

DOCUMENT MICROFILMING IDENTIFICATION

GEOCRES No. 30M4-66

DIST. 4 REGION

W.P. No. 13-82-01

CONT. No. 84-96

W. O. No.

STR. SITE No. 36-85-99

HWY. No. 403

LOCATION Tiddler's Green Rd
Retaining Walls

No. of PAGES -

=====

OVERSIZE DRAWINGS TO BE INCLUDED WITH THIS REPORT.

REMARKS:

FOUNDATION INVESTIGATION REPORT

CONTRACT NO 84-96



Ontario

Ministry of
Transportation and
Communications

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Note: For purposes of the contract this report supersedes all other foundation reports prepared by or for the Ministry in connection with the above-noted project.

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 / 0.3 m)	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
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						

For

W.P. 13-82-01; Site 36-85-99

Fiddler's Green Underpass; Proposed Retaining Walls

Hwy. #403, District 4, HamiltonINTRODUCTION:

This report summarizes the results of a foundation investigation required for the proposed retaining walls.

The fieldwork was conducted during the period from 84 03 13 to 84 03 19 utilizing a continuous flight auger machine equipped with 82 mm I.D. hollow-stem augers.

This work consisted of 4 sampled boreholes/dynamic cone penetration tests.

SITE DESCRIPTION

The site is located in the Township of Flamborough, Regional Municipality of Hamilton-Wentworth at the intersection of Hwy. 403 and Fiddler's Green Road (Reg. Rd. 16).

There is an existing underpass at this site.

Physiographically, the site lies in the Norfolk Sand Plain, at this location an area of sandy to silty deltaic deposits.

At this site the local topography is relatively flat, with Hwy. 403 in cut east of the existing overpass. Land use is residential.

SUBSURFACE CONDITIONSGeneral

The Record of Borehole Sheets, (Appendix) illustrate the conditions at the borehole locations. The locations and elevations of the boreholes, and stratigraphical profiles based on the borehole data, are shown on Drawing No. 138201A of the Contract Drawings.

The overburden consists of over 17 m of material generally decreasing in grain size with depth, and ranging from sand to silty clay. Above elev. 232 ± m the material is essentially silt, containing irregular sand layers.

Subsurface Material Descriptions

SAND TO SILTY SAND; TRACE GRAVEL AND CLAY

This loose to compact material extends from the surface, with thickness ranging from 3.0 to 3.8 m, at the borehole locations.

Figure 1 illustrates a typical grain size distribution for this material.

SANDY SILT; TRACE GRAVEL AND CLAY

This compact to very dense material underlies the surface Sand to Silty Sand at BH #7, BH #8 and BH #9, with thickness ranging from 3.2 to 9.0 m. At BH #10 this deposit underlies an extensive layer of Silty Sand.

Figure 2 illustrates a typical grain size distribution for this material.

SILTY SAND; SOME GRAVEL, TRACE CLAY

This compact to very dense material immediately underlies the surface Sand to Silty Sand at BH #10, where it extends for a thickness of 7.9 m. At BH #7, BH #8 and BH #9 zones of Silty Sand, up to 3.0 m in thickness were encountered within the Sandy Silt layer.

Figure 3 illustrates a typical grain size distribution for this material.

SILT; TRACE SAND AND CLAY

This compact to very dense material was encountered immediately below the Sandy Silt layer at BH #7, BH #8 and BH #9. The deposit was penetrated only at BH #7 and BH #9, where its thickness ranged from 3.7 to 8.8 m.

SILTY CLAY (CL); TRACE SAND

This hard material of low plasticity was encountered immediately below the Silt layer at BH #7 and BH #9.

GROUNDWATER

At the time of the field investigation, the groundwater elevation was at elev. 244⁺₋ m.



D. H. Dundas

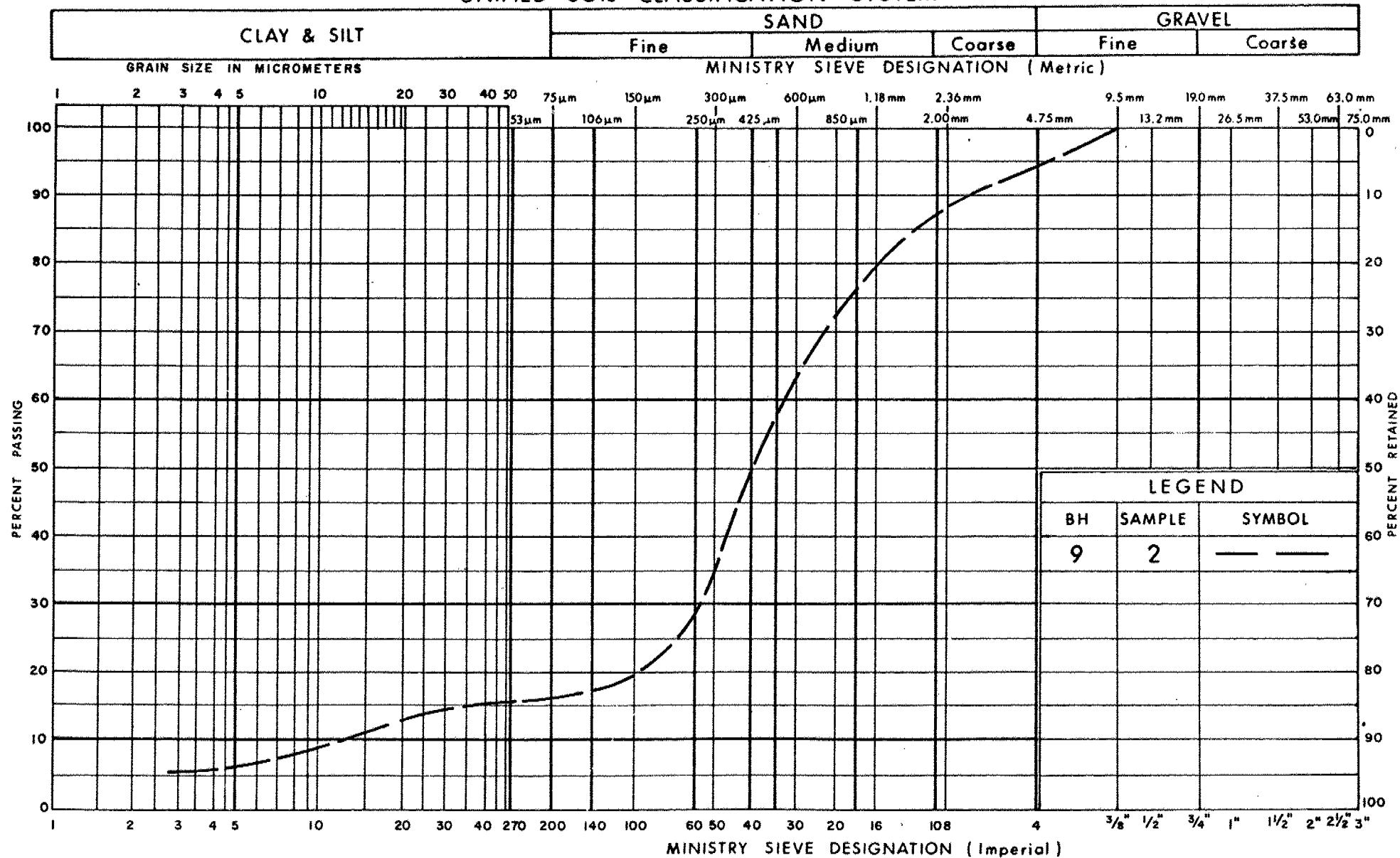
D.H. Dundas, P. Eng.
Foundations Engineer

K. G. Selby

K.G. Selby, P. Eng.
Chief Foundations Engineer
(West)

