ENGINEERING MATERIALS OFFICE
SOIL MECHANICS SECTION

WP 33-76-07 DIST 6

HWY NWMA STR SITE 37-1056

Maple Leaf Drive Underpass

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SAMPLE DISPOSITION NOTICE

TYPE	DISCARD AFTER	RECOMM. BY
JARS	78 08 15	DJ
TUBES	—	—
ROCK CORES	—	—

GEOCRES 30M11-176

DATE JUN 0 9 1978

FOUNDATION INVESTIGATION REPORT

For

Maple Leaf Drive Underpass
W.P. 33-76-07, Site 37-1056
NWMA, District 6, Toronto

INTRODUCTION

This report contains the results of foundation investigations for the above mentioned project carried out during the period of January 18, 1965 and also during the period of April 11, 1978 to April 13, 1978. The former investigation was for feasibility study purposes. It consisted of one 166 foot deep sampled borehole advanced by washboring techniques. In the recent additional investigation, four sampled boreholes which ranged in depth from 51 to 91 feet were put down using a bombardier mounted drill rig which is equipped with 3 ¼" I.D. hollow stem augers.

SITE AND GEOLOGY

The site is on Maple Leaf Drive approximately 0.2 miles east of Jane Street in the Borough of North York, Metropolitan Toronto.

The surrounding terrain is relatively flat and sloping gently in a westerly direction. However, in the vicinity of the site on either side of Maple Leaf Drive, the land is covered with a layer of fill which is about 17 feet higher in relief than the adjoining area.

Residential development is the major land use, consisting mainly of detached houses.

Physiographically the site is located in a region known as "the South Slope" which is the southern slope of the interlobate moraines laid down in the Pleistocene epoch.

SUBSURFACE CONDITIONS

General

On either side of Maple Leaf Drive the site is covered with a layer of earth fill. Beneath the fills or below the ground surface elsewhere, is a 93 foot thick deposit of clayey silt which is followed by an extensive stratum of silty sand to sandy silt. In one particular location, a 10 foot thick alluvial deposit containing organic matter is sandwiched between the earthfill and the clayey silt deposit.

The boundaries between the various strata are shown on the Record of Borehole Sheets. The locations and elevations of the borings, together with the estimated stratigraphical sections and profiles, are shown on Dwg. No. 337607-A. From ground surface downwards, the various subsoil types encountered are described as follows.

Fill

Earthfill has been placed at this site on either side of Maple Leaf Drive. This earthfill is composed mainly of clayey silt with some sand and gravel and has a thickness of up to 29 feet. The Standard Penetration Test 'N' values recorded in the fill vary from 16 blows/foot to 26 blows/foot which suggest that the fill was relatively uniformly compacted.

According to the available information, part of the earthfill on the south side of Maple Leaf Drive was placed on the old floodplain of the Black Creek.

Clayey Silt With Organics and Sand and Silt With Organics

In one particular location on the south side of the site a 10 foot thick alluvial deposit was found underlying the fill material. The upper 4 foot portion of the alluvial deposit consists of clayey silt with organics and some sand. The lower portion of it consists of layers of sandy silt to silty sand with organics, shells and decayed vegetation. The organic contents in the upper and the lower portions of the alluvial deposit are found to be 0.8% and 6.2% respectively.

Clayey Silt

Beneath the fills and the alluvial deposit or below the ground surface elsewhere, is an extensive stratum about 93 feet thick of clayey silt with some sand and gravel. Typical grain size distribution curves obtained from samples in this stratum are shown in Figure 1. Within this stratum occasional layers of silt and silty sand were also encountered. Typical identity indices of the clayey silt are tabulated below:

Identity Indices		Ranges
Natural Moisture Content	(W) %	10-25
Plasticity Limit	(W_p) %	10-22
Liquid Limit	(W_L) %	19-32

The Atterberg Limits are also plotted on the Plasticity Chart, Figure 2. The results indicate that the clayey silt has a low plasticity.

Unconfined compression tests and in situ vane tests gave an undrained shear strength in the range of 1100 psf to 5000 psf. Based on these results, together with the 'N' values which range from 13 blows/foot to 69 blows/foot, the consistency of the clayey silt is classified as stiff to hard, but generally being very stiff to hard.

Silty Sand to Sandy Silt

Below the clayey silt deposit is a stratum of silty sand to sandy silt. This stratum was investigated to a depth of 166 feet below the ground surface. The material in this stratum is composed of silty sand to sandy silt, with a trace of gravel. The 'N' values of Standard Penetration Tests range mostly from 25 blows/foot to 75 blows/foot. The relative density of this granular deposit, inferred from these 'N' values, varies from compact to very dense.

Groundwater Conditions

The groundwater levels were measured in the open boreholes during or shortly after the completion of the field investigation. The groundwater level was found to vary between elevation 367 and elevation 384. The large variation in the observed groundwater levels may be attributed to the low permeability of the cohesive subsoil and the short duration of observation.

DISCUSSION AND RECOMMENDATIONS

At the proposed crossing of Maple Leaf Drive and the Northwest Metro Arterial (NWMA), a two-span underpass structure is to be built to carry Maple Leaf Drive over the NWMA. The underpass structure will have a total length of 188 feet and perched abutments within the approaches. The proposed profile grades of NWMA and Maple Leaf Drive are such that a cut section up to 8 feet deep and fills up to 20 feet high will be required for NWMA and Maple Leaf Drive respectively. Our recommendations for the structure foundations and the approaches are as follows.

Structure Foundations

It is recommended that the abutments and the pier be supported on piled foundations composed of 50 foot long #14 timber friction piles. These piles can be designed for a bearing capacity of up to 35 tons per pile. This recommended piling capacity is based on the results of a pile loading test conducted in the general area with a similar subsoil condition.

Alternatively, the abutments and the pier can also be supported on spread footings. If such a scheme is adopted it may be advantageous to perch the abutment footings on a compacted granular 'A' pad within the approaches so that the heights of the abutments can be minimized. Abutment footings on compacted granular 'A' pad can be designed for an allowable pressure of up to 2.5 tsf. Also in connection with the spread footing scheme, the pier footing should be founded in the natural ground at or below elevation 399 and designed for an allowable pressure of up to 2 tsf. It should be noted that in this case the alluvial deposit containing organic matter which exists in the vicinity of the pier should be sub-excavated to its full depth and replaced with mass concrete. The boundary of sub-excavation will be determined after utilities at the site have been relocated.

For frost protection purposes the underside of the footings or the pile caps should have a minimum 4 feet of earth cover. No major dewatering problems during excavations for the foundations are

anticipated, as the cohesive subsoil is relatively impervious. Seepage into the excavations can be removed by pumping.

Approaches

The required 20 foot high fills and the 8 foot deep cuts can be safely constructed with forward slopes and side slopes of 2:1.

