

REMARKS: _____



Ontario

Ministry of
Transportation and
Communications

FILE No. _____ DATE _____

REMARKS

Site 37-270R

NP 164-79-02

COB 84-23

METRIC

DIMENSIONS ARE IN METRES
AND/OR MILLIMETRES
UNLESS OTHERWISE SHOWN

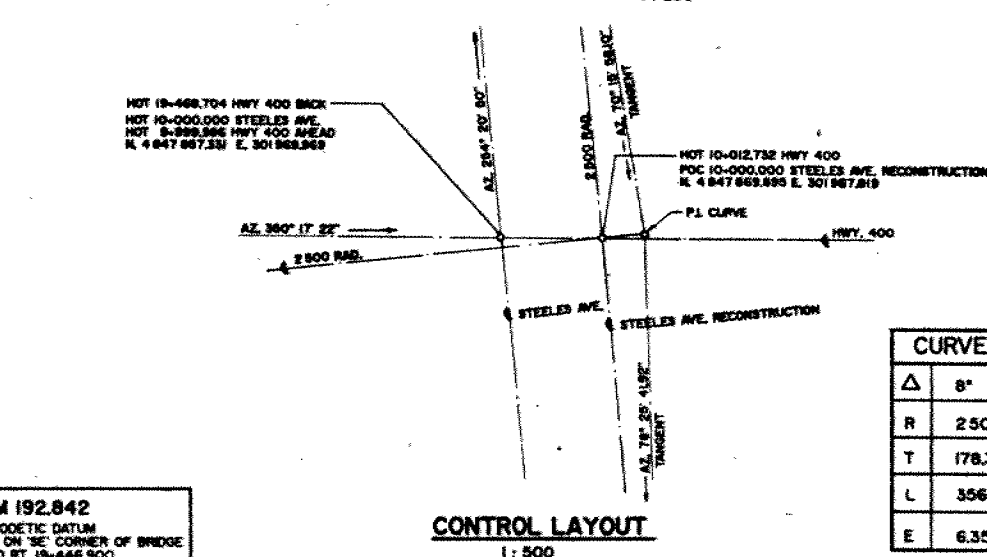
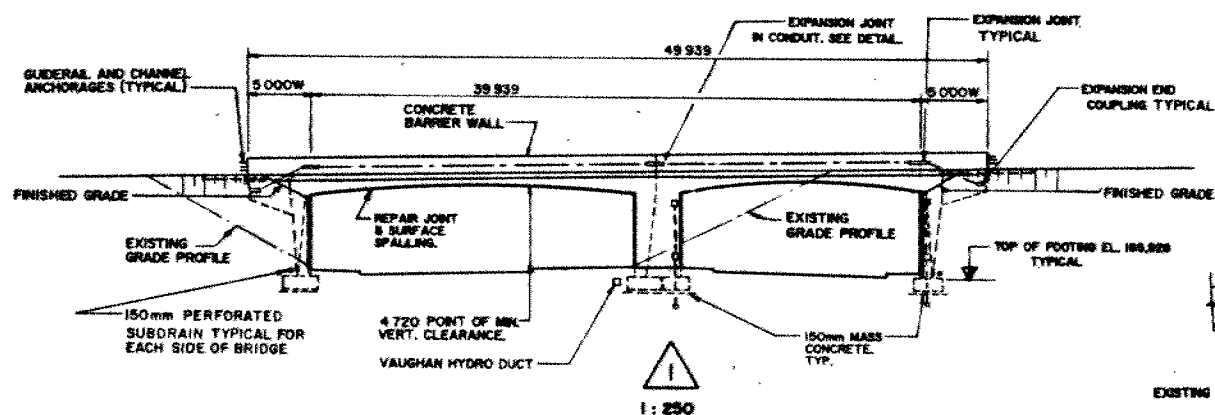
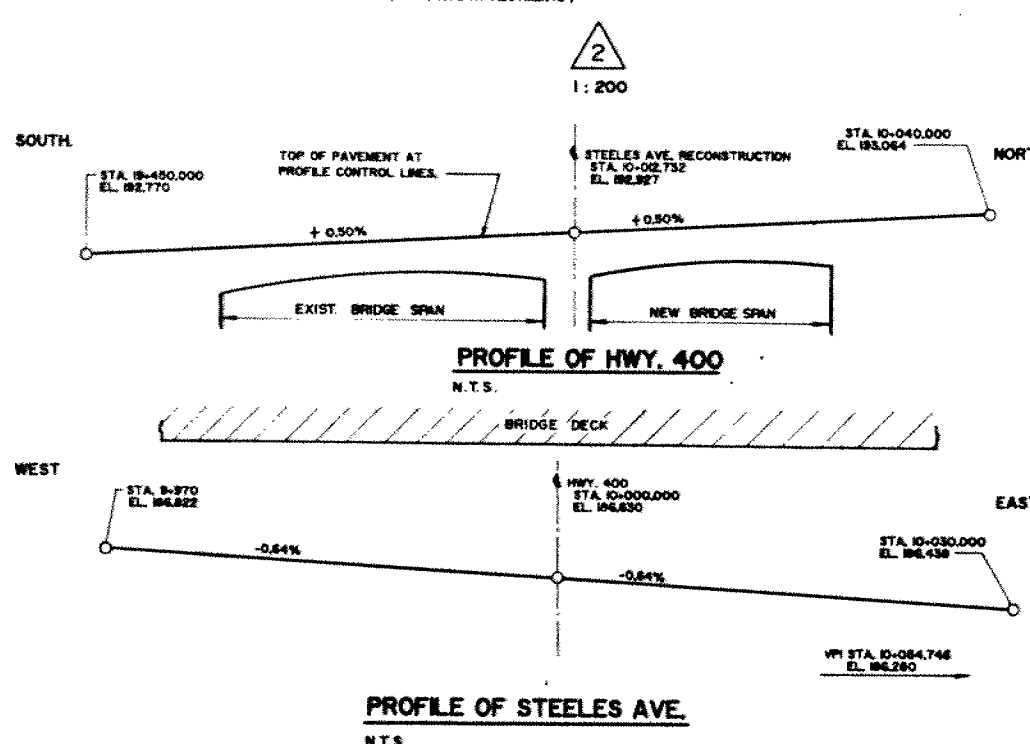
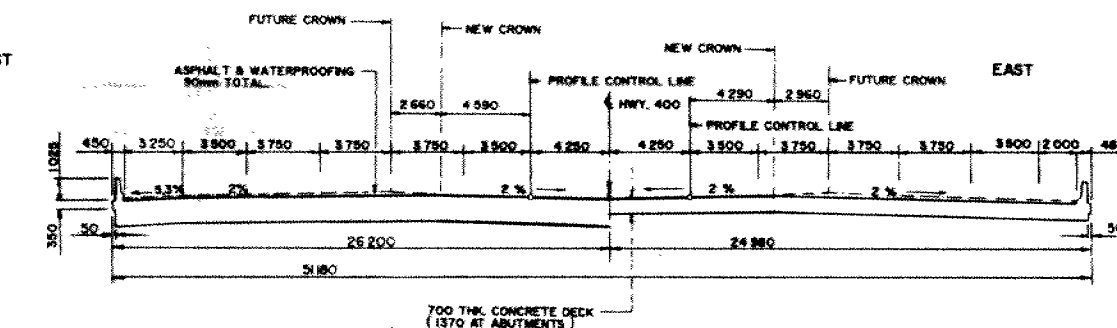
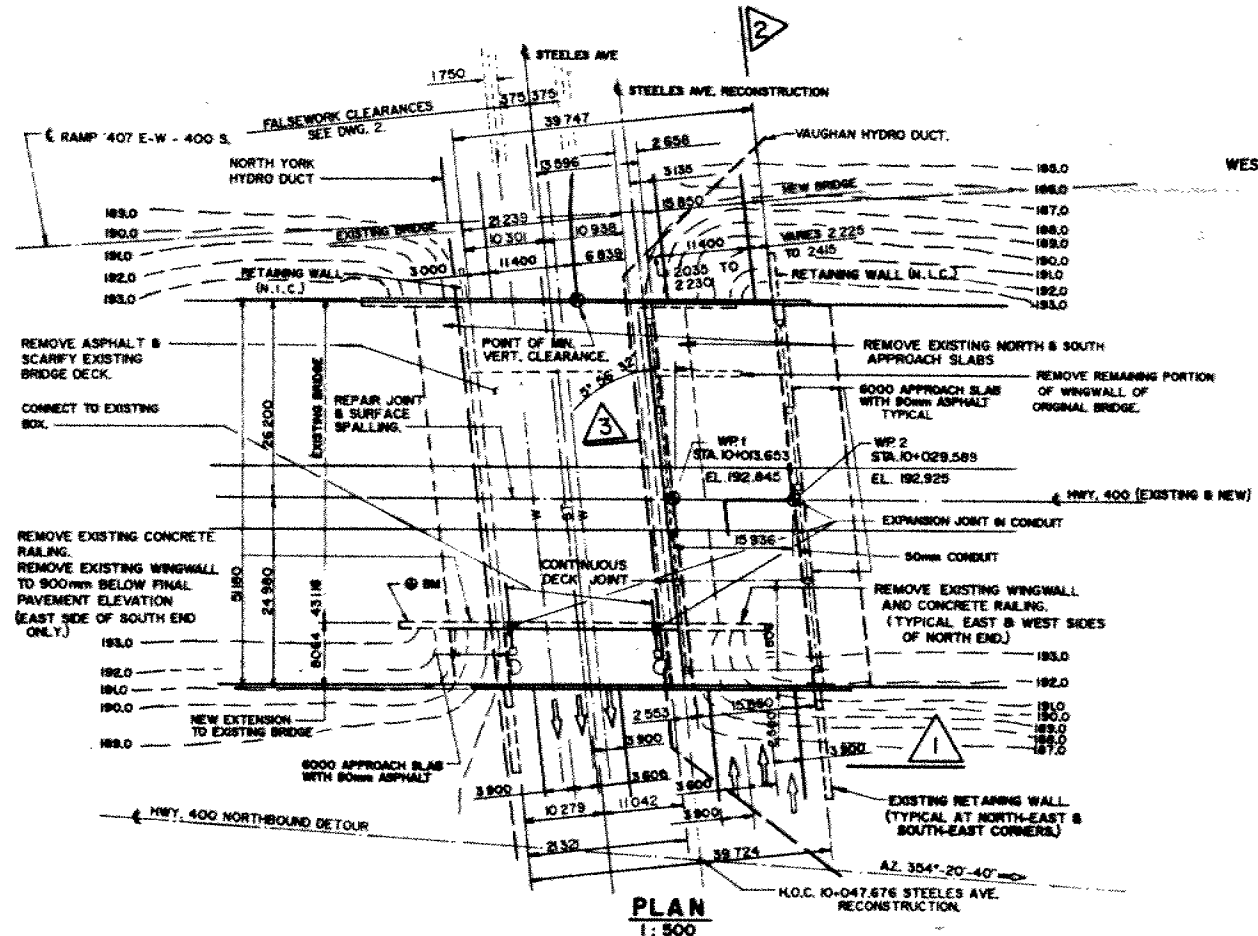
DIST No 6
CONT No
WP No 138-87-03



HIGHWAY 400 OVER
STEELES AVE. (STRUCT. 2)
GENERAL ARRANGEMENT.

