

G.I.F-30 SEPT. 1976

GEOCRES No.

4037-9
4037-19DIST. 1 REGION

W.P. No.

257-66-08

CONT. No.

80-33

W. O. No.

STR. SITE No.

6-288

HWY. No.

ERE

LOCATION

Central Ave. Extension
Underpass

No. of PAGES -

OVERSIZE DRAWINGS TO BE INCLUDED WITH THIS REPORT.

REMARKS:

FOUNDATION INVESTIGATION REPORT

CONTRACT NO 80 - 33



Ministry of
Transportation and
Communications



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NOTE: For purposes of the contract these reports supercede all other Foundation Reports prepared by or for the Ministry in connection with the above mentioned projects.

EXPLANATION OF TERMS USED IN REPORT

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

FIELD SAMPLING

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

EARTH PRESSURE TERMS

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

INDEX PROPERTIES

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

STRENGTH PARAMETERS

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

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

HYDRAULIC TERMS

h HYDRAULIC HEAD OR POTENTIAL
 q RATE OF DISCHARGE
 v VELOCITY OF FLOW
 i HYDRAULIC GRADIENT
 j SEEPAGE FORCE PER UNIT VOLUME
 η COEFFICIENT OF VISCOSITY
 k COEFFICIENT OF HYDRAULIC CONDUCTIVITY
 k_h k IN HORIZONTAL DIRECTION
 k_v k IN VERTICAL DIRECTION
 α_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_c OVERCONSOLIDATION RATIO (OCR)

FOUNDATION INVESTIGATION REPORT

For

Central Avenue Extension Underpass
0.8 Miles East of Walker Road
W.P. 257-66-08, Site 6-288
E.C. Row Expressway, District 1, Chatham

INTRODUCTION

This report contains the results of a foundation investigation carried out for the above project. Fieldwork consisted of four sampled boreholes advanced during the period May 19 to 23, 1979. An auger machine mounted on a tracked vehicle was employed to advance the boreholes with hollow stem augers. Casing and wash-boring techniques were, however, used for the deeper portion of the two deep boreholes. Bedrock was proven in one borehole through the recovery of a BXL size rock core.

SITE DESCRIPTION

The site is located in the southern portion of the City of Windsor 200 feet west of the present intersection of Central Avenue and E.C. Row Avenue. During the period of fieldwork construction for the E.C. Row Expressway was underway with the roadbed granular base and paving being placed across the site under Contract 77-43. The surrounding area is flat reflecting its physiographic designation as part of the St. Clair Clay Plain. Land use is partly agricultural with industrial uses rapidly taking over. Windsor Airport lies immediately to the south.

SUBSURFACE CONDITIONSGeneral

Subsoil consists of about 125 feet of clayey silt (clay of low plasticity) followed by six to eight feet of very dense granular till. These deposits overly sound limestone bedrock.

Reference should be made to the Record of Borehole Sheets which are contained in the report Appendix. They show the boundaries

between soil types, as well as a summary of all field and laboratory tests performed. Reference should also be made to Drawing 6-288-2 which shows the location and elevation of all boreholes, together with an inferred subsoil stratigraphy.

Clayey Silt

The upper 125 feet of overburden consists of clayey silt with sand and a trace of gravel. A plot of liquid limit versus plastic index is shown as Figure 1 of the Appendix. A 10 to 15 foot thick desiccated crust has developed in the area. It is brown in colour and has an undrained shear strength ranging from 10,000 to 2500 psf. Below the crust the soil is grey and the undrained shear strength ranges from 2500 to 1500 psf except in the lower 25 feet where somewhat higher values are found. Moisture contents are generally between 12 and 20 percent with the lower values located in the crust.

Granular Till

A six to eight foot thick deposit of very dense granular till was encountered overlying the bedrock. It consists of a mixture of boulders, cobbles, gravel, sand, silt and clay. A single Standard Penetration Test in this layer showed less than a foot of penetration for 100 hammer blows.

Bedrock

Bedrock was encountered at about elevation 484 some 133 feet below the surface. It consisted of sound limestone.

Groundwater

Groundwater readings were taken in the open boreholes during the period of investigation. These levels varied considerably reflecting the generally low permeability of the soil and the presence of small water bearing sand lenses. It is estimated that the groundwater level was about four feet below the surface during the period of fieldwork.

K. G. Selby

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

January, 1980

APPENDIX



RECORD OF BOREHOLE No 1

W P 257-66-08 LOCATION Coords. N 15 363 087; E 872 813 ORIGINATED BY PRK
DIST 1 HWY E.C.Row Expy. BOREHOLE TYPE Hollow Stem Augers and B Casing COMPILED BY PRK
DATUM Geodetic DATE May 18 to 22, 1979 CHECKED BY *PRK*

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 (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100					
614.8	Ground Level																
0.0																	
			1	SS	14		610										
			2	SS	47												
			3	SS	33												
			4	SS	20												
			5	SS	14		600										
			6	SS	9												
			7	SS	9												
			8	SS	11		590										
			9	SS	11												
			10	SS	7		580										
			11	SS	12		570										
			12	SS	11		560										
			13	SS	16		550										
			14	SS	6		540										
			15	SS	17		530										
			16	SS	27		520										
							510										
							500										
495.8																	
119.0																	

OFFICE REPORT ON SOIL EXPLORATION

+3, x5: Numbers refer to
Sensitivity

20
15
10
5 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 1 cont.

W P 257-66-08 LOCATION _____ ORIGINATED BY PRK
DIST 1 HWY E.C.Row Expy. BOREHOLE TYPE Hollow Stem Augers and B Casing COMPILED BY PRK
DATUM Geodetic DATE May 22, 1979 CHECKED BY *el. J.*

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT Y	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100					
495.8																	
119.0																	
490.8			17	SS	88/ 7"		490										14 56 (30)
124.0	Mixture of Cobbles, Gravel, Sand, Silt & Clay, Very Dense (Glacial Till)																
483.8																	
131.0	Limestone Bedrock		18	RC EXL	100% Rec.		480										
478.8																	
136.0	End of Borehole																

OFFICE REPORT ON SOIL EXPLORATION

RECORD OF BOREHOLE No 2

W P 257-66-08 LOCATION Coords. N 15 363 123; E 872 787 ORIGINATED BY PRK
 DIST 1 HWY E.C. Row Expy. BOREHOLE TYPE Hollow Stem Augers COMPILED BY PRK
 DATUM Geodetic DATE May 2A, 1979 CHECKED BY WJ

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT Y	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			20	40	60	80	100					
614.6	Ground Level															
0.0	Brown Grey Clayey Silt Some Sand Trace of Gravel Hard to Stiff		1	SS	29											
			2	SS	46											
			3	SS	49											
			4	SS	29											
			5	SS	22											
			6	SS	15											
			7	SS	14											
			8	SS	14											
			9	SS	13											
			10	SS	13											
			11	SS	14											
573.1																
41.5	End of Borehole															
	Note: Water Level Not Recorded															

OFFICE REPORT ON SOIL EXPLORATION

+3, x⁵: Numbers refer to
Sensitivity

20
15
10
5 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 3

W P 257-66-08 LOCATION Coords. N 15 363 196; E 872 163 ORIGINATED BY PRK
 DIST 1 HWY EC Row Expy. BOREHOLE TYPE Hollow Stem Augers COMPILED BY PRK
 DATUM Geodetic DATE May 24, 1979 CHECKED BY o/f.

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 PCF	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			'N' VALUES	SHEAR STRENGTH PSF						WATER CONTENT (%)	
								○ UNCONFINED ● QUICK TRIAXIAL							+ FIELD VANE x LAB VANE
615.0	Ground Level						20 40 60 80 100								
0.0	Brown Grey Clayey Silt Some Sand Trace of Gravel Hard to Stiff		1	SS	19										
			2	TW	PH										
			3	SS	39										
			4	SS	29										
			5	TW	PH										
			6	SS	17										
			7	TW	PH										
			8	SS	12										
			9	TW	PH										
			10	SS	11										
			11	TW	PH										
572.0															
43.0	End of Borehole														
	Note: Water Level Not Recorded														

OFFICE REPORT ON SOIL EXPLORATION

+³, x⁵: Numbers refer to
Sensitivity

20
15-5 (%) STRAIN AT FAILURE
10



W P 257-66-08 LOCATION Coords. N 15 363 249; E 872 731 ORIGINATED BY PRK
DIST 1 HWY E.C.Row Expy. BOREHOLE TYPE Hollow Stem Augers, Tricone Washboring COMPILED BY PRK
DATUM Geodetic DATE May 23, 1979 CHECKED BY g.f.

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 (%) GR SA SI CL						
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20 40 60 80 100							WATER CONTENT (%)					
								SHEAR STRENGTH ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE 400 800 1200 1600 2000							10 20 30					
616.9	Ground Level																			
0.0	Brown Grey Clayey Silt Some Sand Trace of Gravel Hard to Stiff		1	SS	12		615													
			2	SS	43						○									
			3	SS	36						○									
			4	SS	18		610				○									
			5	SS	10															
			6	SS	9						○									
			7	SS	9		600													
			8	SS	12															
			9	SS	9															
			10	SS	8		590													
			11	SS	12															
			12	SS	8															
		13	SS	12		560														

+3, x⁵; Numbers refer to Sensitivity

OFFICE REPORT ON SOIL EXPLORATION

RECORD OF BOREHOLE No 4 cont.

W P 257-66-08 LOCATION _____ ORIGINATED BY PRK
DIST 1 HWY E.C.Row Expy. BOREHOLE TYPE Hollow Stem Augers and Tricone Washboring COMPILED BY PRK
DATUM Geodetic DATE May 23, 1979 CHECKED BY J.S.

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 (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES		20	40	60	80	100					
497.9																
119.0			16	SS	43											
490.9						490										
126.0	Mixture of Cobbles Gravel, Sand, Silt and Clay, Very Dense (Glacial Till)	Progress Slow														
483.9		Refusal to Tricone														
133.0	Probable Bedrock End of Borehole															

OFFICE REPORT ON SOIL EXPLORATION

+³, x⁵: Numbers refer to
Sensitivity

20
15
10

5 (%) STRAIN AT FAILURE

FOUNDATION INVESTIGATION REPORT

For

Jefferson Boulevard Overpass
2.3 Miles East of Walker Road
W.P. 259-66-05, Site 6-295
E.C. Row Expressway, District 1, Chatham

INTRODUCTION

This report contains the results of a foundation investigation carried out for the above project. Fieldwork consisted of four sampled boreholes advanced during the period May 15 to 18, 1979 employing an auger machine mounted on a tracked vehicle. Bedrock was proven in one borehole by obtaining a BXL size rock core.

SITE DESCRIPTION

The site is located on the southeastern boundary of the City of Windsor approximately 200 feet south of the intersection of Jefferson Boulevard and the existing E.C. Row Avenue. The surrounding area is flat reflecting its physiographic designation as part of the St. Clair Clay Plain. Land use in the area is gradually changing from agricultural to industrial as development of the area proceeds. At the crossing Jefferson Boulevard is a two lane paved road flanked by gravel shoulders and shallow ditches.

SUBSURFACE CONDITIONS

General

Subsoil consists of about 125 feet of clayey silt followed by 10 to 15 feet of very dense granular till. These deposits overly weathered grey shale bedrock.

Reference should be made to the Record of Borehole Sheets which are contained in the report Appendix. They show the boundaries between soil types, as well as a summary of all field and laboratory tests performed. Reference should also be made to Drawing No. 6-295-2 which shows the location and elevations of all borings, as well as inferred subsoil stratigraphy.

Clayey Silt

The upper 125 feet of overburden consists of clayey silt with sand and a trace of gravel. A plot of liquid limit versus plastic index for samples from this deposit are shown as Figure 1 of the Appendix. The deposit has developed a 10 to 15 foot thick desiccated crust which is brown in colour and has an undrained shear strength ranging from 10,000 to 2500 psf. Below the crust the undrained shear strength ranges from 2500 to 1500 psf with the exception of the lower 25 feet where somewhat higher values are found. Moisture contents are generally between 12 and 20 percent with the lower values found in the crust.

Granular Till

A 10 to 15 foot thick deposit of very dense granular till was encountered overlying the bedrock. It consists of a mixture of boulders, cobbles, gravel, sand, silt and clay. Standard Penetration tests resulted in 'N' values ranging from 40 to in excess of 100 blows per foot. Other tests resulted in no penetration due to the sampler bouncing on cobbles or boulders. When refusal to a tricone bit occurred a five foot run with a BXL core barrel was taken. Several pieces of sedimentary and metamorphic rock were recovered with the largest being about 10 inches in length. The moisture content of samples tested from this deposit varied from 6 to 10 percent.

Bedrock

Bedrock was encountered at elevation 464 some 138 feet below the surface. It consisted of weathered grey shale containing seams of clay up to 1/2 inch in thickness.

Groundwater

Groundwater entered the boreholes slowly until the granular till was encountered. It then rose slowly to about four feet below the surface.

K. G. Selby

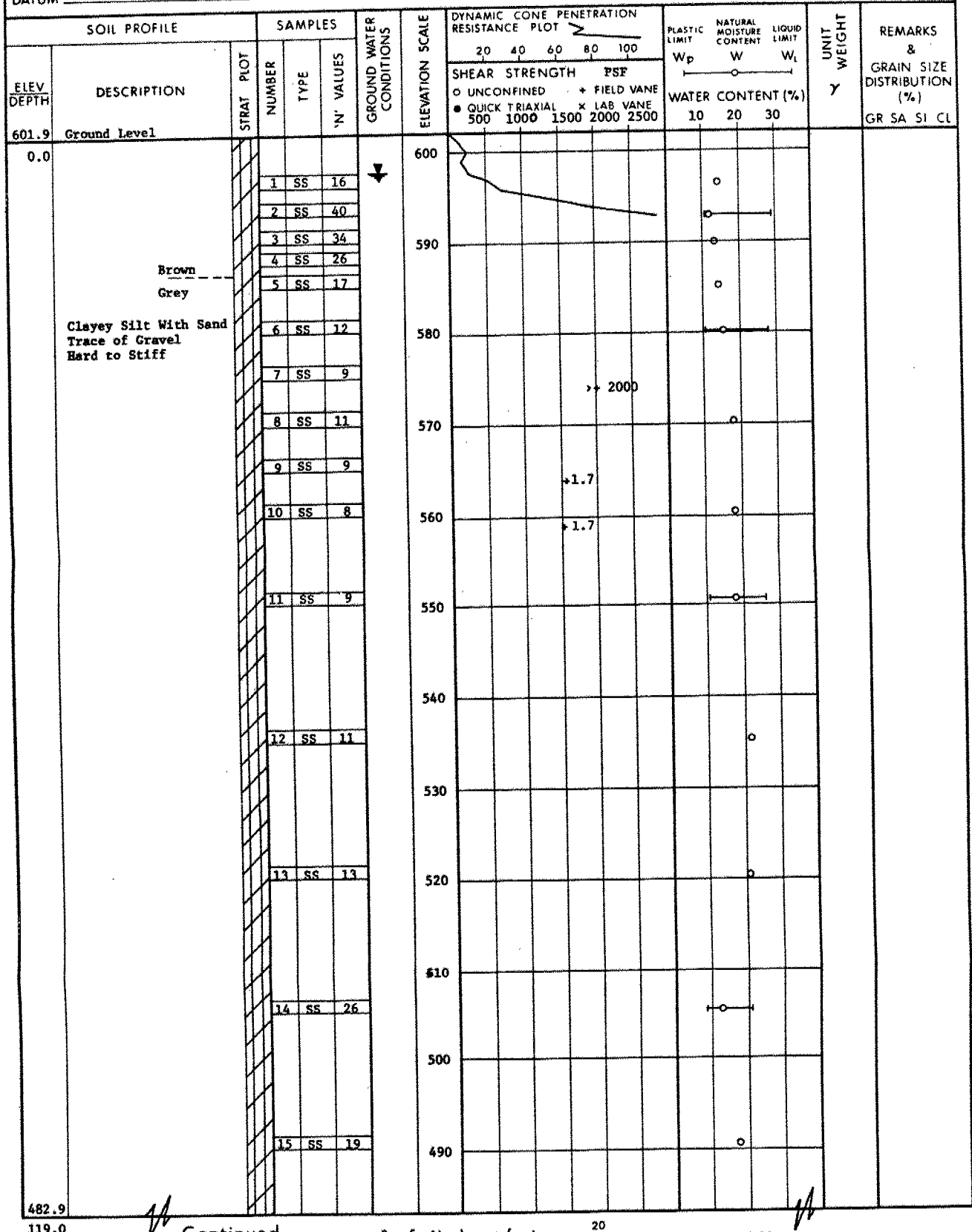
K. G. Selby, P. Eng.
Senior Foundations Engineer.

