

DOCUMENT MICROFILMING IDENTIFICATION

GEOCRES No. 30M13-76

DIST. 6 REGION

W.P. No. 142-87-03

CONT. No. 90-60

W. O. No.

STR. SITE No. 37-1177

HWY. No. 400/407

LOCATION Ramp 400N to 407 EW over
Ramp EW to S (Bridge #13)

No. of PAGES -

=====

OVERSIZE DRAWINGS TO BE INCLUDED WITH THIS REPORT.

REMARKS:

METRIC

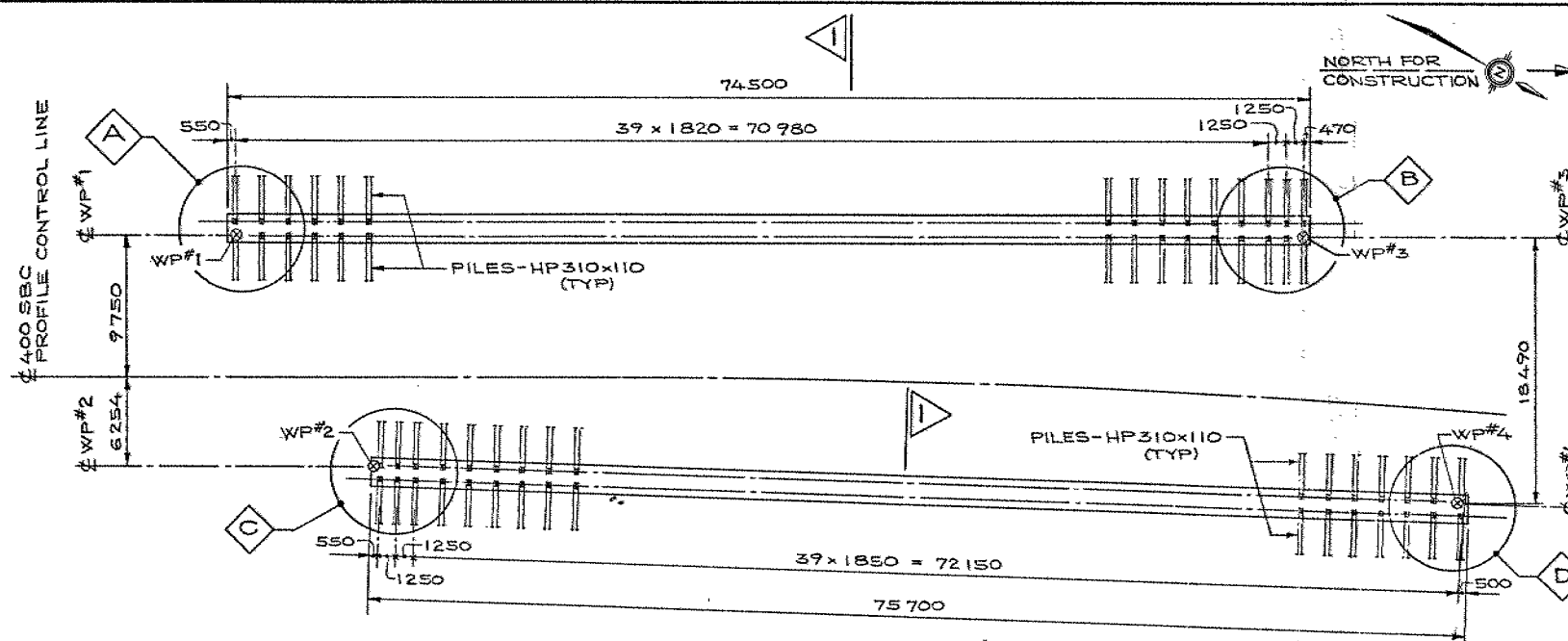
DIST No 6
CONT No
WP No 142-87-03



BRIDGE NO. 13
RAMP 400N TO 407EW OVER
RAMP E & W TO S
PILE & FOUNDATION LAYOUT

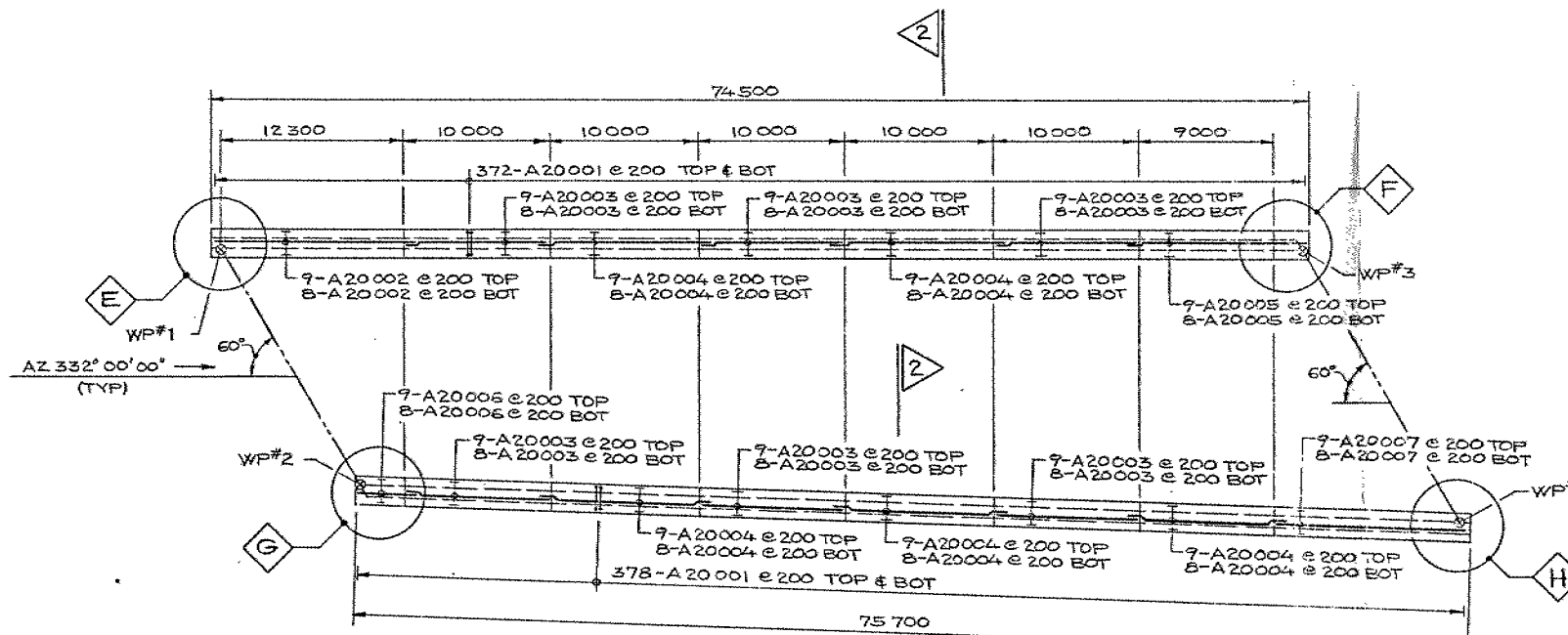
SHEET

A.P.D. & ASSOCIATES
CONSULTING ENGINEERS
A DIVISION OF SANDWELL SWAN WOOSTER



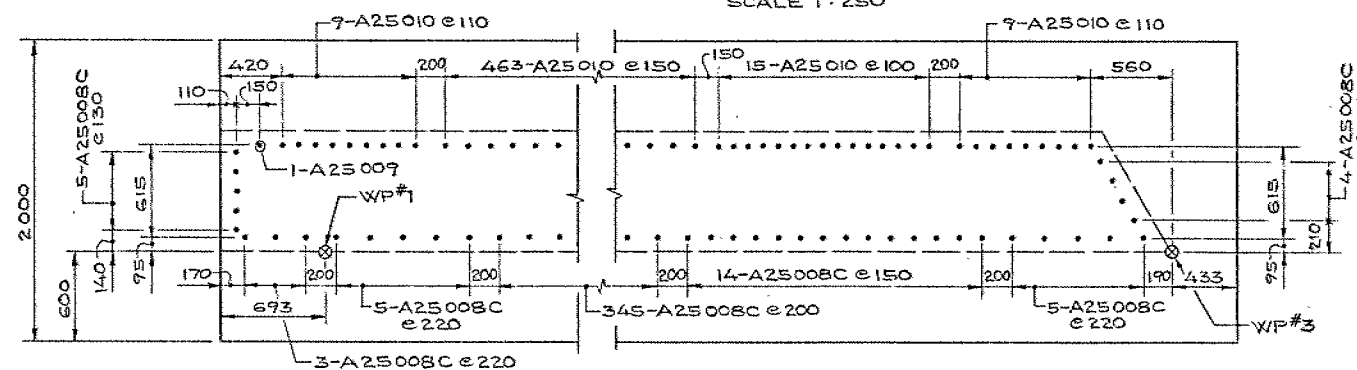
PLAN PILE LAYOUT

SCALE 1:250



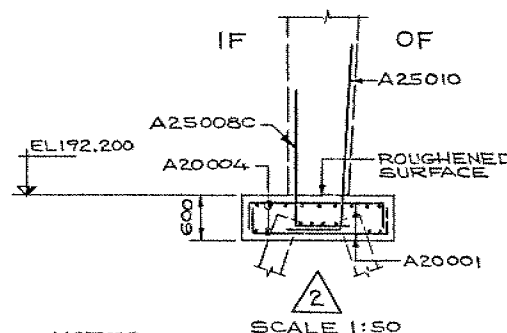
PLAN FOUNDATION LAYOUT

SCALE 1:250



E
SCALE 1:25

F
SCALE 1:25

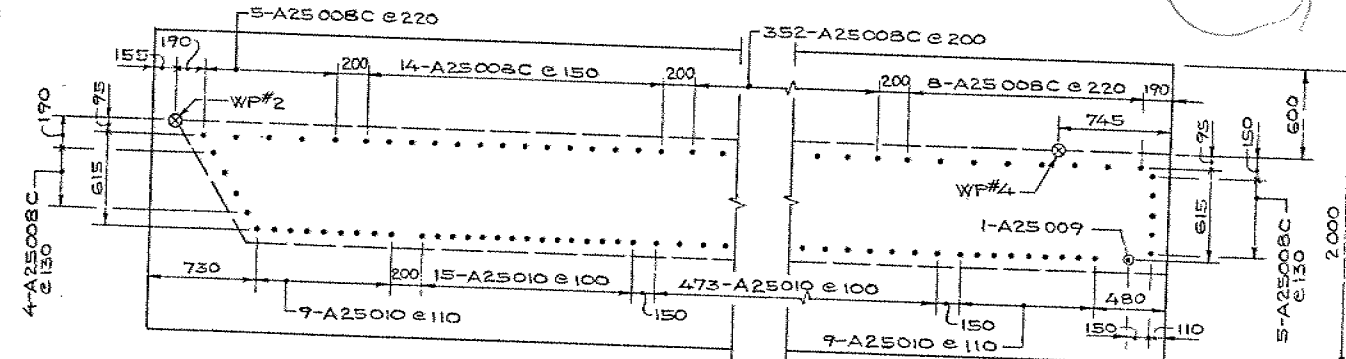


SCALE 1:50

NOTES:

- 1) ALL PILES TO BE HP310x110 STEEL PILES.
