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DIST. 4 REGION

W.P. No. 169-67-03

CONT. No. 86-44

W. O. No.

STR. SITE No. 10-147

HWY. No. Q.E.W.

LOCATION Walker's Line Underpass

No of PAGES -

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OVERSIZE DRAWINGS TO BE INCLUDED WITH THIS REPORT.

REMARKS:

RETURN TO
CONTRACT CONTROL OFFICE

FOUNDATION INVESTIGATION REPORT

CONTRACT NO 86 - 44



Ministry of
Transportation and
Communications

I N D E XPAGE NO.DESCRIPTION

1	Index
2	Abbreviations and Symbols
3-11	Foundation Investigation Report Walkers Line Underpass W. P. 169-67-03; Site: 10-147

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.

N VALUE: THE STANDARD PENETRATION TEST (SPT) N VALUE IS THE NUMBER OF BLOWS REQUIRED TO CAUSE A STANDARD 51mm O.D. SPLIT BARREL SAMPLER TO PENETRATE 0.3m INTO UNDISTURBED GROUND IN A BOREHOLE WHEN DRIVEN BY A HAMMER WITH A MASS OF 63.5kg, FALLING FREELY A DISTANCE OF 0.76m. FOR PENETRATIONS OF LESS THAN 0.3m N VALUES ARE INDICATED AS THE NUMBER OF BLOWS FOR THE PENETRATION ACHIEVED. AVERAGE N VALUE IS DENOTED THUS \bar{N} .

DYNAMIC CONE PENETRATION TEST: CONTINUOUS PENETRATION OF A CONICAL STEEL POINT (51mm O.D. 60° CONE ANGLE) DRIVEN BY 475 J IMPACT ENERGY ON 'A' SIZE DRILL RODS. THE RESISTANCE TO CONE PENETRATION IS MEASURED AS THE NUMBER OF BLOWS FOR EACH 0.3m ADVANCE OF THE CONICAL POINT INTO THE UNDISTURBED GROUND.

SOILS ARE DESCRIBED BY THEIR COMPOSITION AND CONSISTENCY OR DENSENESS.

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

c_u (kPa)	0 - 12	12 - 25	25 - 50	50 - 100	100 - 200	> 200
	VERY SOFT	SOFT	FIRM	STIFF	VERY STIFF	HARD

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

N (BLOWS/0.3m)	0 - 5	5 - 10	10 - 30	30 - 50	> 50
	VERY LOOSE	LOOSE	COMPACT	DENSE	VERY DENSE

ROCKS ARE DESCRIBED BY THEIR COMPOSITION AND STRUCTURAL FEATURES AND / OR STRENGTH.

RECOVERY: SUM OF ALL RECOVERED ROCK CORE PIECES FROM A CORING RUN EXPRESSED AS A PERCENT OF THE TOTAL LENGTH OF THE CORING RUN.

MODIFIED RECOVERY: SUM OF THOSE INTACT CORE PIECES, 100mm+ IN LENGTH EXPRESSED AS A PERCENT OF THE LENGTH OF THE CORING RUN. THE ROCK QUALITY DESIGNATION (RQD), FOR MODIFIED RECOVERY, IS:

RQD (%)	0 - 25	25 - 50	50 - 75	75 - 90	90 - 100
	VERY POOR	POOR	FAIR	GOOD	EXCELLENT

JOINTING AND BEDDING:

SPACING	50mm	50 - 300mm	0.3m - 1m	1m - 3m	> 3m
JOINTING	VERY CLOSE	CLOSE	MOD. CLOSE	WIDE	VERY WIDE
BEDDING	VERY THIN	THIN	MEDIUM	THICK	VERY THICK

ABBREVIATIONS AND SYMBOLS

FIELD SAMPLING

SS SPLIT SPOON	TP THINWALL PISTON
WS WASH SAMPLE	OS OSTERBERG SAMPLE
ST SLOTTED TUBE SAMPLE	RC ROCK CORE
BS BLOCK SAMPLE	PH TW ADVANCED HYDRAULICALLY
CS CHUNK SAMPLE	PM TW ADVANCED MANUALLY
TW THINWALL OPEN	FS FOIL SAMPLE

STRESS AND STRAIN

u_w kPa	PORE WATER PRESSURE
r_u 1	PORE PRESSURE RATIO
σ kPa	TOTAL NORMAL STRESS
σ' kPa	EFFECTIVE NORMAL STRESS
τ kPa	SHEAR STRESS
$\sigma_1, \sigma_2, \sigma_3$ kPa	PRINCIPAL STRESSES
ϵ %	LINEAR STRAIN
$\epsilon_1, \epsilon_2, \epsilon_3$ %	PRINCIPAL STRAINS
E kPa	MODULUS OF LINEAR DEFORMATION
G kPa	MODULUS OF SHEAR DEFORMATION
μ 1	COEFFICIENT OF FRICTION

MECHANICAL PROPERTIES OF SOIL

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

PHYSICAL PROPERTIES OF SOIL

ρ_s kg/m ³	DENSITY OF SOLID PARTICLES	e 1, %	VOID RATIO	e_{min} 1, %	VOID RATIO IN DENSEST STATE
γ_s kN/m ³	UNIT WEIGHT OF SOLID PARTICLES	n 1, %	POROSITY	I_D 1	DENSITY INDEX = $\frac{e_{max} - e}{e_{max} - e_{min}}$
ρ_w kg/m ³	DENSITY OF WATER	w 1, %	WATER CONTENT	D mm	GRAIN DIAMETER
γ_w kN/m ³	UNIT WEIGHT OF WATER	S_r %	DEGREE OF SATURATION	D_n mm	n PERCENT - DIAMETER
ρ kg/m ³	DENSITY OF SOIL	w_L %	LIQUID LIMIT	C_u 1	UNIFORMITY COEFFICIENT
γ kN/m ³	UNIT WEIGHT OF SOIL	w_p %	PLASTIC LIMIT	h m	HYDRAULIC HEAD OR POTENTIAL
ρ_d kg/m ³	DENSITY OF DRY SOIL	w_s %	SHRINKAGE LIMIT	q m ³ /s	RATE OF DISCHARGE
γ_d kN/m ³	UNIT WEIGHT OF DRY SOIL	I_p %	PLASTICITY INDEX = $w_L - w_p$	v m/s	DISCHARGE VELOCITY
ρ_{sat} kg/m ³	DENSITY OF SATURATED SOIL	I_L 1	LIQUIDITY INDEX = $\frac{w - w_p}{I_p}$	i 1	HYDRAULIC GRADIENT
γ_{sat} kN/m ³	UNIT WEIGHT OF SATURATED SOIL	I_C 1	CONSISTENCY INDEX = $\frac{w_L - w}{I_p}$	k m/s	HYDRAULIC CONDUCTIVITY
ρ' kg/m ³	DENSITY OF SUBMERGED SOIL	e_{max} 1, %	VOID RATIO IN LOOSEST STATE	j kN/m ³	SEEPAGE FORCE
γ' kN/m ³	UNIT WEIGHT OF SUBMERGED SOIL				

FOUNDATION INVESTIGATION REPORT

for

Walkers Line Underpass
W. P. 169-67-03; Site: 10 - 147
Q.E.W. District #4, Burlington

INTRODUCTION

This report contains the results of a foundation investigation carried out at the aforementioned site during the period of 81 08 17 and 81 08 18. The field work consisted of four sampled boreholes accompanied with dynamic cone penetration tests. A muskeg vehicle mounted flight auger machine using solid augers and BX size rock coring equipment was employed for the boring operation.

SITE DESCRIPTION

The site is located at the intersection of Walkers Line and Q.E.W. in the City of Burlington. The surrounding terrain (with the exception of the existing Walkers Line Overpass approach embankments) is relatively flat. Physiographically, the area lies in the Region referred to as the Iroquois Plain.

SUBSURFACE CONDITIONSGeneral

The subsurface conditions as determined from the borings were found to be quite uniform. Below the cohesive type fill material, the original subsoil consists of a relatively shallow (up to 2.5 m thick) deposit of Glacial Till (heterogeneous mixture of silty clay, sand and gravel), followed by weathered shale and in turn sound shale of Queenston Formation.

Reference should be made to the Record of Borehole Sheets contained in the Appendix for boundary elevations of the different deposits. These sheets also contain the description of the encountered strata and, in summarized form, the results of all field and laboratory tests performed.

The Stratigraphical Sections shown on Drawing Number #2 are of the contract documents based on this information. The drawing also shows the locations and elevations of the borings. Detailed description of the various deposit types are given below.

Fill Material

This fill material, which was placed during the construction of the existing interchange complex, was encountered at all boring locations. The thickness, however, varies from about 0.6 m to 6.7 m depending on the location of the boreholes. The components of this soil mass are basically silty clay of low plasticity with some sand and traces to some gravel. Occasionally, organic substances were also observed within this fill material, especially in the lower portion. Physical properties as determined in the laboratory, exhibit relatively the same properties as the underlying Glacial Till deposit:

Moisture Content:	9 - 16%
Liquid Limit:	25 - 35%
Plastic Limit:	14 - 18%

Grain-size distribution;	Gravel:	2 - 26%
	Sand:	22 - 38%
	Silt:	24 - 48%
	Clay:	12 - 28%

Standard Penetration Test Results indicate a relatively wide range of compaction effort, the obtained 'N' values ranged from 6 to 33 blows per 0.3 m. The consistency is estimated to vary from firm to hard.

Heterogeneous Mixture of Silty Clay, Sand and Gravel (Glacial Till)

Below the above-described fill material, the original subsoil (assumed original ground level El. 115.3 ±) was found to consist of a heterogeneous mixture of silty clay with some sand and traces of gravel. The overall thickness ranges from 1.5 to 2.5 m. The silty clay (matrix) is of low plasticity. Organic substances (believed to be the original topsoil) were encountered within the upper portion of the deposit. Occasional shale fragments in the vicinity of the lower boundary were also observed.

Physical properties of the stratum are as follows:

Natural Moisture Content (%)	12 - 13
Liquid Limit (%)	28 - 29
Plastic Limit (%)	14 - 15

Grain-size distribution curves are plotted on Figure #1 of the Appendix.

The extreme upper portion of the deposit appears to be weathered and the consistency may be described as firm. Below this weathered portion, the consistency is very stiff to hard.

Bedrock

Reddish coloured shale bedrock was encountered between El. 112.8 and El. 113.8. The extreme upper portion of the bedrock is very badly decomposed (weathered) and was penetrated without difficulties with conventional augering methods. The shale appears to be sound below El. 112.2 ±.

Groundwater Conditions

The following groundwater levels were observed 48 hours after the completion of the fieldwork:

Borehole Number #1	El. 113.4
Borehole Number #2	No observation was carried out
Borehole Number #3	No observation was carried out
Borehole Number #4	El. 114.9

It is assumed that the position of the groundwater level is subjected to seasonal variation.

