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W. O. No.

STR. SITE No. 37-270

HWY. No. 400

LOCATION Tonawha

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OVERSIZE DRAWINGS TO BE INCLUDED WITH THIS REPORT.

REMARKS:

FOUNDATION INVESTIGATION REPORT

CONTRACT NO 84-33



Ontario

Ministry of
Transportation and
Communications

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NOTE: For purposes of the contract, this report supercedes all other foundation reports prepared by or for the Ministry in connection with the above mentioned project.

EXPLANATION OF TERMS USED IN REPORT

2

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'_{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 = $\frac{c_u}{\tau_r}$

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						

FOUNDATION INVESTIGATION REPORT

For

Steeles Avenue Overpass Widening
W.P. 164-79-02, Site 37-270
Hwy. 400, District 6, Toronto

INTRODUCTION

This report contains the results of foundation investigations carried out at the above site during the periods of June 11 to June 20, 1959 and February 10 to February 11, 1981.

Four boreholes were drilled and sampled in June of 1959 as part of the foundation investigation prior to the construction of the existing 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 two of these boreholes (boreholes 1 and 2) are utilized in this report.

An additional four boreholes were advanced and sampled in February of 1981 by means of a continuous flight auger machine equipped with solid and hollow stem augers. These boreholes extended to depths between 8.1 and 9.6 metres below the ground surface.

SITE DESCRIPTION AND GEOLOGY

The site is located on moderately level ground. Steeles Avenue and Hwy. 400 have elevations 186.5 and 193.1 respectively in the site vicinity. The existing structure is a 21.3 x 34.7 metre single span bridge constructed with earth embankments approximately 4.6 metres in height. Both the structure and its approaches show no visual signs of distress.

The site lies on the physiographic region known as the Peel Plain. 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 dense silty sand to sandy silt.

SUBSOIL CONDITIONS

The subsoil conditions encountered across the site were very uniform in nature. Two distinct subsoil layers were identified in the field investigation.

The first layer consists of a silty clay with some sand and a trace of gravel which extends from the existing ground surface to depths between 6.1 and 6.2 metres. Underneath this silty clay, very dense silty sand to sandy silt is present. Approximately 11 metres of this very dense material was proven.

The embankments of the existing structure are composed of approximately 4.6 metres of silty clay fill material.

More detailed descriptions of the two distinct subsoil layers and the embankment fill material will now be presented.

(1) . Silty Clay

A layer of silty clay with some sand and a trace of gravel extends from the existing ground surface to depths between 6.1 and 6.2 metres. On the south side of Steeles Avenue all of the material was determined to have a brownish colour. On the north side the material changes in colour from brown to grey at approximately elevation 184.0.

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

<u>Properties</u>	<u>Range</u>	<u>Average</u>
Natural Moisture Content (W)%	9-19.5	10.9
Liquid Limit (W _L)%	15.5-31	20.5
Plastic Limit (W _p)%	10-13.5	11.4
Plasticity Index (I _p)%	4-17.5	9.1

The Atterberg Limit Test results are illustrated on the Plasticity Chart (see Figure 1). From the chart it is evident that the layer can be classified as an inorganic silty clay of low plasticity (CL). Standard Penetration Test 'N' values between 13 and 100 indicate 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 silty clay 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.

Laboratory grain size analysis indicates that the soil varies between a silty sand and a sandy silt. Traces of clay and gravel are also present. A grain size distribution curve for this particular soil is presented in Figure 2.

'N' values obtained from the Standard Penetration Tests were greater than 100 for all samples in this layer. This indicates that the soil can be interpreted as being very dense.

(3) Embankment Fill Material

The soil used in the embankment fills consists of a brown silty clay with some sand and traces of gravel. Atterberg Limit Tests indicate that the soil can be classified as a silty clay of low plasticity (CL) (see Figure 1). The test results are summarized below:

<u>Properties</u>		<u>Range</u>	<u>Average</u>
Natural Moisture Content (W)%		11.5-14.5	12.6
Liquid Limit	(W _L)%	20.0-28.0	24.0
Plastic Limit	(W _p)%	10.5-13.0	11.8
Plasticity Index	(I _p)%	9.5-15.0	12.3

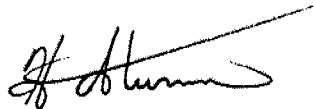
From the test results and through visual observation, it is apparent that the embankment fill material is similar to the layer of silty clay immediately below the existing ground surface. It is therefore likely that the fill material came from the immediate vicinity. Standard Penetration Test 'N' values between 7 and 28 indicate that the soil can be interpreted as being firm to very stiff.

The results of all field and laboratory testing, along with a summary of the subsoils encountered in each borehole are shown on the Record of Borehole sheets. A stratigraphical profile is shown on Drawing #2. Also shown on this drawing is a

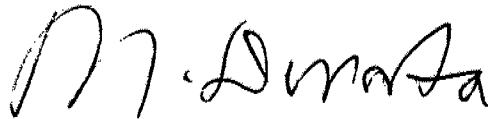
generalized plan of the site area showing the locations of the boreholes with respect to the widened structure.

GROUNDWATER CONDITIONS

Groundwater conditions were observed through the measurements of water levels in the open boreholes. Through this procedure the groundwater level was determined to occur at elevation 182.3 metres (approximately 4.5 to 6.1 metres below the existing ground surface).



H. STURM,
Project Foundations Engineer



M. DEVATA, P.Eng.,
Senior Foundations Engineer

APPENDIX

W P 164-79-02 LOCATION Coordinates N 4, 847, 842.0 E 301, 951.0 ORIGINATED BY M.D.
DIST 6 HWY 400 BOREHOLE TYPE Washbore COMPILED BY _____
DATUM Geodetic DATE 1959 06 11 CHECKED BY _____

[illegible]

OFFICE REPORT ON SOIL EXPLORATION

RECORD OF BOREHOLE No 2

9

W P 164-79-02 LOCATION Coordinates: N 4, 847, 860.0 E 301, 946.5 ORIGINATED BY M.D.
DIST 6 HWY 400 BOREHOLE TYPE Washbore COMPILED BY A.L.
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							SHEAR STRENGTH ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE	WATER CONTENT (%) 10 20 30
188.7	Ground Level															
0.0	Fill Material Brown Silty Clay of Low Plasticity Some to Trace of Sand Trace of Gravel Occasional Sandy Silt Layers Hard						188						23.8			
187.8																
0.9			1	SS	44											
			2	SS	75											
			3	SS	89											
			4	SS	125											
	5	SS	110										24.0			
	6	SS	157										25.0			
181.4	7	SS	133										23.5			
7.3	8	SS	145													
178.9	9	SS	158													
9.8	10	SS	163													
174.7	11	SS	172													
14.0	12	SS	90													
169.9	13	SS	151													
18.8	End of Borehole															

OFFICE REPORT ON SOIL EXPLORATION

RECORD OF BOREHOLE No 5

10

W P 164-79-02 LOCATION Coordinates: N 4, 847, 874.0 E 301, 932.0 ORIGINATED BY K.M.
 DIST 6 HWY 400 BOREHOLE TYPE Hollow Stem Augers COMPILED BY K.M.
 DATUM Geodetic DATE 81 02 10 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	'IN' VALUES			20	40	60	80	100					
186.3	Ground Level																GR SA SI CL
0.0	Silty Clay of Low Plasticity Some to Trace of Sand Trace of Gravel Hard		1	SS	70		186										
			2	SS	100/	28 cm											
			3	SS	100/	20 cm	184										
			4	SS	49												
			5	SS	97		182										
			6	SS	59												
180.1	Sandy Silt Very Dense Grey		7	SS	100/	20 cm	180										
6.2			8	SS	100/	20 cm											2 40 50 8
178.2	End of Borehole						178										
8.1																	

OFFICE REPORT ON SOIL EXPLORATION



11

W P 164-79-02 LOCATION Coordinates: N 4, 847, 862.0, E 301, 942.0 ORIGINATED BY K.M.
DIST 6 HWY 400 BOREHOLE TYPE Solid Stem Augers COMPILED BY _____
DATUM Geodetic DATE 81-02-10 CHECKED BY _____

