

DOCUMENT MICROFILMING IDENTIFICATION

GEOCRES No. 30M12-181

DIST. 6 REGION

W.P. No. 21-79-08

CONT. No. 86-80

W. O. No.

STR. SITE No. 24-145-473

HWY. No. 410

LOCATION Franceschini Dr. Underpass

No of PAGES -

OVERSIZE DRAWINGS TO BE INCLUDED WITH THIS REPORT.

REMARKS:

G.I.-30 SEPT. 1976

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 COLUMN	35 MPa
ABUTMENTS, WINGWALLS	
& BARRIER WALLS	30 MPa
FOOTINGS	20 MPa
REMAINDER	20 MPa

REINFORCING STEEL

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

CLEAR COVER

TO REINF. STEEL

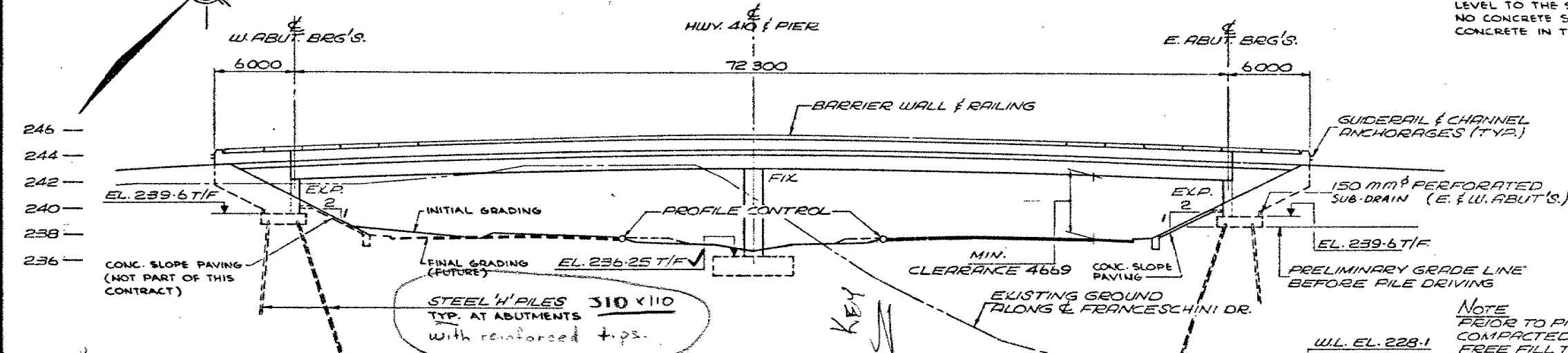
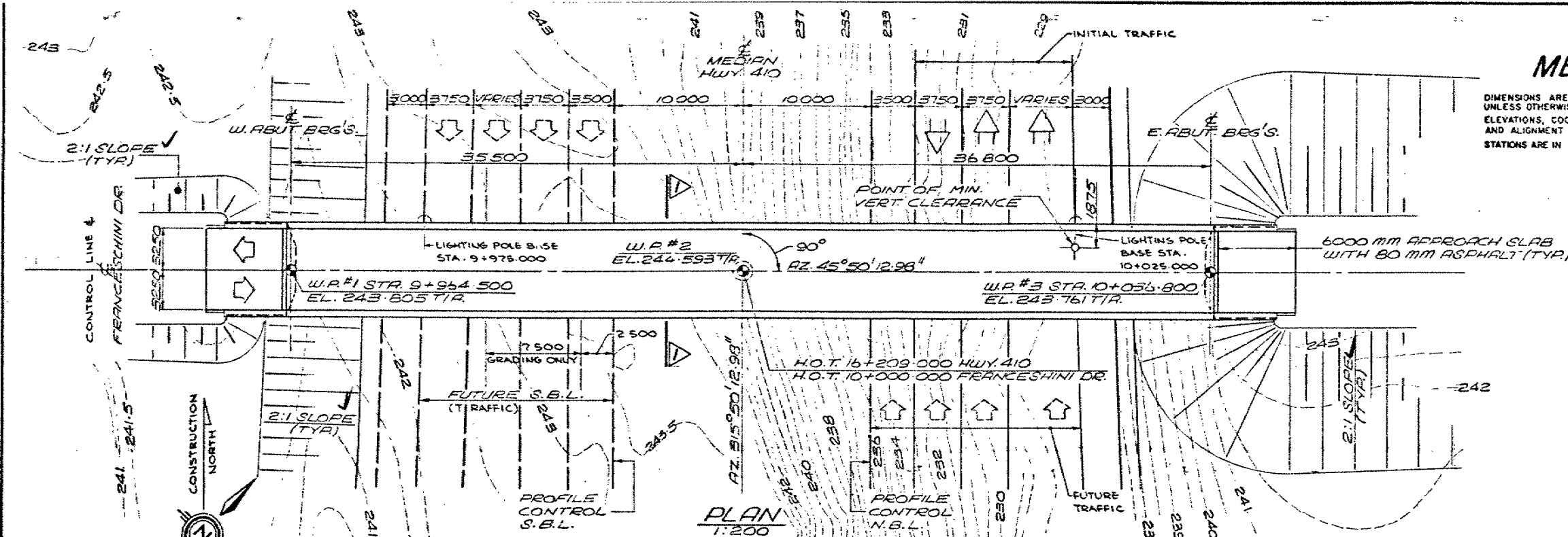
FOOTINGS	100±25
ABUTMENTS FRONT FACE	80±20
ABUTMENTS BACK FACE	70±20
DECK TOP	70±20
DECK BOT. AND SIDES	50±10
PIER COLUMN	80±20
REMAINDER UNLESS OTHERWISE NOTED	70±20

