

DOCUMENT MICROFILMING IDENTIFICATION

GEOCRES No. 30M5-104

DIST. 4 REGION

W.P. No. 125-66-05

CONT. No. 82-86

W. O. No.

STR. SITE No. 10-279

HWY. No. QEW

LOCATION 1.3 M W of Hwy 25

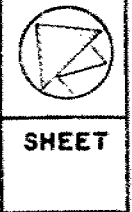
No of PAGES -

=====  
OVERSIZE DRAWINGS TO BE INCLUDED WITH THIS REPORT.

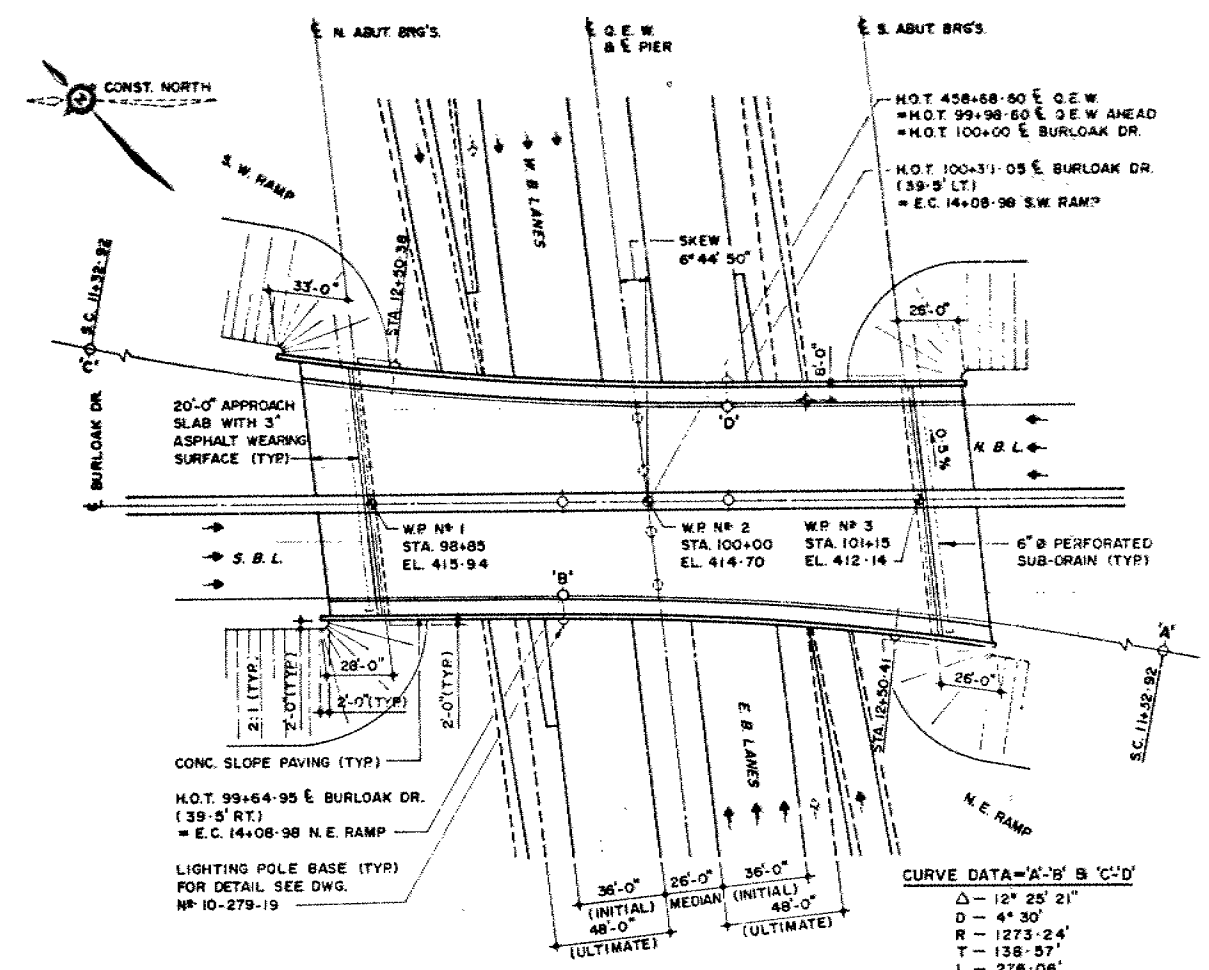
REMARKS:

CONT No  
WP No. 125-66-05

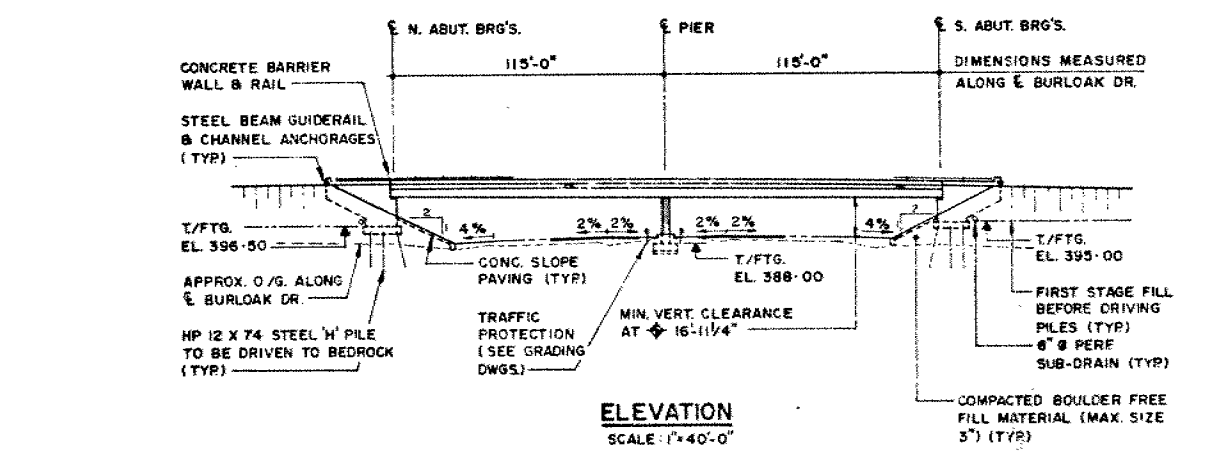
BURLOAK DRIVE UNDERPASS  
GENERAL ARRANGEMENT  
DISTRICT # 4



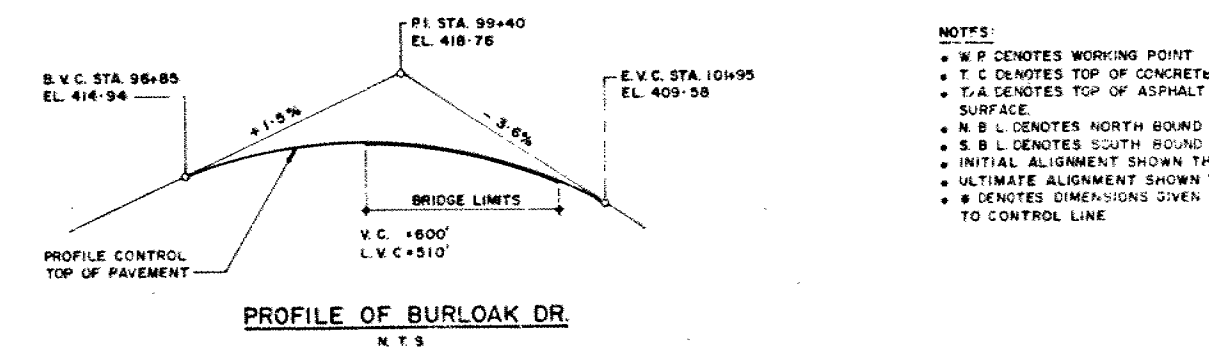
totten sims hubicki associates limited  
CONSULTANTS



PLAN  
SCALE 1" = 40'-0"