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT	PLASTIC LIMIT	NATURAL MOISTURE CONTENT	LIQUID LIMIT	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20 40 60 80 100	W _p	W	W _L			
								SHEAR STRENGTH		WATER CONTENT (%)				
							○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE							
186.8	Ground Level													
0.0	Silty Clay of Low Plasticity Some to Trace of Sand Trace of Gravel Brown Grey Very Stiff to Hard		1	SS	13		186							
			2	SS	35									
			3	SS	100/	18 cm		184						
			4	SS	100/	18 cm								
			5	SS	100/	18 cm								
			6	SS	84			182						
180.7	Sandy Silt Trace of Gravel Very Dense Grey		7	SS	100/	10 cm	180							
6.1			8	SS	100/	28 cm								
178.7	End of Borehole						178						1 29 65 5	

+3, x5: Numbers refer to Sensitivity

20
15 ϕ 5 (%) STRAIN AT FAILURE
10

MINIMUM PAYE TIME IN MONTHS BEFORE OFFICE



RECORD OF BOREHOLE No 7

12

W P 164-79-02 LOCATION Coordinates: N 4, 847, 825.0 E 301, 945.0 ORIGINATED BY K.M.
DIST 6 HWY 400 BOREHOLE TYPE Solid Stem Augers COMPILED BY _____
DATUM Geodetic DATE 81-02-10/11 CHECKED BY _____

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT	NATURAL MOISTURE CONTENT	LIQUID LIMIT	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL	
ELEV DEPTH	DESCRIPTION	STRAT	PLOT	NUMBER	TYPE			'N' VALUES	20 40 60 80 100		W _p	W			W _L
									SHEAR STRENGTH						
								○ UNCONFINED	+ FIELD VANE						
								● QUICK TRIAXIAL	× LAB VANE						
188.4	Ground Level														
0.0	Silty Clay of Low Plasticity With Sand & Gravel Very Stiff to Hard Brown			1	SS	19									
				2	SS	34									
				3	SS	52									
				4	SS	100/	15 cm								
				5	SS	100/	25 cm								
				6	SS	44									
				7	SS	100/	13 cm								
182.4	Sandy Silt to Silty Sand Very Dense Brown - Grey			8	SS	100/	20 cm							1 60 36 3	
6.1				9	SS	100/	15 cm							2 35 59 4	
				10	SS	100/	10 cm							1 43 52 5	
178.8				11	SS	100/	28 cm							9 35 56 0	
9.6	End of Borehole														

OFFICE REPORT ON SOIL LABORATORY

+³, x⁵: Numbers refer to
Sensitivity

20
15 5 (%) STRAIN AT FAILURE
10

RECORD OF BOREHOLE No 8

13

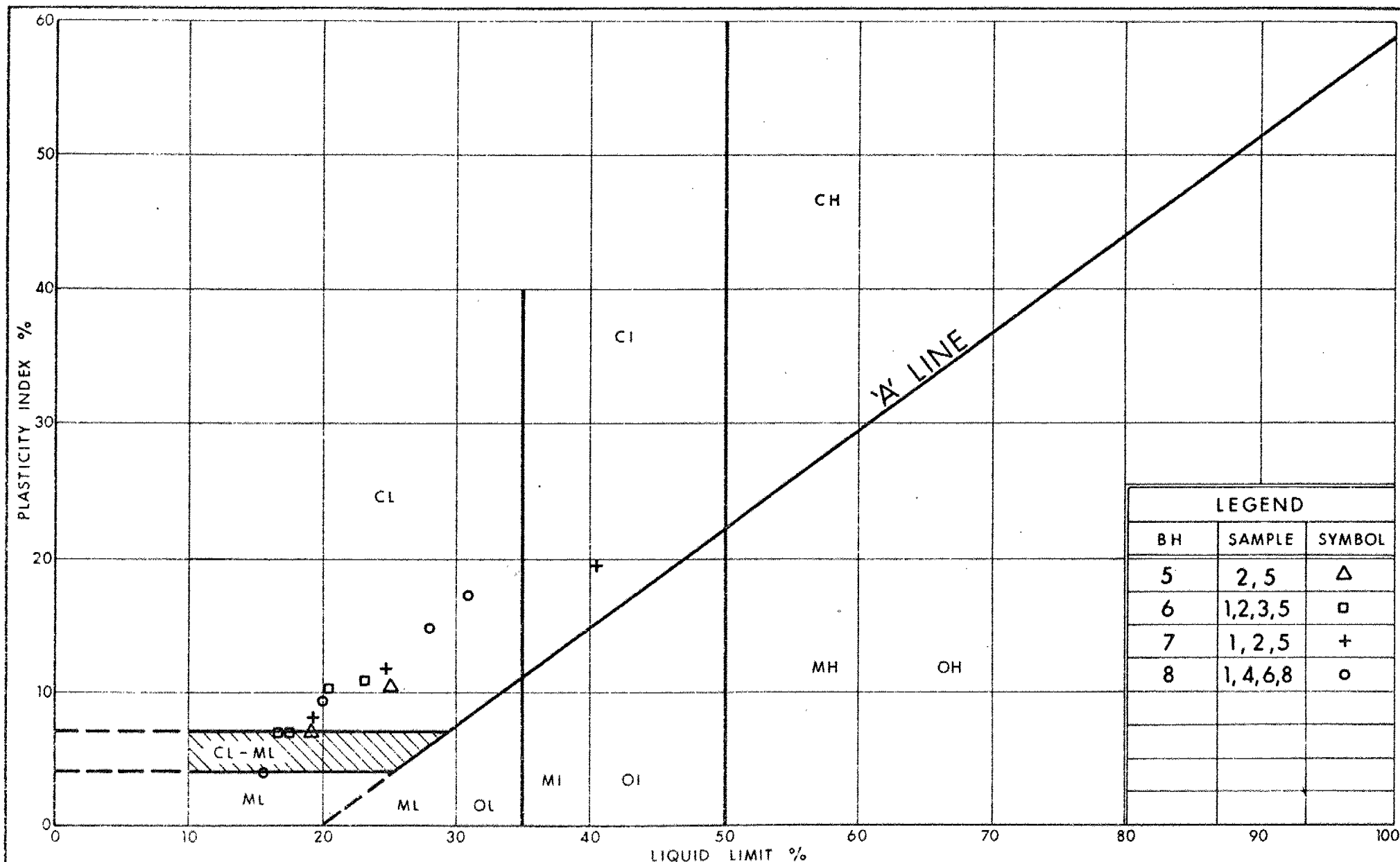
W P 164-79-02 LOCATION Coordinates: N 4, 847, 833.0 E 301, 954.5 ORIGINATED BY K.M.
 DIST 6 HWY 400 BOREHOLE TYPE Solid Stem Augers COMPILED BY K.M.
 DATUM Geodetic DATE 81-02-11 CHECKED BY _____

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					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		
192.1	Ground Level													
0.0	(Fill) Brown		1	SS	7		192							
	Silty Clay, Some Sand		2	SS	7									
	Trace of Gravel		3	SS	28		190							
	Firm to Very Stiff		4	SS	17									
188.6			5	SS	32									
3.5			6	SS	32		188							
	Silty Clay		7	SS	47									
	Low Plasticity		8	SS	56		186							
	Some Sand													
	Hard													
184.0	Brown		9	SS	100/	25 cm	184							
8.1	End of Borehole													