CONSTRUCTION NOTES

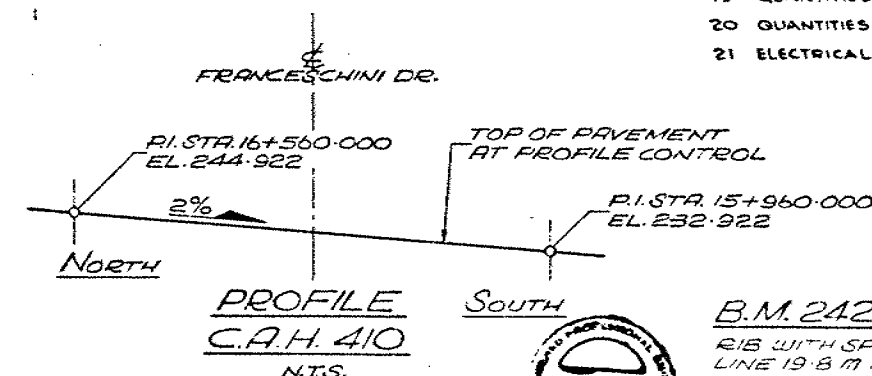
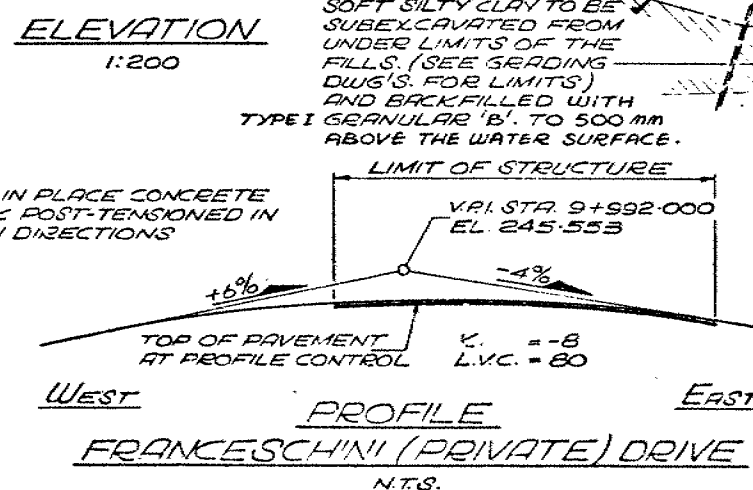
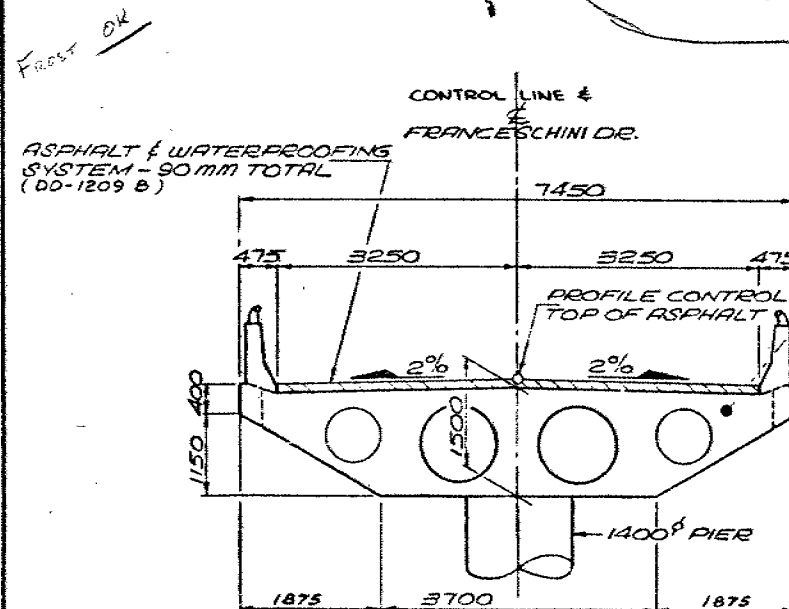
THE CONTRACTOR IS RESPONSIBLE FOR FINISHING THE BEARING SEATS DEAD
LEVEL TO THE SPECIFIED ELEVATIONS WITH A TOLERANCE OF ± 3 mm.
NO CONCRETE SHALL BE PLACED ABOVE THE ABUTMENT BEARING SEATS UNTIL THE
CONCRETE IN THE DECK HAS BEEN PLACED.