APPENDIX

UNIFIED SOIL CLASSIFICATION SYSTEM



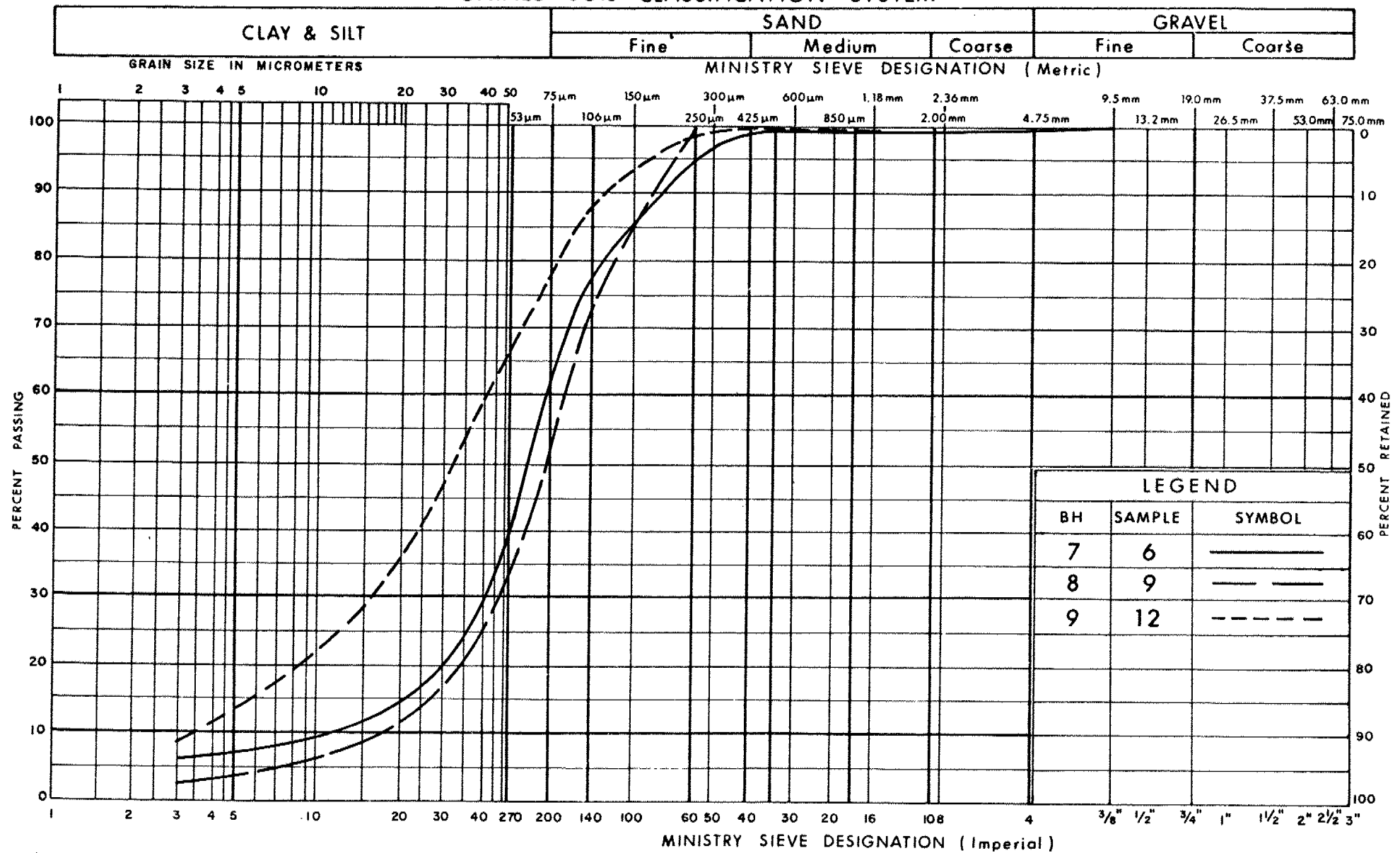
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GRAIN SIZE DISTRIBUTION
SAND TO SILTY SAND
TRACE GRAVEL AND CLAY

FIG No 1

W P 13-82-01

UNIFIED SOIL CLASSIFICATION SYSTEM



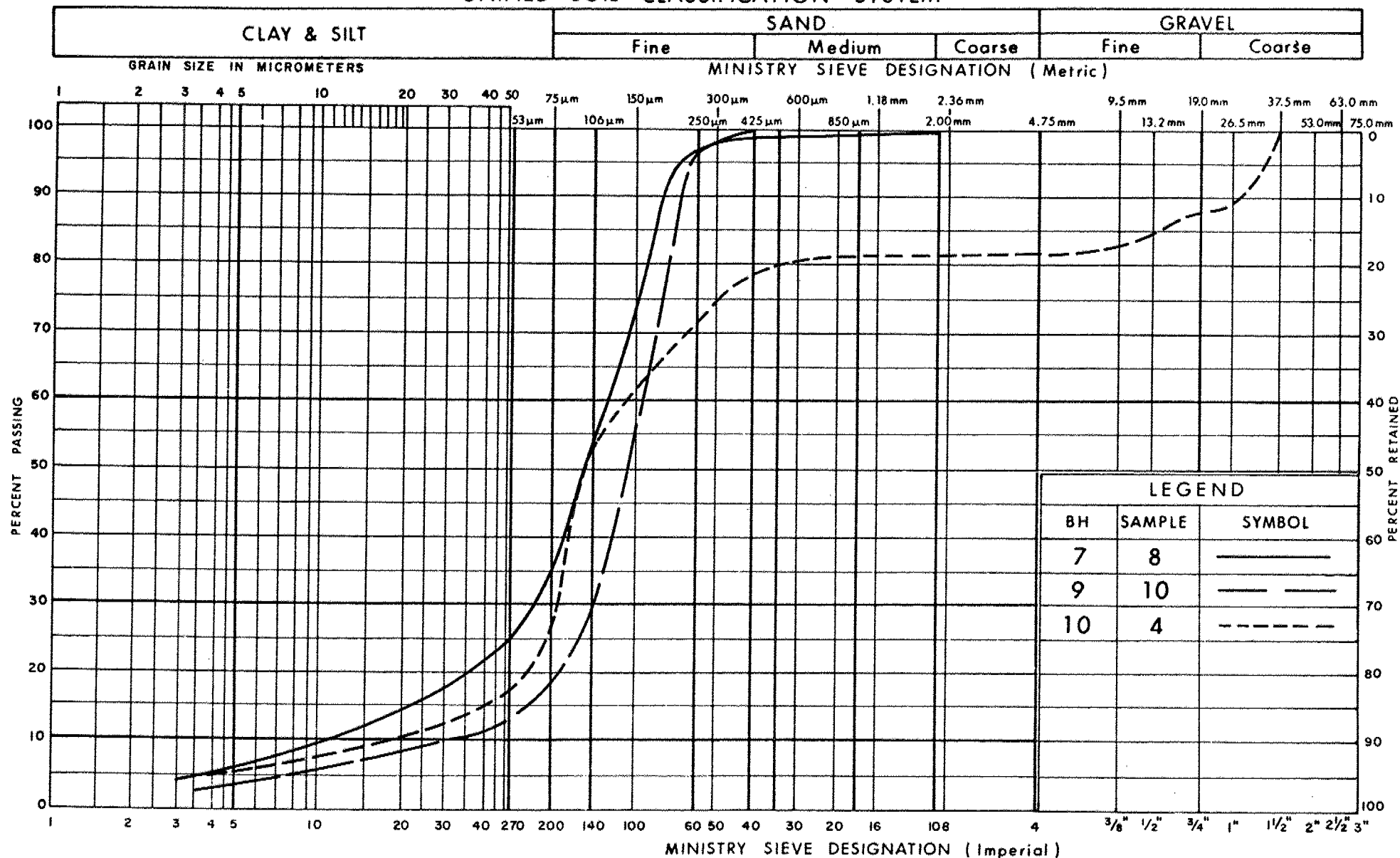
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GRAIN SIZE DISTRIBUTION
SANDY SILT
TRACE GRAVEL AND CLAY