OFFICE REPORT ON SOIL EXPLORATION

+3, x^s: Numbers refer to
Sensitivity

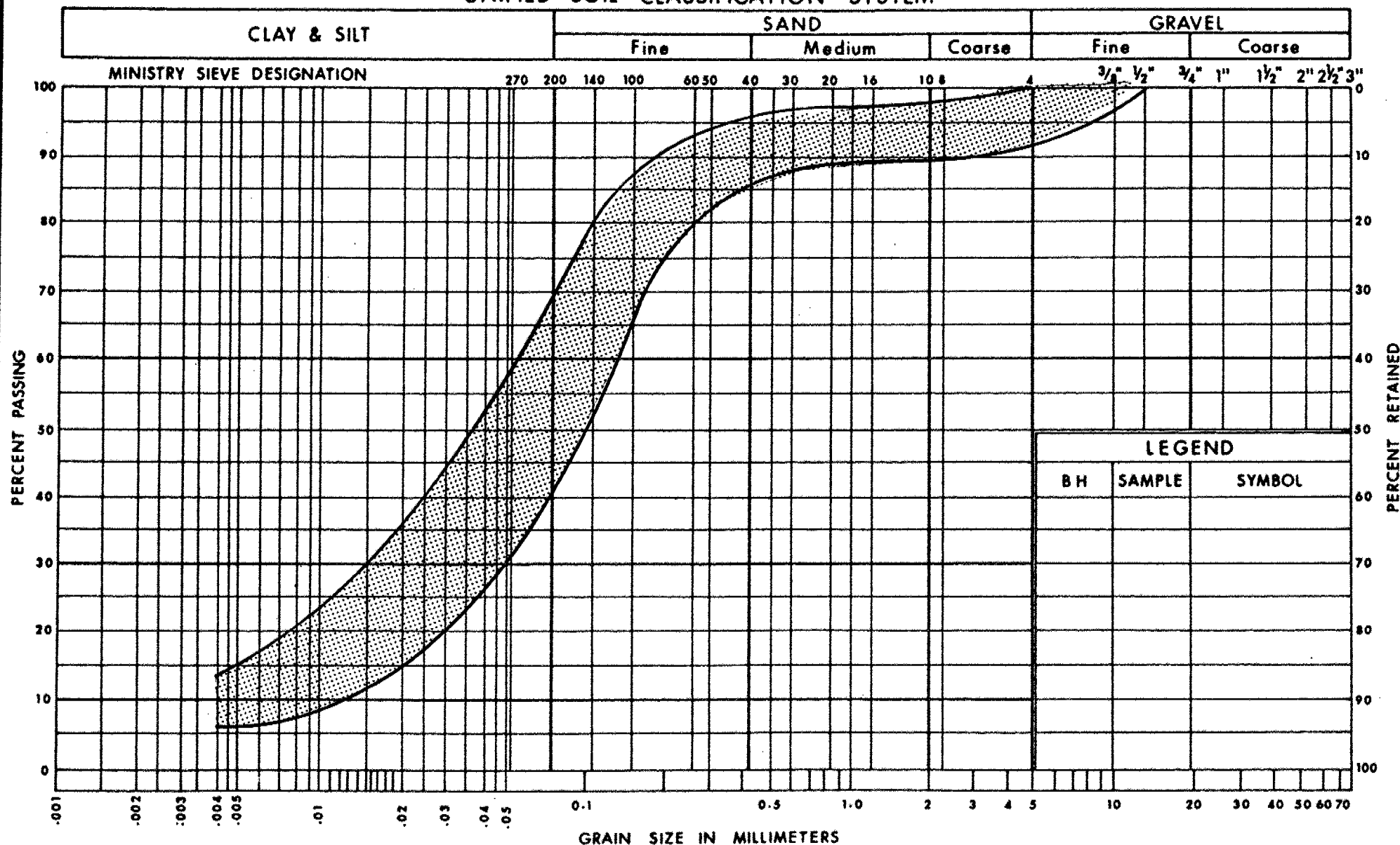
20
15 5 (%) STRAIN AT FAILURE
10



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PLASTICITY CHART SILTY CLAY WITH SOME SAND TRACE OF GRAVEL

FIG No 1
W P 164-79-02



Ontario

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GRAIN SIZE DISTRIBUTION SILTY SAND TO SANDY SILT

FIG No 2

W P 164-79-02



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foundation investigation and design report

ENGINEERING MATERIALS OFFICE
PAVEMENT & FOUNDATION DESIGN SECTION

WP 164-79-02

DIST 6

HWY 400

STR SITE 37-270

Steeles Avenue Overpass Widening

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FOUNDATION INVESTIGATION REPORT

For

Steeles Avenue Overpass Widening
W.P. 164-79-02, Site 37-270
Hwy. 400, District 6, Toronto

INTRODUCTION

This report contains the results of foundation investigations carried out at the above site during the periods of June 11 to June 20, 1959 and February 10 to February 11, 1981.

Four boreholes were drilled and sampled in June of 1959 as part of the foundation investigation prior to the construction of the existing 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 two of these boreholes (boreholes 1 and 2) are utilized in this report.

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SITE DESCRIPTION AND GEOLOGY

The site is located on moderately level ground. Steeles Avenue and Hwy. 400 have elevations 186.5 and 193.1 respectively in the site vicinity. The existing structure is a 21.3 x 34.7 metre single span bridge constructed with earth embankments approximately 4.6 metres in height. Both the structure and its approaches show no visual signs of distress.

The site lies on the physiographic region known as the Peel Plain. 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 dense silty sand to sandy silt.

SUBSOIL CONDITIONS

The subsoil conditions encountered across the site were very uniform in nature. Two distinct subsoil layers were identified in the field investigation.

The first layer consists of a silty clay with some sand and a trace of gravel which extends from the existing ground surface to depths between 6.1 and 6.2 metres. Underneath this silty clay, very dense silty sand to sandy silt is present. Approximately 11 metres of this very dense material was proven.

The embankments of the existing structure are composed of approximately 4.6 metres of silty clay fill material.

More detailed descriptions of the two distinct subsoil layers and the embankment fill material will now be presented.

(1) Silty Clay

A layer of silty clay with some sand and a trace of gravel extends from the existing ground surface to depths between 6.1 and 6.2 metres. On the south side of Steeles Avenue all of the material was determined to have a brownish colour. On the north side the material changes in colour from brown to grey at approximately elevation 184.0. *on the north side of Steeles Ave. and about 179 South side of St. Reginald.*

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

<u>Properties</u>	<u>Range</u>	<u>Average</u>
Natural Moisture Content (W)%	8.5-19.5 ^{22.5}	10.9
Liquid Limit (W _L)%	15.5-31.4 ⁹	20.5
Plastic Limit (W _p)%	10-13.5 ^{17.0}	11.4
Plasticity Index (I _p)%	4-17.5 ³⁰	9.1

The Atterberg Limit Test results are illustrated on the Plasticity Chart (see Figure 1). From the chart it is evident that the layer can be classified as an inorganic silty clay of low plasticity (CL). Standard Penetration Test 'N' values between 13 and 100 indicate 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 silty clay 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.

Laboratory grain size analysis indicates that the soil varies between a silty sand and a sandy silt. Traces of clay and gravel are also present. A grain size distribution curve for this particular soil is presented in Figure 2.

'N' values obtained from the Standard Penetration Tests were greater than 100 for all samples in this layer. This indicates that the soil can be interpreted as being very dense.

(3) Embankment Fill Material

The soil used in the embankment fills consists of a brown silty clay with some sand and traces of gravel. Atterberg Limit Tests indicate that the soil can be classified as a silty clay of low plasticity (CL) (see Figure 1). The test results are summarized below:

<u>Properties</u>	<u>Range</u>	<u>Average</u>
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Liquid Limit (W _L)%	20.0-28.0	24.0
Plastic Limit (W _p)%	10.5-13.0	11.8
Plasticity Index (I _p)%	9.5-15.0	12.3

From the test results and through visual observation, it is apparent that the embankment fill material is similar to the layer of silty clay 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 soil can be interpreted as being firm to very stiff.

The results of all field and laboratory testing, along with a summary of the subsoils encountered in each borehole are shown on the Record of Borehole sheets (see Appendix 1). A stratigraphical profile is shown on Drawing #1647902-A. Also shown on this drawing is a

generalized plan of the site area showing the locations of the boreholes with respect to the widened structure.

GROUNDWATER CONDITIONS

Groundwater conditions were observed through the measurements of water levels in the open boreholes. Through this procedure the groundwater level was determined to occur at elevation 182.3 metres (approximately 4.5 to 6.1 metres below the existing ground surface).

DISCUSSION AND RECOMMENDATIONS

$$21.3 + 8.75 = 30.05 \text{ m}$$

The existing structure is a 21.3 metre single span rigid frame. It is proposed to widen the west side of the structure 8.75 metres from the existing edge of the deck.

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

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

(1) Abutment Foundations

The proposed widened portion of the structure should 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 placed at the existing foundation level (184.9 metres).
- 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.
- during excavation, care must be taken to avoid undermining the existing foundation.
- normal construction joints with dowels should be used to attach the widened foundation to the existing foundation.
- the bases of all excavated surfaces should be covered immediately with a slab of lean mass concrete to prevent softening of the soil due to water accumulation.
- a minimum of 1.2 metres of soil should be placed over the footing to serve as frost protection.

If these recommendations are followed, the abutment foundations can be designed for a bearing capacity at the serviceability limit state (Type II) equal to 400 kPa and a factored bearing capacity at the ultimate limit state equal to 600 kPa.