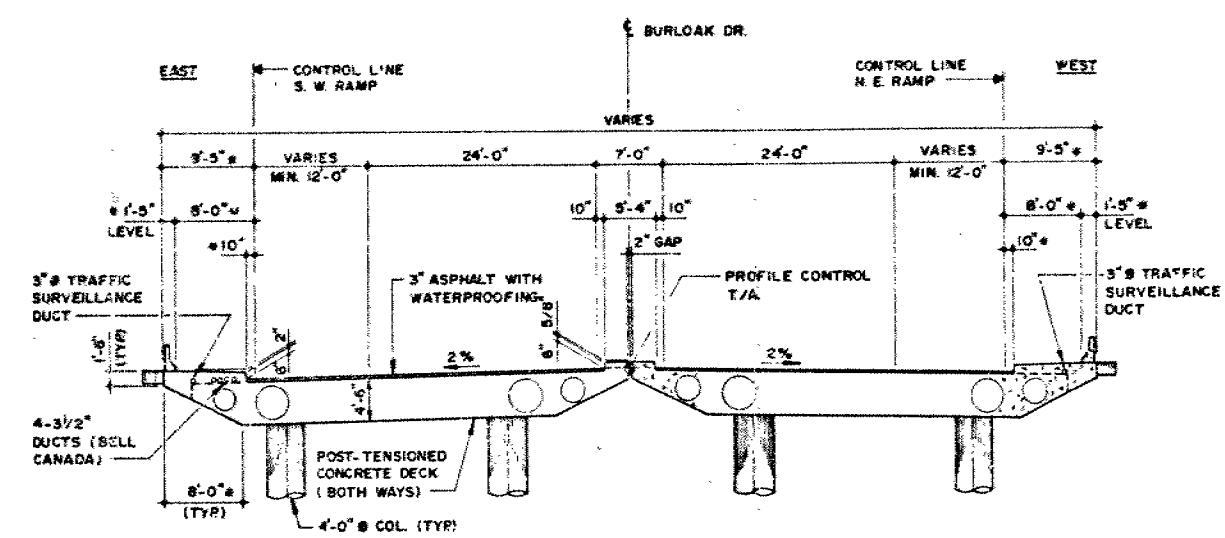


ELEVATION  
SCALE 1" = 40'-0"

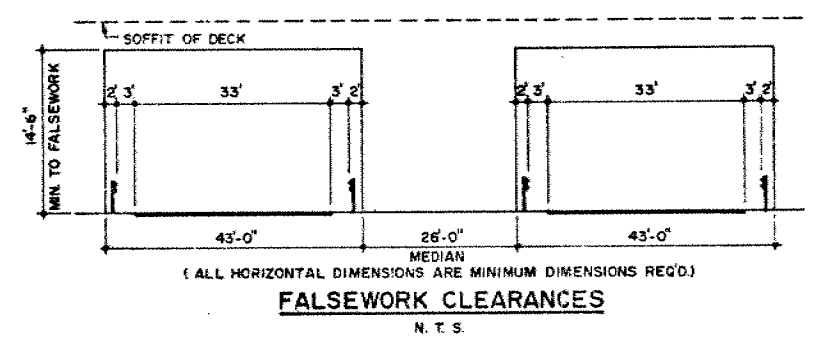


PROFILE OF BURLOAK DR.  
N.T.S.

- NOTES:
- W.P. DENOTES WORKING POINT
  - T.C. DENOTES TOP OF CONCRETE JAM
  - T.A. DENOTES TOP OF ASPHALT WEARING SURFACE
  - N.B.L. DENOTES NORTH BOUND LANE
  - S.B.L. DENOTES SOUTH BOUND LANE
  - INITIAL ALIGNMENT SHOWN THUS
  - ULTIMATE ALIGNMENT SHOWN THUS
  - \* DENOTES DIMENSIONS GIVEN RADIALY TO CONTROL LINE



TYP DECK CROSS SECTION  
SCALE 1" = 10'-0"



FALSEWORK CLEARANCES  
N.T.S.

NOTES:

- CLASS OF CONCRETE:
- DECKS, SIDEWALKS & MEDIAN 3,000 P.S.I.
  - ABUTMENTS, PIERS & BARRIER WALLS 4,000 P.S.I.
  - REMAINDER 3,000 P.S.I.

- CLEAR COVER TO REINFORCING STEEL:
- FOOTINGS & ABUTMENTS 3"
  - DECKS: TOP - 2" BOT - 1 1/2"
  - SIDEWALKS, MEDIAN & APPROACH SLABS 2"
  - BARRIER WALLS AS NOTED
  - COLUMNS 2 1/2"

- CONSTRUCTION:
- THE CONTRACTOR IS RESPONSIBLE FOR FINISHING THE BEARING SEATS DEAD LEVEL TO THE SPECIFIED ELEVATIONS WITH A TOLERANCE OF  $\pm 1/8"$ .
  - NO CONCRETE SHALL BE PLACED ABOVE THE ABUTMENT BEARING SEATS UNTIL THE CONCRETE IN DECK HAS BEEN PLACED, STRESSED AND GROUTED.
  - REINFORCING STEEL SHALL BE IN ACCORDANCE WITH C.S.A. G 30-12-M1977, GRADE 400 EXCEPT AS NOTED. REINFORCING BARS WITH THE DESIGNATION 'C' AT THE END OF BAR MARKS SHALL BE COATED BARS.
  - TO ACHIEVE THE MINIMUM CLEAR COVER OF 2" SPECIFIED, THE TOP LAYER OF DECK STEEL SHALL BE PLACED PRIOR TO CONCRETING WITH A CLEAR COVER OF 2 1/2"  $\pm 1/2"$  TOLERANCE.

LIST OF DRAWINGS:

- 10-279-1-GENERAL ARRANGEMENT
- 2-BORHOLE LOCATIONS & SOIL STRATA
- 3-FOOTINGS
- 4-NORTH ABUTMENT
- 5-SOUTH ABUTMENT
- 6-PIER
- 7-DECK LAYOUT
- 8-LONGITUDINAL CABLE LAYOUT
- 9-LONGITUDINAL CABLE DETAILS
- 10-TRANSVERSE CABLES
- 11-DECK REINFORCEMENT - I
- 12-DECK REINFORCEMENT - II
- 13-BARRIER WALL WITH SIDEWALK
- 14-20 FT. APPROACH SLAB
- 15-STEEL RAILING (SINGLE TUBE)
- 16-DETAIL OF CONC SLOPE PAVING
- 17-STANDARDS
- 18-STANDARD
- 19-STANDARDS
- 20-AS CONSTRUCTED ELEV. & DIM.



FUNCTIONS OF  
6° 44' 50"

SIN.	0.11749
COS.	0.99307
TAN.	0.11831
SEC.	1.00697

CONCRETE QUANTITIES

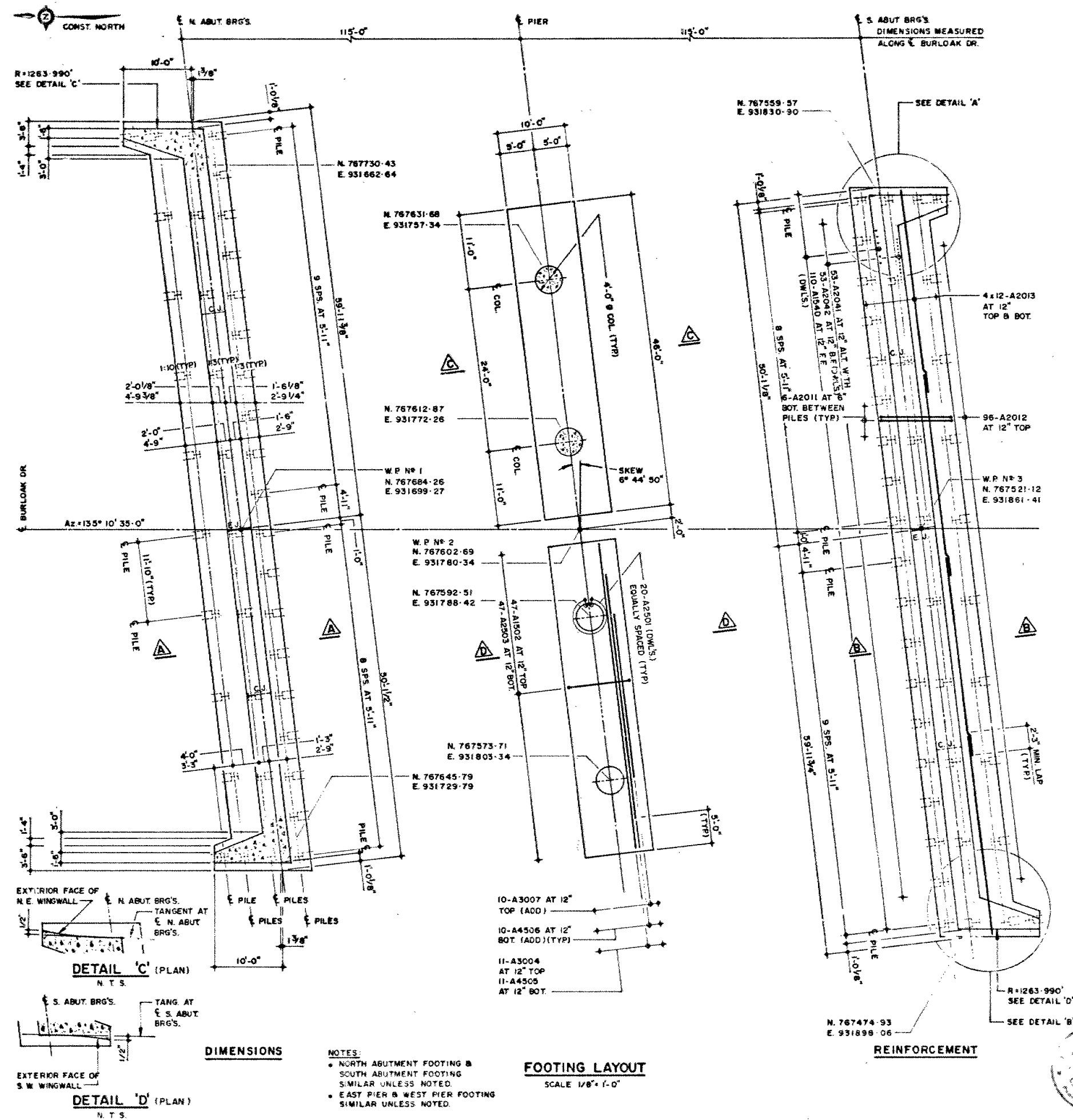
CONCRETE QUANTITIES ARE LISTED BELOW FOR THE APPROPRIATE CONCRETE LUMP SUM TENDER ITEMS:	
CONCRETE IN PIERS, ABUTMENTS AND WINGWALLS	599 Cu. Yd.
PRESTRESSED CONCRETE BRIDGE DECK	2753 Cu. Yd.
CONCRETE IN BARRIER WALLS	45 Cu. Yd.
CONCRETE IN APPROACH SLABS	123 Cu. Yd.
CONCRETE IN SLOPE PAVING	63 Cu. Yd.