January, 1980

APPENDIX

RECORD OF BOREHOLE No 1

W P 259-66-05 LOCATION Coorde. N 15 365 212; E 881 157 ORIGINATED BY PRK
DIST 1 HWY E.C. Row BOREHOLE TYPE Hollow Stem Auger and B Casing COMPILED BY PRK
DATUM Geodetic DATE May 15, 1979 CHECKED BY J.P.



OFFICE REPORT ON SOIL EXPLORATION



RECORD OF BOREHOLE No 1 Continued

W P 259-66-05 LOCATION Coords. N 15 365 212; E 881 157 ORIGINATED BY FRK
DIST 1 HWY E.C. Row Expy BOREHOLE TYPE Tri-Cone With Casing, BXL Core COMPILED BY FRK
DATUM Geodetic DATE May 15, 1979 CHECKED BY *CP*

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 (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100					
482.9	continued																
119.0	Clayey Silt						480										
476.9																	
125.0	Mixture of Boulders Cobbles, Gravel, Sand, Silt and Clay Very Dense (Glacial Till)		16	SS	40												
			17	BXL RC	31% Rec		270										
			18	SS	100												
464.2			19	SS													
137.7	Grey Shale Bedrock (Weathered)		20	BXL RC	50% Rec	Bouncing											
458.5			21	SS	100	5"	460										
143.4	End of Borehole																

OFFICE REPORT ON SOIL EXPLORATION

+³, x⁵: Numbers refer to
Sensitivity

20
15 + 5 (%) STRAIN AT FAILURE
10

RECORD OF BOREHOLE No 2

W P 259-66-05 LOCATION Coords. N 15 365 116; E 881 211 ORIGINATED BY PRK
DIST 1 HWY E.C.Row Expy BOREHOLE TYPE Hollow Stem Auger COMPILED BY PRK
DATUM Geodetic DATE May 17, 1979 CHECKED BY *CP*

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 PCF	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			'N' VALUES	SHEAR STRENGTH PSF					WATER CONTENT (%)				
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE 500 1000 1500 2000 2500					10 20 30				
601.6	Ground Level																
0.0	Brown Grey Clayey Silt With Sand Trace of Gravel Hard to Stiff		1	SS	30												
			2	SS	50												
			3	SS	32												
			4	SS	17												
			5	TW	PH										137		
			6	TW	PH										137		
			7	TW	PH										137		
			8	TW	PH										139		
			9	SS	12												
			10	SS	11												
560.1																	
41.5	End of Borehole																
	Note: Water Level Not Established																

OFFICE REPORT ON SOIL EXPLORATION

+3, x5: Numbers refer to
Sensitivity

20
15
10
5 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 3

W P 259-66-05 LOCATION Coords. N 15 365 192; E 881 046 ORIGINATED BY PRK
 DIST 1 HWY E.C.Row Expy BOREHOLE TYPE Hollow Stem Auger COMPILED BY PRK
 DATUM Geodetic DATE May 17, 1979 CHECKED BY *CP*

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					
602.1	Ground Level																
0.0			1	SS	11		600										
			2	SS	40												
			3	SS	35		590										
			4	SS	13												
			5	TW	PH												
			6	TW	PH		580										
			7	TW	PH												
			8	TW	PH		570										
			9	SS	8												
			10	SS	12												
560.6																	
41.5	End of Borehole																

OFFICE REPORT ON SOIL EXPLORATION

+3, x5: Numbers refer to
Sensitivity

20
15
10
5 (%) STRAIN AT FAILURE



RECORD OF BOREHOLE No 4

W P 259-66-05 LOCATION Coords. N 15 365 072; E 881 083 ORIGINATED BY PRK
DIST 1 HWY E.C.Row Expy BOREHOLE TYPE Hollow Stem Augers, Tri-cone Washboring COMPILED BY PRK
DATUM Geodetic DATE May 17, 1979 CHECKED BY EP

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	NUMBER	TYPE	'N' VALUES			20' 40' 60' 80' 100'	SHEAR STRENGTH P _{SP}					
							○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE 500 1000 1500 2000 2500	10 20 30					
601.6	Ground Level												
0.0						600							
		1	SS	12									
		2	SS	39									
		3	SS	34									
		4	SS	20									
	Brown	5	SS	14									
	Grey	6	SS	15									
	Clayey Silt With Sand Trace of Gravel Hard to Stiff	7	SS	12									
		8	SS	14									
		9	SS	11									
		10	SS	11									
		11	SS	13									
		12	SS	7									
		13	SS	6									
		14	SS	15									
		15	SS	31									
		16	SS	30									
482.6						490							
119.0													

OFFICE REPORT ON SOIL EXPLORATION

Continued

+3, x³: Numbers refer to
Sensitivity

20
15 + 5 (%) STRAIN AT FAILURE
10



RECORD OF BOREHOLE No 4 Continued

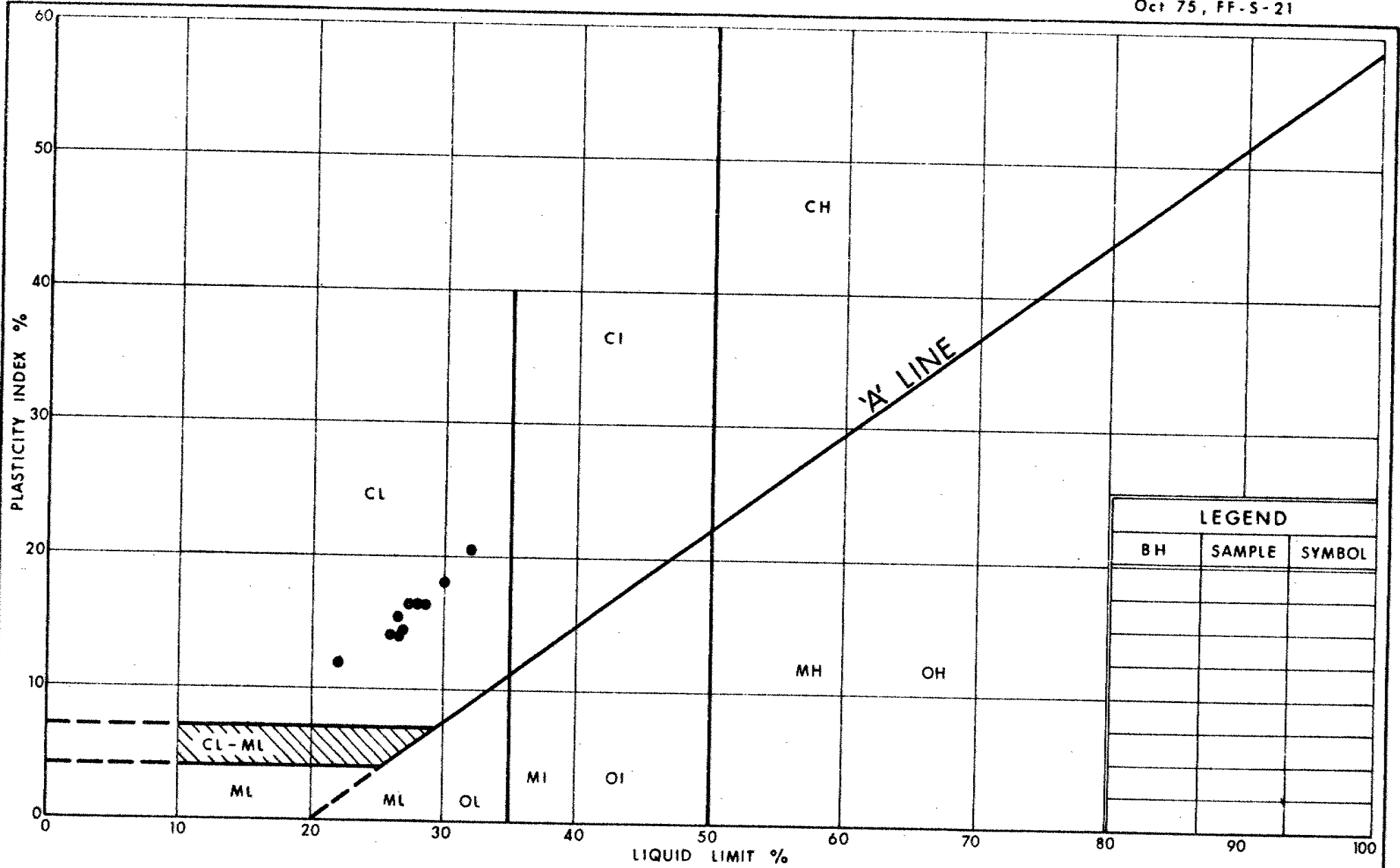
W P 259-66-05 LOCATION Coords. N 15 365 072; E 881 083 ORIGINATED BY PRK
DIST 1 HWY E.C.Row Expy BOREHOLE TYPE Tri-Cone Washboring COMPILED BY PRK
DATUM Geodetic DATE May 17, 1979 CHECKED BY EP

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 (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100					
482.6	Continued																
119.0	Clayey Silt						480										
476.6																	
125.0	Boulders, Cobbles Gravel, Sand, Silt and Clay, Very Dense (Glacial Till)																
470.1			17	SS	120/6"								0				38 45 12 5
131.5	End of Borehole																

+3, x5: Numbers refer to
Sensitivity

20
15 5 (%) STRAIN AT FAILURE
10

OFFICE REPORT ON SOIL EXPLORATION



Ontario

Ministry of
Transportation and
Communications

PLASTICITY CHART

CLAYEY SILT

FIG No 1

W P 259-66-05

XXXXXXXXXXXXXXXXXXXX

MEMORANDUM

40J-48

GEOCRES No.

To: Mr. A. P. Watt, (2)
Regional Bridge Planning Engineer,
Southwestern Region,
London, Ontario.

FROM: Foundations Office,
Design Services Branch,
Central Bldg., Downsview.

ATTENTION:

DATE: January 3, 1972.

OUR FILE REF.

IN REPLY TO

JAN 7 1972

SUBJECT:

FOUNDATION INVESTIGATION REPORT

For

The Proposed E.C. Row Expressway
And Central Ave. Extension Crossing
Lot 103, Con. 2

City of Windsor -- County of Essex
District #1 (Chatham)

W.J. 71-11117 -- W.P. 257-66-08

40J-9

GEOCRES No.

Attached, we are forwarding to you our detailed foundation investigation report on the subsoil conditions existing at the above structure site.

We believe that the factual data and recommendations contained therein, will prove adequate for your design requirements. Should additional information be required, please do not hesitate to contact our Office.

A. G. Stermac

A. G. Stermac,

PRINCIPAL FOUNDATION ENGINEER.

AGS/ao
Attach.

cc: Messrs. D. W. Farren
B. R. Davis
A. Rutka
W. A. Zonnenberg
F. C. Brown
B. J. Giroux
J. R. Roy
G. A. Wrong
B. A. Singh

Foundations Files ✓
Documents

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 - 4.3) Limestone Bedrock
5. GROUNDWATER CONDITIONS
6. DISCUSSION AND RECOMMENDATIONS:
 - 6.1) General
 - 6.2) Foundations
 - 6.3) Approach Embankments
7. MISCELLANEOUS

FOUNDATION INVESTIGATION REPORT

FOR

The Proposed E.C.Row Expressway
and Central Ave. Extension Crossing
Lot 103 Con. 2
City of Windsor - County of Essex
District #1 - (Chatham)
W.J. 71-11117 - W.P. 257-66-08

1. INTRODUCTION:

A request for a foundation investigation at the crossing of the Proposed E. C. Row Expressway and Central Ave. Extension was received from Mr. A. P. Watt, Regional Bridge Planning Engineer, in a memorandum dated October 12, 1971.

A preliminary foundation investigation covering this area was carried out in April 1968 (68-11015-3). A more detailed field investigation was subsequently carried out to determine the sub-soil conditions existing at the site.

This report contains the results of both investigations and our recommendations pertaining to the design of the proposed structure foundations and approach embankments.

2. DESCRIPTION OF THE SITE:

The site of the proposed overpass structure is situated in the eastern part of the City of Windsor, approx. 0.9 miles east of the intersection of the existing E.C. Row Blvd. and Walker Rd.

The surrounding terrain is flat and in most parts cultivated farmland.

Physiographically, the site is located in the region referred to as the St.Clair Clay Plain.

3. FIELD AND LABORATORY INVESTIGATION PROCEDURES:

A total of ten sampled boreholes and eleven dynamic cone penetration tests was carried out during the course of the field work. Boring was achieved by means of bombardier mounted continuous flight auger machines, and conventional diamond drilling equipment adapted for soil sampling purposes. During the field work, disturbed samples were obtained by means of a standard split-spoon sampler: the energy used in driving it, conformed to the requirements of the Standard Penetration Test. 'Undisturbed' samples were recovered using 2 inch I.D. shelby tubes which were pushed into the soil hydraulically or by hand. Where possible, field vane tests were carried out at elevations generally 12-inches below sample depths.

Dynamic cone penetration tests were carried out adjacent to each borehole, and also at one other location. Driving energy to advance the cone was 350 ft.-lbs per blow.

The bedrock was proved at one borehole location using AXT rock coring equipment.

All boreholes were surveyed in the field by personnel from London Region Engineering Surveys Section. The locations and elevations of the borings are shown on Drawing No. 71-11117A which accompanies this report.

All samples were visually examined and classified at the site as well as in the laboratory. Following this inspection laboratory tests were carried out on selected samples to determine the following physical properties:

- Atterberg Limits
- Moisture Content
- Grain-Size Distribution
- Undrained Shear Strength
- Bulk Density

The test results are summarized on the Record of Borehole sheets contained in the Appendix of this report.

4. SOIL TYPES AND SOIL CONDITIONS:

4.1) General:

Generally uniform subsoil conditions were found to prevail over the site area. The subsoil consists of a deep deposit of cohesive soil, followed by limestone bedrock. The boundaries between different deposits are shown on the Record of Borehole sheets attached to the Appendix. The estimated stratigraphical profile of Drawing 71-11117A is based upon this information.

From ground level downward, the various strata are described in some detail with regard to soil types and soil properties, as follows:

4.2) Clayey Silt with Sand and Traces of Gravel:

This deposit was intersected in all borings and extends from immediately below the ground surface, down to the bedrock surface for a minimum depth of 119 ft. The material in the deposit consists of clayey silt with sand and traces of gravel. A plot of Plasticity Index versus Liquid Limit (Fig.1) shows the points to fall within the CL zone. In some boreholes relatively thin layers of granular soils were found to occur within the main deposit.