FIG No 2

W P 13 - 82 - 01

UNIFIED SOIL CLASSIFICATION SYSTEM



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GRAIN SIZE DISTRIBUTION
SILTY SAND
SOME GRAVEL, TRACE CLAY

FIG No 3

W P 13-82-01



RECORD OF BOREHOLE No 7

METRIC 10

W P 13-82-01 LOCATION Co-ords: N 4 784 979.5, E 265, 511.0 ORIGINATED BY BE
DIST 4 HWY 403 BOREHOLE TYPE Cone Test, H-S Auger COMPILED BY DD
DATUM Geodetic DATE 84 03 13 - 14 CHECKED BY SO

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		
247.6	GROUND SURFACE													
0.0	Sand to Silty Sand trace gravel and clay		1	SS	15		246							
			2	SS	18									
			3	SS	22									
	compact		4	SS	5									
	loose to compact		5	SS	14		244							0 84 12 4
243.8	Sandy Silt		6	SS	18									1 30 63 6
3.8	trace gravel and clay		7	SS	40									
	compact to dense		8	SS	22		242							0 66 33 1
	Silty Sand		9	SS	8									
240.6			10	SS	54		240							0 8 89 3
7.0	Silt		11	SS	87									
	trace sand and clay		12	SS	84		238							
	compact to very dense		13	SS	73									
			14	SS	104		236							
			15	SS	50		234							0 1 93 6
231.8	Silty Clay (CL)						232							
15.8	trace sand													
230.7	hard													0 10 76 14
16.9	END OF BOREHOLE													

+3, x⁵: Numbers refer to
Sensitivity

20
15 5 (%) STRAIN AT FAILURE
10



RECORD OF BOREHOLE No 8

METRIC

11

W P 13-82-01 LOCATION Co-ords: N 4 784 975.5, E 265 471.5 ORIGINATED BY BE
DIST 4 HWY 403 BOREHOLE TYPE Cone Test, H-S Auger COMPILED BY DD
DATUM Geodetic DATE 84 03 14 CHECKED BY SD

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 (%)	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES							
247.9	GROUND SURFACE											
0.0	Sand to Silty Sand trace gravel and clay loose to compact		1	SS	6							
			2	SS	13							
			3	SS	9							
244.7	Sandy Silt trace gravel and clay very dense		4	SS	51							
3.2			5	SS	62							
			6	SS	73							
			7	SS	53							
	Silty Sand		8	SS	43							
			9	SS	48							
239.4												
8.5	Silt trace sand and clay very dense		10	SS	80							
			11	SS	38							
235.3			12	SS	100							
12.6	END OF BOREHOLE											



RECORD OF BOREHOLE No 9

METRIC

12

W P 13-82-01

LOCATION Co-ords: 4 784 919.0, E 265 481.0

ORIGINATED BY BE

DIST 4 HWY 403

BOREHOLE TYPE Cone Test, H-S Auger

COMPILED BY DD

DATUM Geodetic

DATE 84 03 14 - 15

CHECKED BY SO *b*

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	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	N' VALUES								
247.4	GROUND SURFACE												
0.0	Sand to Silty Sand trace gravel and clay compact		1	SS	15		246						6 78 12 4
			2	SS	25								
244.4			3	SS	16								
3.0	Sandy Silt trace gravel and clay compact to very dense		4	SS	48		244						3 9 85 3
			5	SS	44								
			6	SS	64								
			7	SS	57		242						
			8	SS	35								
			9	SS	82		240						
	Silty Sand		10	SS	15		238						0 82 16 2
			11	SS	47								
			12	SS	64		236						
234.9													
12.5	Silt trace sand and clay very dense						234						0 23 73 4
			13	SS	58		232						
231.2													
16.2	Silty Clay (CL) trace sand												
230.2	hard		14	SS	62								0 5 64 31
17.2	END OF BOREHOLE												



RECORD OF BOREHOLE No 10

METRIC 13

W P 13-82-01 LOCATION Co-ords: N 4 784 930.5, E 265 524.0 ORIGINATED BY BE
DIST 4 HWY 403 BOREHOLE TYPE Cone Test, H-S Auger COMPILED BY DD
DATUM Geodetic DATE 84 03 16 - 19 CHECKED BY SO

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						
247.4	GROUND SURFACE										
0.0	Sand to Silty Sand trace gravel and clay compact		1	SS	19		246				
243.7			2	SS	12		244				
3.7	Silty Sand some gravel trace clay compact to very dense		3	SS	31		242				
			4	SS	13		240				18 60 19 3
			5	SS	39		238				
			6	SS	24		236				
			7	SS	50						
235.8			8	SS	48						0 26 70 4
11.6	Sandy Silt trace gravel and clay dense										
234.8											
12.6	END OF BOREHOLE										
	* water level not observed										

34-96

ENGINEERING MATERIALS OFFICE
PAVEMENT & FOUNDATION DESIGN SECTION

WP 13-82-01

DIST 4

HWY 403

STR SITE 36-85-99

Fiddler's Green Road
Retaining Walls

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FOUNDATION INVESTIGATION REPORT

For

W.P. 13-82-01; Site 36-85-99

Fiddler's Green Underpass; Proposed Retaining Walls

Hwy. #403, District 4, Hamilton

INTRODUCTION:

This report summarizes the results of a foundation investigation required for the proposed retaining walls.

The fieldwork was conducted during the period from 84 03 13 to 84 03 19 utilizing a continuous flight auger machine equipped with 82 mm I.D. hollow-stem augers.

This work consisted of 4 sampled boreholes/dynamic cone penetration tests.

SITE DESCRIPTION

The site is located in the Township of Flamborough, Regional Municipality of Hamilton-Wentworth at the intersection of Hwy. 403 and Fiddler's Green Road (Reg. Rd. 16).

There is an existing underpass at this site.

Physiographically, the site lies in the Norfolk Sand Plain, at this location an area of sandy to silty deltaic deposits.

At this site the local topography is relatively flat, with Hwy. 403 in cut east of the existing overpass. Land use is residential.

SUBSURFACE CONDITIONS

General

The Record of Borehole Sheets, (Appendix) illustrate the conditions at the borehole locations. The locations and elevations of the boreholes, and stratigraphical profiles based on the borehole data, are shown on Drawing No. 138201A.

The overburden consists of over 17 m of material generally decreasing in grain size with depth, and ranging from sand to silty clay. Above elev. 232 ± m the material is essentially silt, containing irregular sand layers.

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SILT; TRACE SAND AND CLAY

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SILTY CLAY (CL); TRACE SAND

This hard material of low plasticity was encountered immediately below the Silt layer at BH #7 and BH #9.

GROUNDWATER

At the time of the field investigation, the groundwater level was at elev. 244.4[±]m.

TO BE ADDED TO CONTRACT

DISCUSSION AND RECOMMENDATIONS

In order to permit the construction of ramps between the abutments and their adjacent piers, walls have been proposed to retain the forward slopes of the existing structure.

It is recommended that the proposed retaining walls should be founded on spread footings on compacted Granular 'A'.

General Recommendations

EARTH PRESSURE CALCULATIONS:

Backfill to structures should consist of granular material in accordance with MTC Standard Special Provision #121 (83 10). Computation of earth pressures should be in accordance with Section 6.6.1.2 of the O.H.B.D.C.

If Granular 'A' backfill is to be used the following properties may be assumed for design.

$$\gamma = 22 \text{ kN/m}^3$$

$$\phi = 35^\circ$$

(Refer to Subsection 6.6.1.2.1 of the O.H.B.D.C.)

If Granular 'B' backfill is to be used, a fairly wide range of values for γ and ϕ exist, and unless the exact source of the material is known and tests are done, predictions of both γ and ϕ may be subject to considerable error. (Refer to Subsection 6.6.1.2.2 of the O.H.B.D.C.).

At this site, the foundation is considered to be 'yielding' and the active condition applies insofar as lateral earth pressures are concerned.

SETTLEMENT CONSIDERATIONS:

The majority of settlement should occur during construction. However the walls should be designed to accommodate differential settlements up to 25 mm.

SLOPE STABILITY:

No stability problems are anticipated for embankments or cuts with slopes of 2:1 or flatter. If steeper slopes are required, please contact this section for recommended slope angles.

