

G.I.-30 SEPT. 1976

GEOCRES No. 40I14-94DIST. 2 REGION W.P. No. 41-66-08CONT. No. 77-61W. O. No. STR. SITE No. 19-544HWY. No. 402LOCATION Hwy 4 Interchange
UnderpassNo. of PAGES -

OVERSIZE DRAWINGS TO BE INCLUDED WITH THIS REPORT. REMARKS:



Ministry of
Transportation and
Communications

Memorandum

Mr. A.P.Watt, (2)
Regional Structural Planning Eng.
Southwestern Region, London

From: Soil Mechanics Section
Geotechnical Office
West Building, Downsview.

Attention:

Date:

Our File Ref.

10th June 1975
In Reply to JUN 18 1975

Subject:

FOUNDATION INVESTIGATION REPORT
for

Hwy. 4 Underpass Hwy 402
Twp. of Westminster, Dist.2, London
W.P. 41-66-08, Site 19-544

40114-94
GEOCREs No.

CONTRACT No 77-6

Attached we are forwarding to you our detailed Foundation Investigation Report on the subsoil conditions existing at the abovementioned 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.

K. G. Selby
K.G.SELBY
Supervising Engineer

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FOUNDATION INVESTIGATION REPORT

for

Hwy. 4 Underpass Hwy. 402
Twp. of Westminster, District 2, London
W.P. 41-66-08 Site 19-544

1. INTRODUCTION

A request for a foundation investigation at the above site was received from Mr.A.P.Watt, Regional Structural Planning Engineer, Southwestern Region, London.

A field investigation was subsequently carried out by the Soil Mechanics Section to determine the subsoil conditions existing at the site. This report contains the results of our field and laboratory investigations, together with our recommendations relating to the design of the proposed structure foundations.

2. DESCRIPTION OF THE SITE

The proposed underpass is located 1 mile south of the town of Lambeth in an area of mixed farming. The land is gently rolling and in the immediate vicinity of the underpass slopes predominantly to the East.

Physiographically, the site is situated in an area referred to as the Mount Elgin Ridges.

3. FIELD AND LABORATORY INVESTIGATION PROCEDURES

Field work consisted of six sampled boreholes advanced employing hollow stem augers, as well as, six dynamic cone penetration tests.

Disturbed samples were obtained using a 2-inch O.D. split spoon sampler driven according to the specifications for the Standard Penetration Test.

All boreholes were surveyed in the field by personnel from London Region, Engineering Surveys Section. The locations and elevations of the boreholes are shown on Drawing No. 416608-A 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 representative samples to determine the following physical properties:

Atterberg Limits
Natural Moisture Content
Grain-size Distribution
Undrained Shear Strength

The test results are summarized on the Record of Borehole Sheets contained in the appendix of this report.

4. SUBSOIL CONDITIONS

4.1 General

Subsoil at this site consists of a deep deposit of clayey silt in excess of 145 ft. in thickness. Contained within this deposit at depths between 25 and 65 ft. is a discontinuous deposit of fine sand and silt.

4.2 Clayey Silt

The upper portion of the clayey silt deposit with a thickness of about 15 ft. represents the dessicated crust. It is brown in colour and has a very stiff to hard consistency. Beneath this crust the clayey silt is grey and, between the depth of 15 ft. and 40 ft., has a stiff to very stiff consistency. At depths greater than 40 ft. the consistency is very stiff to hard with Standard Penetration 'N' values ranging from 25 to 90.

4.3. Sand and Silt

A layer of compact to very dense sand and silt was found to extend over a portion of the site. Its thickness varies from zero to greater than 30 ft. This sand and silt stratum was encountered in boreholes 2, 3 and 6 at depths ranging between 25 and 55 ft.

It was not, however, encountered in borehole 2 which was terminated at a depth of 75 ft. This deposit has a compact to very dense consistency with Standard Penetration Test 'N' values ranging from 26 to in excess of 200.

4.4 Groundwater

Groundwater was encountered in the sand and silt stratum and slowly rose in the boreholes to within 3 ft. of the ground surface or approximate elevation 832.

5. RECOMMENDATIONS

5.1 General

It is proposed to construct a structure to carry Hwy. 4 over Hwy. 402. This will involve the construction of embankments approximately 20 ft. in height and a bridge of two spans each of which will be 114 in length.

5.2 Center Pier

It is recommended that the center pier be supported on spread footings at approximate elev. 830. A net safe bearing pressure of 3 tons per sq. ft. may be used for design purposes. Resistance to sliding may be determined using an adhesion design value of 2000 p.s.f.

5.3 Perched Abutments

The abutments may be constructed within the approach fills supported on steel tubes piles ($12\frac{3}{4} \times 1\frac{1}{4}$ ") driven into the dessicated crust. These piles should be driven to elevation 828 for the south abutment and 830 for the north abutment. The piles must not be driven below these elevations as undrained shear strength decreases with depth. A safe load of 25 tons per pile should be assumed for design purposes. Any horizontal loading should be resisted by battered piles.

As an alternative, the abutments may be supported on spread footings placed on well compacted G.B.C. Class 'A'. A net safe design load of 2.5 t.s.f. may be assumed. For calculations of sliding resistances, a friction coefficient of 0.6 may be assumed to apply between the footing and G.B.C. Class 'A'. A detailed construction scheme is outlined on Fig. 1 of the appendix.

5.4 Settlements

Long term settlements of approximately 2 inches at the abutments and 1 inch under the center pier is anticipated. Any bridge design should therefore have the ability to tolerate the resulting differential settlements.

To minimize these differential settlements between the abutments and the center pier footings, it is recommended that the approach embankments be built in advance of the structure by as long a period as possible.

5.5 Dewatering

No dewatering problems are anticipated during excavations for footings due to the relatively impervious nature of the subsoil.

5.6 Approach Embankments

No stability problems are anticipated with 20 ft. embankment fills if 2:1 slopes are employed. Care, however, should be taken that no material exceeding 3" grain size is placed in the fills at locations through which piles have to be driven.

5.7. Frost Protection

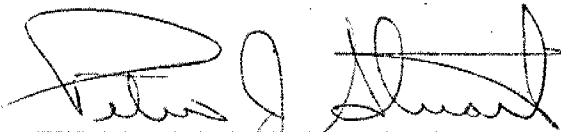
All pile caps or spread footings should be protected against frost action by a minimum 4 ft. of cover.

6. MISCELLANEOUS

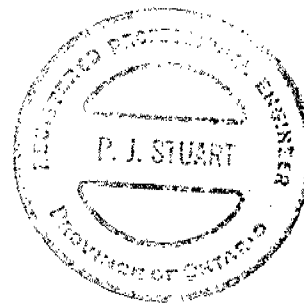
The field work on the project was carried out May 1 to 7, 1975 under the supervision of Mr. P.J.Stuart, Project Foundation Engineer, who also prepared this report.


The equipment was owned and operated by Master Soil Investigation Limited.

This report was reviewed by Mr. K.G.Selby, Supervising Foundation Engineer.



P.J.STUART
Project Engineer





K.G.SELBY
Supervising Engineer.

APPENDIX

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS-ONTARIO
ENGINEERING SERVICES BRANCH-GEOTECHNICAL OFFICE-SOIL MECHANICS SECTION

RECORD OF BOREHOLE NO 1

W.P. 41-66-08

LOCATION Sta. 226+14 52' Rt.

ORIGINATED BY PJS

DIST. 2 HWY. 402

BORING DATE May 5, 1975

COMPILED BY PJS

DATUM Geodetic

BOREHOLE TYPE Hollow Stem Auger

CHECKED BY *W.J.*

SOIL PROFILE			SAMPLES			GROUND WATER ELEV.	DYNAMIC CONE PENETRATION RESISTANCE PLOT					LIQUID LIMIT — w_L PLASTIC LIMIT — w_p WATER CONTENT — w			UNIT WEIGHT γ	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	N' VALUES		20	40	60	80	100	w_p	w	w_L		
835.3	Ground Level															
0.0	Clayey Silt															
	trace of sand		1	SS	16											
	Stiff to Hard		2	SS	47											
			3	SS	24											
			4	TW	PH											
			5	TW	PH											
			6	SS	10											
			7	SS	48											
803.8																
31.5	End of Borehole															

ENGINEERING SERVICES BRANCH-GEOTECHNICAL OFFICE-SOIL MECHANICS SECTION

RECORD OF BOREHOLE NO 2

W.P. 41-66-08

LOCATION Sta. 226+08 30' Lt.

ORIGINATED BY PJS

DIST. 2 HWY. 402

BORING DATE May 7, 1975

COMPILED BY PJS

DATUM Geodetic

BOREHOLE TYPE Hollow Stem Auger

CHECKED BY *d.f.*

SOIL PROFILE			SAMPLES			GROUND WATER ELEV.	DYNAMIC CONE PENETRATION RESISTANCE PLOT		LIQUID LIMIT w_L PLASTIC LIMIT w_p WATER CONTENT w		UNIT WEIGHT γ	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	N' VALUES		20 40 60 80 100		w_p w w_L			
840.1	Ground Level											
	Clayey Silt trace of sand Very Stiff to Hard		1	SS	17	830						
			2	SS	34							
			3	SS	41							
			4	SS	34							
			5	SS	27							
			6	TW	PH	820					132	1 4 59 36
			7	SS	24							
			8	SS	23	810						
			9	SS	24	800						
			10	SS	26	790						
			11	SS	33	780						
			12	SS	32							
						770						
763.6			13	SS	35							
76.5	End of Borehole Note - Water level not established											

ENGINEERING SERVICES BRANCH-GEOTECHNICAL OFFICE-SOIL MECHANICS SECTION

RECORD OF BOREHOLE NO 3

W.P. 41-66-08

LOCATION Sta. 227+27 55' Rt.