- 2) PILE SPACING IS MEASURED AT CUT-OFF ELEVATION.
- 3) PILES TO BE DRIVEN IN ACCORDANCE WITH STANDARD SS-103-II USING AN ULTIMATE CAPACITY OF 1900 KN.
- 4) PILE DRIVING HAMMER TO HAVE A MINIMUM ENERGY OF 5000 JOULES/BLOW.
- 5) PILE LENGTHS SHOWN IN TABLE ARE THEORETICAL LENGTHS BELOW CUT-OFF ELEVATION.
- 6) PILE DESIGN LOADS:
CAPACITY AT SLS TYPE II = 900 KN.
FACTORED CAPACITY AT ULS = 1250 KN.

PILE DATA			
LOCATION	BATTER	NO. REQ'D	LENGTH(m)
FOOTINGS	1:3	168	16.76



G
SCALE 1:25

H
SCALE 1:25



DRAWING NOT TO BE SCALED
100 mm ON ORIGINAL DRAWING

REVISIONS	DATE	BY	DESCRIPTION
DESIGN	SCF	CHECK	BE
DRAWING	SCF	CHECK	BE
			LOADING OHBDC-A-83
			SITE No 37-1177
			DATE FEB 89
			DWG 3

METRIC
DIMENSIONS ARE IN METRES
AND/OR MILLIMETRES
UNLESS OTHERWISE SHOWN

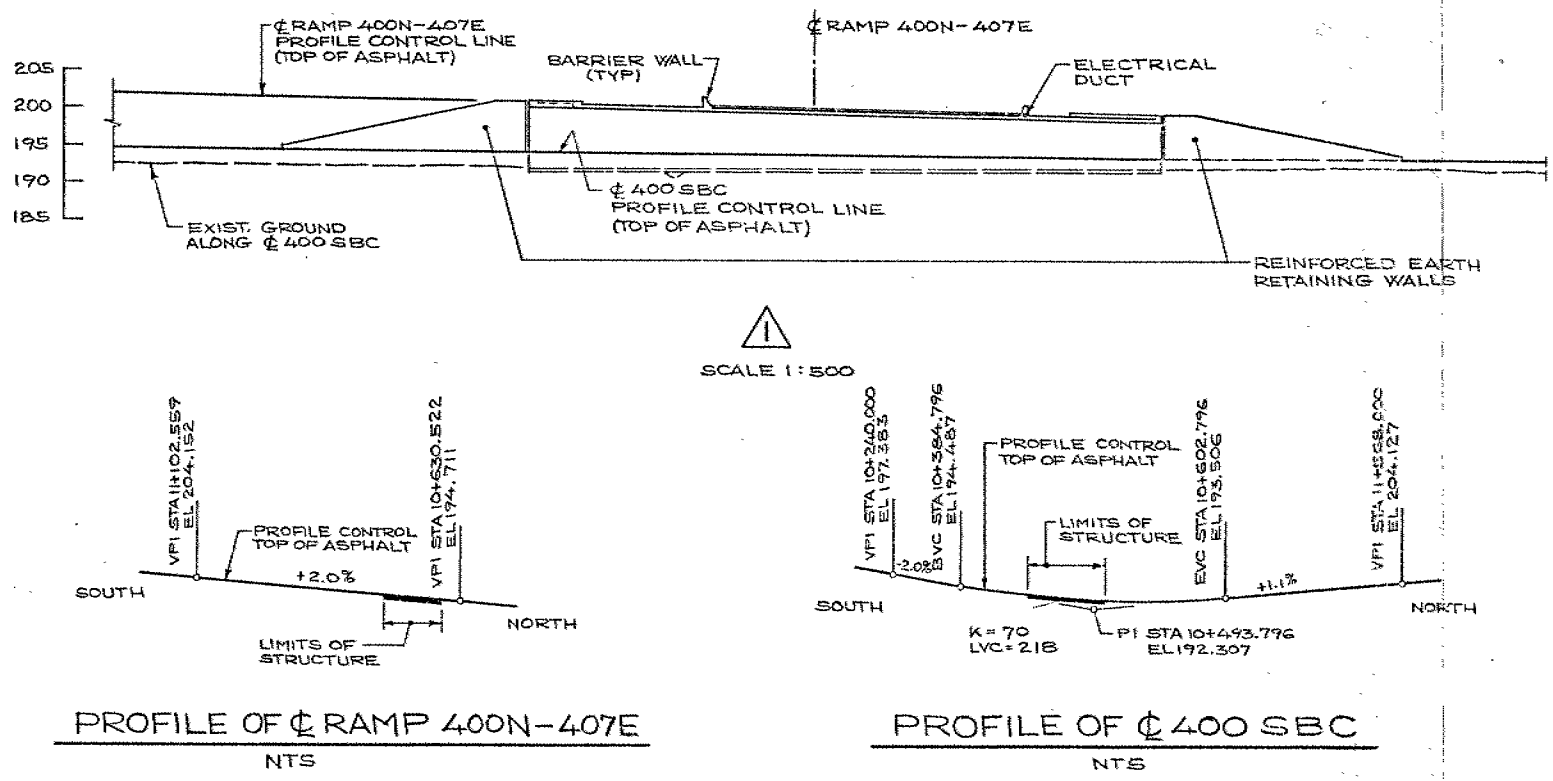
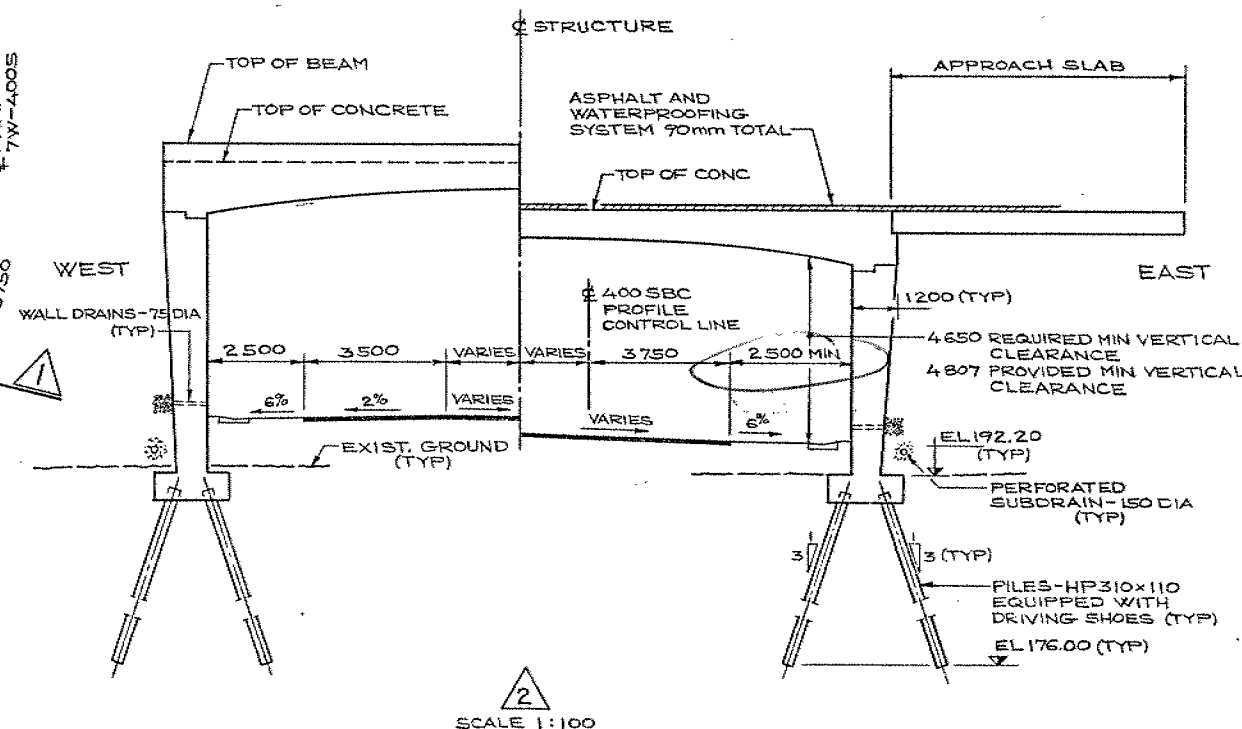
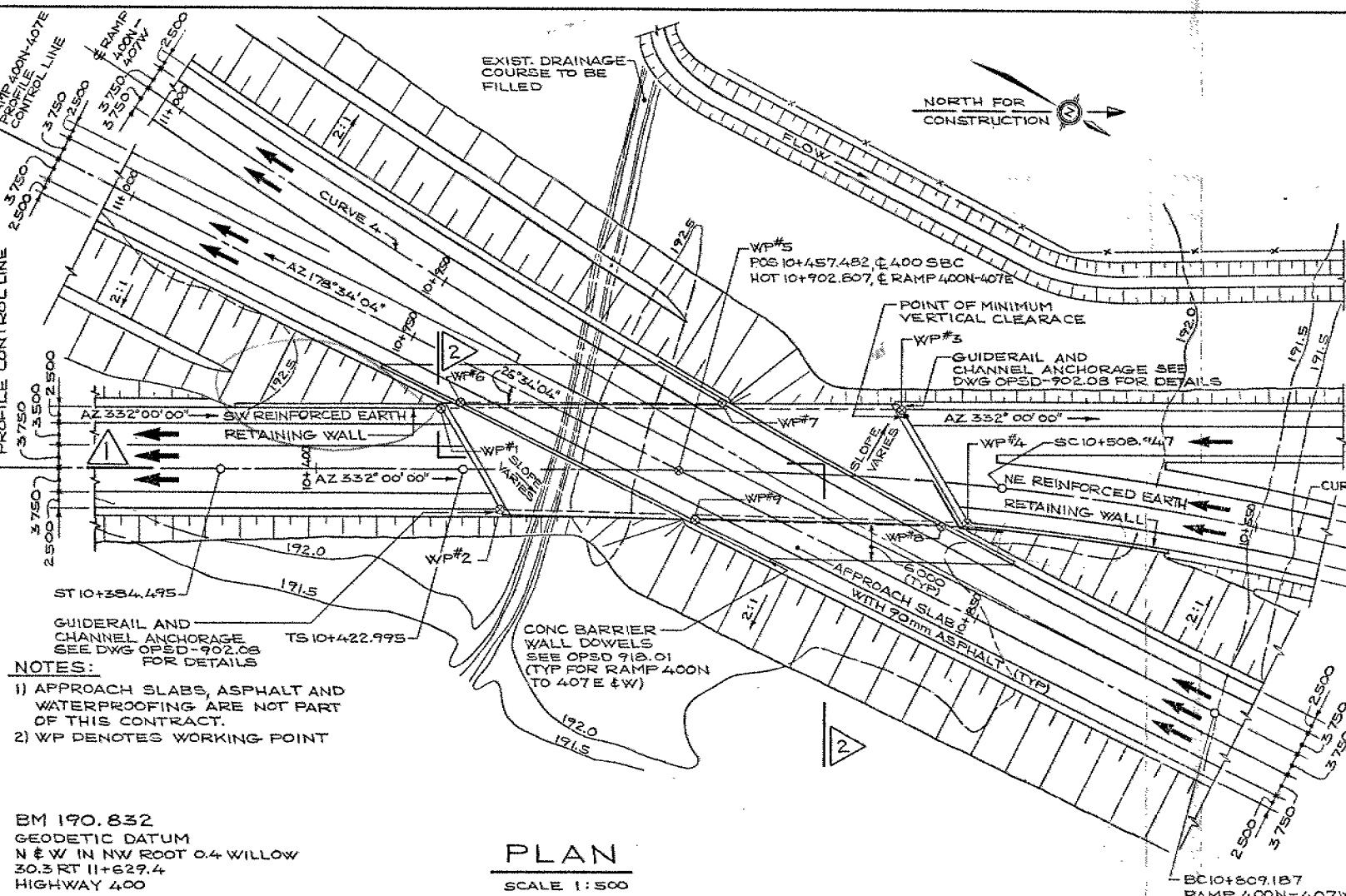
DIST No 6
CONT No
WP No 142-87-03