(2) Retaining Wall Foundations

The retaining walls for the widened structure should be founded on stepped spread footings in a manner similar to the existing structure. The following recommendations should be taken into consideration during construction:

- stepped footings should be founded at the same elevations corresponding to the stepped footings supporting the existing retaining wall (i.e. 185.2, 186.1 and 187.1 metres).
- the material around the footings to be founded at 186.1 and 187.1 metres on the north side of Steeles Avenue and the material around the footing to be founded at 187.1 metres on the south side of Steeles Avenue should be excavated to elevation 185.2 metres and replaced with compacted granular 'A' as specified in Figure 3.
- normal construction joints with dowels should be used to fasten together the stepped footings.
- the bases of excavated surfaces should be covered with a slab of lean mass concrete to prevent softening of the soil due to water accumulation.
- a minimum of 1.2 metres of soil should be placed over the footings to serve as frost protection.

If these recommendations are followed, the retaining wall foundations can be designed for a bearing capacity at the serviceability limit state (Type II) equal to 250 kPa and a factored bearing capacity at the ultimate limit state equal to 375 kPa.

(3) Other Construction Considerations

Since the water level is approximately 2.5 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.

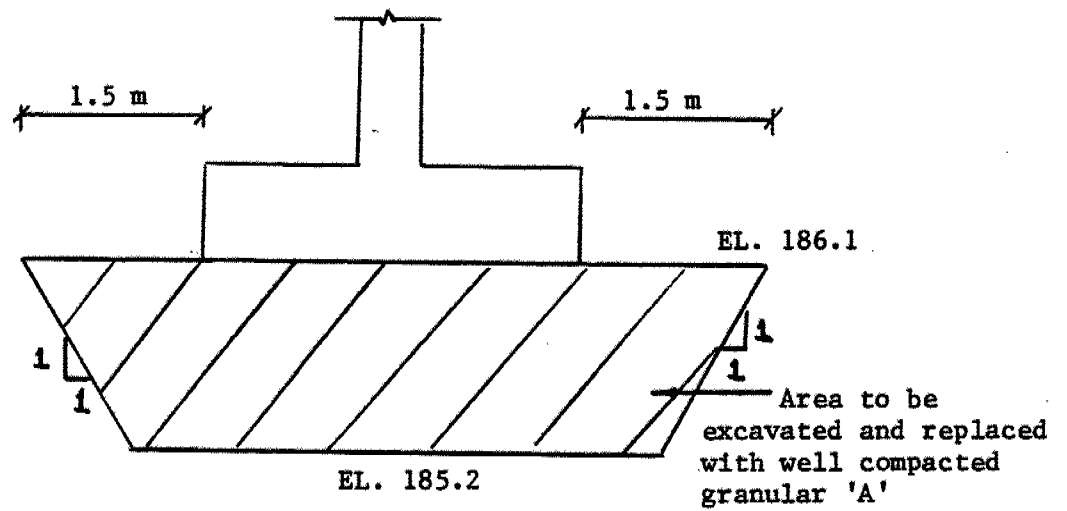
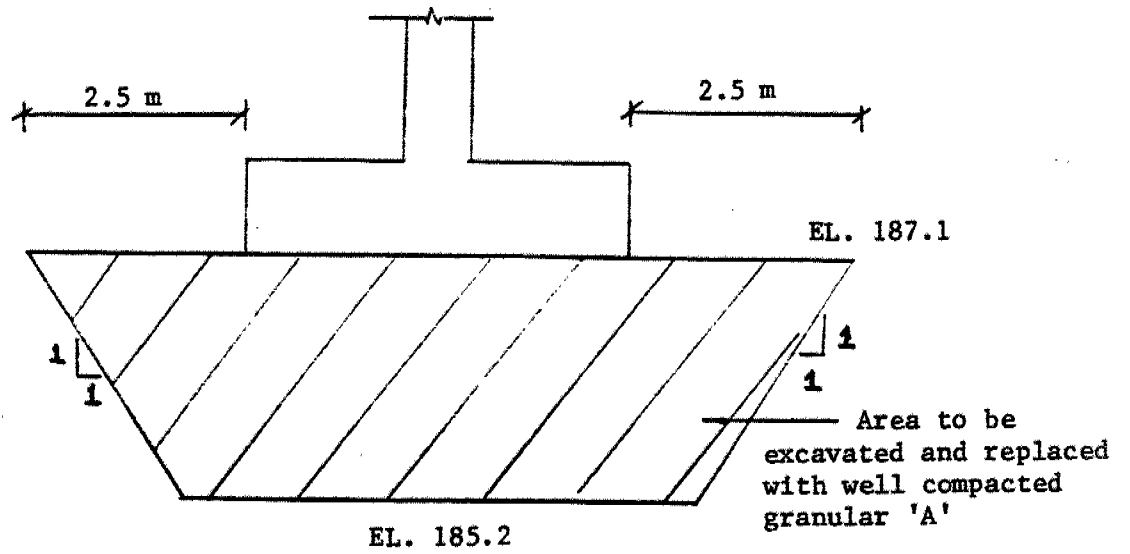


FIGURE 3: RETAINING WALL FOOTING REQUIREMENTS

(4) Approach Embankment Widening

Required widenings of the approach fills must be benched and keyed as per MTC specifications. No stability problems are anticipated using fills constructed with a slope of 2:1.

Backfill for the abutments should be composed of free draining granular material placed and compacted as per MTC specifications, with provisions made for adequate drainage. It should be noted that the use of heavy vibratory equipment should be restricted so that damage to the existing and widened abutments will not occur.

Lateral earth pressures exerted on the abutment walls by the granular backfill should be calculated using the at-rest condition as per clause C6.6.1.2.1 of the Ontario Bridge Code, using a unit weight of backfill equal to 20 kN/m³. It is assumed that the abutment walls will not experience any lateral deformations due to the pressure exerted by the granular backfills.

An adhesion value of 95 kPa between the footing bases and the underlying soil may be assumed in calculating the resistance to sliding.

MISCELLANEOUS

The fieldwork for this report was carried out under the supervision of Mr. K. Morrison, Student Technician, using equipment rented from Master Soil Investigation, Toronto.

This report was prepared by Mr. K. Morrison under the supervision of Mr. M. Devata, Senior Foundations Engineer, and Mr. T. Kazmierowski, Foundations Engineer. The report was reviewed by Mr. M. Devata.

Kirk M. Morrison

K. Morrison
Student Technician

T. Kazmierowski
T. Kazmierowski, P. Eng.
Foundations Engineer



April 10, 1981

APPENDIX

RECORD OF BOREHOLE No 1

W P 164-79-02 LOCATION Coordinates N 4, 847, 842.0 E 301, 951.0 ORIGINATED BY M.D.
DIST 6 HWY 400 BOREHOLE TYPE Washbora COMPILED BY _____
DATUM Geodetic DATE 1959 06 11 CHECKED BY _____

[illegible]

+3, x5: Numbers refer to Sensitivity



Ministry of
Transportation and
Communications
Ontario

RECORD OF BOREHOLE No 2

W P 164-79-02 LOCATION Coordinates: N 4, 847, 860.0 E 301, 946.5 ORIGINATED BY M.D.
DIST 6 HWY 400 BOREHOLE TYPE Washbore COMPILED BY C. A.
DATUM Geodetic DATE 1959 06 11 CHECKED BY

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					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		
188.7	Ground Level													
0.0	Fill Material						188							
187.8														
0.9	Brown		1	SS	44								23.8	
	Silty Clay of Low Plasticity		2	SS	75									
	Some to Trace of Sand		3	SS	89		186						24.0	
	Trace of Gravel		4	SS	123								25.0	
	Occasional Sandy Silt Layers		5	SS	110		184						23.5	
	Hard		6	SS	157		182							
181.4	Grey		7	SS	133									
7.3	Sandy Silt Very Dense		8	SS	145		180							
178.9			9	SS	158		178							
9.8	Sand With Gravel		10	SS	163		176							
	Very Dense		11	SS	172		174							
174.7	Grey		12	SS	90		172							
14.0	Silty Sand to Sandy Silt With Gravel		13	SS	151		170							
169.9	Very Dense						168							
18.8	End of Borehole													

+3, x5: Numbers refer to
Sensitivity

20
15
10

(%) STRAIN AT FAILURE



W P 164-79-02 LOCATION Coordinates: N 4, 847, 874.0 E 301, 932.0 ORIGINATED BY K.M.
DIST 6 HWY 400 BOREHOLE TYPE Hollow Stem Augers COMPILED BY K.M.
DATUM Geodetic DATE 81 02 10 CHECKED BY _____

