNAMIC CONE PENETRATION TEST: CONTINUOUS PENETRATION OF A CONICAL STEEL POINT (51mm O.D. 60° CONE ANGLE) DRIVEN BY 475 J IMPACT ENERGY ON 'A' SIZE DRILL RODS. THE RESISTANCE TO CONE PENETRATION IS MEASURED AS THE NUMBER OF BLOWS FOR EACH 0.3m ADVANCE OF THE CONICAL POINT INTO THE UNDISTURBED GROUND.

SOILS ARE DESCRIBED BY THEIR COMPOSITION AND CONSISTENCY OR DENSENESS.

CONSISTENCY: COHESIVE SOILS ARE DESCRIBED ON THE BASIS OF THEIR UNDRAINED SHEAR STRENGTH (c_u) AS FOLLOWS:

c_u (kPa)	0 - 12	12 - 25	25 - 50	50 - 100	100 - 200	> 200
	VERY SOFT	SOFT	FIRM	STIFF	VERY STIFF	HARD

DENSENESS: COHESIONLESS SOILS ARE DESCRIBED ON THE BASIS OF DENSENESS AS INDICATED BY SPT N VALUES AS FOLLOWS:

N (BLOWS/0.3m)	0 - 5	5 - 10	10 - 30	30 - 50	> 50
	VERY LOOSE	LOOSE	COMPACT	DENSE	VERY DENSE

ROCKS ARE DESCRIBED BY THEIR COMPOSITION AND STRUCTURAL FEATURES AND / OR STRENGTH.

RECOVERY: SUM OF ALL RECOVERED ROCK CORE PIECES FROM A CORING RUN EXPRESSED AS A PERCENT OF THE TOTAL LENGTH OF THE CORING RUN.

MODIFIED RECOVERY: SUM OF THOSE INTACT CORE PIECES, 100mm+ IN LENGTH EXPRESSED AS A PERCENT OF THE LENGTH OF THE CORING RUN. THE ROCK QUALITY DESIGNATION (R Q D), FOR MODIFIED RECOVERY, IS:

R Q D (%)	0 - 25	25 - 50	50 - 75	75 - 90	90 - 100
	VERY POOR	POOR	FAIR	GOOD	EXCELLENT

JOINTING AND BEDDING:

SPACING	50mm	50 - 300mm	0.3m - 1m	1m - 3m	> 3m
JOINTING	VERY CLOSE	CLOSE	MOD. CLOSE	WIDE	VERY WIDE
BEDDING	VERY THIN	THIN	MEDIUM	THICK	VERY THICK

ABBREVIATIONS AND SYMBOLS

FIELD SAMPLING

S S	SPLIT SPOON	T P	THINWALL PISTON
W S	WASH SAMPLE	O S	OSTERBERG SAMPLE
S T	SLOTTED TUBE SAMPLE	R C	ROCK CORE
B S	BLOCK SAMPLE	P H	T W ADVANCED HYDRAULICALLY
C S	CHUNK SAMPLE	P M	T W ADVANCED MANUALLY
T W	THINWALL OPEN	F S	FOIL SAMPLE

