

Mr. A. M. Toye,  
Bridge Engineer.  
Materials & Research Division,  
(Foundation Section)  
Attention: Mr. S. McCombie.

August 10, 1962.

D.H.O. FOUNDATION INVESTIGATION  
REPORT  
W.J. 62-F-86 -- W.P. 104-62.

Re: Proposed Basket Weave Structure at  
Springview Ave. South & Hwy. #401,  
Toronto, Ontario.  
District #6.

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

We believe that the factual data and recom-  
mendations contained therein, should prove adequate for  
your future design work. Should you require additional  
information, please feel free to contact our Office.

KYL/MdeF  
Attach.

cc: Messrs. A. M. Toye (2)  
H. A. Tregaskes  
H. D. McMillan  
C. K. Hunter  
C. Fraser  
T. J. Kovich  
J. Roy  
J. E. Gruspier  
E. R. Saint  
F. Norman  
A. Watt  
Foundations Office  
Gen. Files.

*KYL*  
K. Y. Lo,  
SUPERVISING FOUNDATION ENGR.  
For:

A. G. Stermac,  
PRINCIPAL FOUNDATION ENGR.

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# FOUNDATION INVESTIGATION

For

Proposed Basket Weave Structure at  
Springview Ave. South & Hwy. #401,  
Toronto, District #6.  
W.J. 62-F-86      --      W.P. 104-62.

## 1. INTRODUCTION:

A request for a foundation investigation at the site of the proposed basket weave structure at Springview Ave. South and Hwy. #401 was received from the Bridge Location Section in a memo dated July 12, 1962.

A field investigation was subsequently carried out by this Section to determine the subsoil conditions existing at the location of the proposed structure. Presented in this report are the results of this investigation, together with recommendations pertaining to the design of the proposed structure foundations.

## 2. DESCRIPTION OF SITE:

The basket weave structure is about 180 ft. south of Hwy. #401 Centre Line at Station 96+35 in Metropolitan Toronto. The structure is part of the proposed new Hwy. #401 system.

At the site the immediate topography is rolling with a slight downward slope in a westerly direction. The site area is undulating and the ground has a grass cover.

Physiographically, the site lies in the South Slope Region which is the south slope of an interlobate moraine. This moraine consists of a clayey till deposited during the Pleistocene Ice Epoch.

### 3. FIELD INVESTIGATION PROCEDURE:

A total of four auger boreholes and two dynamic cone penetration tests was carried out in the field investigation. Two of the boreholes were sampled boreholes and the other two were exploratory boreholes. During the field work, disturbed and undisturbed samples were obtained. Disturbed samples were obtained by means of a standard split-spoon sampler driven into the soil with an energy of 350 ft. lbs. per blow. Undisturbed samples were obtained by means of 2-inch I.D. Shelby tubes which were pushed into the soil hydraulically. Some disturbed samples were also obtained in the Shelby tubes. In-situ vane tests were carried out wherever possible, at elevations 12" below the various sample depths. A measure of the relative density of the predominantly granular deposits was obtained by means of the Standard Penetration tests.

Ground water levels in the boreholes were recorded throughout the duration of the investigation.

### 4. LABORATORY TESTS:

Samples were visually examined and classified at the site as well as in the laboratory.

Laboratory tests were carried out to determine:-

- (a) Natural Moisture Content.
- (b) Atterberg Limits.
- (c) Unit Weight.
- (d) Unconfined Compressive Strength.
- (e) Grain Size Distribution.

Laboratory and field test results are summarized and included under Appendix I of this report.

cont'd. /3 ...

5. SOIL TYPES AND SOIL CONDITIONS:

5.1) General:

The subsoil at the site was found to be uniform and consists of glacial deposits of clayey silt with varying amounts of sand.