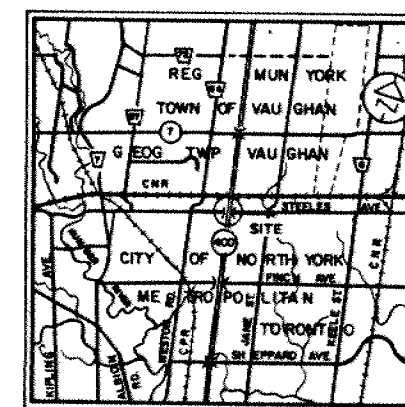
Gregg and Edens Limited
engineers · planners · economists

SHEET



CURVE DATA	
Δ	8° 09' 43.82"
R	2500
T	178.373
L	356.142
E	6.355

STATIONS		CO-ORDINATES	
B.C.	9+821.929	N	4 847 815.787
P.I.	10+000.302		847 876.015
E.C.	10+178.071		847 911.796
WP 1	10+013.654		847 870.805
WP 2	10+029.590		847 886.512
			301 964.975



KEY PLAN
1:1000

DRAWING NOT TO BE SCALED
100 mm ON ORIGINAL DRAWING

GENERAL NOTES:

- CLASS OF CONCRETE.
MASS CONCRETE 20 MPa
REMAINDER 30 MPa
- CLEAR COVER TO REINFORCING STEEL.
FOOTINGS 100 ± 25mm
ABUTMENTS 80 ± 20mm
FRONT FACE 70 ± 20mm
BACK FACE 70 ± 20mm
DECK 70 ± 20mm
TOP 70 ± 20mm
BOTTOM 80 ± 10mm
REMAINDER UNLESS NOTED 70 ± 20mm
- REINFORCING STEEL.
REINFORCING STEEL SHALL BE GRADE 400
UNLESS SPECIFIED OTHERWISE.
BAR MARKS WITH SUFFIX 'C' DENOTE COATED BARS.
- FOR STAGE CONSTRUCTION AND ROADWAY PROTECTION
SEE DWG. 2.
- REINFORCING STEEL IN ABUTMENT EXTENDING INTO EXISTING
WHIRLWALLS & FOOTINGS, WHICH ARE TO BE REMOVED,
TO BE CUT OFF 750mm BEYOND FACE OF EXISTING
ABUTMENT TO FORM DOWELS.

LIST OF DRAWINGS.

DWG. No.	TITLE
1.	GENERAL ARRANGEMENT.
2.	STAGING.
3.	REMOVAL AND REPAIRS.
4.	ROADWAY PROTECTION.
5.	FOOTINGS - STAGE 1.
6.	FRAME DETAILS I - STAGE 1.
7.	FRAME DETAILS I - STAGE 1.
8.	CONCRETE OVERLAY - STAGES 1 & 2.
9.	6000mm APPROACH SLABS.
10.	BARRIER WALL - STAGE 1.
11.	FOOTINGS - STAGE 2.
12.	FRAME DETAILS I - STAGE 2.
13.	FRAME DETAILS I - STAGE 2.
14.	BARRIER WALL - STAGE 2.
15.	FOOTINGS & FRAME - STAGE 3.
16.	SECTIONS AND DETAILS.
17.	BARRIER WALL - STAGE 3.
18.	BRIDGE DATE & SITE NUMBER DATA
19.	AS CONSTRUCTED ELEV. & DIM.

APPLICABLE STANDARD DRAWINGS.

SD-3503 REV. 3.
SD-4802 REV. 0.
SD-1611 REV. 2
SD-1613 REV. 1.

BM 192.842
GEODETIC DATUM
CC ON 'SE' CORNER OF BRIDGE
17.0 RT. 19+446.900

CONTROL LAYOUT
1:500

DATE	BY	DESCRIPTION
DESIGN M.B.	CHK	CODE 1983 - ONSDC LOAD CLASS A
DRAWN B.D.	CHK	SITE 37-270R
		STRUCT
		SCHEME
		DWG



Ministry of
Transportation and
Communications

cont 90-60

FOUNDATION DESIGN SECTION

**foundation
investigation and
design report**

CONT 90-60
ENGINEERING MATERIALS OFFICE
FOUNDATION DESIGN SECTION

WP 138-87-03 ~~1385~~ DIST 6
HWY 400 STR SITE 37-270R

Highway 400 Over Steeles Avenue
Structure #2

DISTRIBUTION

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File

FOUNDATION INVESTIGATION REPORT
For
Highway 400 Over Steeles Avenue
Structure #2
W.P. 138-87-03 ~~138-87-03~~, Site No. 37-270 R
District 6, Toronto

INTRODUCTION

This report summarizes the information obtained from a foundation investigation carried out at the above mentioned site during the periods of June 11 to June 20, 1959, February 10 to February 11, 1981, and December 14 to December 18, 1987.

Four boreholes were drilled and sampled in June of 1959 as part of the foundation investigation prior to the construction of the original Hwy. 400 structure. All four boreholes were advanced using a standard diamond drill and conventional washboring techniques. All of the boreholes extended to depths of 18.7 metres below the ground surface. The results obtained from these boreholes (Boreholes 1 to 4) are utilized in this report.

Additional four boreholes (Boreholes 5 to 8) were advanced and sampled in February of 1981 as part of lengthening the existing structure westerly by means of a continuous flight auger machine equipped within solid and hollow stem augers. These boreholes extended to depths between 8.1 and 9.6 metres below the ground surface. The information from these boreholes is also utilized in this report.

During the December of 1987, two additional boreholes (Boreholes #2-1 and #2-2) were advanced and sampled as part of this project by means of hollow stem augers and washboring techniques. These boreholes extended down to depths between 17.0 and 18.6 metres below the ground surface.

This report contains factual information together with recommendations pertaining to the foundations of lengthening of the existing structure and a new rigid frame structure shown on Drawing No. 1388703&05-A.

SITE DESCRIPTION AND GEOLOGY

The site is located on Hwy. 400 where it crosses the existing Steeles Avenue. The existing structure will be lengthened easterly and a new rigid frame structure will be constructed north and parallel to the existing structure. At this location, Steeles Avenue and Highway 400 have elevations between 186.5 m and 193.0 m respectively. The existing bridge over the Steeles Avenue is a 21.3 x 43.5 metres single span rigid frame bridge constructed with earth embankments up to 6.5 meters in height.

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 overlying very dense silty sand to sandy silt. Land use is mainly for industrial purposes.

SUBSURFACE CONDITIONS

General

The subsoil conditions encountered across the site were generally uniform consisting primarily of two distinct deposits. The upper layer consists of a clayey silt to silt with sand and a trace of gravel which extends down to the elevations between 179.2 m at BH #3 and 182.4 m at BH #7 as shown on the sections (Drawing No. 1388703&05-A). The thickness of this layer varies between 4.6 m at BH #2-2 location and 7.8 m at BH #3 location. Underneath this clayey silt to silt, very dense silty sand to sandy silt with the occasional sand layers is present. Approximately 11.5 metres of this very dense material was proven. These deposits are of glacial origin.

The embankments of the existing structure are composed by approximately 6.5 metres of sand and clayey silt fill materials.

More detailed description of the two distinct subsoil deposits and the embankment fill material will be presented.

1) Clayey Silt to Silt

A layer of clayey silt to silt with sand and a trace of gravel extends from the ground surface to depths between 4.6 and 7.8 metres. The material changes in colour from brown to grey at approximately elevation 184.0 m on the north side of Steeles Avenue and 179.0 m on the south side of the road (at BH #4, elevation 186.0 m).

The results from laboratory tests performed on this material are summarized as follows:

<u>Properties</u>	<u>Range (%)</u>
Moisture Content (w)	8.5 - 19.5
Liquid Limit (w_L)	15.5 - 31.0
Plastic Limit (w_p)	10.0 - 13.0
Plasticity Index (I_p)	4 - 17.5

The Atterberg Limit Test results are illustrated on the Plasticity Charts (See Figure 1 and 2). From the charts it is evident that the layer can be classified as an inorganic clayey silt to silt with low plasticity (CL or CL-ML).

Grain size distribution tests were carried out on these materials. Figure 4 in the Appendix shows the result in envelope form.

Standard Penetration Test 'N' values between 13 and over 100 indicated that the soil can be interpreted as being stiff to hard.

2) Sandy Silt to Silty Sand

Silty sand to sandy silt was encountered below the clayey silt layer. All samples recovered from the north side of Steeles Avenue had a grey colour whereas samples recovered above elevation 179.0 metres on the south side were brown in colour. Samples taken below elevation 179.0 metres on the south side were grey in colour.

Grain size distribution analysis indicates that the soil varies between a silty sand and sandy silt. Trace of clay and gravel are also present. This layer is basically non-plastic. The Atterberg Limit Test results are shown on the plasticity chart (See Figure 3). From the charts it is evident that the layer can be classified as sandy silt to silty sand (ML). A gradation limit curve for this particular soil is present in Figure 5.

In this stratum, the 'N' values ranged from 54 to over 100 blows/0.3 m indicating a state of compaction described as very dense.

3) Embankment Fill Material

The soil used in the embankment fills consists of a brown clayey silt with some sand and trace of gravel. Atterberg Limit Tests indicate that the soil can be classified as a clayey silt of low plasticity (CL) (See Figure 2). The test results are summarized below:

<u>Properties</u>	<u>Range (%)</u>
Moisture Content (w)	11.5 - 14.5
Liquid Limit (w _L)	20.0 - 28.0
Plastic Limit (w _p)	10.5 - 15.0
Plasticity Index (I _p)	7.5 - 15.0

From the test results and through visual observation, it is apparent that the embankment fill material is similar to the layer of clayey silt to silt immediately below the existing ground surface. It is therefore likely that the fill material came from the immediate vicinity. Standard Penetration Test 'N' values between 7 and 28 indicate that the fill material is in a firm to very stiff 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. 1388703&05-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 structures.

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 180.5 metres at BH #2-2 and elevation 183.3 metres at BH #2-1 about 5.6 metres below the original ground surface.

DISCUSSION AND RECOMMENDATIONS

The recommendations in this report apply to the bridge structures, the retaining walls and related approaches.

The existing structure is a 21.3 metre single span rigid frame over Steeles Avenue. This structure was lengthened about 8.75 metres westly from the original length of 34.7 metres to the existing width of 43.5 metres during the 1984 construction season.

Hwy. 400 and 407 interchange complex requires widening of Hwy. 400 in the vicinity of Steeles Avenue. To accommodate this requirement, it is proposed to widen the east side of the existing structure about 8.4 metres from the existing edge of the deck. In addition, it is also proposed to construct a new 16.7 metre rigid frame structure about 3.7 m north of and parallel to the existing structure.

The existing structure is founded on spread footings approximately 1.0 metres thick. The base of the footings are located at elevation 184.9 m. There is approximately 1.2 metres of soil cover over the top of the footings.

Associated retaining walls for the existing structure are founded on stepped spread footings. Similar retaining walls will be required for the new structure.

1. Abutment Foundations

The proposed widened portion of the structure and new rigid frame structure may be supported on spread footings in a manner similar to the existing structure. The following measures should be taken into consideration during construction:

- footings should be at the existing foundation level of 184.9 metres
- during excavation, care must be taken to avoid undermining the existing foundation

- if, during excavation, the material at the footing level adjacent to the existing foundation appears to be soft and disturbed, it should be carefully excavated and replaced with mass concrete
- footings must have a minimum earth cover of 1.2 m for frost protection

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

Factored Bearing Capacity at U.L.S. 600 kPa

Bearing Capacity at S.L.S. Type II 400 kPa

2. Retaining Wall Foundations

The retaining walls for the widened and new structures should be founded on spread footings constructed within the very stiff to hard clayey silt deposit at or below the elevation of 184.9 m. Normal construction joints with dowels should be used to fasten together the footings. A minimum of 1.2 metres of soil should be placed over the footings to serve as frost protection.

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

Factored Bearing Capacity at U.L.S. 375 kPa

Bearing Capacity at S.L.S. Type II 250 kPa

3. Other Construction Considerations

Backfill to 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' $\gamma = 21.2 \text{ kN/m}^3$ $\phi = 30^\circ$ $K_A = 0.33$

Lateral pressures should be computed in accordance with Section 6.6.1.2.1 of the code. A yielding foundation condition may be assumed. Sliding resistance may be computed by assuming an adhesion of 75 kPa to apply between the underside of footings and the soil.