B. Ly

B. Ly, P. Eng.
Senior Engineer

M. Devata

M. Devata, P. Eng.
Supervising Engineer

June, 1978

Ministry of Transportation and Communications
Ontario

HIGHWAY ENGINEERING DIVISION - ENGINEERING MATERIALS OFFICE - SOIL MECHANICS SECTION

RECORD OF BOREHOLE No 8

W P 33-76-07 LOCATION Coords. N 15,882,133 E 999,590 ORIGINATED BY O.J.

DIST 6 HWY NWMA BOREHOLE TYPE Hollow Stem Auger and Cone Test COMPILED BY B.L.

DATUM Geodetic DATE April 13, 1978 CHECKED BY

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES
422.0	Ground Level				
0.0	Fill Clayey Silt, Some Sand and Gravel. Uniformly Compacted		1	SS	17
			2	SS	26
			3	SS	20
			4	SS	24
393.0			5	SS	26
29.0 / 389.0	Clayey Silt, organic and some sand		6	SS	12
33.0 / 383.5	Silty fine Sand to sandy silt with organics shells, decayed wood very loose.		7	TW	PH
38.5	Clayey Silt with some sand and gravel, Grey Stiff to very Stiff		8	SS	25
			9	SS	24
			10	SS	28
			11	SS	23
			12	TW	PH
			13	SS	21
			14	TW	PH
			15	SS	23
			16	TW	PH
330.5			17	SS	27
91.5	End of Borehole				

GROUND WATER CONDITIONS

ELEVATION SCALE: 420, 410, 400, 390, 380, 370, 360, 350, 340

DYNAMIC CONE PENETRATION RESISTANCE PLOT: 20 40 60 80 100

SHEAR STRENGTH: ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE; 400 800 1200 1600 2000

+S=2.0

+S=2.0

+2000

PLASTIC LIMIT Wp — NATURAL MOISTURE CONTENT W — LIQUID LIMIT Wl

WATER CONTENT (%): 20 40 60

Air dried org. cont.

Oven dried 0.8%

NP 6.2%

UNIT WEIGHT γ

REMARKS & GRAIN SIZE DISTRIBUTION (%)

GR SA SI CL

2 18 42 38

1 23 42 34

+3, ×5 : Numbers refer to Sensitivity

15 20 5 (%) STRAIN AT FAILURE 10

OFFICE REPORT ON SOIL EXPLORATION

Ministry of Transportation and Communications
Ontario

HIGHWAY ENGINEERING DIVISION - ENGINEERING MATERIALS OFFICE - SOIL MECHANICS SECTION

RECORD OF BOREHOLE No 9

W P 33-76-07 LOCATION Coords. N 15,882,252 E 999,636 ORIGINATED BY B.L.

DIST 6 HWY NWMA BOREHOLE TYPE Hollow Stem Auger COMPILED BY O.J.

DATUM Geodetic DATE April 11, 1978 CHECKED BY

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES 'N' VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH (o UNCONFINED, • QUICK TRIAXIAL, + FIELD VANE, x LAB VANE) / WATER CONTENT (%) (PLASTIC LIMIT W_p, NATURAL MOISTURE CONTENT W, LIQUID LIMIT W_l; 20 40 60)	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
412.0	Ground Level									
0.0	Clayey Silt With Some Sand and Gravel						410			
	Brown		1	SS	62					
			2	SS	23		400			
	Silt some Clay		3	SS	35					0 2 73 25
	Grey		4	SS	23		390			
	Stiff to Very Stiff		5	SS	25					
			6	SS	41		380			
			7	SS	35					
			8	SS	28		370			
			9	SS	39					
360.5			10	SS	31					
51.5	End of Borehole W.L. Not observed									

+3, x5 : Numbers refer to Sensitivity

15 20 10 5 (%) STRAIN AT FAILURE

OFFICE REPORT ON SOIL EXPLORATION

Ministry of Transportation and Communications
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HIGHWAY ENGINEERING DIVISION - ENGINEERING MATERIALS OFFICE - SOIL MECHANICS SECTION

RECORD OF BOREHOLE No 10

W P 33-76-07 LOCATION Coords N 15 882 225 E 999 540 ORIGINATED BY O.J.

DIST 6 HWY NWMA BOREHOLE TYPE Hollow Stem Auger & Cone Test COMPILED BY O.J.

DATUM Geodetic DATE April 12, 1978 CHECKED BY

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES 'N' VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH (O UNCONFINED, ● QUICK TRIAXIAL, + FIELD VANE, × LAB VANE; 400 800 1200 1600 2000)	PLASTIC LIMIT Wp / NATURAL MOISTURE CONTENT W / LIQUID LIMIT WL; WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
407.4	Ground Level										
0.0	Brown		1	SS	27		400				
	Grey		2	SS	24						
	Clayey Silt with some sand and gravel. Stiff to very Stiff		3	TW	PH		390	3290			
			4	SS	25			2000			
			5	TW	PH		380	2000			
			6	SS	41			2000			
			7	TW	PH		370	S=2.0			
			8	SS	20			S=2.0			
			9	TW	PH		360	2000			
			10	SS	31						
			11	TW	PH		350	2000			
345.9			12	SS	33						
61.5	End of Borehole W.L. Not observed										

+3, ×5 : Numbers refer to Sensitivity

15 ◇ 5 (%) STRAIN AT FAILURE (20 / 10)

OFFICE REPORT ON SOIL EXPLORATION

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HIGHWAY ENGINEERING DIVISION - ENGINEERING MATERIALS OFFICE - SOIL MECHANICS SECTION

RECORD OF BOREHOLE No 11

W P 33-76-07 LOCATION Coords. N 15 882 202 E 99 715 ORIGINATED BY O.J.

DIST 6 HWY NWMA BOREHOLE TYPE Hollow Stem Auger & Cone Test COMPILED BY O.J.

DATUM Geodetic DATE April 13, 1978 CHECKED BY

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES 'N' VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH (o UNCONFINED, • QUICK TRIAXIAL, + FIELD VANE, × LAB VANE)	PLASTIC LIMIT Wp / NATURAL MOISTURE CONTENT W / LIQUID LIMIT WL — WATER CONTENT (%)	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
416.5	Ground Level							20 40 60 80 100 / 400 800 1200 1600 2000	20 40 60		
0.0	Brown		1	SS	31		410				
	Grey		2	SS	25	▽		+>2000			
			3	TW	PH		400	o>5360			
	Clayey silt with Some sand and gravel.		4	SS	13			+>2000			
			5	SS	20		390	+>2000			
	Stiff to very stiff		6	TW	PH			•>5210			
			7	SS	22		380				
			8	SS	21			+>2000			
365.0			9	TW	PH		370	×>3960			
51.5	End of Borehole		10	SS	30						

$+^3$, $\times^5$: Numbers refer to Sensitivity

20
15 ⊹ 5 (%) STRAIN AT FAILURE
10

OFFICE REPORT ON SOIL EXPLORATION

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HIGHWAY ENGINEERING DIVISION - ENGINEERING MATERIALS OFFICE - SOIL MECHANICS SECTION

RECORD OF BOREHOLE No 12 (formerly job 65-F-40)

W P 33-76-07 LOCATION Co-ords. N 15 882 194; E 999 450 ORIGINATED BY H.S.