BRIDGE NO. 13
RAMP 400N TO 407EW OVER
RAMP E & W TO S
GENERAL ARRANGEMENT

SHEET

A.P.D. & ASSOCIATES
CONSULTING ENGINEERS
A DIVISION OF SANDWELL SWAN WOOSTER



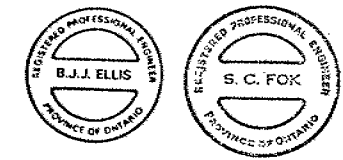
CURVE 3 DATA

A = 29° 34' 00.0"	A = 9° 10' 00.0"
Δc = 17° 50' 28.2"	R = 1500
R = 420	L = 239.983
Lc = 130.783	T = 120.248
Δs = 5° 51' 45.9"	

CURVE 4 DATA

WORKING POINTS DATA

WP	NORTHING	EASTING
1	4 849 409.720	301 614.377
2	4 849 425.392	301 624.170
3	4 849 474.507	301 579.951
4	4 849 492.614	301 591.265
5	4 849 448.028	301 605.301
6	4 849 410.761	301 612.485
7	4 849 448.554	301 592.389
8	4 849 491.035	301 593.373
9	4 849 434.234	301 611.393



DRAWING NOT TO BE SCALED
100 mm ON ORIGINAL DRAWING

DATE	BY	DESCRIPTION
DESIGN	EE	CHECK
DRAWING	EE	CHECK

LOADING OHBDC-A-83
SITE No 37-1177
DATE FEB 89
DWG I

ENGINEERING MATERIALS OFFICE
FOUNDATION DESIGN SECTION

CONT 90-60

WP 142-87-03

DIST 6

HWY 400

STR SITE 37-1177

Ramp Hwy. 400 N to Hwy. 407 E W
Hwy. 400 South Bound Collector
(Structure #13)

DISTRIBUTION

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G. Szekreny
B. Steeves (Cover Only)
M. MacLean (Cover Only)
File

FOUNDATION INVESTIGATION REPORT
For
Ramp Hwy. 400 N to Hwy. 407 E W
Hwy. 400 South Bound Collector (Structure #13)
W.P. 142-87-03 Site 37-1177
District 6, Toronto

INTRODUCTION

This report summarizes the information obtained from the foundation investigation carried out for the above-noted project during the period of December 21, 1987 to January 11, 1988.

Seven boreholes (BH #13-1 to #13-7) were advanced and sampled as part of this project by means of hollow stem augers and washboring techniques. These boreholes extended to depths between 12.2 and 23.3 metres below the ground surface.

This report contains factual information together with recommendations pertaining to the foundations for the structure and associated retaining walls as shown on Drawing No. 1428703-A.

SITE DESCRIPTION AND GEOLOGY

The site is located at the proposed Hwy. 407/400 interchange, 200 metres west of Hwy. 400 and about 0.5 km south of Hwy. 7. Topography is mainly flat. The land to the east contains Hwy. 400 and the construction site of the Hwy. 400 & 7 interchange. To the west is a Drive-In Theatre and service station.

The site is located in the physiographic region known as the "Peel Plain" as described by the physiography of Southern Ontario (Chapman and Putnam, 1984). This region is characterized by a level to gently undulating topography sloping gradually towards the south. The underlying soil consists of a hard layer of glacial till. The till deposits are interbedded with some continuous lacustrine layers and frequent random discontinuous silt to sand pockets.

Bedrock was not encountered during the investigation but is reported to be composed of shale and limestone laminations and located below elevation 120± metres. Land use is mainly for agricultural purposes.

SUBSURFACE CONDITIONS

The record of Borehole Sheets in the Appendix illustrate the subsurface conditions at the borehole locations. The locations and elevations of the boreholes, along with stratigraphical profiles based on the borehole data are shown on Drawing No. 1428703-A.

The subsoil conditions encountered across the site were generally uniform consisting primarily of the following generalized deposits, in sequence, from the surface down:

<u>Elevations (m)</u>		<u>Material</u>
<u>From</u>	<u>To</u>	
193.2	190.3	Clayey Silt (Glacial Till)
190.3	175.4	Clayey silt to silt with random silt and sand pockets (Glacial Till with lacustrine Interbeds)
175.4	Undetermined	Silty Clay with thin silt seams (Lacustrine)

Properties of the glacial till deposits are variable across the site, and the boundaries between the soil strata are transitional.

More detailed description of the subsoil deposits will be presented.

Clayey Silt (Glacial Till)

A layer of clayey silt with some sand and a trace of gravel extends from the ground surface to depths between 2.9 and 4.4 metres. The material changes in colour from brown to grey at two borehole locations (at BH #13-1, elevation 190.2 metres, at BH #13-6, elevation 188.9 metres).

Typical properties of the material, as determined by laboratory tests of representation samples are summarized as follows:

<u>Properties</u>	<u>Range (%)</u>
Moisture Content (w)	10.0 - 14.0
Liquid Limit (w_L)	18.5 - 23.5
Plastic Limit (w_p)	11.0 - 12.0
Plasticity Index (I_p)	7.5 - 11.0

The Atterberg Limit Test results are illustrated on the Plasticity Chart (Figure 1). From the chart it is evident that the layer can be classified as an inorganic clayey silt (CL).

Grain size distribution tests were carried out on these samples. Figure 3 in the Appendix shows the results in envelope form.

Standard Penetration Test 'N' values between 6 and 85 indicated that the soil can be interpreted as being firm to hard.