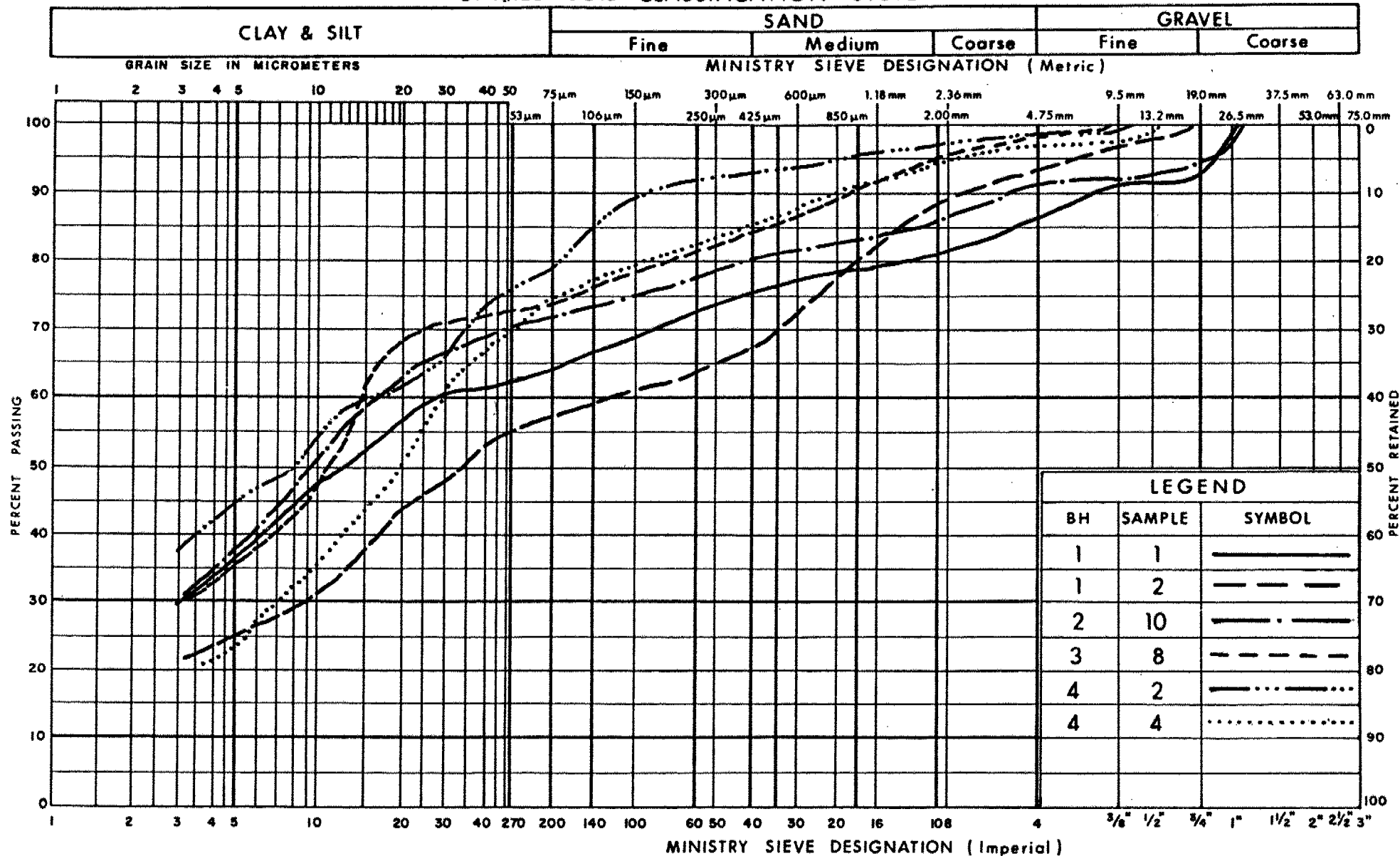


P. Payer
 P. Payer, P. Eng.,
 Senior Foundations Engineer

K. G. Selby
 K. G. Selby, P. Eng.,
 Chief Foundations Engineer

APPENDIX

UNIFIED SOIL CLASSIFICATION SYSTEM



Ministry of
Transportation and
Communications

GRAIN SIZE DISTRIBUTION
GLACIAL TILL
HETEROGENEOUS MIX. OF SILTY CLAY SAND & GRAVEL

FIG No 1

W P 169-67-03

RECORD OF BOREHOLE No 1

W P 168-67-03 LOCATION Sta. 9+974.0 31.0 m Rt. ORIGINATED BY P. G.
 DIST 4 HWY Q. E. W. BOREHOLE TYPE Cont. Flight Auger COMPILED BY H. A.
 DATUM Geodetic DATE 81 08 17 CHECKED BY

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100	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								
115.8	Ground Level											
0.0	Topsoil & silty clay											
115.2	Topsoil material											
0.6	Glacial till* Hard		1	SS	55							13 23 42 22
113.7	Occasional shale fragments		2	SS	59							6 37 40 17
2.1	Weathered		3	SS	100/13.4							
			4	SS	100/5							
	Sound Shale		5	RC	98%							
109.5	End of Borehole											
6.3	*Heterogeneous mixture of silty clay, sand and gravel											

OFFICE REPORT ON SOIL EXPLORATION

RECORD OF BOREHOLE No 2

W P 169-67-03 LOCATION Sta. 9+266.5 8.5 m l.c. ORIGINATED BY P. G.
 DIST 4 HWY Q. E. W. BOREHOLE TYPE Cont. Flight Auger COMPILED BY M. A.
 DATUM Geodetic DATE 81-08-17 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			20	40	60	80	100			
122.2 0.0	Ground Level													
	Fill Material		1	SS	10									
	Silty Clay		2	SS	5									
	some sand and		3	SS	8									
	gravel		4	SS	10									
	occasional		5	SS	13									
	organics		6	SS	26									
	Firm to very stiff		7	SS	16									
115.5			8	SS	14									
6.7	Glacial Till*		9	SS	48									
113.8	Hard		10	SS	90									
113.4	Weathered shale		11	SS	100/13 cm									
8.8	End of Borehole													
	*Heterogeneous mixture of silty clay, sand and gravel													
	** WL NOT OBSERVED													

OFFICE REPORT ON SOIL EXPLORATION

*³, *⁵: Numbers refer to
Sensitivity

20
15 → 5 (%) STRAIN AT FAILURE
10

RECORD OF BOREHOLE No 3

W P 169-67-03 LOCATION Sta. 10+034.0 11.0 m Rt. ORIGINATED BY P. G.
 DIST 4 HWY Q. E. W. BOREHOLE TYPE Cont. Flight Auger COMPILED BY H. A.
 DATUM Geodetic DATE 81 08 18 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 (%)					
121.2	Ground Level													GR SA SI CL
0.0	Fill Material					**								
	Silty Clay, some sand and traces of gravel		1	SS	8		120							
			2	SS	11									
	Occasional organic substances		3	SS	9		118						Org. 1.9%	2 22 48 28
	Firm to Hard		4	SS	9									
			5	SS	6									
115.4			6	SS	33		116							
5.8	Organic Substances		7	SS	19									
	Glacial Till*		8	SS	22								Org. 3.6%	1 25 50 24
113.6	Very Stiff		9	SS	29		114							
7.6	Weathered Shale		10	SS	100	13 cm								
112.4			11	SS	91									
8.8	End of Borehole						112							
	*Heterogeneous mixture of silty clay, sand and gravel													
	** WL NOT OBSERVED													

+3, x5: Numbers refer to
Sensitivity

20
15 ÷ 5 (%) STRAIN AT FAILURE
10

OFFICE REPORT ON SOIL EXPLORATION

RECORD OF BOREHOLE No 4

W P 169-67-03 LOCATION Sta. 10+028.0 32.0 m Lt. ORIGINATED BY P. G.
 DIST 4 HWY Q. E. W. BOREHOLE TYPE Cont. Flight Auger COMPILED BY N. A.
 DATUM Geodetic DATE 81-08-18 CHECKED BY _____

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20 40 60 80 100	PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L		
116.5	Ground Level												
0.0	Top soil, and fill material												
115.3	Very stiff		1	SS	27		116						
1.2	Organic substances		2	SS	8								2 19 48 31
	Glacial Till		3	SS	48		114						
112.8	Firm to Hard		4	SS	79								2 23 61 14
	occasional shale fragments												
3.7	Shale		5	SC	94.22		112						
110.2													
6.3	End of Borehole						110						
	*Silty clay, some sand and traces of gravel												
	**Heterogeneous mixture of silty clay, sand and gravel												

*³, *⁵: Numbers refer to
Sensitivity

20
15
10
5
0
5
10
15
20
(%) STRAIN AT FAILURE

OFFICE REPORT ON SOIL EXPLORATION

ENGINEERING MATERIALS OFFICE
PAVEMENT & FOUNDATION DESIGN SECTION

WP 169-67-03 DIST 4
HWY Q. E. W. STR SITE 10-147
Walkers Line Underpass

DISTRIBUTION

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FOUNDATION INVESTIGATION REPORT

For

WALKERS LINE UNDERPASS
W. P. 169-67-03 - Site 10 - 147
Q. E. W. District 4 (Hamilton)

INTRODUCTION

This Report contains the results of a foundation investigation carried out at the aforementioned site during the period of 81 08 17 and 81 08 18. The field work consisted of four sampled boreholes accompanied with dynamic cone penetration tests. A muskeg vehicle mounted flight auger machine using solid augers and BX size rock coring equipment was employed for the boring operation.

SITE DESCRIPTION

The site is located at the intersection of Walkers Line and Q. E. W. in the City of Burlington. The surrounding terrain (with the exception of the existing Walkers Line Overpass approach embankments) is relatively flat. Physiographically, the area lies in the Region referred to as the Iroquois Plain.

SUBSURFACE CONDITIONS

GENERAL

The subsurface conditions as determined from the borings were found to be quite uniform. Below the cohesive type fill material, the original subsoil consists of a relatively shallow (up to 2.5 m thick) deposit of Glacial Till (heterogeneous mixture of silty clay, sand and gravel), followed by weathered shale and in turn sound shale of Queenston Formation.

Reference should be made to the record of borehole sheets contained in the Appendix for boundary elevations of the different deposits. These sheets also contain the description of the characteristics of the encountered strata and, in summarized form, the results of all field and laboratory tests performed.

The Stratigraphical Sections shown on Drawing Number 1696703-A are based on this information. The drawing also shows the locations and elevations of the borings. Detailed description of the various deposit types are given below.

FILL MATERIAL

This fill material, which was placed during the construction of the existing interchange complex, was encountered at all boring locations. The thickness, however, varies from about 0.6 m to 6.7 m depending on the location of the boreholes. The components of this soil mass are basically silty clay of low plasticity with some sand and traces to some gravel. Occasionally, organic substances were also observed within this fill material, especially in the lower portion. Physical characteristics, as determined in the laboratory, exhibit relatively the same properties as the underlying Glacial Till deposit:

Moisture Content:	9 - 16%
Liquid Limit:	25 - 35%
Plastic Limit:	14 - 18%

Grain size distribution; gravel: 2 - 26%; sand: 22 - 38%; silt: 24 - 48%; clay: 12 - 28%.

Standard penetration test results indicate a relatively wide range of compaction effort, the obtained 'N' values ranged from 6 to 33 blows per 0.3 m. The consistency is estimated to vary from firm to hard.

HETEROGENEOUS MIXTURE OF SILTY CLAY, SAND AND GRAVEL (GLACIAL TILL)

Below the above-described fill material, the original subsoil (assumed original ground level El. 115.3+) was found to consist of a heterogeneous mixture of silty clay with some sand and traces of gravel. The overall

thickness ranges from 1.5 to 2.5 m. The silty clay (matrix) is of low plasticity. Organic substances (believed to be the original topsoil) were encountered within the upper portion of the deposit. Occasional shale fragments in the vicinity of the lower boundary were also observed.

Physical properties of the stratum are as follows:

Natural Moisture Content (%)	12 - 13
Liquid Limit (%)	28 - 29
Plastic Limit (%)	14 - 15

Grain size distribution curves are plotted on figure number 1 of the Appendix.

The extreme upper portion of the deposit appears to be weathered and the consistency may be described as firm. Below this weathered portion, the consistency is very stiff to hard.

BEDROCK

Reddish coloured shale bedrock was encountered between El. 112.8 and El. 113.8. The extreme upper portion of the bedrock is very badly decomposed (weathered) and was penetrated without difficulties with conventional augering methods. The shale appears to be sound below El. 112.2+.

The core samples were examined by M. T. C. Geologist Mrs. Z. Koniuszy and a detailed description is included in the Appendix.

GROUNDWATER CONDITIONS

The following groundwater levels were observed 48 hours after the completion of the fieldwork:

Borehole Number 1	El. 113.4
Borehole Number 2	No observation was carried out
Borehole Number 3	No observation was carried out
Borehole Number 4	El. 114.9

It is assumed that the position of the groundwater level is subjected to seasonal variation.

DISCUSSION AND RECOMMENDATIONS

EXISTING AND PROPOSED STRUCTURES

The existing structure at this site is a single span reinforced concrete bridge founded on spread footings within shale bedrock at elevation 112.6. The width of the bridge is 10.36 m and the span 34.75 m. It was constructed under Contract 58-632 and its present condition appears to be good. It is now proposed to replace this bridge with a new 62 m two span bridge about 24 m wide. The new ∇ of Walker's Line and the new profile grade some 0.25 m below that of the existing structure at ∇ of Median Q. E. W. Thus approach embankments some 7 m high will be required.