STRESS AND STRAIN

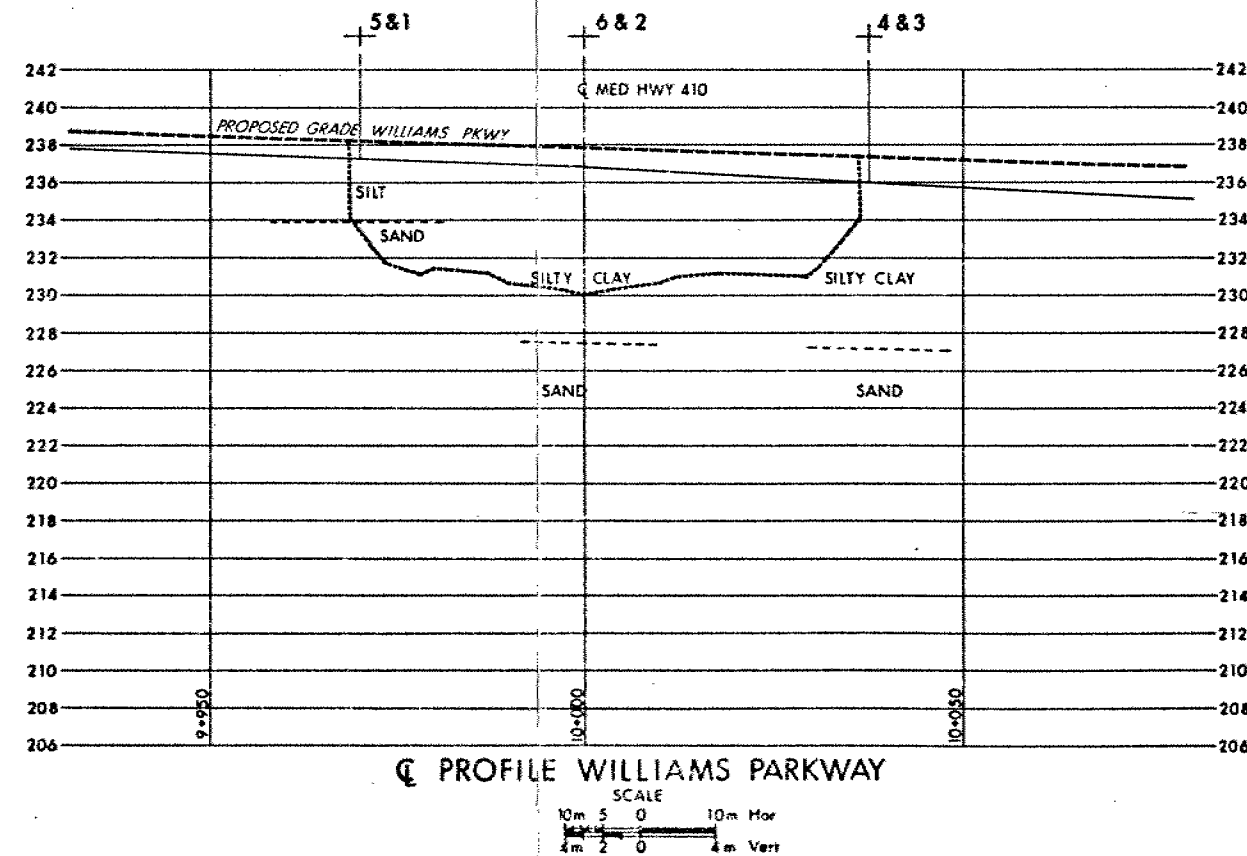
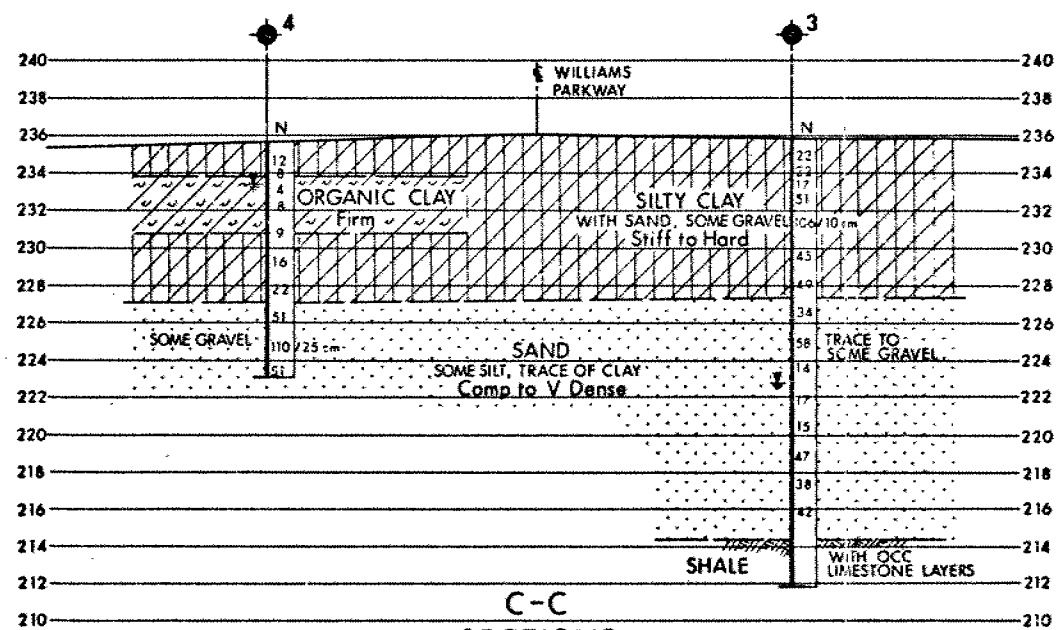
u_w	kPa	PORE WATER PRESSURE
T_u	1	PORE PRESSURE RATIO
σ	kPa	TOTAL NORMAL STRESS
σ'	kPa	EFFECTIVE NORMAL STRESS
τ	kPa	SHEAR STRESS
$\sigma_1, \sigma_2, \sigma_3$	kPa	PRINCIPAL STRESSES
ϵ	%	LINEAR STRAIN
$\epsilon_1, \epsilon_2, \epsilon_3$	%	PRINCIPAL STRAINS
E	kPa	MODULUS OF LINEAR DEFORMATION
G	kPa	MODULUS OF SHEAR DEFORMATION
μ	1	COEFFICIENT OF FRICTION





MECHANICAL PROPERTIES OF SOIL

m_v	kPa ⁻¹	COEFFICIENT OF VOLUME CHANGE
C_c	1	COMPRESSION INDEX
C_s	1	SWELLING INDEX
C_α	1	RATE OF SECONDARY CONSOLIDATION
c_v	m ² /s	COEFFICIENT OF CONSOLIDATION
H	m	DRAINAGE PATH
T_v	1	TIME FACTOR
U	%	DEGREE OF CONSOLIDATION
σ'_{vo}	kPa	EFFECTIVE OVERBURDEN PRESSURE
σ'_p	kPa	PRECONSOLIDATION PRESSURE
τ_f	kPa	SHEAR STRENGTH
c'	kPa	EFFECTIVE COHESION INTERCEPT
ϕ'	-°	EFFECTIVE ANGLE OF INTERNAL FRICTION
c_u	kPa	APPARENT COHESION INTERCEPT
ϕ_u	-°	APPARENT ANGLE OF INTERNAL FRICTION
τ_R	kPa	RESIDUAL SHEAR STRENGTH
τ_r	kPa	REMOULDED SHEAR STRENGTH
S_r	1	SENSITIVITY = $\frac{c_u}{\tau_r}$

PHYSICAL PROPERTIES OF SOIL

ρ_s	kg/m ³	DENSITY OF SOLID PARTICLES	e	1, %	VOID RATIO	e_{min}	1, %	VOID RATIO IN DENSEST STATE
γ_s	kN/m ³	UNIT WEIGHT OF SOLID PARTICLES	n	1, %	POROSITY	I_D	1	DENSITY INDEX = $\frac{e_{max} - e}{e_{max} - e_{min}}$
ρ_w	kg/m ³	DENSITY OF WATER	w	1, %	WATER CONTENT	D	mm	GRAIN DIAMETER
γ_w	kN/m ³	UNIT WEIGHT OF WATER	S_r	%	DEGREE OF SATURATION	D_n	mm	n PERCENT - DIAMETER
ρ	kg/m ³	DENSITY OF SOIL	w_L	%	LIQUID LIMIT	C_u	1	UNIFORMITY COEFFICIENT
γ	kN/m ³	UNIT WEIGHT OF SOIL	w_p	%	PLASTIC LIMIT	h	m	HYDRAULIC HEAD OR POTENTIAL
ρ_d	kg/m ³	DENSITY OF DRY SOIL	w_s	%	SHRINKAGE LIMIT	q	m ³ /s	RATE OF DISCHARGE
γ_d	kN/m ³	UNIT WEIGHT OF DRY SOIL	I_p	%	PLASTICITY INDEX = $w_L - w_p$	v	m/s	DISCHARGE VELOCITY
ρ_{sat}	kg/m ³	DENSITY OF SATURATED SOIL	I_L	1	LIQUIDITY INDEX = $\frac{w - w_p}{I_p}$	i	1	HYDRAULIC GRADIENT
γ_{sat}	kN/m ³	UNIT WEIGHT OF SATURATED SOIL	I_C	1	CONSISTENCY INDEX = $\frac{w_L - w}{I_p}$	k	m/s	HYDRAULIC CONDUCTIVITY
ρ'	kg/m ³	DENSITY OF SUBMERGED SOIL	e_{max}	1, %	VOID RATIO IN LOOSEST STATE	j	kN/m ³	SEEPAGE FORCE
γ'	kN/m ³	UNIT WEIGHT OF SUBMERGED SOIL						