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT	PLASTIC LIMIT	NATURAL MOISTURE CONTENT	LIQUID LIMIT	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	W _p	W		
186.3	Ground Level											
0.0	Silty Clay of Low Plasticity Some to Trace of Sand Trace of Gravel Hard		1	SS	70	28 cm	186					
			2	SS	100/		184					
			3	SS	100/							
			4	SS	49							
			5	SS	97							
			6	SS	59							
180.1			7	SS	100/	20 cm	180					
6.2	Sandy Silt											
178.2	Very Dense Grey		8	SS	100/	20 cm						2 40 50 8
8.1	End of Borehole						178					

+3, x5 : Numbers refer to Sensitivity

20
15 ϕ 5 (%) STRAIN AT FAILURE
10

RECORD OF BOREHOLE No 6

W P 164-79-02 LOCATION Coordinates: N 4, 847, 862.0, E 301, 942.0 ORIGINATED BY K.M.
DIST 6 HWY 400 BOREHOLE TYPE Solid Stem Augers COMPILED BY
DATUM Geodetic DATE 81-02-10 CHECKED BY

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT Y	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100		
186.8	Ground Level													
0.0	Silty Clay of Low Plasticity		1	SS	13		186							
	Some to Trace of Sand		2	SS	35									
	Trace of Brown Gravel Grey		3	SS	100/	18 cm	184							
			4	SS	100/	18 cm								
			5	SS	100/	18 cm								
	Very Stiff to Hard		6	SS	84		182							
180.7			7	SS	100/	10 cm	180							
6.1	Sandy Silt Trace of Gravel													
178.7	Very Dense Grey		8	SS	100/	28 cm								1 29 65 5
8.1	End of Borehole						178							

+3, x5: Numbers refer to
Sensitivity

20
15 5 (%) STRAIN AT FAILURE
10



W P 164-79-02 LOCATION Coordinates: N 4, 847, 825.0 E 301, 945.0 ORIGINATED BY K.M.
DIST 6 HWY 400 BOREHOLE TYPE Solid Stem Augers COMPILED BY _____
DATUM Geodetic DATE 81-02-10/11 CHECKED BY _____

+3, x5: Numbers refer to Sensitivity

OFFICE REPORT ON SOIL EXPLORATION



Ministry of
Transportation and
Communications

RECORD OF BOREHOLE No 8

W P 164-79-02 LOCATION Coordinates: N 4, 847, 833.0 E 301, 954.5 ORIGINATED BY K.M.
DIST 6 HWY 400 BOREHOLE TYPE Solid Stem Augers COMPILED BY K.M.
DATUM Geodetic DATE 81-02-11 CHECKED BY _____

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					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		
192.1	Ground Level												
0.0	(Fill) Brown					192							
	Silty Clay, Some Sand		1	SS	7								
	Trace of Gravel		2	SS	7								
	Firm to Very Stiff		3	SS	28	190							
			4	SS	17								
188.6			5	SS	32	188							
3.5	Silty Clay		6	SS	32								
	Low Plasticity		7	SS	47								
	Some Sand		8	SS	56	186							
	Hard												
184.0	Brown		9	SS	100/	184							
8.1	End of Borehole												

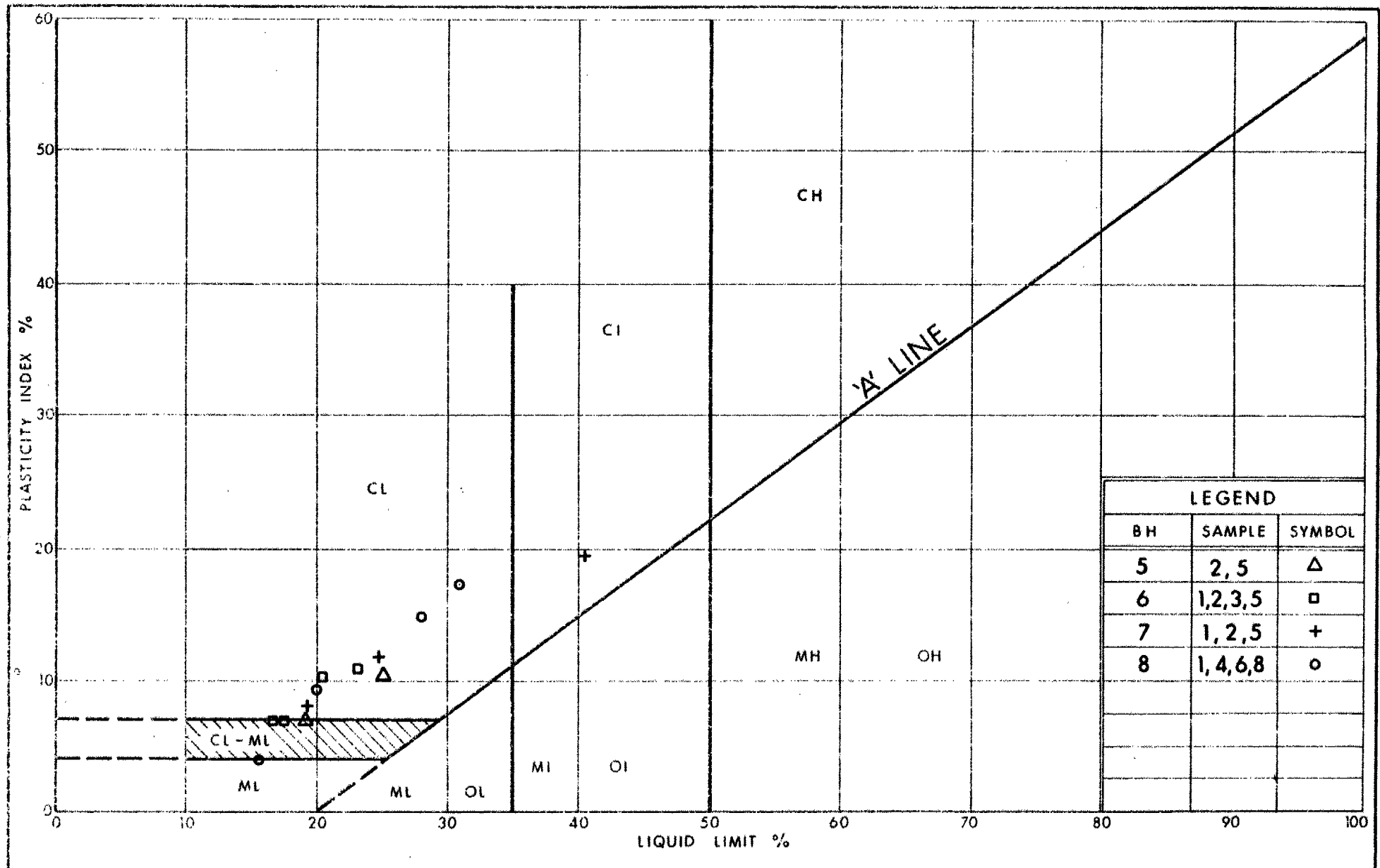
+3, x5: Numbers refer to
Sensitivity

20
15-5 (%) STRAIN AT FAILURE
10



GRAIN SIZE DISTRIBUTION SILTY SAND TO SANDY SILT

W P 164-79-02



Ministry of
Transportation and
Communications

**PLASTICITY CHART
SILTY CLAY
WITH SOME SAND TRACE OF GRAVEL**

FIG No 1

W P 164-79-02

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 31mm 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 (31mm 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 UNRAINED SHEAR STRENGTH (C_u) AS FOLLOWS:

C_u (kPa)	0 - 12	12 - 23	23 - 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	30mm	30 - 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	P	TW ADVANCED HYDRAULICALLY
CS	CHUNK SAMPLE	PW	TW ADVANCED MANUALLY
TW	THINWALL OPEN	FS	FOIL SAMPLE