The boundaries of the various deposits are shown on the accompanying borelog sheets. The estimated stratigraphical profiles and cross sections shown on Drawing #62-F-86A are based on information from the boreholes. From ground level downwards, the various soil types are as follows:-

5.2) Clayey Silt with some Sand (Glacial Till):

This stratum was established in all boreholes and it extended from ground surface to elev. 410', approximately. The depth of this stratum at the site is 32 ft. The material is predominantly a clayey silt containing some fine to coarse sand and traces of fine gravel. It was found to be compact with an average 'N' value of 27 blows/ft. The material has the following average properties:-

Moisture Content	:	14.7%
Liquid Limit	:	24.3%
Plastic Limit	:	13.7%
Unit Weight	:	141 lbs./cu.ft.

cont'd. /4 ...

5. SOIL TYPES AND SOIL CONDITIONS: (cont'd.) ...

5.3) Clayey Silt to Silty Clay:

This stratum was established in Boreholes No. 1 and 4 and it extends from elev. 410' to elev. 395'. Its thickness as established in Borehole No. 4, is 17 ft. The clayey silt to silty clay is firm to stiff and has the following average properties:-

Moisture Content	:	26.9%
Liquid Limit	:	32.3%
Plastic Limit	:	18.6%
Unit Weight	:	135 lbs./cu.ft.
Shear Strength from Field Vane Tests	:	700 p.s.f.

5.4) Clayey Silt with some Sand (Glacial Till):

This stratum was established in Borehole No. 4 and it extends from elev. 395' to the depth tested, elev. 391.5'. The material is firm and it has similar properties to the material in Section 5.2.

6. GROUND WATER LEVEL:

The ground water level was observed at elevation 409' in Borehole No. 2 during the time of the field investigation.

cont'd. /5 ...



7. DISCUSSION AND RECOMMENDATIONS:

7.1) General:

It is proposed to build a basket weave bridge in Metropolitan Toronto as part of the new Hwy. #401 system. The bridge is on the south side of Hwy. #401, Station 96+50, between Jane St. and Keele St.

7.2) Structure Foundation:

The structure should be supported on approximately 6-ft. wide spread footings founded at or below elevation 436' using a design load of 2.0 T.S.F. The design load is based on a maximum theoretical settlement of 1 inch.

No dewatering problems are anticipated.

No stability problems are anticipated for the embankments provided 2:1 slopes are used.

8. SUMMARY:

- (1) It is proposed to construct a basket weave bridge on the south side of Hwy. #401 at Station 96+50.
- (2) Subsoil at the site consists of 32 ft. of compact to very dense clayey silt with some sand (glacial till) underlain by 17 ft. of firm to stiff clayey silt to silty clay, followed by dense clayey silt with some sand (glacial till).

8. SUMMARY: (cont'd.) ...

- (3) It is recommended to found the structure at elev. 436' or lower, on 6-ft. wide spread footings using a design load of 2.0 T.S.F. This load is based on a maximum settlement of 1".
- (4) The ground water level was observed at elev. 409'.
- (5) No dewatering problems are anticipated.
- (6) No stability problems are anticipated for embankments provided 2:1 slopes are used.

9. MISCELLANEOUS:

The field work was undertaken during the period from July 10th to July 11th, 1962 by Mr. I. Holubec, who also prepared the report under the supervision of Mr. K. G. Selby.

August 1962.



APPENDIX I.

## 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

Q <sub>u</sub>	UNCONFINED COMPRESSION	L.V.	LABORATORY VANE
Q	UNDRAINED TRIAXIAL	F.V.	FIELD VANE
Q <sub>cu</sub>	CONSOLIDATED UNDRAINED TRIAXIAL	C	CONSOLIDATION
Q <sub>d</sub>	DRAINED TRIAXIAL	S	SENSITIVITY