Clayey Silt to Silt (Glacial Till)

This deposit has been described as clayey silt to silt, some sand, trace of gravel, with random silt and sand pockets and occasional boulders. The main component of this deposit varies randomly from non-plastic silt (ML), to slightly plastic silt (CL-ML), to clayey silt (CL). Within this deposit there are frequent random discontinuous pockets of silts and sands. A semi-continuous layer of lacustrine silt to sand, varying in thickness was encountered at the various elevations, at all boreholes.

At the Bridge #13 site, this material was encountered at all borehole locations where it extended for thickness varying from over 9.3 to 14.9 metres.

Typical properties of the basic cohesive material matrix, as determined by laboratory tests of representative samples are summarized as follows:

<u>Properties</u>	<u>Range (%)</u>
Moisture Content (w)	8.0 - 19.0
Liquid Limit (w_L)	15.0 - 31.5
Plastic Limit (w_p)	10.5 - 15.0
Plasticity Index (I_p)	4.0 - 18.5

Figure 1 illustrates the plasticity chart for this material, based on representatives samples.

Figure 3 illustrates an envelope of typical grain size distribution for this material.

Based on 'N' values which ranged from 9 to over 100 blows/0.3 m for this structure, the denseness of this deposit can be described as loose to very dense for the non-cohesive zones while the consistency is stiff to hard for the cohesive zones. Generally, the deposit may be considered to be dense to very dense for the non-cohesive component or hard for the cohesive component.

Silty Clay (Lacustrine)

This lacustrine deposit has been described as silty clay with thin silt seams. The thickness of this deposit was not fully explored at this site, but it is in excess of 5.5 metres. Within this deposit there is occasional thin layer of silt, generally up to 1.5 m thick at Borehole #13-2.

Atterberg Limit Test results are summarized below:

<u>Properties</u>	<u>Range (%)</u>
Moisture Content (w)	13.5 - 24.0
Liquid Limit (w_L)	35.0 - 50.0
Plastic Limit (w_p)	15.0 - 17.0
Plasticity Index (I_p)	19.0 - 33.0

The Atterberg Limit Test results are illustrated on the plasticity chart (Figure 2).

Grain size distribution tests were carried out on these samples. Figure 4 shows that the results in envelope form. Standard Penetration Test 'N' values between 52 and over 100 blows/0.3 m indicate that this deposit is in hard state.

The results of all field and laboratory testing, along with a summary of the subsoil conditions encountered in each borehole are shown on the Record of Borehole Sheets (See Appendix). Stratigraphical profiles are shown on Drawing No. 1428703-A. Also shown on this drawing is a generalized plan of the site area showing the locations of the boreholes with respect to the relevant structure.

GROUNDWATER CONDITIONS

Groundwater conditions were observed through the measurements of water levels in the open boreholes. Groundwater level in the borings was found to range between elevation 190.9 metres at BH #13-7 and elevation 192.7 metres at BH #13-1 about 1.0 metres below the existing ground surface.

DISCUSSION AND RECOMMENDATIONS

The recommendations in this report apply to the bridge structure, the retaining wall and related approaches.

This structure is one of Hwy. 400 and 407 interchange complex. Bridge #13 is for the Ramp Hwy. 400 N to Hwy. 407 E.W. over the ramp from Hwy. 7 E.W. to Hwy. 400 S. A single span rigid frame (74 m) structure with related retaining walls (30, 45 m) is proposed. The proposed deck elevation is about 202± metres, which is about 9.0± metres above the existing natural ground surface.

Structure Foundation & Retaining Walls

The proposed structure & retaining walls may be supported on piles driven into the hard clayey silt at an elev. 176.0 m.

For purpose of the O.H.B.D.C. the following design values are recommended:

<u>Pile Type</u>	<u>Factored Capacity At U.L.S. (kN)</u>	<u>Allowable Capacity at S.L.S. Type II (kN)</u>
310 HP 79	900	700 650
310 HP 110	1250	900 ✓

All footings must ^{have} be a minimum earth cover of 1.2 m for frost protection.

The alternative to this may be to support the structure and retaining walls on spread footings constructed within the stiff to hard clayey silt deposit at the elev. 188.0 m. All footings must have a minimum earth cover of 1.2 m for frost protection.

For purposes of the O.H.B.D.C. the following design values are recommended:

Abutments & Retaining Walls:

Factored Bearing Capacity at U.L.S.	525 kPa
Bearing Capacity at S.L.S. Type II	350 kPa

Alternatively, the structure and retaining walls may be supported on spread footings composed of compacted Granular 'A' core at the higher elevation of about 192.0 m or above. In this case, existing material should be excavated down to elevation 188.0 metres and the excavation can be backfilled with compacted Granular 'A' core to an elevation where a minimum 1.2 m cover is provided to the underside of the footings. Details of this scheme are shown on Figure 5. If this scheme is used, the allowable bearing capacity at S.L.S. Type II can be taken as 350 kPa, while the factored capacity at the U.L.S. can be considered to be 900 kPa.

Other Construction Considerations

Backfill to the abutments and retaining walls should consist of Granular 'A' or Granular 'B' for which the following properties are recommended:

Granular 'A'	$\gamma = 22.8 \text{ kN/m}^3$	$\phi = 35^\circ$	$K_A = 0.27$
Granular 'B'	$\gamma = 21.2 \text{ kN/m}^3$	$\phi = 30^\circ$	$K_A = 0.33$

If the proposed single span structure is a rigid unyielding type, the earth pressure at the rest should be used in computing lateral pressures. If a yielding foundation condition is assumed, sliding resistance may be computed by assuming an adhesion of 75 kPa to apply between the underside of footings and the soil. In case of foundations constructed on compacted Granular 'A' core (non-cohesive soil), a sliding resistance can be calculated assuming a coefficient of friction of 0.7 between the concrete footings and the Granular 'A' pad.

Excavations for footings carried out below the water level prevailing at time of construction will require dewatering. Due to the relatively impervious nature of the clayey silt subsoil no major problems are anticipated.

Approach fills and cuts should be constructed with standard 2:1 side and forward slopes in which even, in general, no major stability problems are anticipated.

MISCELLANEOUS

The fieldwork for this investigation was carried out during the period of 87-12-21 to 88-01-11 under the supervision of Ken Zasitko (Technician). The equipment was owned and operated by Master Soil Investigation Toronto.

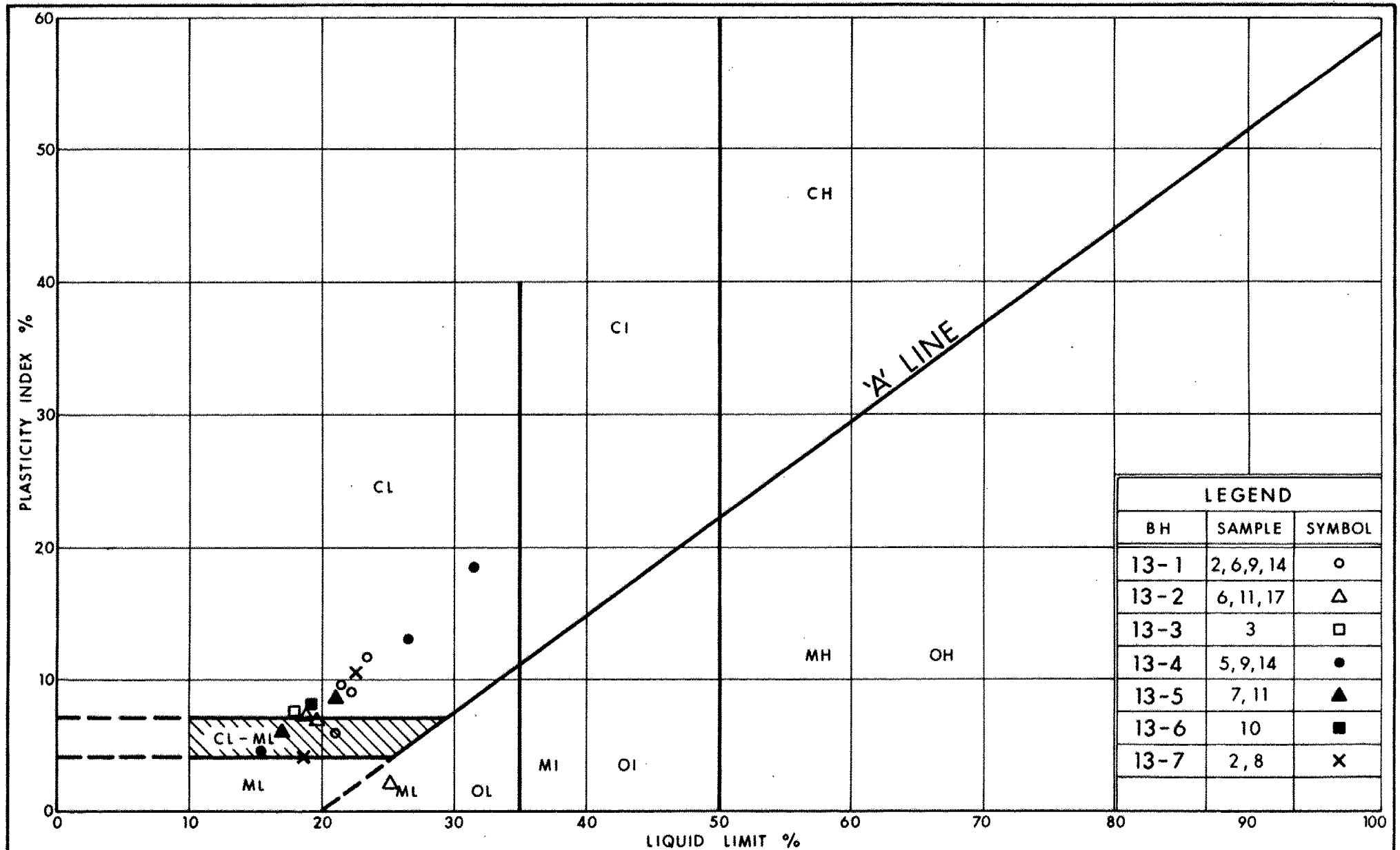
This report was written by T.C. Kim, Foundation Engineer and reviewed by M. Devata, Chief Foundations Engineer (East).