A highly overconsolidated zone due to the desiccation and/or weathering, with a thickness ranging from 9 to 15 was found to extend from the upper surface of the stratum. This zone is brown in color due to oxidation and apart from the upper 3 to 5 ft. (frost affected zone) has a very stiff to hard consistency: 'N' values ranged from 21 to 71 Blows per foot. Based on the Standard Penetration Test results only, the undrained shear strength of this desiccated zone is estimated to be in the order of 2,500 PSF to 10,000 PSF. Below the desiccated layers the color of the soil is grey and the consistency ranges somewhat randomly from stiff to hard. For design purposes the following undrained shear strength values are suggested:

Ground Level - El. 609	2,000 PSF
El. 609 - 600	5,000 PSF
El. 600 - 590	2,500 PSF
El. 590 - 496	1,500 PSF

Physical properties of the overall deposit, as determined from field and laboratory tests, are as follows:

Natural Moisture Content: (%)	11 - 21
Liquid Limit: (%)	24 - 30
Plastic Limit: (%)	12 - 17
Bulk Density: (PCF)	130 - 137
Unconfined Shear Strength: (PSF)	660 - 2255
Field Vane Test: (PSF)	1360 - 2400
Sensitivity:	1.5 - 2.7
'N' Value: (Blows/Ft.)	9 - 79

Typical Grain-Size distribution curves are included in the Appendix of this report (Fig. 2).

4.3) Limestone Bedrock:

Bedrock at this site was found to consist of generally sound limestone at El. 496. (B.H.#84).

5. GROUNDWATER CONDITIONS:

The following groundwater levels were observed during the field investigation:

B.H.#82	Not Established
83	Not Established
84	El. 600.2'
85	Not Established
154	El. 601.4'
155	El. Dry
156	El. 594.0'
157	El. 595.2'
158	El. 597.4'
159	El. 595.0'

It is pointed out that the foregoing quoted figures may not represent the true groundwater levels, due to the relatively impermeable nature of the subsoil and the short duration of the field work.

6. DISCUSSION AND RECOMMENDATIONS:

6.1) General:

It is proposed to build a three-span (40'-91'-40') overpass structure at the crossing of E. C. Row Expressway and Central Ave. Extension. The proposed profile grade of E.C. Row Expressway will be approximately 23 ft. above the existing Central Ave. Extension grade of elevation 613'.

As described in the previous paragraphs of this report, the subsoil at the site consists of a deep deposit of clayey silt with sand and traces of gravel, underlain by limestone bedrock. The upper portion of the deposit contains a very stiff to hard desiccated zone. Below this depth the undrained shear strength of the material decreases. The desiccated crust appears to be suitable for spread footing type foundations.

Because of the compressible nature of the subsoil, it is inevitable that consolidation settlements will occur over a long-term period due to the imposed loads of structure and embankment. Past experience, however, indicates that these settlements will be of a minor nature.

6.2) Foundations:

(a) Spread Footings in Original Ground:

The entire structure may be supported on spread footings placed within the very stiff to hard desiccated zone of the subsoil between El. 609 and El. 600. A safe net pressure of 3.5 TSF may be assumed for design purposes.

The desiccated zone is susceptible to softening on contact with water, therefore, it is recommended that the base of the footing excavations be protected by a concrete working slab, immediately on exposure.

All foundations should be protected against frost action by at least 4 feet of earth cover. No dewatering problems are anticipated.

The estimated maximum settlement will be in the order of 1.0 and 1.5 inches under the pier footings.

(b) Spread Footings on Compacted Fill:

As an alternative, the abutments may be supported on spread footings placed on well compacted, suitable granular material within the approach fills. A safe design load of

2.0 TSF may be assumed. The granular material should consist of G.B.C. Class 'A' and should be fully compacted according to the current Standards. A detailed construction scheme is outlined on Figure 3 of the Appendix.

(c) Perched Abutments on Short Piles:

As a second alternative, the abutments may be constructed within the approach fills and supported on short piles driven through the fill and some 10.0 ft. into the original ground. In the case of 12-3/4" O.D. and 1/4" thick wall steel tube piles, a safe design load of 25 tons per pile may be used.

It should be pointed out, that this latter proposal is based on experience with similar structures and similar subsoil conditions in the general area.

Regardless of which method is adopted, the structure should be built to accommodate the 2.0 to 2.5 inches differential settlement between the abutments and piers.

(d) End-Bearing Piles:

As another alternative, the abutments and piers may be supported on steel H-piles driven to bedrock. The maximum allowable load for the particular steel section may be assumed for design purposes.

6.3) Approach Embankments:

The shear strength of the subsoil is such that it will be able to safely support the 23 ft. high approach embankments constructed with 2:1 side slopes. The fill should consist of well compacted acceptable material. Care should be taken to ensure that no bouldery fill is placed within the approaches through which piles have to be driven, and it is recommended that this portion of the fill contain no larger grain sizes than 3 inches.

Based on performance of structures and embankments built in the same general area and under somewhat similar subsoil conditions, it is estimated that a maximum settlement of 3 to 4 inches will take place over a long period of time under the fill at the abutment location.

To minimize the effect of differential settlements between the abutments and pier footings, it is recommended that the approach embankments be built in advance of the structure for as long a period as possible. The topsoil and the soft surficial material should be removed in accordance with the pertinent Standards within the construction area.

7. MISCELLANEOUS:

The field work was carried out during the periods of April 8 to 10, 1968, and November 19 to 23, 1971, under the supervision of Mr. A. Prakash and Mr. P. Payer, Project Foundation Engineers.

Equipment was owned and operated by Dominion Soil Investigation Ltd., and Master Soil Investigation Ltd.

This report was written by Mr. P. Payer and reviewed by Mr. K. G. Selby, Supervising Foundation Engineer.

December 1971

P. Payer
P. Payer, P.Eng.



K. G. Selby
K. G. Selby, P. Eng.

APPENDIX

JOB <u>71-11117</u>	LOCATION <u>Co-ords. 99,976 N; 80,838 E.</u>	ORIGINATED BY <u>AP</u>
W.P. <u>257-66-08</u>	BORING DATE <u>April 8 & 9, 1968</u>	COMPILED BY <u>AMS</u>
DATUM <u>Geodetic</u>	BOREHOLE TYPE <u>Washbore - NX Casing</u>	CHECKED BY _____

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION	RESISTANCE	LIQUID LIMIT	PLASTIC LIMIT	BULK DENSITY	REMARKS	
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS/FOOT		BLOWS / FOOT						
							20	40	60	80			100
						SHEAR STRENGTH P.S.F.				WATER CONTENT			
						○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB. VANE				w_p — w — w_L			
						500 1000 1500 2000 2500				WATER CONTENT %			
										10 20 30			
615.0	Ground Level												
0.0	Clayey silt with sand, traces of gravel. Hard to very stiff		1	SS	11	610							
			2	SS	69								
			3	SS	79								
			4	SS	43								
			5	SS	34	600							
			6	SS	-								
			7	TW	PM	590							
			8	TW	PM								
579.5			9	TW	PM	580							
36.5	End of Borehole												
						570							

RECORD OF BOREHOLE No. 83 (68-11015-3) FOUNDATION SECTION

JOB	<u>71-11117</u>	LOCATION	<u>Co-ords. 99,852 N; 80,657 E.</u>	ORIGINATED BY	<u>AP</u>
W.P.	<u>257-66-08</u>	BORING DATE	<u>April 8 & 9, 1968</u>	COMPILED BY	<u>AMS</u>
DATUM	<u>Geodetic</u>	BOREHOLE TYPE	<u>Washbore - NX Casing</u>	CHECKED BY	<u></u>

[illegible]

JOB 71-11117 LOCATION Co-ords. 92,846 W; 80,843 E ORIGINATED BY GEH
W.P. 257-66-08 BORING DATE April 9, 1968 COMPILED BY AMS
DATUM Geodetic BOREHOLE TYPE Penn Drill and Core Drill CHECKED BY

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE					LIQUID LIMIT ——— w_L PLASTIC LIMIT ——— w_p WATER CONTENT ——— w			BULK DENSITY γ P.C.F.	REMARKS GR. SA. SI. CL.		
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS/FOOT		BLOWS / FOOT											
							20 40 60 80 100											
							SHEAR STRENGTH P.S.F.					w_p ——— w ——— w_L						
							○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB. VANE							WATER CONTENT %				
							500 1000 1500 2000 2500							10 20 30				
615.0	Ground Level																	
0.0																		
			1	SS	9	610												
			2	SS	47													
			3	SS	77													
			4	SS	50													
			5	SS	24	600												
			6	SS	16													
	Hard to		7	TW	PH	590												
	Very Stiff		8	TW	PH													
	Stiff		9	TW	PH	580												
	Clayey silt		10	TW	PH													
	with sand,					570												
	traces of		11	TW	PH													
	gravel.					560												
544.0			12	TW	PH													
61.0	Sand Seams					550												
549.0																		
66.0						540												
			13	TW	PH													
						530												
						520												
			14	SS	55													
						510												
						500												
496.2																		
418.8	Limestone Bedrock		15	AXT	100%													
491.2																		
123.8	End of Borehole					490												

JOB 71-11117 LOCATION Co-ords. 99,974 N; 80,652 E. ORIGINATED BY GEH
W.P. 257-66-08 BORING DATE April 9 & 10, 1968 COMPILED BY AMS
DATUM Geodetic BOREHOLE TYPE Cont. Flight Auger CHECKED BY

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE					LIQUID LIMIT ——— w_L PLASTIC LIMIT ——— w_p WATER CONTENT ——— w			BULK DENSITY γ P.C.F.	REMARKS GR. SA. SI. CL.	
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS/FOOT		BLOWS / FOOT										
							SHEAR STRENGTH P.S.F.										
							○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB. VANE					WATER CONTENT % w_p ——— w ——— w_L					
							500	1000	1500	2000	2500	10	20	30			
614.8	Ground Level																
0.0	Clayey silt with sand, traces of gravel. Hard to Very Stiff Stiff		1	SS	13	610										2 30 44 24	
			2	SS	41												
			3	SS	51												
			4	SS	27	600											
			5	SS	13												
			6	TW	PH											137	2 30 40 28
			7	TW	PH	590											
			8	TW	PH												
			9	TW	PH	580											
			10	TW	PH											135	
			11	TW	PH	570											
			12	TW	PH	560											
			13	TW	PH	550											
			14	TW	PH	540											
			15	SS	31	530											
494.8																	
120.0	End of Borehole Probable Bedrock																

DEPARTMENT OF HIGHWAYS- ONTARIO
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No. 154

FOUNDATION SECTION

JOB 71-11117 LOCATION Co-ords. 99,849 N; 80,805 E.

ORIGINATED BY PP

W.P. 257-66-08 BORING DATE Nov. 19, 1971

COMPILED BY PP

DATUM Geodetic BOREHOLE TYPE Cont. Flight Auger

CHECKED BY

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE					LIQUID LIMIT ——— w_L PLASTIC LIMIT ——— w_p WATER CONTENT ——— w			BULK DENSITY γ P.C.F.	REMARKS		
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FOOT		BLOWS / FOOT					SHEAR STRENGTH P.S.F.					WATER CONTENT %	
							20	40	60	80	100	P.S.F.						
							○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB. VANE					w_p ——— w ——— w_L						
615.0	Ground Level																	
0.0	Clayey silt with sand and trace of gravel. Stiff to Hard.		1	SS	9	610												
			2	SS	36													
			3	SS	10													
			4	SS	71													
			5	SS	39													
			6	SS	32													
			7	SS	22	600												
			8	SS	15													
593.5					9	SS		17										
					10	SS		20										
21.5	End of Borehole					590												



SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION	RESISTANCE	LIQUID LIMIT	PLASTIC LIMIT	WATER CONTENT	BULK DENSITY γ P.C.F.	REMARKS	
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS/FOOT		BLOWS / FOOT			w_L	w_p			w
							20	40	60	80	100			SHEAR STRENGTH P.S.F.
							○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB. VANE			WATER CONTENT % 10 20 30				
615.2	Ground Level													
0.0	Clayey silt with sand and trace of gravel. Very stiff to hard		1	SS	16	610							B.H. Dry	
			2	SS	53									
			3	SS	64									
			4	SS	60									
			5	SS	24									
			6	SS	19									
			7	SS	25									
			8	SS	20									
			9	SS	26									
			10	SS	16									
593.7														
21.5	End of Borehole				(1)	590								

DEPARTMENT OF HIGHWAYS- ONTARIO
MATERIALS & TESTING OFFICE


RECORD OF BOREHOLE No. 156

FOUNDATION SECTION

JOB 71-11117 LOCATION Co-ords. 99,875 N; 80,675 E. ORIGINATED BY PP
W.P. 257-66-08 BORING DATE Nov. 22, 1971 COMPILED BY PP
DATUM Geodetic BOREHOLE TYPE Cont. Flight Auger CHECKED BY _____

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE					LIQUID LIMIT — w_L PLASTIC LIMIT — w_p WATER CONTENT — w			BULK DENSITY γ P.C.F.	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FOOT		BLOWS / FOOT					WATER CONTENT %				
							20	40	60	80	100	w_p — w — w_L				
							SHEAR STRENGTH P.S.F.									
							○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB. VANE									
615.0	Ground Level															
0.0	Clayey silt with sand and trace of gravel. Stiff to Hard		1	SS	21	610										
			2	SS	51											
			3	SS	42											
			4	SS	36											
			5	SS	22		600									
			6	SS	18											
			7	SS	14											
592.5																
22.5	End of Borehole				204	590									594.0 	

120/11"

594.0 7-20-71
204
120/11"

DEPARTMENT OF HIGHWAYS- ONTARIO
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No. 157

FOUNDATION SECTION

JOB 71-11117

LOCATION Co-ords. 99,957 N; 80,659 E.

ORIGINATED BY PP

W.P. 257-66-08

BORING DATE Nov. 23, 1971

COMPILED BY PP

DATUM Geodetic

BOREHOLE TYPE Cont. Flight Auger

CHECKED BY

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT					LIQUID LIMIT — w_L PLASTIC LIMIT — w_p WATER CONTENT — w		BULK DENSITY γ P.C.F.	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FOOT		20	40	60	80	100	WATER CONTENT % w_p — w — w_L			
615.0	Ground Level														
0.0	Clayey silt with sand and trace of gravel. Stiff to Hard		1	SS	14	610									
			2	SS	14										
			3	SS	58										
			4	SS	26										
			5	SS	21										
			6	SS	16										
			7	SS	14										
592.5						600									
22.5	End of Borehole					590									