# ABBREVIATIONS USED IN THIS REPORT

## SOIL PROPERTIES

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

## GENERAL

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

## STRESS AND STRAIN

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

## EARTH PRESSURE

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

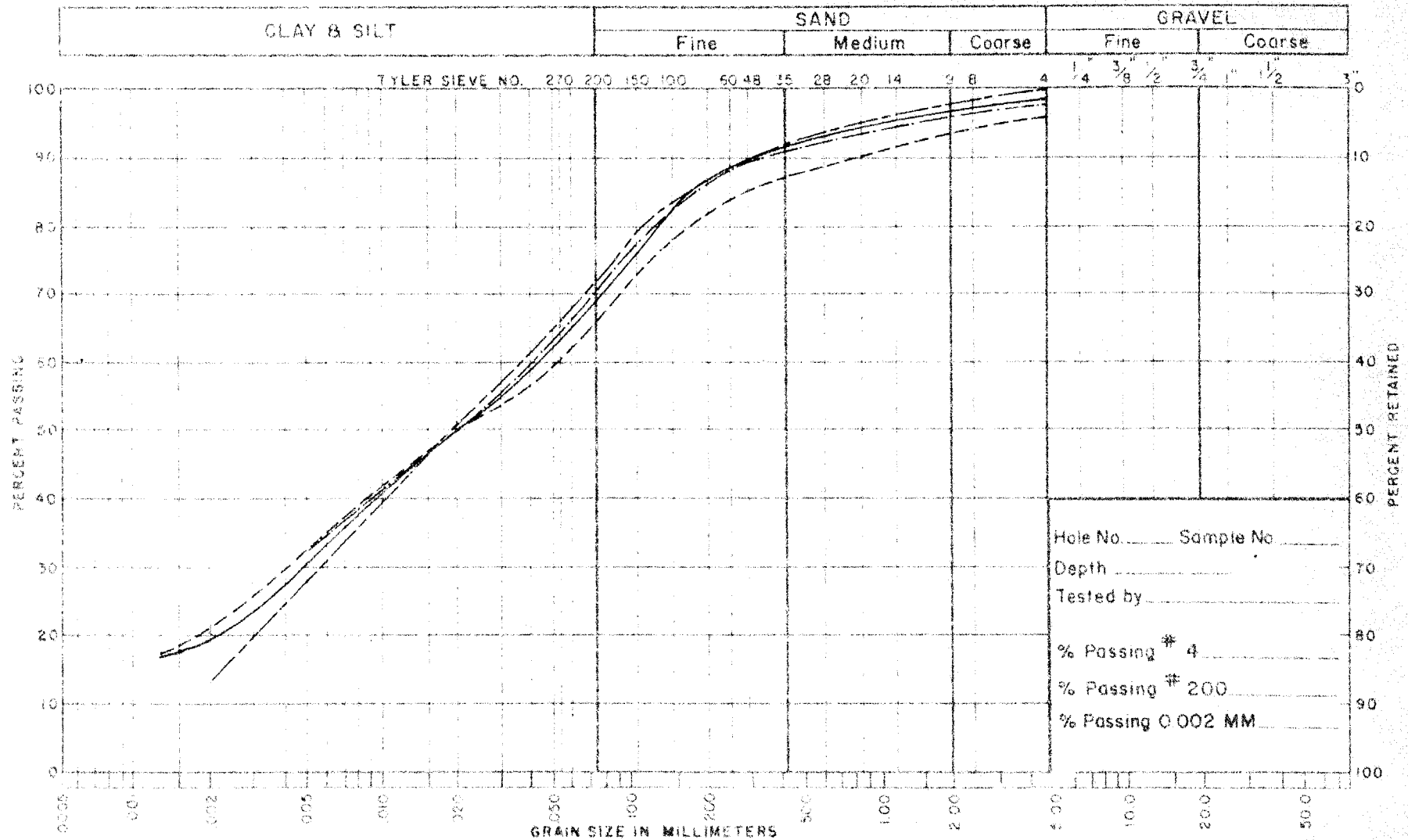
## FOUNDATIONS

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

## SLOPES

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

# UNIFIED SOIL CLASSIFICATION SYSTEM



NOTES BOREHOLE -1, SAMPLE 3

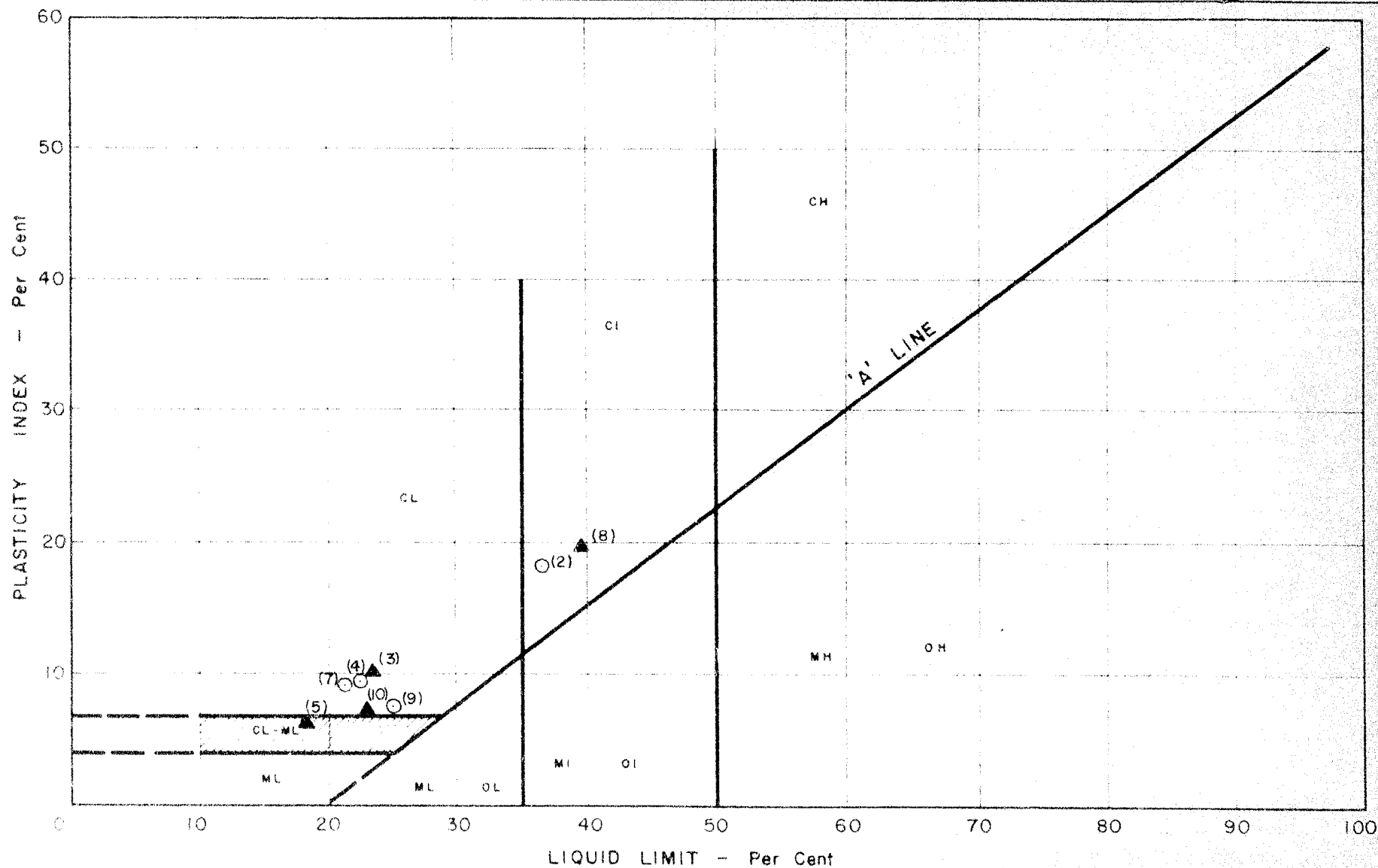
" -1, " 5

" -4, " 3

" -4, " 6

DEPARTMENT OF HIGHWAYS - ONTARIO  
MATERIALS & RESEARCH SECTION  
GRAIN SIZE DISTRIBUTION

Job No. 62-F-86 W.R. No. 104-62  
Location HWY. NO. 401, TORONTO



NOTES ○ SAMPLES FROM BOREHOLES NO. 1  
 ▲ SAMPLES FROM BOREHOLE NO. 4  
 SAMPLE NUMBER INDICATED INSIDE BRACKETS

DEPARTMENT OF HIGHWAYS - ONTARIO  
 MATERIALS & RESEARCH DIVISION  
 PLASTICITY CHART

Job No. 62 - F - 86 W.P. No. 104 - 62  
 Location HWY. NO 401, TORONTO

Mr. A. M. Toye,  
Bridge Engineer,  
Bridge Division.  
Attention: Mr. B. Davis

Mr. A. G. Stermac,  
Principal Foundation Engr.,  
Foundation Section,  
Materials & Research Division.  
December 20, 1962.