FROST PROTECTION:

For frost protection, cover should be greater than 1.2 m.

DE-WATERING:

A de-watering scheme will be required if footings or the granular pads are constructed below the prevailing groundwater level. This scheme should be designed to prevent any boiling or disturbance of the foundation soil. Note that non-cohesive soil such as the material at this site, is highly susceptible to conditions of unbalanced hydrostatic heads. It is recommended that an item - 'Unwatering Structure Excavations' should be included, together with a Special Provision which describes the soil and groundwater conditions and the effects of unbalanced hydrostatic heads on the foundation soil.

SLOPE PROTECTION DURING CONSTRUCTION:

Due to the proposed geometry of the retaining walls, the existing forward slopes at the abutments must be protected during construction.

For the required excavations, the existing embankment fill may be removed above the base of the abutment pile caps. Excavations below the level of the abutment pile caps will require shoring at those locations where a 1:1 slope can not be maintained. It is recommended that consideration be given to constructing the proposed walls in sections with lengths of 5 ± m.

UNDERGROUND UTILITY CONSIDERATIONS:

According to locates provided by the respective utilities, both Bell and Union Gas are outside the limits of the proposed retaining walls.

However, the locations of these underground utilities should be verified for construction purposes and should it be required, foundation recommendations relating to these utilities will be provided at that time.

Please note that a Region of Hamilton-Wentworth watermain lies within the proposed retaining wall limits, to the west of the existing underpass. The representative of the region was unable to provide accurate location information for this utility. This Section has been advised that it is intended to re-locate this utility prior to construction of the proposed retaining walls. No foundation problems are anticipated if the watermain excavation, within the confines of the retaining wall, is backfilled with properly compacted Granular 'A'. In the event that bridging of this utility is required (i.e. the watermain is not re-located) this Section is prepared to provide foundation recommendations, depending upon the availability of accurate location information.

Design Details

SPREAD FOOTINGS ON COMPACTED GRANULAR 'A'

The proposed retaining walls may be supported on spread footings founded on a minimum 0.6 m thickness of compacted Granular 'A'. The base of the spread footings should be determined by frost protection requirements. Refer to Fig. 4 for design details.

For computing sliding resistance between the base of the concrete footing and the compacted fill, the friction coefficient = 0.6.

The following design values are recommended:

- net safe bearing capacity = 340 kPa

and for the purposes of the O.H.B.D.C.:

- Factored Bearing Capacity at U.L.S. = 900 kPa
- Bearing Capacity at S.L.S. Type II = 340 kPa

MISCELLANEOUS

The fieldwork for this project was carried out under the supervision of Mr. B. Eckert, Student Engineer. The report was written by Mr. D. H. Dundas, Foundations Engineer, and reviewed by Mr. K. G. Selby, Chief Foundations Engineer. The equipment used was owned and operated by Master Soil Investigation Ltd.

D. H. Dundas

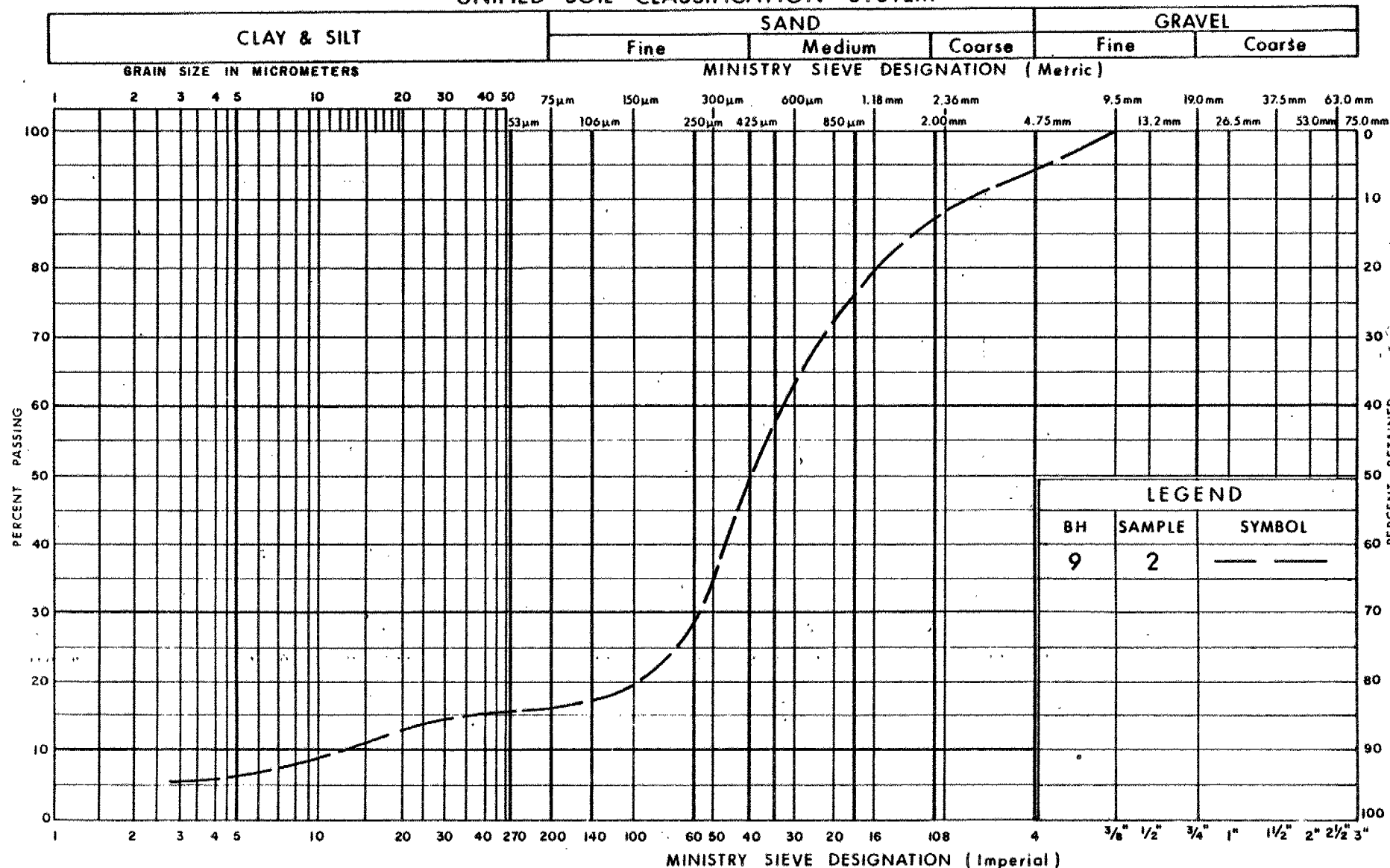
D. H. Dundas, P. Eng.
Project Foundation Engineer