LIST OF DRAWINGS

- 1 GENERAL ARRANGEMENT
- 2 BORE HOLE LOCATIONS & SOIL STRATA
- 3 FOOTING LAYOUT AND DETAILS
- 4 ABUTMENTS AND WINGWALLS
- 5 PIER DETAILS
- 6 DECK DETAILS
- 7 CABLE DETAILS - I
- 8 CABLE DETAILS - II
- 9 DECK REINFORCING
- 10 BARRIER WALL
- 11 RAILING FOR BARRIER WALL
- 12 6 000 mm APPROACH SLAB
- 13 DETAILS OF CONC. SLOPE PAVING
- 14 AS CONSTRUCTED ELEV. & DIM.
- 15 BRIDGE DATE & SITE NUMBER DATA
- 16 PILE DRIVING - STEAM & DIESEL HAMMERS
- 17 JOINT, ANCHORAGE AND ARMOURING
- 18 STANDARD DETAILS
- 19 QUANTITIES
- 20 QUANTITIES
- 21 ELECTRICAL EMBEDDED WORK



NOTE
PRIOR TO PILE DRIVING
COMPACTED BOULDER
FREE FILL TO BE PLACED
TO UNDERSIDE OF
FOOTINGS AND IN THE
AREA OF THE PILES
(MAXIMUM PARTICLE SIZE
75 mm) ✓



B.M. 242.871

RIS WITH SPLIT PLATE ON FENCE
LINE 19.8 M N. OF GRAVEL ENTRANCE
53.67 LT. STA. 13+230.08.

REVISED							
	DATE	BY	DESCRIPTION				
	DESIGN <i>DAW</i>	CHECK <i>RS</i>	LOADING <i>2-20-67</i>			DATE <i>2-2-68</i>	
	DRAWING <i>2-70</i>	CHECK	SITE <i>2-14-67</i>			DWG <i>1</i>	

DRAWING NOT TO BE SCALED
100 mm ON ORIGINAL DRAWING

ENGINEERING MATERIALS OFFICE
PAVEMENT & FOUNDATION DESIGN SECTION

WP 21-79-08

DIST 6

HWY 410

STR SITE 24-145-473

Francheschini (Private) Drive Underpass

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FOUNDATION INVESTIGATION REPORT
For
Francheschini (Private) Drive Underpass
W.P. 21-79-08; Site 24-145-473
Hwy. #410, District 6, Toronto

INTRODUCTION:

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 CONDITIONS

General

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 Drawing No. 217908-A, 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.

DISCUSSION AND RECOMMENDATIONS

General

In order to provide access to the Franceschini gravel pit upon closure of Heart Lake Rd. it is proposed to construct a two span (36m,37m) underpass structure over Highway 410. The alignment of the proposed Franceschini (Private) Drive will be maintained west of Heart Lake Road and will be extended to the east over Hwy. 410 and then swing south to intersect with Williams Parkway. The proposed profile grades will require earth cuts of up to 6 m on the proposed southbound lanes of Hwy. 410 and fills up to 13 m on the northbound lanes. Franceschini Drive will require earth fills in the order of 17 m where it crosses the abandoned gravel pit, the bottom of which is some 16 m lower than existing Heart Lake Rd.

The subsoil was investigated to a maximum depth of 32 m and a compact to very dense sand was found to be the predominant deposit across the site. The sand is generally overlain and intersected by 0.8 to 5.2 m layers of silty clay. Sand and gravel zones are also found interbedded in the sand stratum which is underlain by shale bedrock.

The eastern portion of the site lies at the base of the abandoned gravel pit and is covered by 1.8 to 3.5 m of water which is underlain by 0.4 to 4.1 m of silty clay. Underlying the silty clay is the very dense sand.

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

Structure Foundations

Abutments

The abutments can be founded on end bearing piles. A steel HP 310 X 110 pile may be designed for a load of 1600 kN for the factored axial capacity and a load of 1150 kN for the bearing capacity at the S.L.S. Type II. An estimated pile tip elevation of 216.0 for the west abutment and 219.5 for the east abutment can be used for estimating purposes.

Pier

The pier can be founded by means of spread footings at or below elevation 237 for a factored bearing capacity at the U.L.S. of 600 kPa and a bearing capacity of 300 kPa at the S.L.S. Type II.

An alternative to spread footings would be to use end bearing piles driven to the very dense sand stratum. A steel HP 310 X 110 pile may be used with design loadings as indicated above, and a tip elevation of 215.0 to be used for estimating purposes.

General Foundation Requirements

All pile tips should be reinforced because of the presence of cobbles and/or boulders in the sand stratum.

The maximum gradation of all fill placed in the zone of pile penetration should be restricted to 75 mm.

The abutments should be backfilled with a free draining granular material and 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.

No dewatering difficulties are anticipated for footing or pile cap excavations in consideration of the relatively low water table. Localized seepage into excavations can be controlled by pumping from sumps.

Slope Stability and Settlement

The 0.4 to 4.1 m layer of very soft to soft silty clay at the bottom of the abandoned gravel pit will underlie the 13 m fills of the northbound lanes of Hwy. 410 and the 17 m fills of Franceschini Drive. To ensure stability of these proposed fills the soft material should be completely excavated down to the competent sand approximately 4 m on the western edge of the pond and should extend to the planned limits of the fill. This will also minimize long term settlement of the fill. Backfill material placed below the water level at the bottom of the pit must be a non-cohesive granular material.

Fills over 10 m in height should be constructed with a 5 m mid-height berm in order to prevent major erosion problems on the fill slopes. If the abandoned gravel pit is filled to a level which reduces the fill heights to 10 m or less berms will not be required. No stability problems are anticipated for the fills up to 17 m in height, provided the soft silty clay is sub-excavated from under the limits of the fills and they are constructed to a 2:1 geometry. The 6 m deep Hwy. 410 cuts constructed with 2:1 slopes should be stable.