Tae C. Kim
Tae C. Kim, P.Eng.
Project Foundation Engineer

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

APPENDIX



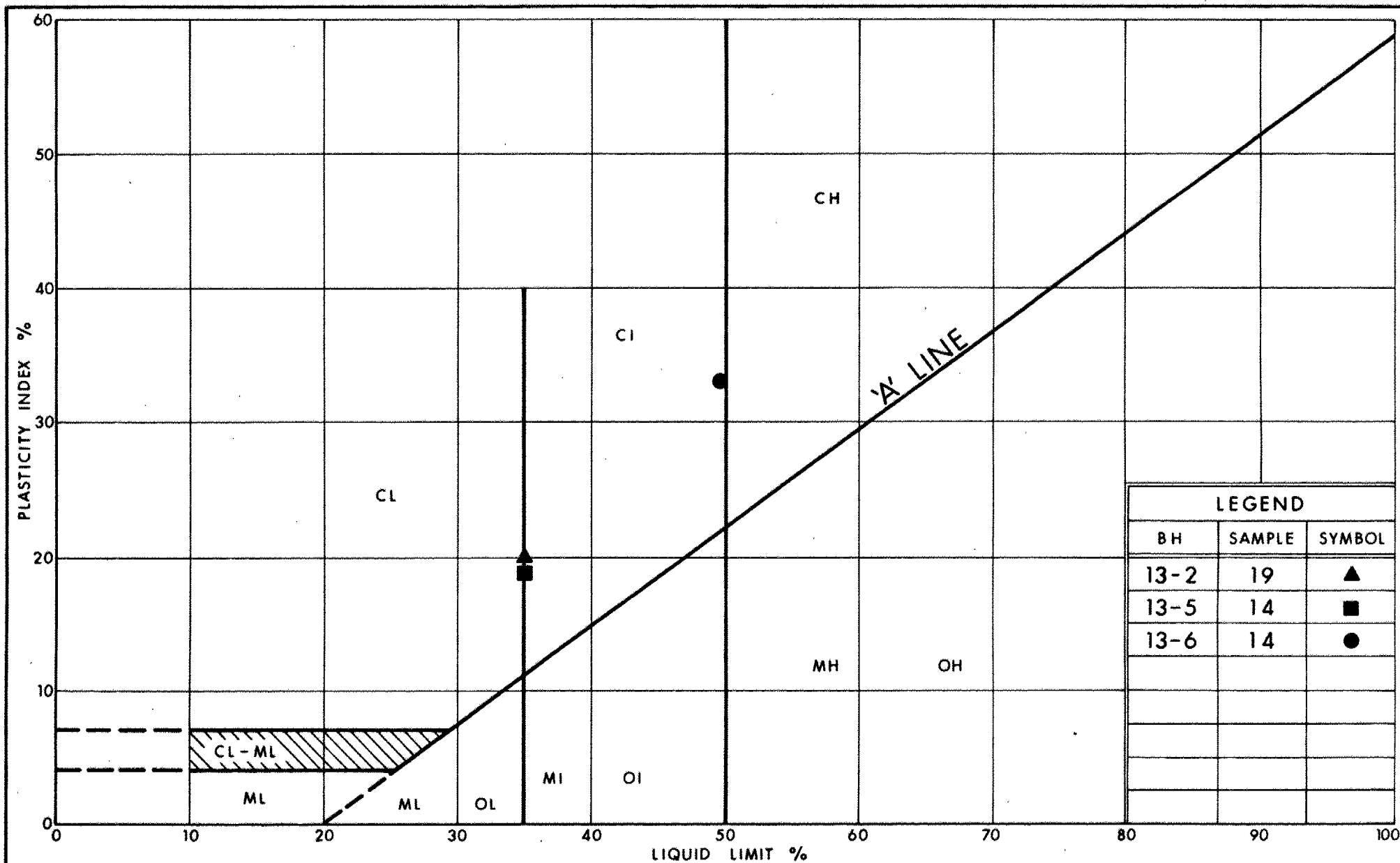
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Transportation