K. G. Selby

K. G. Selby, P. Eng.
Chief Foundations Engineer
(West)

APPENDIX

UNIFIED SOIL CLASSIFICATION SYSTEM



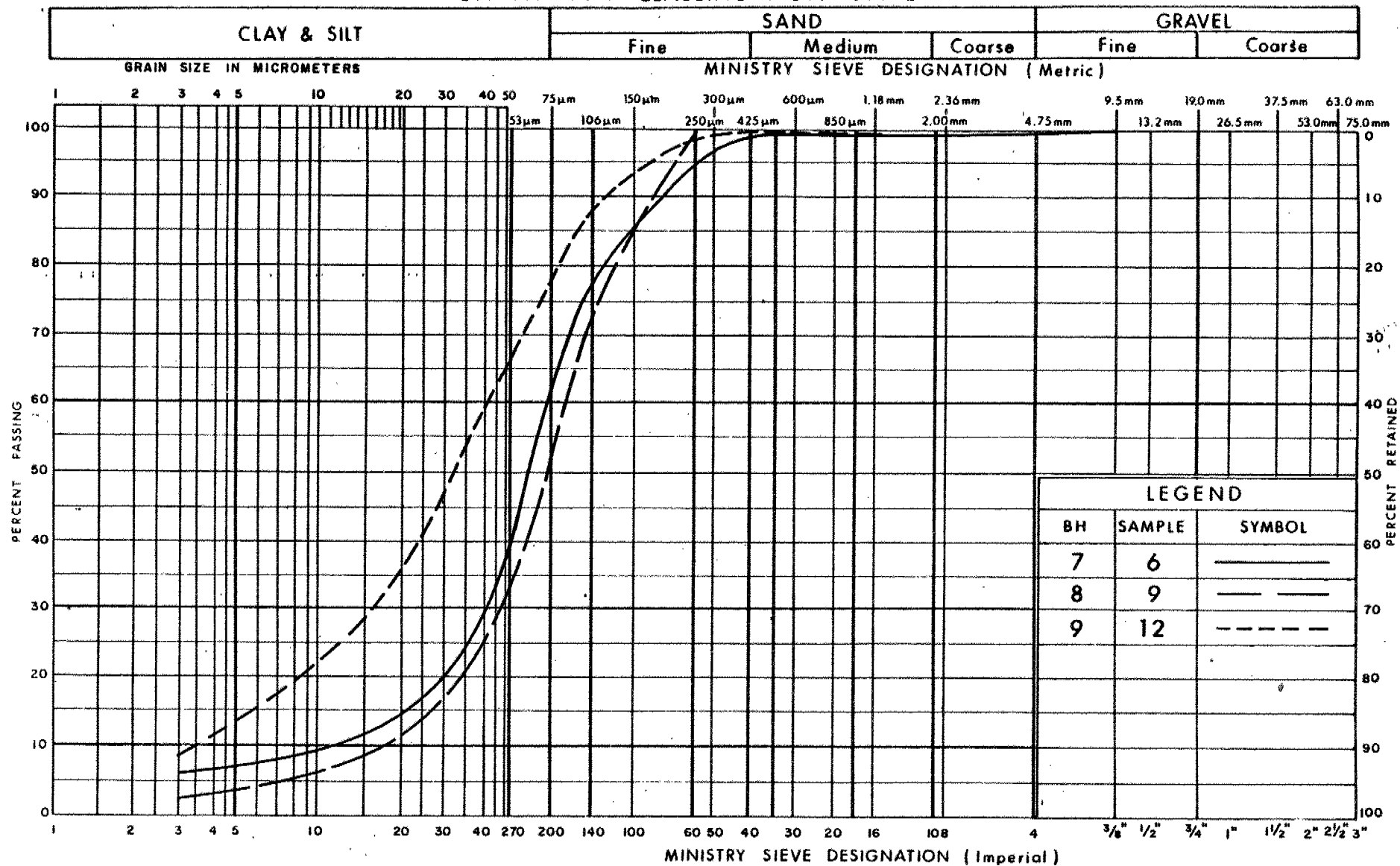
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GRAIN SIZE DISTRIBUTION
SAND TO SILTY SAND
TRACE GRAVEL AND CLAY

FIG No 1

W P 13-82-01

UNIFIED SOIL CLASSIFICATION SYSTEM



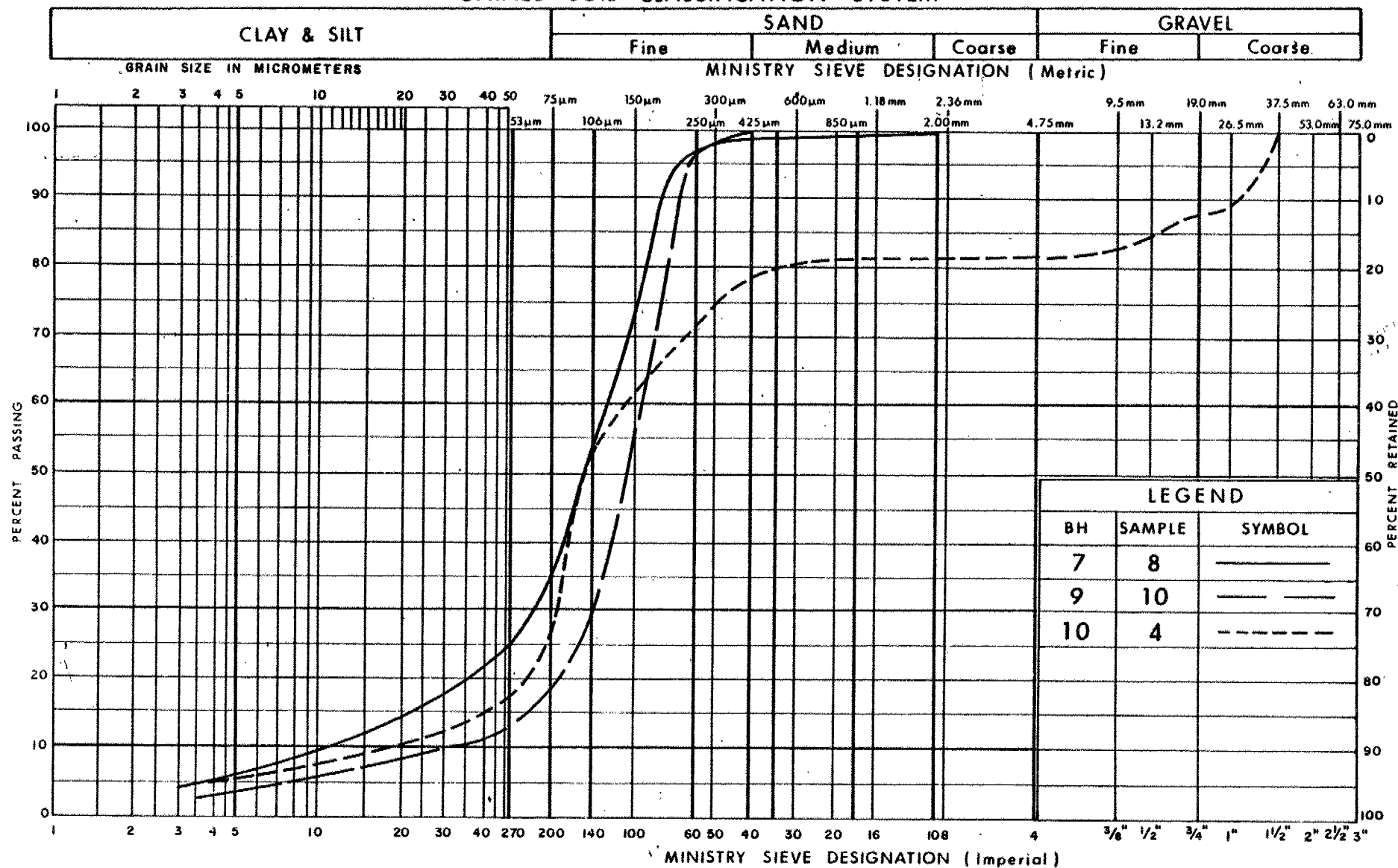
Ministry of
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GRAIN SIZE DISTRIBUTION
SANDY SILT
TRACE GRAVEL AND CLAY