FOR REDUCED PLAN  
USE SCALE BELOW



DATE	BY	DESCRIPTION
DESIGN	T.M.	CHECK P.Y. LOADING HS 20-44
DRAWING	AG	CHECK SITE No. 10-273 DWG. 1



LIST OF PILES			
LOCATION	N°	LENGTH	TYPE
NORTH ABUT.	41	18'-0"	HP 12 X 74
SOUTH ABUT.	41	20'-0"	HP 12 X 74

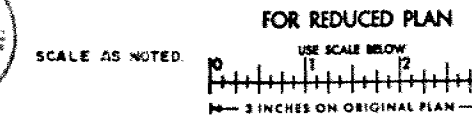
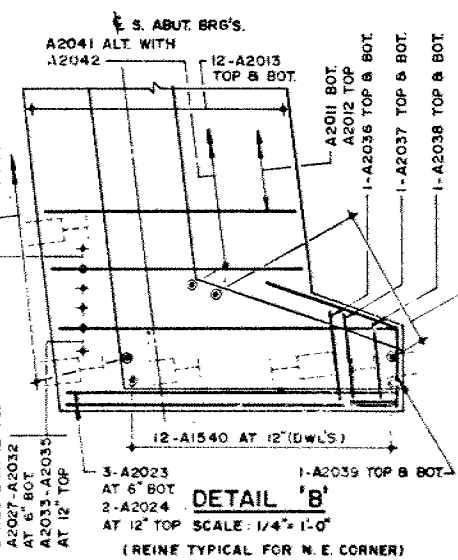
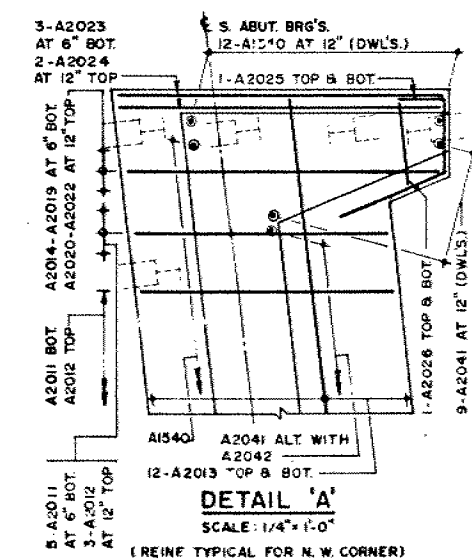
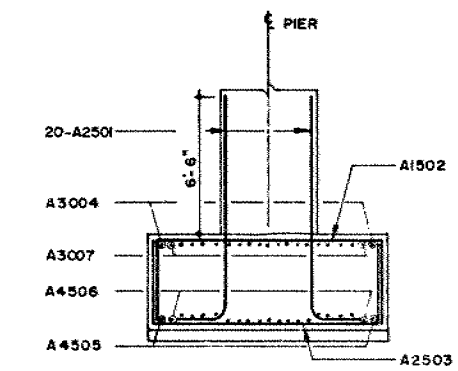
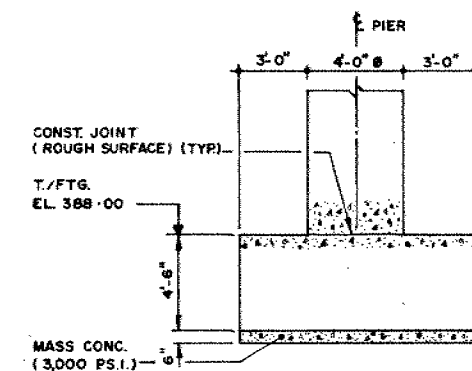
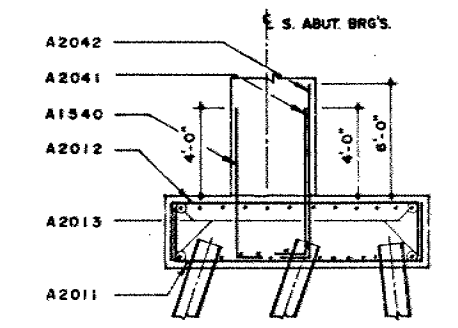
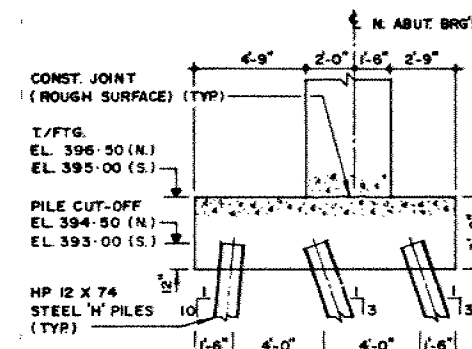
- NOTES:**
- SPACING OF PILES TO BE MEASURED AT UNDERSIDE OF FOOTINGS.
  - PILES TO BE DRIVEN TO BEDROCK.
  - SIDES OF PIER FOOTING AND MASS CONCRETE UNDER PIER TO BE CAST ON UNDISTURBED MATERIAL WITHIN 24 HRS AFTER EXCAVATION IS COMPLETED.
  - DESIGN BEARING PRESSURE UNDER PIER FOOTINGS 14 K.S.F.

CONT No  
WP No 125-66-05

BURLOAK DRIVE UNDERPASS  
FOOTINGS

SHEET

totten sims hubicki associates limited  
CONSULTANTS



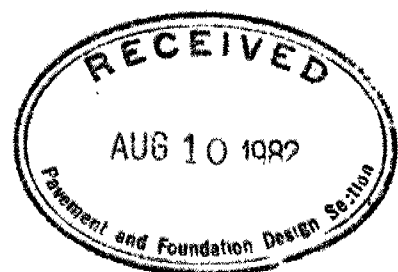
REVISIONS	DATE	BY	DESCRIPTION
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			

# FOUNDATION INVESTIGATION REPORT

CONTRACT NO 82-86



Ministry of  
Transportation and  
Communications



INDEX

<u>Page No.</u>	<u>Description</u>
1	Index
2	Abbreviations and Symbols
3	Soil Classification System
4 - 13	Foundation Investigation Report For W.P. 125-66-05 Burloak Drive Underpass

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

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

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

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

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

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

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

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

**ROCK QUALITY:** ROCKS ARE DESCRIBED BY THEIR COMPOSITION AND STRUCTURAL FEATURES AND/OR STRENGTH.

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

**MODIFIED RECOVERY:** SUM OF THOSE NATURALLY FRACTURED CORE PIECES, 4" IN LENGTH EXPRESSED AS A PERCENT OF THE LENGTH OF THE CORING RUN. THE ROCK QUALITY DESIGNATION (RQD), FOR MODIFIED RECOVERY, IS:

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

**JOINTING AND BEDDING:**

SPACING	2"	2" - 12"	1' - 3'	3' - 10'	> 10'
JOINTING	VERY CLOSE	CLOSE	MOD. CLOSE	WIDE	VERY WIDE
BEDDING	VERY THIN	THIN	MEDIUM	THICK	VERY THICK