DIST 6 HWY N-W M A Rd. BOREHOLE TYPE Washboring, Cone Test COMPILED BY H.S.

DATUM Geodetic DATE January 18, 1965 CHECKED BY M.D.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH PSF (O UNCONFINED, ● QUICK TRIAXIAL, + FIELD VANE, × LAB VANE; 800, 1600)	PLASTIC LIMIT Wp — NATURAL MOISTURE CONTENT W — LIQUID LIMIT WL; WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES						GR SA SI CL
404.0 / 0.0	Ground Level										
	Clayey Silt With Sand and Occ. Gravel		1	SS	30		400				
			2	SS	41						
			3	SS	47						
			4	SS	38		390				
			5	SS	24						
			6	SS	25	▼	380				
			7	SS	29						
			8	SS	17						
			9	TW	PH		370				
			10	TW	PH						
			11	SS	23						
			12	TW	PH		360				
			13	SS	39						
			14	SS	43		350				
			15	SS	38						
	Silty Sand Dense		16	SS	46		340				
			17	SS	46						
			18	SS	69		330				
			19	SS	59						
			20	SS	69		320				
	Firm to Hard		21	SS	55						
311.0			22	SS	60		310				
93.0			23	SS	47						42 54 14
	Silty Sand to Sandy Silt		24	SS	64						
			25	SS	64		300				10 76 14
			26	SS	81						
							290				
285.5			27	SS	25						
118.5											

Continued

$+^3$, $\times^5$: Numbers refer to Sensitivity

15 ⟡ 5 (%) STRAIN AT FAILURE (20 / 10)

OFFICE REPORT ON SOIL EXPLORATION

Ministry of Transportation and Communications
Ontario

HIGHWAY ENGINEERING DIVISION - ENGINEERING MATERIALS OFFICE - SOIL MECHANICS SECTION

RECORD OF BOREHOLE No 12 cont (formerly job 65-F-40)

W P 33-76-07 LOCATION Co-ords. N 15 882 134; E 999 450 ORIGINATED BY H.S.

DIST 6 HWY N-W M A Rd. BOREHOLE TYPE Washboring, Cone Test COMPILED BY H.S.

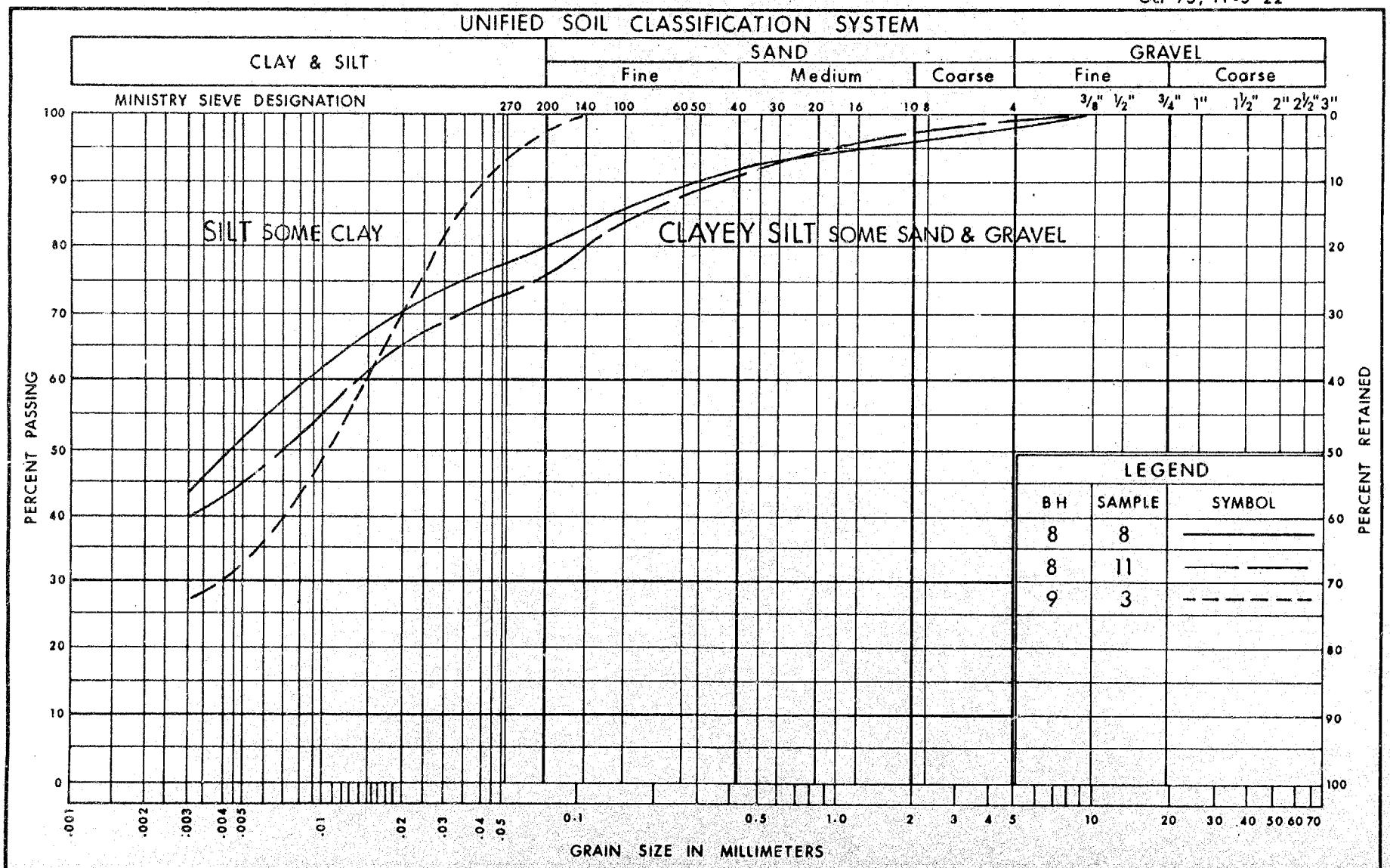
DATUM Geodetic DATE January 18, 1965 CHECKED BY M.D.