ORIGINATED BY PJS

DIST. 2 HWY. 402

BORING DATE May 1st, 2nd, and 5th, 1975

COMPILED BY PJS

DATUM Geodetic

BOREHOLE TYPE 3/4" Hollow Stem Auger

 CHECKED BY *el.f.*

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 γ	REMARKS % GR. SA. SI. CL.
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	'N' VALUES					
836.0	Ground Level									
	Clayey Silt trace of sand stiff to hard		1	SS	40	830				0 5 58 37
			2	SS	31					
			3	SS	45					
			4	SS	27					
			5	SS	18					
			6	SS	14	820				
814.0	Silt and Sand Compact to Very Dense		7	SS	19					0 48 (52)
			8	SS	31	810				
			9	SS	52					
			10	SS	64	800				
			11	SS	26	790				
780.0	Clayey Silt trace of sand very stiff to hard					780				0 1 74 25
			12	SS	27	770				
			13	SS	50	760				
56.0						750				
						740				

RECORD OF BOREHOLE NO 3 (Continued)

W.P. 41-66-08 LOCATION Sta. 227+27 55' Rt. ORIGINATED BY PJS
 DIST. 2 HWY. 402 BORING DATE May 1st, 2nd, and 5th, 1975 COMPILED BY PJS
 DATUM Geodetic BOREHOLE TYPE 3/4" Hollow Stem CHECKED BY W.J.

SOIL PROFILE			SAMPLES			GROUND WATER ELEV.	DYNAMIC CONE PENETRATION RESISTANCE PLOT					LIQUID LIMIT w_L PLASTIC LIMIT w_p WATER CONTENT w			UNIT WEIGHT γ	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	N' VALUES		20	40	60	80	100	w_p	w	w_L		
732.0	Continued															
104.0	Clayey Silt trace of sand Very Stiff to Hard		14	SS	79	730							o			
						720										
						710							o			
			15	SS	55	700										
689.5																
			16	SS	89	690							o			
146.5	End of Borehole															

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS-ONTARIO
ENGINEERING SERVICES BRANCH-GEOTECHNICAL OFFICE-SOIL MECHANICS SECTION

RECORD OF BOREHOLE NO 4

W.P. 41-66-08 LOCATION Sta. 227+25 28' Lt. ORIGINATED BY PJS
DIST. 2 HWY. 402 BORING DATE May 7, 1975 COMPILED BY PJS
DATUM Geodetic BOREHOLE TYPE Hollow Stem Auger CHECKED BY W.J.

SOIL PROFILE			SAMPLES			GROUND WATER ELEV.	DYNAMIC CONE PENETRATION RESISTANCE PLOT					LIQUID LIMIT W_L PLASTIC LIMIT W_P WATER CONTENT W			UNIT WEIGHT γ	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	'N' VALUES		20	40	60	80	100	W_P	W	W_L		
839.2	Ground Level															
0.0	Clayey Silt		1	SS	36											
			2	SS	42	830										
			3	SS	42											
	Trace of Sand		4	SS	23											
			5	SS	17											
	Very Stiff to Hard		6	SS	16	820										
			7	SS	18											
			8	SS	23	810										
			9	SS	33											
			10	SS	41	790										
784.2			11	SS	100											
55.0	Silt Very Dense		12	SS	171	780										
			13	SS	221											
772.7																
66.5	End of Borehole Note - Water level not established															

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS-ONTARIO
ENGINEERING SERVICES BRANCH-GEOTECHNICAL OFFICE-SOIL MECHANICS SECTION

RECORD OF BOREHOLE NO 5

W.P. 41-66-08 LOCATION Sta. 228+48 55' Rt. ORIGINATED BY PJS
 DIST. 2 HWY. 402 BORING DATE May 5, 1975 COMPILED BY PJS
 DATUM Geodetic BOREHOLE TYPE Hollow Stem Auger CHECKED BY W.J.

SOIL PROFILE			SAMPLES			GROUND WATER ELEV.	DYNAMIC CONE PENETRATION RESISTANCE PLOT					LIQUID LIMIT w_L PLASTIC LIMIT w_p WATER CONTENT w			UNIT WEIGHT γ	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				
836.8	Ground Level															
0.0	Clayey silt		1	SS	39											
	trace of sand		2	SS	63	830								100/76		
	Stiff to Hard		3	SS	39											
			4	SS	34											
			5	SS	29	820										
			6	SS	19											
			7	SS	17	810										
			8	SS	20											
			9	SS	20	800										
795.3			10	SS	77											
41.5	End of Borehole															

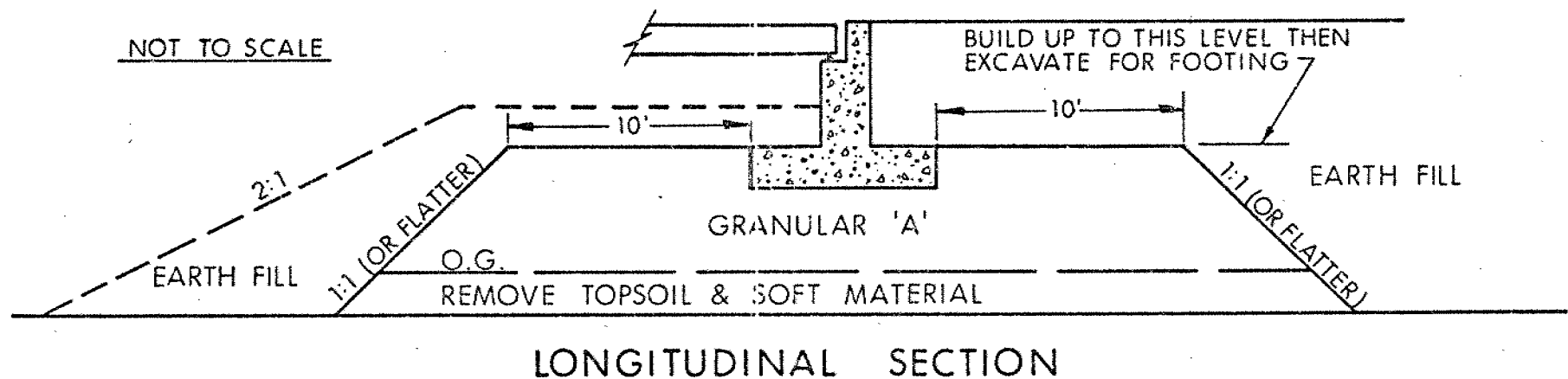
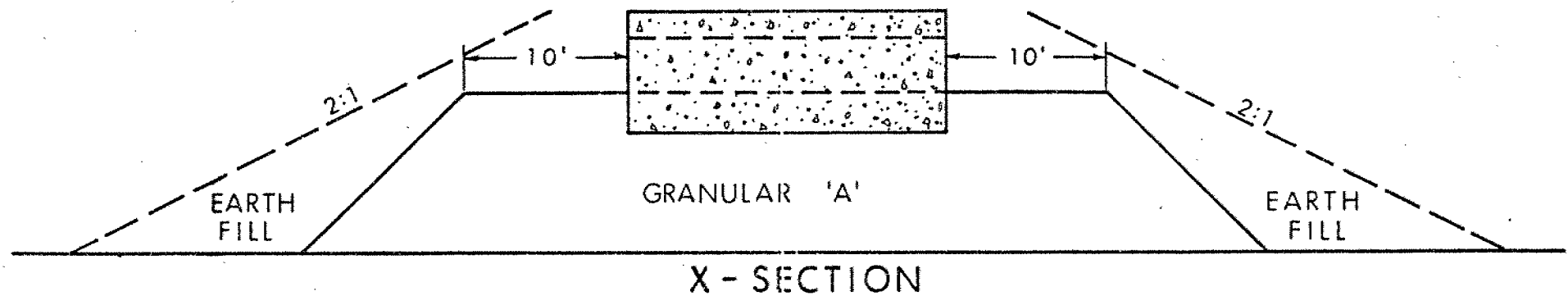
MINISTRY OF TRANSPORTATION AND COMMUNICATIONS-ONTARIO
ENGINEERING SERVICES BRANCH-GEOTECHNICAL OFFICE-SOIL MECHANICS SECTION

RECORD OF BOREHOLE NO 6

W.P. 41-66-08 LOCATION Sta. 228+35 34' Lt.
DIST. 2 HWY. 402 BORING DATE May 6, 1975
DATUM Geodetic BOREHOLE TYPE 3/4" Hollow Stem Auger
ORIGINATED BY PJS
COMPILED BY PJS
CHECKED BY W.J.