Since the water level is approximately 1.5 metres below the proposed foundation level and the foundation soil is of low permeability, dewatering problems are not anticipated. If surface water does accumulate in the excavation, it should be removed by means of a sump pump.

Required widenings of the approach fills must be benched and keyed as per M.T.O. specifications. Approach fills and cuts should be constructed with standard 2:1 side and forward slopes in which event in general no major stability problems are anticipated.

MISCELLANEOUS

The fieldwork for this investigation was carried out during the period of 87-12-14 to 87-12-18 under the supervision of Tae C. Kim and Ken Zasitko (Technician). The equipment was owned and operated by Master Soil Investigation Toronto.

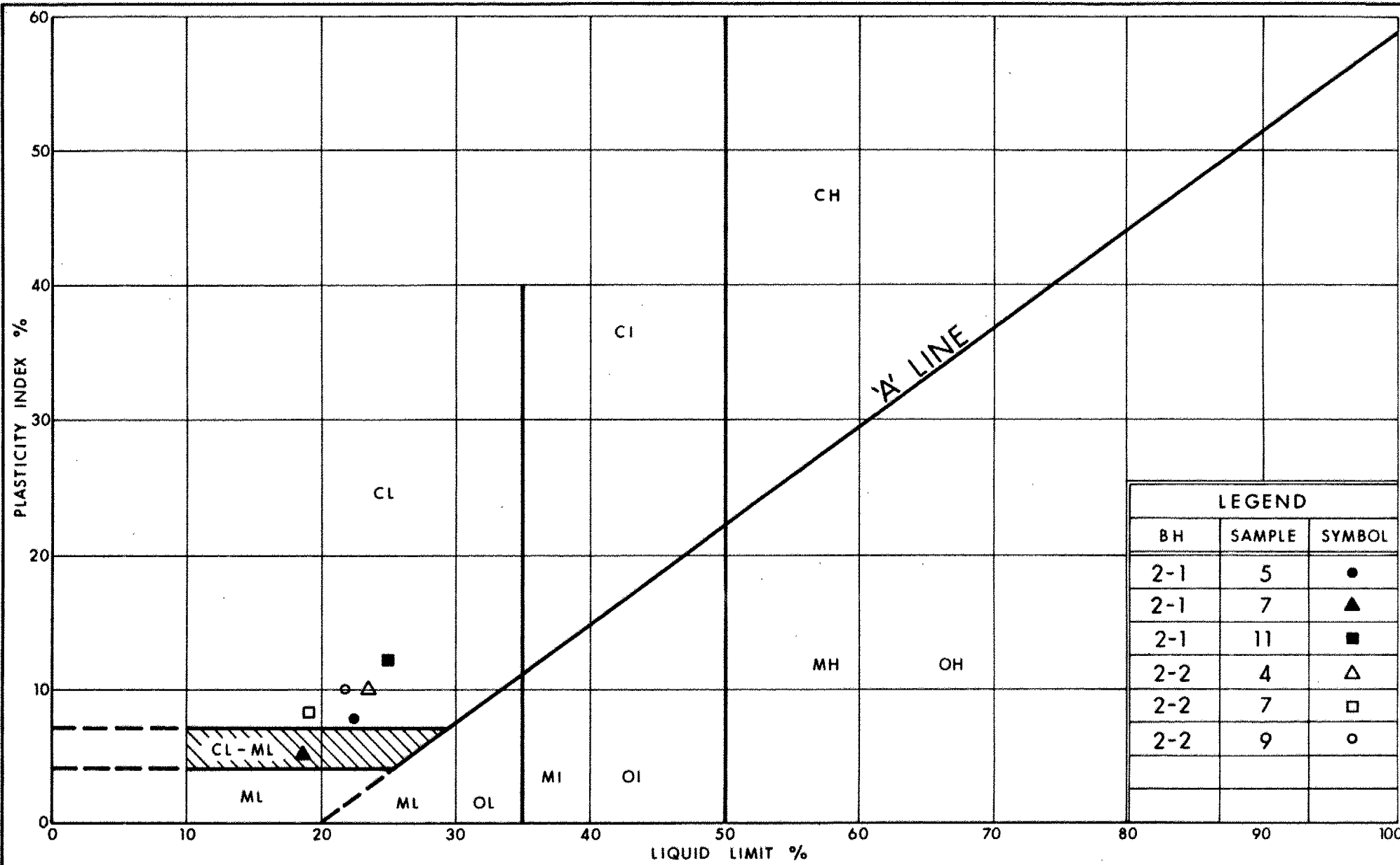
This report was written by T.C. Kim, Foundation Engineer and reviewed by M. Devata, Chief Foundations Engineer (East).



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

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

APPENDIX



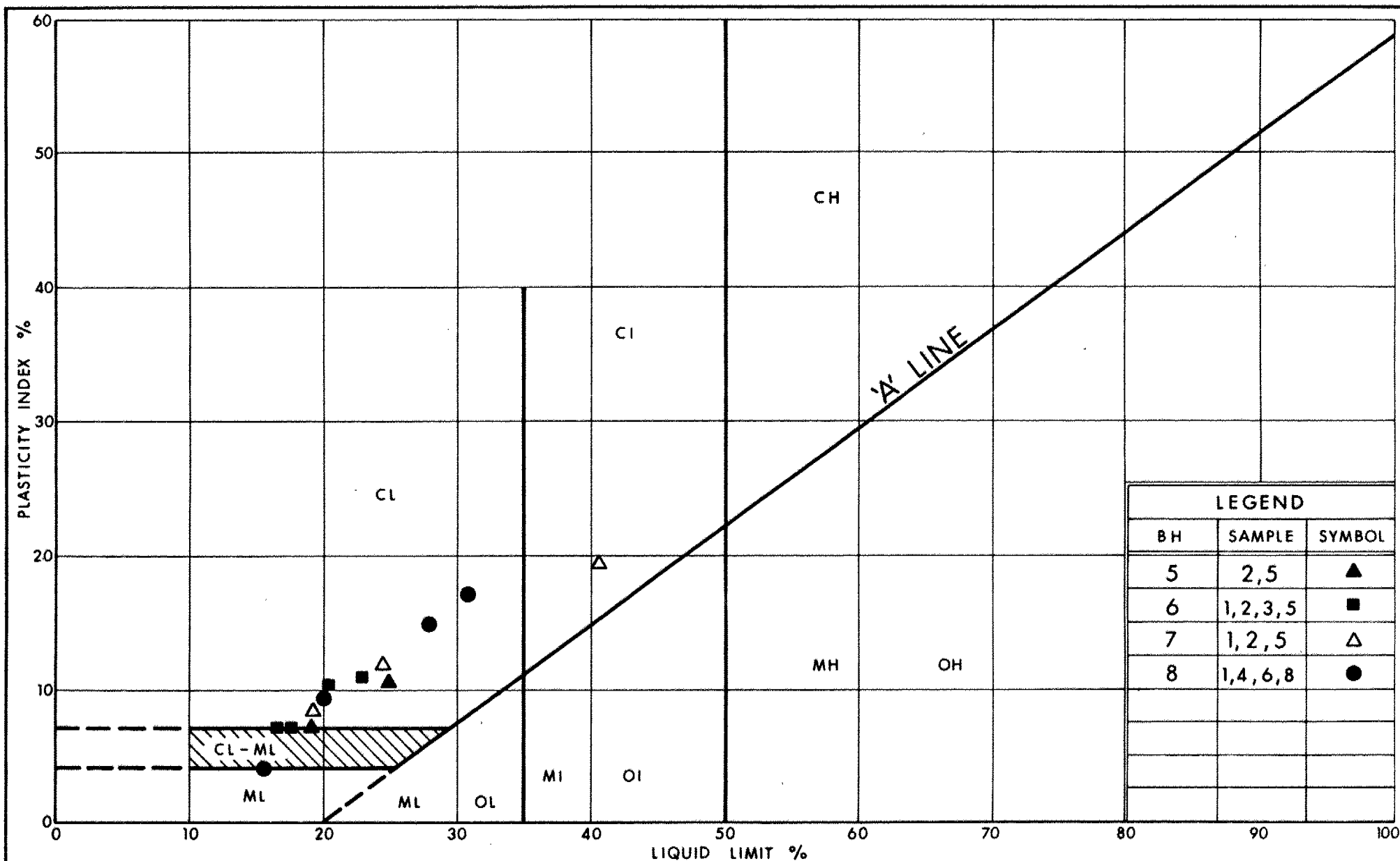
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PLASTICITY CHART CLAYEY SILT TO SILT

FIG No 1

W P 138-87-03 & 05

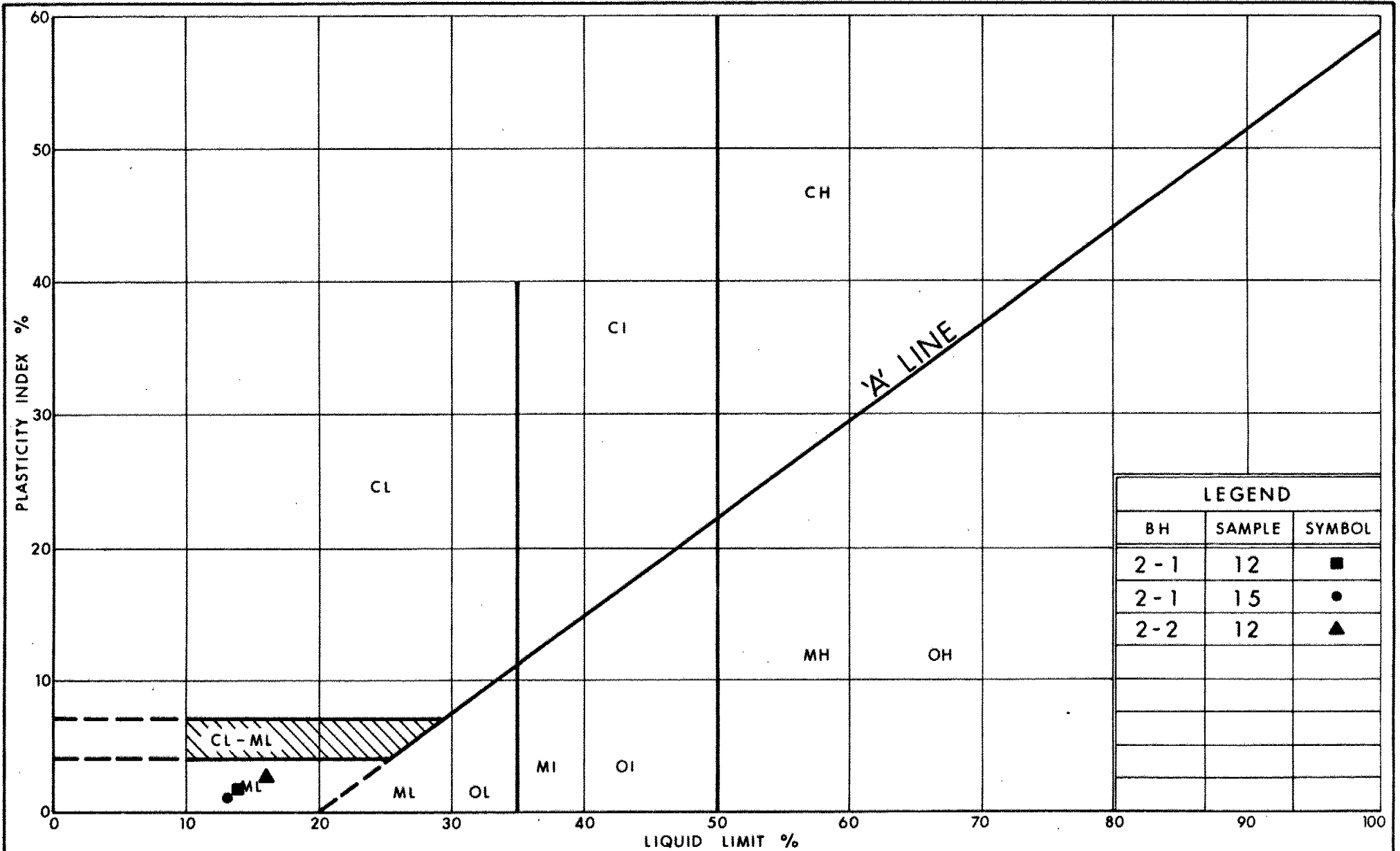


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PLASTICITY CHART CLAYEY SILT TO SILT