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 Wp — NATURAL MOISTURE CONTENT W — LIQUID LIMIT Wl WATER CONTENT (%)	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES						
285.5											
118.5							280				
			28	SS	1						38 55 17
	Silty Sand to Sandy Silt		29	SS	15						66 29 5
							270				
			30	SS	23						
			31	SS	26		260				
			32	SS	146						
	Compact to Very Dense						250				
			33	SS	132						
			LOST	SS	63						
237.0			34	SS	75		240				
166.5	End of Borehole										
							230				

+3, ×5 : Numbers refer to Sensitivity

15 ⊹ 5 (%) STRAIN AT FAILURE (20 / 10)

OFFICE REPORT ON SOIL EXPLORATION



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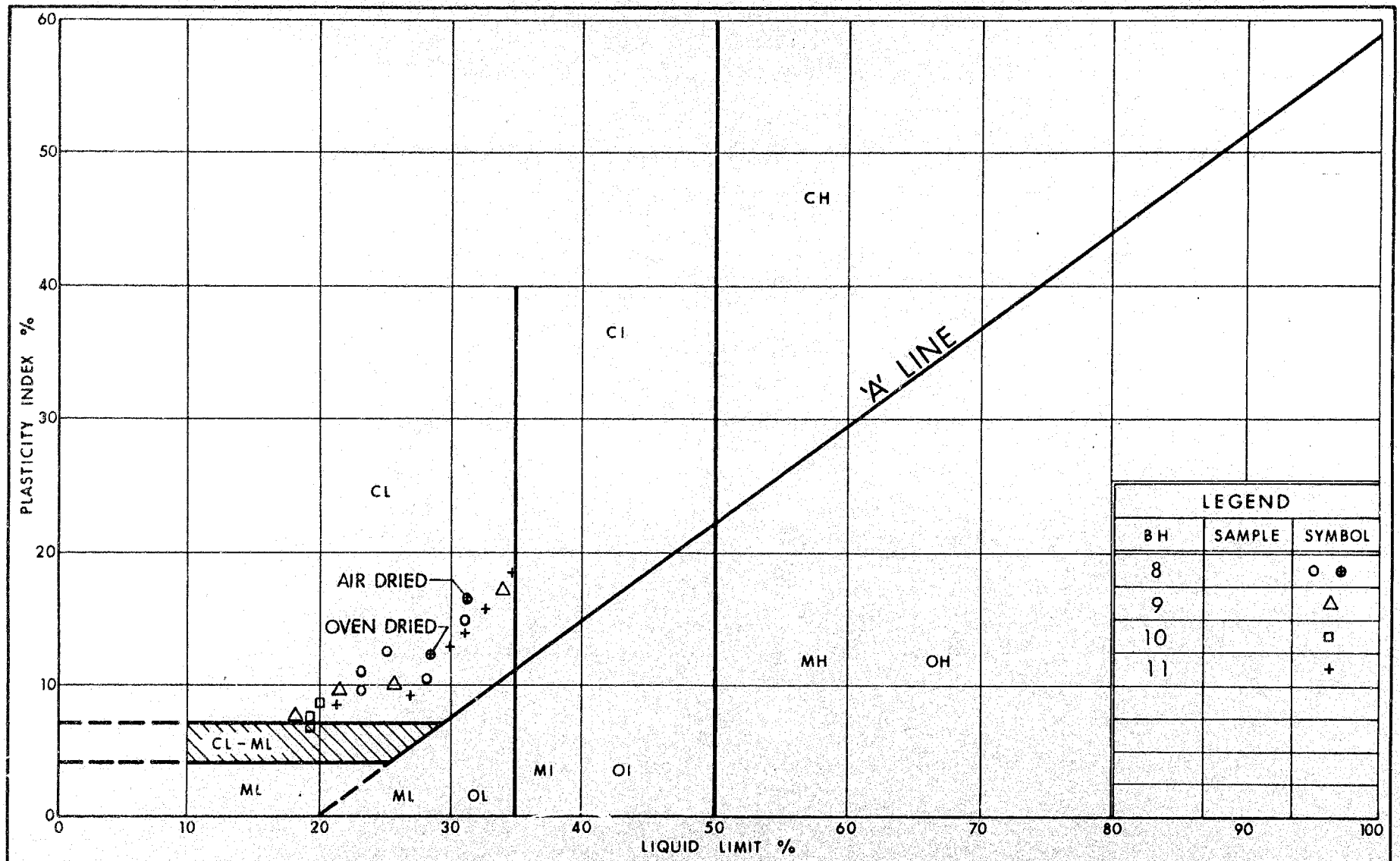
GRAIN SIZE DISTRIBUTION
CLAYEY SILT
WITH LAYERS OF SILT

FIG No 1
W P 33-76-07



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PLASTICITY CHART
CLAYEY SILT

FIG No 2
W P 33-76-07

EXPLANATION OF TERMS USED IN REPORT

'N' VALUE: AN INDICATOR OF SUBSOIL QUALITY. IT IS OBTAINED FROM THE STANDARD PENETRATION TEST (CSA STD. A119.1). SPT 'N' VALUE IS THE NUMBER OF BLOWS REQUIRED TO CAUSE A STANDARD 2 INCH O.D. SPLIT-BARREL SAMPLER TO PENETRATE 12 INCHES INTO UNDISTURBED GROUND IN A BOREHOLE WHEN DRIVEN BY A HAMMER WEIGHING 140 POUNDS, FALLING FREELY A DISTANCE OF 30 INCHES. FOR PENETRATIONS OF LESS THAN 12 INCHES 'N' VALUES ARE INDICATED AS THE NUMBER OF BLOWS FOR THE PENETRATION ACHIEVED. 'N' VALUES CORRECTED FOR OVERBURDEN PRESSURE ARE DENOTED THUS $\bar{N}$.

DYNAMIC CONE PENETRATION TEST (CSA STD. A119.3): CONTINUOUS PENETRATION OF A CONICAL STEEL POINT (2" O.D. 60 CONE ANGLE) DRIVEN BY 350 FT-LB IMPACTS ON 'A' SIZE DRILL RODS. THE RESISTANCE TO CONE PENETRATION IS MEASURED AS THE NUMBER OF BLOWS FOR EACH 12 INCH ADVANCE OF THE CONICAL POINT INTO THE UNDISTURBED GROUND.

SOIL QUALITY: SOILS ARE DESCRIBED BY THEIR COMPOSITION AND CONSISTENCY OR DENSITY.

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

S_u (PSF)	0 - 250	250 - 500	500 - 1000	1000 - 2000	2000 - 4000	>4000
	VERY SOFT	*SOFT*	*FIRM*	*STIFF*	*VERY STIFF*	*HARD*

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

'N' (BLOW/FT)	0 - 5	5 - 10	10 - 30	30 - 50	> 50
	VERY LOOSE	*LOOSE*	*COMPACT*	*DENSE*	*VERY DENSE*

ROCK QUALITY: 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 DRILLED IN THAT CORING RUN.