SOIL PROFILE			SAMPLES			GROUND WATER ELEV.	DYNAMIC CONE PENETRATION RESISTANCE PLOT					LIQUID LIMIT — w_L PLASTIC LIMIT — w_p WATER CONTENT — w			UNIT WEIGHT γ	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	N° VALUES		20	40	60	80	100	w_p	w	w_L		
839.0	Ground Level															
0.0	Clayey Silt trace of sand Very Stiff to Hard		1	SS	57											
			2	SS	45	830										
			3	SS	21	820										
			4	TW	PH											
			5	SS	17	810										
			6	SS	20											
796.0			7	SS	132	800										
41.0	Fine Sand and Silt Dense to Very Dense		8	SS	41	790										
			9	SS	205											
781.0																
58.0	Clayey Silt					780										
777.5	trace of sand		10	SS	35											
61.5	End of Borehole Note: Water level not established.															

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 M.T.C. STANDARDS.
- 3 - EXCAVATE COMPACTED GRANULAR 'A' MATERIAL FOR FOOTING.

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

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
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
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_i	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

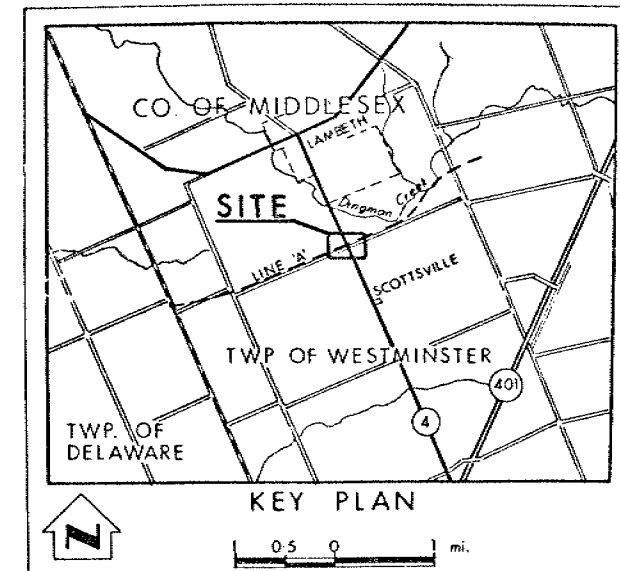
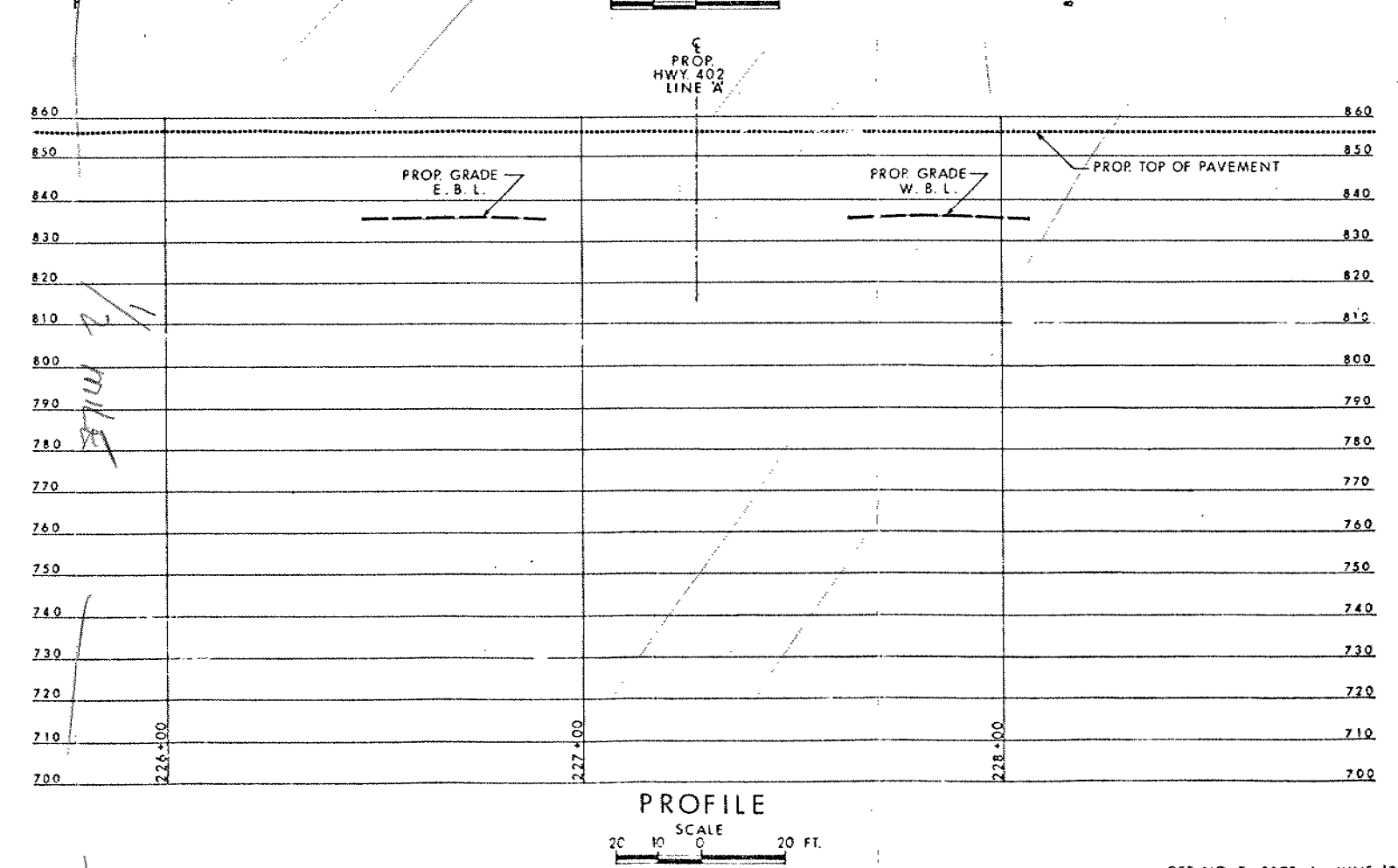
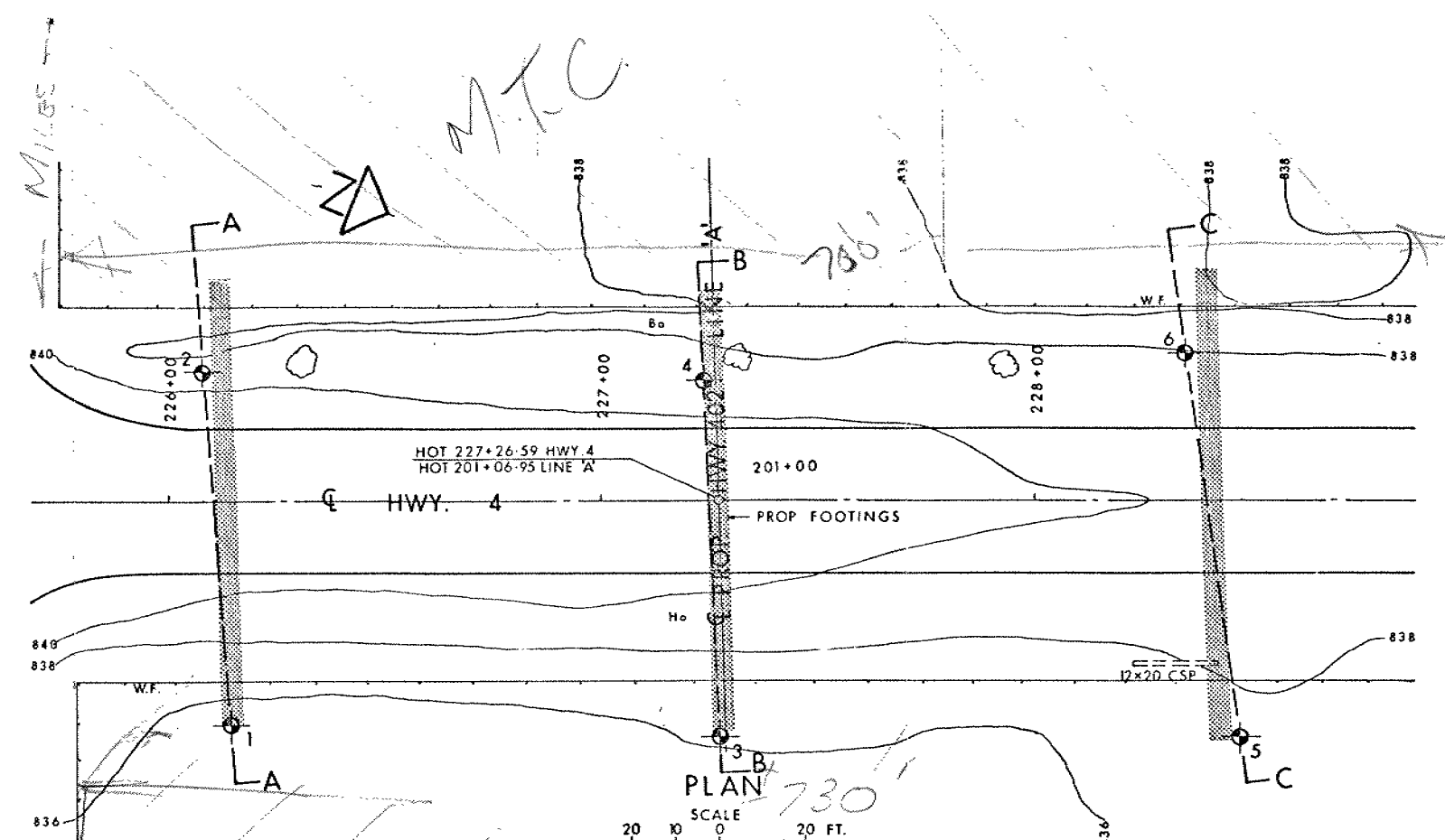
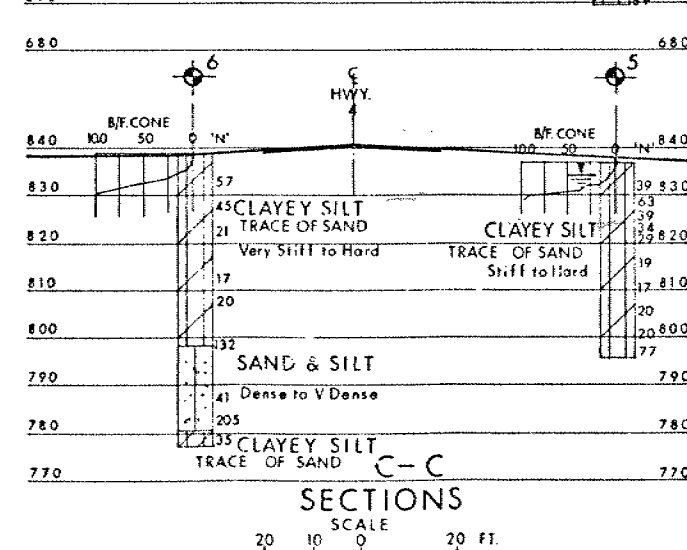
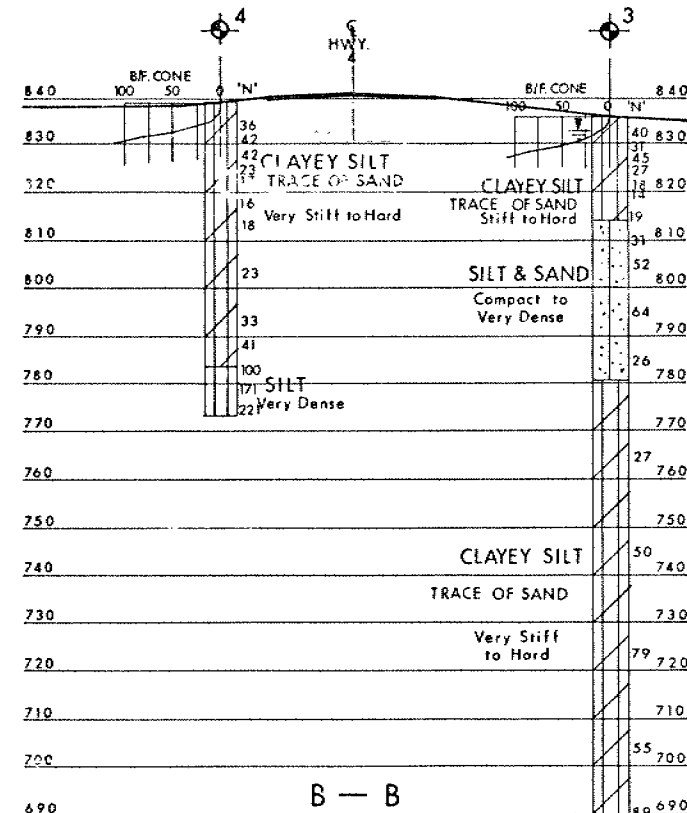
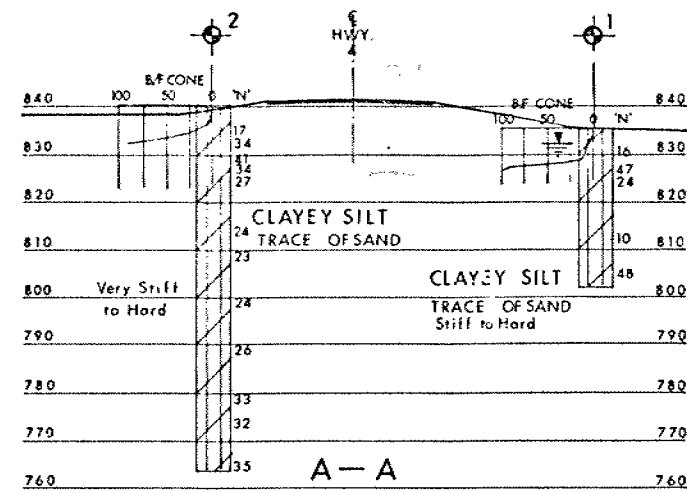
d	DISTANCE FROM TOP OF WALL TO POINT OF APPLICATION OF PRESSURE
δ	ANGLE OF WALL FRICTION
K	DIMENSIONLESS COEFFICIENT TO BE USED WITH VARIOUS SUFFIXES IN EXPRESSIONS REFERRING TO NORMAL STRESS ON WALLS
K_0	COEFFICIENT OF EARTH PRESSURE AT REST