MISCELLANEOUS

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

M. Maclean

for

H. J. Sturm, P. Eng.
Project Foundations Engineer




M. Devata

M. Devata, P. Eng.
Senior Foundations Engineer

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			20	40	60	80	100					
241.2	Ground Surface																
0.0	Sand																
240.0			1	SS	33		240										
1.2	Silty Clay		2	SS	13												18 55 16 11
	With Sand		3	SS	2												19 44 23 14
238.2	Stiff to Firm																
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
	Sand Some Silt Trace Clay Trace Gravel		9	SS	20		232										
	Compact		10	SS	27		230										
			11	SS	18												12 71 15 2
			12	SS	3		228										35 61 3 1
	Silty Clay Seams 30 to 100 mm Thick		13	SS	19		226										
	Sand & Gravel Occasional Cobbles or Boulders		14	SS	70		224										32 55 11 1
			15	SS	85		222										5 80 12 3
			16	SS	87												
	Very Dense		17	SS	81		220										7 81 10 2
			18	SS	114		218										
			19	SS	100		216										5 80 13 2
215.3			20	SS	150												
25.9	Grey Shale (80%) With Randomly Interbedded Limestone Layers (20%) 15 to 90 mm Thick		21	RC			214										
			22	RC													
			23	RC													
			24	RC													
			25-27	RC													
212.3			28	RC													
			BQ														
28.9	End of Borehole																

+3, x5: Numbers refer to
Sensitivity

20
15
10
5 (%) STRAIN AT FAILURE

OFFICE REPORT ON SOIL EXPLORATION

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 *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 (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20 40 60 80 100	W _p W W _L					
242.1	Ground Surface													GR SA SI CL
0.0	Sand and Gravel					*	242							50 41 6 3
240.0			1	SS	37		240							
2.1			2	SS	27									
			3	SS	14		238							
			4	SS	21		236							4 73 18 5
			5	SS	27		234							2 66 30 2
			6	SS	46									
			7	SS	45		232							4 76 16 4
			8	SS	62		230							
227.9			9	SS	46		228							31 52 13 4
14.2	End of Borehole													
	* NOTE: No water table encountered													

OFFICE REPORT ON SOIL EXPLORATION

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		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						
243.3	Ground Surface													
0.0	Silty Clay With Sand Some Gravel		1	SS	32		242							
			2	SS	6									
	Clay		3	SS	13									
	Firm to Very Stiff		4	SS	33		240							
			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							
			10	SS	100		232							68 27 4 1
	Sand and Gravel		11	SS	22									2 91 6 1
	Compact to Very Dense		12	SS	30		230							46 47 6 1
	Sand and Gravel		13	SS	15		228							
			14	SS	26		226							5 71 20 4
226.1			15	SS	100	10 cm	224							
17.2	Silty Clay With Sand Some Gravel	Hard												
224.4			16	SS	72		222							5 85 9 1
18.9	Cobbles or Boulders		17	SS	83									
			18	SS	89		220							56 36 8 0
	Sand and Gravel		19	SS	60		218							0 73 25 2
	Sand Some Silt Trace of Clay Trace of Gravel Very Dense		20	SS	95		216							
			21	SS	96	15 cm								
			22	SS	105	15 cm	214							0 52 45 3
213.1														

OFFICE REPORT ON SOIL EXPLORATION

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		23	SS	150	13 cm										
30.2																
211.3	Highly Weathered Grey Shale															
32.0	End of Borehole															

OFFICE REPORT ON SOIL EXPLORATION

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 *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 Y	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20 40 60 80 100	SHEAR STRENGTH					
228.1	Water Level													GR SA SI CL
0.0	Water						228							
225.4							226							
2.7	Silty Clay Very Soft		1	SS	1		224							
223.2	Silt Hard		2	SS	100	5 cm	224							16 44 30 10
4.9			3	SS	100	10 cm	222							
			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	216							
215.5			8	SS	109		216							0 67 32 1
12.6	End of Borehole													

OFFICE REPORT ON SOIL EXPLORATION

+3, x5: Numbers refer to
Sensitivity

20
15
10
5 (%) STRAIN AT FAILURE



Ministry of
Transportation and
Communications

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 (%) GR SA SI CL								
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20 40 60 80 100						SHEAR STRENGTH kPa			WATER CONTENT (%)				
								O UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE													
228.1	Water Level						228														
0.0	Water						226														
226.3							224														
1.8	Silty Clay With Sand Some Gravel Very Soft to Soft		1	TW	PM		222							19 35 41 5							
223.0			2	SS	106		220							1 87 11 1							
5.1			3	SS	133	45 cm	218							18 65 15 2							
	Sand Some Silt Trace Clay Trace Gravel Very Dense		4	SS	133		216							0 83 16 1							
			5	SS	120																
			6	SS	100	10 cm															
215.6			7	SS	100	5 cm															
12.5	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 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 *CP*

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																
0.0	Water																
224.6																	
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

RECORD OF BOREHOLE No 7

METRIC

W P 21-79-08 LOCATION Co-ords N 4 841 939.4; 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 *Q*