D.H.C. SUPPLEMENTARY FOUNDATION INVESTIGATION REPORT -  
Proposed Structure for South Service Rd. and Hwy. #401  
between Jane St. and Keele St., District #6, Toronto.  
-- W.J. 62-F-86 W.P. 104-62 --

1. INTRODUCTION:

Since the original foundation investigation for the above structure was carried out, changes have been made in the design proposals to such an extent that our former recommendations are no longer practicable. Because of the very large loadings and the fact that little or no settlements can be tolerated, it now becomes necessary to support the structure by means of piled foundations. In order to decide upon the most suitable type of pile and design load, further borings were carried out at the site. The results of these borings, together with our recommendations are contained in this report.

2. FIELD WORK:

A total of four borings was carried out at the site using a diamond drill adapted for soil sampling purposes. Soil samples were obtained by means of a standard split-spoon sampler. Rock core samples were obtained by means of an AXT core barrel drilled 10' into the bedrock. All survey work was carried



2. FIELD WORK (Cont'd.) ...

out by D.H.O. personnel from Toronto District. The locations and elevations of all borings are shown on the accompanying Drawing #62-F-86B.

3. SUBSOIL TYPES:

Subsoil at the site consists of the following strata:

- (1) About 60' of clayey silt with the upper 12' desiccated, and having a hard to stiff consistency, and the lower 48' having a firm to stiff consistency.
- (2) From 15 to 30 feet of dense to very dense sandy silt with occasional gravels.
- (3) A very dense deposit of glacial origin varying in depth, from 10 to 25 feet, consisting of a heterogeneous mixture of clayey silt, sand, gravel and boulders.
- (4) Shale bedrock with a weathered zone at the surface extending for a depth of from 4 to 8 feet.

4. DISCUSSION AND RECOMMENDATIONS:

It is proposed to construct a three-span structure at this site. The vertical loads at the piers will be in the order of 1800 tons and at the abutments in the order of 600 tons. For the proposed footings, design requirements are such that the maximum loading is required over the smallest possible area. To achieve this, it is suggested that the entire structure be supported on steel H-piles driven to bedrock. A design load of

cont'd. /3 ...

4. DISCUSSION AND RECOMMENDATIONS: (Cont'd.) ...

up to 70 tons per pile may be used in the case of 12 BP at 74 sections. Because of the existence of the extensive weathered zone in the shale bedrock, it would probably be advisable to carry out a pile loading test to ensure that the design loads are being achieved. This test could probably be carried out during the course of the main contract.

5. SUMMARY:

Additional borings have been carried out at the site of the proposed structure for the South Service Rd. and Hwy. #401 between Jane St. and Keele St. These borings revealed the presence of deposits of clayey silt, sandy silt, and glacial till. Shale bedrock was located at depths ranging from 95' to 101' below ground level. It is recommended that the proposed structure be supported on piled foundations. Details are given in (4) above.

6. MISCELLANEOUS:

The field work was carried out during the period of Sept. 24/62 to Oct. 17/62.

Equipment used was owned and operated by Canadian Longyear Ltd., and supervised by Mr. H. Szymanski of the D.H.O.

cont'd. /4 ...

6. MISCELLANEOUS: (Cont'd.) ...

This report was written by Mr. K. G. Selby.

KGS/tt  
Attach.

- cc: Messrs. A. M. Teye (2)  
H. A. Tregaskes  
H. D. McMillan  
G. K. Hunter (2)  
C. Fraser  
T. J. Kovich  
J. Roy  
J. E. Gruspier  
E. R. Saint  
F. Norman

Foundations Office  
Gen. Files

## RECORD OF BOREHOLE NO. 1

FOUNDATION SECTION

JOB 62-F-86  
W.P. 104-6 2  
DATUM 441.0

LOCATION Hwy. #401, Sta. 9545, 173' Rt. of C  
BORING DATE July 10, 1982.  
BOREHOLE TYPE 4 1/2" Auger Borehole.