LEGEND			
	Bore Hole		
	Dynamic Cone Penetration Test (Cone)		
	Bore Hole & Cone		
N	Blows/0.3m (Std Pen Test, 475 J/blow)		
CONE	Blows/0.3m (60° Cone, 475 J/blow)		
	W L at time of investigation 1983 05		
No	ELEVATION	CO-ORDINATES	
		NORTH	EAST
1	237.2	4841516.5	284467.5
2	236.7	4841540.5	284485.0
3	235.9	4841567.0	284513.0
4	235.7	4841587.0	284492.5
5	237.3	4841544.0	284441.0
6	236.7	4841560.5	284467.0

NOTE: The complete foundation investigation and design report for this project and other related documents may be examined at the Engineering Materials Office, Downsview. Information contained in this report and related documents is specifically excluded in accordance with the conditions of Section 102-2 of Form 100.

REV				
	DATE	BY	DESCRIPTION	
Geocres No 30M12-179				
HWT No 410			DIST 6	
SUBMID H S	CHECKED	DATE 83 07 22	SITE 2d-145-A	
DRAWN S C	CHECKED	APPROVED	DWG 217907-A	

METRIC

DIMENSIONS ARE IN MILLIMETRES
UNLESS OTHERWISE SHOWN.
ELEVATIONS, COORDINATES, CURVE
AND ALIGNMENT DATA ARE IN METRES.
STATIONS ARE IN KILOMETRES + METRES.

NOTES

CLASS OF CONCRETE

DECK & PIER COLUMNS	35 MPa
ABUTMENTS, WINGWALLS & BARRIER WALLS	30 MPa
REMAINDER	20 MPa

REINFORCING STEEL

GRADE 400
BARS MARKED WITH SUFFIX 'C' DENOTES
COATED BARS.

CLEAR COVER TO REINFORCING STEEL

FOOTINGS	100 ± 25
ABUTMENTS FRONT FACE	30 ± 20
ABUTMENTS BACK FACE	70 ± 20
DECK TOP	10 ± 20
DECK BOT AND SIDES	30 ± 10
PIER COLUMNS	80 ± 20
REMAINDER UNLESS OTHERWISE NOTED	70 ± 20

CONSTRUCTION NOTES

THE CONTRACTOR IS RESPONSIBLE FOR
FINISHING THE BEARING SEATS DEAD
LEVEL TO THE SPECIFIED ELEVATIONS
WITH A TOLERANCE OF ± 3 mm.

LIST OF DRAWINGS

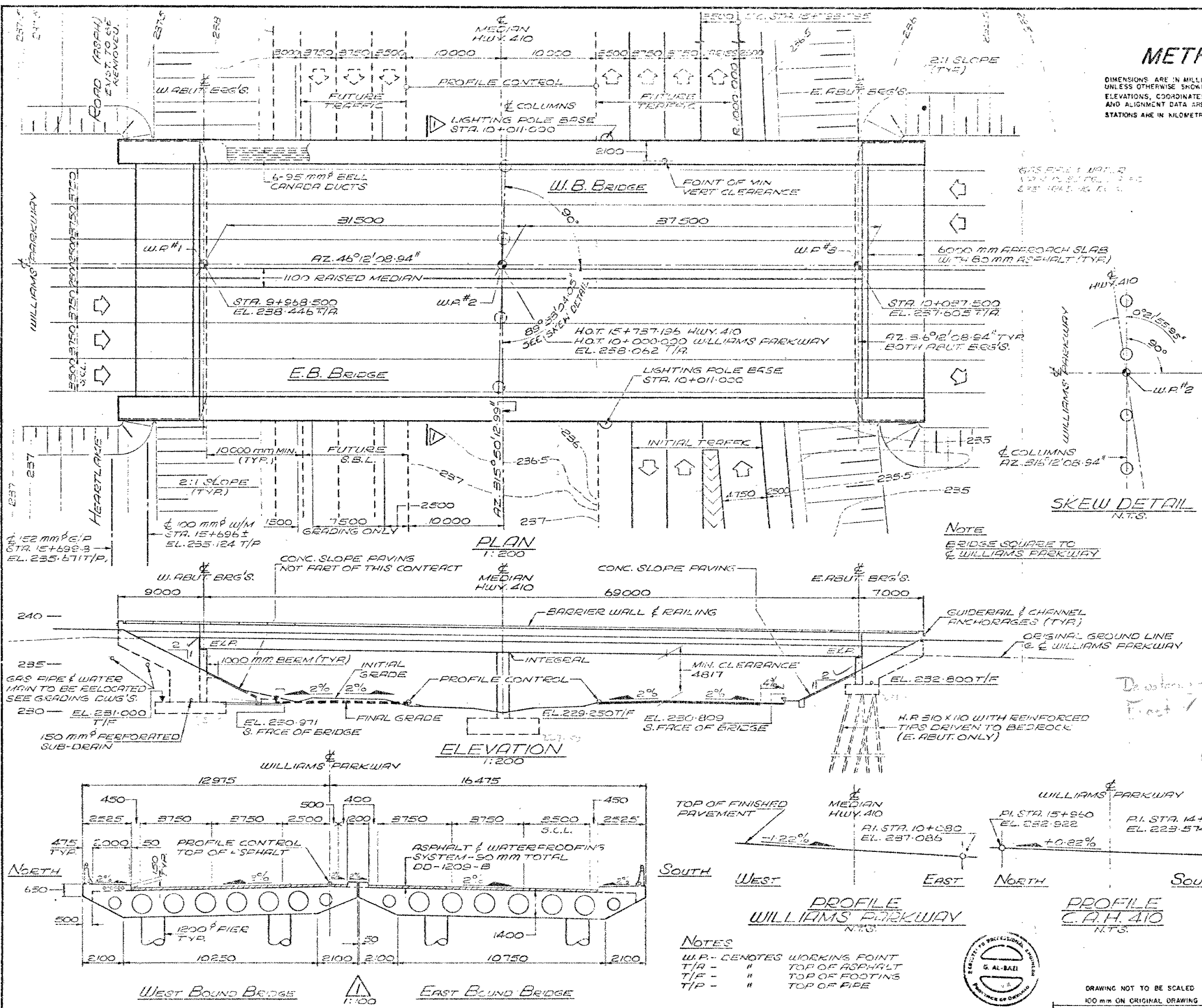
- 1 - GENERAL ARRANGEMENT
- 2 - BORE HOLE LOCATION AND SOIL STRATA
- 3 - FOOTING LAYOUT AND DETAILS
- 4 - WEST ABUTMENT
- 5 - EAST ABUTMENT
- 6 - PIER DETAILS
- 7 - DECK DETAILS
- 8 - LONGITUDINAL TENDON DETAILS
- 9 - TRANSVERSE TENDON DETAILS
- 10 - DECK REINFORCING DETAILS I
- 11 - DECK REINFORCING DETAILS II
- 12 - DECK REINFORCING DETAILS III
- 13 - JOINT ANCHORAGE AND REMOURING
- 14 - BARRIER WALL ON SIDEWALK
- 15 - RAILING FOR BARRIER WALL
- 16 - 6000 mm APPROACH SLAB
- 17 - DETAILS OF CONCRETE SLOPE PAVING
- 18 - AS CONSTRUCTED ELEV. & DIM.
- 19 - BRIDGE DATE AND SITE NUMBER DATA
- 20 - QUANTITIES - STRUCTURE I
- 21 - QUANTITIES - STRUCTURE II
- 22 - STANDARD DETAILS
- 23 - ELECTRICAL EMBEDDED WORK