STRUCTURE FOUNDATIONS

The entire structure (abutments and pier) may be founded on spread footings constructed within the shale bedrock.

It is recommended that these footings be founded at or below elevation 112.2 and that a net safe pressure of 1.0 MPa be assumed for design purposes. In computing resistance to lateral forces, it may be assumed that a friction coefficient of 0.4 will apply between the footing base and the shale bedrock.

As an alternative to spread footings, the new abutments may be "perched" within the structure approaches and supported on steel H piles driven to bedrock. A design load of 1150 kN may be assumed for 310 HP @ 110 steel piles with reinforced tips. It is estimated that these piles will require to be driven to about elevation 112.0. For H piles of different size, the safe capacities may be assumed to be directly proportional to their cross sectional areas.

If the structure is to be designed under the new O. H. B. D. C., the following will be applicable.

(1) Spread Footings on Bedrock at el. 112.5

Factored bearing capacity at U. L. S.	1500 kPa
(Design not governed by settlement)	
Friction coefficient between base and rock	0.40

(2) Piles Driven to Bedrock (el. 112.0)

(310 x 110 steel H Piles)

Factored capacity at U. L. S.	1600 kN
Capacity at S. L. S. Type II	1150 kN

For H piles of different size, the capacities may be assumed to be directly proportional to their cross sectional areas.

- (3) Earth pressures should be computed as per Subsection 6.6.1.2.2 of the O. H. B. D. C.

APPROACH EMBANKMENTS

It is required to widen the existing approaches by about 7 m on each side. If non-cohesive material is used for this widening, it will be necessary to bench the side slopes of the existing cohesive embankments. If cohesive material is used for the widening, benching will not be required and it will be necessary only to remove all vegetation and topsoil before placing the new fill.

Care should be taken that no material larger than 75 mm in diameter is placed at locations where piles may have to be driven.

OTHER CONSIDERATIONS

The frost protection requirements in this area is 1.2 m of earth cover.

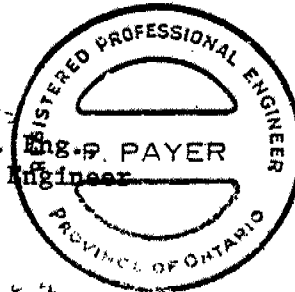
If excavations for footings are below the prevailing groundwater level at the time of construction, measures should be taken for the removal of the water, this could be achieved by pumping from suitable sumps.

MISCELLANEOUS

The field work for this investigation was carried out under the supervision of Mr. P. Goodman, Student Technician. The equipment was owned by Atcost Soil Drilling Inc.

This report was written by Mr. P. Payer and reviewed by Mr. K. G. Selby.

P. Payer
P. Payer, P. Eng.
Foundations Engineer



K. G. Selby
K. G. Selby, P. Eng.,
Senior Foundations Engineer



Ministry of
Transportation and
Communications
Ontario

RECORD OF BOREHOLE No 1

W P 169-67-03 LOCATION Sta. 9+974.0 31.0 m Rt. ORIGINATED BY P. G.
DIST 4 HWY Q. E. W. BOREHOLE TYPE Cont. Flight Auger COMPILED BY N. A.
DATUM Geodetic DATE 81 08 17 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								
115.8	Ground Level												
0.0	Topsoil & silty clay												
115.2	Fill material												
0.6	Glacial till* Hard		1	SS	55								13 23 42 22
113.7	Occasional shale fragments		2	SS	59								6 37 40 17
2.1	Weathered		3	SS	100/13 cm								
			4	SS	100/5 cm								
	Sound Shale		5	RC	98%								
109.5	End of Borehole												
6.3	*Heterogeneous mixture of silty clay, sand and gravel												

+3, x5: Numbers refer to
Sensitivity

20
15 5 (%) STRAIN AT FAILURE
10

RECORD OF BOREHOLE No 2

W P 169-67-03 LOCATION Sta. 9+966.5 8.5 m Lt. ORIGINATED BY P. G.
 DIST 4 HWY Q. E. W. BOREHOLE TYPE Cont. Flight Auger COMPILED BY N. A.
 DATUM Geodetic DATE 81-08-17 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 (%)	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20 40 60 80 100	W _p W W _L	WATER CONTENT (%)					
122.2	Ground Level									10 20 30			GR SA SI CL		
0.0	Fill Material Silty Clay some sand and gravel occasional organics Firm to very stiff		1	SS	10								Org. 2.9% Org. 1.6%	26 38 24 12 10 31 40 19 9 19 50 22	
			2	SS	5										
			3	SS	8										
			4	SS	10										
			5	SS	13										
			6	SS	26										
			7	SS	16										
115.5			8	SS	14										
6.7	Glacial Till*		9	SS	48										
113.8	Hard		10	SS	90										
113.4	Weathered shale		11	SS	100/13 cm										
8.8	End of Borehole														
	*Heterogeneous mixture of silty clay, sand and gravel														

+3, x5: Numbers refer to
Sensitivity

20
15
10
5 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 3

W P 169-67-03 LOCATION Sta. 10+034.0 11.0 m Rt. ORIGINATED BY P. G.
 DIST 4 HWY Q. E. W. BOREHOLE TYPE Cont. Flight Auger COMPILED BY N. A.
 DATUM Geodetic DATE 81 08 18 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				
121.2	Ground Level															GR SA SI CL
0.0	Fill Material		1	SS	8		120									
	Silty Clay, some sand and traces of gravel		2	SS	11											
	Occasional organic substances		3	SS	9											
	Firm to Hard		4	SS	9											
			5	SS	6											
			6	SS	33											
115.4			7	SS	19											
5.8	Organic Substances		8	SS	22											
	Glacial Till*		9	SS	29											
113.6	Very Stiff															
7.6	Weathered Shale		10	SS	100	13 cm										
112.4			11	SS	91											
8.8	End of Borehole						112									
	*Heterogeneous mixture of silty clay, sand and gravel															

+3, x5: Numbers refer to
Sensitivity

20
15 5 (%) STRAIN AT FAILURE
10



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RECORD OF BOREHOLE No 4

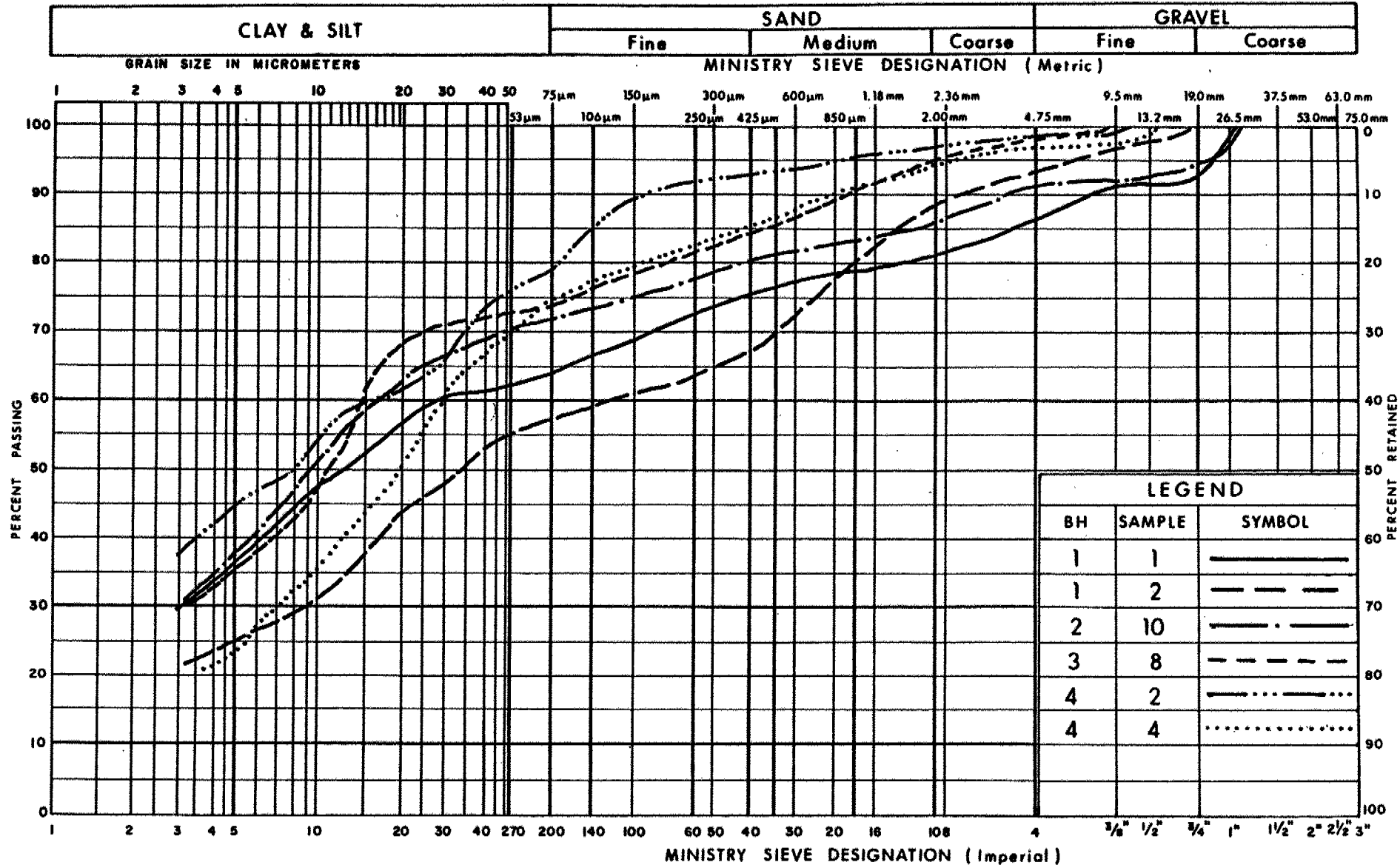
W P 169-67-03 LOCATION Sta. 10+028.0 32.0 m Lt. ORIGINATED BY P. G.
DIST 4 HWY Q. E. W. BOREHOLE TYPE Cont. Flight Auger COMPILED BY N. A.
DATUM Geodetic DATE 81-08-18 CHECKED BY

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								
116.5	Ground Level												
0.0	Top soil, and fill material												
115.3	Very stiff		1	SS	27								
1.2	organic substances		2	SS	8								
	Glacial Till**		3	SS	48								
	Firm to Hard		4	SS	79								
112.8	occasional shale fragments												
3.7	Shale		5	RC	94.7%								
110.2													
6.3	End of Borehole												
	*Silty clay, some sand and traces of gravel												
	**Heterogeneous mixture of silty clay, sand and gravel												

+3, x5: Numbers refer to
Sensitivity

20
15
10
5 (%) STRAIN AT FAILURE

UNIFIED SOIL CLASSIFICATION SYSTEM



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Communications

GRAIN SIZE DISTRIBUTION
GLACIAL TILL
HETEROGENEOUS MIX. OF SILTY CLAY SAND & GRAVEL

FIG No 1

W P 169-67-03

EXPLANATION OF TERMS USED IN REPORT

N VALUE: THE STANDARD PENETRATION TEST (SPT) N VALUE IS THE NUMBER OF BLOWS REQUIRED TO CAUSE A STANDARD 51mm O.D. SPLIT BARREL SAMPLER TO PENETRATE 0.3m INTO UNDISTURBED GROUND IN A BOREHOLE WHEN DRIVEN BY A HAMMER WITH A MASS OF 63.5kg, FALLING FREELY A DISTANCE OF 0.76m. FOR PENETRATIONS OF LESS THAN 0.3m N VALUES ARE INDICATED AS THE NUMBER OF BLOWS FOR THE PENETRATION ACHIEVED. AVERAGE N VALUE IS DENOTED THUS \bar{N} .