595.2 ▼

DEPARTMENT OF HIGHWAYS- ONTARIO
MATERIALS & TESTING OFFICE

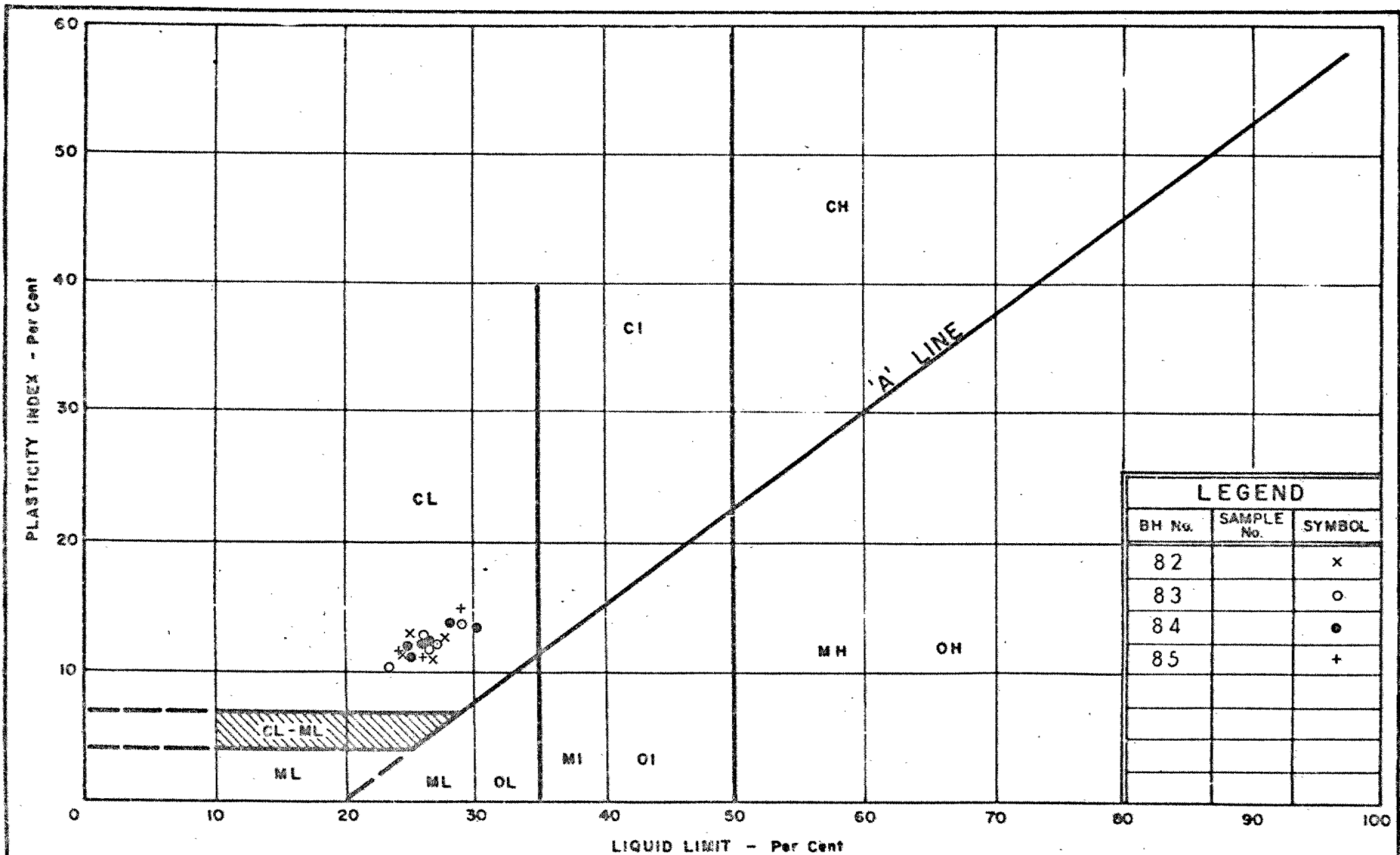
RECORD OF BOREHOLE No. 160

FOUNDATION SECTION

JOB 71-11117 LOCATION Sta. 99, 956 N, 80,814 E ORIGINATED BY PP
 W.P. 257-66-08 BORING DATE Nov. 23, 1971 COMPILED BY PP
 DATUM Geodetic BOREHOLE TYPE Cone Test Only CHECKED BY _____

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT					LIQUID LIMIT — w_L PLASTIC LIMIT — w_p WATER CONTENT — w			BULK DENSITY γ P.C.F.	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FOOT		20	40	60	80	100	WATER CONTENT % w_p — w — w_L				
615.0	Ground Level															
0.0	Probable Clayey Silt					610										
603.0																
12.0	End of Cone					600										

○ UNCONFINED + FIELD VANE
 ● QUICK TRIAXIAL x LAB. VANE



DEPARTMENT OF HIGHWAYS
MATERIALS and
TESTING
DIVISION

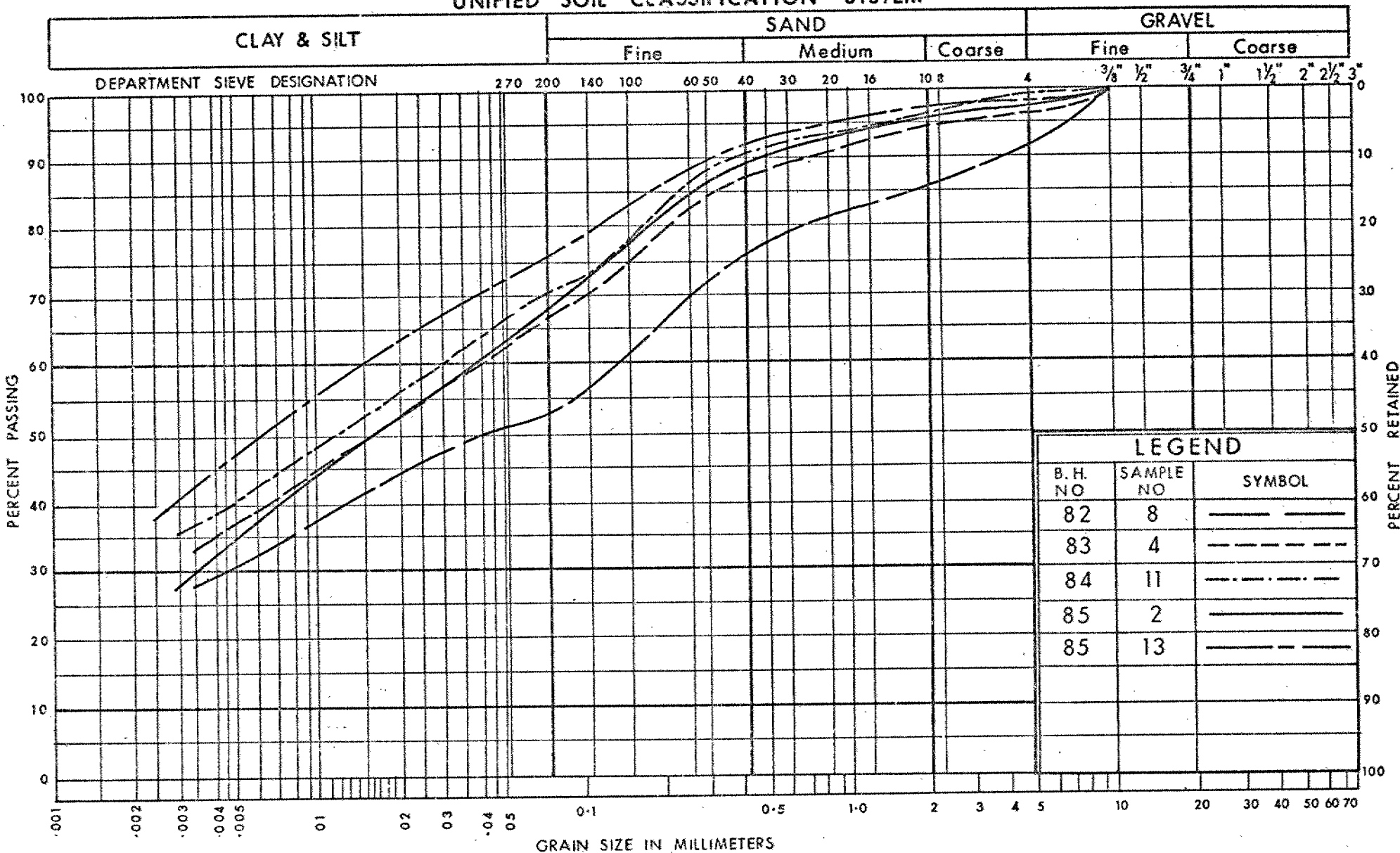
PLASTICITY CHART CLAYEY SILT

WP. No. 257-66-08

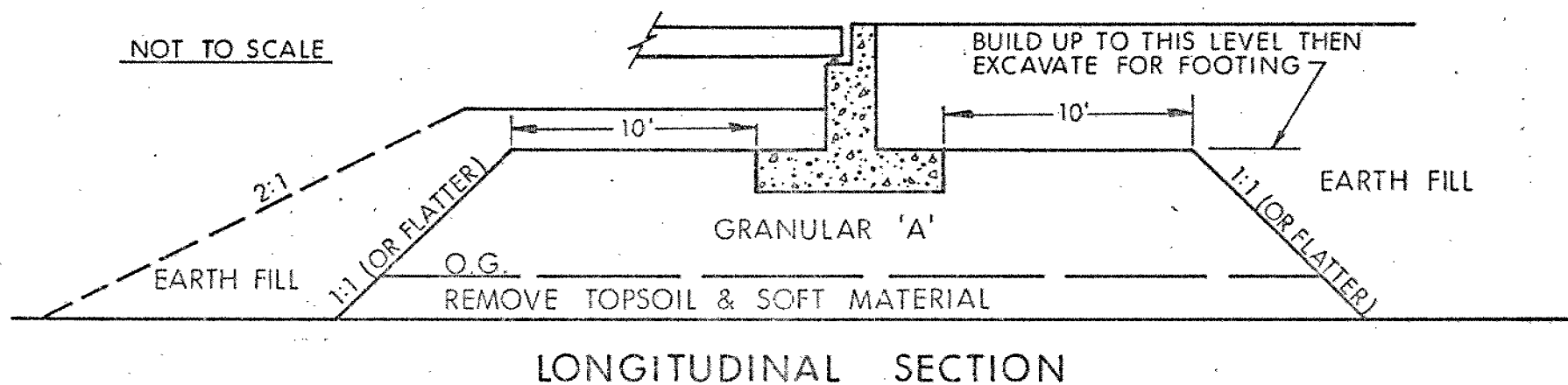
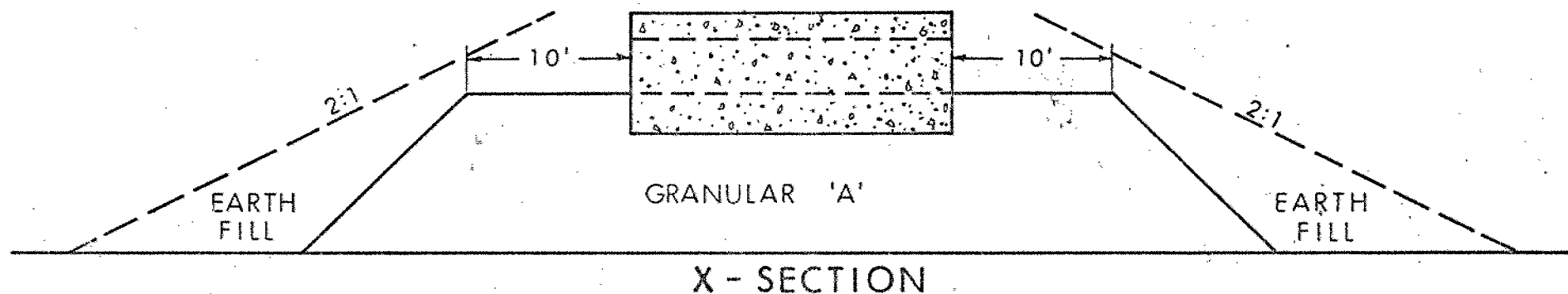
JOB No. 71-11117

FIG. 1

UNIFIED SOIL CLASSIFICATION SYSTEM



ABUTMENT ON COMPACTED FILL SHOWING GRANULAR 'A' CORE



NOTES

- 1 - REMOVE TOPSOIL &/OR SOFT SUBSOIL UNDER AREA OF COMPACTED GRANULAR 'A'.
- 2 - PLACE GRANULAR 'A' TO TOP OF FOOTING LEVEL, COMPACTED ACCORDING TO CURRENT D.T.C. STANDARDS.
- 3 - EXCAVATE COMPACTED GRANULAR 'A' MATERIAL FOR FOOTING.

ABBREVIATIONS USED IN THIS REPORT

PENETRATION RESISTANCE

STANDARD PENETRATION RESISTANCE 'N' - 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>'N' BLOWS / FT.</u>	<u>c LB. / SQ. FT.</u>	<u>DENSENESS</u>	<u>'N' BLOWS / FT.</u>
VERY SOFT	0 - 2	0 - 250	VERY LOOSE	0 - 4
SOFT	2 - 4	250 - 500	LOOSE	4 - 10
FIRM	4 - 8	500 - 1000	COMPACT	10 - 30
STIFF	8 - 15	1000 - 2000	DENSE	30 - 50
VERY STIFF	15 - 30	2000 - 4000	VERY DENSE	> 50
HARD	> 30	> 4000		

TYPE OF SAMPLE

S.S.	SPLIT SPOON	T.W.	THINWALL OPEN
W.S.	WASHED SAMPLE	T.P.	THINWALL PISTON
S.B.	SCRAPER BUCKET SAMPLE	O.S.	OESTERBERG SAMPLE
A.S.	AUGER SAMPLE	F.S.	FOIL SAMPLE
C.S.	CHUNK SAMPLE	R.C.	ROCK CORE
S.T.	SLOTTED TUBE SAMPLE		
	P.H. SAMPLE ADVANCED HYDRAULICALLY		
	P.M. SAMPLE ADVANCED MANUALLY		

SOIL TESTS

Qu	UNCONFINED COMPRESSION	L.V.	LABORATORY VANE
Q	UNDRAINED TRIAXIAL	F.V.	FIELD VANE
Qcu	CONSOLIDATED UNDRAINED TRIAXIAL	C	CONSOLIDATION
Qd	DRAINED TRIAXIAL	S	SENSITIVITY

ABBREVIATIONS USED IN THIS REPORT

SOIL PROPERTIES

γ	UNIT WEIGHT OF SOIL (BULK DENSITY)
γ_s	UNIT WEIGHT OF SOLID PARTICLES
γ_w	UNIT WEIGHT OF WATER
γ_d	UNIT DRY WEIGHT OF SOIL (DRY DENSITY)
γ'	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
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
τ_f	SHEAR STRENGTH
c'	EFFECTIVE COHESION INTERCEPT
ϕ'	EFFECTIVE ANGLE OF SHEARING RESISTANCE, OR FRICTION
c_u	APPARENT COHESION
ϕ_u	APPARENT ANGLE OF SHEARING RESISTANCE, OR FRICTION
μ	COEFFICIENT OF FRICTION
S_t	SENSITIVITY

GENERAL

π	$= 3.1416$
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
σ	NORMAL STRESS
σ'	NORMAL EFFECTIVE STRESS ($\bar{\sigma}$ IS ALSO USED)
τ	SHEAR STRESS
ϵ	LINEAR STRAIN
γ	SHEAR STRAIN
ν	POISSON'S RATIO (μ IS ALSO USED)
E	MODULUS OF LINEAR DEFORMATION (YOUNG'S MODULUS)
G	MODULUS OF SHEAR DEFORMATION
K	MODULUS OF COMPRESSIBILITY
η	COEFFICIENT OF VISCOSITY