STRESS AND STRAIN

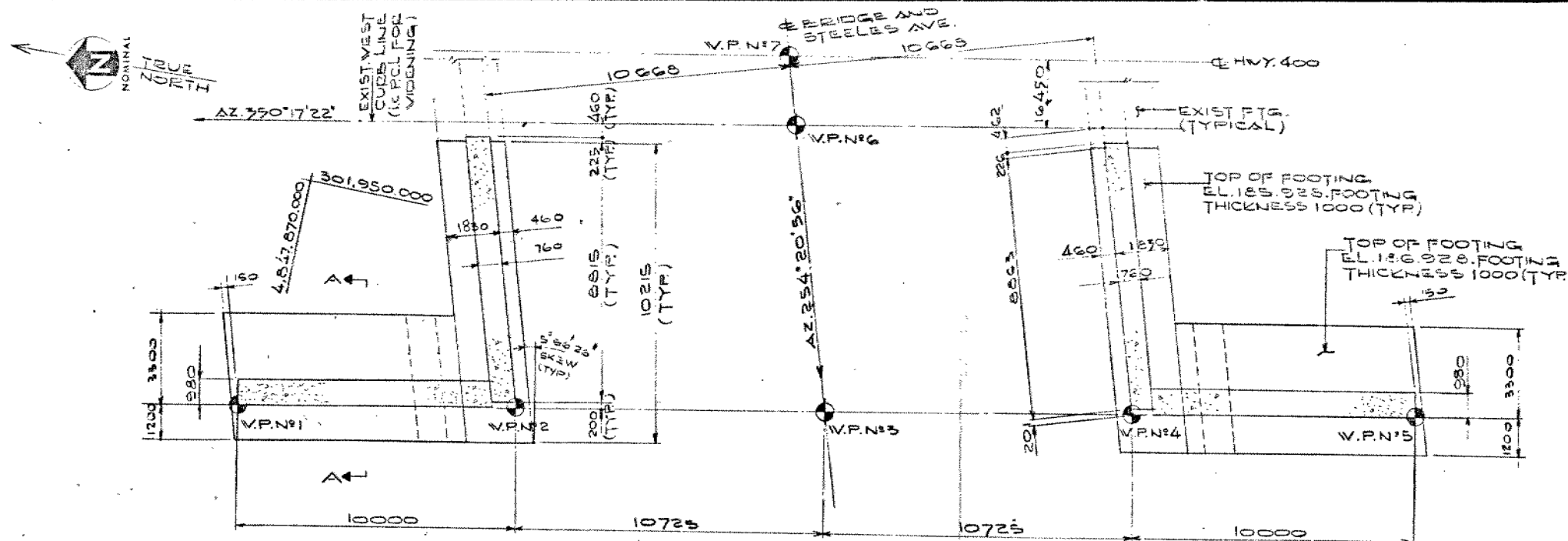
u_w	kPa	PORE WATER PRESSURE
u	l	PORE PRESSURE RATIO
σ	kPa	TOTAL NORMAL STRESS
σ'	kPa	EFFECTIVE NORMAL STRESS
τ	kPa	SHEAR STRESS
$\sigma_1, \sigma_2, \sigma_3$	kPa	PRINCIPAL STRESSES
ϵ	%	LINEAR STRAIN
$\epsilon_1, \epsilon_2, \epsilon_3$	%	PRINCIPAL STRAINS
E	kPa	MODULUS OF LINEAR DEFORMATION
G	kPa	MODULUS OF SHEAR DEFORMATION
μ	l	COEFFICIENT OF FRICTION

MECHANICAL PROPERTIES OF SOIL

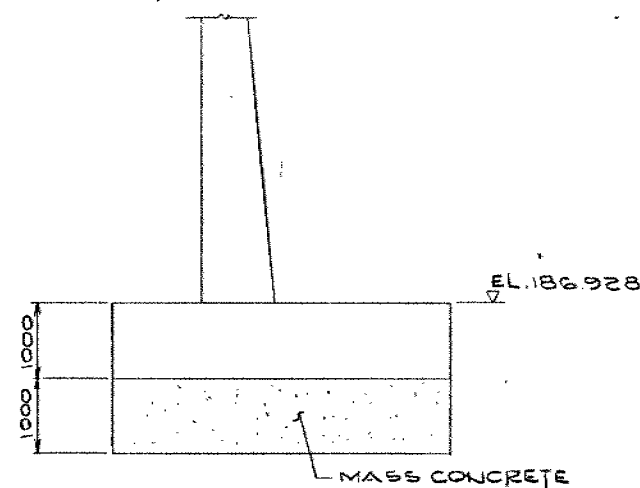
m_v	kPa ⁻¹	COEFFICIENT OF VOLUME CHANGE
C_c	l	COMPRESSION INDEX
C_s	l	SWELLING INDEX
C_{α}	l	RATE OF SECONDARY CONSOLIDATION
C_v	m ² /s	COEFFICIENT OF CONSOLIDATION
M	m	DRAINAGE PATH
T_v	l	TIME FACTOR
U	%	DEGREE OF CONSOLIDATION
σ'_{vo}	kPa	EFFECTIVE OVERBURDEN PRESSURE
σ'_p	kPa	PRECONSOLIDATION PRESSURE
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_r	l	SENSITIVITY = $\frac{C_u}{\tau_r}$

PHYSICAL PROPERTIES OF SOIL

ρ_s	kg/m ³	DENSITY OF SOLID PARTICLES	e	l, %	VOID RATIO	e_{min}	l, %	VOID RATIO IN DENSEST STATE
γ_s	kN/m ³	UNIT WEIGHT OF SOLID PARTICLES	n	l, %	POROSITY	I_D	l	DENSITY INDEX = $\frac{e_{max} - e}{e_{max} - e_{min}}$
ρ_w	kg/m ³	DENSITY OF WATER	w	l, %	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	l	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	l	LIQUIDITY INDEX = $\frac{w - w_p}{I_p}$	i	l	HYDRAULIC GRADIENT
γ_{sat}	kN/m ³	UNIT WEIGHT OF SATURATED SOIL	I_C	l	CONSISTENCY INDEX = $\frac{w_L - w}{I_p}$	k	m/s	HYDRAULIC CONDUCTIVITY
ρ'	kg/m ³	DENSITY OF SUBMERGED SOIL	e_{max}	l, %	VOID RATIO IN LOOSEST STATE	j	kN/m ²	SEEPAGE FORCE
γ'	kN/m ³	UNIT WEIGHT OF SUBMERGED SOIL						



FOUNDATION LAYOUT
SCALE 1:100



SECTION A - A
SCALE 1:50
(N. RETAINING WALL FOOTING ONLY)