MODIFIED RECOVERY: SUM OF THOSE NATURALLY FRACTURED CORE PIECES, 4"+ 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	2"	2" - 12"	1' - 3'	3' - 10'	> 10'
JOINTING	*VERY CLOSE*	*CLOSE*	*MOD. CLOSE*	*WIDE*	*VERY WIDE*
BEDDING	*VERY THIN*	*THIN*	*MEDIUM*	*THICK*	*VERY THICK*

ABBREVIATIONS & SYMBOLS

LABORATORY TESTING

TRIAXIAL TESTS ARE DESCRIBED IN TERMS OF WHETHER THEY ARE CONSOLIDATED (C) OR NOT (U)
ISOTROPICALLY (I) OR NOT (A)
AND SHEARED DRAINED (D) OR UNDRAINED (U)
WITH PORE PRESSURE MEASUREMENTS (BAR OVER SYMBOLS)
EG. $\overline{CIU}$ = CONSOLIDATED ISOTROPIC UNDRAINED TRIAXIAL WITH PORE PRESSURE MEASUREMENT
UNLESS OTHERWISE SPECIFIED IN REPORT ALL TESTS ARE IN COMPRESSION

FIELD SAMPLING

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

EARTH PRESSURE TERMS

μ	COEFFICIENT OF FRICTION
δ	ANGLE OF WALL FRICTION
k_o	COEFFICIENT OF EARTH PRESSURE AT REST
k_A	COEFFICIENT OF ACTIVE EARTH PRESSURE
k_P	COEFFICIENT OF PASSIVE EARTH PRESSURE
i	ANGLE OF INCLINATION OF SURCHARGE
w	SLOPE ANGLE-BACKFACE OF WALL
β	ANGLE OF SLOPE
N_γ, N_q, N_c	BEARING CAPACITY FACTORS
D_f	DEPTH OF FOOTING
B,L	FOOTING DIMENSIONS

INDEX PROPERTIES

γ	UNIT WEIGHT OF SOIL (BULK DENSITY)
γ_w	UNIT WEIGHT OF WATER
γ_d	UNIT DRY WEIGHT OF SOIL (DRY DENSITY)
γ'	UNIT WEIGHT OF SUBMERGED SOIL
G_s	SPECIFIC GRAVITY OF SOLIDS
e	VOIDS RATIO
e_o	INITIAL VOIDS RATIO
e_{max}	e IN LOOSEST STATE
e_{min}	e IN DENSEST STATE
D_r	RELATIVE DENSITY = $\frac{e_{max} - e}{e_{max} - e_{min}}$
n	POROSITY
w	WATER CONTENT
w_L	LIQUID LIMIT
w_P	PLASTIC LIMIT
w_S	SHRINKAGE LIMIT
I_p	PLASTICITY INDEX = $w_L - w_P$
I_L	LIQUIDITY INDEX = $\frac{w - w_P}{I_p}$
I_c	CONSISTENCY INDEX = $\frac{w_L - w}{I_p}$
A_c	ACTIVITY = $\frac{I_p \text{ of soil}}{\%< 2\mu m \text{ Soil Fraction}}$
Om	ORGANIC MATTER CONTENT
S_r	DEGREE OF SATURATION
S	SENSITIVITY = $\frac{S_u \text{ (undisturbed)}}{S_u \text{ (remoulded)}}$

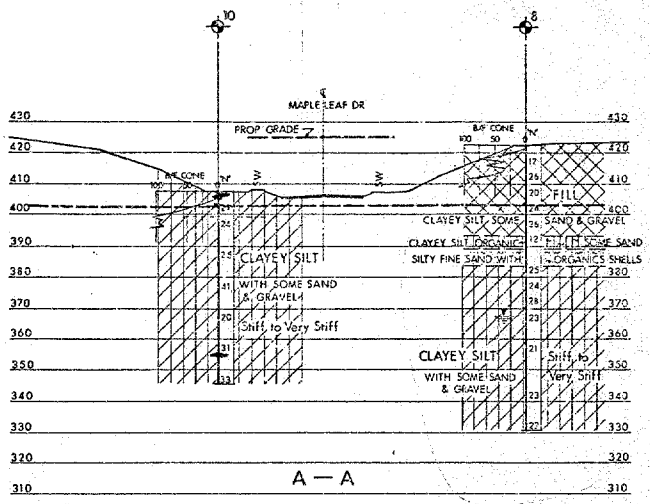
STRENGTH PARAMETERS

$\varnothing$	ANGLE OF SHEARING RESISTANCE
τ_f	PEAK SHEAR STRENGTH
τ_R	RESIDUAL SHEAR STRENGTH
c	COHESION INTERCEPT
$\sigma_1, \sigma_2, \sigma_3$	NORMAL PRINCIPAL STRESSES
u	PORE WATER PRESSURE
u_e	EXCESS u
r_u	PORE PRESSURE RATIO
q_u	UNCONFINED COMPRESSIVE STRENGTH
s_u	UNDRAINED SHEAR STRENGTH
ϵ	LINEAR STRAIN
γ	SHEAR STRAIN
ν	POISSON'S RATIO
E	MODULUS OF ELASTICITY
G	MODULUS OF SHEAR DEFORMATION
k_s	MODULUS OF SUBGRADE REACTION
m,n	STABILITY COEFFICIENTS
A,B	PORE PRESSURE COEFFICIENTS

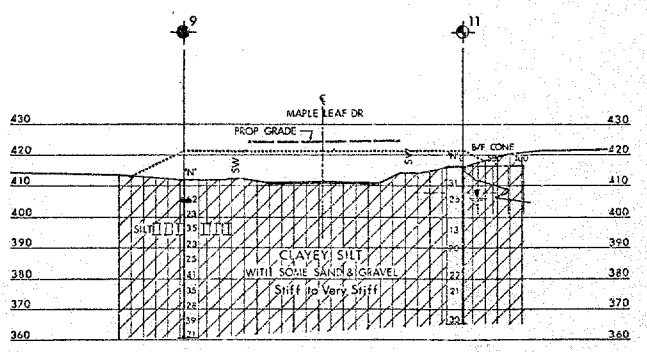
NOTE: EFFECTIVE STRESS PARAMETERS ARE DENOTED BY USE OF APOSTROPHE ABOVE THE SYMBOL, THUS: $\varnothing'$ = EFFECTIVE ANGLE OF SHEARING RESISTANCE; σ' = EFFECTIVE NORMAL STRESS

HYDRAULIC TERMS

h	HYDRAULIC HEAD OR POTENTIAL
q	RATE OF DISCHARGE
v	VELOCITY OF FLOW
i	HYDRAULIC GRADIENT
j	SEEPAGE FORCE PER UNIT VOLUME
η	COEFFICIENT OF VISCOSITY
k	COEFFICIENT OF HYDRAULIC CONDUCTIVITY
k_h	k IN HORIZONTAL DIRECTION
k_v	k IN VERTICAL DIRECTION
m_v	COEFFICIENT OF VOLUME CHANGE
c_v	COEFFICIENT OF CONSOLIDATION
C_c	COMPRESSION INDEX
C_r	RECOMPRESSION INDEX
d	DRAINAGE PATH DISTANCE
T_v	TIME FACTOR
U	DEGREE OF CONSOLIDATION
O_r	OVERCONSOLIDATION RATIO (OCR)