FIG No 2

W P 13-82-01

UNIFIED SOIL CLASSIFICATION SYSTEM

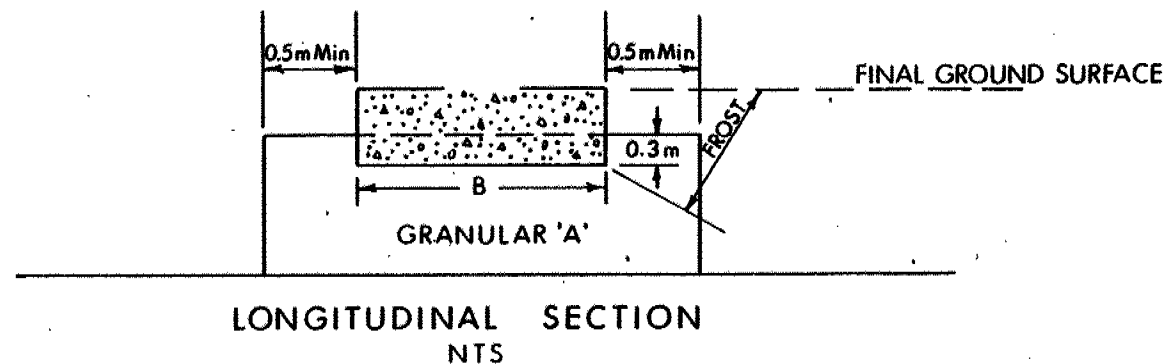
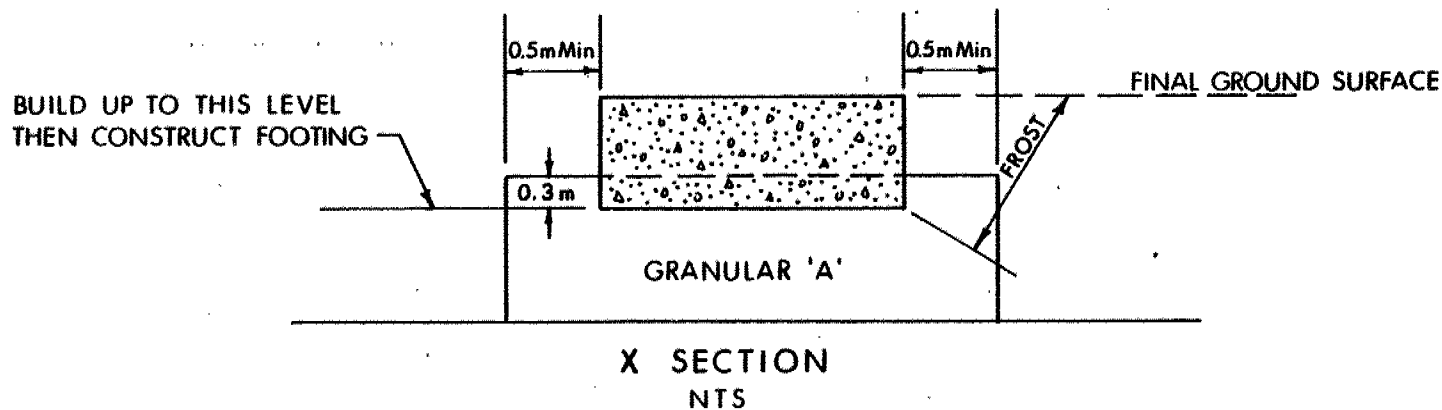


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GRAIN SIZE DISTRIBUTION
SILTY SAND
SOME GRAVEL, TRACE CLAY

FIG No 3

W P 13-82-01



NOTES:

- 1 - EXCAVATE EXISTING MATERIAL.
- 2 - PLACE GRANULAR 'A' & EARTH FILL TO BOTTOM OF FOOTING LEVEL, COMPACTED ACCORDING TO CURRENT MTC STANDARDS.
- 3 - CONSTRUCT CONCRETE FOOTING.
- 4 - PLACE REMAINDER OF GRANULAR 'A' & EARTH FILL AS REQUIRED.

FOOTING ON COMPACTED GRANULAR 'A'

FIGURE 4
WP 13-82-01

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						



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RECORD OF BOREHOLE No 7

METRIC

W P 13-82-01

LOCATION Co-ords: N 4 784 979.5, E 265, 511.0

ORIGINATED BY BE

DIST 4 HWY 403

BOREHOLE TYPE Cone Test, H-S Auger

COMPILED BY DD

DATUM Gonderic

DATE 84 03 13 - 14

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			SHEAR STRENGTH							
247.6	GROUND SURFACE							20 40 60 80 100							GR SA SI CL
0.0	Sand to Silty Sand trace gravel and clay		1	SS	15										
			2	SS	18										
			3	SS	22										
	compact loose to compact		4	SS	5										0 84 12 4
243.8			5	SS	14										
3.8	Sandy Silt trace gravel and clay compact to dense		6	SS	18										1 30 63 6
	Silty Sand		7	SS	40										0 66 33 1
			8	SS	22										
240.6															
7.0	Silt trace sand and clay compact to very dense		9	SS	8										0 8 89 3
			10	SS	54										
			11	SS	87										
			12	SS	84										
			13	SS	73										0 1 93 6
			14	SS	104										
231.8															
15.8	Silty Clay (CL) trace sand hard		15	SS	50										0 10 76 14
230.7															
16.9	END OF BOREHOLE														

+3, x⁵ : Numbers refer to
Sensitivity

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

RECORD OF BOREHOLE No 8

METRIC

W P: 13-82-01 LOCATION Co-ords: N 4 784 975.5, E 265 471.5 ORIGINATED BY BE
DIST 4 HWY 403 BOREHOLE TYPE Cone Test, H-S Auger COMPILED BY DD
DATUM Geodetic DATE 84 03 14 CHECKED BY SD

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 * LAB VANE	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								
247.9	GROUND SURFACE												
0.0	Sand to Silty Sand trace gravel and clay loose to compact		1	SS	6								
			2	SS	13								
			3	SS	9								
244.7			4	SS	51								
3.2	Sandy Silt trace gravel and clay very dense		5	SS	62								
			6	SS	73								
			7	SS	53								
	Silty Sand		8	SS	43								
			9	SS	48								
239.4			10	SS	80								
8.5	Silt trace sand and clay very dense		11	SS	38								
			12	SS	100								
235.3													
12.6	END OF BOREHOLE												

OFFICE REPORT ON SOIL EXPLORATION



Ministry of
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Ontario

RECORD OF BOREHOLE No 9

METRIC

W P 13-82-01 LOCATION Co-ords: 4 784 919.0, E 265 481.0 ORIGINATED BY BF
DIST 4 HWY 403 BOREHOLE TYPE Cone Test, H-S Auger COMPILED BY DD
DATUM Geodetic DATE 84 03 14 - 15 CHECKED BY SO *b*

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 × LAB VANE										
247.4	GROUND SURFACE																
0.0	Sand to Silty Sand trace gravel and clay compact		1	SS	15									6 78 12 4			
			2	SS	25												
			3	SS	16												
244.4	Sandy Silt trace gravel and clay compact to very dense		4	SS	48									3 9 85 3			
3.0			5	SS	44												
			6	SS	64												
			7	SS	57												
			8	SS	35												
			9	SS	82												
			10	SS	15									0 82 16 2			
			11	SS	47												
234.9	Silty Sand		12	SS	64									0 23 73 4			
12.5																	
	Silt trace sand and clay very dense																
			13	SS	58												
231.2	Silty Clay (CL) trace sand hard																
16.2			14	SS	62									0 5 64 31			
230.2	END OF BOREHOLE																
17.2																	

+3, x5: Numbers refer to
Sensitivity

20
15 5 (%) STRAIN AT FAILURE
10

RECORD OF BOREHOLE No 10

METRIC

W P- 13-82-01 LOCATION Co-ords: N 4 784 930.5, E 265 524.0 ORIGINATED BY BE
DIST 4 HWY 403 BOREHOLE TYPE Cone Test, H-S Auger COMPILED BY DD
DATUM Geodetic DATE 84 03 16 - 19 CHECKED BY SO

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	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES									
247.4	GROUND SURFACE													
0.0	Sand to Silty Sand trace gravel and clay compact		1	SS	19		246							
243.7			2	SS	12		244							
3.7	Silty Sand some gravel trace clay compact to very dense		3	SS	31		242							
			4	SS	13		240							18 60 19 3
			5	SS	39									
			6	SS	24		238							
			7	SS	50		236							
235.8														
11.8	Sandy Silt trace gravel and clay													
234.8	dense		8	SS	48									0 26 70 4
12.6	END OF BOREHOLE													
	* water level not observed													