NOTE
ORGANIC MATERIAL ENCOUNTERED AT THE
NORTH CORNER OF THE EAST ABUTMENT
MUST BE COMPLETELY SUBEXCAVATED AND
BACKFILLED WITH TYPE 1 GRANULAR 'B'
MATERIAL BELOW THE ABUTMENT AND
THE AREA OF THE APPROACH FOR
LIMITS, SEE GRADING DRAWINGS.

NO CONCRETE TO BE PLACED ABOVE
ABUTMENT BEARING SEATS UNTIL THE
CONCRETE IN THE DECK HAS
BEEN STRESSED AND GROUTED.

B.M. 236.852

TOP OF W. BOLT UPPER
RIM OF FIRE HYDRANT
31-2 LT. 15+570.2



SKEW DETAIL
N.T.S.

NOTE
BRIDGE SQUARE TO
WILLIAMS PARKWAY

PROFILE
WILLIAMS PARKWAY
N.T.S.

PROFILE
C.A.H. 410
N.T.S.

NOTES
W.P. - DENOTES WORKING POINT
T/A - " TOP OF ASPHALT
T/F - " TOP OF FOOTING
T/P - " TOP OF PIPE



DRAWING NOT TO BE SCALED
100 mm ON ORIGINAL DRAWING

REVISIONS	DATE	BY	DESCRIPTION
DESIGN	3-23-82	CHK	LOADING
DRAWING	3-23-82	CHK	SITE

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS ONTARIO

METRIC

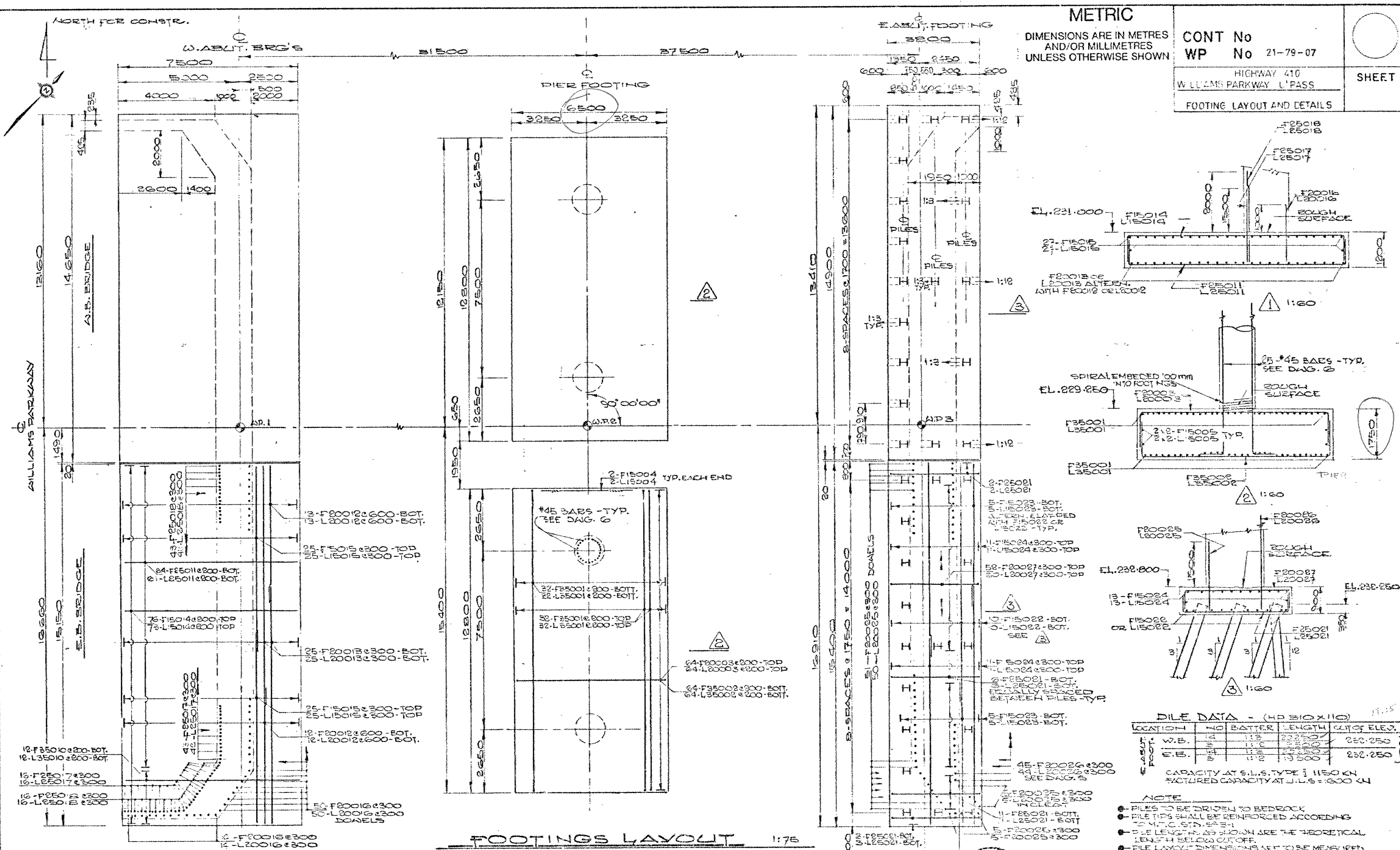
DIMENSIONS ARE IN METRES
AND/OR MILLIMETRES
UNLESS OTHERWISE SHOWN

CONT No
WP No 21-79-07

HIGHWAY 410
WILLIAMS PARKWAY L'PASS

FOOTING LAYOUT AND DETAILS

SHEET



W.D. CO-ORDINATES			
W.P.	STATION	NORTH	EAST
1	0+335.000	464553.503	284553.148
2	0+070.000	464550.334	284553.152
3	0+037.500	464516.649	284563.519

NOTE

- REINFORCING BARS WITH DESIGNATION - U - ARE FOR A.B. BRIDGE
- REINFORCING BARS WITH DESIGNATION - F - ARE FOR E.B. BRIDGE

DRAWING NOT TO BE SCALED
100 mm ON ORIGINAL DRAWING

PILE DATA - (HP B10X110)				
LOCATION	NO	BATTER	LENGTH	CUT OF ELEV.
E. 400'	W.B.	1:1	20'-0"	232.250
	E.B.	1:1	20'-0"	232.250

CAPACITY AT S.L.S. TYPE I 1150 KN
FACTURED CAPACITY AT U.L.S. = 1600 KN

NOTE

- ② FILES TO BE DRIVEN TO BEDROCK
- ③ FILE TIPS SHALL BE REINFORCED ACCORDING TO THE STD. SPEC.
- ④ THE LENGTHS AS SHOWN ARE THE THEORETICAL LENGTHS TO BE CUT OFF.
- ⑤ FILE LAYOUT DIMENSIONS ARE TO BE MEASURED AT THE UNDERSIDE OF FOOTING.

REVISIONS	DESCRIPTION			
	DATE	BY	DESCRIPTION	DATE
DESIGN	CHECK	LOADING	DATE	
DRAWING	CHECK	SITE PLAN	DWG	

ADDITIONAL
BOREHOLES

RECORD OF BOREHOLE No 7										METRIC					
W P 21-79-07		LOCATION Co-ords. N 4 841 609.5; E 284 517.0				ORIGINATED BY RM									
DIST 6 HWY 410		BOREHOLE TYPE Solid Stem Auger				COMPILED BY HS									
DATUM Geodetic		DATE 1983 07 27				CHECKED BY <i>EP</i>									
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60					
234.9 0.0	Ground Surface														