EARTH PRESSURE

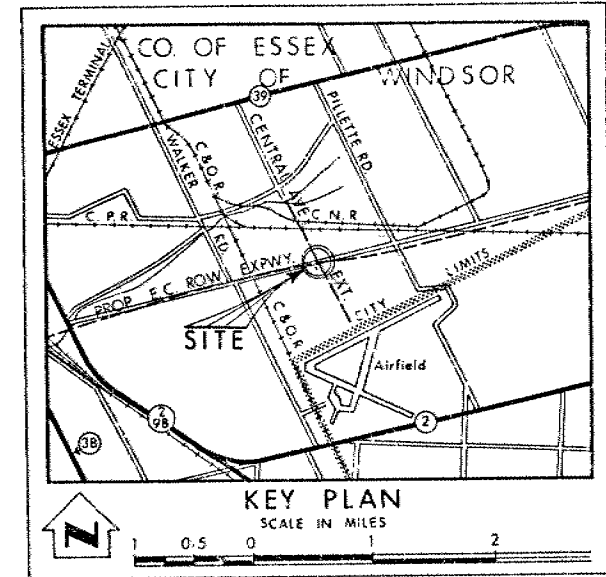
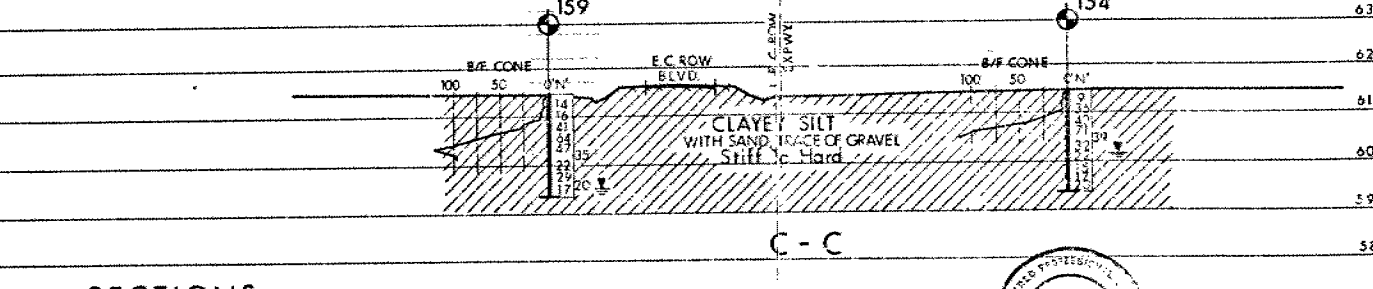
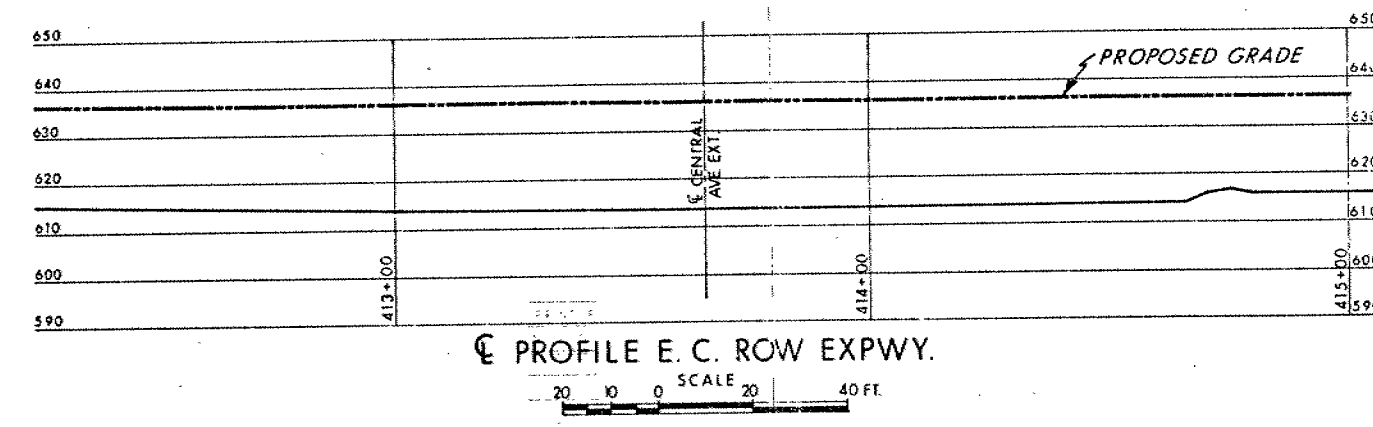
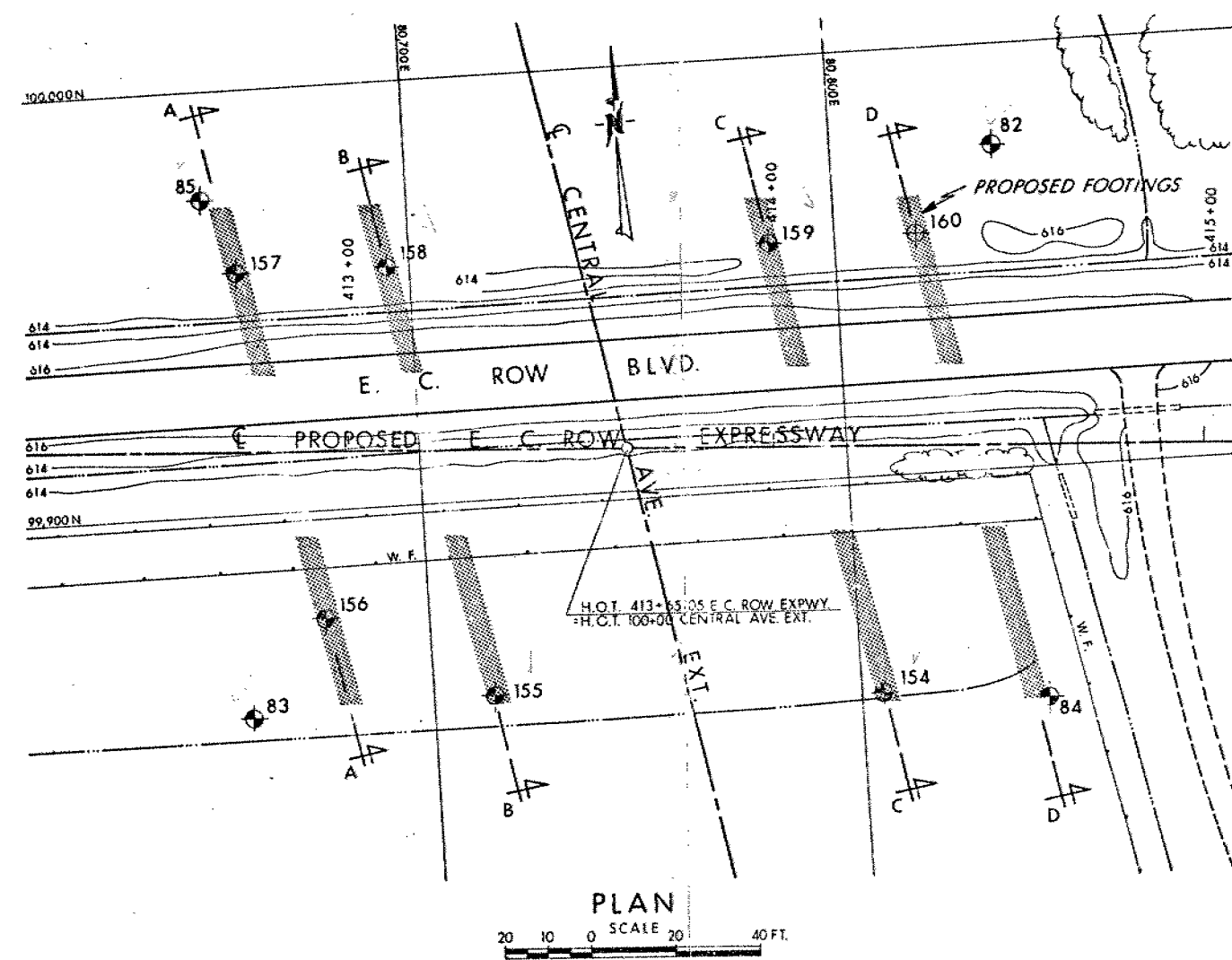
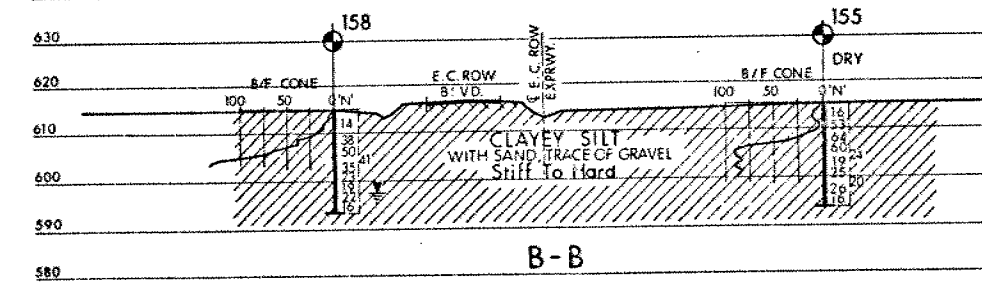
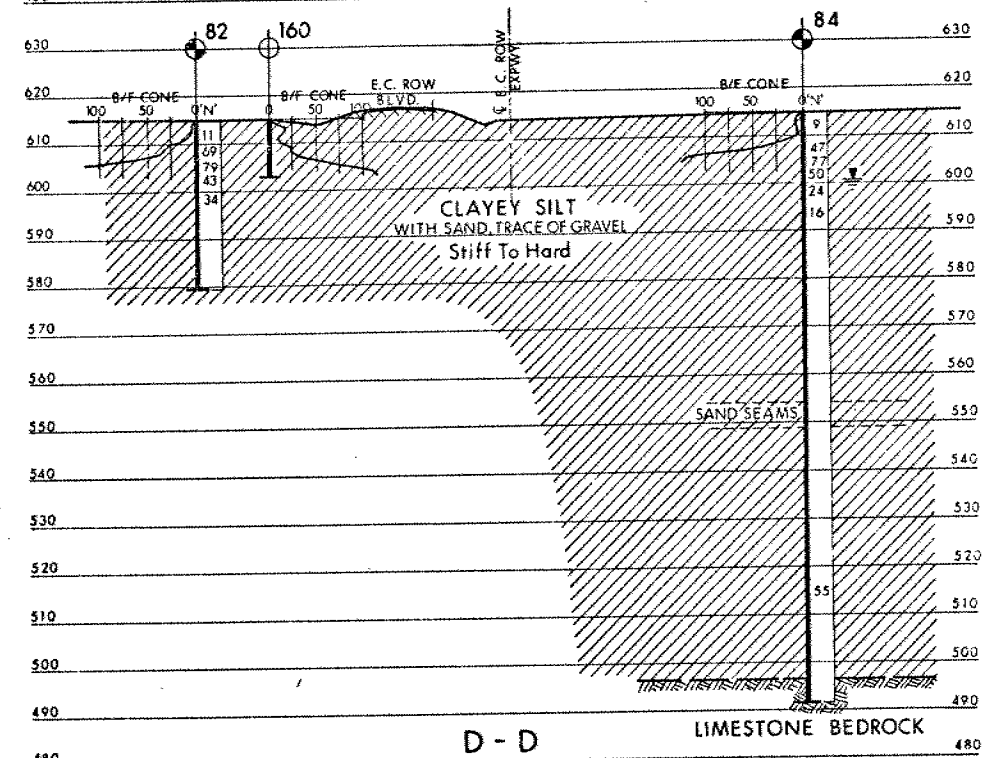
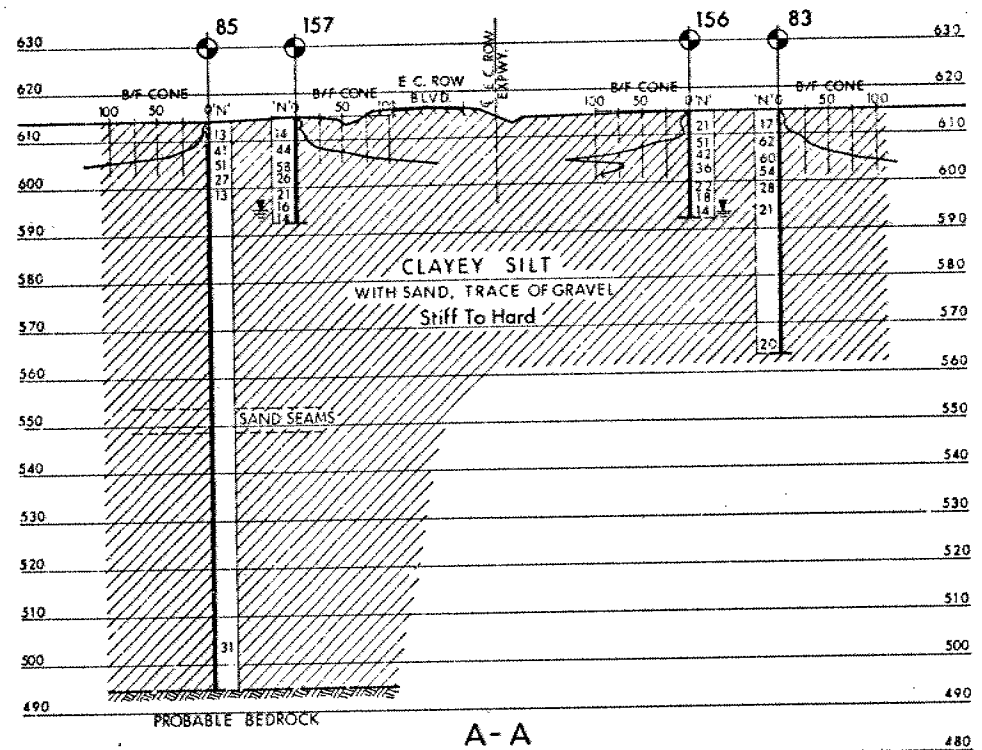
d	DISTANCE FROM TOP OF WALL TO POINT OF APPLICATION OF PRESSURE
δ	ANGLE OF WALL FRICTION
K	DIMENSIONLESS COEFFICIENT TO BE USED WITH VARIOUS SUFFIXES IN EXPRESSIONS REFERRING TO NORMAL STRESS ON WALLS
K_0	COEFFICIENT OF EARTH PRESSURE AT REST

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
β	ANGLE OF SLOPE TO HORIZONTAL



LEGEND

- Bore Hole
- Cone Penetration Test
- Bore Hole & Cone Test
- Water Levels established at time of field investigation, Nov. 1971.

W.L. not established in B.H. 82 - 83 & 85.

NO.	ELEVATION	CO. ORDINATES	
		NORTH	EAST
82	615.0	99,976	80,838
83	615.0	99,852	80,657
84	615.0	99,846	80,843
85	614.8	99,974	80,652
154	615.0	99,849	80,805
155	615.2	99,854	80,714
156	615.0	99,875	80,675
157	615.0	99,957	80,659
158	615.1	99,956	80,695
159	614.9	99,956	80,785
160	615.0	99,956	80,814

NOTE

The boundaries between soil strata have been established only at Bore Hole locations. Between Bore Holes the boundaries are assumed from geological evidence and may be subject to considerable error.

REVISIONS	DATE	BY	DESCRIPTION

DEPARTMENT OF TRANSPORTATION & COMMUNICATIONS
DESIGN SERVICES BRANCH — FOUNDATION OFFICE

CENTRAL AVE. EXTENSION

HIGHWAY NO. E.C. ROW EXPWY. DIST. NO. 1
CO. ESSEX CITY OF WINDSOR
TWP. LOT 103 CON.

BORE HOLE LOCATIONS & SOIL STRATA

SUBMD. PR. <input checked="" type="checkbox"/>	W.P. NO. 257-66-08	DRAWING NO. 71-11117A
DRAWN <input checked="" type="checkbox"/>	JOB NO. 71-11117	BRIDGE DRAWING NO.
DATE <u>JANUARY 3, 1972</u>	SITE NO.	
APPROVED <u>[Signature]</u>	CONT. NO.	

PRINCIPAL FOUNDATION ENGINEER



REF. NO. E-5310-1

ENGINEERING MATERIALS OFFICE
SOIL MECHANICS SECTION

WP 257-66-08 DIST 1

HWY E.C.Row Expy STR SITE 6-288

Central Avenue Extension Underpass
0.8 Miles East of Walker Road

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FOUNDATION INVESTIGATION REPORT

For

Central Avenue Extension Underpass
0.8 Miles East of Walker Road
W.P. 257-66-08, Site 6-288
E.C. Row Expressway, District 1, Chatham

INTRODUCTION

This report contains the results of a foundation investigation carried out for the above project. Fieldwork consisted of four sampled boreholes advanced during the period May 19 to 23, 1979. An auger machine mounted on a tracked vehicle was employed to advance the boreholes with hollow stem augers. Casing and wash-boring techniques were, however, used for the deeper portion of the two deep boreholes. Bedrock was proven in one borehole through the recovery of a BXL size rock core.

SITE DESCRIPTION

The site is located in the southern portion of the City of Windsor 200 feet west of the present intersection of Central Avenue and E.C. Row Avenue. During the period of fieldwork construction for the E.C. Row Expressway was underway with the roadbed granular base and paving being placed across the site under Contract 77-43. The surrounding area is flat reflecting its physiographic designation as part of the St. Clair Clay Plain. Land use is partly agricultural with industrial uses rapidly taking over. Windsor Airport lies immediately to the south.

SUBSURFACE CONDITIONS

General

Subsoil consists of about 125 feet of clayey silt (clay of low plasticity) followed by six to eight feet of very dense granular till. These deposits overly sound limestone bedrock.

Reference should be made to the Record of Borehole Sheets which are contained in the report Appendix. They show the boundaries

between soil types, as well as a summary of all field and laboratory tests performed. Reference should also be made to Drawing 2576608-A which shows the location and elevation of all boreholes, together with an inferred subsoil stratigraphy.