FIG No 2

W P 138-87-03 & 05



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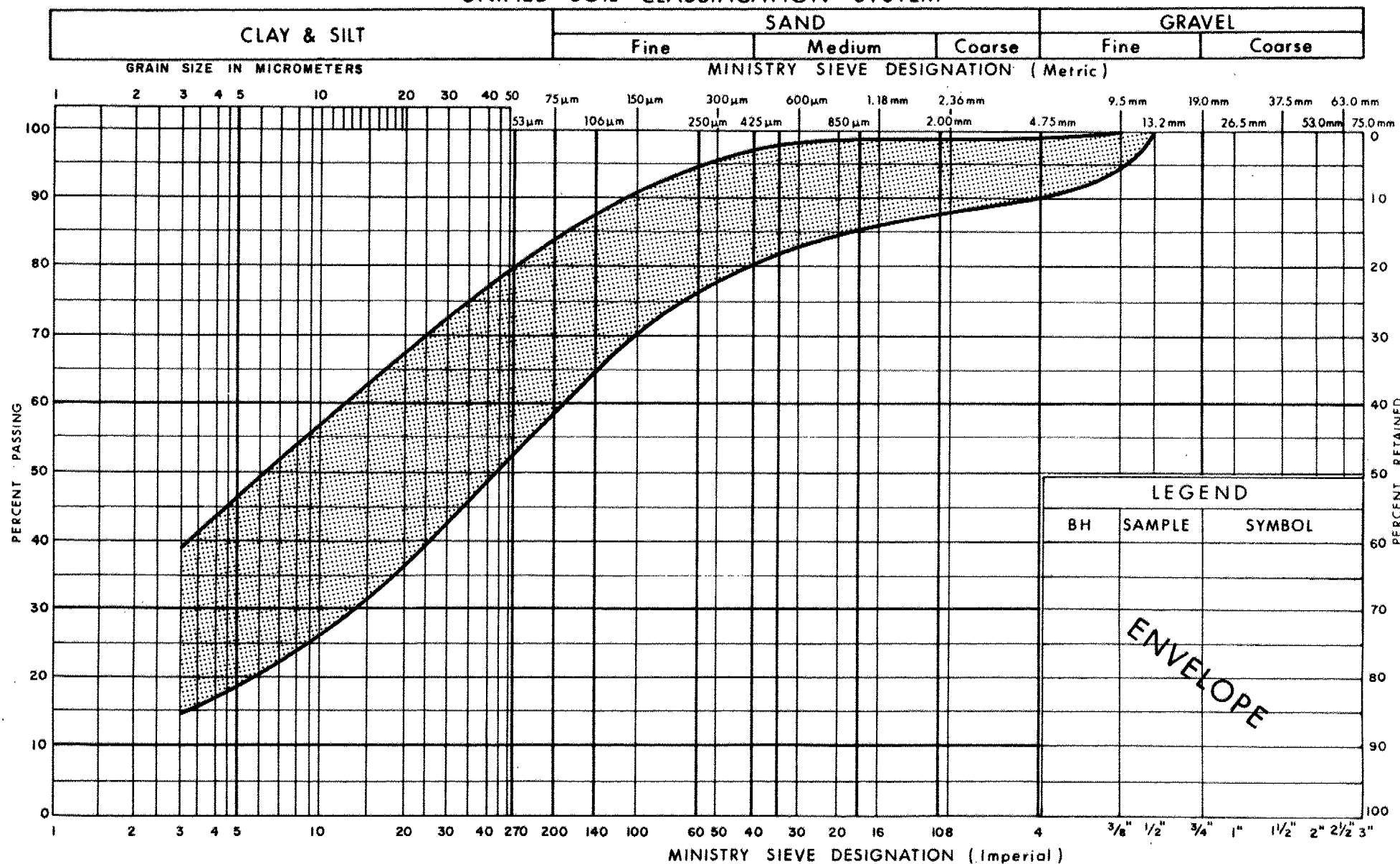
Ontario

PLASTICITY CHART SANDY SILT TO SILTY SAND

FIG No 3

W P 138-87-03 & 05

UNIFIED SOIL CLASSIFICATION SYSTEM



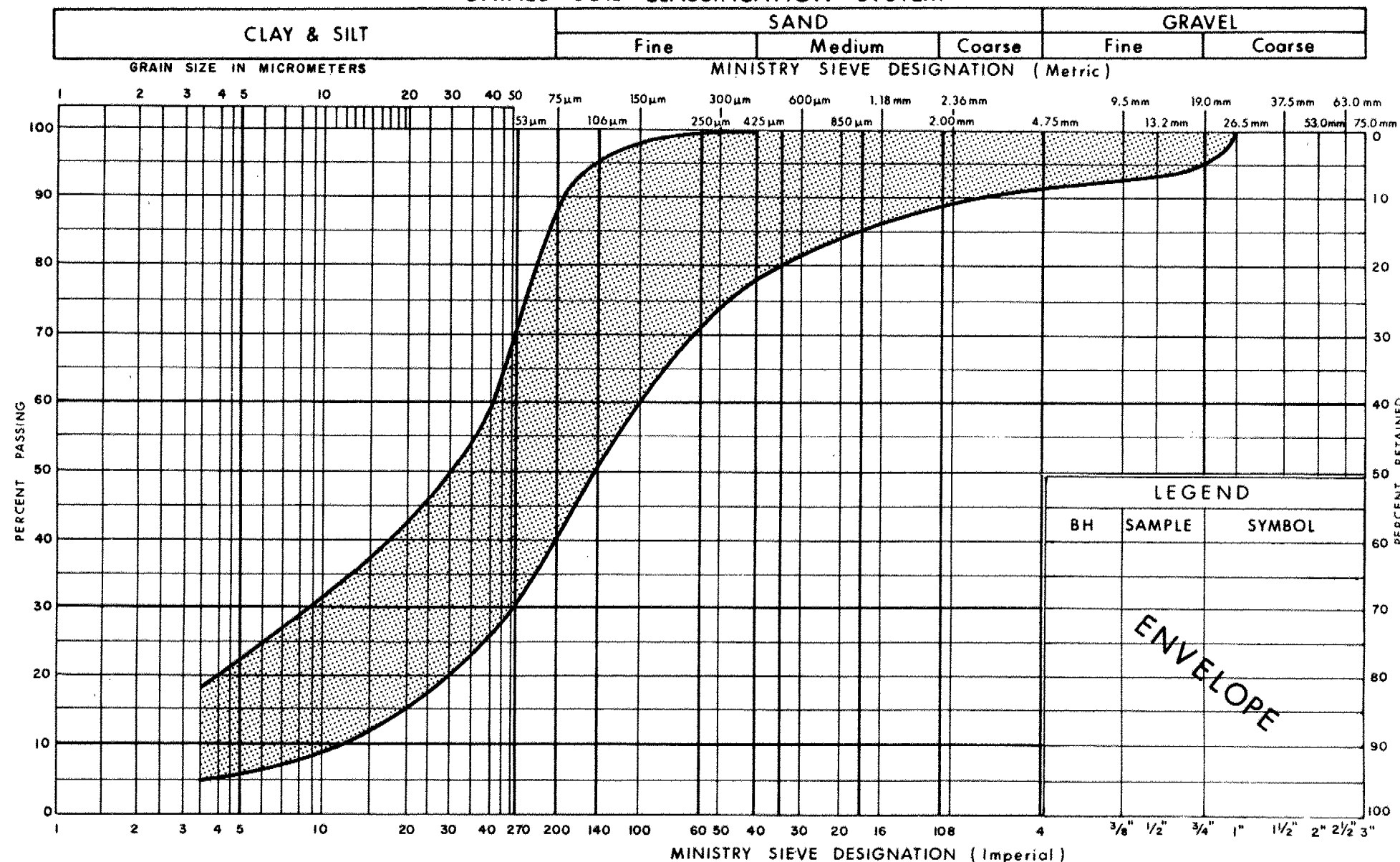
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GRAIN SIZE DISTRIBUTION
CLAYEY SILT TO SILT

FIG No 4

W P 138-87-03 & 05

UNIFIED SOIL CLASSIFICATION SYSTEM



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GRAIN SIZE DISTRIBUTION
SANDY SILT TO SILTY SAND

FIG No 5

W P 138-87-03 & 05

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:

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

MECHANICAL PROPERTIES OF SOIL

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

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

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 = $\frac{w_L - w_p}{I_p}$	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 1

METRIC

W P 138-87-03 & 05 LOCATION Coordinates N 4 847 842.0; E 301 951.0 ORIGINATED BY MD
DIST 6 HWY 400 BOREHOLE TYPE Washbore & Cone Test COMPILED BY
DATUM Geodetic DATE 1959 06 11 CHECKED BY

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ KN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100				
189.4	Ground Level															
0.0	Clayey Silt (Fill)															
188.2																
1.2	Clayey Silt to Silt With Sand, Trace of Gravel Occasional Silty Sand Layers Hard (Glacial Till)		1	SS	48		188								23.6	
			2	SS	60		186								24.6	
			3	SS	155										24.4	
			4	SS	110		184								22.9	
			5	SS	151											
181.8			6	SS	160		182									
7.6			7	SS	167		180									
	Brown Grey		8	SS	160											
			9	SS	160		178									
	Silty Sand to Sandy Silt Very Dense		10	SS	170		176								25.5	
			11	SS	-											
173.5			12	SS	160		174									
15.9	Sand with Gravel Very Dense						172									
170.8			13	SS	135											
18.6	End of Borehole															
	NOTE: This borehole was done prior to construction of existing bridge. Therefore soil inform- ation above Elev.185± does not apply.															

+3, x⁵: Numbers refer to
Sensitivity

20
15 ÷ 5 (%) STRAIN AT FAILURE
10



Ministry of
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RECORD OF BOREHOLE No 2

METRIC

W P 138-87-03 & 05 LOCATION Coordinates: N 4 847 860.0; E 301 946.5 ORIGINATED BY MD
DIST 6 HWY 400 BOREHOLE TYPE Washbore & Cone Test COMPILED BY
DATUM Geodetic DATE 1959 06 11 CHECKED BY

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)					
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60						80	100	WATER CONTENT (%)		
								SHEAR STRENGTH								10	20	30		
188.7	Ground Level																			
0.0	Clayey Silt (Fill)																			
187.8																				
0.9	Clayey Silt to Silt Some to Trace of Sand Trace of Gravel		1	SS	44									23.8						
			2	SS	75									24.0						
			3	SS	89									25.0						
			4	SS	125															
			5	SS	110															
			6	SS	157									23.5						
181.4	Occasional Silty Sand Layers Hard (Glacial Till)		7	SS	133															
7.3	Sandy Silt Very Dense		8	SS	145															
178.9			9	SS	158															
9.8	Sand With Gravel Very Dense		10	SS	163															
			11	SS	172															
174.7			12	SS	90															
14.0	Silty Sand to Sandy Silt With Gravel Very Dense																			
169.9			13	SS	151															
18.8	End of Borehole																			
<p>NOTE:</p> <p>This Borehole was done prior to construction of existing bridge, therefore soil information above Elev. 185 ± does not apply.</p>																				

NOTE:

This Borehole was
done prior to
construction of
existing bridge,
therefore soil
information above
Elev. 185 ± does
not apply.