	Very Stiff Silty Clay (Fill) with sand trace gravel Firm to Stiff		1	SS	29	*	234								13 30 42 15
			2	SS	18		232								
			3	SS	6		230								
			4	SS	9		228								
			5	SS	7										
226.8		6	SS	11										3 22 48 27	
8.1	End of Borehole														
	* Groundwater elevation not established														

OFFICE REPORT ON SOIL EXPLORATION



RECORD OF BOREHOLE No 8

METRIC

W P 21-79-07 LOCATION Co-ords. N 4 841 599.0; E 284 506.0 ORIGINATED BY RM
 DIST 6 HWY 410 BOREHOLE TYPE Solid Stem Auger COMPILED BY HS
 DATUM Geodetic DATE 83 07 27 CHECKED BY [Signature]

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			UNIT WEIGHT Y	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20 40 60 80 100	PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W		
235.0	Ground Surface											
0.0	Silty Clay (Fill) with sand trace gravel		1	SS	25	*	234					9 28 42 21
			2	SS	18							
			3	SS	6		232					
			4	SS	7		230					
228.4			5	SS	9							
6.6	End of Borehole											
	* Groundwater elevation not established											

OFFICE REPORT ON SOIL EXPLORATION

+3, x5: Numbers refer to 20
Sensitivity 15 5 (%) STRAIN AT FAILURE
10



RECORD OF BOREHOLE No 9

METRIC

W P 21-79-07 LOCATION Co-ords. N 4 841 593.5; E 284 500.5 ORIGINATED BY RM
DIST 6 HWY 410 BOREHOLE TYPE Solid Stem Auger COMPILED BY HS
DATUM Geodetic DATE 83 07 27 CHECKED BY CP

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 SHEAR STRENGTH ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE	PLASTIC LIMIT W _p NATURAL MOISTURE CONTENT W LIQUID LIMIT W _L WATER CONTENT (%) 10 20 30	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	'N' VALUES						
235.3	Ground Surface										
0.0	Sand (Fill) some gravel										
234.1	trace silt dense		1	SS	38		234		○		27 62 11 0
1.2			2	SS	9	*					
	Silty Clay (Fill) with sand trace gravel Firm to Stiff		3	SS	7		232				
			4	SS	9		230		○		4 24 48 24
228.7			5	SS	12				○		
6.6	End of Borehole										
	* Groundwater elevation not established										

OFFICE REPORT ON SOIL EXPLORATION

+3, x5: Numbers refer to
Sensitivity

20
15 5 (%) STRAIN AT FAILURE
10



Ministry of
Transportation and
Communications
Ontario

RECORD OF BOREHOLE No 10

METRIC

W P 21-79-07 LOCATION Co-ords. N 4 841 589.5; E 284 496.0 ORIGINATED BY RM
DIST 6 HWY 410 BOREHOLE TYPE Solid Stem Augers COMPILED BY HS
DATUM Geodetic DATE 83 07 27 CHECKED BY [Signature]