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
- Dynamic Cone Penetration Resistance Test
- Bore Hole & Cone Test
- Water Levels established at time of field investigation: 7 May 1975
W.L. in B.H. 2, 4, & 6 not established

	NO.	ELEVATION	STATIONS	OFFSET	EAST
15,586,401	1	835.3	226+14	52' RT.	1,323,443
15,586,372	2	840.1	226+08	30' LT.	1,323,562
15,586,513	3	836.0	227+27	55' RT.	1,323,610
15,586,183	4	839.2	227+25	28' LT.	1,323,533
15,586,627	5	836.8	228+48	55' RT.	1,323,572
15,586,588	6	839.0	228+35	34' LT.	1,323,491

NOTE: FOR CONTRACT DOCUMENTS
The complete foundation investigation report for this structure may be examined at the Structural Office and Foundations Office, Downsview, and at the LONDON District Office.

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

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS-ONTARIO
ENGINEERING SERVICES BRANCH-GEOTECHNICAL OFFICE-SOIL MECHANICS SECTION

HWY. NO. 4

HIGHWAY NO. PROP. HWY. 402 LINE 'A' DIST NO. 2

CO. MIDDLESEX

TWP. WESTMINSTER LOT 66 CONE & W. NBTR

BORE HOLE LOCATIONS & SOIL STRATA

SUBMD P. S.	CHECKED	W. P. NO. 41-66-08	DRAWING NO.
DRAWN J. J.	CHECKED	W. P. NO.	416608-A
DATE	11 JUNE 1975	STANDARD 19-544	BROG. DRAWING NO.
APPROVED		CONT. NO.	

REF. NO. E-5373-1, JUNE '74



SEE DWG 19-544-2

KEY PLAN

LEGEND

- Bore Hole
- ⊕ Dynamic Cone Penetration Test (Cone)
- ⊗ Bore Hole & Cone
- N' Blows/ft (Std Pen Test, 350 ft lbs energy)
- CONE Blows/ft (60° Cone, 350 ft lbs energy)
- W.I. at time of investigation Aug 1977
- Pile

No	ELEVATION	STATION	OFFSET & HWY 402
BH 7	839.7	202+13.5	58' LT
PILES			
1	839.7	202+03	55' LT
2	839.7	202+03	60' LT
3	839.7	202+03	65' LT

-NOTE-

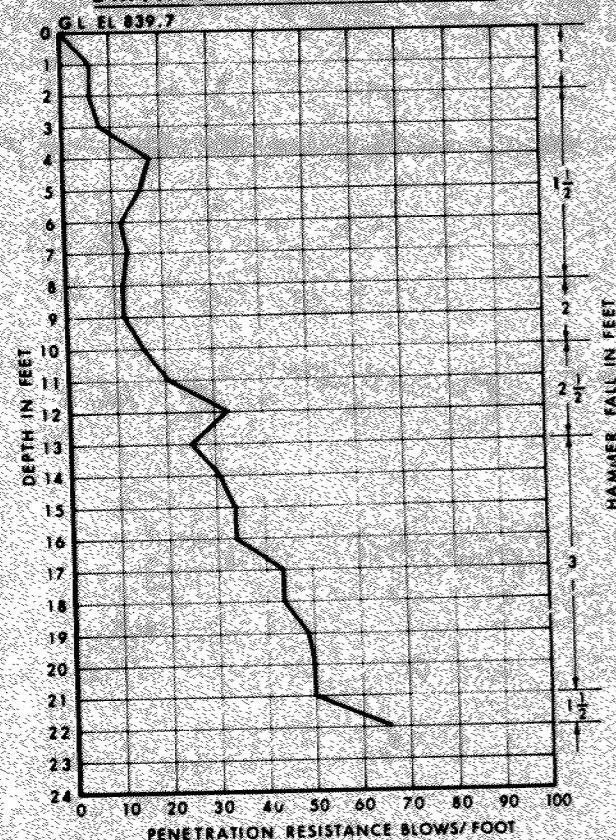
The boundaries between soil strata have been established only at Bore Hole locations. Between bore holes the boundaries are assumed from geological evidence.