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					
228.1	Water Level													
0.0	Water													
224.8														
3.3	Sand to Silt		1	SS	145									
223.9	Very Dense		2	SS	100	10 cm								
4.2	End of Borehole													

OFFICE REPORT ON SOIL EXPLORATION

RECORD OF BOREHOLE No 8

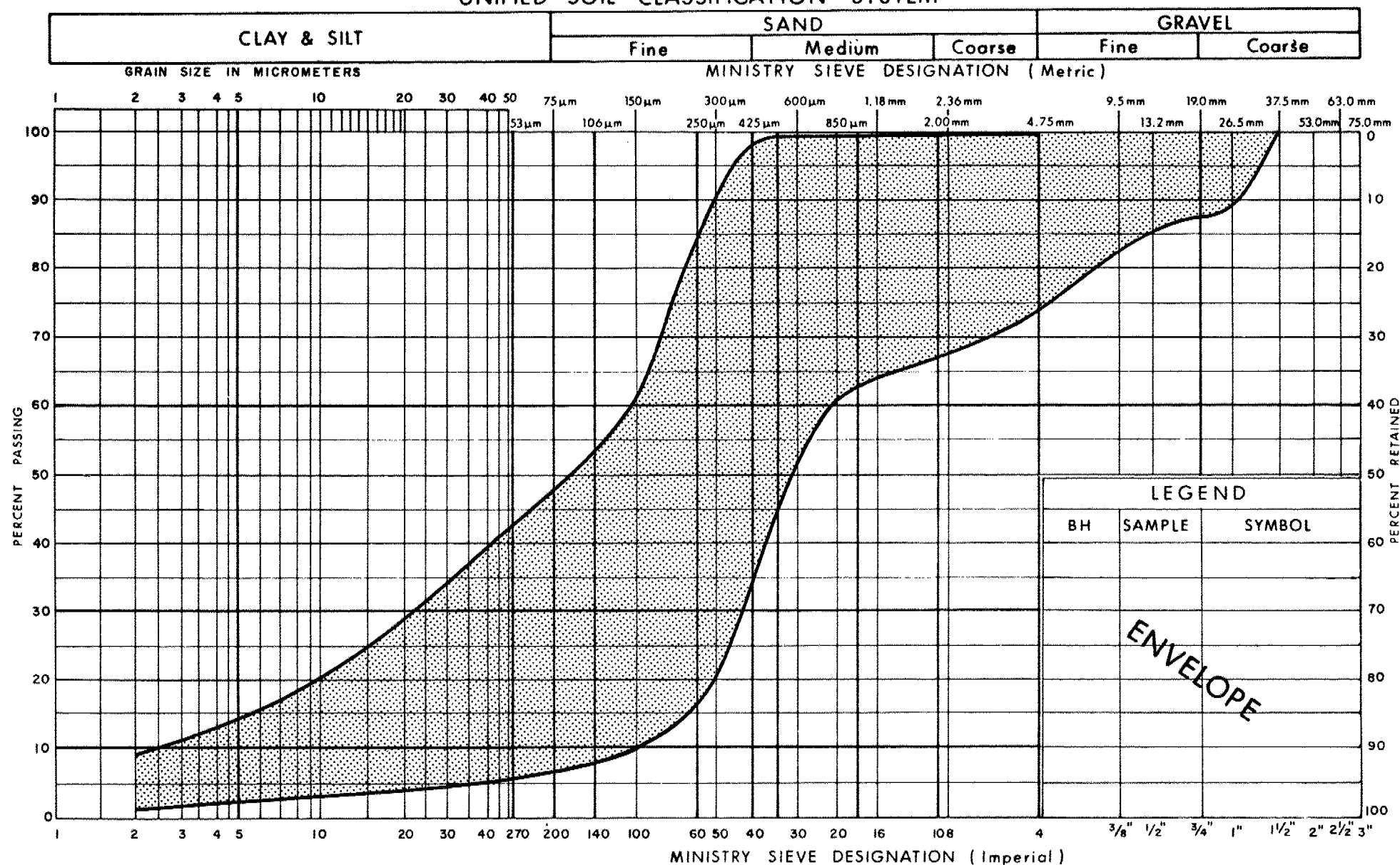
METRIC

W P 21-79-08 LOCATION Co-ords N 4 841 914.4; E 284 167.8 ORIGINATED BY RM
DIST 6 HWY 410 BOREHOLE TYPE Wash Bore COMPILED BY HS
DATUM Geodetic DATE 1983 08 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					
228.1	Water Level																
0.0	Water																
226.3																	
1.8	very soft																
	Silty Clay with Sand some Gravel Firm		1	TW	PM												
			2	SS	10												
			3	TW	PM												
222.1	Silt Hard		4	SS	68												
5.9	End of Borehole																