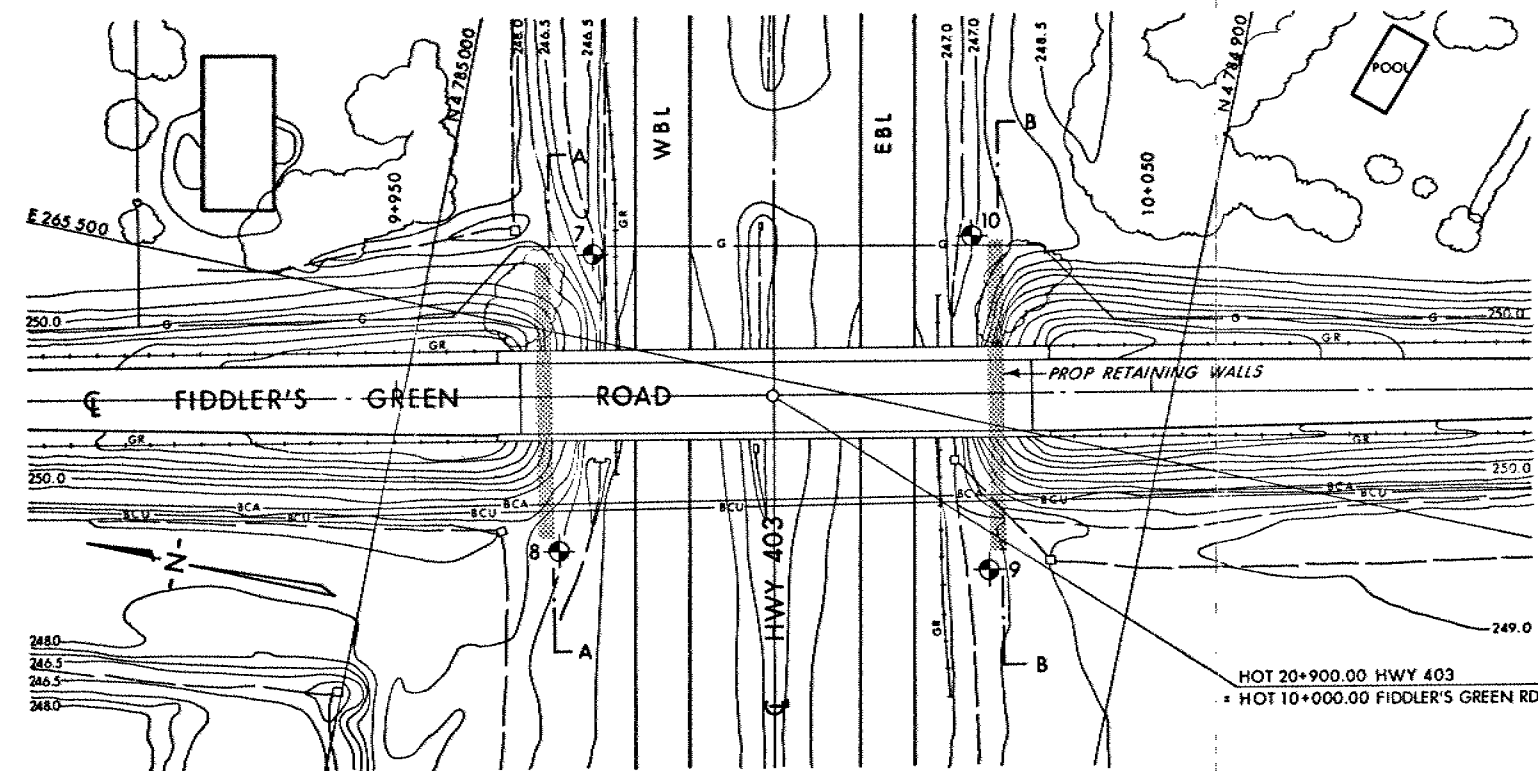
METRIC
DIMENSIONS ARE IN METRES
AND/OR MILLIMETRES UNLESS
OTHERWISE SHOWN. STATIONS
IN KILOMETRES + METRES.

CONT No
WP No 13-82-01

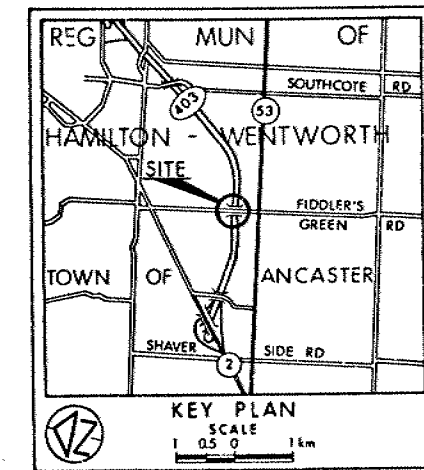


FIDDLER'S GREEN ROAD
BORE HOLE LOCATIONS & SOIL STRATA

SHEET



PLAN
SCALE
10m 5 0 10m



LEGEND

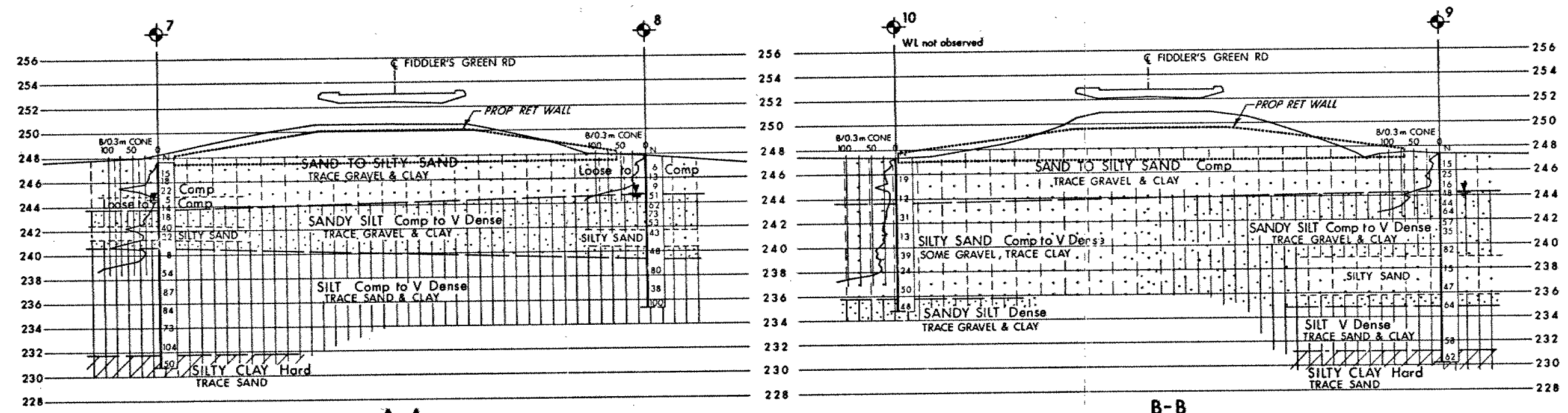
- ◆ Bore Hole
- ⊕ Dynamic Cone Penetration Test (Cone)
- ⊙ Bore Hole & Cone
- N Blows/0.3m (Std Pen Test, 475 J/blow)
- CONE Blows/0.3m (60° Cone, 475 J/blow)
- ↓ WL at time of investigation 84.03
- WL not observed in Bore Hole 10

No	ELEVATION	CO-ORDINATES	
		NORTH	EAST
7	247.6	4784 979.5	265 511.0
8	247.9	4784 975.5	265 471.5
9	247.4	4784 919.0	265 481.0
10	247.4	4784 930.5	265 524.0

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 excluded in accordance with the conditions of Section 102-2 of Form 100.