DYNAMIC CONE PENETRATION TEST: CONTINUOUS PENETRATION OF A CONICAL STEEL POINT (51mm O.D. 60° CONE ANGLE) DRIVEN BY 475 J IMPACT ENERGY ON 1" 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 (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'_{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	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

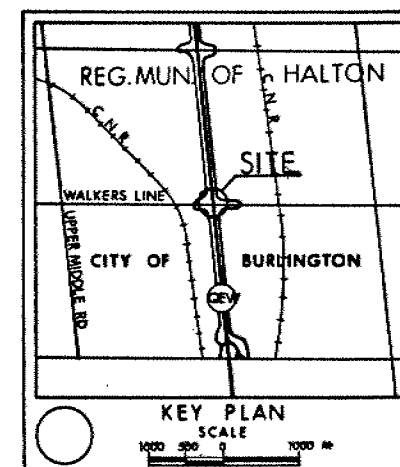
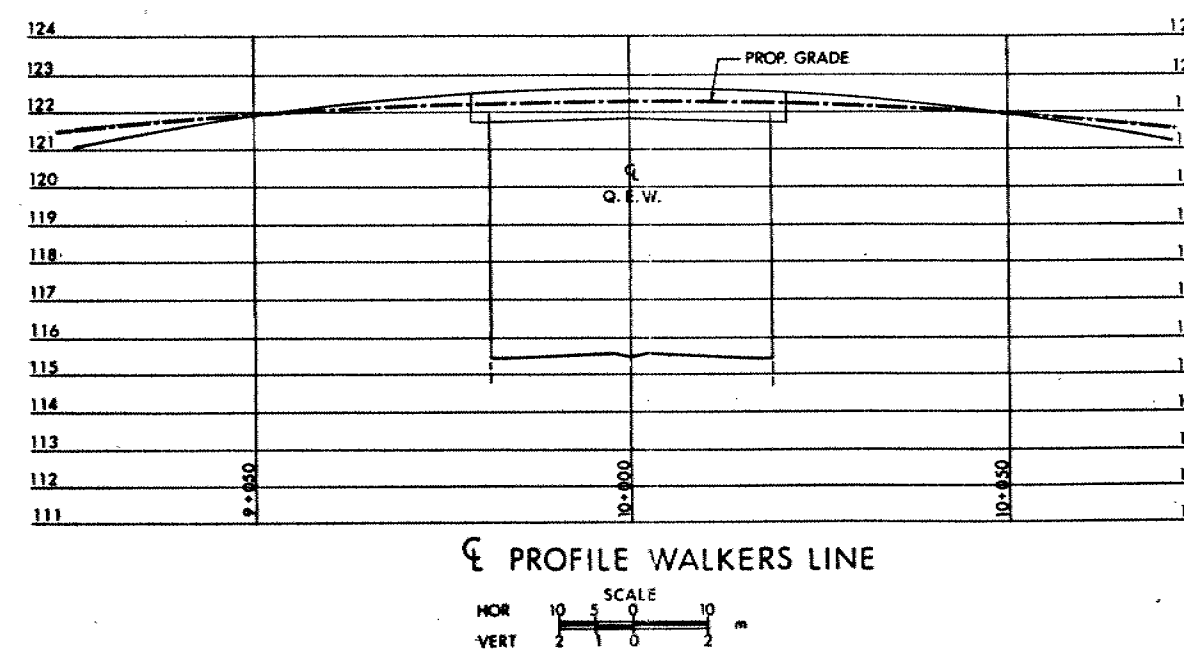
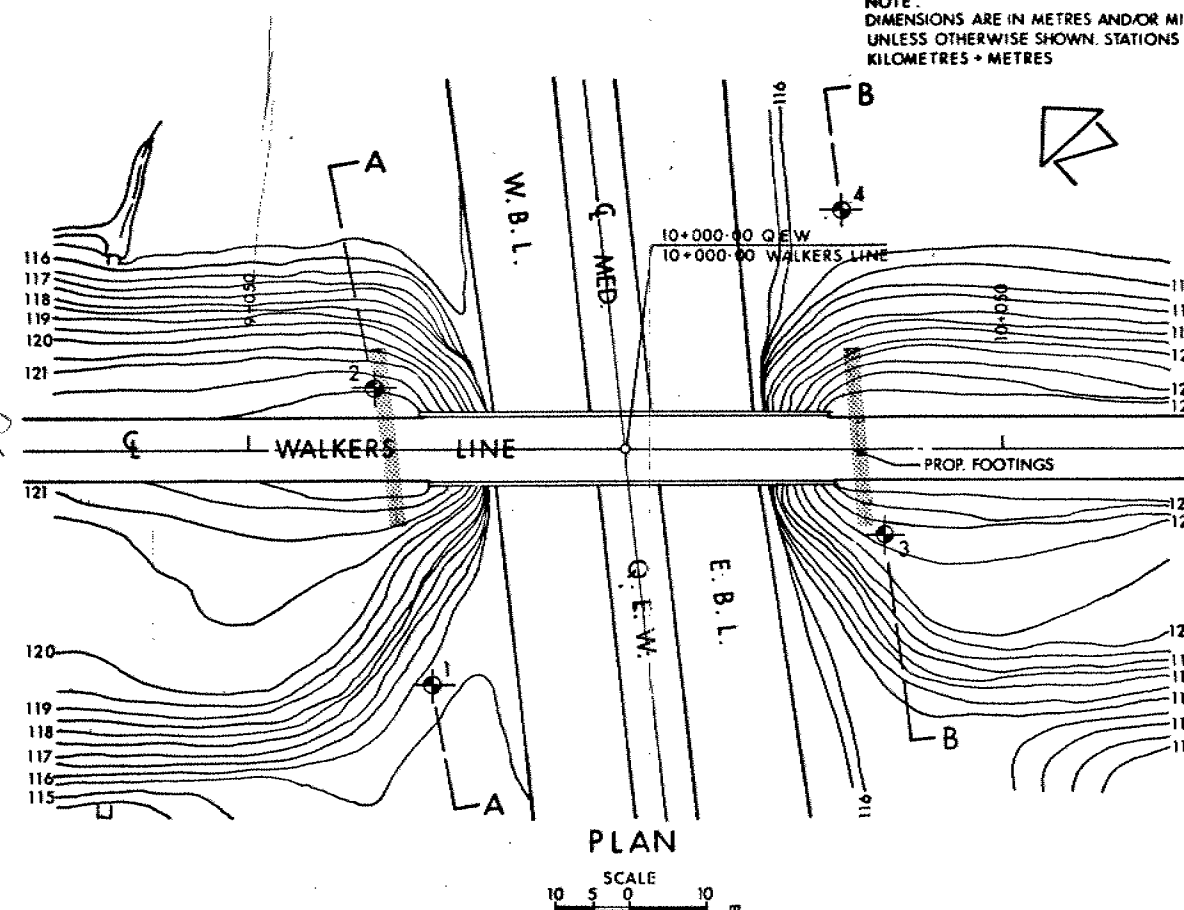
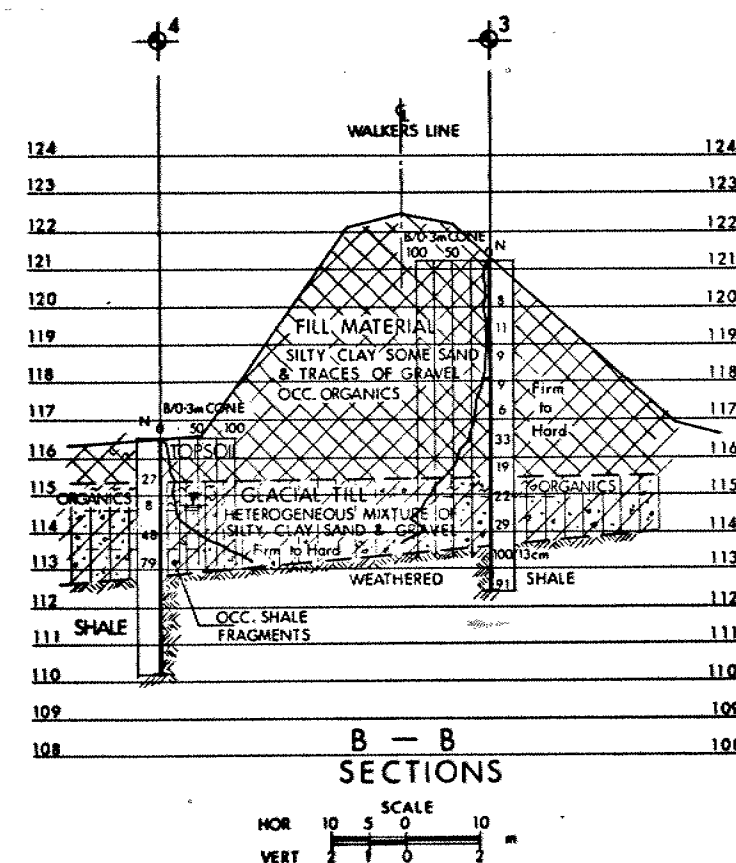
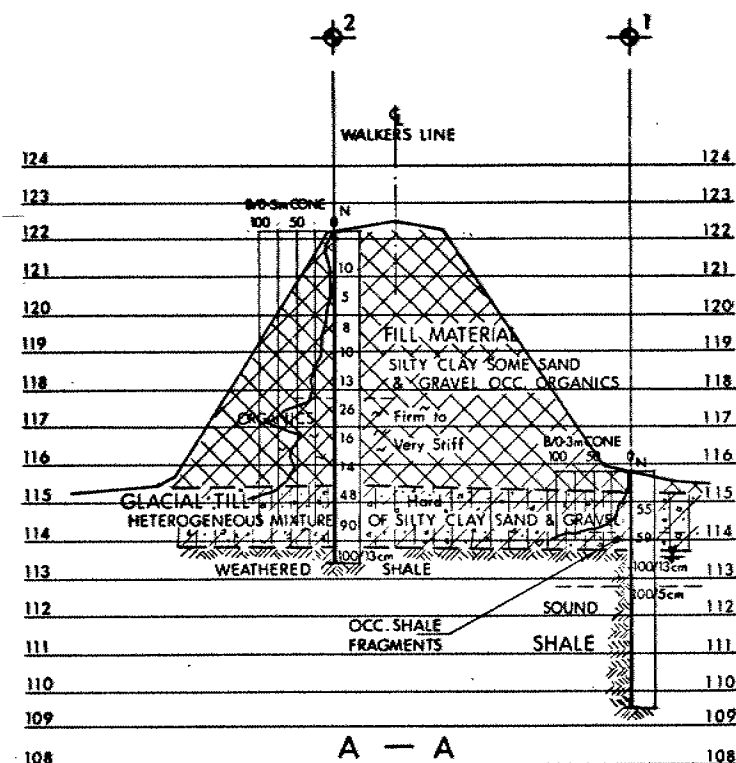
PHYSICAL PROPERTIES OF SOIL

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 = $w_L - w_p$	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 ²	SEEPAGE FORCE
γ'	kn/m ³	UNIT WEIGHT OF SUBMERGED SOIL						

METRIC

CONT No
WP No 169-67-03

WALKERS LINE UNDERPASS AT Q.E.W.
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)
- WL at time of investigation 81 08 18

No	ELEVATION	STATION	OFFSET
1	115.8	9+974.0	31.0 RT.
2	122.2	9+966.5	8.5 LT.
3	121.2	10+034.0	11.0 RT.
4	116.5	10+028.0	32.0 LT.

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

REVISIONS	DATE	BY	DESCRIPTION

Geocres No 30M5-132

HWY No	Q.E.W.	DIST	4
SUBWD P.G.	CHECKED	DATE	81 09 18
DRAWN	CHECKED	APPROVED	SITE 10-147
			DWG 1696703-A

memorandum



To: G.W. Henderson
Construction Analyst
Central Region
5000 Yonge St.