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100					
235.5	Ground Surface																
0.0																	
			1	SS	31		234										6 21 49 24
			2	SS	4												
			3	SS	5		232										
			4	SS	13												
230.5			5	SS	17		230										
5.0			6	SS	19												
			7	SS	31		228										4 21 47 28
			8	SS	46												
226.1			9	SS	25		226										
9.4			10	SS	17												
224.4																	14 50 25 11
11.1																	

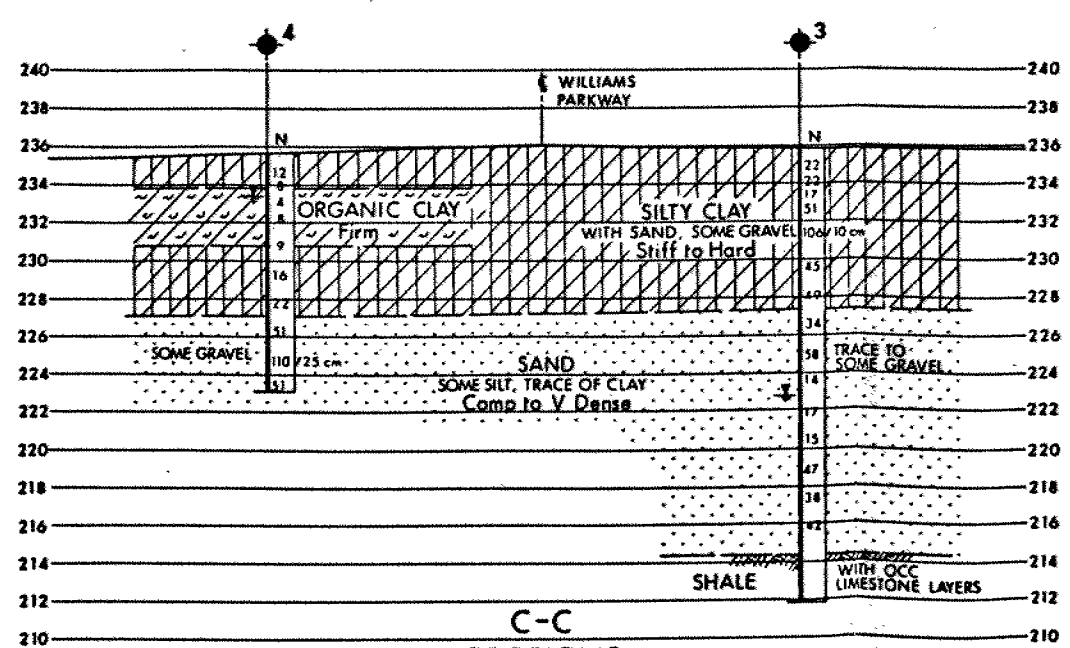
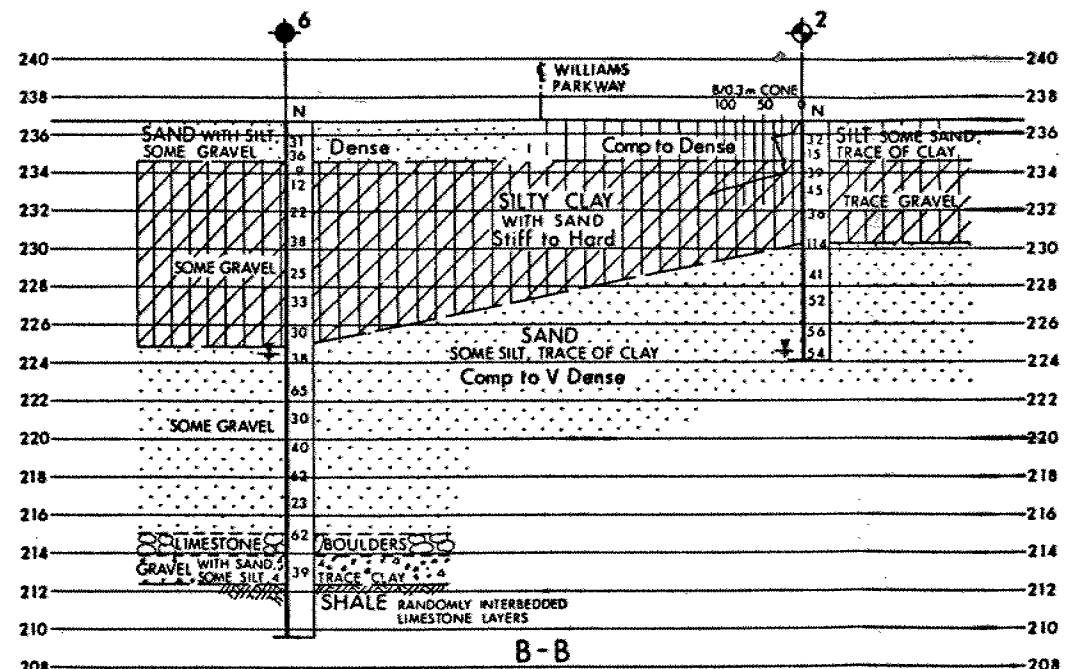
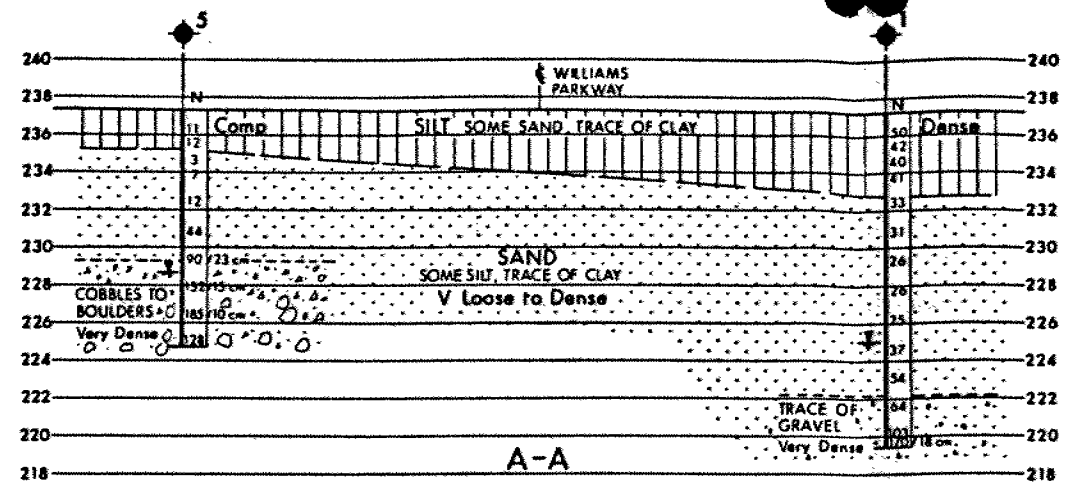
* Org.M. indicates
percentage of
organic matter.