Ontario

PLASTICITY CHART CLAYEY SILT TO SILT

FIG No 1

W P 142-87-03



Ministry of
Transportation

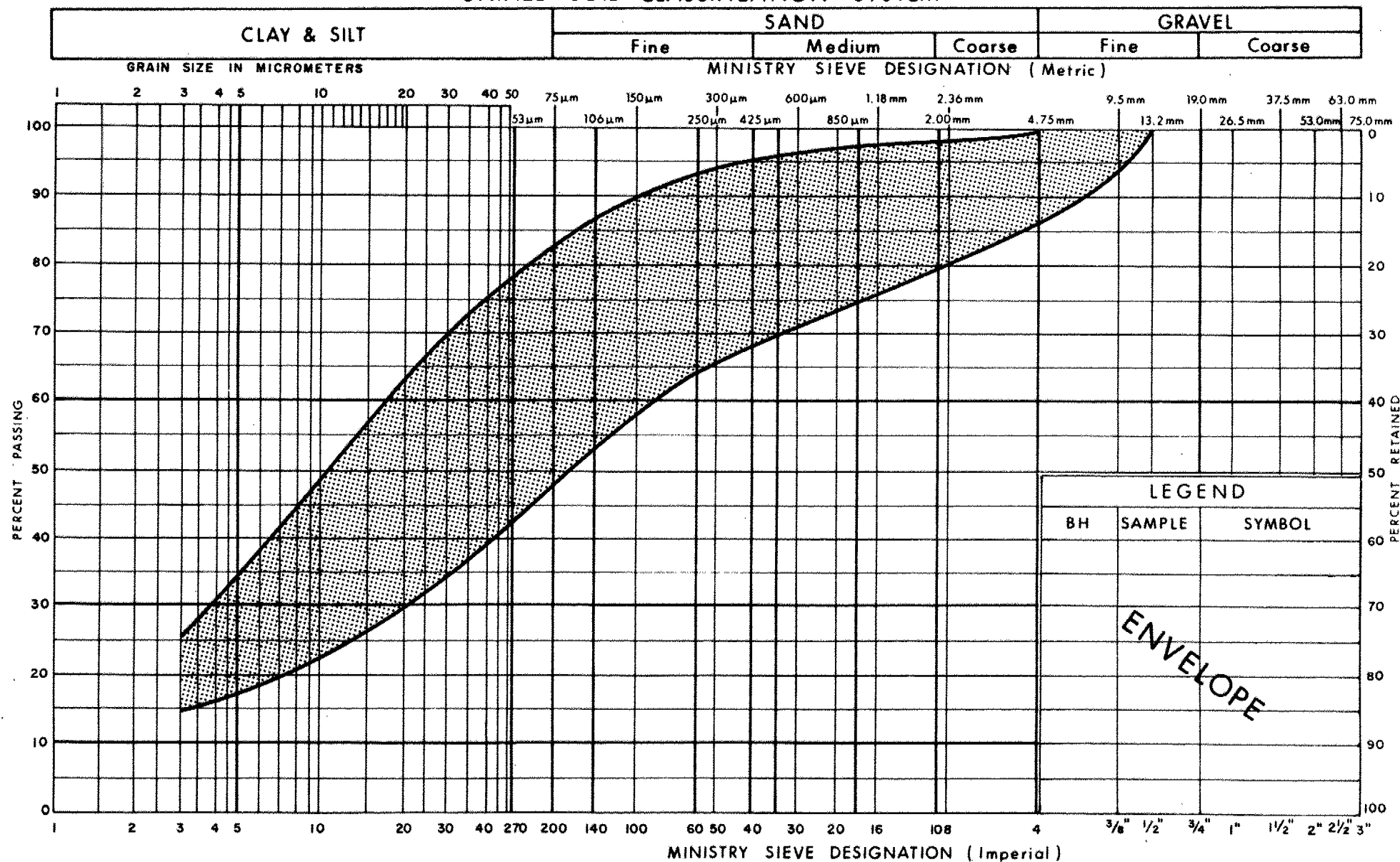
Ontario

PLASTICITY CHART SILTY CLAY

FIG No 2

W P 142-87-03

UNIFIED SOIL CLASSIFICATION SYSTEM

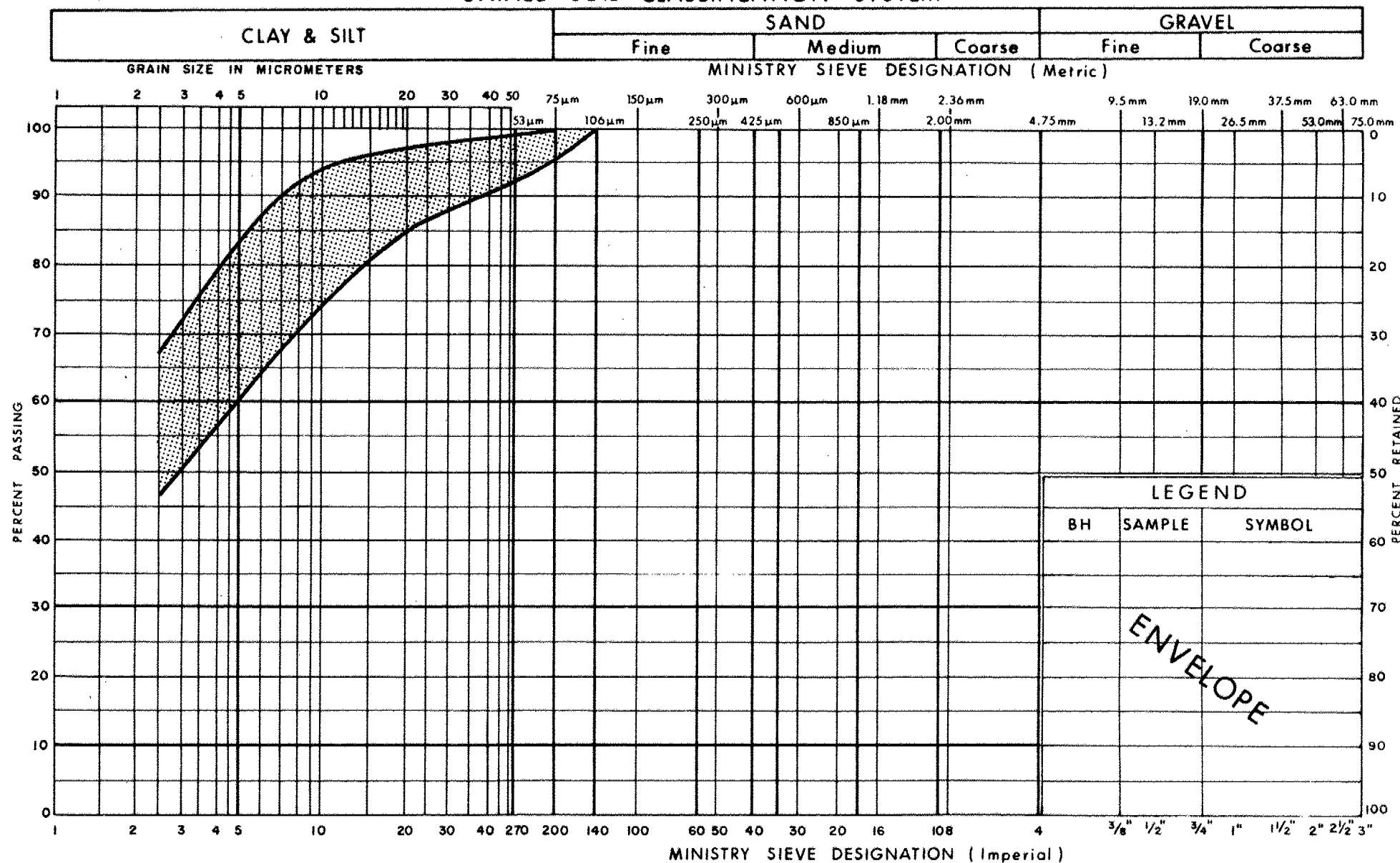

 Ministry of
Transportation

 GRAIN SIZE DISTRIBUTION
CLAYEY SILT TO SILT

FIG No 3

W P 142 - 87-03

UNIFIED SOIL CLASSIFICATION SYSTEM

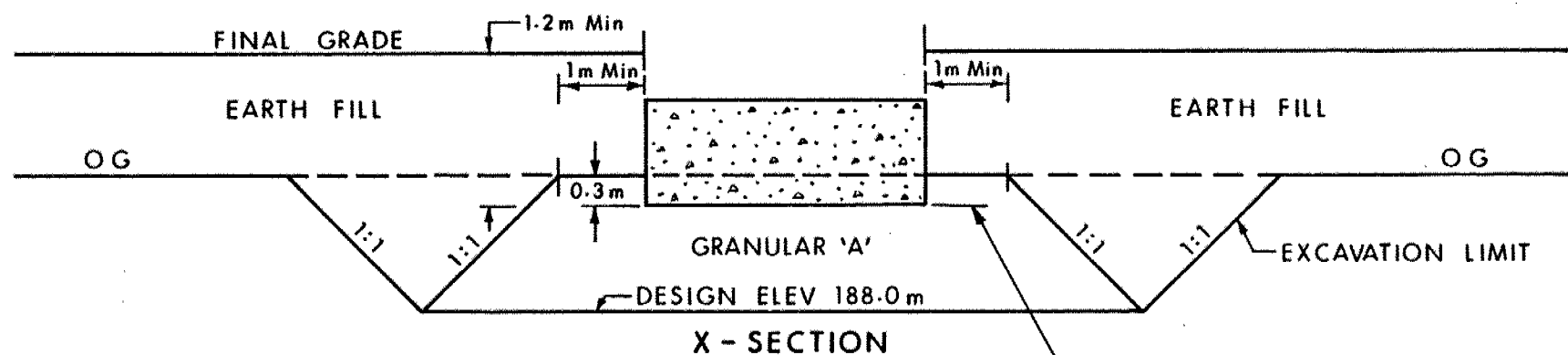


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Transportation

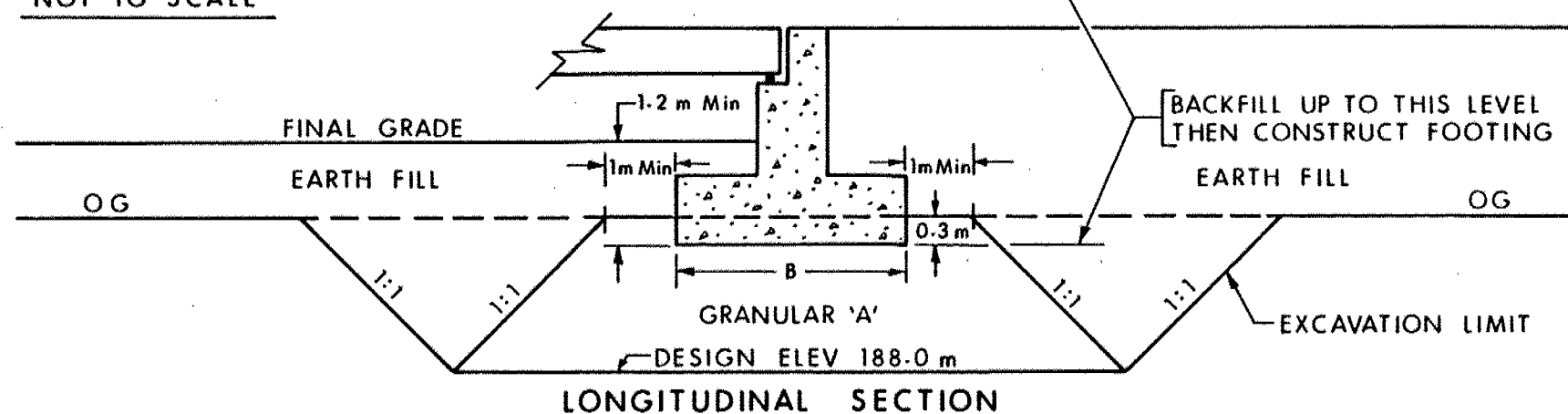
GRAIN SIZE DISTRIBUTION SILTY CLAY

FIG No 4

W P 142-87-03



NOT TO SCALE



NOTES:

- 1-EXCAVATE TO DESIGN ELEVATION UNDER AREA OF COMPACTED GRANULAR 'A'.
- 2-BACKFILL GRANULAR 'A' & EARTH FILL TO BOTTOM OF FOOTING LEVEL, COMPACTED ACCORDING TO CURRENT MTO STANDARDS.
- 3-CONSTRUCT CONCRETE FOOTING.
- 4-PLACE REMAINDER OF GRANULAR 'A' & EARTH FILL AS REQUIRED.



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ABUTMENT IN EXCAVATED AREA SHOWING GRANULAR 'A' CORE

FIG No 5

W P 142-87-03

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

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'_{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_t	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						

RECORD OF BOREHOLE No 13-1

METRIC

W P 142-87-03 LOCATION Co-ords. N 4 849 385.2; E 301 629.5 ORIGINATED BY KZ
 DIST 6 HWY 400 BOREHOLE TYPE Hollow Stem Auger & Cone Test COMPILED BY KZ
 DATUM Geodetic DATE 87 12 21 & 22 CHECKED BY TCK

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 ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE									
							WATER CONTENT (%) 10 20 30										
193.2	Ground Level																
0.0	Clayey Silt Some Sand Trace Gravel Stiff to Hard Brown Grey (Glacial Till)		1	SS	16									5 38 38 19			
			2	SS	10												
			3	SS	17												
			4	SS	16												
188.8			5	SS	85												
4.4	Silt V. Dense (Lacustrine) Clayey Silt to Silt Some Sand Trace Gravel Occ. Sandy Silt Layers Hard (Glacial Till) Sand and Silt		6	SS	76										0 6 74 20		
			7	SS	50												
			8	SS	96												
			9	SS	100												
			10	SS	73												
			11	SS	39												
			12	SS	105		25 cm										
			13	SS	146												
177.7			14	SS	150		25 cm										
15.5			End of Borehole													1 20 61 18	

+³, x⁵: Numbers refer to
Sensitivity

20
15 5 (%) STRAIN AT FAILURE
10



RECORD OF BOREHOLE No 13-2

METRIC

W P 142-87-03 LOCATION Co-ords. N 4 849 411.5; E 301 615.0 ORIGINATED BY KZ
DIST 6 HWY 400 BOREHOLE TYPE Hollow Stem Auger, Wash Boring, Cone Test COMPILED BY KZ
DATUM Geodetic DATE 87 12 22, 23 CHECKED BY TCK