Tel: 235-3731
Date: 1987 06 18

From: Foundation Design Section
Room 315, Central Building

RE: Claim on Contract 86-44, Walkers Line Bridge
QEW, District 4, Burlington

This will confirm my advice to Mr. D. Guistini, Quality Assurance Supervisor in a telephone conversation October 1986 regarding pile driving operations on the abovementioned contract. Mr. Guistini requested guidance as to the penetration resistance at which to terminate driving. He explained that the hammer used was a B 400 and that they had reached a resistance of 30 blows per inch although the pile tips were still a few feet higher than the design elevation. I advised that driving could be terminated right away for the piles in question and that for future piles there was no need to exceed 30 blows per inch since this would indicate an adequate penetration into bedrock. Attached are copies of 6 piles driven on Contract 86-44. For these piles driving time within the bedrock ranged from about 2 to 10 minutes each with an average of 6 minutes per pile. Whilst penetrating the bedrock the driving resistance ranged from about 2 to 35 blows per inch.

Imperial units have been used in this memo as in the telephone conversation referred to above.

I hope the foregoing will be of use to you in your evaluation of the contractor's claim on this project. Please advise if further information is required.

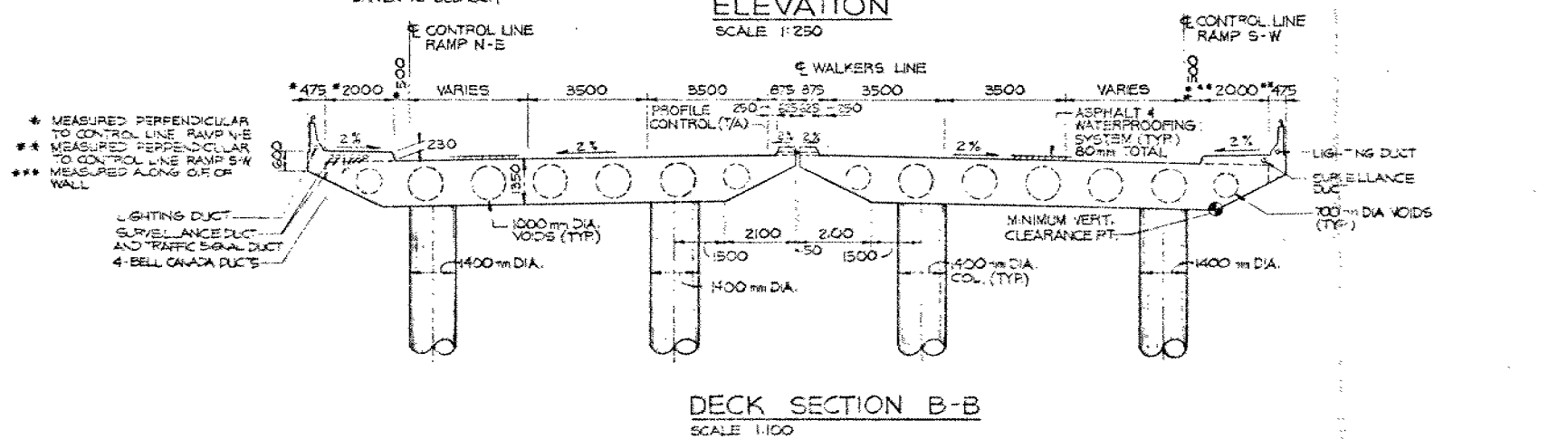
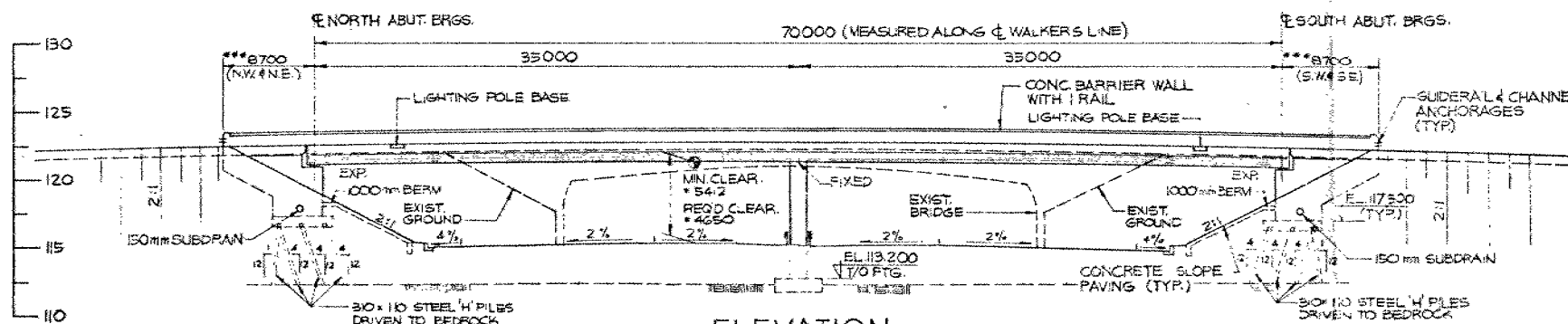
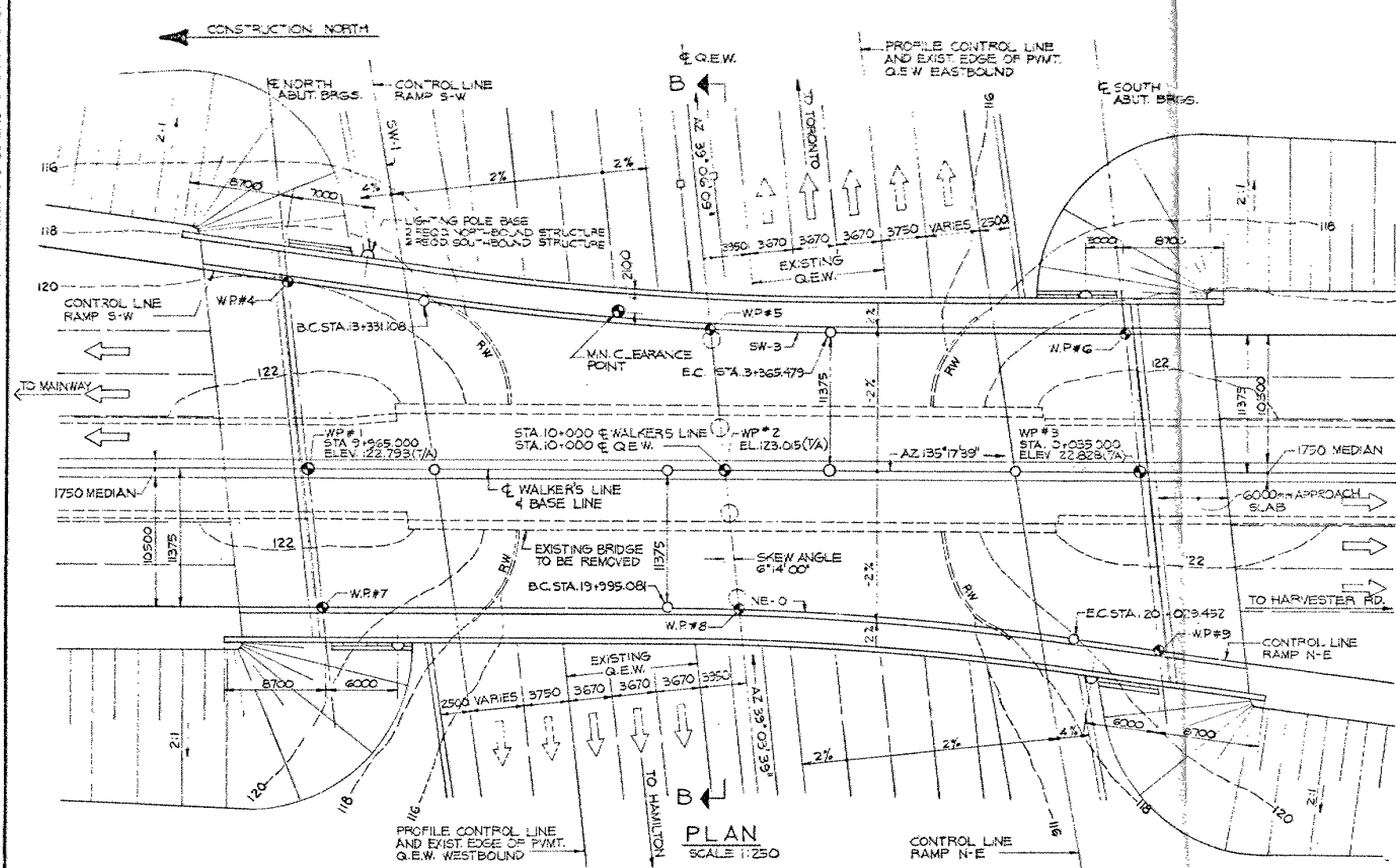
A handwritten signature in dark ink, appearing to read "K. G. Selby".

K.G. Selby
Chief Foundations Engineer
(West)

KGS/pb

c.c: D. Guistini

Attachment



M.T.C. - TORONTO
RECEIVED
JUN 29 1962
STRUCTURAL
OFFICE

METRIC

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

DISTRICT 4
CONT No
WP No 169-67-03

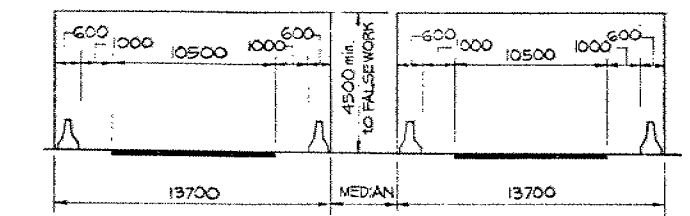
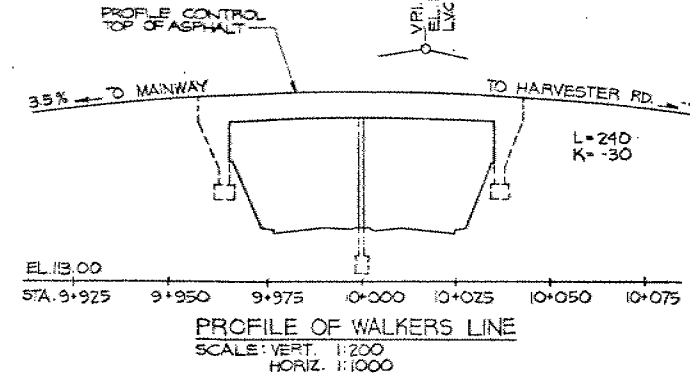
WALKER'S LINE UNDERPASS
Q.E.W.
GENERAL ARRANGEMENT

SHEET
110

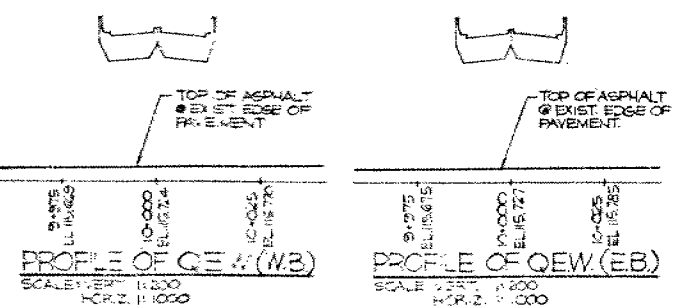
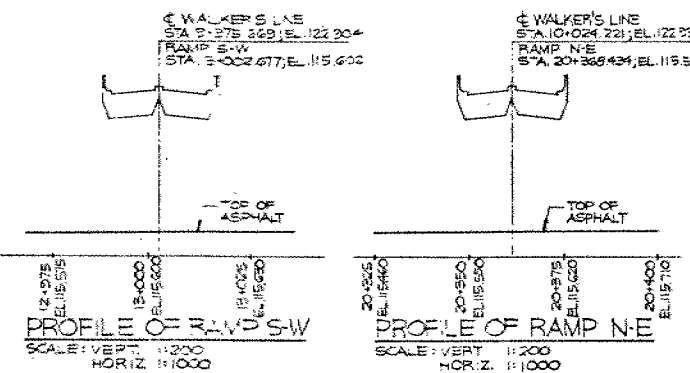
Underwood McLellan Ltd.
Consulting Engineers and Planners
Toronto

GENERAL NOTES:

- CLASS OF CONCRETE**
 - PIERS, DECKS & SIDEWALKS 35 MPa
 - BARRIER WALLS, ABUTMENTS & WING WALLS 30 MPa
 - REMAINDER 20 MPa
 - CLEAR COVER TO REINFORCING STEEL**
 - ABUTMENTS: FRONT FACE 80 ± 20
 - BACK FACE 70 ± 20
 - PIER COLUMNS 80 ± 20
 - FOOTINGS 100 ± 25
 - DECK: TOP 70 ± 20
 - BOTTOM 50 ± 10
 - REMAINDER 50 ± 10
 - GRADE OF REINFORCING STEEL**
 - REINFORCED STEEL SHALL BE GRADE 400
 - UNLESS OTHERWISE SPECIFIED, BARS MARKED WITH SUFFIX 'C' SHALL BE COATED BARS
- CONSTRUCTION NOTES:**
THE CONTRACTOR SHALL FINISH THE BEARING SEATS DEAD LEVEL TO THE SPECIFIED ELEVATIONS TO A TOLERANCE OF 3mm±.