OFFICE REPORT ON SOIL EXPLORATION

UNIFIED SOIL CLASSIFICATION SYSTEM



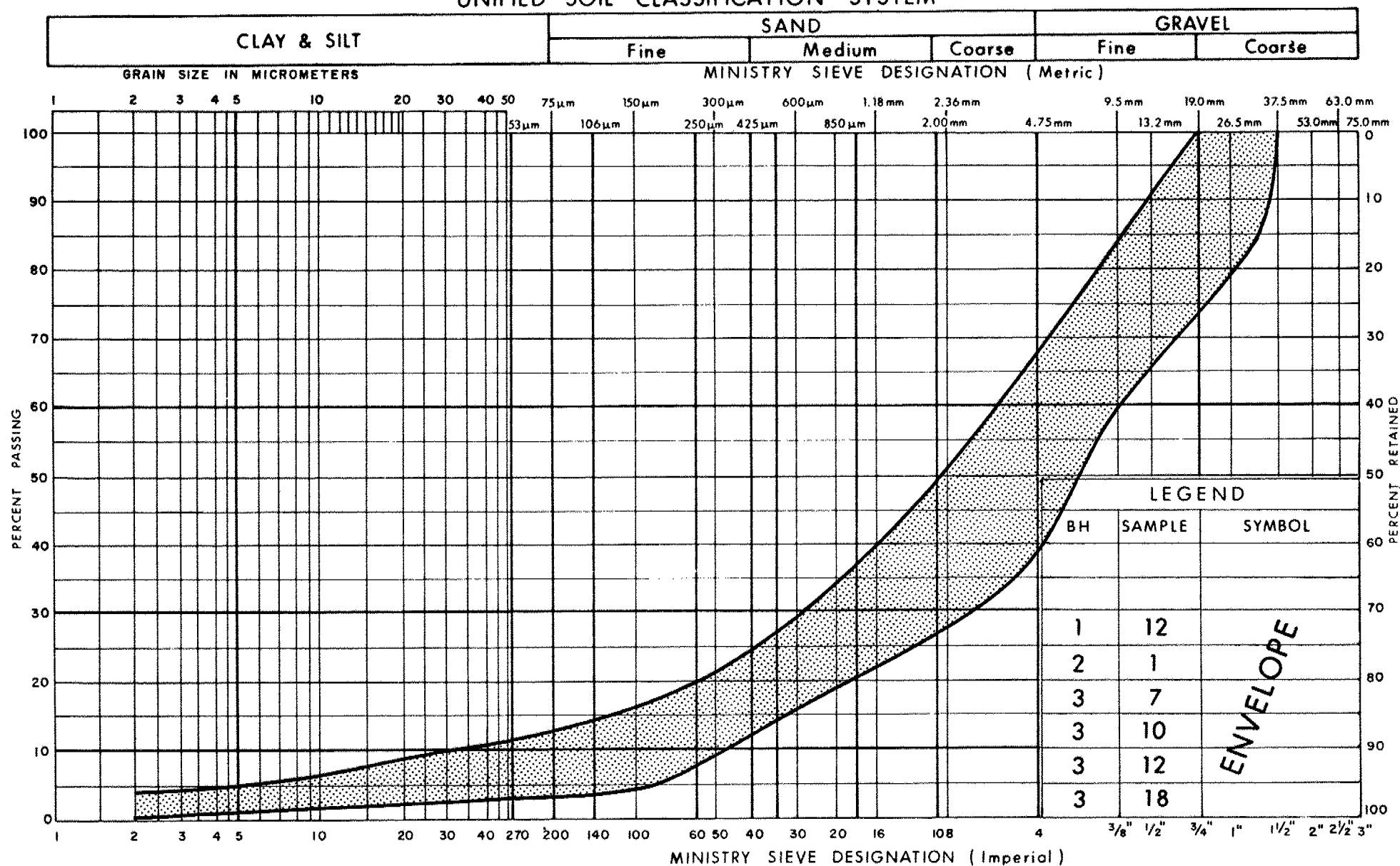
Ministry of
Transportation and
Communications