Clayey Silt

The upper 125 feet of overburden consists of clayey silt with sand and a trace of gravel. A plot of liquid limit versus plastic index is shown as Figure 1 of the Appendix. A 10 to 15 foot thick desiccated crust has developed in the area. It is brown in colour and has an undrained shear strength ranging from 10,000 to 2500 psf. Below the crust the soil is grey and the undrained shear strength ranges from 2500 to 1500 psf except in the lower 25 feet where somewhat higher values are found. Moisture contents are generally between 12 and 20 percent with the lower values located in the crust.

Granular Till

A six to eight foot thick deposit of very dense granular till was encountered overlying the bedrock. It consists of a mixture of boulders, cobbles, gravel, sand, silt and clay. A single Standard Penetration Test in this layer showed less than a foot of penetration for 100 hammer blows.

Bedrock

Bedrock was encountered at about elevation 484 some 133 feet below the surface. It consisted of sound limestone.

Groundwater

Groundwater readings were taken in the open boreholes during the period of investigation. These levels varied considerably reflecting the generally low permeability of the soil and the presence of small water bearing sand lenses. It is estimated that the groundwater level was about four feet below the surface during the period of fieldwork.

PROPOSED DESIGN

It is proposed that Central Avenue pass over the E.C. Row Expressway on a two span structure with each span approximately 85 feet in length. The abutment will be perched in the 23 foot high approach fills.

RECOMMENDATIONS

Piers

Piers may be supported on spread footings in original ground at elevation 310 with a design loading of 3 tons per square foot. Resistance to sliding may be calculated employing a design adhesion value of 2000 psf. It is predicted that settlement will not exceed two inches.

Perched Abutments

Perched abutments may be supported on compacted granular 'A' cores within the approach fills with a design loading of three tons per square foot. For calculations of sliding resistance a friction coefficient of 0.5 may be assumed to apply between the footing and the granular 'A'. A suggested construction scheme is shown as Figure 2 of the Appendix.

Alternately, perched abutments may be supported on closed end tube piles driven into the crust. A design loading of 25 tons per pile may be employed for 12 3/4" x 1/4" piles driven to elevation 605.

It is predicted that settlements of the abutments in these cases will not exceed four inches. This value could be reduced through the use of stage construction.

Piles to Bedrock

Alternately, the structure may be supported on piles driven to bedrock at elevation 484. Either steel tube piles (12 3/4" x 1/4") or H piles with a 74 lb section will carry design loads of up to 120 tons per pile. If tube piles are adopted the driving energy must be reduced to less than 30,000 ft.-lb per blow when the pile tip is below elevation 495. This measure is necessary to prevent

damage to the pile when it contacts the bedrock. If H piles are employed the pile tips should be fitted with standard flange plates to prevent damage from boulders in the till layer, as well as to increase the contact area between the pile tip and the bedrock. If piles to bedrock are used the settlement of the structure will be less than one inch.

Dewatering

No dewatering problems are anticipated due to the relatively impervious nature of the subsoil.

Frost Protection

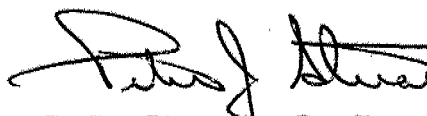
The base of all footings should be protected from frost action by a minimum of four feet of cover.

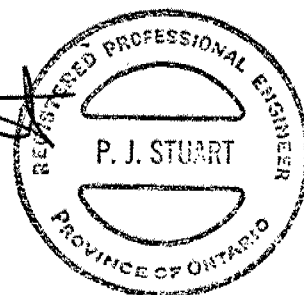
Approach Fills

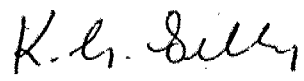
No stability problems are anticipated with 25 foot high approach fills if 2 horizontal to 1 vertical slopes are employed.

Earth Pressure

It is anticipated that backfill to the abutments will consist of quarried rock meeting granular 'A' specifications. It is estimated to have a unit weight of 150 pcf. Earth pressure at the abutments may be calculated employing this value and a coefficient of earth pressure of .3 if spread footings or short tube piles are employed. If piles to bedrock are used to support the abutment, the coefficient of earth pressure should be increased to 0.4.


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




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

July, 1979

APPENDIX



RECORD OF BOREHOLE No 1

W P 257-66-08 LOCATION Coords. N 15 363 087; E 872 813 ORIGINATED BY PRK
DIST 1 HWY E.C.Row Expy. BOREHOLE TYPE Hollow Stem Augers and B Casing COMPILED BY PRK
DATUM Geodetic DATE May 18 to 22, 1979 CHECKED BY *prk*

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					
614.8	Ground Level																
0.0																	
			1	SS	14		610										
			2	SS	47												
			3	SS	33												
			4	SS	20												
			5	SS	14		600										
			6	SS	9												
			7	SS	9												
			8	SS	11		590										
			9	SS	11												
			10	SS	7		580										
			11	SS	12		570										
			12	SS	11		560										
			13	SS	16		550										
			14	SS	6		540										
			15	SS	17		530										
			16	SS	27		520										
							510										
							500										

Brown
Grey

Clayey Silt
Some Sand
Trace of Gravel
Hard to Stiff

+2200

+ 1.9

+ 1.9

+2.8

+3.5

+3, x5: Numbers refer to
Sensitivity

20
15 5 (%) STRAIN AT FAILURE
10



RECORD OF BOREHOLE No 1 cont.

W P 257-66-08 LOCATION _____ ORIGINATED BY PRK
DIST 1 HWY E.C.Row Expy. BOREHOLE TYPE Hollow Stem Augers and B Casing COMPILED BY PRK
DATUM Geodetic DATE May 22, 1979 CHECKED BY *d.j.*

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 (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100					
495.8																	
119.0																	
490.8			17	SS	88/ 7"		490										14 56 (30)
124.0	Mixture of Cobbles, Gravel, Sand, Silt & Clay, Very Dense (Glacial Till)																
483.8																	
131.0	Limestone Bedrock		18	RC BXL	100% Rec.		480										
478.8																	
136.0	End of Borehole																



Ministry of
Transportation and
Communications

HIGHWAY ENGINEERING DIVISION-ENGINEERING MATERIALS OFFICE-SOIL MECHANICS SECTION

RECORD OF BOREHOLE No 2

W P 257-66-08 LOCATION Coords. N 15 363 123; E 872 787
DIST 1 HWY E.C.Row Expy. BOREHOLE TYPE Hollow Stem Augers
DATUM Geodetic DATE May 24, 1979
ORIGINATED BY PRK
COMPILED BY PRK
CHECKED BY *l.f.*

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 (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20 40 60 80 100	SHEAR STRENGTH					
614.6	Ground Level													
0.0	Brown Grey Clayey Silt Some Sand Trace of Gravel Hard to Stiff		1	SS	29									
			2	SS	46									
			3	SS	49									
			4	SS	29									
			5	SS	22									
			6	SS	15									
			7	SS	14									
			8	SS	14									
			9	SS	13									
			10	SS	13									
			11	SS	14									
573.1														
41.5	End of Borehole													
	Note: Water Level Not Recorded													

+³, x⁵: Numbers refer to
Sensitivity

20
15 \div 5 (%) STRAIN AT FAILURE
10



RECORD OF BOREHOLE No 3

W P 257-66-08 LOCATION Coords. N 15 363 196; E 872 163 ORIGINATED BY PRK
DIST 1 HWY EC Row Expy. BOREHOLE TYPE Hollow Stem Augers COMPILED BY PRK
DATUM Geodetic DATE May 24, 1979 CHECKED BY W.F.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100					
SHEAR STRENGTH PSF											10	20	30				
○ UNCONFINED + FIELD VANE																PCF	GR SA SI CL
● QUICK TRIAXIAL x LAB VANE																	
615.0	Ground Level																
0.0	Brown Grey Clayey Silt Some Sand Trace of Gravel Hard to Stiff		1	SS	19		610										
			2	TW	PH												
			3	SS	39												
			4	SS	29												
			5	TW	PH		600										
			6	SS	17												
			7	TW	PH												
			8	SS	12		590										
			9	TW	PH												
			10	SS	11		580										
			11	TW	PH												
572.0																	
43.0	End of Borehole																
	Note: Water Level Not Recorded																

OFFICE REPORT ON SOIL EXPLORATION



RECORD OF BOREHOLE No 4

W P 257-66-08 LOCATION Coords. N 15 363 249; E 872 731 ORIGINATED BY PRK
DIST 1 HWY E.C.Row Expy. BOREHOLE TYPE Hollow Stem Augers, Tricone Washboring COMPILED BY PRK
DATUM Geodetic DATE May 23, 1979 CHECKED BY *el.f.*

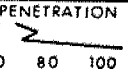
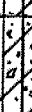

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	N' VALUES			20	40	60	80	100					
616.9	Ground Level																
0.0																	
			1	SS	12		615										
			2	SS	43												
			3	SS	36												
			4	SS	18		610										
			5	SS	10												
			6	SS	9												
			7	SS	9		600										
			8	SS	12												
			9	SS	9												
			10	SS	8		590										
			11	SS	12												
			12	SS	8		580										
			13	SS	12		570										
			14	SS	10		560										
							550										
							540										
							530										
			15	SS	28												
							520										
							510										

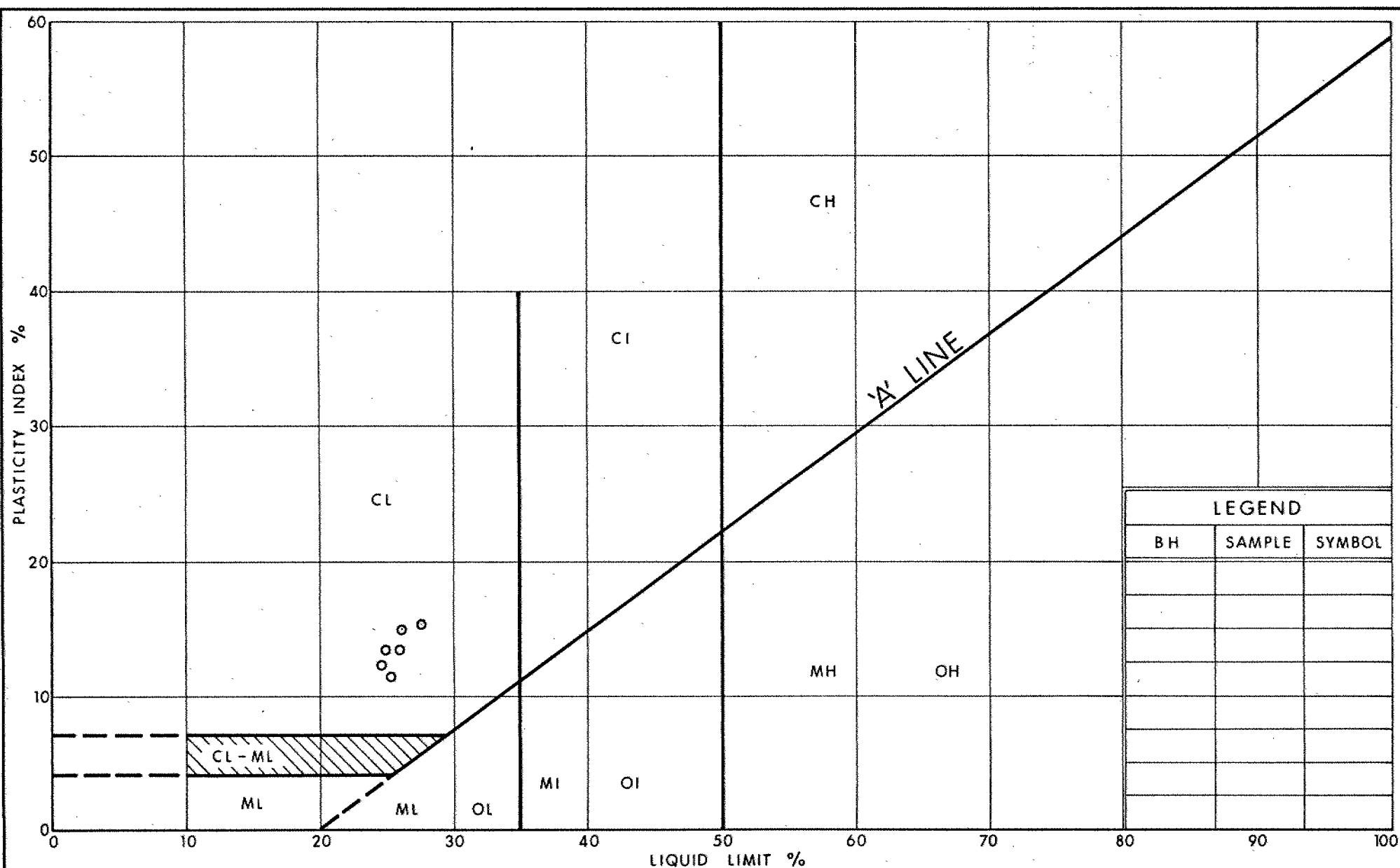
+³, x⁵: Numbers refer to 20
15 \div 5 (%) STRAIN AT FAILURE
Sensitivity 10



RECORD OF BOREHOLE No 4 cont.

W P 257-66-08 LOCATION _____ ORIGINATED BY PRK
DIST 1 HWY E.C.Row Expy. BOREHOLE TYPE Hollow Stem Augers and Tricone Washboring COMPILED BY PRK
DATUM Geodetic DATE May 23, 1979 CHECKED BY *W.F.*

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT Y	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100					
497.9																	
119.0			16	SS	43												
490.9																	
126.0	Mixture of Cobbles Gravel, Sand, Silt and Clay, Very Dense (Glacial Till)			Progress	Slow												
483.9				Refusal to Tricone													
133.0	Probable Bedrock End of Borehole																

Ministry of
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Ontario

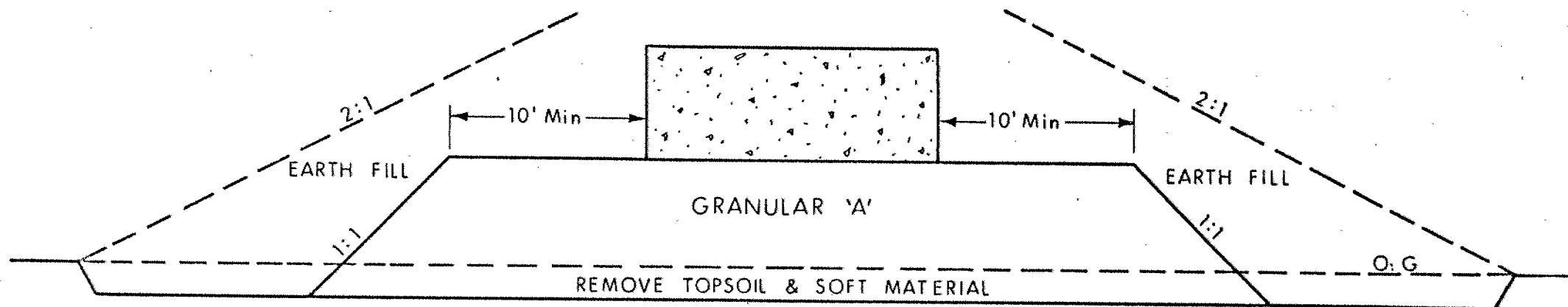
ENGINEERING SERVICES BRANCH

PLASTICITY CHART
CLAYEY SILT
SOME SAND TRACE OF GRAVEL

FIG No 1

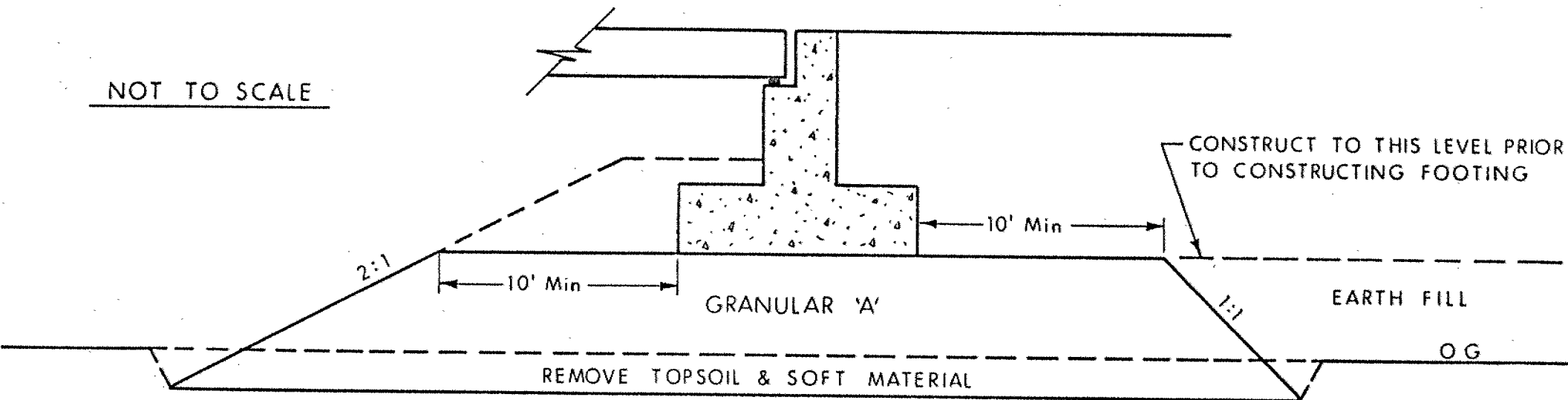
W P 257-66-08

ABUTMENT ON COMPACTED FILL SHOWING GRANULAR 'A' CORE



X SECTION

NOT TO SCALE



LONGITUDINAL SECTION

NOTE:

REMOVE TOPSOIL & OR SOFT SUBSOIL UNDER AREA OF COMPACTED GRANULAR 'A' AND EARTH FILL.