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 (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20 40 60 80 100	120/20 cm					
193.2	Ground Level													
0.0	Clayey Silt Some Sand Trace Gravel Stiff (Glacial Till)		1	SS	9	88 1 4	192							
			2	SS	11									
190.3			3	SS	12									
2.9	Silt (Compact) (Lacustrine)		4	SS	13		190							
	Brown Grey Clayey Silt to Silt		5	SS	41									
	Some Sand		6	SS	101		188							1 22 65 12
	Trace Gravel		7	SS	108									
	Occ. Silt Layers		8	SS	45		186							
	Hard (Glacial Till)		9	SS	67		184							
			10	SS	32		182							2 24 58 16
			11	SS	38									
			12	SS	66		180							
			13	SS	44		178							13 9 67 11
	Silt		14	SS	50		176							
			15	SS	127		174							
175.4			16	SS	52		172							
17.8	Silty Clay		17	SS	100	8 cm								0 0 95 5
	Occ. Silt Layers	Silt Trace Clay	18	SS	114		170							
	Hard (Lacustrine)		19	SS	90									0 0 44 56
169.9														
23.3	End of Borehole													

+³, x⁵: Numbers refer to
Sensitivity

20
15 5 (%) STRAIN AT FAILURE
10



RECORD OF BOREHOLE No 13-3

METRIC

W P 142-87-03 LOCATION Co-ords. N 4 849 418.6; E 301 627.8 ORIGINATED BY KZ
DIST 6 HWY 400 BOREHOLE TYPE Hollow Stem Auger, Wash Boring, Cone Test COMPILED BY KZ
DATUM Geodetic DATE 87 12 23 and 88 01 04 CHECKED BY TCK

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 ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE					
193.0	Ground Level													
0.0	Clayey Silt Some Sand Trace Gravel Stiff (Glacial Till)		1	SS	13	88 1 6	192							14 38 33 15
			2	SS	10									
190.1			3	SS	14									
2.9	Silt, Loose (Lacustrine)	4	SS	9										
		5	SS	38										
	Brown Grey	6	SS	52										
		7	SS	56										
	Clayey Silt to Silt Some Sand	8	SS	46										
		9	SS	111										
	Trace Gravel Occ. Sandy Silt Layers	10	SS	54										
		11	SS	35										
	Very Stiff to Hard (Glacial Till)	12	SS	32										
		13	SS	24										
	Sand Some Gravel and Silt	14	SS	100	10 cm									
177.5													30 43 24 3	
15.5	End of Borehole													

+3, x⁵: Numbers refer to
Sensitivity

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

RECORD OF BOREHOLE No 13-4

METRIC

W P 142-87-03 LOCATION Co-ords. N 4 849 450.5; E 301 609.5 ORIGINATED BY KZ
 DIST 6 HWY 400 BOREHOLE TYPE Hollow Stem Auger & Cone Test COMPILED BY KZ
 DATUM Geodetic DATE 88 01 7, 8 CHECKED BY TCK

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	WATER CONTENT (%)
								SHEAR STRENGTH kPa										

192.2	Ground Level													
0.0	Clayey Silt Some Sand Trace Gravel Firm to Very Stiff (Glacial Till) <i>Brown Grey</i>		1	SS	16	88 111								
			2	SS	13									
			3	SS	16									
188.5			4	SS	7									
3.7	Silt, Dense (Lacustrine)		5	SS	35									6 38 41 15
	Clayey Silt to Silt Some Sand Trace Gravel		6	SS	51									
			7	SS	69									
	Trace Gravel		8	SS	39									
	Occ. Sandy Silt Layers		9	SS	24									0 4 79 17
	Very Stiff to Hard (Glacial Till)		10	SS	42									
			11	SS	55									
	Silt Trace Clay		12	SS	37									
			13	SS	132	23 cm								0 0 99 1
			14	SS	101									0 5 45 50
175.0			15	SS	114	23 cm								
17.2	End of Borehole													

+³, x⁵: Numbers refer to
Sensitivity

20.
15 5 (%) STRAIN AT FAILURE
10

RECORD OF BOREHOLE No 13-5

METRIC

W P 142-87-03 LOCATION Co-ords. N 4 849 449.0; E 301 594.5 ORIGINATED BY KZ
 DIST 6 HWY 400 BOREHOLE TYPE Hollow Stem Auger & Cone Test COMPILED BY KZ
 DATUM Geodetic DATE 88 01 07 CHECKED BY TCK

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	20 40 60 80 100					
192.2	Ground Level						192							
0.0	Clayey Silt Some Sand Trace Gravel Firm to Very Stiff (Glacial Till)		1	SS	6	88 18	190							
188.5	Brown		2	SS	10		188							6 37 48 9
3.7	Grey		3	SS	17		186							1 20 67 12
	Sandy Silt (Lacustrine)		4	SS	9		184							
	Clayey Silt to Silt Some Sand Trace Gravel Occ. Sandy Silt Layers Hard (Glacial Till)		5	SS	82	20 cm	182							2 32 52 14
			6	SS	45		180							
			7	SS	118		178							
			8	SS	40		176							0 0 61 39
			9	SS	47									
			10	SS	28									
			11	SS	47									
			12	SS	35									
	Sand and Gravel		13	SS	74									
177.5			14	SS	111									
14.7	Silty Clay Occ. Silt Layers Hard (Lacustrine)		15	SS	114	25 cm								
175.0														
17.2	End of Borehole													

+3, x5: Numbers refer to
Sensitivity

20
15
10

(%) STRAIN AT FAILURE

RÉCORD OF BOREHOLE No 13-6

METRIC

W P 142-87-03 LOCATION Co-ords. N 4 849 483.4; E 301 592.1 ORIGINATED BY KZ
 DIST 6 HWY 400 BOREHOLE TYPE Hollow Stem Auger and Cone Test COMPILED BY KZ
 DATUM Geodetic DATE 88 01 05 CHECKED BY TCK

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	SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE					
192.3	Ground Level						192							
0.0	Clayey Silt Some Sand Trace Gravel Stiff to Very Stiff (Glacial Till)		1	SS	13									
			2	SS	13									
			3	SS	17									
			4	SS	12									
188.6	Brown Grey		5	SS	23									
3.7	Sand, Compact (Lacustrine)		6	SS	49									3 76 18 3
	Clayey Silt to Silt Some Sand Trace Gravel Occ. Sandy Silt Layers Very Stiff to Hard (Glacial Till)		7	SS	77									
			8	SS	31									
			9	SS	20									
			10	SS	64									1 29 58 12
			11	SS	87									0 81 17 2
	Sand Some Silt		12	SS	55									
			13	SS	100	10 cm								
177.7			14	SS	129									0 0 40 60
14.6	Silty Clay Occ. Silt Lyers Hard (Lacustrine)													
175.1			15	SS	116									
17.2	End of Borehole													

RECORD OF BOREHOLE No 13-7

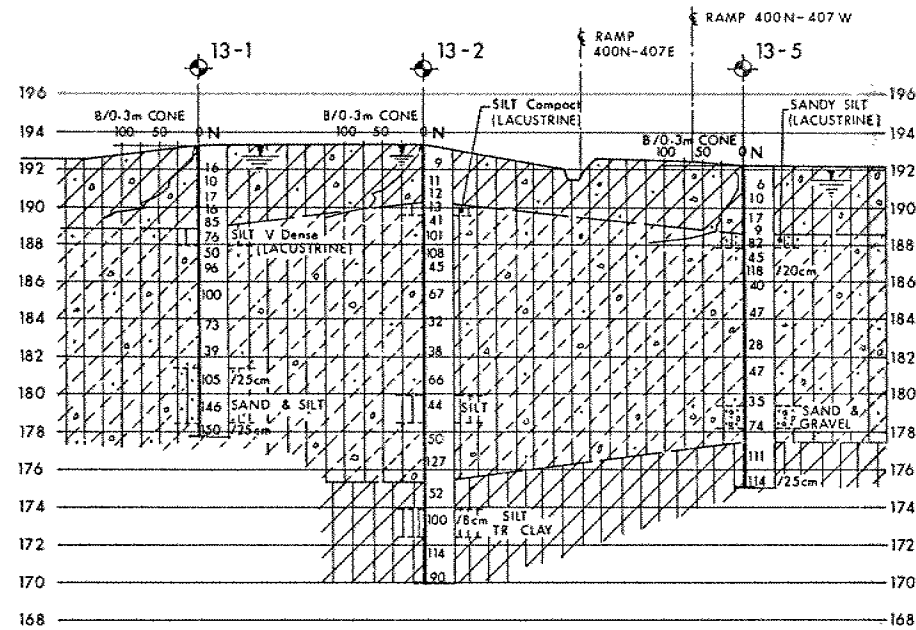
METRIC

W P 142-87-03 LOCATION Co-ords. N 4 849 501.5; E 301 584.0 ORIGINATED BY KZ
 DIST 6 HWY 400 BOREHOLE TYPE Hollow Stem Auger & Cone Test COMPILED BY KZ
 DATUM Geodetic DATE 88 01 11 CHECKED BY TCR

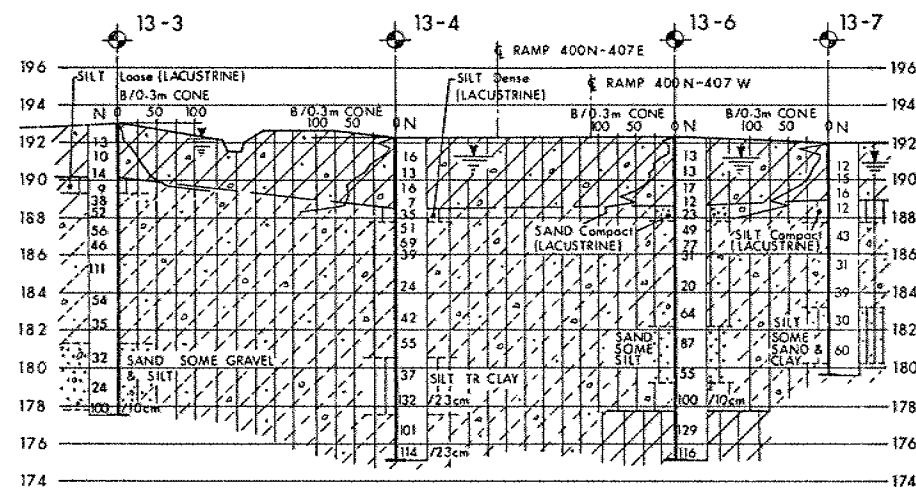
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT Y	REMARKS & GRAIN SIZE DISTRIBUTION (%)		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20 40 60 80 100								WATER CONTENT (%)	GR SA SI CL
								SHEAR STRENGTH kPa									
191.8	Ground Level																
0.0	Clayey Silt Some Sand Trace Gravel Stiff to Very Stiff (Glacial Till)		1	SS	12										3 34 46 17		
			2	SS	15												
188.9			3	SS	16												
2.9	Silt, Compact Brown Grey (Lacustrine)		4	SS	12												
	Clayey Silt to Silt Some Sand Trace Gravel Occ. Sandy Silt Layers Hard (Glacial Till)		5	SS	43										1 21 66 12		
			6	SS	31												
			7	SS	39												
	Silt Some Sand and Clay		8	SS	30										2 16 66 16		
			9	SS	60										0 16 77 7		
179.6																	
12.2	End of Borehole Refusal to Auger Due to Apparent Boulders																