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

FIG No 1

W P 21-79-08

UNIFIED SOIL CLASSIFICATION SYSTEM



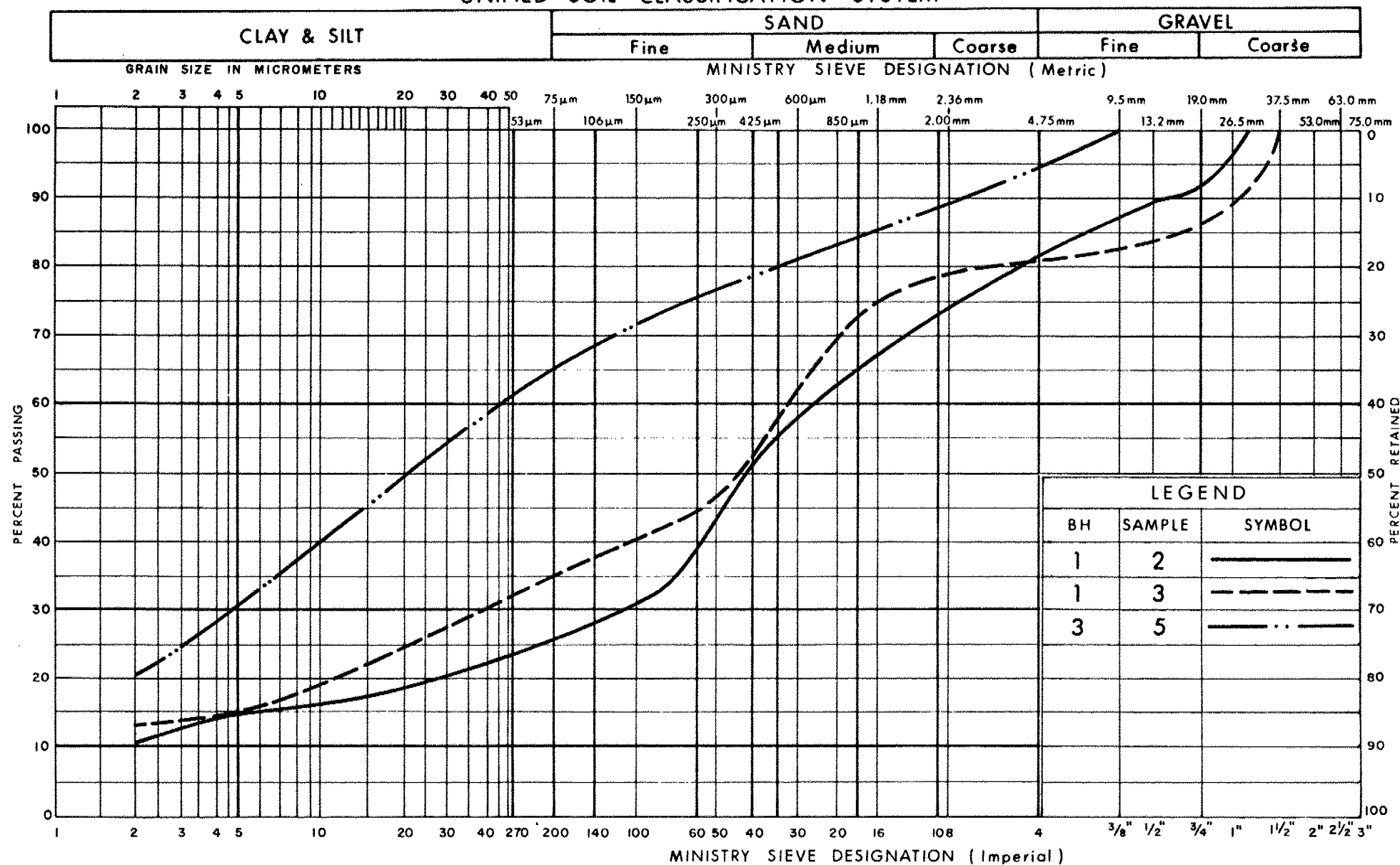
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Communications