### ABBREVIATIONS & SYMBOLS




#### LABORATORY TESTING

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

#### FIELD SAMPLING

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

#### EARTH PRESSURE TERMS

$\mu$  COEFFICIENT OF FRICTION  
 $\delta$  ANGLE OF WALL FRICTION  
 $k_o$  COEFFICIENT OF EARTH PRESSURE AT REST  
 $k_A$  COEFFICIENT OF ACTIVE EARTH PRESSURE  
 $k_P$  COEFFICIENT OF PASSIVE EARTH PRESSURE  
 $i$  ANGLE OF INCLINATION OF SURCHARGE   
 $w$  SLOPE ANGLE-BACKFACE OF WALL   
 $\beta$  ANGLE OF SLOPE   
 $N_q, N_c, N_{\gamma}$  BEARING CAPACITY FACTORS  
 $D_f$  DEPTH OF FOOTING  
 $B, L$  FOOTING DIMENSIONS

#### INDEX PROPERTIES

$\gamma$  UNIT WEIGHT OF SOIL (BULK DENSITY)  
 $\gamma_w$  UNIT WEIGHT OF WATER  
 $\gamma_d$  UNIT DRY WEIGHT OF SOIL (DRY DENSITY)  
 $\gamma'$  UNIT WEIGHT OF SUBMERGED SOIL  
 $G_s$  SPECIFIC GRAVITY OF SOLIDS  
 $e$  VOIDS RATIO  
 $e_o$  INITIAL VOIDS RATIO  
 $e_{max}$   $e$  IN LOOSEST STATE  
 $e_{min}$   $e$  IN DENSEST STATE  
 $D_r$  RELATIVE DENSITY =  $\frac{e_{max} - e}{e_{max} - e_{min}}$   
 $n$  POROSITY  
 $w$  WATER CONTENT  
 $w_L$  LIQUID LIMIT  
 $w_p$  PLASTIC LIMIT  
 $w_s$  SHRINKAGE LIMIT  
 $I_p$  PLASTICITY INDEX =  $w_L - w_p$   
 $I_L$  LIQUIDITY INDEX =  $\frac{w - w_p}{I_p}$   
 $I_c$  CONSISTENCY INDEX =  $\frac{w_L - w}{I_p}$   
 $A_c$  ACTIVITY =  $\frac{I_p}{2.45 - 0.009 I_p}$  Soil Fraction  
 $O_m$  ORGANIC MATTER CONTENT  
 $S_r$  DEGREE OF SATURATION  
 $S$  SENSITIVITY =  $\frac{S_u(\text{undisturbed})}{S_u(\text{remoulded})}$

#### STRENGTH PARAMETERS

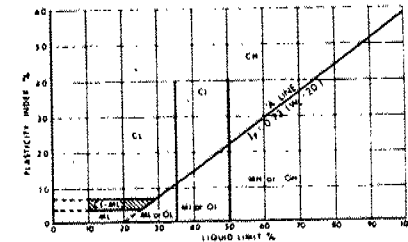
$\phi$  ANGLE OF SHEARING RESISTANCE  
 $\tau_f$  PEAK SHEAR STRENGTH  
 $\tau_R$  RESIDUAL SHEAR STRENGTH  
 $c$  COHESION INTERCEPT  
 $\sigma_1, \sigma_2, \sigma_3$  NORMAL PRINCIPAL STRESSES  
 $u$  PORE WATER PRESSURE  
 $u_e$  EXCESS  $u$   
 $r_u$  PORE PRESSURE RATIO  
 $q_u$  UNCONFINED COMPRESSIVE STRENGTH  
 $s_u$  UNDRAINED SHEAR STRENGTH  
 $\epsilon$  LINEAR STRAIN  
 $\gamma$  SHEAR STRAIN  
 $\nu$  POISSON'S RATIO  
 $E$  MODULUS OF ELASTICITY  
 $G$  MODULUS OF SHEAR DEFORMATION  
 $k_s$  MODULUS OF SUBGRADE REACTION  
 $m, n$  STABILITY COEFFICIENTS  
 $A, B$  PORE PRESSURE COEFFICIENTS  
**NOTE:** EFFECTIVE STRESS PARAMETERS ARE DENOTED BY USE OF APOSTROPHE ABOVE THE SYMBOL, THUS:  
 $\phi'$  = EFFECTIVE ANGLE OF SHEARING RESISTANCE;  
 $\sigma'$  = EFFECTIVE NORMAL STRESS

#### HYDRAULIC TERMS

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

# EXTENDED CASAGRANDE SOIL CLASSIFICATION SYSTEM

FIELD IDENTIFICATION PROCEDURES (EXCLUDING PARTICLES LARGER THAN 75 μm AND BASING FRACTIONS ON ESTIMATED MASS)						GRP SYMP	TYPICAL NAMES	INFORMATION REQUIRED FOR DESCRIBING SOILS	LABORATORY CLASSIFICATION CRITERIA			
COARSE GRAINED SOILS MORE THAN HALF OF MATERIAL IS LARGER THAN 75 μm (LARGER THAN 4.75 mm)	GRAVELS	CLEAN GRAVELS (LITTLE OR NO FINES)	WIDE RANGE IN GRAIN SIZE & SUBSTANTIAL AMOUNTS OF ALL INTERMEDIATE PARTICLE SIZE			GW	WELL GRADED GRAVELS, GRAVEL-SAND MIXTURES; LITTLE OR NO FINES	GIVE TYPE, NAME, IF NECESSARY, INDICATE APPROX % OF SAND & GRAVEL, MAX. SIZE; ANGULARITY, SURFACE CONDITION, & HARDNESS OF THE COARSE GRAINS, LOCAL OR GEOLOGIC NAME & OTHER PERTINENT DESCRIPTIVE INFORMATION; & SYMBOL IN PARENTHESES.  FOR UNDISTURBED SOILS ADD INFORMATION ON STRATIFICATION, DEGREE OF COMPACTNESS, CEMENTATION, MOISTURE CONDITIONS & DRAINAGE CHARACTERISTICS	DETERMINE PERCENTAGES OF GRAVEL & SAND FROM GRAIN SIZE CURVE, DEPENDING ON PERCENTAGE OF FINES (FRACTION SMALLER THAN 75 μm) COARSE GRAINED SOILS ARE CLASSIFIED AS FOLLOWS:  LESS THAN 5% GW, GP, SM, SP MORE THAN 12% GM, GC, SH, SC 5% TO 12% <b>BORDERLINE CASES</b> REQ. USE OF DUAL SYMBOLS			
			PREDOMINANTLY ONE SIZE OF A RANGE OF SIZES WITH SOME INTERMEDIATE SIZES MISSING			GP	POORLY GRADED GRAVELS, GRAVEL-SAND MIXTURES, LITTLE OR NO FINES		$C_u = \frac{D_{60}}{D_{10}}$ GREATER THAN 4 $C_c = \frac{(D_{30})^2}{D_{10} \cdot D_{60}}$ BETWEEN ONE AND 3  NOT MEETING ALL GRADATION REQUIREMENTS FOR GW			
		GRAVEL WITH FINES (APPRECIABLE AMOUNT OF FINES)	NON-PLASTIC FINES (FOR IDENTIFICATION PROCEDURES SEE ML BELOW)			GM	SILTY GRAVELS, POORLY GRADED GRAVEL-SAND-SILT MIXTURES		ATTERBERG LIMITS BELOW A-LINE, OR $I_p$ LESS THAN 4			
			PLASTIC FINES (FOR IDENTIFICATION PROCEDURES SEE CL BELOW)			GC	CLAYEY GRAVELS, POORLY GRADED GRAVEL-SAND-CLAY MIXTURES		ATTERBERG LIMITS ABOVE A-LINE WITH $I_p$ GREATER THAN 7			
	SANDS	CLEAN SANDS (LITTLE OR NO FINES)	WIDE RANGE IN GRAIN SIZES & SUBSTANTIAL AMOUNTS OF ALL INTERMEDIATE PARTICLE SIZES			SW	WELL GRADED SANDS, GRAVELLY SANDS; LITTLE OR NO FINES		$C_u = \frac{D_{60}}{D_{10}}$ GREATER THAN 6 $C_c = \frac{(D_{30})^2}{D_{10} \cdot D_{60}}$ BETWEEN ONE AND 3  NOT MEETING ALL GRADATION REQUIREMENTS FOR SW			
			PREDOMINANTLY ONE SIZE OR A RANGE OF SIZES WITH SOME INTERMEDIATE SIZES MISSING			SP	POORLY GRADED SANDS, GRAVELLY SANDS; LITTLE OR NO FINES		ATTERBERG LIMITS BELOW A-LINE OR $I_p$ LESS THAN 4			
		SANDS WITH FINES (APPRECIABLE AMOUNT OF FINES)	NON-PLASTIC FINES (FOR IDENTIFICATION PROCEDURES SEE ML BELOW)			SM	SILTY SANDS, POORLY GRADED SAND-SILT MIXTURES		ATTERBERG LIMITS ABOVE A-LINE WITH $I_p$ GREATER THAN 7			
			PLASTIC FINES (FOR IDENTIFICATION PROCEDURES SEE CL BELOW)			SC	CLAYEY SANDS, POORLY GRADED SAND-CLAY MIXTURES					
FINE GRAINED SOILS MORE THAN HALF OF MATERIAL IS SMALLER THAN 75 μm (75 μm IS ABOUT THE SMALLEST PARTICLES VISIBLE TO THE NAKED EYE)	IDENTIFICATION PROCEDURES ON FRACTION SMALLER THAN 425 μm							GIVE TYPE, NAME, IF NECESSARY, INDICATE DEGREE & CHARACTER OF PLASTICITY, AMOUNT & MAXIMUM SIZE OF COARSE GRAINS, COLOUR IN WET CONDITION, ODOUR, IF ANY, LOCAL OR GEOLOGIC NAME & OTHER PERTINENT DESCRIPTIVE INFORMATION & SYMBOL IN PARENTHESES.  FOR UNDISTURBED SOILS AND INFORMATION ON STRUCTURE, STRATIFICATION, CONSISTENCY IN UNDISTURBED & REMOULDED STATES, MOISTURE & DRAINAGE CONDITIONS				
	LIQUID LIMIT LESS THAN 35%		DRY STRENGTH (CRUSHING CHARACTERISTICS)	DILATANCY (REACTION TO SHAKING)	TOUGHNESS (CONSISTENCY NEAR PLASTIC LIMIT)	ML	INORGANIC SILTS & SANDY SILTS OF SLIGHT PLASTICITY, ROCK FLOUR					
			NONE	QUICK	NONE	CL	CLAYEY SILTS (INORGANIC), GRAVELLY CLAYS, SANDY CLAYS, LEAN CLAYS					
			MEDIUM TO HIGH	NONE TO VERY SLOW	MEDIUM	OL	ORGANIC SILT OF LOW PLASTICITY, ORGANIC SANDY SILTS					
	LIQUID LIMIT BETWEEN 35% AND 50%		SLIGHT TO MEDIUM	SLOW	SLIGHT	MI	INORGANIC COMPRESSIBLE FINE SANDY SILT WITH CLAY OF MEDIUM PLASTICITY, CLAYEY SILTS					
			HIGH	NONE	MEDIUM TO HIGH	CI	SILTY CLAYS (INORGANIC) OF MEDIUM PLASTICITY					
			SLIGHT TO MEDIUM	VERY SLOW	SLIGHT	DI	ORGANIC SILTY CLAYS OF MEDIUM PLASTICITY					
	LIQUID LIMIT GREATER THAN 50%		SLIGHT TO MEDIUM	SLOW TO NONE	MEDIUM	MH	INORGANIC SILTS, HIGHLY COMPRESSIBLE MICACEOUS OR DIATOMACEOUS FINE SANDY SILTS, ELASTIC SILTS					
			HIGH TO VERY HIGH	NONE	HIGH	CH	CLAYS (INORGANIC) OF HIGH PLASTICITY, FAT CLAYS					
			MEDIUM TO HIGH	NONE TO VERY SLOW	SLIGHT TO MEDIUM	OH	ORGANIC CLAYS OF HIGH PLASTICITY					
	READILY IDENTIFIED BY COLOUR, ODOUR, SPONGY FEEL & FREQUENTLY BY FIBROUS TEXTURE					PE	PEAT & OTHER HIGHLY ORGANIC SOILS					