+3, x⁵: Numbers refer to
Sensitivity

20
15 5 (%) STRAIN AT FAILURE
10

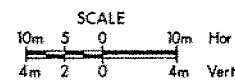


A-A

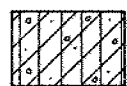


B-B

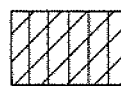
SECTIONS



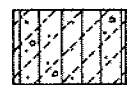
SOIL STRATIGRAPHY LEGEND



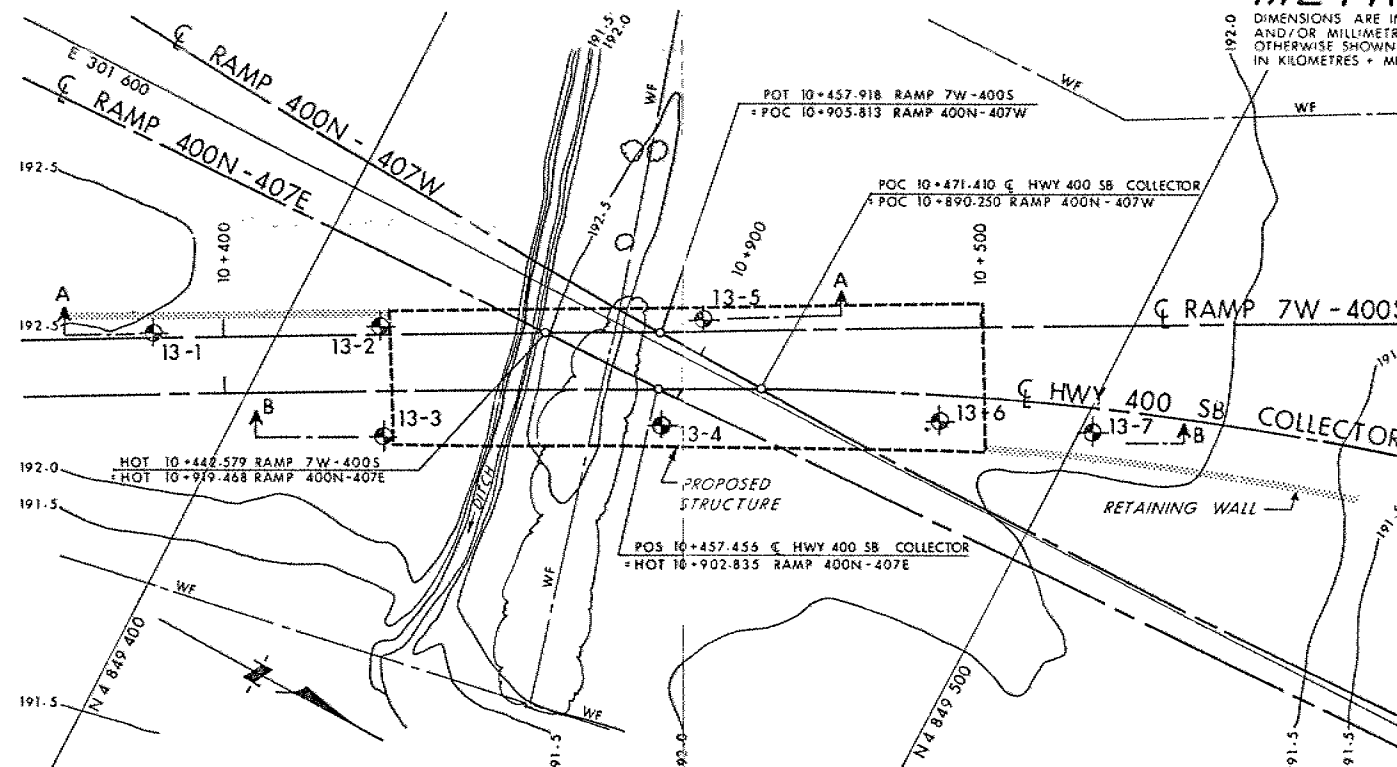
CLAYEY SILT
SOME SAND, TRACE GRAVEL
Firm to Hard
(GLACIAL TILL)



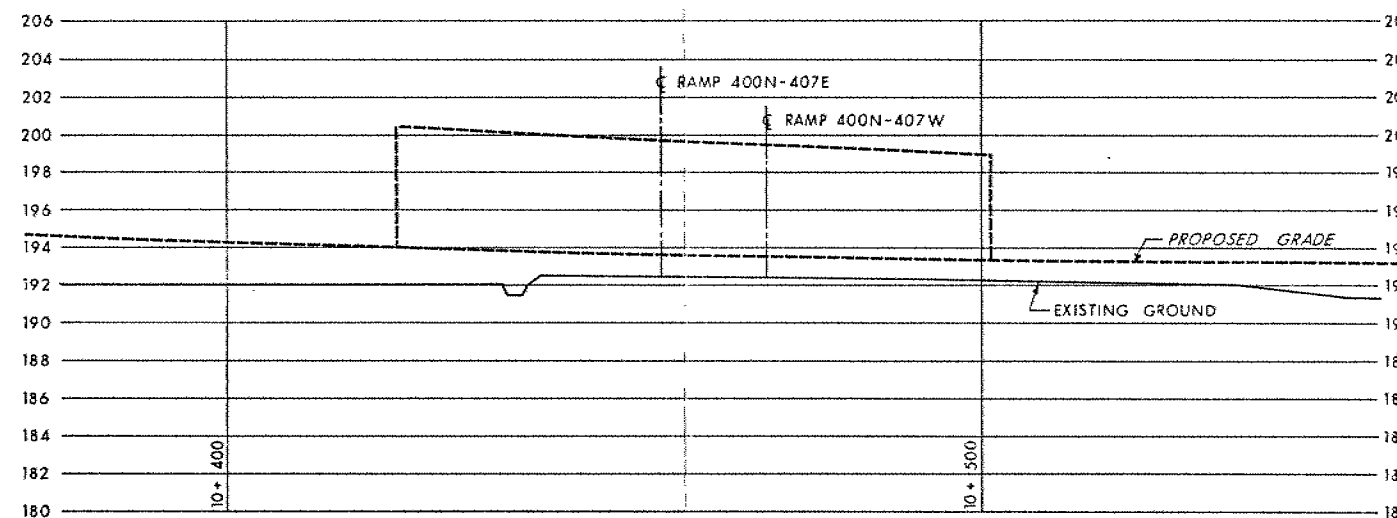
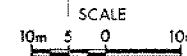
SILTY CLAY
OCCASIONAL SILT LAYERS
Hard
(LACUSTRINE)



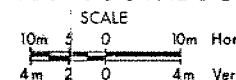
CLAYEY SILT TO SILT
SOME SAND, TRACE GRAVEL
OCC SANDY SILT LAYERS
Very Stiff to Hard
(GLACIAL TILL)



PLAN



PROFILE HWY 400 SOUTHBOUND COLLECTOR



METRIC

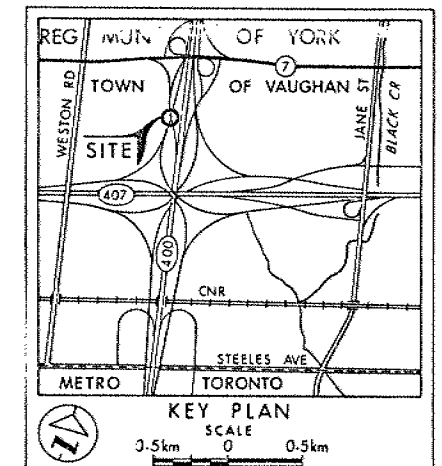
DIMENSIONS ARE IN METRES
AND/OR MILLIMETRES UNLESS
OTHERWISE SHOWN. STATIONS
IN KILOMETRES + METRES.

CONT No
WP No 142-87-03

RAMP 400N TO 407EW
(BRIDGE-13)
BORE HOLE LOCATIONS & SOIL STRATA



SHEET



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
87 12 and 88 01

No	ELEVATION	CO-ORDINATES	
		NORTH	EAST
13-1	193.2	4 849 385.2	301 629.5
13-2	193.2	4 849 411.5	301 615.0
13-3	193.0	4 849 418.6	301 627.8
13-4	192.2	4 849 450.5	301 609.5
13-5	192.2	4 849 449.0	301 594.5
13-6	192.3	4 849 483.4	301 592.1
13-7	191.8	4 849 501.5	301 584.0

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.

DATE	BY	DESCRIPTION
88 03 30	DATE	88 03 30
88 03 30	DATE	88 03 30
88 03 30	DATE	88 03 30