GRAIN SIZE DISTRIBUTION
Interbedded SAND & GRAVEL Layers

FIG No 2

WP 21-79-08

UNIFIED SOIL CLASSIFICATION SYSTEM

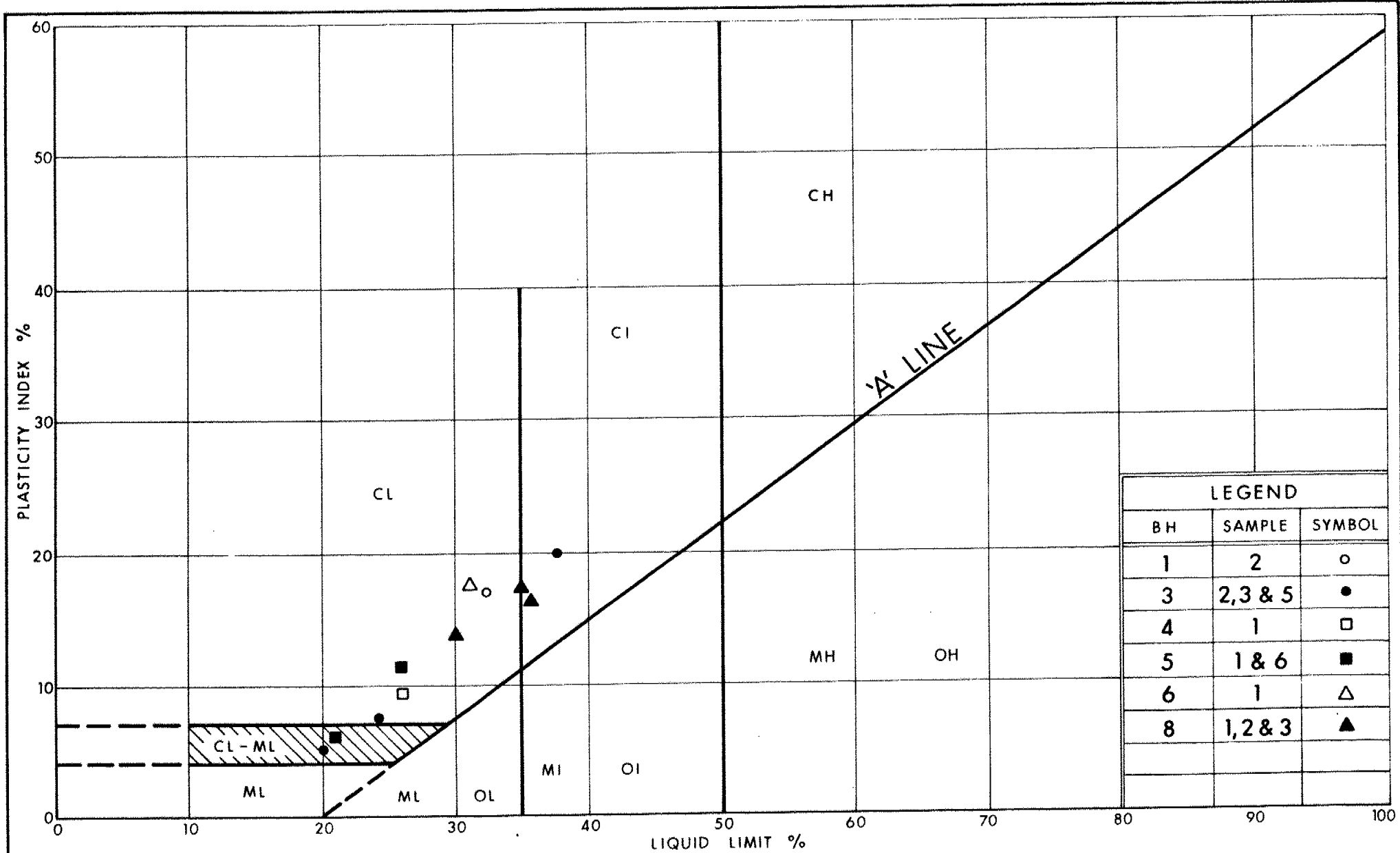


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Communications

GRAIN SIZE DISTRIBUTION
SILTY CLAY WITH SAND SOME GRAVEL

FIG No 3

W P 21-79-08

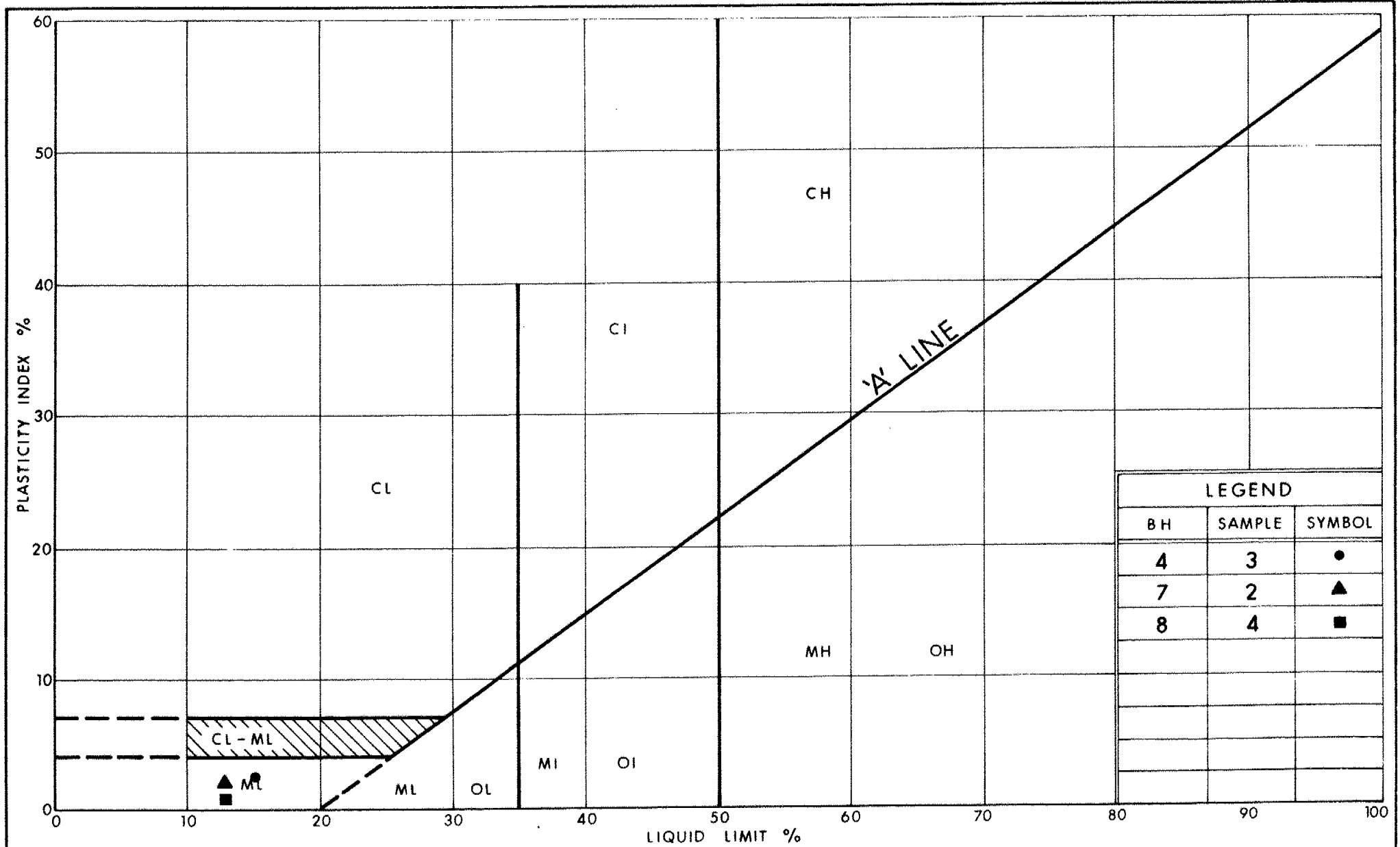


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Communications

PLASTICITY CHART SILTY CLAY: WITH SAND, SOME GRAVEL

FIG No 4

W P 21-79-08



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Ontario

PLASTICITY CHART : SILT

FIG No 5

W P 21-79-08

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 (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

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
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'_{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_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						