ORIGINATED BY I.H.  
COMPILED BY H.S.  
CHECKED BY I.H.

SOIL PROFILE					DYNAMIC PENETRATION RESISTANCE		LIQUID LIMIT — % PLASTIC LIMIT — % WATER CONTENT — %		BULK DENSITY P.C.F.	REMARKS
ELEV DEPTH	DESCRIPTION	STRAT. PLT.	SAMPLES NUMBER TYPE	BLOWS / FOOT	ELEV SCALE	BLOWS / FOOT 20 40 60 80 100	SHEAR STRENGTH P.S.F. 500 1000 1500 2000 2500	WATER CONTENT % 10 20 30		
441.0	Groundlevel									
0.0					440					
	Clayey silt with some fine to coarse sand and traces of fine gravel. <i>VERY STIFF.</i> Compact to dense. (Glacial Till)	1	SS	19						
		2	SS	26					133	
		3	SS	38	430					
		4	SS	24					146	
		5	SS	22						
		6	SS	22	420					
		7	SS	22					140	
		8	SS	19	410					
408.0										
33.0	Clayey silt to silty clay stiff.									
		9	SS	11	400					
398.0										
43.0	End of borehole.									
					390					

61-4391

DEPARTMENT OF HIGHWAYS - ONTARIO  
MATERIALS & RESEARCH DIVISION

## RECORD OF BOREHOLE NO. 2

FOUNDATION SECTION

JOB 62-F-86 LOCATION Hwy. #401, Sta. 96+48, 197' Rt. of E ORIGINATED BY I.H.  
 W.P. 104-62 BORING DATE July 11, 1962. COMPILED BY H.S.  
 DATUM 444.0 BOREHOLE TYPE 4" Auger borehole. CHECKED BY I.H.

SOIL PROFILE			SAMPLES			DYNAMIC PENETRATION RESISTANCE			LIQUID LIMIT — WL			BULK DENSITY P.C.F.	REMARKS	
ELEV. DEPTH	DESCRIPTION	STRAT. PLT	NUMBER	TYPE	BLOWS / FOOT	ELEV. SCALE	BLOWS / FOOT			PLASTIC LIMIT — WP				
							SHEAR STRENGTH P.S.F.			WATER CONTENT — W				
444.0	Groundlevel													
0.0	Clayey silt with some fine to coarse sand and traces of fine gravel.					440								
						430								
424.0														
20.0	End of borehole.					420								

DEPARTMENT OF HIGHWAYS - ONTARIO  
MATERIALS & RESEARCH DIVISION

RECORD OF BOREHOLE NO. 3

FOUNDATION SECTION

JOB 62-F-86 LOCATION Hwy. #401, Sta. 96+48, 150' Rt. of C ORIGINATED BY I.H.  
W.P. 104-62 BORING DATE July 11, 1962. COMPILED BY H.S.  
DATUM 443.0 BOREHOLE TYPE 4 1/2" Auger Borehole. CHECKED BY I.H.

SOIL PROFILE			SAMPLES			DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT			LIQUID LIMIT ——— WL PLASTIC LIMIT ——— WP WATER CONTENT ——— W WD ——— W ——— WL WATER CONTENT %			BULK DENSITY PCF	REMARKS
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FOOT	ELEV SCALE	SHEAR STRENGTH P.S.F.						
443.0 0.0	Groundlevel  Clayey silt with some fine to coarse sand and traces of fine gravel.					440							
						430							
423.0 20.0	End of borehole.					420							



51-4391

DEPARTMENT OF HIGHWAYS - ONTARIO  
MATERIALS & RESEARCH DIVISION

## RECORD OF BOREHOLE NO. 4

FOUNDATION SECTION

JOB 62-F-86 LOCATION Hwy. #401, Sta. 97+50, 174' Rt. of E ORIGINATED BY I.H.  
 W.P. 104-62 BORING DATE July 10, 1962. COMPILED BY H.S.  
 DATUM 443.0 BOREHOLE TYPE 4 1/2" Auger CHECKED BY I.H.