A — A

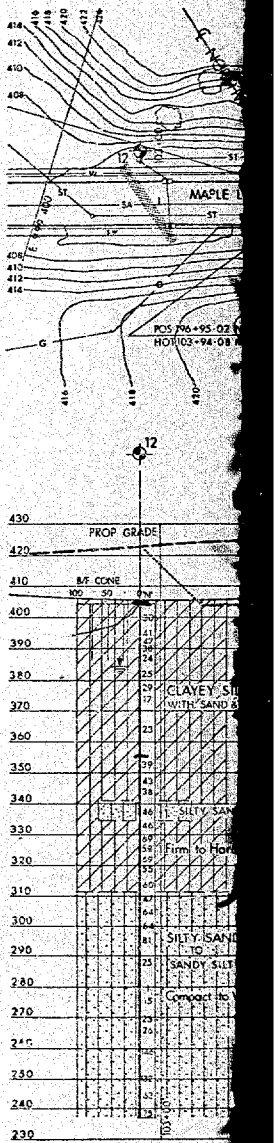


B — B

SECTIONS

SCALE

20 10 0 20 FT

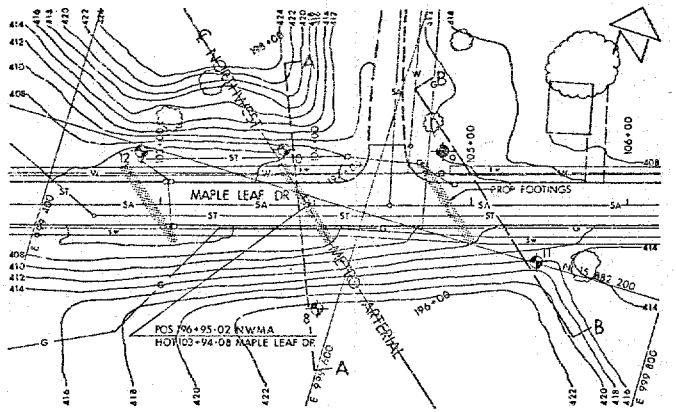


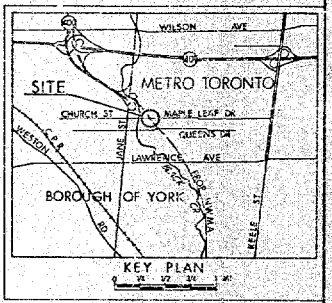
CONT No
WP No 33-76-07

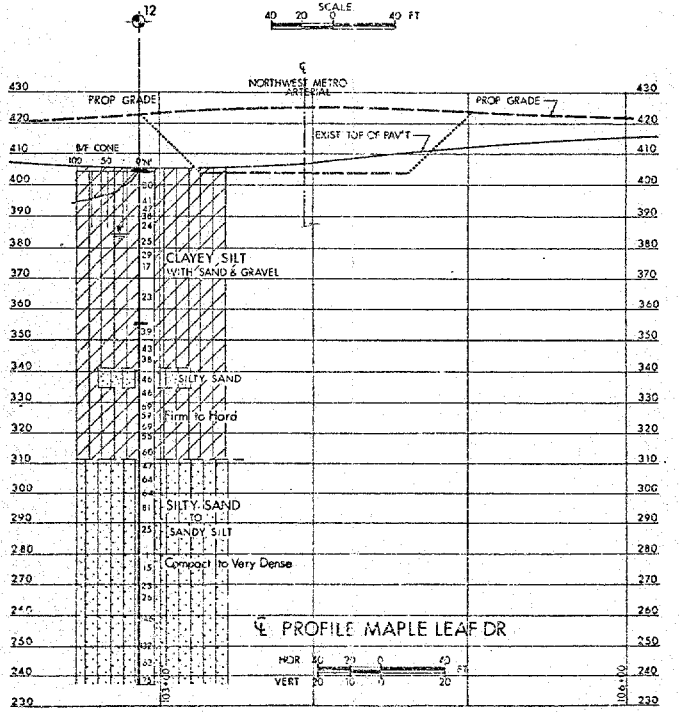
NORTHWEST METRO ARTERIAL & MAPLE LEAF DR UNDERPASS

BORE HOLE LOCATIONS & SOIL STRATA

SHEET







LEGEND

- Bore Hole
- Dynamic Cone Penetration Test (Cone)
- Bore Hole & Cone
- 'N' Blows/ft (Std Pen Test 350 ft lbs energy)
- CONE Blows/ft (60° Cone, 350 ft lbs energy)
- W.L at time of investigation
  NO WL observed in BH No 9 & 10
  BH No 12 JAN 1965
  BH No 8 & 11 APR 1978

No	ELEVATION	CO-ORDINATES NORTH	CO-ORDINATES EAST
8	422·0	15 882 133	999 590
9	412·0	15 882 252	999 636
10	407·4	15 882 225	999 540
11	416·5	15 882 202	999 715
12	404·0	15 882 194	999 450

JOB 65-F-40

-NOTE-

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

REVISIONS			
DATE	BY	DESCRIPTION	

HWY No NWMA		DIST 6	
SUBJECT	CHECKED	DATE 10 MAY 1978	SITE 37-1056
DRAWN HOK	CHECKED		DWG 337607-A

Mr. D.E. Thrasher,
Manager,
Construction Office,
Central Region.

Mr. S. Dunham

G.C.E. Burkhardt,
Structural Section,
Central Region.

1978-08-11

RE: Relocation of Utilities,
Maple Leaf Drive Structure,
W.P. 33-76-07, Site 37-1056,
District 6, Toronto

According to Soil Mechanics Section, additional boreholes will be required at the location of the proposed centre pier for the above mentioned structure. Due to the presence of North York Hydro overhead lines and underground services at the location, Soil Mechanics Section can carry out drilling only after the relocation of underground services and hydro overhead lines has been completed.

Would you please inform us as soon as North York Hydro has established their schedule for the removal of existing hydro utilities from the proposed bridge site, so that we will be able to notify Soil Mechanics Section at least two weeks prior to the completion of North York Hydro utilities removal.

ASPM:gj

A.S.P. Ma,
Senior Structural Engineer,
for:
G.C.E. Burkhardt,
Head, Structural Section.

c.c. N. Devata
K. Worsley

Ministry of Transportation and Communications
Ontario

Memorandum

To: Mr. C.S. Grebski
Head, Central Section
Structural Office
2nd Floor, West Building

Attention:

Our File Ref.

From: Soil Mechanics Section
Engineering Materials Office
Room 315, Central Building

Date: 78 10 18

In Reply to

Subject: Re: Maple Leaf Drive Underpass
W.P. 33-76-07, Site 37-1056
Northwest Metro Arterial
District 6, Toronto

A foundation investigation and design report for the above mentioned structure was submitted by the Soil Mechanics Section on 78 06 08. At the time of this original investigation the extent and depth of the organic material which exists in the vicinity of the southern portion of the center pier was not fully explored due to the presence of overhead hydro lines. It was agreed that this Office would investigate this aspect once the overhead hydro lines are relocated prior to the construction of the structure. As agreed, we have recently completed the additional investigation in the southern portion of the center pier after the relocation of the overhead hydro lines were completed. In order to discuss the various alternatives for the center pier foundation in the light of the new information, a meeting was held in the Structural Office on 78 10 11, attended by Messrs. C. Grebski, W. Lin, V. Boehnke, M. Devata and B. Ly.

The presence of organic material requires extensive sub-excavation and backfilling with well compacted Granular 'A' or mass concrete. Alternatively, the center pier could be supported on friction piles similar to those recommended for the abutment foundations. It was agreed that the alternative of pile foundations would be more suitable and practical. In this case the center pier should be supported on #14 timber piles driven to tip elevation 355 (approximate length of 45 feet). Such piles would provide a safe load of 35 tons per pile.