** Groundwater
elevation not
established.

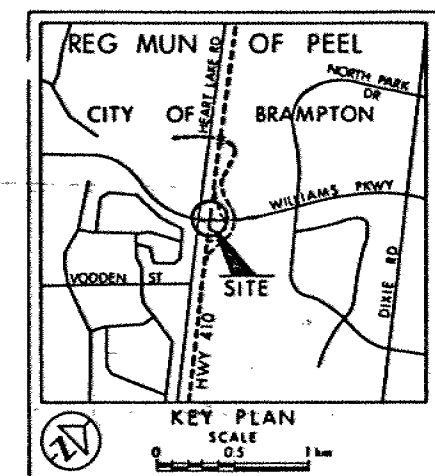
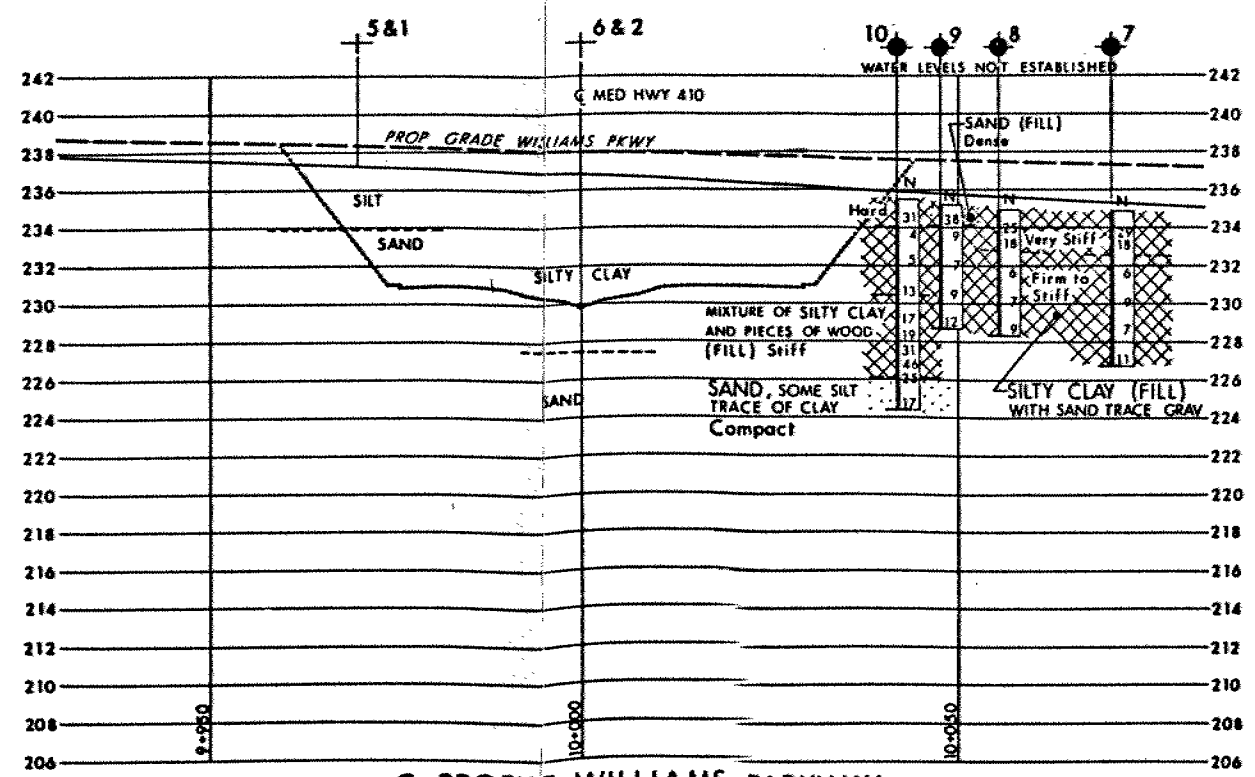
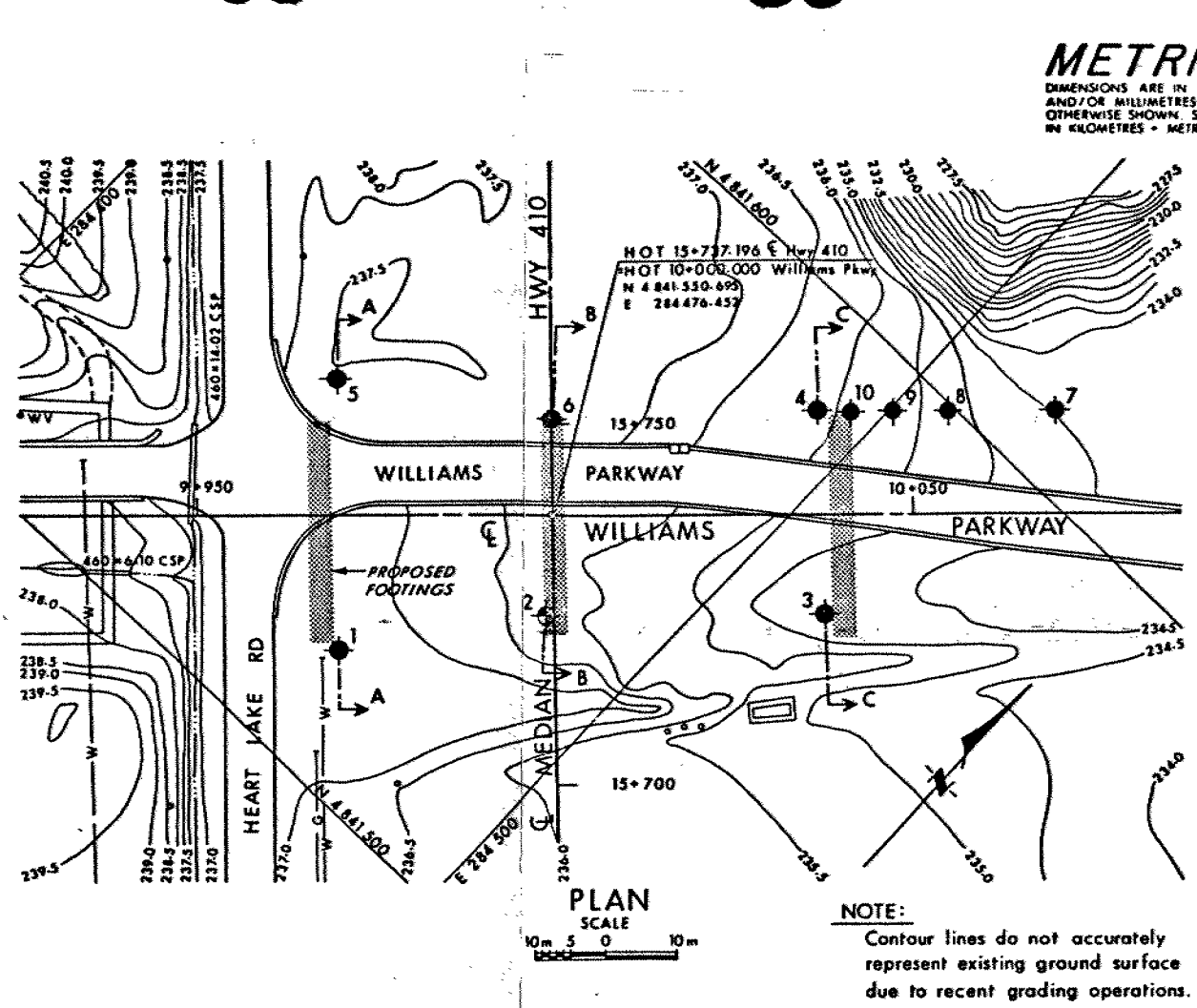
OFFICE REPORT ON SOIL EXPLORATION