+3, x5: Numbers refer to
Sensitivity

20
15
10

(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 3

METRIC

W P 138-87-03 & 05 LOCATION Co-ordinates N 4 847 874.5; E 301 988.0 ORIGINATED BY BK
DIST 6 HWY 400 BOREHOLE TYPE Washboring COMPILED BY BK
DATUM Geodetic DATE 1959 06 18 CHECKED BY MD

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 KN/m ³	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									
								O UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE									
							50 100 150 200 250					WATER CONTENT (%) 10 20 30					
188.7	Ground Level																
0.0	Clayey Silt (Fill)						188								21.2		
187.8															20.9		
0.9	Clayey Silt to Silt With Sand, Trace of Gravel, Occ. Silty Sand Layer		1	TP	18												
			2	TP	23												
	Brown Grey Very Stiff to Hard (Glacial Till)		3	TP	29												
			4	SS	56												
			5	SS	117												
			6	TP	42												
179.2			7	SS	134												
9.5			8	SS	172												
			9	SS	163												
	Sand with Gravel																
			10	SS	132												
	Silty Sand to Sandy Silt with Fine Gravel																
	Very Dense																
169.9			11	SS	268												
18.8	End of Borehole																
NOTE: This Borehole was done prior to construction of existing bridge, therefore soil information above Elev. 185± does not apply																	

OFFICE REPORT ON SOIL EXPLORATION

RECORD OF BOREHOLE No 4

METRIC

W P 138-87-03 & 05 LOCATION Co-ords N 4 847 853.5; E 301 993.0 ORIGINATED BY BK
 DIST 6 HWY 400 BOREHOLE TYPE Washboring COMPILED BY BK
 DATUM Geodetic DATE 1959 06 18 CHECKED BY MD

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT Y	REMARKS & GRAIN SIZE DISTRIBUTION (%)			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40						60	80	100
								SHEAR STRENGTH kPa									
188.8	Ground Level																
0.0	Clayey Silt																
187.8	(Fill)																
1.0			1	SS	21								21.5				
			2	TP	29								22.1				
			3	TP	42								22.1				
			4	SS	110								24.9				
			5	SS	76								22.3				
181.1			6	SS	54								22.6				
7.7			7	SS	126												
			8	SS	80												
			9	SS	169												
			10	SS	141												
			11	SS	148												
170.0			12	SS	149												
18.8	End of Borehole																
NOTE: This borehole was done prior to construction of existing bridge, therefore soil information above Elev. 185± does not apply																	

RECORD OF BOREHOLE No 6

METRIC

W P 138-87-03 & 05 LOCATION Co-ords N 4 847 862.0 ; E 301 942.0
 DIST 6 HWY 400 BOREHOLE TYPE Solid Stem Augers
 DATUM Geodetic DATE 81 02 10
 ORIGINATED BY KM
 COMPILED BY KM
 CHECKED BY

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT Y	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100				
186.8	Ground Level															
0.0																
	Clayey Silt to Silt		1	SS	13		186									
	Some to Trace of Sand		2	SS	35											
			3	SS	100/	18 cm	184									
	Brown		4	SS	100/	18 cm										
	Grey		5	SS	100/	18 cm										
	Trace of Gravel		6	SS	84		182									
	Occ. Silty Sand Layers															
	Very Stiff to Hard															
	(Glacial Till)															
180.7			7	SS	100/	10 cm	180									
6.1	Sandy Silt															
	Trace of Gravel															
	Very Dense															
178.7			8	SS	100/	28 cm										
8.1	End of Borehole															1 29 65 5

+3, x5: Numbers refer to
Sensitivity

20
15 ϕ 5 (%) STRAIN AT FAILURE
10



RECORD OF BOREHOLE No 7

METRIC

W P 138-87-03 & 05 LOCATION Co-ords N 4 847 825.0; E 301 945.0 ORIGINATED BY KM
DIST 6 HWY 400 BOREHOLE TYPE Solid Stem Augers COMPILED BY KM
DATUM Geodetic DATE 81 02 10-11 CHECKED BY _____

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20 40 60 80 100						
								SHEAR STRENGTH						
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE		WATER CONTENT (%)				
188.4	Ground Level									10	20	30		GR SA SI CL
0.0	Clayey Silt to Silt With Sand and Gravel Occ. Silty Sand Layers Very Stiff to Hard (Glacial Till)		1	SS	19	*	188							
			2	SS	34									
			3	SS	52									
			4	SS	100/	15 cm								
			5	SS	100/	25 cm								
			6	SS	44									
			7	SS	100/	13 cm								
182.3	Sandy Silt to Silty Sand Very Dense <u>Brown</u> <u>Grey</u>		8	SS	100/	20 cm	182							1 60 36 3
6.1			9	SS	100/	15 cm								2 35 59 4
			10	SS	100/	10 cm								1 42 52 5
							180							
178.8			11	SS	100/	28 cm								9 35 56 0
9.6	End of Borehole													
	* W.L. Not Established													

+3, x5: Numbers refer to
Sensitivity

20
15 5 (%) STRAIN AT FAILURE
10



RECORD OF BOREHOLE No 8

METRIC

W P 138-87-03 & 05 LOCATION Co-ords N 4 847 833.0; E 301 954.5 ORIGINATED BY KM
DIST 6 HWY 400 BOREHOLE TYPE Solid Stem Augers COMPILED BY KM
DATUM Geodetic DATE 81 02 11 CHECKED BY _____

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 SHEAR STRENGTH ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE	PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES									
192.1	Ground Level						192							
0.0	Clayey Silt Some Sand Trace of Gravel Firm to Very Stiff (Fill)	[X]	1	SS	7	*	190							
			2	SS	7									
			3	SS	28									
			4	SS	17									
188.6	Clayey Silt to Silt Some Sand Occ. Silty Sand Layers Hard (Glacial Till)	[X]	5	SS	32		188							
3.5			6	SS	32									
			7	SS	47									
			8	SS	56									
184.0			9	SS	100/25 cm		186							
8.1	End of Borehole													
	* W.L. Not Established													

+³, x⁵: Numbers refer to
Sensitivity

20
15
10
5 (%) STRAIN AT FAILURE



RECORD OF BOREHOLE No 2-1

METRIC

W P 138-87-03 & 05 LOCATION Co-ords N 4 847 893.0; E 301 981.0 ORIGINATED BY KZ
DIST 6 HWY 400 BOREHOLE TYPE Hollow Stem Auger & Cone Test COMPILED BY KZ
DATUM Geodetic DATE 1987 12 14 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	W _p					
193.0 0.0	Ground Level													
190.5 2.5	Sand with Gravel (Fill)		1	SS	10		192							
			2	SS	7		190							
			3	SS	20		188							
			4	SS	20		186							
			5	SS	18		184							
185.5 7.5	Clayey Silt to Silt With Some Sand Trace of Gravel Occ. Silty Sand Layers Very Stiff to Hard (Glacial Till)		6	SS	24		184						9 33 42 16	
			7	SS	105		184						3 33 52 12	
			8	SS	86	25 cm	184							
			9	SS	90	15 cm	184							
			10	SS	100	15 cm	182							
			11	SS	85		180						2 19 44 35	
			12	SS	88		180						9 42 38 11	
			13	SS	75	15 cm	178							
			14	SS	60	15 cm	176							
			15	SS	60	12 cm	174						6 39 50 5	
176.8 16.2	Sandy Silt, Trace Of Gravel and Clay Very Dense													
174.4 18.6	End of Borehole													

OFFICE REPORT ON SOIL EXPLORATION

RECORD OF BOREHOLE No 2-2

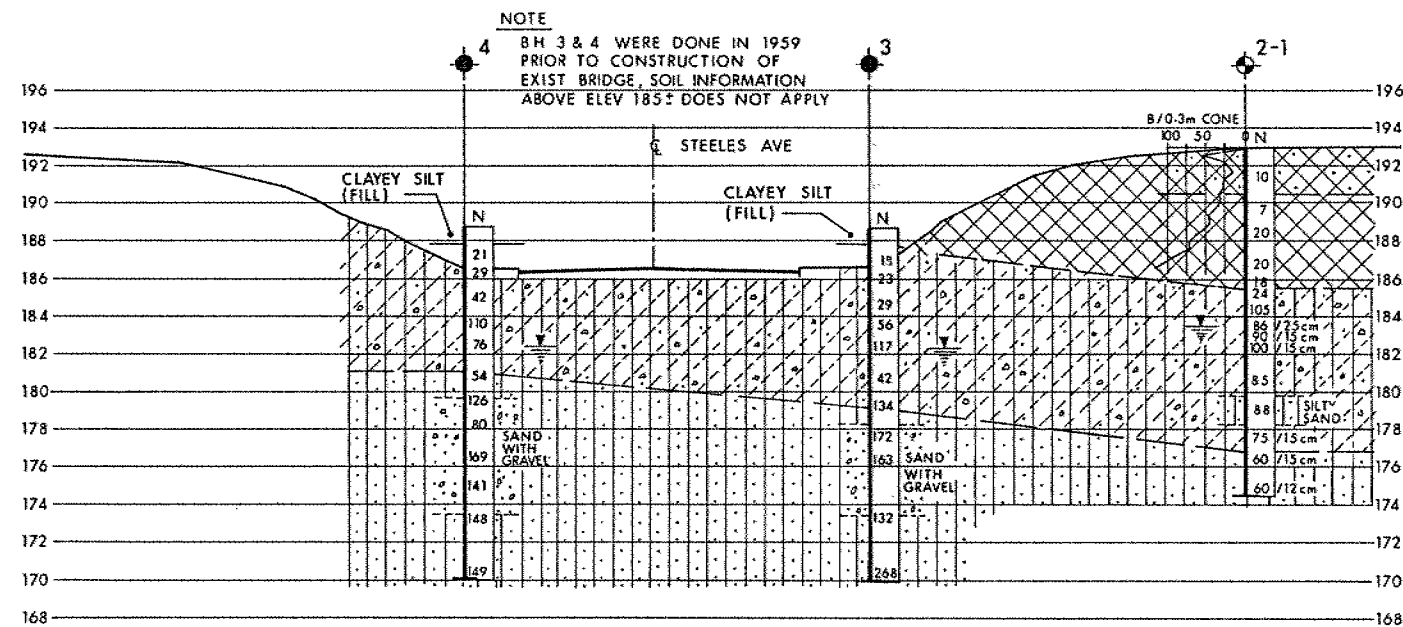
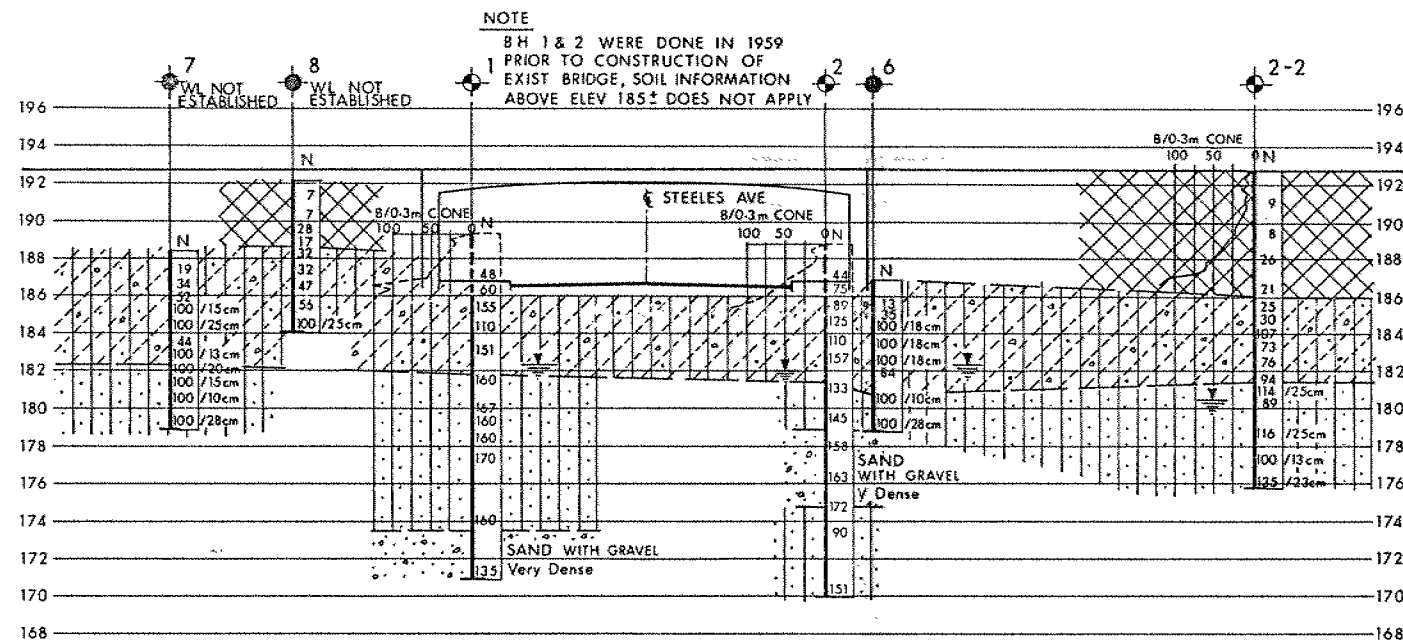
METRIC