It was further agreed in the meeting that your Office would make the necessary revisions and modifications to the structure contract. If we could be of any further assistance with regard to this project, please contact us.

B. Ly
Senior Engineer

For: M. Devata
Supervising Engineer

BL/MD/gs

cc: G.C.E. Burkhardt V. Boehnke Files ✓
M. Devata
W. Lin B. Ly

MINUTES OF MEETING - W.P. 33-76-12

SUBJECTS: (1) Additional soil information recently obtained, regarding the design of the pier footing of Maple Leaf Drive Structure.

(2) Additional information regarding pile design capacity of Black Creek Structure.

BETWEEN: Central Section, Structural Office.
Soil Mechanics Section.
Structural Section, Central Region.

HELD AT: Soil Mechanics Section Office, Central Building.

HELD ON: Wednesday, May 24, 1978.

PRESENT: W. Lin, Structural Office
O. Ramakko, Structural Office
M. Devata, Soil Mechanics Section
B. Ly, Soil Mechanics Section
T. Kazmierowski, Soil Mechanics Section
V. Boehnke, Structural Section, Central Region
A. Ma, Structural Section, Central Region

POINTS COVERED

(1) Mr. B. Ly explained that an addition borehole (B.H. #10) recently taken at approximately 40' south of the south side of the proposed pier footing of Maple Leaf Drive Structure revealed a layer (12'+) of organic material which will affect the preliminary recommendation of spread footing on native soil. Granular A pad or pile foundation was suggested. Due to the presence of existing utilities, Soil Mechanic Section cannot move into the site for drilling a few more additional boreholes.

(2) Mr. W. Lin expressed that granular A pad would require extensive excavation; pile foundation would require re-design of the pier footing and changes of steel schedule. The present scheduling is very tight and there would be insufficient time to make changes in the design. It was agreed that organic material under the pier footing should be excavated and replaced with mass concrete.

(3) It was agreed upon the use of mass concrete. The maximum depth of mass concrete would be 10'+, subject to further investigation. An additional item will be included in the D4 of the structure by the Structural Office. (Mr. V. Boehnke talked to Mr. D. MacDonald and Mr. G. Pearce on 78-05-26 about the tender item of mass concrete. Mr. V. Boehnke was advised not to include

...../2

this additional item of mass concrete in tender list at this time, but to add the item (if it has to) at a later time, i.e., re-negotiation with the contractor).

(4) Mr. B. Ly will carry out additional boreholes on the location of the proposed pier footing after the relocation of utilities and Structural Section, Central Region will inform him two weeks prior to the completion of utility relocation.

(5) Mr. T. Kazmierowski informed, based on additional information regarding pile capacity of the Black Creek Structure, the design capacity can be increased from 30 tons as previously recommended to 35 tons. The increase in capacity could reduce 15%± of piles required for the Black Creek Structure.

(6) Mr. W. Lin pointed out that the increase in pile capacity could be allowed for vertical piles only. Structural Office would like to look into the possibility of redesigning the pile foundation with consideration to the amount of saving and time involved.

(7) A note of pile driving sequence will be included on the drawing by Structural Office.

A.S.P. Ma,
Senior Structural Engineer.

GEOCRES No. 36 H 11-176

DIST 6 REGION CENTRAL

W.P. No. 33-76-07

CONT. No. 76-99

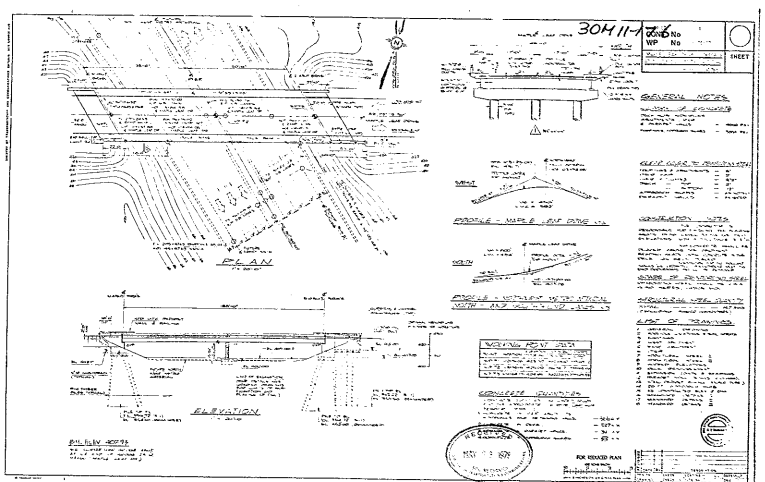
W.O. No.