NOTE: ALL HORIZONTAL DIMENSIONS ARE MINIMUM
DIMENSIONS REQUIRED



LIST OF DRAWINGS:

- GENERAL ARRANGEMENTS
- BOREHOLE LOCATIONS AND SOIL STRATA
- CONSTRUCTION STAGES
- FOUNDATION LAYOUT
- ABUTMENTS AND WING WALLS
- PIERS
- DECK DIMENSIONS & SKEED ELEVATIONS
- DECK LONGITUDINAL CABLES
- DECK TRANSVERSE CABLES
- DECK REINFORCING
- DECK REINFORCING DETAILS
- BARRIER WALL ON SIDEWALK
- RAILING FOR BARRIER WALL
- GOOD APPROACH SLABS
- DETAILS OF CONCRETE SLOPE PAVING
- AS CONSTRUCTED ELEVATIONS AND DIMENSIONS
- STANDARDS
- BRIDGE DATE AND SITE NUMBER DATA
- ELECTRICAL EMBEDDED WORK I
- ELECTRICAL EMBEDDED WORK II
- ELECTRICAL STANDARDS

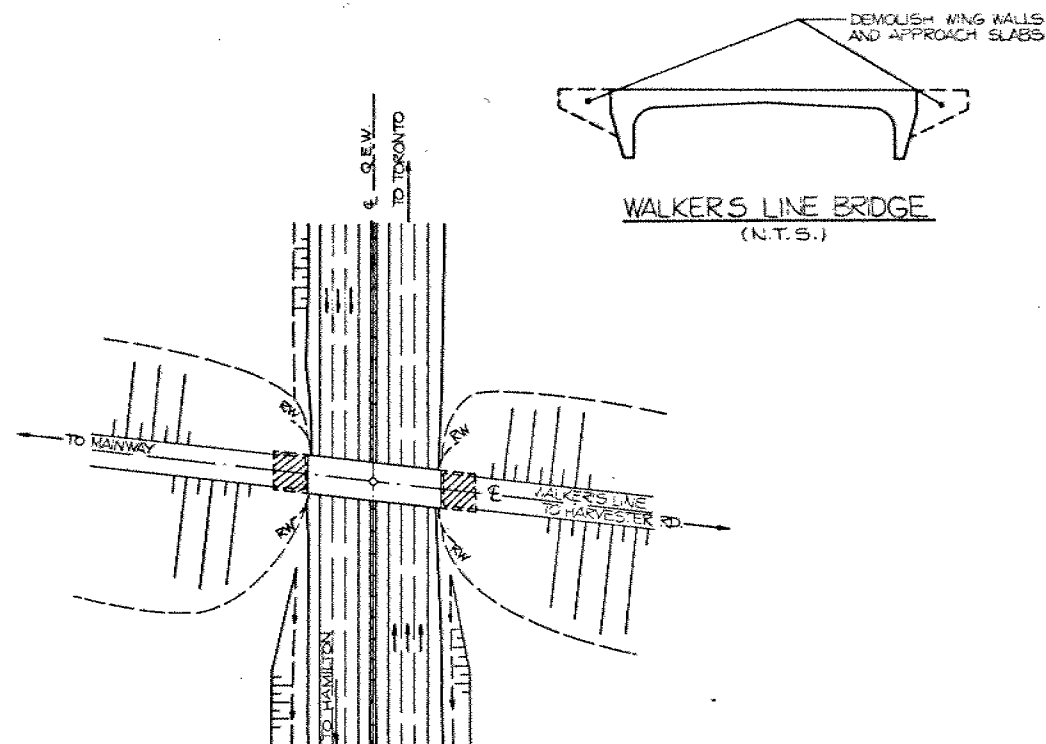
CONCRETE QUANTITIES: (FOR VOLUME SUM)

- CONCRETE IN BARRIER WALLS, ABUTMENTS AND WING WALLS 760 m³
- CONCRETE IN PIERS, DECKS, AND SIDEWALKS 2207 m³
- CONCRETE IN APPROACH SLABS 85 m³
- CONCRETE IN SLOPE PAVING 23 m³

NOTE:
WP - WORKING POINT
T/A - TOP OF ASPHALT PAVEMENT

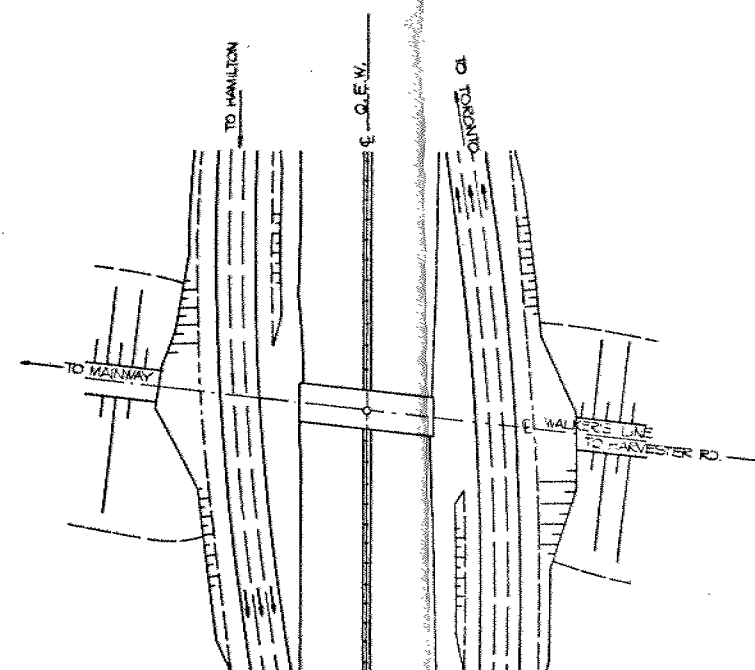
REVISIONS	DATE	BY	DESCRIPTION
DESIGN			
CHECK			
DRAWING			
CHECK			
SITE			

DRAWING NOT TO BE SCALED
100 mm ON ORIGINAL DRAWING



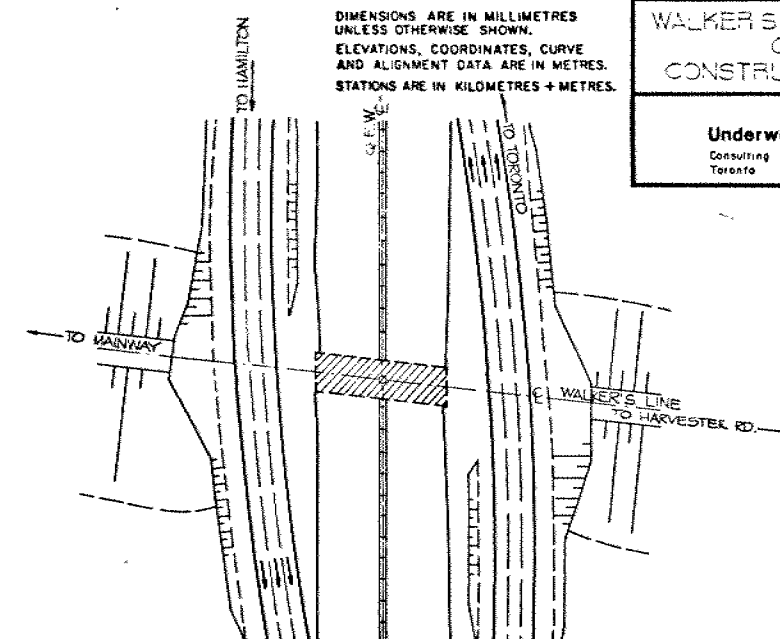
STAGE 1

1. CLOSE TRAFFIC ON WALKER'S LINE
2. DEMOLISH: APPROACH SLABS, WING WALLS AND RETAINING WALLS.



STAGE 2

- CONSTRUCT DETOUR AND DIVERT
Q.E.W. TRAFFIC.

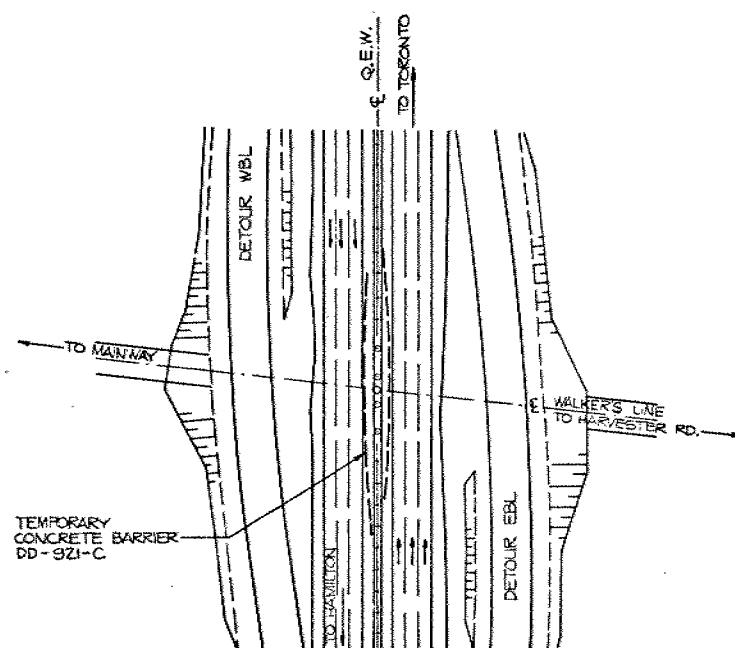


STAGE 3

1. DEMOLISH REMAINDER OF EXISTING BRIDGE
2. CONSTRUCT PIERS FOR BOTH HALVES OF NEW BRIDGE.
3. ERECT PART OF FALSEWORK OVER Q.E.W. TRAFFIC LANES SHOWN IN STAGE 4.

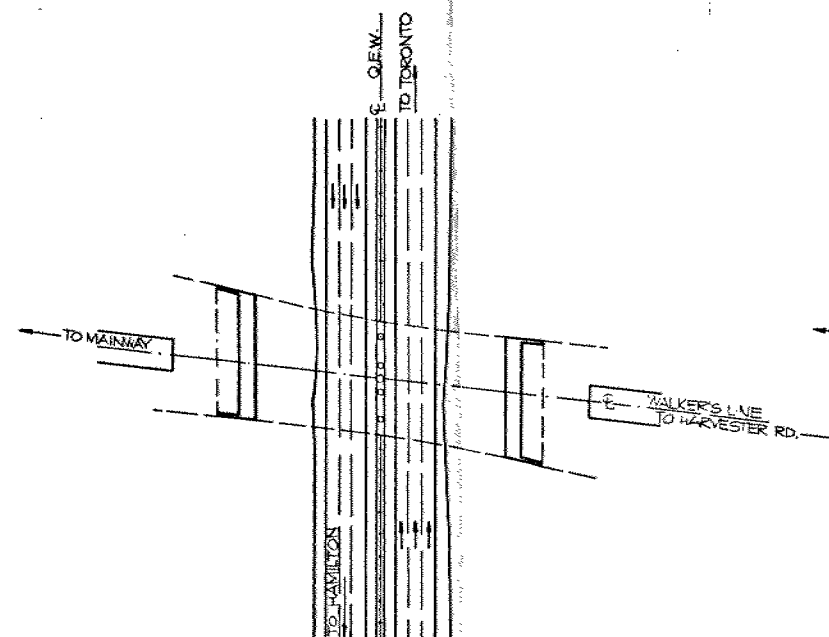
NOTES:

- FOR GENERAL NOTES, SEE DWG. 1
- FOR TRAFFIC STAGES SEE SHEET NOS 3 TO 9
- DURING DEMOLITION OF THE DECK, THE PAVEMENT ON THE G.E.W. SHALL BE PROTECTED AGAINST DAMAGE BY MEANS OF A 450 mm THICK LAYER OF SAND OR AS APPROVED BY THE ENGINEER.
- FOR ALIGNMENT OF DETOURS SEE SHEET NOS 34 TO 36.