REVISIONS	DATE	BY	DESCRIPTION

HWY No 402
SUBMITTAL CHECKED DATE Aug 12, 1977 SITE 19-544
DRAWN S CHECKED APPROVED DWG 19-544-2

TWP 94-544-2-1

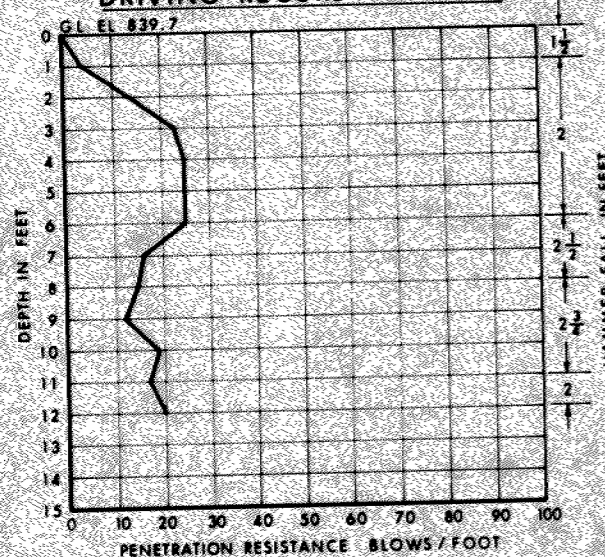
DRIVING RECORD PILE No 1



PILE No 1

Total continuous driving time 0' - 22', 22 minutes
Drop Hammer
Hammer Weight: 6100 lbs
Height of Fall: As shown
Date Driven: July 14, 1977

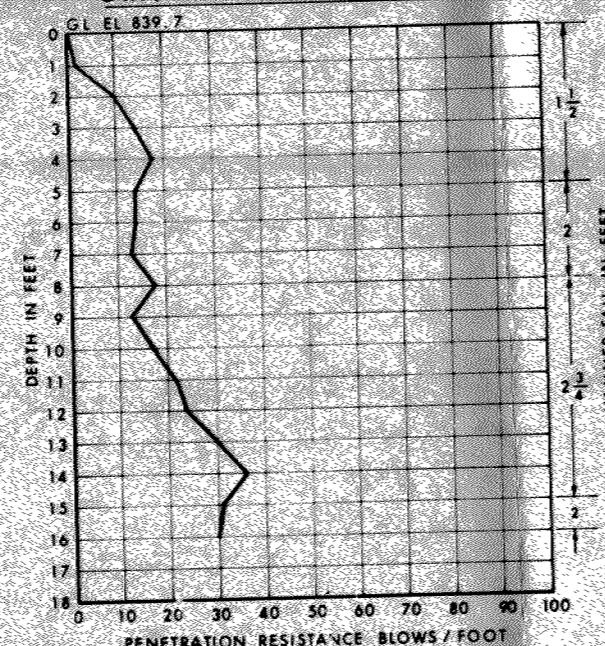
DRIVING RECORD PILE No 3



PILE No 3

Total continuous driving time 0' - 12', 7 min 30 sec
Drop Hammer
Hammer Weight: 6100 lbs
Height of Fall: As shown
Date Driven: July 14, 1977

DRIVING RECORD PILE No 2

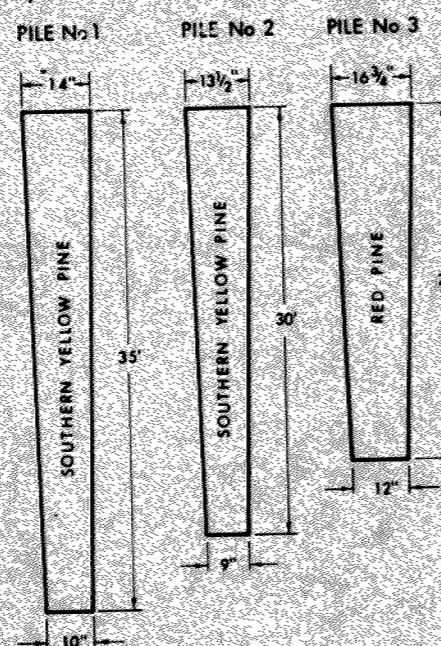


PILE No 2

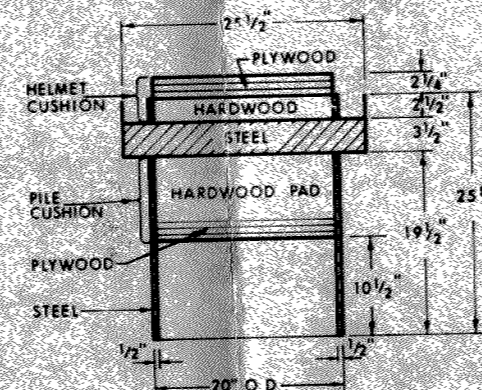
Total continuous driving time 0' - 16', 7 minutes
Drop Hammer
Hammer Weight: 6100 lbs
Height of Fall: As shown
Date Driven: July 14, 1977

PILE DETAILS AS DRIVEN

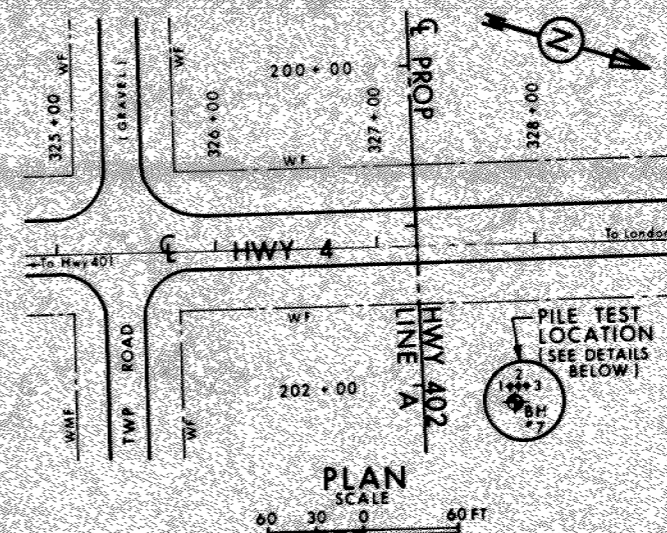
(All Piles No 14 Treated Timber)



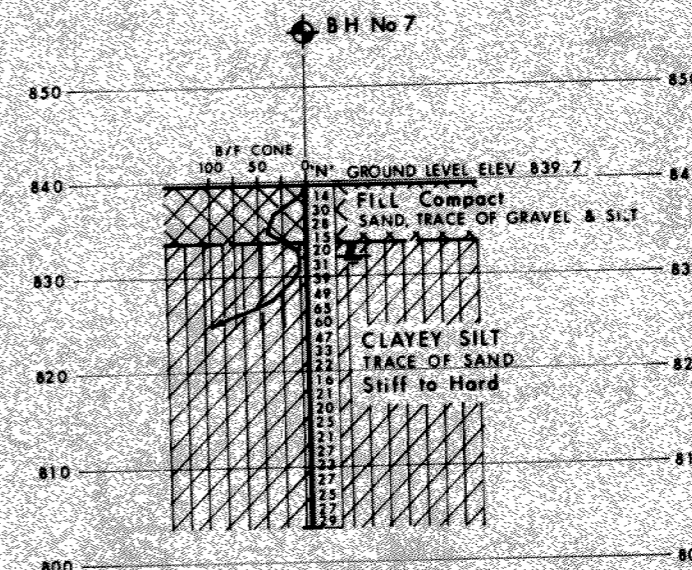
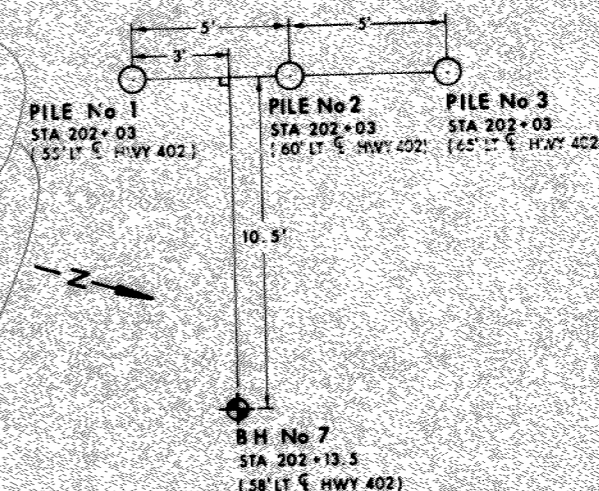
HELMET DETAILS