A-A

B-B

SECTIONS
SCALE
4m 2 0 4m

REV	DATE	BY	DESCRIPTION
Geocres No 30M4-66			
HWY No 403		DIST 4	
SUBM'D	DD	CHECKED	DATE 1984 04 25 SITE 36-85-99
DRAWN	SO	CHECKED	APPROVED DWG 138201-A

METRIC

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

CONT No
 WP No 13-82-01

RETAINING WALLS
 @ Hwy 403 & Fiddler's Green Rd.
 GENERAL ARRANGEMENT

SHEET

NOTES:

CLASS OF CONCRETE

FOOTINGS 20 MPa
 RETAINING WALLS 30 MPa

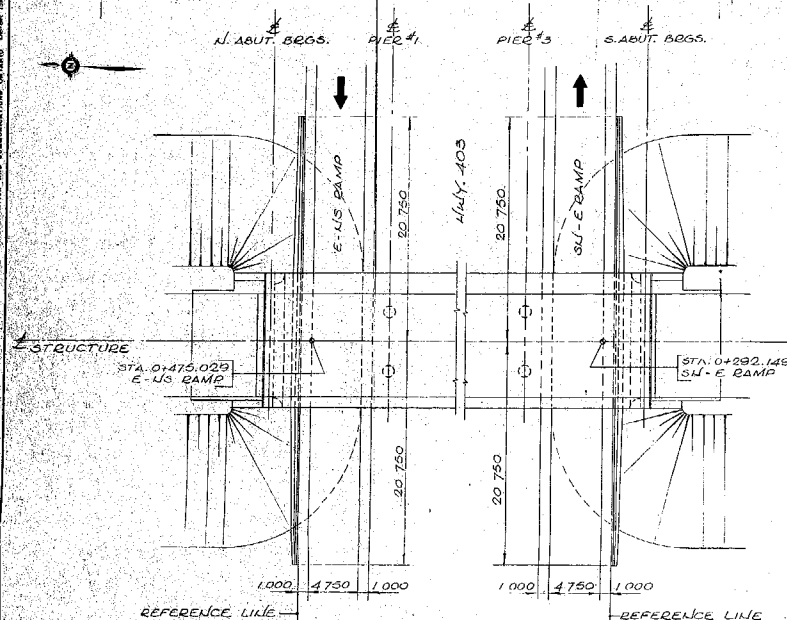
REINFORCING STEEL

GRADE 400

BARS WITH DESIGNATION 'E' AT END OF
 BAR MARKS SHALL BE COATED BARS.

CLEAR COVER TO REINF. STEEL

FOOTINGS 100 mm ± 25 mm
 RETAINING WALLS 80 mm ± 20 mm



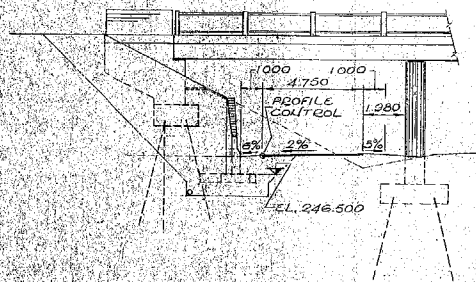
PLAN



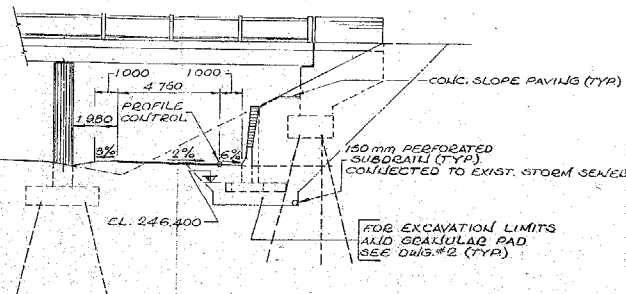
PROFILE OF E-NS RAMP



PROFILE OF SW-E RAMP



NORTH



SOUTH

ELEVATION

LIST OF DRAWINGS:

1. GENERAL ARRANGEMENT
2. DETAILS
3. REINFORCING DETAILS
4. DETAILS OF CONC. SLOPE PAVING

DRAWING NOT TO BE SCALED
 100 mm = ORIGINAL DRAWING

REVISIONS	DATE	BY	DESCRIPTION	DATE
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				

STRUCTURE

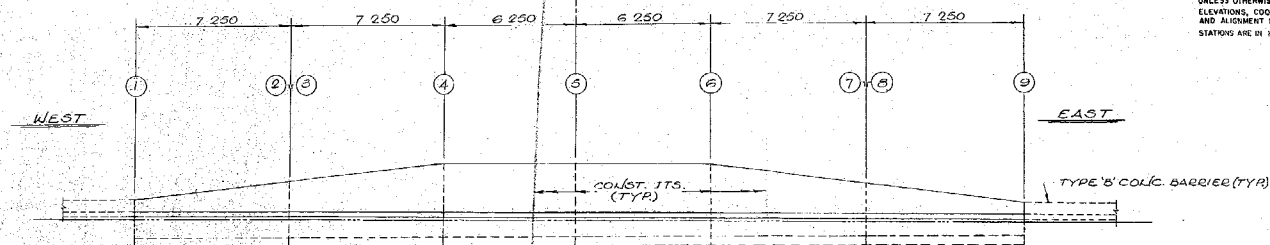
METRIC

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

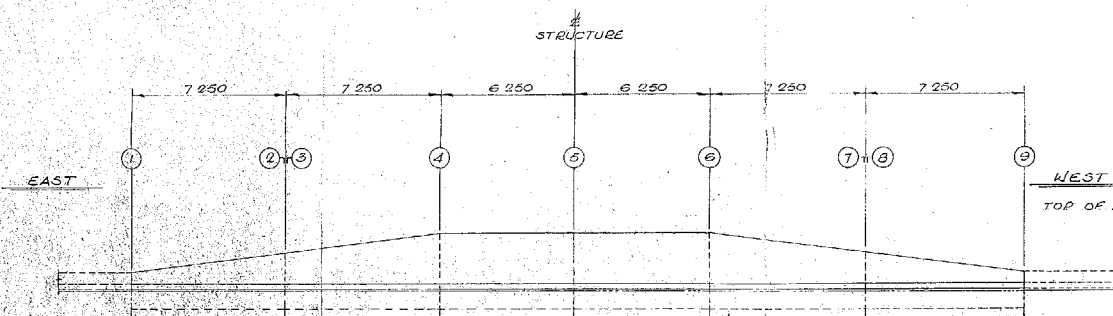
CONT No
WP No 13-82-01

RETAINING WALLS
@ Hwy. 403 & Fiddler's Green Rd.
DETAILS

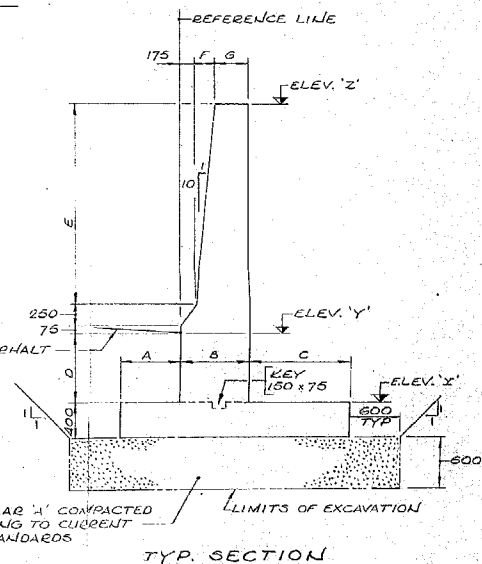
SHEET



FRONT ELEVATION - NORTH WALL



FRONT ELEVATION - SOUTH WALL



GRANULAR 'A' COMPACTED
ACCORDING TO CURRENT -
M.T.C. STANDARDS

TYP. SECTION

[illegible]

SOUTH WALL									
POINT	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
A	822	630	881	700	700	700	891	630	822
B	425	617	617	608	608	608	617	617	425
C	690	690	1190	1190	1190	1190	1190	690	690
D	831	845	845	860	872	885	899	899	914
E	500	1413	1413	2325	2325	2325	1413	1413	500
F	50	141	141	233	233	233	141	141	50
G	200	300	300	400	400	400	300	300	200
X	246.400								
Y	24.723	24.724	24.724	24.726	24.727	24.728	24.729	24.729	24.734
Z	249.056	249.383	249.383	249.310	249.322	249.335	249.037	249.037	248.136

DRAWING NOT TO BE SCALED
100 mm. ON ORIGINAL DRAWING

REVISIONS				
	DATE	BY	DESCRIPTION	
	DESIGN	CHECK	LOADING	DATE 8/26
	DRAWING 8.3	CHECK	SITE No 36-85-99	DWG 2