+³, x⁵: Numbers refer to
Sensitivity

20
15 → 5 (%) STRAIN AT FAILURE
10



SECTIONS
SCALE
4m 2 0 4m



LEGEND

- ◆ Bore Hole
- ⊕ Dynamic Cone Penetration Test (Cone)
- ⊕ Bore Hole & Cone
- N Blows/0.3m (Std Pen Test, 475 J/blow)
- CONE Blows/0.3m (60° Cone, 475 J/blow)
- W.L. at time of investigation 1983 05
- W.L. Not Established in Borehole 7, 8, 9 and 10

No	ELEVATION	CO-ORDINATES	
		NORTH	EAST
1	237.2	4841516.5	284467.5
2	236.7	4841540.5	284485.0
3	235.9	4841567.0	284513.0
4	235.7	4841587.0	284492.5
5	237.3	4841544.0	284441.0
6	236.7	4841560.5	284467.0
7	234.9	4841609.5	284517.0
8	235.0	4841599.0	284506.0
9	235.3	4841593.5	284500.5
10	235.5	4841589.5	284496.0

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

NOTE: The complete foundation investigation and design report for this project and other related documents may be examined at the Engineering Materials Office, Downsview. Information contained in this report and related documents is specifically included in accordance with the conditions of Section 102-2 of Form 100.

831230GFP BOREHOLE 7, 8, 9 and 10 ADDED

DATE BY DESCRIPTION

Geocres No 30M125179

HWY No 410

SUBARD H5 CHECKED DATE 83 07 22 SITE 24-145-474

DRAWN SO CHECKED DATE 83 07 22 DWG 217907-A

REF No E-6028-1; 1983 04

memorandum



To: W.L. Lin
Design Engineer
Structural Office
3501 Dufferin Street

Date: 1983 09 16

From: Pavement & Foundation
Design Section
Room 315, Central Building

Re: Williams Parkway Underpass
W.P. 21-79-07, Site 24-145-474
Highway 410, District 6, Toronto

We have reviewed the recommendations in the foundation investigation report and provide the following alternative foundation schemes.

West Abutment and Pier

The west abutment spread footings can be raised to a founding elevation of 231.0, with bearing capacities as outlined in the foundation report.

The pier can be placed on spread footings at a minimum founding elevation of 231.0 as an alternative to piles. The pier footing should be designed to the same bearing capacities as the west abutment.

East Abutment

The east abutment should remain founded on piles with bearing capacities as described in the foundation report. This is necessary as a relatively deep zone of organic clay underlies the proposed abutment location.

General

Additional boreholes were augered to the east of the previously completed holes and the organic clay was found to extend 4.5 m east of borehole 4 with a maximum depth of 9.1 m (elevation 226.1). The southerly limit of the organic deposit was not determined.

This organic deposit must be subexcavated and backfilled with granular material as outlined in the foundation investigation report.

The additional record of borehole sheets and revised drawing No. 217907-A will be forwarded at a later date.

A handwritten signature in dark ink, appearing to read "H. Sturm".

H. Sturm, P. Eng.

for

M. Devata, P. Eng.
Senior Foundations Engineer

MD/HS/mmj

memorandum



To: W.L. Lin
Design Engineer
Structural Office
Central Region

Date: 1983 10 19

From: Foundation Design Section
Room 315, Central Building

Re: Highway 410
Williams Parkway Underpass
W.P. 21-79-07, Site 24-145-474
District 6, Toronto

We have reviewed the preliminary general arrangement drawing 24-145-474-P1 for the above mentioned project and provide the following comments:

The earth cover for the east and west abutment footings appears to be less than the required minimum of 1.2 m.

In our opinion the pier can be founded on spread footings at an elevation of 229 or lower which would provide a higher founding elevation than the proposed pile cap. The spread footing should be designed for a factored bearing capacity at the U.L.S. of 600 kPa and a bearing capacity of 290 kPa at the S.L.S. Type II.

A handwritten signature in cursive script, appearing to read "Harry Sturm", with a long horizontal flourish extending to the right.

H. Sturm, P. Eng.
Project Foundations Engineer

HS/mmj