Total Weight of Helmet = 850 lbs

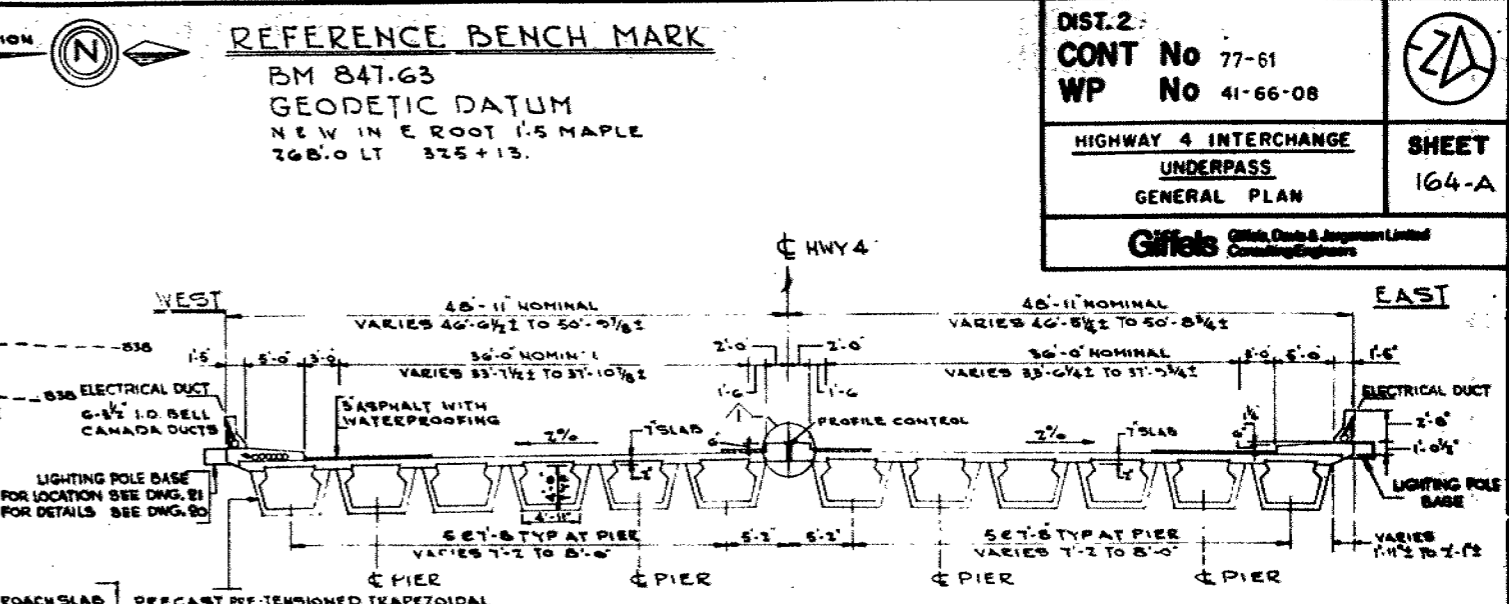
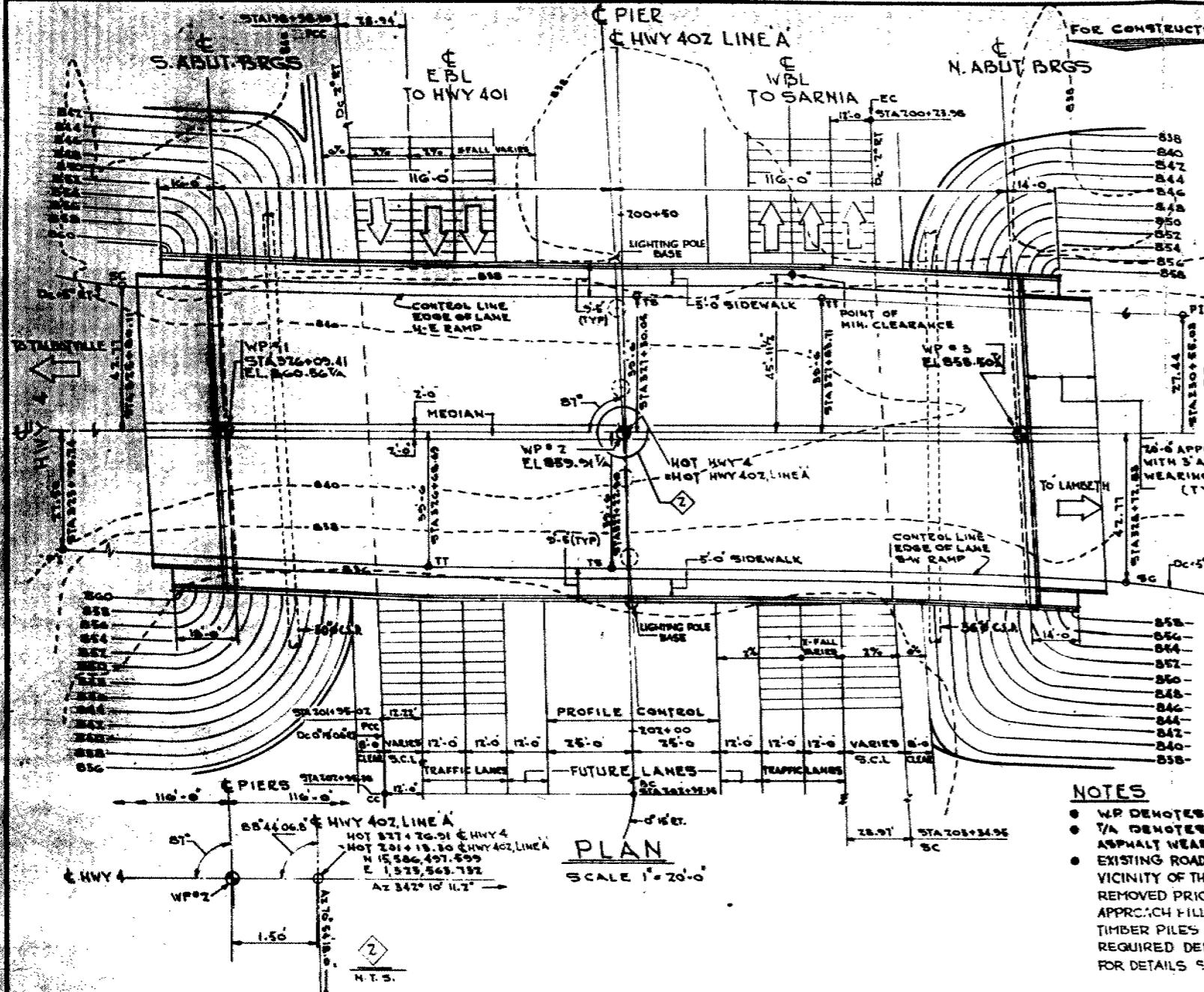


PILE TEST LOCATION

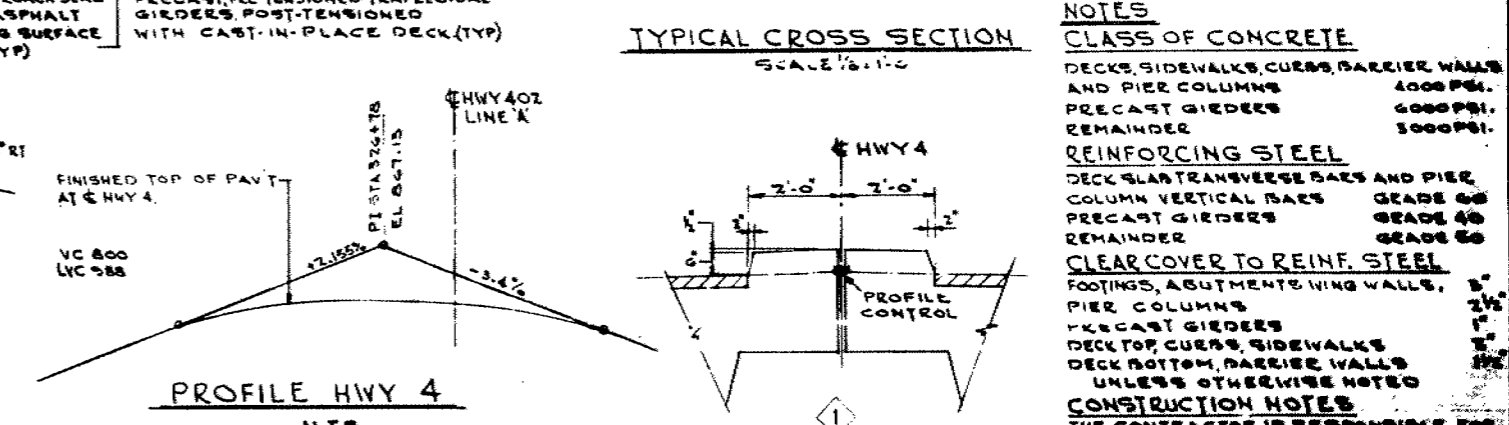


BORE HOLE No 7 STRATIGRAPHY





TYPICAL CROSS SECTION
SCALE 1/2" = 1'-0"

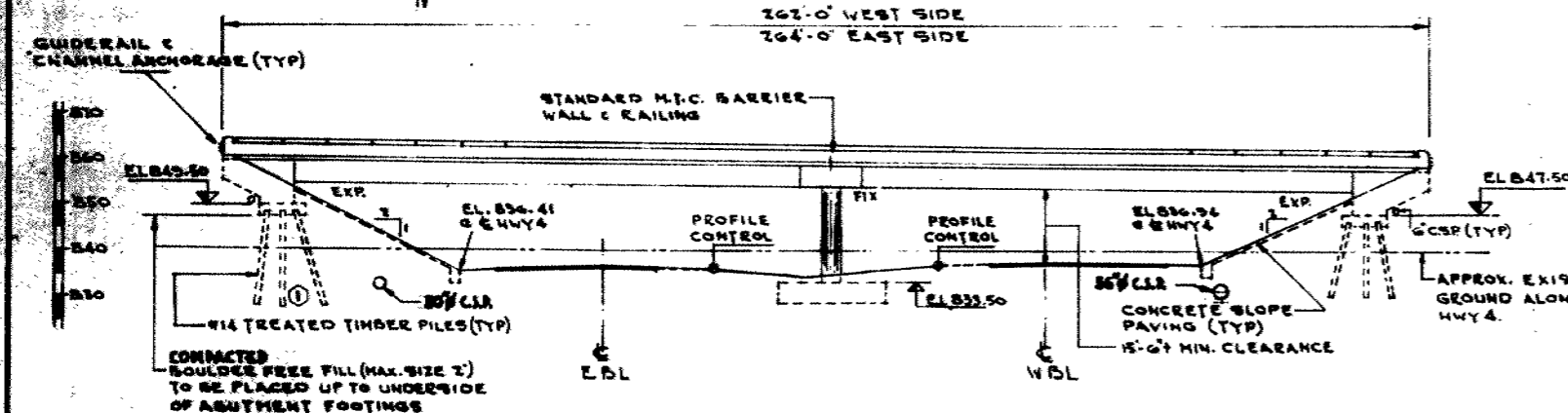


PROFILE HWY 4
N.T.S.