EXPLANATION OF TERMS USED IN REPORT

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

FIELD SAMPLING

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

EARTH PRESSURE TERMS

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

INDEX PROPERTIES

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

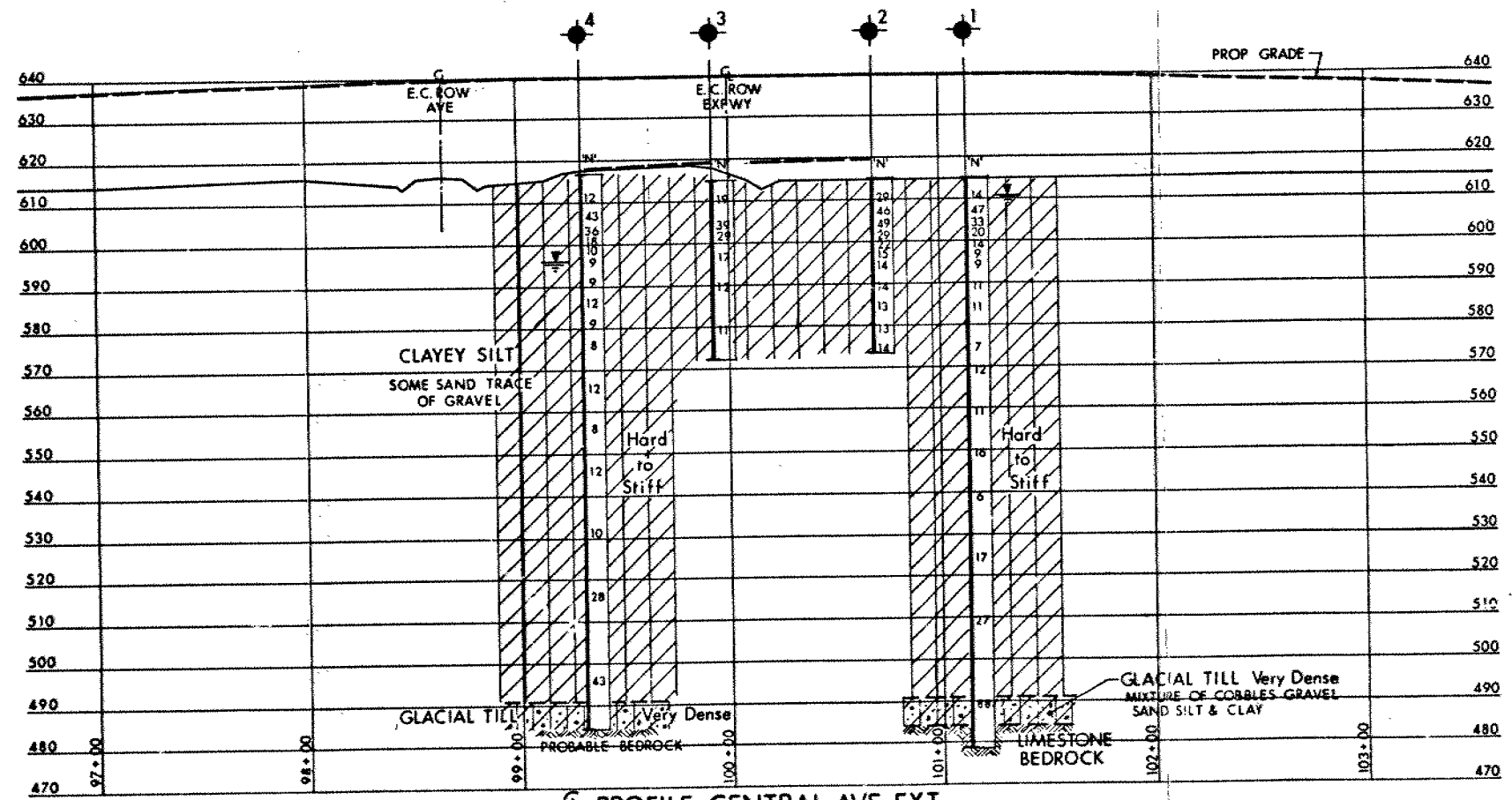
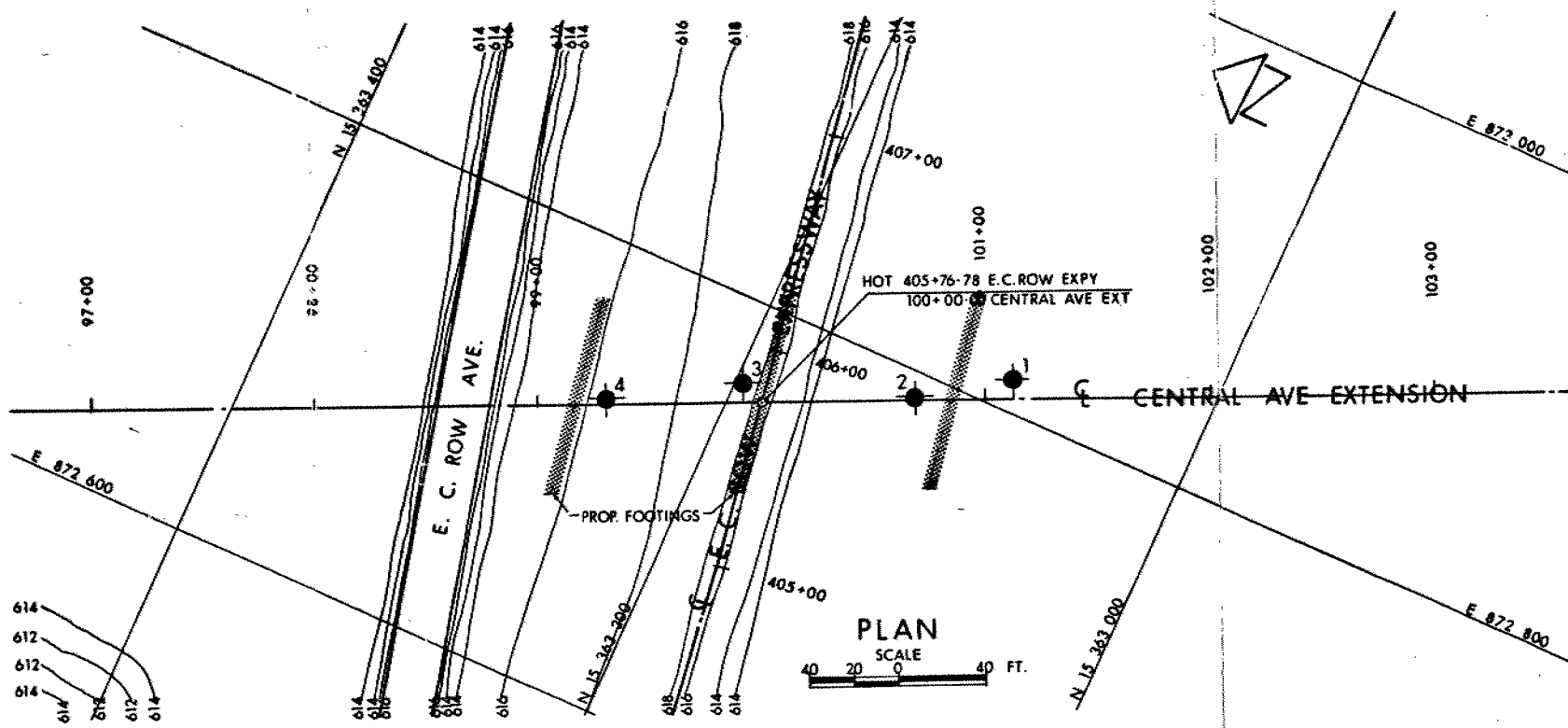
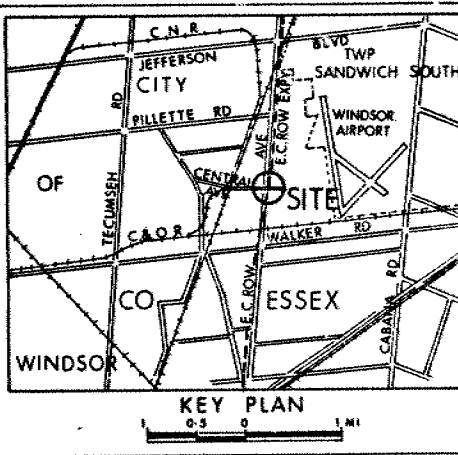
STRENGTH PARAMETERS

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

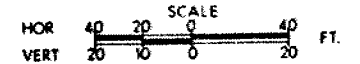
HYDRAULIC TERMS

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

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



PROFILE CENTRAL AVE EXT.



LEGEND

- Bore Hole
- Dynamic Cone Penetration Test (Cone)
- Bore Hole & Cone
- 'N' Blows/ft (Std Pen Test 350ft lbs energy)
- CONE Blows/ft (60° Cone, 350ft lbs energy)
- W.L. at time of investigation MAY 1979
- W.L. NOT ESTABLISHED IN B.H. No 2 & 3

No	ELEVATION	CO-ORDINATES	
		NORTH	EAST
1	614.8	15 363 087	872 813
2	614.6	15 363 123	872 787
3	615.0	15 363 196	872 163
4	616.9	15 363 249	872 731

-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

E.C. ROW EXPRESSWAY
CENTRAL AVENUE UNDERPASS



Consulting Engineers & Planners

PILE DATA

LOCATION	BATTER	No.	LENGTH
NORTH ABUTMENT	VERT.	6	139'
	1:4	6	143'
	1:3	8	147'
	1:8	2	140'
PIER	VERT.	4	132'
	1:8	16	133'
SOUTH ABUTMENT	VERT.	6	141'
	1:4	12	145'
	1:3	2	149'
	1:8	2	142'

COORDINATES

POINT	NORTH	EAST
WP#1.0	15,363,262.770	872,723.337
WP#1.1	15,363,269.266	872,764.220
WP#1.2	15,363,255.538	872,677.824
WP#2.0	15,363,185.637	872,759.050
WP#2.1	15,363,191.489	872,795.879
WP#2.2	15,363,179.104	872,717.940
WP#3.0	15,363,108.503	872,794.762
WP#3.1	15,363,114.999	872,835.645
WP#3.2	15,363,101.271	872,749.250

NOTES

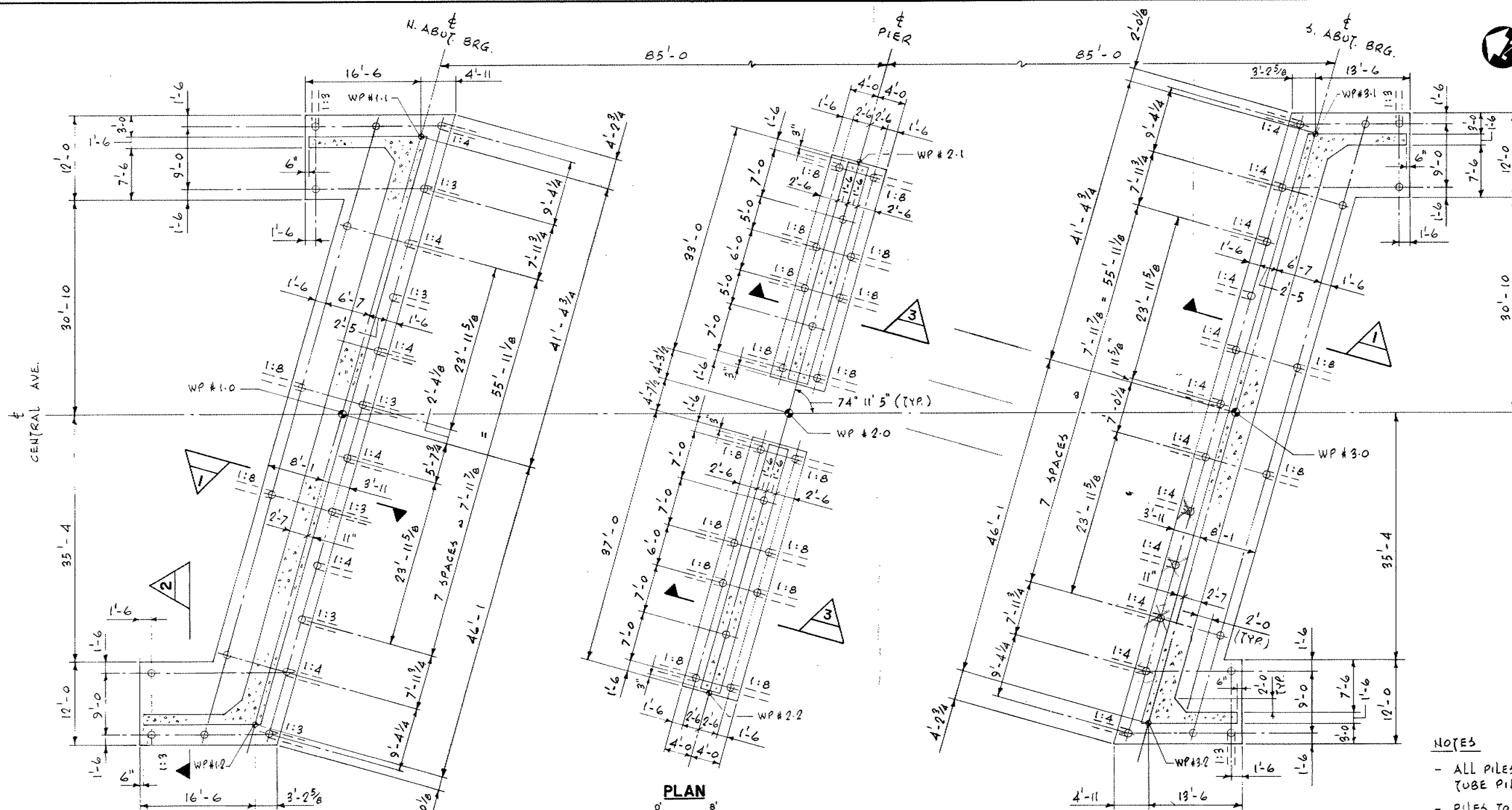
- ALL PILES TO BE 12.6" O.D. x 0.25" WALL DESIGN LOAD = 190 TONS
TUBE PILES TO BE FILLED WITH CONC. TOTAL VOL. = 272 C.Y.
- PILES TO BE DRIVEN TO BEDROCK.
- ① DRIVING ENERGY SHALL NOT EXCEED 41,000 FT. LBS./BLOW WHEN THE PILE TIP IS ABOVE EL. 500.0 AND 30,000 FT. LBS./BLOW WHEN THE TIP IS BELOW EL. 500.0.
- PILE LENGTHS SHOWN ARE THEORETICAL LENGTH BELOW CUT-OFF
- PILE SYMBOLS
O INDICATES VERTICAL PILE
□ INDICATES BATTERED PILE
- CONCRETE STRENGTH
TUBE PILES 30 MPa
- FOR PILE SPLICE AND DRIVING SHOE DETAILS SEE 33 3-2 ON DWG No. 21