PLASTICITY CHART  
FOR LABORATORY CLASSIFICATION OF FINE GRAINED SOILS

BOUNDARY CLASSIFICATIONS

SOILS POSSESSING CHARACTERISTICS OF TWO GROUPS ARE DESIGNATED BY COMBINATIONS OF GROUP SYMBOLS. FOR EXAMPLE GW-GC, WELL GRADED GRAVEL-SAND MIXTURE WITH CLAY BINDER

## FOUNDATION INVESTIGATION REPORT

For  
Burloak Drive Underpass  
W.P. 125-66-05, Site 10-279  
Q.E.W., District 4, Hamilton

---

### INTRODUCTION

This report contains the results of a foundation investigation carried out for the above-mentioned project. Fieldwork consists of 7 boreholes advanced during the period March 1st to 3rd 1977, utilizing a truck mounted C.M.E. 55 auger machine. Both solid and hollow stem augers were employed although sloughing problems with open boreholes were minimal. Two boreholes were cased with BX size casing and the bedrock was proven by recovering BXL size rock core samples.

### SITE DESCRIPTION

The site is located approximately 1 mile west of Bronte Creek on the Burlington Oakville boundary. Land use in the area is generally agricultural with the exception of Bronte Creek Provincial Park, which lies in the north east quadrant.

The Q.E.W. in this area consists of 6 traffic lanes with a paved median and median barrier. It is paralled by North and South Service Roads. Burloak Drive which is discontinuous at the Q.E.W. is gravel to the north of the Highway and paved to the south.

### SUBSURFACE CONDITIONS

Reference should be made to the Record of Borehole Sheets contained in the report appendix and to Drawing 2 of the Contract Drawings.



Subsoil consists of a shallow deposit of red clayey silt ranging from 3 to 10 feet in depth. It has a stiff to hard consistency with Standard Penetration N values generally in the 20 to 80 range. Moisture content varies from 16 to 20 percent.

Queenstone shale bedrock underlies the clayey silt. It is generally red in colour, but contains harder greenish shaley dolomitic bands which are generally less than 2 inches in thickness. The shale shows evidence of severe weathering at the surface, but improves in quality with depth with the exception of a weaker layer some 5 to 6 feet below its surface.

Groundwater was encountered in the shale and rose to elevation 385 north of the Q.E.W. and to elevation 383 on the south side. This suggests the groundwater level follows the natural slope of the ground surface toward the south lying some 7 to 8 feet below that surface.

*K.G. Selby*

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

## APPENDIX

## RECORD OF BOREHOLE NO 1

WP 125-66-05 LOCATION Co-ords. N 15 767 640; E 931 655 ORIGINATED BY PJS  
 DIST 4 HWY QEW BORING DATE March 1, 1977 COMPILED BY PJS  
 DATUM Geodetic BOREHOLE TYPE Solid Auger & Cone Test CHECKED BY [Signature]

SOIL PROFILE			SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT				LIQUID LIMIT — $w_L$ PLASTIC LIMIT — $w_p$ WATER CONTENT — $w$			UNIT WEIGHT $\gamma$	REMARKS
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	N' VALUES		20	40	60	80	100	$w_p$	$w$	$w_L$	
392.0	Ground Level														
0.0	Clayey Silt					390									
388.0	Stiff to Hard		1	SS	51										
4.0	Queenston Shale Bedrock		2	SS	100/10"										
	Severely to Moderately Weathered		3	SS	100/4"										0 18 52 30
			4	SS	100/3"										
			5	SS	100/8"										
376.7			6	SS	100/4"	380									
15.3	End of Borehole		7	SS	100/4"										

20  
 15 0-5 % STRAIN AT FAILURE  
 10

## HIGHWAY ENGINEERING DIVISION - ENGINEERING MATERIALS OFFICE - SOIL MECHANICS SECTION

8

## RECORD OF BOREHOLE NO 2

WP 125-66-05

LOCATION Co-ords N 15 767 694; E 931 698

ORIGINATED BY PJS

DIST 4 HWY QEW

BORING DATE March 1, 1977

COMPILED BY PJS

DATUM Geodetic

BOREHOLE TYPE Solid Auger &amp; Cone Test

 CHECKED BY *CP.*

SOIL PROFILE			SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 SHEAR STRENGTH ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE	LIQUID LIMIT $W_L$ PLASTIC LIMIT $W_P$ WATER CONTENT $W$ $W_P$ — $W$ — $W_L$ WATER CONTENT % 10 20 30	UNIT WEIGHT $\gamma$	REMARKS
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	'N' VALUES					
392.5	Ground Level									
0.0	Clayey Silt		1	SS	77	390				
388.5	Stiff to Hard		2	SS	100.2					
4.0	Queenston Shale		3	SS	100.2					
	Bedrock		4	SS	100.6					
	Severely to Moderately weathered		5	SS	88.8					
			6	SS	60.3	380				
377.1			7	SS	60.5					
15.4	End of Borehole									
	Note: Water Level not established									

 20  
15 0-5 % STRAIN AT FAILURE  
10

RECORD OF BOREHOLE NO 3

WP 125-66-05 LOCATION Co-ords N 15 767 726; E 931 721 ORIGINATED BY PJS  
 DIST 4 HWY QEW BORING DATE March 3, 1977 COMPILED BY PJS  
 DATUM Geodetic BOREHOLE TYPE Solid Auger, B casing, BXL core CHECKED BY *[Signature]*