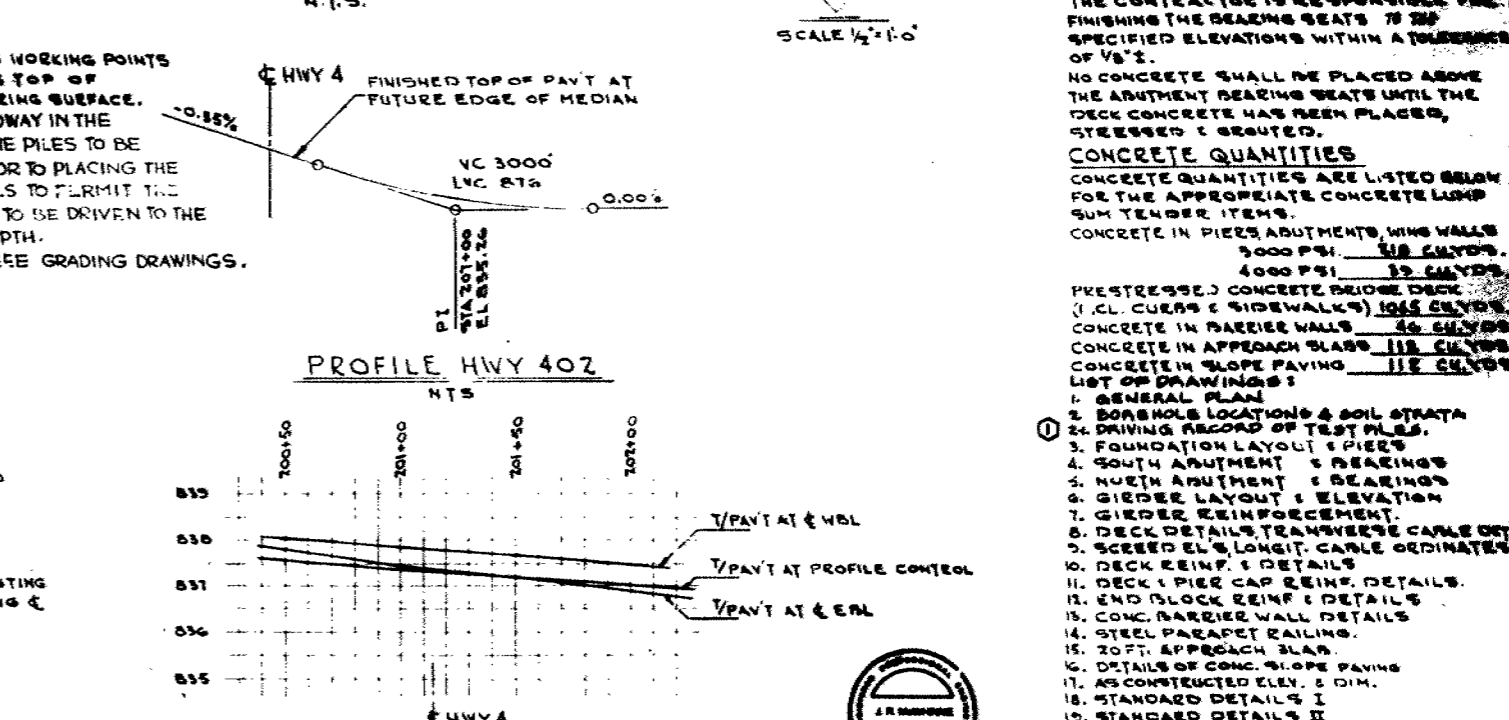
NOTES

- WP DENOTES WORKING POINTS
- 1/4" DENOTES TOP OF ASPHALT WEARING SURFACE.
- EXISTING ROADWAY IN THE VICINITY OF THE PILES TO BE REMOVED PRIOR TO PLACING THE APPROACH PILLS TO PERMIT THE TIMBER PILES TO BE DRIVEN TO THE REQUIRED DEPTH.
- FOR DETAILS SEE GRADING DRAWINGS.

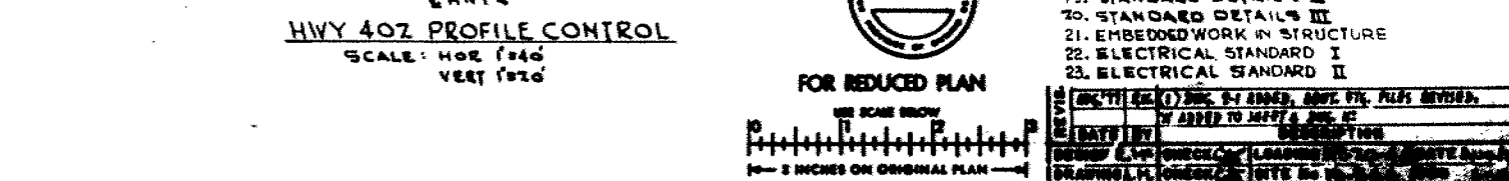
PLAN
SCALE 1" = 20'-0"



ELEVATION
SCALE 1" = 20'-0"



PROFILE HWY 402
N.T.S.



HWY 402 PROFILE CONTROL
SCALE: HOR 1" = 40' VERT 1" = 2'-0"

NOTES

- CLASS OF CONCRETE
DECK, SIDEWALKS, CURBS, BARRIER WALLS AND PIER COLUMNS 4000 PSI.
PRECAST GIRDERS 4000 PSI.
REMAINDER 3000 PSI.
- REINFORCING STEEL
DECK SLAB TRANSVERSE BARS AND PIER COLUMN VERTICAL BARS GRADE 60
PRECAST GIRDERS GRADE 40
REMAINDER GRADE 60
- CLEAR COVER TO REIN. STEEL
FOOTINGS, ABUTMENTS, WING WALLS, PIER COLUMNS
PRECAST GIRDERS
DECK TOP, CURBS, SIDEWALKS
DECK BOTTOM, BARRIER WALLS
UNLESS OTHERWISE NOTED

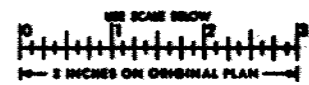
CONSTRUCTION NOTES

- THE CONTRACTOR IS RESPONSIBLE FOR FINISHING THE BEARING SEATS TO THE SPECIFIED ELEVATIONS WITHIN A TOLERANCE OF 1/8".
- NO CONCRETE SHALL BE PLACED ABOVE THE ABUTMENT BEARING SEATS UNTIL THE DECK CONCRETE HAS BEEN PLACED, STRESSED & CURED.
- CONCRETE QUANTITIES ARE LISTED BELOW FOR THE APPROPRIATE CONCRETE LUMP SUM TENDER ITEMS.
- CONCRETE IN PIERS, ABUTMENTS, WING WALLS
3000 PSI. 118 CU YDS.
4000 PSI. 118 CU YDS.

- PRESTRESSED CONCRETE BRIDGE DECK (1 CL CURBS & SIDEWALKS) 1018 CU YDS.
- CONCRETE IN BARRIER WALLS 40 CU YDS.
- CONCRETE IN APPROACH SLABS 118 CU YDS.
- CONCRETE IN SLOPE PAVING 118 CU YDS.