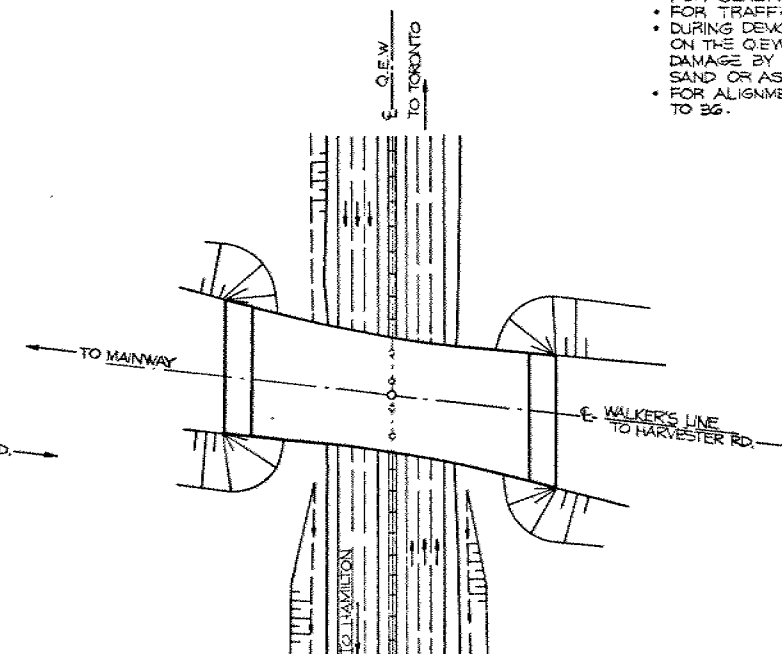
STAGE 4

- SWITCH QEW DETOUR TRAFFIC BACK TO QEW.



STAGE 5

- ERECT REMAINDER OF FALSEWORK
AND CONSTRUCT ABUTMENTS



STAGE 6

- CONSTRUCT REMANDER OF NEW BRIDGE

DRAWING NOT TO BE SCALED
100 mm ON ORIGINAL DRAWING

REVISIONS								
	DATE	BY	DESCRIPTION					
DESIGN	✓	✓	CHECK	✓	LOADING	✓	CHOC-A-79	DATE JUNE 98
DRAWING	✓	✓	CHECK	✓	SITE	✓	SWG	✓

DISTRICT 4
CONT No
WP No 163-67-03



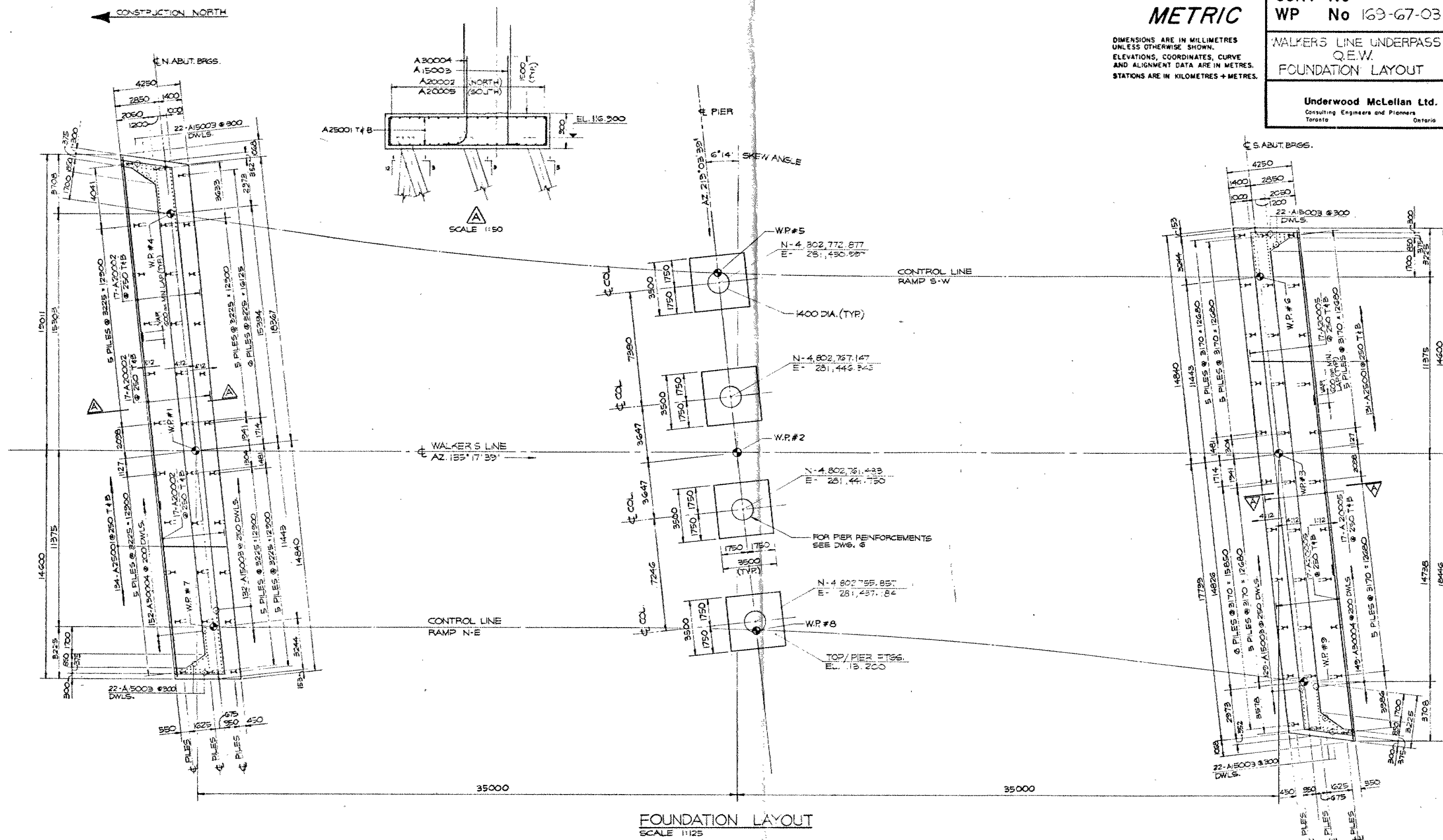
METRIC

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

WALKER'S LINE UNDERPASS
Q.E.W.
FOUNDATION LAYOUT

SHEET
13

Underwood McLeellan Ltd.
Consulting Engineers and Planners
Toronto Ontario



PILE DATA				
LOCATION	NO. REQD	LENGTH	TYPE	PILES TO BE
NORTH ABUT.	34	4400	30 WP 110	DRIVEN TO
SOUTH ABUT.	34	4650	30 WP 110	BEDROCK

NOTE: PILE LENGTHS SHOWN ARE THE
VERTICAL LENGTH BELOW CUTOFF

PILE DESIGN DATA
DESIGN LOAD AT S.L.S. TYPE II = 1150 KN
FACTORED CAPACITY AT U.L.S. = 1600 KN

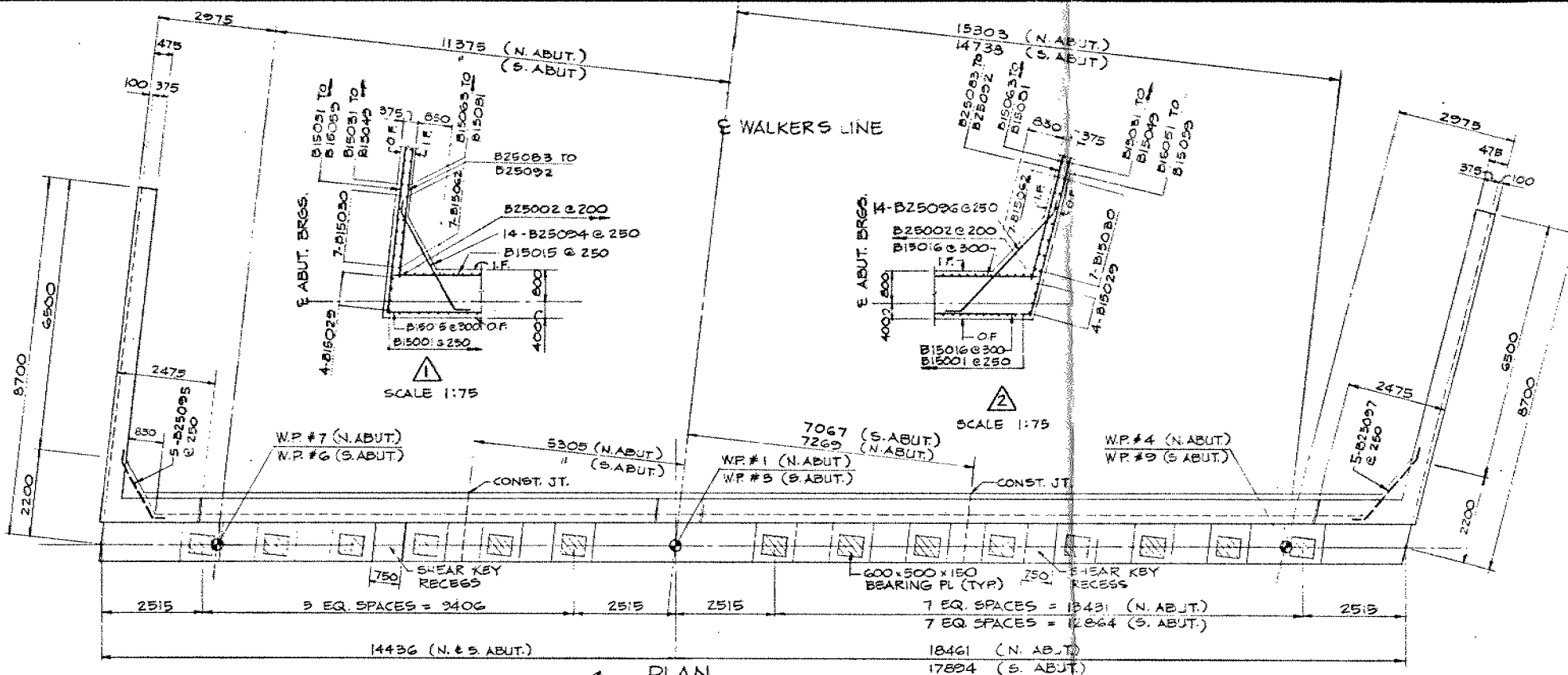
WORK POINTS		
CO-ORDINATES		
NO	NORTH	EAST
1	4,802,783.190	281,419.426
2	4,802,784.315	281,444.048
3	4,802,783.439	281,468.669
4	4,802,801.43	281,429.27
5	4,802,778.559	281,451.393
6	4,802,748.324	281,419.680
7	4,802,780.806	281,412.26
8	4,802,755.371	281,436.790
9	4,802,727.927	281,459.326

NOTES:

- FOR GENERAL NOTES SEE DWG. 1
- THIS DRAWING TO BE READ IN CONJUNCTION
WITH DWGS. 5 & 6.