W P 138-87-03 & 05 LOCATION Co-ords N 4 847 882.0; E 301 941.5
 DIST 6 HWY 400 BOREHOLE TYPE Hollow Stem Auger & Cone Test
 DATUM Geodetic DATE 1987 12 17
 ORIGINATED BY KZ
 COMPILED BY KZ
 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	20 40 60 80 100					
192.7 0.0	Ground Level													GR SA SI CL
186.0 6.7	Clayey Silt with Sand Trace of Gravel (Fill)		1	SS	9		192							
			2	SS	8		190							
			3	SS	26		188							
			4	SS	21		186							3 35 41 21
181.4 11.3	Clayey Silt to Silt With some Sand Trace of Gravel Brown Grey Occ. Silty Sand Layer Very Stiff to Hard (Glacial Till)		5	SS	25		184							2 25 57 16
			6	SS	30									
			7	SS	107									
			8	SS	73									
			9	SS	76									1 15 64 20
			10	SS	94									
175.7 17.0	Sandy Silt, Some to Trace of Clay and Gravel Very Dense		11	SS	114/	25 cm	180							9 26 48 17
			12	SS	89									
			13	SS	116/	25 cm								
			14	SS	100/	13 cm								
			15	SS	135/	23 cm	176						0 11 85 4	
17.0	End of Borehole													

+3, x5: Numbers refer to
Sensitivity

20.
15 5 (%) STRAIN AT FAILURE
10



SECTION
SCALE
4m 2 0 4m

SOIL STRATIGRAPHY LEGEND



SAND WITH GRAVEL
(FILL)



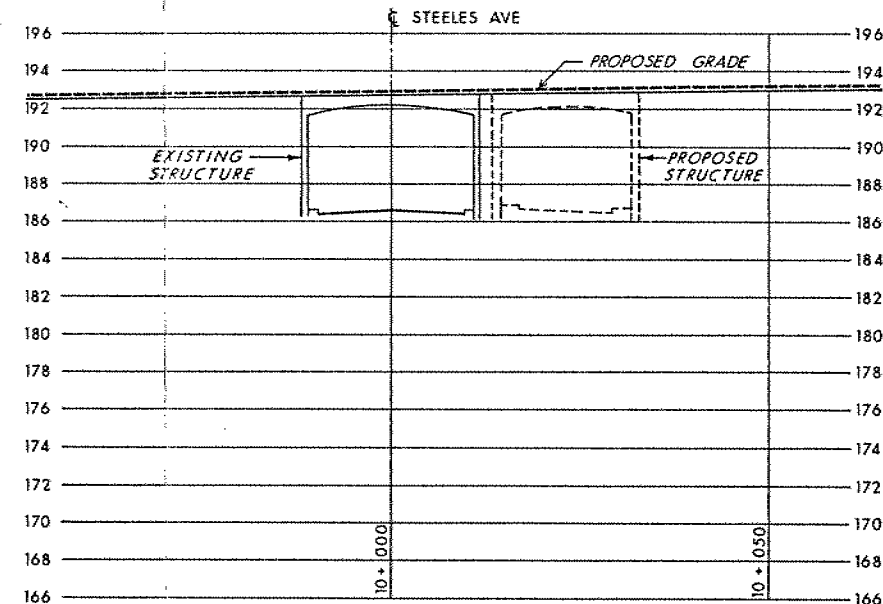
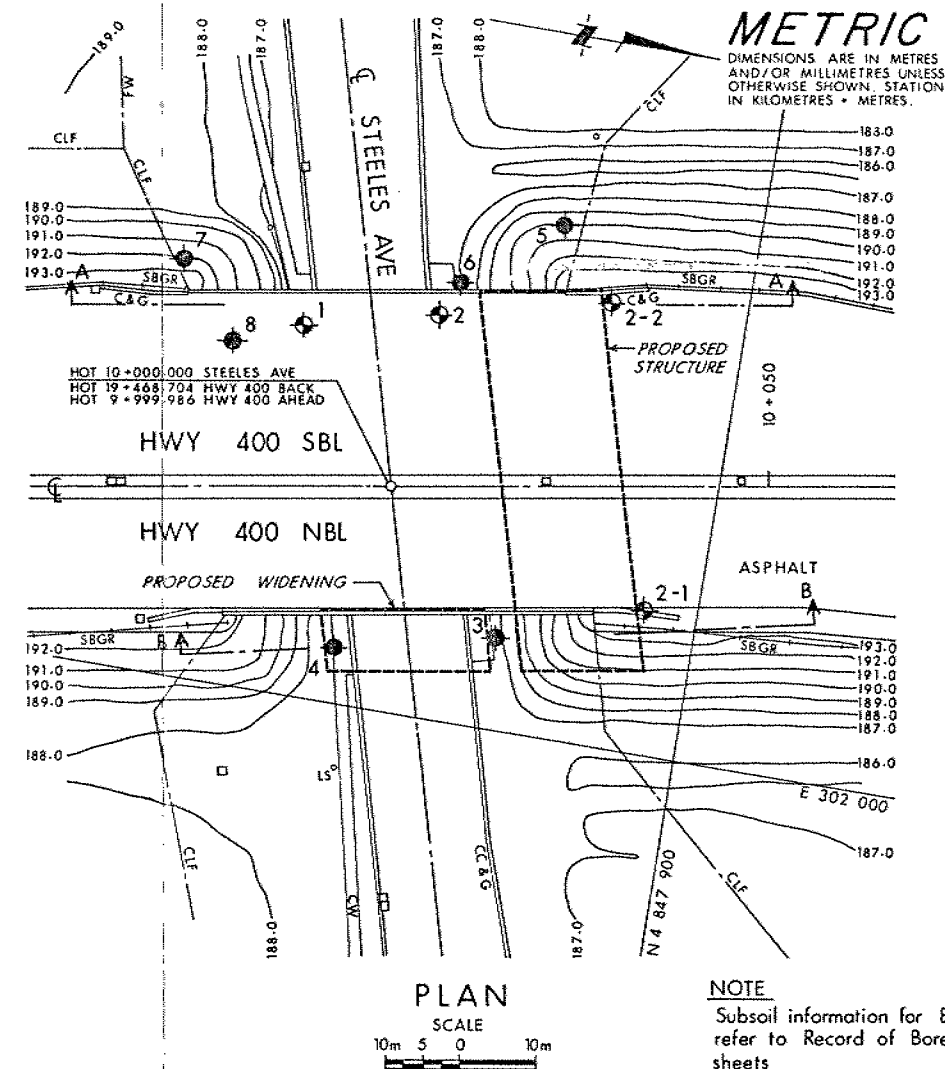
CLAYEY SILT TO SILT
TRACE TO WITH SAND
TRACE OF GRAVEL
OCC SILTY SAND LAYERS
Very Stiff to Hard
(GLACIAL TILL)



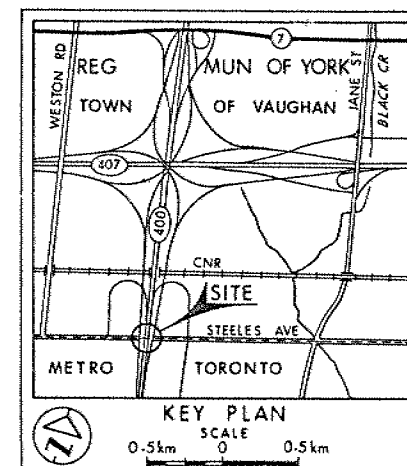
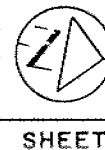
CLAYEY SILT
SOME TO WITH SAND
TRACE OF GRAVEL
Firm to Very Stiff
(FILL)



SILTY SAND TO SANDY SILT
WITH FINE GRAVEL
Very Dense



CONT No
WP No 138-87-03/05
HWY 400 OVER STEELES AVE
(BRIDGE - 2)
BORE HOLE LOCATIONS & SOIL STRATA



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
59 06, 81 02 and 87 12

No	ELEVATION	CO - ORDINATES NORTH	EAST
1	189.4	4 847 842.0	301 951.0
2	188.7	4 847 860.0	301 946.5
3	188.7	4 847 874.5	301 988.0
4	188.8	4 847 853.5	301 993.0
5	186.3	4 847 874.0	301 932.0
6	186.8	4 847 862.0	301 942.0
7	188.4	4 847 825.0	301 945.0
8	192.1	4 847 833.0	301 954.5
2-1	193.0	4 847 893.0	301 981.0
2-2	192.7	4 847 882.0	301 941.5

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.

REV.	DATE	BY	DESCRIPTION
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memorandum



To: Carl Wride
Project Supervisor

From: Foundation Design Section
Room 315, Central Building


Re: Contract 90-60
W.P. 138-87-03, Site 37-270 R
Steeles Ave. Overpass
Bridge #2
Hwy. 400, District 6, Toronto

Date: 1990 11 19

Further to our telephone conversation on Nov. 2/90, we recommend that you accept the BBR proposal of Oct. 22 & 23/90 to post grout soil anchors to achieve 350 psi. In our opinion, this approach was reasonable in order to ensure that the soil anchor did not fail and that there was no delay to construction caused by the soil anchor operation.

We also recommend that BBR's proposed charge of \$50 per bag for the post grouting operation (including materials and installation) is reasonable.

If there are any questions, please call.


D. Dundas, P. Eng.
Sr. Foundation Engineer

DD/jb

memorandum



To: Mr. B. Farago
Design Engineer
Structural Office
3501 Dufferin St.

Date: 1989 06 20

From: Foundation Design Section
Room 315, Central Building

RE: Final Drawing Review
Hwy. 400 Overpass Steeles Ave.
W.P. 138-87-03, Site 37-270R
Hwy. 400, District 6, Toronto

Further to your memo dated March 20, 1989, this letter summarizes our review on the submitted final drawings and provisions.

Based on the above review, it is concluded that the design confirms to our recommendations. However, it should be emphasized that care must be taken to avoid disturbing the existing foundation during excavation and installation of the temporary shoring system.

We have no further comments. If you have any questions, please contact us.


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

TCK/sp

memorandum

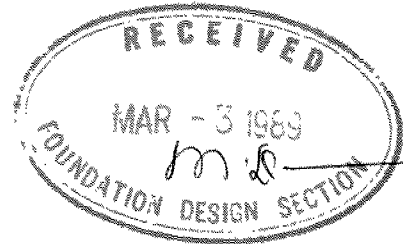


Tel: (416) 235-4959

To: M. Devata
Chief Foundation Engineer
Foundation Design Section


Date: 89 03 02

Re: W.P. 138-87-03, Site 37-270R
Highway 400 over Steeles Ave.
(Structure No. 2)



This is to confirm the contents of our telephone conversation concerning the foundation design of the above structure:

1. The foundation report warned that care must be taken to avoid undermining the existing foundation. It also noted that "if, during excavation, the material at the footing level adjacent to the existing foundation appears to be soft or disturbed, it should be carefully excavated and replaced with mass concrete."
2. Because the designer has no control over the precautions taken during construction, the Structural Office recommended to specify placing 150 mm mass concrete immediately following completion of excavation, similarly to what was done at the adjacent structure to the east. Foundation Section agreed with this suggestion.