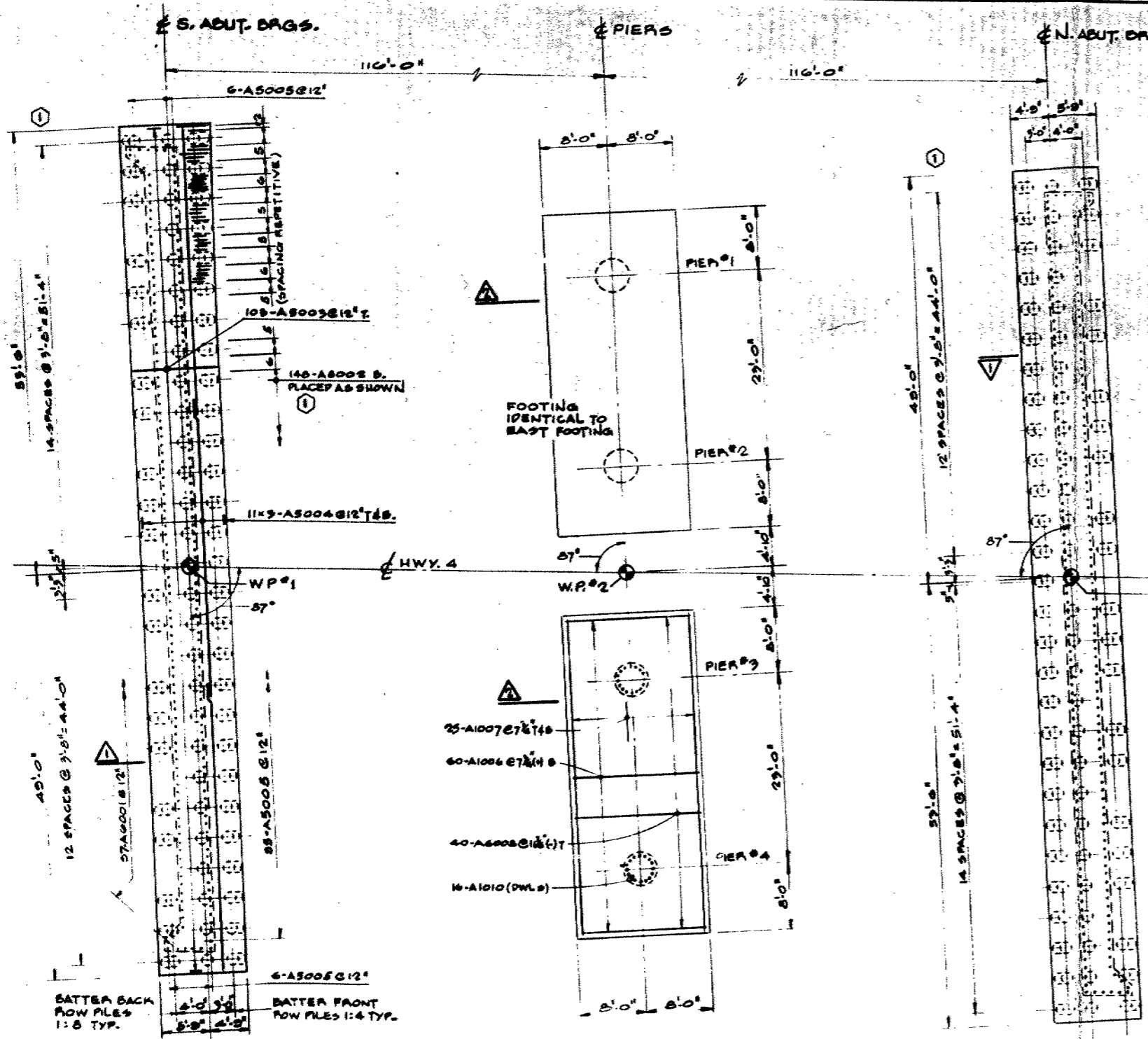
- GENERAL PLAN
- BOREHOLE LOCATIONS & SOIL STRATA
- DRIVING RECORD OF TEST PILES
- FOUNDATION LAYOUT & PIERS
- SOUTH ABUTMENT & BEARINGS
- NORTH ABUTMENT & BEARINGS
- GIRDER LAYOUT & ELEVATION
- GIRDER REINFORCEMENT
- DECK DETAILS TRANSVERSE CABLE ORTS
- SCREEN EL'S, LONGIT. CABLE ORIGINATES
- DECK REIN. & DETAILS
- DECK & PIER CAP REIN. DETAILS
- END BLOCK REIN. DETAILS
- CONC. BARRIER WALL DETAILS
- STEEL PARAPET RAILING
- 20 FT. APPROACH SLAB
- DETAILS OF CONC. SLOPE PAVING
- AS CONSTRUCTED ELEV. & DIM.
- STANDARD DETAILS I
- STANDARD DETAILS II
- STANDARD DETAILS III
- EMBEDDED WORK IN STRUCTURE
- ELECTRICAL STANDARD I
- ELECTRICAL STANDARD II

FOR REDUCED PLAN



NO.	DATE	BY	DESCRIPTION
1	10/1/77	W.P.	ISSUED FOR CONSTRUCTION
2	10/1/77	W.P.	ISSUED FOR CONSTRUCTION

Twp. 94-S44-1-A



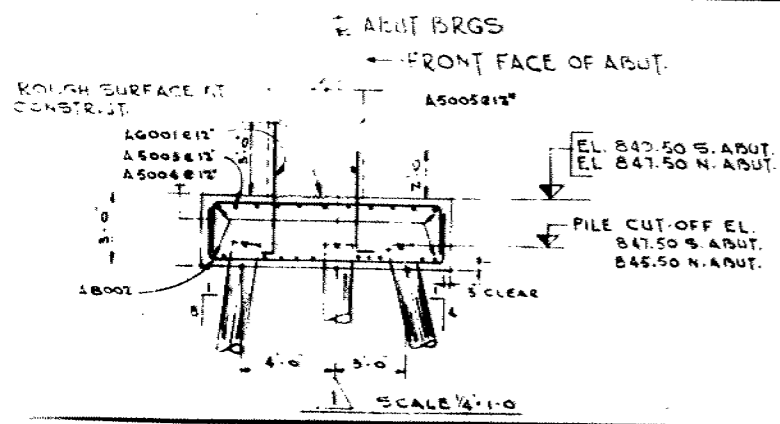
WORKING POINT DATA

WP#	STATION	CO-ORDINATES
1	326+09.41 HWY 4	N15,586,385.743 E 1,323,555.710
2	327+25.41 HWY 4	N15,586,496.171 E 1,323,561.192
3	328+41.41 HWY 4	N15,586,606.798 E 1,323,578.673

PILES

LOCATION	QTY.	TYPE	BATTER	MAX LENGTH
N. ABUT.	28	* 14	1:4	18'-0"
	28	TREATED	VERT	
	21	TIMBER	1:8	
S. ABUT.	28	PILES	1:4	22'-0"
	21		VERT	
	21		1:8	

- NOTES
- PILE SPACINGS TO BE MEASURED AT UNDERSIDE OF FOOTINGS
 - PILES SHALL BE DRIVEN TO THE FOLLOWING ELEVATIONS:
 - NORTH ABUT. EL. 828.5
SOUTH ABUT. EL. 826.5
 - SOUTH ABUT. FOOTING LINE SHALL BE NORTH ABUT. FOOTING.
 - PILES SHALL BE TREATED WITH RED OIL TO GIVE A PRETENTIVE LIFE OF 50 YRS.



FOR REDUCED PLAN

USE SCALE BELOW

1" = 3' INCHES ON ORIGINAL PLAN

REVISION	DATE	BY	DESCRIPTION

DESIGNED BY: CHECKED BY: DATE: 10/1/77
DRAWING NO: 1015-544 DWG 3-A

TWP. 94-54-3-A

Mr. K.C. Bassi
Head, Eastern Section
Structural Office
West Building

Soil Mechanics Section
Engineering Materials Office
West Building

77 08 11

Pile Capacities - Contract 77-61
W.P. 41-66-08/06/07, Hwy. 402
District 2, London

As a result of our recent load tests at London we are revising our recommendations for pile capacities and required lengths as follows on the above mentioned work projects:

(1) W.P. 41-66-08 : Safe Capacity 35T/pile
Length Required
N. Abutment - 18 feet
S. Abutment - 22 feet
Note to Read Drive to elevation 828.5 (N.A.)
826.5 (S.A.)

(2) W.P. 41-66-07 : Safe Capacity 40T/pile
Length Required
(N. Abutment - 40 feet
Increase (Pier - 25 feet
lengths for (S. Abutment - 40 feet
battered piles
Note to Read Drive to elevation 806 (N.A.)
803 (Pier)
805 (S.A.)

(3) W.P. 41-66-06 : Safe Capacity 40T/pile
Length Required
(N. Abutment - 30 feet
Increase (Pier - 25 feet
lengths for (S. Abutment - 30 feet
battered piles
Note to Read Drive to elevation 827 (N.A.)
816 (Pier)
828 (S.A.)

If the above recommendations are followed the savings should be:

W.P. 41-66-08	\$ 8,000.00
W.P. 41-66-07	20,000.00
W.P. 41-66-06	<u>14,000.00</u>
Total	\$42,000.00

We understand that there is adequate time to issue an appropriate addendum to the contract which is presently being advertised.

K.G. Selby
Supervising Engineer

KGS/kr

J. Davidson
B. Giroux
J. Keen
Files ✓

Soil Mechanics Section
Engineering Materials Office
West Building
1201 Wilson Avenue
Downsview, Ontario
M3M 1J8

Tel: (416) 248-3282

August 8, 1977

Mr. L. Crane
Western Caissons Ltd.
150 Creditstone Road
Maple, Ontario

SUBJECT: Pile Load Tests - Hwy. 402, Quality of Timber Piles

W.P. 41-66-07✓16

Dear Sir

As you are aware the six timber piles initially supplied by your firm for the above mentioned project turned out to be defective in that they split or shattered during the first one or two blows of the pile driving hammer even though the delivered energy was less than 8000 foot/lbs. per blow, in all cases. During an inspection of the broken piles, your Superintendant, Mr. D. Crompton and myself were of the opinion that the piles as supplied were not structurally intact and that excessive drying out prior to the injection of creosote may have caused actual separation between growth rings. Since this type of defect cannot be detected by the superficial inspection, which normally occurs in the field we are concerned that the organization supplying the piles (in this case Domtar) was not able to detect it either and that their quality control methods do not proved for a check on intactness and structural integrity.

We would appreciate it therefore if you could obtain from Domtar a full report as to what caused the defects in the piles and also what quality control procedures would be required to identify these defects.

Yours truly

K.G. Selby, P. Eng
Supervising Engineer

KGS/kr

cc: Files ✓