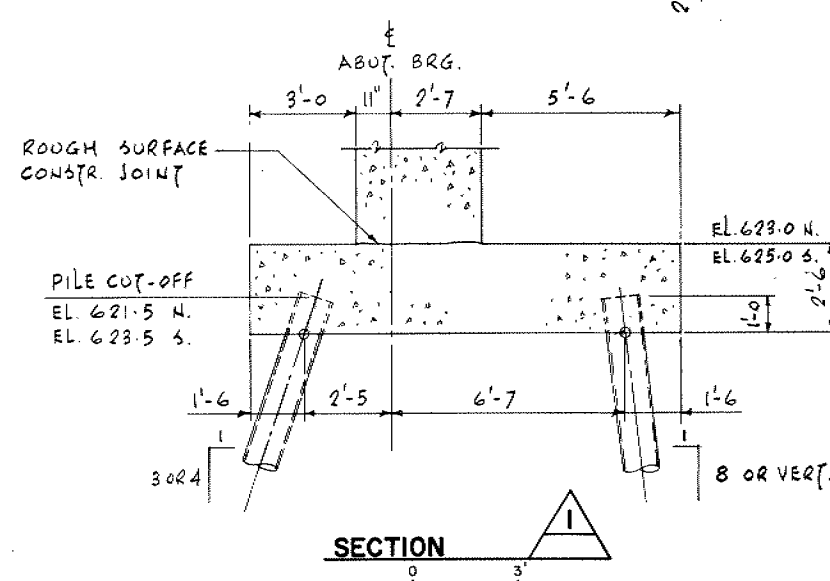
FOR REDUCED PLAN



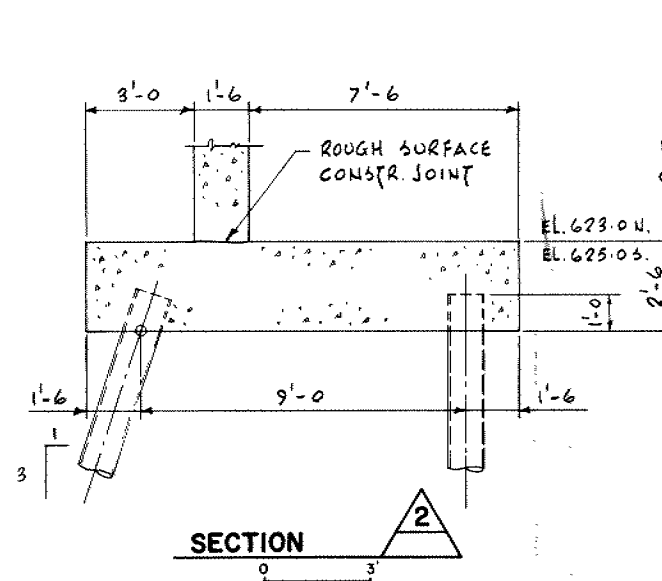
REVISIONS	DATE	BY	DESCRIPTION
1	MAR. 20 2011	JKL	(1) REVISE NOTE RE: DRIVING ENERGY
DESIGN	MDP	CHECK	GK
DRAWING	LTL	CHECK	GLB
LOADING	HS20	DATE	OCT. 79
SITE No	6-288	DWG	3



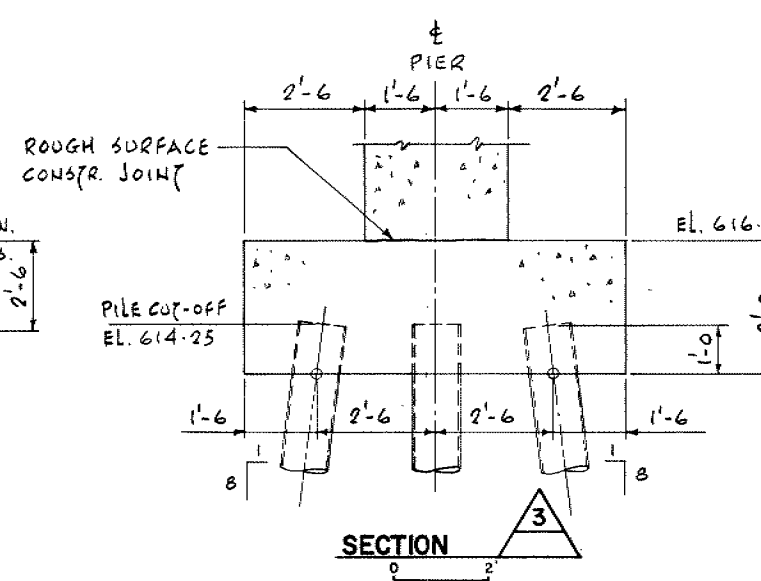
PLAN



SECTION 1



SECTION 2



SECTION 3

Mr. W.G. Sawyer
Area Construction Engineer
Southwestern Region
London

1980-07-30

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

Re:

Pile Driving
E.C. Row Expressway
and Central Ave. U'Pass
Cont. 80-33, District #1 (Chatham)

During pile driving at the south abutment, some of the battered piles were breaking up above the groundlevel when the pile tips have reached the 50 ft. level. It was suspected by the Construction personnel that a hard soil stratum (or boulders) may exist at that level.

Following your request, a drilling crew and equipment was hired by our Section and three boreholes were put down at the suspected locations. These borings did not confirm the presence of any hard zones. The obtained field test results indicate that the subsoil conditions are similar to those shown on our Foundation Drawing No. 2576608-A. It is our conclusion that the breakage was not caused by hard or dense subsoil but by defective piles. This opinion is supported by the reports received from Alpha Ultrasonic Co. Ltd. This firm was hired to investigate the large number of pile failures which have occurred not only at this location, but on other contracts in the same vicinity.

The damaged sections were removed and new pieces were spliced on and the driving was continued until that point when the final penetration resistance of 35 blows per inch was achieved by using a D-22 hammer producing 30,000 ft. lbs. per blow energy.

Should additional information be required please contact our Office.

PP:ea

CC: B. Summers
J. Keen

P. Payer
Foundations Engineer
For:
K.G. Selby
Senior Foundations Engineer

memorandum

80-33



To: Mr. W. Sawyer
Area Construction Engineer
Southwestern Region

Date: 1980-05-20

Attention: Mr. B. Summers

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

Re: Pile Driving Control on Contract 80-33

This memo confirms recommendations given to your Mr. Oellette verbally by our Mr. P. Payer in regard to pile driving at Jefferson Blvd. Overpass.

- (1) Piles may be driven with the Delmag D22 hammer using maximum energy of 41,000 ft. lbs. per blow until the penetration resistance is 10 blows per inch. At this point energy should be reduced to 30,000 ft. lbs. per blow and driving continued until a final penetration resistance of 35 blows per inch is achieved.
- (2) Every pile, when driven, should be immediately measured internally to ensure that no damage has occurred during driving.
- (3) Immediately after driving, elevations should be taken at a convenient point on the pile. These elevations should be rechecked at a later time when all surrounding piles have been driven. If groundheave has caused any upward movement of the piles, they should be redriven to the resistance specified in (1).

K. G. Selby

KGS:ea

K.G. Selby
Senior Foundations Engineer



Ministry of
Transportation and
Communications

Memorandum

WP 257-66-08

To: Mr. J. Edwards,
Planning & Design Section,
Southwestern Region.

From: Pav't. & Foundation Design Section,
Engineering Materials Office,
Room 315, Central Building,
Downsview.

Attention:

Date: 79 10 03

Our File Ref.

In Reply to

Subject: Re: Surficial Sand Deposits at Central Avenue,
W.P. 257-66-08, Site 6-288,
E.C. Row Expressway, District 1, Chatham.

Recently Mr. D. B. James of M. M. Dillon brought to our attention the fact that scattered pockets of water bearing sand up to 3 feet in thickness were encountered during utility installation in the general area of Central Avenue. During our field investigation at Central Avenue, no sand pockets were encountered while advancing borings in the area of the structure footings. It is however possible that a sand lense or pocket may extend into an area of the footing where no borehole was located. If this is the case, it will not require any change in design or should it present any exceptional difficulty to the contractor. It will be noted in the Foundation Contract Report that sand pockets exist in the general area of Central Avenue and that during wet periods of the year, they are water bearing. The contractor will thereby be warned he may encounter this condition during excavation for structure footings.

PJS/cy

P. J. Stuart,
Project Foundation Engineer.

c.c. J. Forester
Files



Memorandum

To: Mr. A.P. Watt
Head, Structural Section
Southwestern Region, London

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

Attention:

Date: 79 01 29

Our File Ref.

In Reply to

Subject: Re: Foundation Recommendations for
The E.C. Row Expressway
W.P.s 259-66-02/04/05/06/08 and
257-66-08, District 1, Chatham

Foundation investigation reports were requested for the above structure sites on the E.C. Row Expressway in Windsor. Due to the urgency of the design schedule, it was also requested that preliminary recommendations should be made in an interim report. Recommendations will be made at this time for all 6 sites although further fieldwork will be required to confirm these recommendations for Central Avenue and Jefferson Blvd. because the line has been shifted since fieldwork was done for these structures.

Subsurface Conditions

Subsoil consists of from 120 to 150 feet of clayey silt overlying relatively flat limestone bedrock. The upper 10 to 20 feet of the clayey silt forms a desiccated crust which is brown in colour and has a moisture content of approximately 15 percent. The remaining 100+ feet of clayey silt is grey in colour with moisture contents ranging from 15 to 20 percent. The undrained shear strength ranges from 2000 to 5000 psf in the crust but decreases to as low as 1000 psf in the underlying soil.

Summary

1. Piers may be supported on spread footings in the crust with design loads of from 2 to 3 tons per square foot. Settlements of from 1 to 3 inches are predicted depending on the location.
2. Perched abutments may be supported by short tube piles driven into the crust with design loads of 25 tons per pile. Alternatively, spread footings on compacted granular cores with design loads of 3 tons per square foot may be considered. In both of these cases large settlements will result from the loads imposed by the embankments. Depending

cont'd.....

on the height and width of the embankment, these settlements will range from 4 inches to 8 inches. These values could be reduced by the use of stage construction.

3. Any or all of the structure footings may be supported on piles to bedrock. In this case settlements will not exceed 1 inch. Either 12 3/4 x 1/4" tube piles or H piles with a 74 pound section will carry a design load of 120 tons per pile. The H piles should be fitted with standard flange plates to prevent damage on boulders and to increase the contact area bearing on the rock. The driving energy for tube piles would have to be reduced to less than 30,000 ft-lb per blow when the pile is within 7 feet of bedrock.
4. Reinforced earth structures should be considered for the 2 railway crossings. These structures would consist of reinforced earth walls with a deck supported on spread footings placed in the granular material back of the wall facing and would be loaded to 2 tons per square foot. The ability of reinforced earth to withstand settlement; its speed of construction; and the cost of a deep piling alternative, suggests reinforced earth will compare favourably, both in cost and time of construction with more conventional alternatives.

Recommendations

E.C. Row and CPR, W.P. 259-66-02

A single span structure is proposed.

1. Spread footings
 - 3 tons/sq. ft. at 598
 - adhesion of 2000 lb/sq. ft.
 - maximum settlement = 10 in.
 - differential settlement 3" in 50 ft.
2. Piles to bedrock at elevation 476.
3. Reinforced earth walls with a deck supported on spread footings loaded at 2 tons per square foot.

E.C. Row and Little River, W.P. 259-66-04

1. Spread footings
 - 2 tons per square foot at 583
 - adhesion of 2000 lb/sq. ft.
 - settlement - 2 in.
2. Piles to bedrock at elevation 470.

*lowered - 1/2" 270-
with 2" by KGE
original*

cont'd.....

E.C. Row and Jefferson Blvd., W.P. 259-66-05

1. Piers

- spread footings at 3 tons/sq. ft. at elev. 598
- adhesion of 2000 psf
- settlement - 2 in.

2. Abutments

- compacted granular at 3 tons/sq. ft.
- settlement - 6 in.
- tube piles to elevation 590 with loads of 25 tons per pile
- settlement 6 in.

3. Piles to bedrock at elevation 460+ 10

E.C. Row and Lauzon, W.P. 259-66-06

1. Center Pier

- spread footing at 487 at 2 tons/sq. ft.
- adhesion of 2000 lb/sq. ft.
- settlement of 2 in.

2. Abutment

- compacted granular at 3 tons/sq. ft.
- settlement of 6 in.
- tube piles to elevation 584 with a design load of 25 tons per pile
- settlement of 6 in.

3. Piles to bedrock at elev. 475

Lauzon Parkway and CPR, W.P. 259-66-08

A 3 span structure is proposed.

1. Piers

- spread footings at 2 tons per sq. ft. at 587
- adhesion of 2000 lb/sq. ft.
- settlement - 3 in.

2. Abutments

- tube piles to 585 with a design load of 25 tons per pile
- settlement - 8 in.

3. Piles to bedrock at elevation 478

4. A single span reinforced earth structure as outlined in the summary.

cont'd.....

E.C. Row and Central Ave., W.P. 257-66-08

1. Piers

- spread footings at 3 tons per sq. ft. at elev. 610
- adhesion of 2000 lb/sq. ft.
- settlement of 2 in.

2. Abutments

- compacted granular at 3 tons/sq. ft.
- settlement - 4 in.
- tube piles to elev. 605 with a design load of 25 tons per pile
- settlement - 4 in.

3. Piles to bedrock at elev. 495+ 10



P.J. Stuart
Project Engineer

PJS/gs

cc: J. Keen
A. Crowley
J. Anderson
Files

Mr. B. J. McKenna,
Structural Planning Engineer,
Southwestern Region,
London, Ontario.

Foundations Office,
Design Services Branch,
West Building, Downsview.

November 16, 1973.

Proposed E.C. Row Expressway and
Central Ave. Extension Crossing
Lot 103, Concession 2
City of Windsor, County of Essex
District #1 (Chatham)
W.O. 71-11117 --- W.P. 257-66-08

In reply to your recent request, our comments regarding the selection of either 20 or 30 feet approach slabs at the above mentioned structure are as follows:

1. Due to long term consolidation of the cohesive subsoil beneath the approach fills and internal settlements within the fills themselves, we estimate the approach fills will undergo settlements of 4-6 inches. These settlements will occur immediately behind the structure abutments and away from the abutment for at least 30 feet.
2. The ends of approach slabs farthest from the abutments will settle with the fills supporting them resulting in 4-6 inches of differential settlement along the slabs.
3. We feel that the criterion for choosing either 20 feet or 30 feet long slabs is essentially one of economics. The shorter slab will cost less to construct initially, but for a given differential settlement along the slab, the longer slab will exhibit a more gradual slope. Continuing maintenance costs associated with the longer slab will therefore be less.

If we may be of further assistance in this matter, please contact this office.

JH/ji c.c. J. L. Keen
J. G. Forster
Found. File
Documents

J. Hodge
J. Hodge,
Project Foundations Engineer,
For: K. G. Selby,
Supervising Foundations Engineer.