B. Farago
Design Engineer
Structural Office

BF/sl

c.c. J. Lam
Gregg & Edens

memorandum



To: G.C.E. Burkhardt
Head, Structural Section
Central Region

Date: 1989 02 10

Atten: J. Lam, Sr. Structural Engineer

From: Foundation Design Section
Room 315, Central Building

RE: W.P. 138-87-00
Hwy. 400/407 Interchange
Review of Approach Drawings
Structures 1, 2, 3 and 13

The submitted construction drawings accompanying your memo dated 89 01 13 and designed by DS-Lea Associates, pertaining to the afore-mentioned structures have been reviewed by the undersigned and the general agreement configurations appear to be in agreement with our recommendations.

However, it should be noted that, as discussed in our previous comments on Drawing 37-1177-P1 (Structure #13, memo dated 1988 12 22), a 2.0 metre wide berm was recommended to the mid-height of the slope at the south approaches for Ramps 400N-407E and 400N-407W, since the approach fill height is about ± 9.5 metres. Based on our review, no safety berm was implemented on the submitted Drawing Sheet 12. As discussed, a more comprehensive review of the reinforced earth retaining walls associated with Structures #1 and #13 will be implemented when further details are submitted.

We have no further comments. If you have any questions, please contact us.

TCK/mmj

c.c. - K. Bassi

T.C. Kim
T.C. Kim, P. Eng.
Foundation Engineer

memorandum



To: B. Farago
Design Engineer
Structural Office
3501 Dufferin Street

Date: 1989 02 02

From: Foundation Design Section
Room 315, Central Building

RE: Highway 400 Over Steeles Avenue Bridge #2
W.P. 138-87-03, Site No. 37-270R
District 6, Toronto

Further to our meeting on January 11, 1989, concerning the proposed temporary shorings prepared by Gregg and Edens, this letter summarizes our recommendation on passive resistance figure.

Based on our review, it is recommended that the designer should use the coefficient of passive earth pressure, $K_p = 3$, for the proposed temporary bracing of footings.

We have no further comments. If you have any questions, please contact us.

Taecheul Kim
T.C. Kim, P. Eng.
Foundation Engineer

for

M. Devata, P. Eng.
Chief Foundation Engineer

TCK/mmj

3:20 pm Feb. 7. 1989.

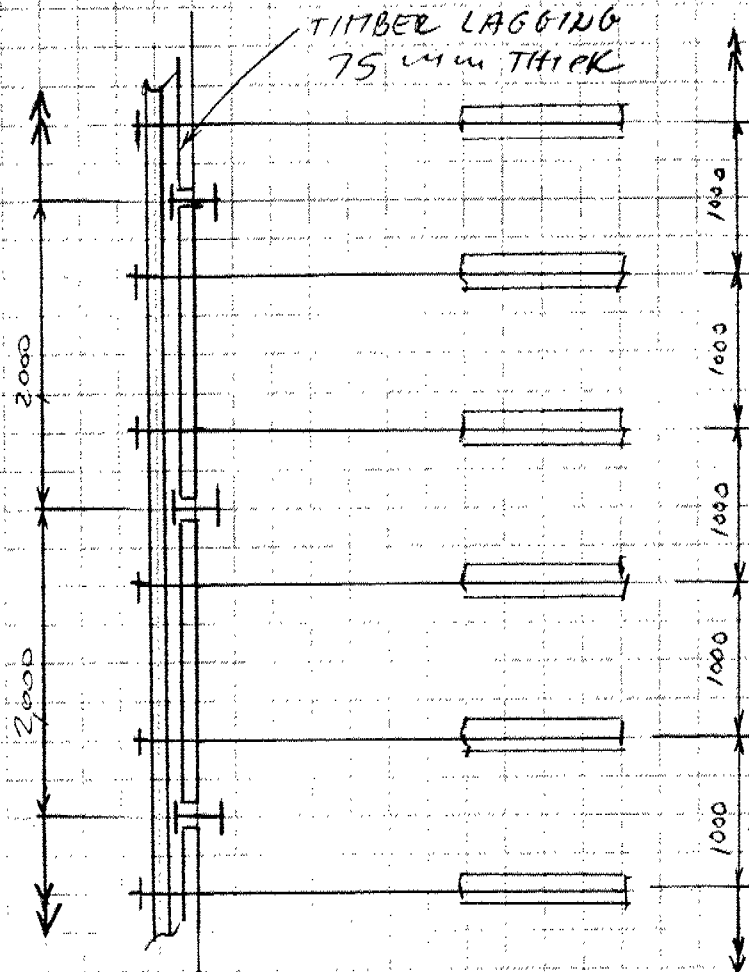
Best phoned: asked why some structure suggest
mass concrete for foundation excavation
and other do not.

Yes. that's true, since different structural
consultant design different bridges
at different time.



Project HWY 400/ STEELES
Item _____

TYPICAL SOLDIER PILE & SOIL ANCHOR LAY-OUT

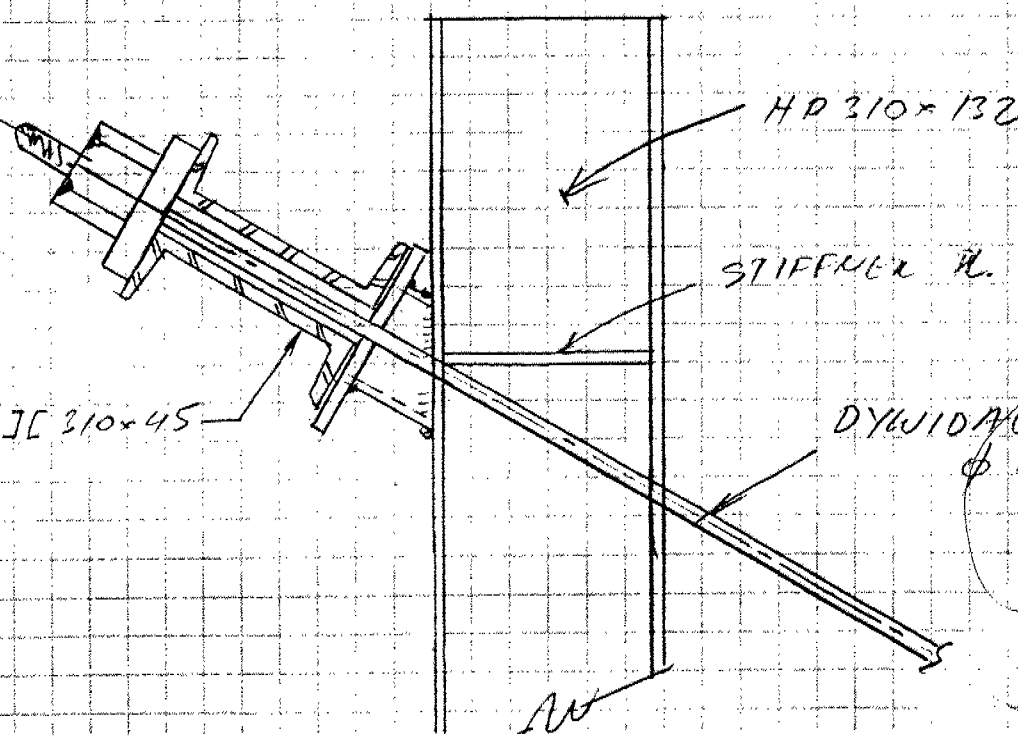


Meeting Jan 11, 1984
10:30 AM

370/m²
100-110/layer

1 1/2 m Borol length

Borol Length
water content
diameter?
depth
Borol.
one or two
Level of
miller?



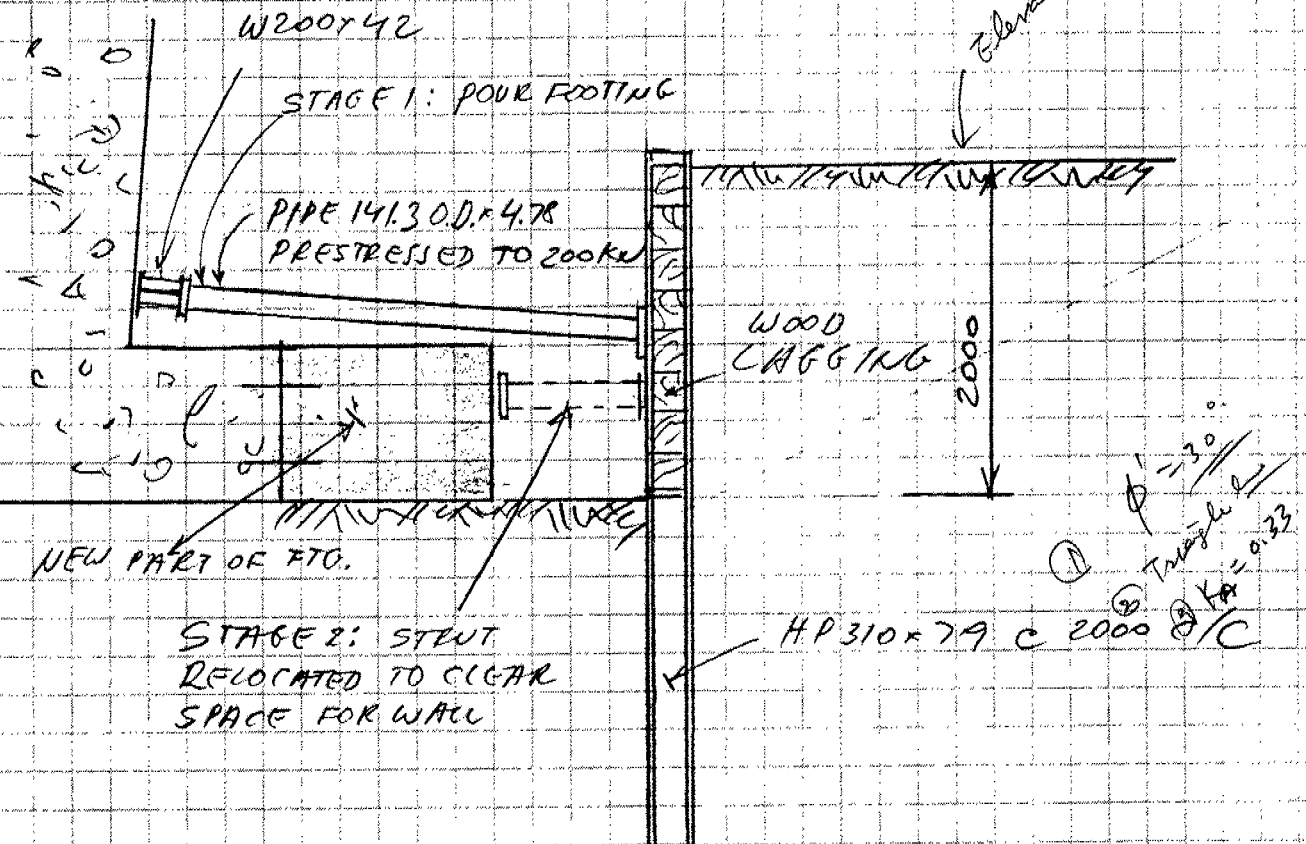
Salts and sand in case in

DYWIDAG SOIL ANCHOR
1 3/8 inch

Project Hwy 400/ STEELES AVE
Item _____

File 8715 Sheet No 8
Made by ED Date 22.12.88
Checked by _____ Date _____

EXISTING FRAME-BRACING OF FOOTING



101.6 OD PIPE : $G = 352 \text{ kN} > 2 \times (123 + 135) = 273 \text{ kN}$
 $\times 3.95$ $3m$

14.13 OD + 4.78 : $G = 462 \text{ KN}$
3cm

HORIZONTAL FRAME RETENTION:

DL CONCRETE	123.0	KN
DL ASPHALT	13.5	KN

$$H = 136.5 \text{ KN/m}$$

memorandum



To: Mr. B. Farago
Design Engineer
Structural Office

Date: 1988 07 07

From: Foundation Design Section
Room 315, Central Building

RE: W.P. 138-87-03
General Arrangement - Staging Drawing Review
Highway 400 over Steeles Ave.