DRAWING NOT TO BE SCALED
100 mm ON ORIGINAL DRAWING

REVISIONS		DATE		BY		DESCRIPTION	
DESIGN	3	CHECK	LOADING	3	DATE	1982	
DRAWING	5	CHECK	SITE	3	DATE	1982	



METRIC

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

DISTRICT 4
CONT No
WP No 69-67-03

WALKER'S LINE UNDERPASS
QEW
ABUTMENTS AND WINGWALLS

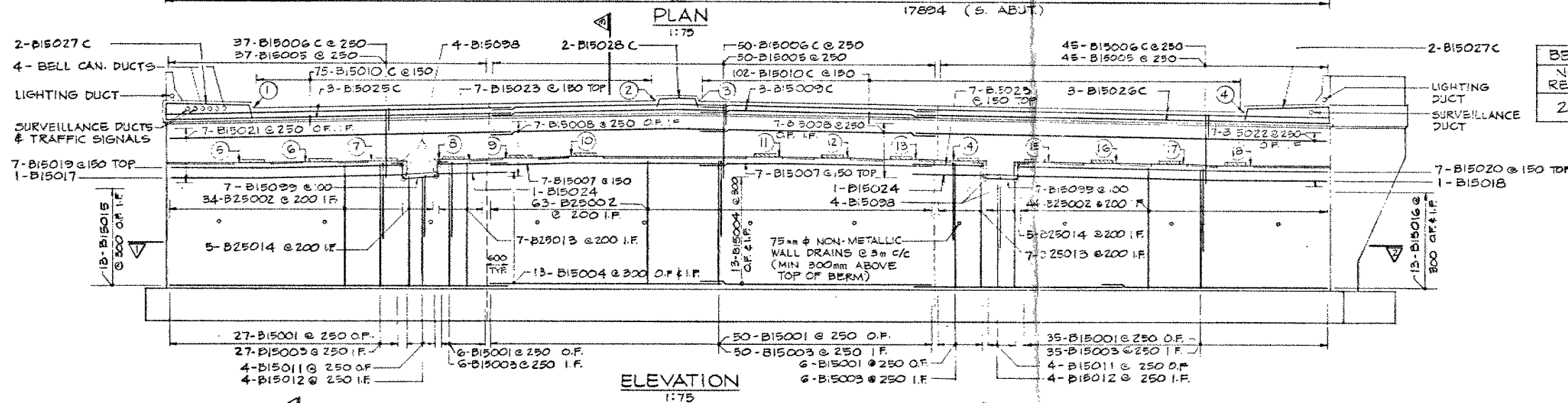
SHEET
114

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Consulting Engineers and Planners
Toronto Ontario

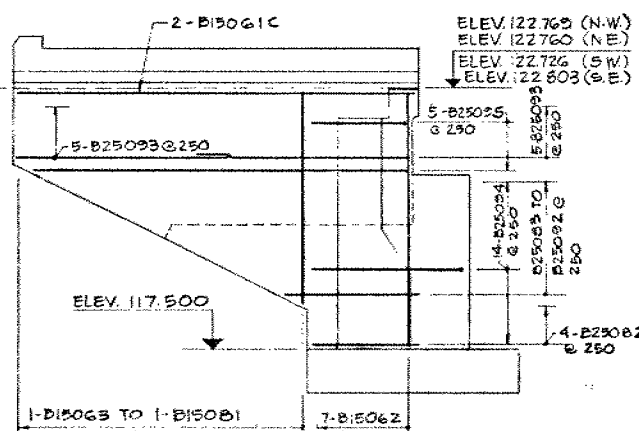
LOC PT.	N ABUTMENT ELEVATIONS	S ABUTMENT ELEVATIONS
1	122.483	122.519
2	122.693	122.730
3	122.692	122.729
4	122.366	122.403
5	120.966	121.001
6	121.001	121.036
7	121.036	121.071
8	121.071	121.106
9	121.106	121.141
10	121.141	121.176
11	121.135	121.170
12	121.094	121.131
13	121.053	121.093
14	121.013	121.054
15	120.972	121.015
16	120.932	120.977
17	120.891	120.938
18	120.850	120.899

BEARING SEATS

BEARING TYPE: LAMINATED ELASTOMERIC					
NO REQD	SIZE	DL	DL+LL+I	MAX MOVEMENT	HORIZONTAL SHEAR STIFF
28	600x500 x150 THK	1230 kN	1440 kN	72 mm	1.63 kN/mm

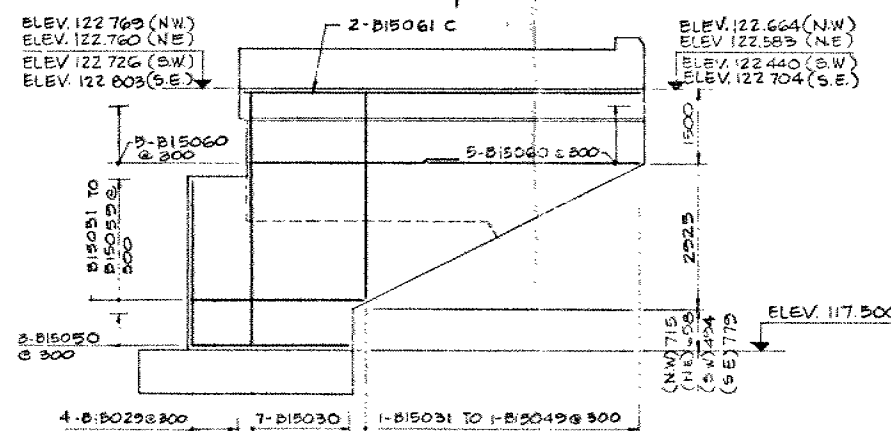


ELEV. 122.664 (N.W.)
ELEV. 122.583 (N.E.)
ELEV. 122.440 (S.W.)
ELEV. 122.704 (S.E.)



INSIDE FACE

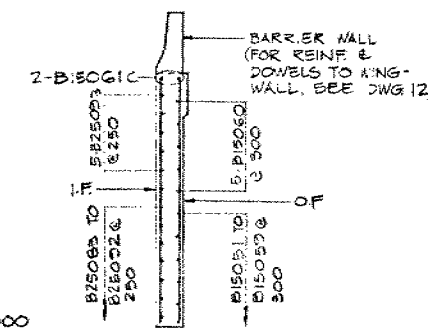
ELEV. 122.769 (N.W.)
ELEV. 122.760 (N.E.)
ELEV. 122.726 (S.W.)
ELEV. 122.803 (S.E.)



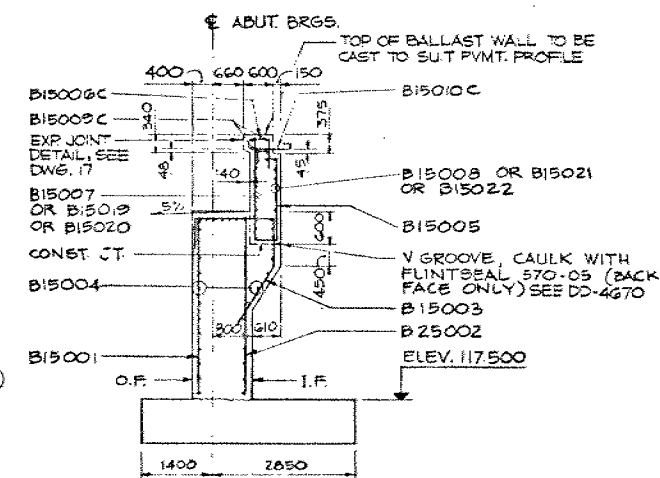
OUTSIDE FACE

TYPICAL ELEVATIONS - WINGWALLS

SCALE 1:75



SCALE 1:50



SCALE 1:75

NOTES:
FOR GENERAL NOTES, SEE DWG. 1
THIS DRAWING TO BE READ IN CONJUNCTION
WITH DWG. 4.

DRAWING NOT TO BE SCALED
100 mm ON ORIGINAL DRAWING

REVISIONS	DATE	BY	DESCRIPTION

memorandum



To: W. Lin
Design Engineer, Operating Section
Structural Office
3501 Dufferin St., 4th Floor

Date: 82 10 18

From: Pavement & Foundation Design Section
Room 315, Central Bldg.
Downsview

Re: W.P. 169-67-03, Site 10-44
Walker's Line Underpass
Hwy. Q.E.W., District 4 (Hamilton)

This section has reviewed the submitted final drawings and provisions for this underpass.

The design is in accordance with our foundation recommendations. However, please note that for widening of the approach embankments;

- if non-cohesive material is used, it will be necessary to bench the side slopes of the existing cohesive embankment
- if cohesive material is used, benching will not be required, but the vegetation and topsoil on the existing embankment should be removed before placing the new fill.

D. H. Dundas

for K.G. Selby, P. Eng.
Senior Foundations Engineer

DD:syc

cc: F. Norman, Planning & Design,
Central Reg.

memorandum



To: Mr. R. A. Jeffries,
Structural Supervisor,
Central Region

Date: 81 08 24

From: Pavement & Foundation Design Section,
Room 315, Central Building

Re: Foundation Investigation for Walker's
Line Underpass, Site 10 - 147
W. P. 169-67-03, Q. E. W., District 4

We have recently completed the fieldwork for the above-mentioned project, and are now in a position to provide you with a summary of our findings, together with detailed recommendations relating to the design and construction of the new structure. A complete report will be forwarded to you upon completion at a later date, however, the information and recommendations contained in this memorandum should be entirely adequate for your structural design purposes.

Existing and Proposed Structures

The existing structure at this site is a single span reinforced concrete bridge founded on spread footings within shale bedrock at elevation 112.6. The width of the bridge is 10.36 m and the span 34.75 m. It was constructed under Contract 58-632 and its present condition appears to be good. It is now proposed to replace this bridge with a new 62 m two span bridge about 24 m wide. The new \mathcal{C} of structure will be coincident with the existing \mathcal{C} of Walker's Line and the new profile grade some 0.25 m below that of the existing structure at \mathcal{C} of Median Q. E. W. Thus approach embankments some 7 m high will be required.

Subsurface Conditions

Subsoil at the site consists of about 6 m of fill material in the existing approaches which is comprised of firm to stiff silty clay with sand and gravel sized shale fragments, followed by about 2.5 m of glacial till consisting of hard silty clay with sand and gravel sized shale fragments followed by Queenston shale bedrock. Groundwater was observed to be at about elevation 113.4 on the north side of the Q. E. W. and about elevation 114.9 on the south side. The bedrock surface is at approximate elevation 113.5 some 2 m below the shoulders of the existing Q. E. W.

Recommendations

1. For the new structure, the pier and abutments may be founded on spread footings constructed within the Queenston shale bedrock. It

is recommended that these footings be founded at or below elevation 112.5 and that a net safe pressure of 1.0 MPa be assumed for design purposes. In computing resistance to lateral forces it may be assumed that a friction coefficient of 0.4 will apply between the footing base and the shale bedrock. Groundwater within excavations for footings should not pose any major problems and should be able to be handled by pumping from suitable sumps.

As an alternative to spread footings, the new abutments may be "perched" within the structure approaches and supported on steel H piles driven to bedrock. A design load of 1150 kN may be assumed for 310 HP @ 110 steel piles with reinforced tips. It is estimated that these piles will require to be driven to about elevation 112.0. For H piles of different size, the safe capacities may be assumed to be directly proportional to their cross sectional areas.

2. It is required to widen the existing approaches by about 7 m on each side. If non-cohesive material is used for this widening, it will be necessary to bench the side slopes of the existing cohesive embankments. If cohesive material is used for the widening, benching will not be required and it will be necessary only to remove all vegetation and topsoil before placing the new fill.

3. If the structure is to be designed under the new O. H. B. D. C., the following will be applicable.

(1) Spread Footings on Bedrock at el. 112.5

Factored bearing capacity at U. L. S. 1500 kPa
(Design not governed by settlement)
Friction coefficient between base and rock 0.40

(2) Piles Driven to Bedrock (el. 112.0)

(310 x 110 steel H Piles)
Factored capacity at U. L. S. 1600 kN
Capacity at S. L. S. Type II 1150 kN

For H piles of different size, the capacities may be assumed to be directly proportional to their cross sectional areas.

(3) Earth pressures should be computed as per Subsection 6.6.1.2.2. of the O. H. B. D. C.

The foregoing should be sufficient for your purposes. If additional information or clarification is required, please contact this office.

K. G. Selby

K. G. Selby,
Senior Foundation Engineer

KS/bd

cc: W. Lin
R. Fitzgibbon