METRIC

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

DIST. No 6
CONT No
WP No 164-79-02

STEELES AVENUE OVERPASS
WIDENING OF S. BOUND STRUCTURE
FOUNDATION LAYOUT

SHEET

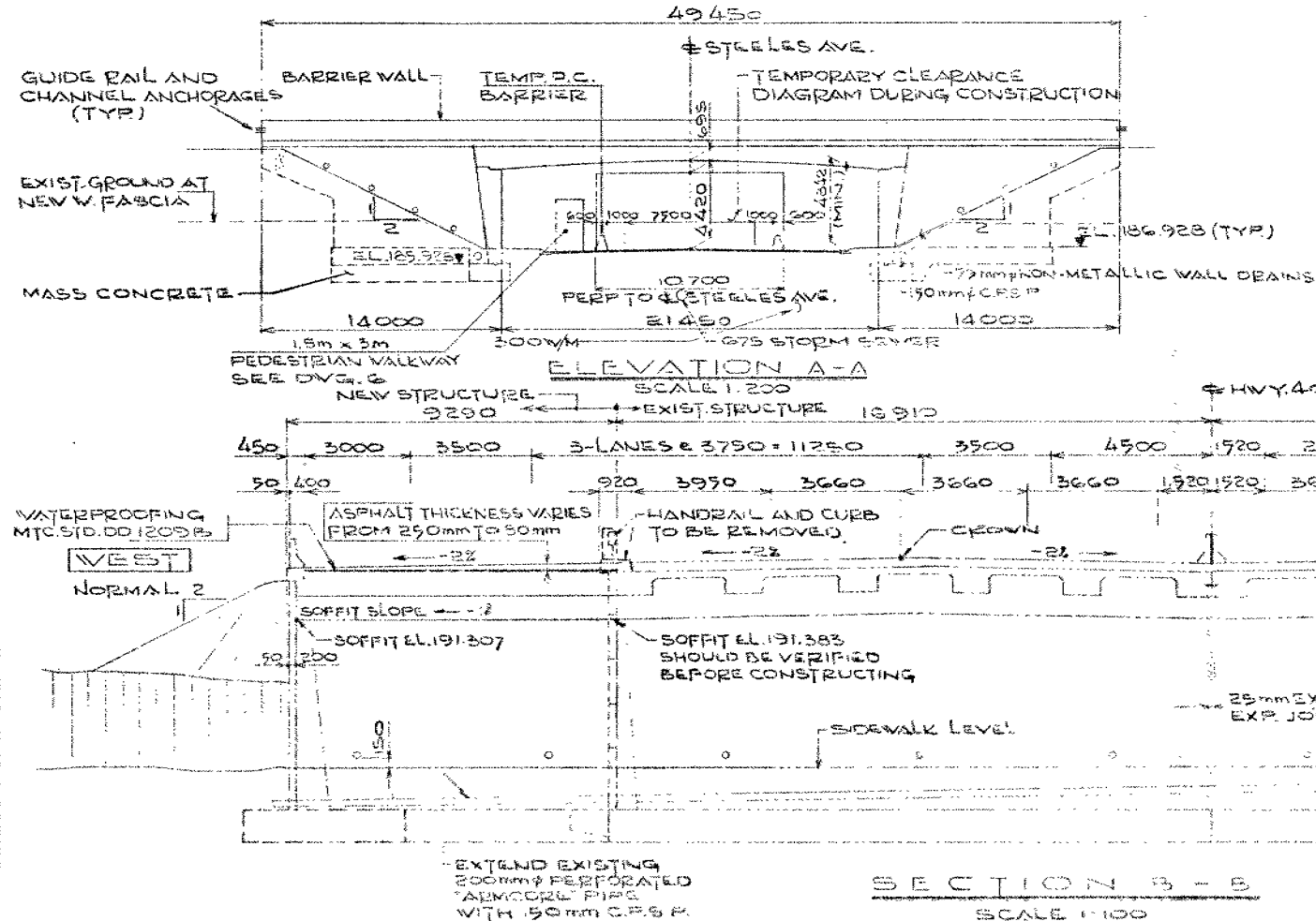
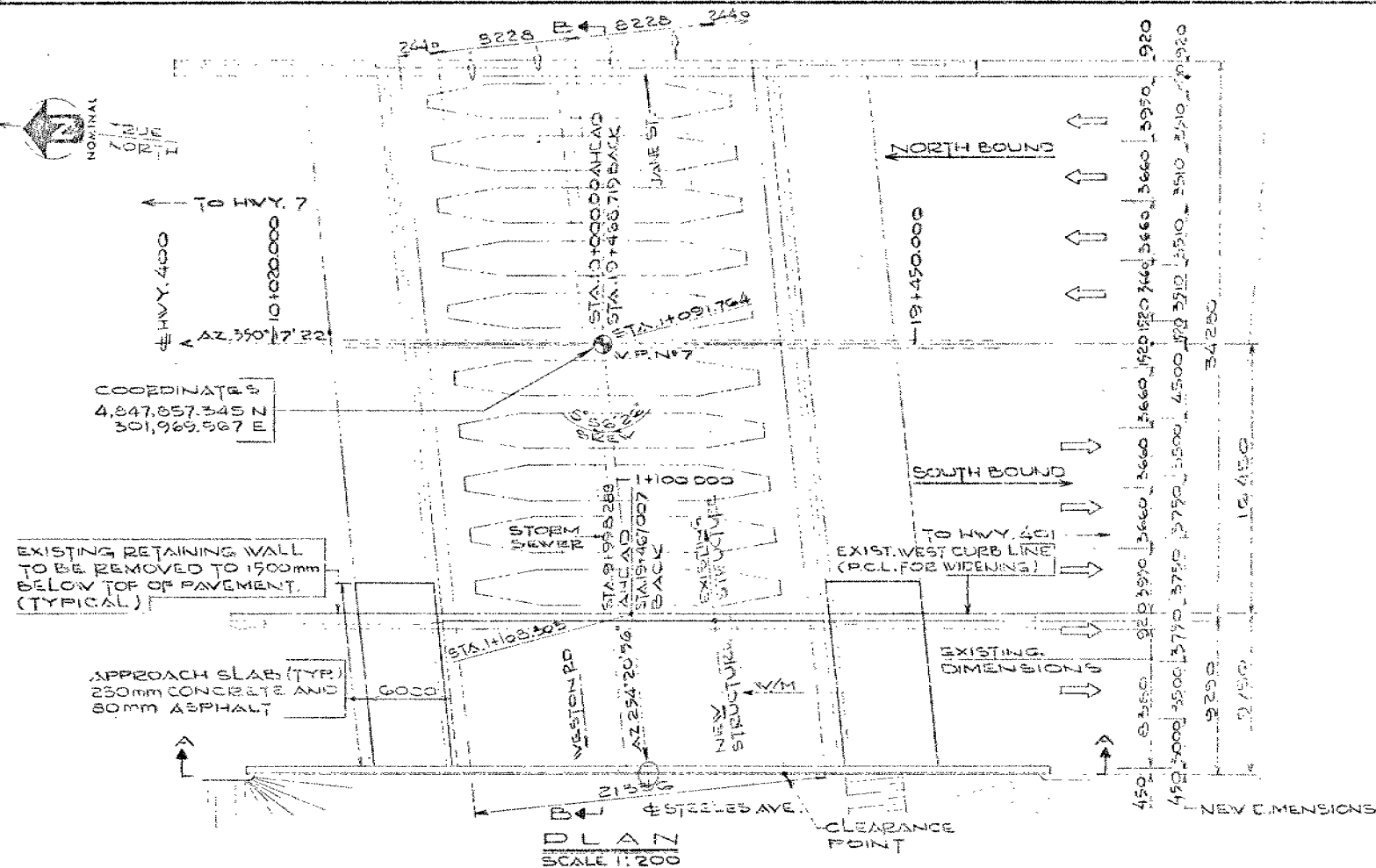
FENCO FENCO CONSULTANTS LTD

V.P.	COORDINATES	
	NORTH	EAST
Nº 1	4,847,870.680	301,941.154
Nº 2	4,847,860.823	301,942.841
Nº 3	4,847,850.252	301,944.650
Nº 4	4,847,839.681	301,946.459
Nº 5	4,847,829.824	301,948.146
Nº 6	4,847,852.883	301,954.041
Nº 7	4,847,857.345	301,969.967

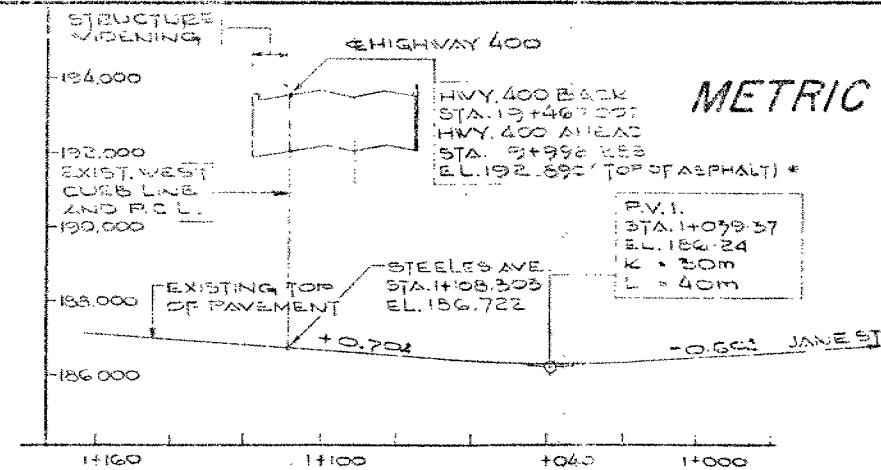
DRAWING NOT TO BE SCALED
100 m = ON ORIGINAL DRAWING

REVISIONS		
DATE	BY	DESCRIPTION
DESIGN J.C.D.	CHECK B.T.P.	LOADING CH80C-A-73 DATE MAY 1981
DRAWING J.C.D.	CHECK J.C.D.	SITE NO 37-220 1:WG 3