As requested, General Arrangement and Staging drawings 37-270R-P1 and P2 for the above project have been reviewed by this office. The proposed footings and temporary shoring locations are in agreement with provided recommendations and consequently there are no further comments at this time.

A handwritten signature in cursive script, appearing to read 'T. Sangiuliano'.

T. Sangiuliano, P. Eng.
Foundations Engineer

TS/mj

Record of Meeting at the Foundation Section
on Friday, June 10, 1988

Present: ✓ M. Devata, Chief Foundation Engineer (East)
T.C. Kim, Project Foundation Engineer
B. Farago, Design Engineer, Structural Office

Re: Highway 400 over Steeles Avenue
W.P. 138-87-03805, Site 37-270-R

Plans prepared by Gregg and Edens were reviewed concerning the protection of the existing rigid frame from high stresses caused by unbalanced earth pressure.

1) Soil anchors installed at footing level:

Installation of soil anchors would be very difficult in the very hard, bouldery till material.

It appears more practicable to install soldier piles in predrilled holes, to resist horizontal movement of footings. This may be combined with a strutted excavation for the new footings.

The cost of soldier piles is expected to be less than that of the soil anchors.

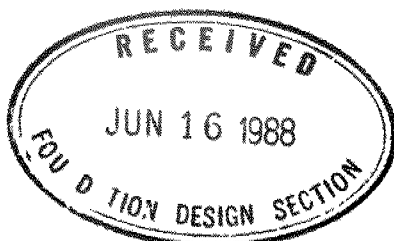
2) Soil anchors installed at deck level.

The soil anchors should be directed towards the original ground and not towards the fill. The angle between the anchor and the vertical plane should be 30° to 45°.

It will be difficult to install the soil anchors for the following reason:

- a) The fill material is very hard ($n > 100$) with boulders. Drilling of the hole will be difficult to accomplish.
- b) The rigid frame has size 11 corner bars at 6" centers, Coring through the concrete will destroy some of these bars.

It might be less expensive to remove the approach slab and to excavate out and store part of the backfill behind the abutment, using roadway protection along the centreline. Backfilling and construction of new approach slabs can be accomplished by filling in stages along both sides of the reconstructed structure.



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Whether to use soil anchors, or remove the approach slab
and excavate the fill out should be based on cost.

A handwritten signature, possibly reading 'BF', in dark ink.

BF/sl
June 14, 1988

c.c. K. Bassi
G. Burkhardt/all present

memorandum



To: G.C.E. Burkhardt
Head, Structural Section
5000 Yonge Street

Date: 1988 02 15

Atten: J.K. Lam, Sr. Structural Engineer

From: Foundation Design Section
Room 315, Central Building

RE: Foundation Investigation for
Hwy. 400 over Steeles Avenue
Structure #2
W.P. 138-87-03 & 05
District 6, Toronto

We have recently completed the fieldwork for the above-mentioned project. Due to the urgency of the project and as requested by you, we are providing for your information and use a summary of subsurface conditions together with complete foundation recommendations for the design and construction of the project. This will enable you to complete your design work without further delay. The complete foundation investigation and design report will be forwarded to you at a later date. However, if additional information is required, please contact this office immediately.

Site Description

The site is located on Hwy. 400 where it crosses the existing Steeles Avenue. Steeles Avenue and Hwy. 400 have elevations 186.5 and 193.0 m respectively in the site vicinity. The existing structure (#2) is a 21.3 x 43.5 metre single span rigid frame bridge constructed with earth embankments approximately 6.5 metres in height. Topography is moderately level ground. Land use is mainly industrial.

Subsurface Conditions

The subsoil conditions encountered across the site were very uniform in nature. Two distinct subsoil layers were identified in the field investigations. The first layer consists of a clayey silt to silt with sand and a trace of gravel which extends down to the elevations between 179.2 m at B.H. #3 and 182.4 m at B.H. #7 as shown on the sections attached. The thickness of this layer varies between 4.6 m at B.H. #2-2 location and 7.8 m at B.H. #3 location. Underneath this clayey silt to silt, very dense silty sand to sandy silt with the occasional sand layers is present. Approximately 11.5 metres of this very dense material was proven. These deposits are of glacial origin. The embankments of the existing structure are composed of approximately 6.5 metres of sand and clayey silt fill materials.

Groundwater level in the borings was found to range between elevation 180.5 at B.H. #2-2 and elevation 183.3 at B.H. #2-1 about 5.6 metres below the original ground surface.

.....2

Recommendations

The existing structure is a 21.3 metre single span rigid frame over Steeles Avenue. This structure was widened about 8.75 metres westly from the original width of 34.7 metres to the existing width of 43.5 metres during the 1984 construction season.

It is proposed to widen the east side of the existing structure about 8.4 metres from the existing edge of the deck. In addition, it is also proposed to construct a new 16.7 metre rigid frame structure about 3.7 m north of and parallel to the existing structure.

The existing structure is founded on spread footings approximately 1.0 metre thick. The base of the footings are located at elevation 184.9 m. There is approximately 1.2 metres of soil cover over the top of the footings.

Retaining walls, founded on stepped spread footings, are also present on the existing structure. Three steps are present on each footing, have base elevations of 185.2, 186.1 and 187.1 metres respectively. Similar retaining walls will be required for the widened and new structures.

1. Abutment Foundations

The proposed widened portion of the structure and new rigid frame structure may be supported on spread footings in a manner similar to the existing structure. The following recommendations should be taken into consideration during construction:

- footings should be at the existing foundation level (184.9 metres)
- during excavation, care must be taken to avoid undermining the existing foundation
- if, during excavation, the material at the footing level adjacent to the existing foundation appears to be soft and disturbed, it should be excavated and replaced with mass concrete
- 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:

Factored Bearing Capacity at U.L.S.:	600 kPa
Bearing Capacity at S.L.S. Type II:	400 kPa

2. Retaining Wall Foundations

The retaining walls for the widened and new structures should be founded on spread footings constructed within the very stiff to hard clayey silt deposit at or below the elevation of 186.0 m. Normal construction joints with dowels should be used to fasten together the footings. A minimum of 1.2 metres of soil should be placed over the footings to serve as frost protection.

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

Factored Bearing Capacity at U.L.S.:	375 kPa
Bearing Capacity at S.L.S. Type II:	250 kPa

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

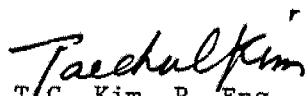
Granular 'A'	=	22.8 kN/m ³	$\phi = 35^\circ$	$K_A = 0.27$
Granular 'B'	=	21.2 kN/m ³	$\phi = 30^\circ$	$K_A = 0.33$

Lateral pressures should be computed in accordance with Section 6.6.1.2.1 of the code. A yielding foundation condition may be assumed. Sliding resistance may be computed by assuming an adhesion of 75 kPa to apply between the underside of footings and the soil.

Since the water level is approximately 1.5 metres below the proposed foundation level and the foundation soil is of low permeability, dewatering problems are not anticipated. If surface water does accumulate in the excavation, it should be removed by means of a sump pump.

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

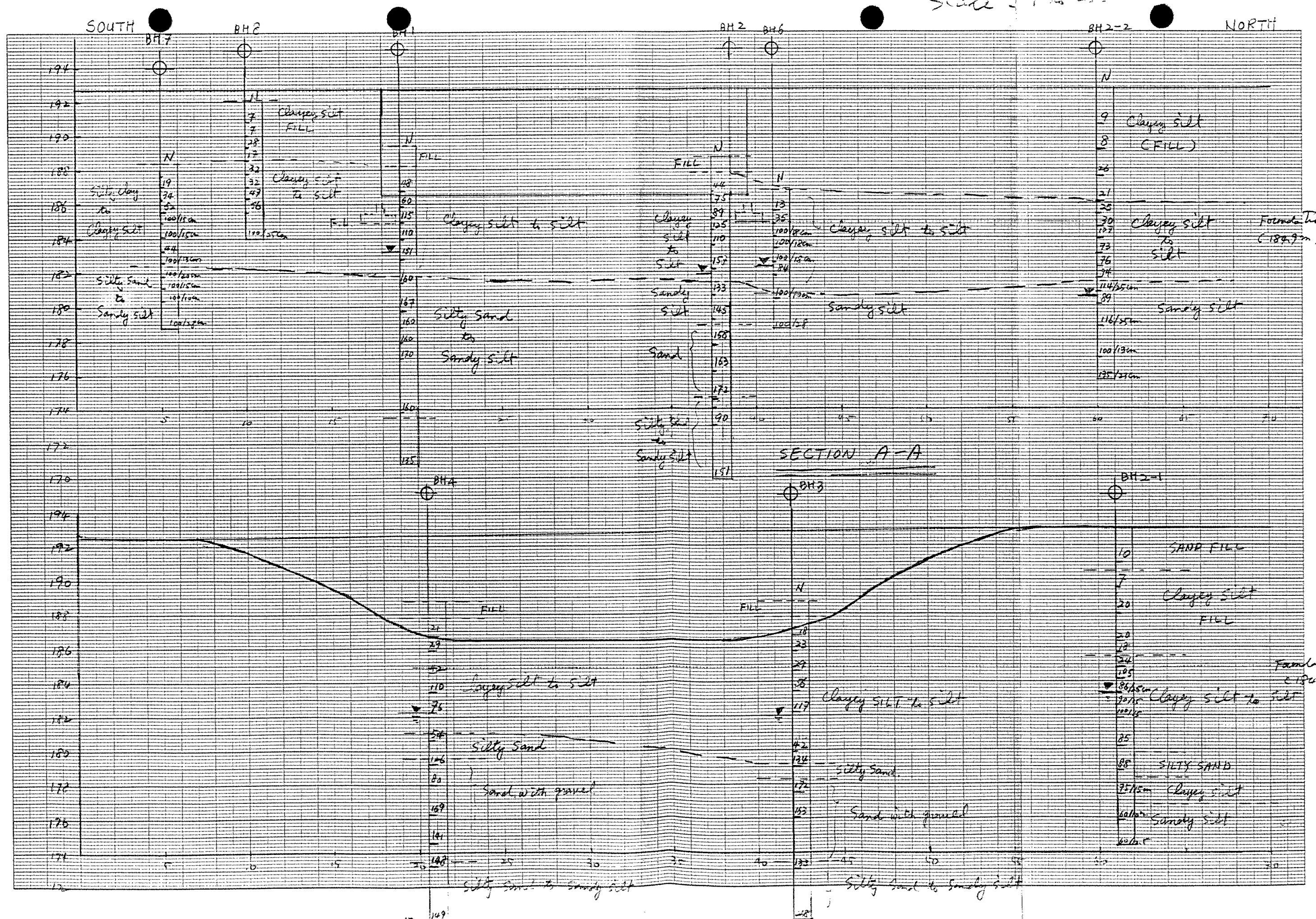
We believe that this memorandum meets with your present requirements. If you have any questions, please contact us.


T.C. Kim, P. Eng.
Project Foundation Engineer
for
M. Devata, P. Eng.
Chief Foundations Engineer
(East)

TK/mmj

c.c. - T. Miles (D.S. Lea)
J. Klowak
B. Lankinen

Scale 1" = 10'



10 X 10 TO THE CENTIMETER 25 X 30 CM.
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