SOIL PROFILE			SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT					LIQUID LIMIT $w_L$ PLASTIC LIMIT $w_P$ WATER CONTENT $w$			UNIT WEIGHT $\gamma$	REMARKS
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	'N' VALUES		20	40	60	80	100	$w_p$	$w$	$w_L$		
392.6	Ground Level															
0.0	Clayey Silt															
389.6	Stiff to Hard															
3.0	Queenston Shale		1	SS	100/10"	390										
	Bedrock		2	SS	100/10"											
	Severely to		3	BXL	60%											
	Moderately Weathered		4	BXL	75%	380										
			5	BXL	65%											
374.1			6	BXL	90%											
18.5	End of Borehole															
	Note: Water Level Not Established															

## RECORD OF BOREHOLE NO 4

WP 125-66-05 LOCATION Co-ords. N 15 767 565; E 931 740 ORIGINATED BY PJS  
 DIST 4 HWY QEW BORING DATE March 2, 1977 COMPILED BY PJS  
 DATUM Geodetic BOREHOLE TYPE Solid Auger CHECKED BY JP

SOIL PROFILE			SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT					LIQUID LIMIT $W_L$ PLASTIC LIMIT $W_P$ WATER CONTENT $W$			UNIT WEIGHT $\gamma$	REMARKS
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	'N' VALUES		20	40	60	80	100	$W_P$	$W$	$W_L$		
391.1	Ground Level															
0.0	Clayey Silt					390										
386.1	Stiff to Hard		1	SS	40											
5.0	Queenston Shale Bedrock		2	SS	100/11"											
			3	SS	100/9"											
	Severely to Moderately Weathered		4	SS	64											
			5	SS	100/3"	380										
376.0			6	SS	75/1"											
15.1	End of Borehole															
	Note: Water Level not Established															

## RECORD OF BOREHOLE NO 5

WP 125-66-05

LOCATION Co-ords. N 15 767 652; E 931 808

ORIGINATED BY PJS


DIST 4 HWY QEW

BORING DATE March 2, 1977.

COMPILED BY PJS

DATUM Geodetic

BOREHOLE TYPE Solid Auger

CHECKED BY 

SOIL PROFILE			SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT					LIQUID LIMIT $w_L$ PLASTIC LIMIT $w_p$ WATER CONTENT $w$			UNIT WEIGHT $\gamma$	REMARKS
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	'N' VALUES		20	40	60	80	100	$w_p$	$w$	$w_L$		
391.7	Ground Level															
0.0						390										
	Clayey Silt		1	SS	37											
385.7	Stiff to Hard		2	SS	19											
6.0	Queenston Shale		3	SS	65	6"										
	Bedrock		4	SS	100	6"										
	Severely to		5	SS	83	9"										
	Moderately Weathered		6	SS												
376.5			7	SS	60	3"										
15.2	End of Borehole															
	Note: Water Level not established															

20  
15  $\phi$  5 % STRAIN AT FAILURE  
10

## RECORD OF BOREHOLE NO 6

WP 125-66-05

LOCATION Co-ords. N 15 767 456; E 931 824

ORIGINATED BY PJS


DIST 4 HWY QEW



BORING DATE March 3, 1976

COMPILED BY PJS

DATUM Geodetic

BOREHOLE TYPE Solid Stem Auger &amp; BXL Core

CHECKED BY 

SOIL PROFILE			SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT					LIQUID LIMIT $w_L$ PLASTIC LIMIT $w_p$ WATER CONTENT $w$			UNIT WEIGHT $\gamma$	REMARKS	
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
390.0	Ground Level																
0.0	Clayey Silt		1	SS	38												
	Stiff to Hard		2	SS	27												
382.0	Queenston Shale		3	SS	53												
8.0	Bedrock		4	SS	100.75	380											
	Severely to		5	BXL	452												
	Moderately Weathered		6	BXL	902												
			7	BXL	1002												
372.0			8	BXL	952												
18.0	End of Borehole																
	Note: Water Level not Established																



## RECORD OF BOREHOLE NO 7

WP 125-66-05

LOCATION Co-ords. N 15 767 549; E 931 906

ORIGINATED BY PJS


DIST 4 HWY QEW

BORING DATE March 2, 1977

COMPILED BY PJS

DATUM Geodetic

BOREHOLE TYPE Hollow Stem Auger &amp; Cone Test

CHECKED BY 

SOIL PROFILE			SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT					LIQUID LIMIT $w_L$ PLASTIC LIMIT $w_p$ WATER CONTENT $w$			UNIT WEIGHT $\gamma$	REMARKS
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	'N' VALUES		20	40	60	80	100	WATER CONTENT % 10 20 30				
390.9	Ground Level															
0.0	Clayey Silt		1	SS	9											
	Stiff to Hard		2	SS	25											
383.9	Queenston Shale		3	SS	50/4"											
7.0	Bedrock		4	SS	100/3"											
	Severely to		5	SS	30/1"											
375.9	Moderately Weathered		6	SS												
15.0	End of Borehole															

20  
15  $\phi$  5 % STRAIN AT FAILURE  
10

ENGINEERING MATERIALS OFFICE  
SOIL MECHANICS SECTION

WP 125-66-05

DIST 4

HWY QEW

STR SITE 10-279

Burloak Drive Interchange Underpass

DISTRIBUTION

G.C.E. Burkhardt (3)  
R.D. Gunter  
M.R. Ernesaks  
D.E. Thrasher (2)

C. Grebski  
G.A. Wrong  
B.J. Giroux  
R.S. Pillar

R. Hore

R. Fitzgibbon )  
J. Anderson } cover only  
G. Sloan }

Files ✓

SAMPLE DISPOSITION NOTICE		
TYPE	DISCARD AFTER	RECOMM. BY
JARS	77-04-14	KJS
TUBES	—	—
ROCK CORES	After contrast removed	KJS

FOUNDATION INVESTIGATION AND DESIGN REPORT  
For

Burloak Drive Interchange Underpass  
WP 125-66-05, Site 10-279  
QEW, District 4, Hamilton

INTRODUCTION

This report contains the results of a foundation investigation carried out for the above mentioned project. Fieldwork consists of 7 boreholes advanced during the period March 1st to 3rd 1977, utilizing a truck mounted C.M.E. 55 auger machine. Both solid and hollow stem augers were employed although sloughing problems with open boreholes were minimal. Two boreholes were cased with BX size casing and the bedrock was proven by recovering BXL size rock core samples.

SITE DESCRIPTION

The site is located approximately 1 mile west of Bronte Creek on the Burlington Oakville boundary. Land use in the area is generally agricultural with the exception of Bronte Creek Provincial Park, which lies in the north east quadrant.

The QEW in this area consists of 6 traffic lanes with a paved median and median barrier. It is paralleled by North and South Service Roads. Burloak Drive which is discontinuous at the QEW is gravel to the north of the Highway and paved to the south.

SUBSURFACE CONDITIONS

Subsoil consists of a shallow deposit of red clayey silt ranging from 3 to 10 feet in depth. It has a stiff to hard consistency with Standard Penetration N values generally in the 20 to 80 range. Moisture content varies from 16 to 20 percent.

Queenston shale bedrock underlies the clayey silt. It is generally red in colour, but contains harder greenish shaley dolomitic bands which are generally less than 2 inches in thickness. The shale shows evidence of severe weathering at the surface, but improves in quality with depth with the exception of a weaker layer some 5 to 6 feet below its surface.

Groundwater was encountered in the shale and rose to elevation 385 north of the QEW and to elevation 383 on the south side. This suggests the groundwater level follows the natural slope of the ground surface toward the south lying some 7 to 8 feet below that surface.

## DISCUSSIONS AND RECOMMENDATIONS

### Discussion

It is proposed that Burloak Drive cross the QEW on a six lane 2 span structure with each span approximately 110 feet in length. The vertical curve for Burloak Drive is located eccentrically so that the high point on the grade is located north of the QEW. In this area the approach embankment is about 25 feet in height.

### Recommendations

Abutments: The abutments should be supported on steel H-piles with reinforced tips, driven into the weathered shale bedrock. These piles may be loaded to their allowable structural capacity. Estimated tip elevation for these piles are 382+ for the north abutment and 378+ for the south abutment.

Center pier: The center pier should be supported by a spread footing in the shale bedrock. If founded at elevation 385 the maximum design loading should be 7 tons per square foot. If the footing is lowered into the sounder shale at elevation 378 the loading may be increased to 10 tons per square foot. Resistance to sliding may be calculated assuming a coefficient of friction of .45

Shale bedrock will deteriorate rapidly on exposure to the elements. For this reason a 6 inch layer of mass concrete should be placed in the bottom of the footing within 3 hours of their reaching grade.

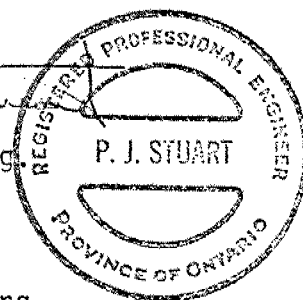
Approach fills: No stability problems are anticipated with the approach fills if the slopes are 2 horizontal to 1 vertical. Cobbles exceeding 3 inches in diameter should be removed from the fill in areas through which piles will have to be driven.