STR. SITE No. 37-1156

HWY. No. NB 9A

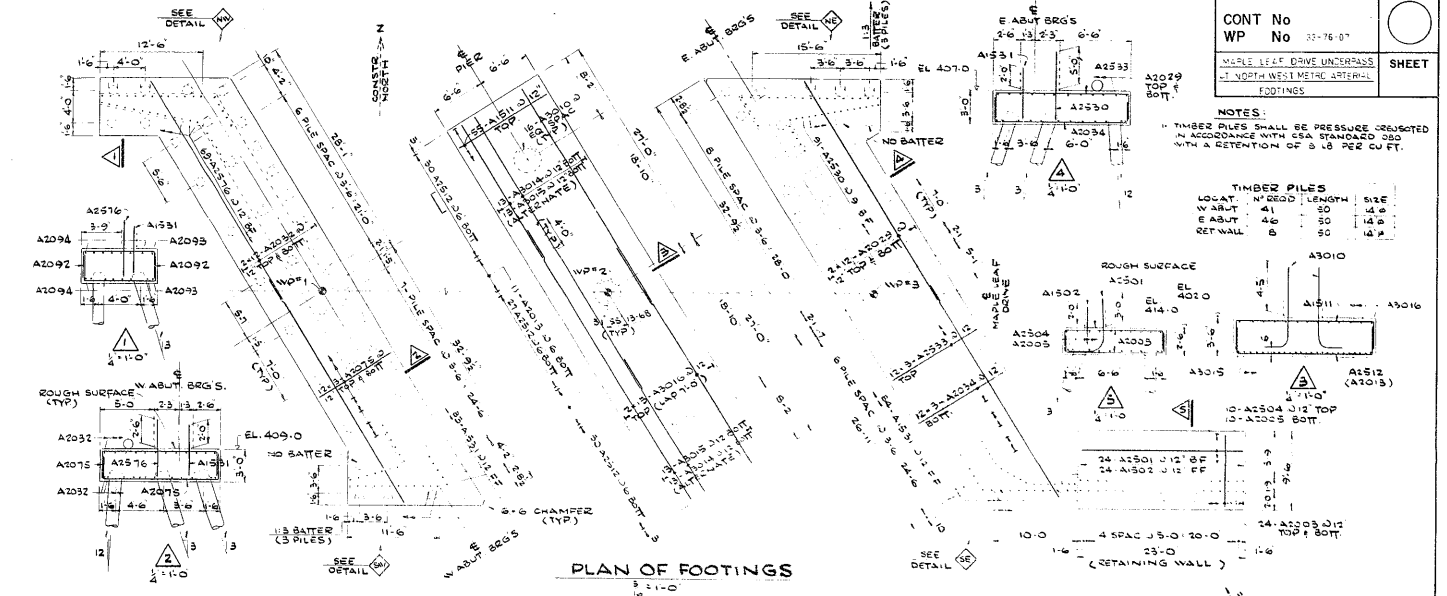
LOCATION MAPLE LEAF DRIVE OVERPASS

3

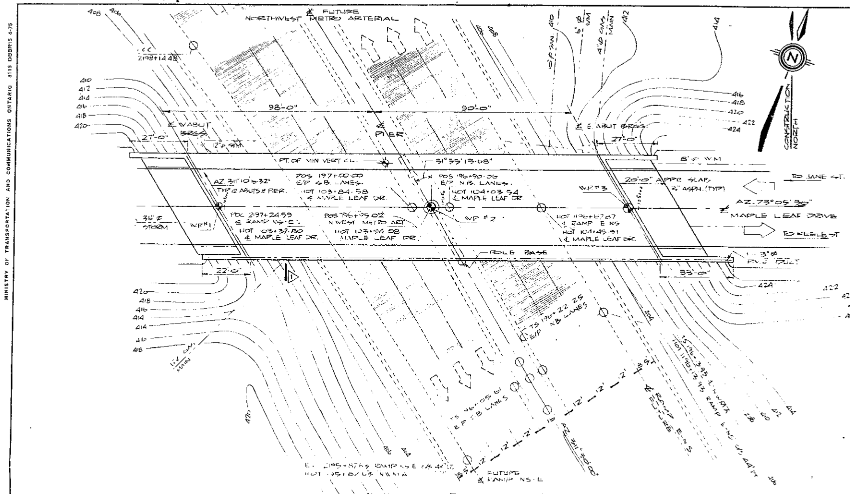

30H11-1
PLAN
ELEVATION
GENERAL NOTES
DESIGN SPECIFICATIONS
LIVE LOAD
CONSTRUCTION NOTES
LIST OF DRAWINGS
FOR REVISED PLAN

30M11-176

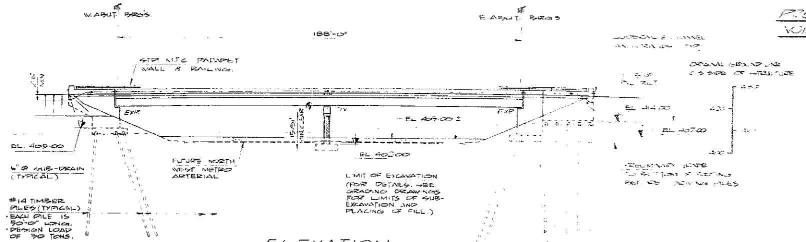
CONT No	
WP No 33-76-07	
MAPLE LEAF DRIVE UNDERPASS	SHEET
N. NORTH WEST METRO ARTERIAL	
FOOTINGS	



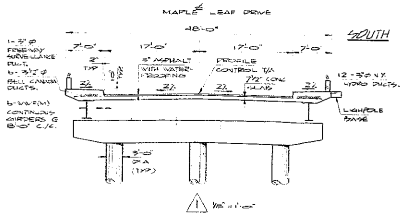
30M11-176

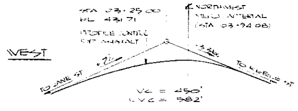


PLAN
1" = 20'-0"

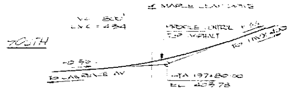


ELEVATION
1" = 20'-0"





PROFILE - MAPLE LEAF DRIVE N.T.S.



PROFILE - NORTHWEST METRO ARTERIAL
NORTH - AND SOUTHBOUND LANES N.T.S.

WORKING POINT DATA

POINT	STATION	ELEVATION TOP OF PAV.	CO-ORDS NORTH	CO-ORDS EAST
WP #1	02+96.06	423.57	882165.67	999469.[illegible]
WP #2	03+94.08	425.00	882194.7[illegible]	999563.48
WP #3	[illegible]+84.08	424.81	882220.35	999649.59

DISTRICT	6
CONT No	
WP No	33-76-07

MAPLE LEAF DRIVE UNDERPASS
AT NORTH WEST METRO ARTERIAL
GENERAL DRAWING

SHEET

GENERAL NOTES

CLASS OF CONCRETE

DECK SLAB; SIDEWALKS
ABUTMENTS ; PIER
& PARAPET WALLS. — 4000 P.S.I.
FOOTINGS, APPROACH SLABS — 3000 P.S.I.

CLEAR COVER TO REINFORCING STEEL

FOOTINGS & ABUTMENTS	3"
PIER CAP	2"
PIER COLUMNS	2½"
DECK — TOP	2"
— BOTTOM	1½"
APPROACH SLABS	2"
PARAPET WALLS	1½"

CONSTRUCTION NOTES

THE CONTRACTOR IS RESPONSIBLE FOR FINISHING THE BEARING SEATS DEAD LEVEL TO THE SPECIFIED ELEVATIONS WITH A TOLERANCE OF ±1/8".

NO CONCRETE SHALL BE PLACED ABOVE THE ABUTMENT BEARING SEATS UNTIL CONCRETE IN THE DECK HAS BEEN PLACED.

GRADE OF REINFORCING STEEL

REINFORCING STEEL SHALL BE C.S.A. G30 SERIES, GRADE 60.

LIST OF DRAWINGS.

1. GENERAL DRAWING.
2. BOREHOLE LOCATIONS & SOIL STRATA.
3. FOOTINGS.
4. WEST ABUTMENT.
5. EAST ABUTMENT.
6. PIER.
7. STRUCTURAL STEEL I.
8. STRUCTURAL STEEL II.
9. SCREED ELEVATIONS.
10. DECK REINFORCEMENT.
11. EXPANSION JOINTS & BEARINGS.
12. PARAPET WALL DETAILS (2'-0" HIGH).
13. STEEL PARAPET RAILING (DOUBLE TUBE.)
14. 20 FT. APPROACH SLAB.
15. AS CONSTRUCTED ELEV. & DIM.
16. STANDARD DETAILS I.
17. STANDARD DETAILS II.
18. STANDARD DETAILS III.

RECEIVED APR 0 6 1978 SOIL MECHANICS MINISTRY OF TRANSPORTATION & COMMUNICATIONS

REGISTERED PROFESSIONAL ENGINEER O. E. RAMAKKO PROVINCE OF ONTARIO

FOR REDUCED PLAN
USE SCALE BELOW
0 1 2 3
3 INCHES ON ORIGINAL PLAN

REVISIONS DATE	BY	DESCRIPTION		
DESIGN O.E.R.	CHECK	LOADING HS20-44	DATE MAR/78	
DRAWING P.P.K.	CHECK	SITE No 37-1056	DWG 1	