FENCO N° 164-79-02-K-1

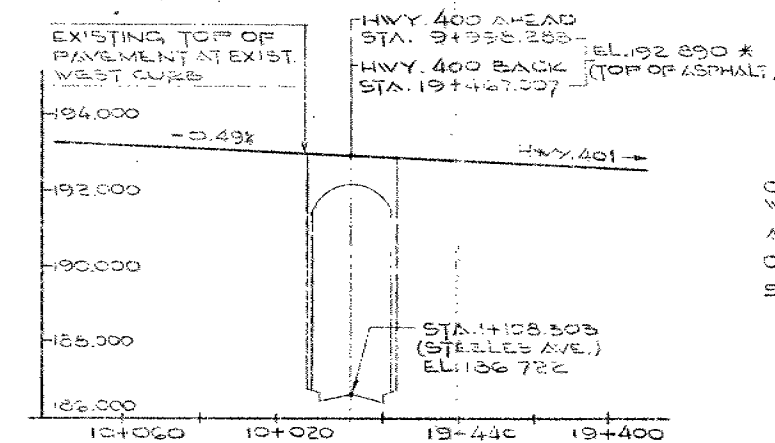


SECTION B-B SCALE 1:100



PROFILE - STEELES AVE

SCALE HORIZ. 1:1000 VERT. 1:100



PROFILE - HIGHWAY 400

SCALE HORIZ. 1:1000 VERT. 1:100

* EL. 192.890 T/A TO BE CONFIRMED ON SITE
ALL CONCRETE ELEVATIONS (EXCEPT TOP OF FOOTING ELS.) ARE DERIVED FROM THIS ELEVATION.
THE CONTRACTOR SHALL VERIFY ALL DIMENSIONS AND ELEVATIONS OF EXISTING WORK BEFORE PROCEEDING WITH THE WORK.

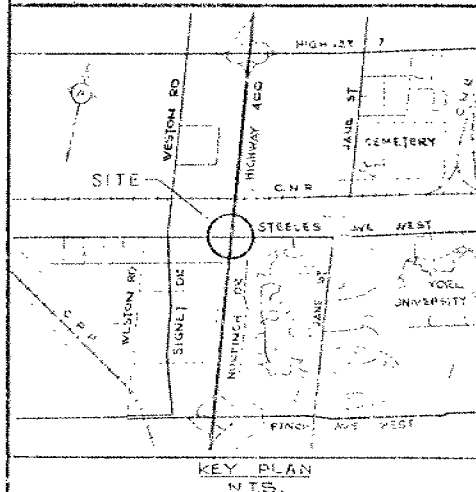
DIST. No 6
CONT No
WP No 164-79-02

STEELES AVENUE OVERPASS
WIDENING OF S. BOUND STRUCTURE
GENERAL ARRANGEMENT

SHEET

FENCO

FENCO CONSULTANTS LTD



QUANTITIES:

CONCRETE IN BRIDGE AND RETAINING WALLS 455m³
APPROACH SLABS 20m³
CONCRETE IN BARRIER WALLS 12m³
SHORING 14m²

LIST OF DRAWINGS:

37-270-1 GENERAL ARRANGEMENT
2-BENCH MARK LOCATIONS AND SOIL STRATA
3-FOUNDATION LAYOUT
4-RIGID FRAME AND DETAILS
5-RETAINING WALLS
6-SCREEN ELEVATIONS & SHORING DETAILS
7-BARRIER WALL
8-6000mm APPROACH SLAB - STANDARD
9-AS CONSTRUCTED ELEV. AND DIMENSION
10-BRIDGE DATE & SITE NO. - DATA

GENERAL NOTES:

CLASS OF CONCRETE 30 MPa
REINFORCING STEEL GRADE 400
CLEAR COVER TO REINFORCING STEEL :-
SURFACE IN CONT. WITH EARTH 75mm
DECK SLAB TOP 50mm
DECK SLAB SOFFIT 40mm
BARRIER WALL - SEE DWG. N27
TO ACHIEVE THE MINIMUM CLEAR COVER OF 50mm SPECIFIED AT TOP OF THE DECK THE TOP LAYER OF REINFORCING STEEL SHALL BE PLACED PRIOR TO CONCRETING WITH A CLEAR COVER OF 65mm 15mm TOLERANCE.
REINFORCING BARS WITH SUFFIX "C" SHALL BE COATED BARS.
STAGE CONSTRUCTION :-
FOR DETAILS SEE DWG. N26
NOTES: M.P. DENOTES - WORK POINT
T/A DENOTES - TOP OF ASPHALT PAVEMENT.

NOTE:

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

REVISIONS	DATE	DESCRIPTION
1	1984-07-10	ISSUED FOR BIDDING
2	1984-07-10	ISSUED FOR BIDDING
3	1984-07-10	ISSUED FOR BIDDING
4	1984-07-10	ISSUED FOR BIDDING
5	1984-07-10	ISSUED FOR BIDDING
6	1984-07-10	ISSUED FOR BIDDING
7	1984-07-10	ISSUED FOR BIDDING
8	1984-07-10	ISSUED FOR BIDDING
9	1984-07-10	ISSUED FOR BIDDING
10	1984-07-10	ISSUED FOR BIDDING

memorandum



To: Mr. W.L. Lin
Design Engineer (Central)
Operating Section
Structural Office

Date: 1981 06 25

From: Pavement & Foundation Design Section
Room 313, Central Building

Re: Steeles Avenue Overpass
Widening of S.B. Structure
W.P. 164-79-02, Site 37-270
Hwy. 400, District #6

This memo will confirm my conversation with Mr. B. Phalp, Fenco Consultants Ltd., regarding retaining wall foundation design and suggested roadway protection details. Design of a single-step retaining wall footing with a footing base elevation of 186, will alter recommendations given in the Foundation Investigation Report.

For retaining wall footings on the south side, subexcavation and backfilling with granular 'A' will no longer be required. For the north retaining wall footing, subexcavation should be carried down to competent foundation soils at elevation 185.2 and then mass concrete should be used to raise the footing to the required elevation. This will insure that roadway protection schemes can be kept to a minimum geometry.

In addition, all soldier piles in the vicinity of the foundations should be cut off at the top of footing so as to prevent long term softening of the subsoils as a result of pile extraction and water ingress into the resultant pile cavities.

All other recommendations contained within the Foundation Investigation Report are still applicable for structure design and construction purposes.

A handwritten signature in dark ink, appearing to read "T.J. Kazmierowski".

T.J. Kazmierowski
Foundations Engineer

TJK:ea

cc: B. Phalp (Fenco Consultants Ltd.)
G. Burkhardt
D. Thrasher

memorandum



To: Mr. K. G. Bassi,
Head, Operating Section,
Structural Office

Date: 81 11 13

From: Pavement & Foundation Design Section

Re: Steeles Avenue Overpass,
W. P. 164-79-02, Site 32-270
Highway 400, District 6

We have reviewed the final bridge drawings and contract documentation for the above-mentioned project and provide the following comments:

1. All Soldier piles used for roadway protection should be cut off above the base of footing elevation and left in place. This will prevent softening of the subsoils as a result of water infiltration into pile cavities which would be formed by pile extraction operations.
2. Proposed widening of the approach fills must be benched into the existing slopes as per M. T. C. specifications. A note in this regard should be made on the appropriate grading drawing by the Regional Design Section.

A handwritten signature in black ink, appearing to read "T. J. Kazmierowski".

T. J. Kazmierowski, P. Eng.,
Foundations Engineer

TJK/bd

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

Pavement & Foundation Design Section
Room 313, Central Building

R. Jeffries

1981 01 12

Steeles Ave. Overpass Widening
W.P. 164-79-01, Site 37-270
Highway 400, Dist. 6, Toronto

In response to your request for a preliminary report a brief subsoil description and preliminary recommendations for the structure widening will be provided in this memo. It is based on soil information from the investigation for the existing structure. A complete foundation report will be provided at a later date.

Subsoil, where no filling or cutting has taken place, consists of approximately 7 metres of hard cohesive glacial till underlain by a very dense deposit of fine silty sand. Groundwater levels were recorded at about elevation 182 some 7 metres below the original ground surface.

It is recommended that the structure extension be supported on spread footings at approximately the same elevation (185) as the existing with a design load of up to 400 kPa. Resistance to sliding may be calculated assuming an adhesion between the footing base and the soil of 100 kPa. Retaining walls similar to the existing may be supported on stepped spread footings with design loads of 300 kPa at founding elevations up to 187.5. The base of all footings should be protected from frost action by a minimum of 1.2 metres of cover.

If permanent slopes of 2 horizontal to 1 vertical and temporary slopes of 1 horizontal to 1 vertical are employed no slope stability problems will result.



Peter J. Stuart
Foundations Engineer

For:

M. Devata
Senior Foundations Engineer

PJS:ea