Frost protection: All footings, and pile caps should be protected against frost action by a minimum 4 feet of cover.

Dewatering: No dewatering problems are anticipated due to the relatively impervious nature of the subsoil. Any seepage into the footing excavation may be removed by pumping from sumps.

*P. J. Stuart*  
P. Stuart, P. Eng.  
Project Engineer

*K. G. Selby*  
K.G. Selby, P. Eng.  
Supervising Engineer



KGS/PS/1f  
April 1977

## APPENDIX

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS-ONTARIO

HIGHWAY ENGINEERING DIVISION - ENGINEERING MATERIALS OFFICE - SOIL MECHANICS SECTION

RECORD OF BOREHOLE NO 1

WP 125-66-05 LOCATION Co-ords. N 15 767 640; E 931 655 ORIGINATED BY PJS  
 DIST 4 HWY QEW BORING DATE March 1, 1977 COMPILED BY PJS  
 DATUM Geodetic BOREHOLE TYPE Solid Auger & Cone Test CHECKED BY [Signature]

SOIL PROFILE		SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT					LIQUID LIMIT $W_L$ PLASTIC LIMIT $W_P$ WATER CONTENT $W$			UNIT WEIGHT $\gamma$	REMARKS
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	'N' VALUES	20	40	60	80	100	$W_P$	$W$	$W_L$		
392.0	Ground Level														
0.0	Clayey Silt		1	SS	51										
388.0	Stiff to Hard		2	SS	100/10"										
4.0	Queenston Shale Bedrock		3	SS	100/4"										
	Severely to Moderately Weathered		4	SS	100/3"										
			5	SS	100/8"										
376.7			6	SS	100/4"										
15.3	End of Borehole		7	SS	100/4"										

OFFICE REPORT ON SOIL EXPLORATION

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS-ONTARIO

HIGHWAY ENGINEERING DIVISION - ENGINEERING MATERIALS OFFICE - SOIL MECHANICS SECTION

RECORD OF BOREHOLE NO 2

WP 125-66-05 LOCATION - Co-ords N 15 767 694; E 931 698 ORIGINATED BY PJS  
 DIST 4 HWY QEW BORING DATE March 1, 1977 COMPILED BY PJS  
 DATUM Geodetic BOREHOLE TYPE Solid Auger & Cone Test CHECKED BY

SOIL PROFILE			SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT					LIQUID LIMIT $W_L$ PLASTIC LIMIT $W_P$ WATER CONTENT $W$ $W_P$ $W$ $W_L$ WATER CONTENT % 10 20 30	UNIT WEIGHT $\gamma$	REMARKS
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	'N' VALUES		20	40	60	80	100			
392.5	Ground Level													
0.0	Clayey Silt		1	SS	77	390								
388.5	Stiff to Hard		2	SS	100/9"									
4.0	Queenston Shale		3	SS	100/9"									
	Bedrock		4	SS	100/6"									
	Severely to		5	SS	88/8"									
	Moderately weathered		6	SS	60/3"	380								
377.1			7	SS	60/5"									
15.4	End of Borehole													
	Note: Water Level not established													


OFFICE REPORT ON SOIL EXPLORATION




MINISTRY OF TRANSPORTATION AND COMMUNICATIONS-ONTARIO

HIGHWAY ENGINEERING DIVISION - ENGINEERING MATERIALS OFFICE - SOIL MECHANICS SECTION

RECORD OF BOREHOLE NO 3

WP 125-66-05 LOCATION Co-ords N 15 767 726; E 931 721 ORIGINATED BY RJS  
 DIST 4 HWY QEW BORING DATE March 3, 1977 COMPILED BY RJS  
 DATUM Geodetic BOREHOLE TYPE Solid Auger, B casing, BXL core CHECKED BY 

SOIL PROFILE			SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT					LIQUID LIMIT $W_L$ PLASTIC LIMIT $W_P$ WATER CONTENT $W$ $W_P$ — $W$ — $W_L$ WATER CONTENT % 10 20 30	UNIT WEIGHT $\gamma$	REMARKS
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	'N' VALUES		20	40	60	80	100			
392.6	Ground Level													
0.0	Clayey Silt													
389.6	Stiff to Hard													
3.0	Queenston Shale		1	SS	100/10"	390								
	Bedrock		2	SS	100/10"									
	Severely to		3	BXL	60%									Corebarrel Jammed
	Moderately Weathered		4	BXL	75%	380								Corebarrel Jammed
			5	BXL	65%									
			6	BXL	90%									
374.1														
18.5	End of Borehole													
	Note: Water Level Not Established													

OFFICE REPORT ON SOIL EXPLORATION

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS-ONTARIO

HIGHWAY ENGINEERING DIVISION - ENGINEERING MATERIALS OFFICE - SOIL MECHANICS SECTION

RECORD OF BOREHOLE NO 4

WP 125-66-05 LOCATION Co-ords. N 15 767 565; E 931 740 ORIGINATED BY PJS  
 DIST 4 HWY QEW BORING DATE March 2, 1977 COMPILED BY PJS  
 DATUM Geodetic BOREHOLE TYPE Solid Auger CHECKED BY [Signature]

SOIL PROFILE			SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT					LIQUID LIMIT $W_L$ PLASTIC LIMIT $W_P$ WATER CONTENT $W$ $W_p$ — $W$ — $W_L$ WATER CONTENT % 10 20 30	UNIT WEIGHT $\gamma$	REMARKS % GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	'N' VALUES		20	40	60	80	100			
391.1	Ground Level													
0.0	Clayey Silt					390								
386.1	Stiff to Hard		1	SS	40									
5.0	Queenston Shale Bedrock		2	SS	100/11"									
			3	SS	100/9"									
	Severely to Moderately Weathered		4	SS	64									
			5	SS	100/3"	380								
376.0			6	SS	75/1"									
15.1	End of Borehole													
	Note: Water Level not Established													


OFFICE REPORT ON SOIL EXPLORATION



MINISTRY OF TRANSPORTATION AND COMMUNICATIONS-ONTARIO

HIGHWAY ENGINEERING DIVISION - ENGINEERING MATERIALS OFFICE - SOIL MECHANICS SECTION

RECORD OF BOREHOLE NO 6

WP 125-66-05 LOCATION Co-ords. N 15 767 456; E 931 824 ORIGINATED BY PJS  
DIST 4 HWY QEW BORING DATE March 3, 1976 COMPILED BY PJS  
DATUM Geodetic BOREHOLE TYPE Solid Stem Auger & BXL Core CHECKED BY 

SOIL PROFILE			SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT					LIQUID LIMIT $w_L$ PLASTIC LIMIT $w_p$ WATER CONTENT $w$			UNIT WEIGHT $\gamma$	REMARKS
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	'N' VALUES		20	40	60	80	100	$w_p$	$w$	$w_L$		
390.0	Ground Level															
0.0	Clayey Silt		1	SS	38											3 14 42 41
	Stiff to Hard		2	SS	27											
382.0			3	SS	53											
8.0	Queenston Shale		4	SS	100	5"380										
	Bedrock		5	BXL	452											
	Severely to		6	BXL	902											
	Moderately Weathered		7	BXL	1002											
372.0			8	BXL	952											
18.0	End of Borehole															
	Note: Water Level not Established															

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS-ONTARIO

HIGHWAY ENGINEERING DIVISION - ENGINEERING MATERIALS OFFICE - SOIL MECHANICS SECTION

RECORD OF BOREHOLE NO 7

WP 125-66-05 LOCATION Co-ords. N 15 767 549; E 931 906 ORIGINATED BY PJS  
 DIST 4 HWY QEW BORING DATE March 2, 1977 COMPILED BY PJS  
 DATUM Geodetic BOREHOLE TYPE Hollow Stem Auger & Cone Test CHECKED BY [Signature]

SOIL PROFILE			SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 SHEAR STRENGTH ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE	LIQUID LIMIT $w_L$ PLASTIC LIMIT $w_p$ WATER CONTENT $w$ $w_p$ — $w$ — $w_L$ WATER CONTENT % 10 20 30	UNIT WEIGHT $\gamma$	REMARKS % GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	'N' VALUES					
390.9	Ground Level									
0.0	Clayey Silt		1	SS	9					
	Stiff to Hard		2	SS	25					
383.9	Queenston Shale		3	SS	50/4"					
7.0	Bedrock		4	SS	100/3"					
	Severely to		5	SS	30/1"					
375.9	Moderately Weathered		6	SS						
15.0	End of Borehole									

OFFICE REPORT ON SOIL EXPLORATION

## ABBREVIATIONS & SYMBOLS USED IN THIS REPORT

### PENETRATION RESISTANCE

'N' STANDARD PENETRATION RESISTANCE :- THE NUMBER OF BLOWS REQUIRED TO ADVANCE A STANDARD SPLIT SPOON SAMPLER 12 INCHES INTO THE SUBSOIL, DRIVEN BY MEANS OF A 140 POUND HAMMER FALLING FREELY A DISTANCE OF 30 INCHES.

DYNAMIC PENETRATION RESISTANCE :- THE NUMBER OF BLOWS REQUIRED TO ADVANCE A 2 INCH, 60 DEGREE CONE, FITTED TO THE END OF DRILL RODS, 12 INCHES INTO THE SUBSOIL, THE DRIVING ENERGY BEING 350 FOOT POUNDS PER BLOW.

### DESCRIPTION OF SOIL

THE CONSISTENCY OF COHESIVE SOILS AND THE RELATIVE DENSITY OR DENSENESS OF COHESIONLESS SOILS ARE DESCRIBED IN THE FOLLOWING TERMS :-

<u>CONSISTENCY</u>	<u>c LB./SQ. FT</u>	<u>DENSENESS</u>	<u>'N' BLOWS / FT</u>
VERY SOFT	0 - 250	VERY LOOSE	0 - 4
SOFT	250 - 500	LOOSE	4 - 10
FIRM	500 - 1000	COMPACT	10 - 30
STIFF	1000 - 2000	DENSE	30 - 50
VERY STIFF	2000 - 4000	VERY DENSE	> 50
HARD	> 4000		

TERMS TO BE USED IN DESCRIBING SOILS :-

TRACE < 10% , SOME 10-25% , WITH 25-40% , > 40% SILTY, SANDY, GRAVELLY, CLAYEY ETC

### TYPE OF SAMPLE

S.S	SPLIT SPOON	T.W	THINWALL OPEN
W.S	WASHED SAMPLE	T.P	THINWALL PISTON
S.T	SLOTTED TUBE SAMPLE	O.S	OESTERBERG SAMPLE
A.S	AUGER SAMPLE	F.S	FOIL SAMPLE
C.S	CHUNK SAMPLE	R.C	ROCK CORE

P.H SAMPLE ADVANCED HYDRAULICALLY

P.M SAMPLE ADVANCED MANUALLY

### SOIL TESTS

U	UNCONFINED COMPRESSION	L.V	LABORATORY VANE
UU	UNCONSOLIDATED UNDRAINED TRIAXIAL	F.V	FIELD VANE
CIU	CONSOLIDATED ISOTROPIC UNDRAINED TRIAXIAL	C	CONSOLIDATION
CID	" " DRAINED "	S	SENSITIVITY
CAU	" ANISOTROPIC UNDRAINED "		
CAD	" " DRAINED "		

## ABBREVIATIONS & SYMBOLS USED IN THIS REPORT

### SOIL PROPERTIES

$\gamma$	UNIT WEIGHT OF SOIL (BULK DENSITY)
$\gamma_s$	UNIT WEIGHT OF SOLID PARTICLES
$\gamma_w$	UNIT WEIGHT OF WATER
$\gamma_d$	UNIT DRY WEIGHT OF SOIL (DRY DENSITY)
$\gamma'$	UNIT WEIGHT OF SUBMERGED SOIL
G	SPECIFIC GRAVITY OF SOLID PARTICLES $G = \frac{\gamma_s}{\gamma_w}$
e	VOID RATIO
n	POROSITY
w	WATER CONTENT
$S_r$	DEGREE OF SATURATION
$w_L$	LIQUID LIMIT
$w_P$	PLASTIC LIMIT
$I_P$	PLASTICITY INDEX
$w_S$	SHRINKAGE LIMIT
$I_L$	LIQUIDITY INDEX = $\frac{w - w_P}{I_P}$
$I_C$	CONSISTENCY INDEX = $\frac{w_L - w}{I_P}$
$e_{max}$	VOID RATIO IN LOOSEST STATE
$e_{min}$	VOID RATIO IN DENSEST STATE
$I_D$	DENSITY INDEX = $\frac{e_{max} - e}{e_{max} - e_{min}}$
	RELATIVE DENSITY $D_r$ IS ALSO USED
h	HYDRAULIC HEAD OR POTENTIAL
q	RATE OF DISCHARGE
v	VELOCITY OF FLOW
i	HYDRAULIC GRADIENT
k	COEFFICIENT OF PERMEABILITY
j	SEEPAGE FORCE PER UNIT VOLUME
$m_v$	COEFFICIENT OF VOLUME CHANGE = $\frac{-\Delta e}{(1+e)\Delta\sigma}$
$c_v$	COEFFICIENT OF CONSOLIDATION
$C_c$	COMPRESSION INDEX = $\frac{\Delta e}{\Delta \log_{10} \sigma}$
$T_v$	TIME FACTOR = $\frac{c_v t}{d^2}$ (d, DRAINAGE PATH)
U	DEGREE OF CONSOLIDATION
$\tau_f$	SHEAR STRENGTH
$c'$	EFFECTIVE COHESION
$\phi'$	EFFECTIVE ANGLE OF SHEARING RESISTANCE, OR FRICTION
$c_u$	APPARENT COHESION
$\phi_u$	APPARENT ANGLE OF SHEARING RESISTANCE, OR FRICTION
$\mu$	COEFFICIENT OF FRICTION
$S_t$	SENSITIVITY

### GENERAL

$\pi$	= 3.1416
e	BASE OF NATURAL LOGARITHMS 2.7183
$\log_e a$ OR $\ln a$	NATURAL LOGARITHM OF a
$\log_{10} a$ OR $\log a$	LOGARITHM OF a TO BASE 10
t	TIME
g	ACCELERATION DUE TO GRAVITY
V	VOLUME
W	WEIGHT
M	MOMENT
F	FACTOR OF SAFETY

### STRESS AND STRAIN

u	PORE PRESSURE
$\sigma$	NORMAL STRESS
$\sigma'$	NORMAL EFFECTIVE STRESS ( $\bar{\sigma}$ IS ALSO USED)
$\tau$	SHEAR STRESS
$\epsilon$	LINEAR STRAIN
$\gamma$	SHEAR STRAIN
$\nu$	POISSON'S RATIO ( $\mu$ IS ALSO USED)
E	MODULUS OF LINEAR DEFORMATION (YOUNG'S MODULUS)
G	MODULUS OF SHEAR DEFORMATION
K	MODULUS OF COMPRESSIBILITY
$\eta$	COEFFICIENT OF VISCOSITY

### EARTH PRESSURE

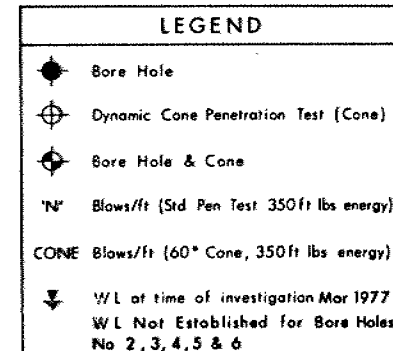
d	DISTANCE FROM TOP OF WALL TO POINT OF APPLICATION OF PRESSURE
$\delta$	ANGLE OF WALL FRICTION
K	DIMENSIONLESS COEFFICIENT TO BE USED WITH VARIOUS SUFFIXES IN EXPRESSIONS REFERRING TO NORMAL STRESS ON WALLS
$K_0$	COEFFICIENT OF EARTH PRESSURE AT REST

### FOUNDATIONS

B	BREADTH OF FOUNDATION
L	LENGTH OF FOUNDATION
D	DEPTH OF FOUNDATION BENEATH GROUND
N	DIMENSIONLESS COEFFICIENT USED WITH A SUFFIX APPLYING TO SPECIFIC GRAVITY, DEPTH AND COHESION ETC IN THE FORMULA FOR BEARING CAPACITY
$k_s$	MODULUS OF SUBGRADE REACTION

### SLOPES

H	VERTICAL HEIGHT OF SLOPE
D	DEPTH BELOW TOE OF SLOPE TO HARD STRATUM
$\beta$	ANGLE OF SLOPE TO HORIZONTAL



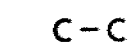
No	ELEVATION	CO-ORDINATES	
		NORTH	EAST
1	392.0	15 767 640	931 655
2	392.5	15 767 694	931 698
3	392.6	15 767 726	931 721
4	391.1	15 767 565	931 740
5	391.7	15 767 652	931 808
6	390.0	15 767 456	931 824
7	390.9	15 767 549	931 906

**-NOTE-**

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

<b>REVISIONS</b>			
	<b>DATE</b>	<b>BY</b>	<b>DESCRIPTION</b>

HWY No Q E W DIST 4  
SUBMIT PJS CHECKED DATE Apr 6, 1977 S-F 10-279  
DRAWN CHECKED APR 20 1977 DWG 1256605



## SECTIONS