ELEV. DEPTH	SOIL PROFILE DESCRIPTION	STRAT. PLOT	SAMPLES		ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT		LIQUID LIMIT — WL PLASTIC LIMIT — WP WATER CONTENT — W		BULK DENSITY P.C.F.	REMARKS
			NUMBER	TYPE		20	40	60	80		
443.0 0.0	Groundlevel										
	Clayey silt to silty clay with some fine to coarse sand and traces of fine gravel. Very dense to compact.		1	SS	62	440					
			2	SS	35						
			3	SS	37						
			4	SS	21	430					
			5	SS	24						
			6	SS	19	420					
			7	SS	15						
412.0 31.0	Clayey silt to silty clay. Firm.		8	SS	8	410					
			9	TW	PH	400					
395.0											
48.0	Clayey silt with some sand, Dense.		10	TW	37	390					
391.5											
51.5	End of borehole.										

Note: Strain Sensitivity

DEPARTMENT OF HIGHWAYS - ONTARIO  
MATERIALS & RESEARCH DIVISION

## RECORD OF BOREHOLE NO. 5

FOUNDATION SECTION

JOB 62-F-86 LOCATION Sta. 287+35 165' Lt. New C Hwy. #401 ORIGINATED BY H.S.  
 W. P. 104-62 BORING DATE Sept. 17/62 COMPILED BY H.S.  
 DATUM 441.6 BOREHOLE TYPE Washboring CHECKED BY B.K.

SOIL PROFILE		SAMPLES			DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT		LIQUID LIMIT ——— WL PLASTIC LIMIT ——— WP WATER CONTENT ——— W		BULK DENSITY P.C.F.	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FOOT	SHEAR STRENGTH P.S.F. ○ Unconfined Compression Test	WATER CONTENT % 20 40 60			
441.6 0.0	Groundlevel									
429.6 12.0	Desiccated zone - Very stiff.		1	SS	22					
			2	SS	29					
			3	SS	28					
			4	SS	19	420				
	Clayey silt with fine gravel.		5	SS	20					
			6	SS	8	20				
	Soft to firm.		7	TW	P					123.0
			8	TW	P					122.0
			9	TW	P	95				
			10	TW	P	390				127.0
383.6 58.0			11	TW	P					127.0
	Sandy silt with some gravel.		12	SS	35	50				
			13	SS	18					
	Dense to very dense.		14	SS	103	75				
			15	SS	>100	360				
			16	SS	90					
351.6 90.0	Clayey silt with sand gravel & boulders. (Glacial Till)		17	SS	>100	40				
341.6 99.8	Very dense.		18	SS	>100					
335.8 101.0	Weathered Bedrock		19	RC	-	105				
	End of borehole.					330				

DEPARTMENT OF HIGHWAYS - ONTARIO  
 MATERIALS & RESEARCH DIVISION

## RECORD OF BOREHOLE NO. 6

FOUNDATION SECTION

 JOB 62-F-86 LOCATION Sta. 285+83 192' Lt. New G. Hwy. #401 ORIGINATED BY H.S.  
 W. P. 104-62 BORING DATE Sept. 21, 1962. COMPILED BY H.S.  
 DATUM 442.7 BOREHOLE TYPE Washboring. CHECKED BY B.K.

SOIL PROFILE			SAMPLES		ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE		LIQUID LIMIT — WL		BULK DENSITY	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE		BLOWS / FOOT	BLOWS / FOOT	PLASTIC LIMIT — WP	PLASTIC LIMIT — WP		
442.7	Groundlevel				450						
0.0	Desiccated zone -										
	Very stiff.										
430.7			1	SS	420						
12.0	Clayey silt with										
	fine gravel.		2	SS							
	Soft to firm.										
			3	SS							
			4	SS	390						
389.7											
53.0	Sandy silt with some		5	SS							
	gravel.										
	Dense to very dense.		6	SS							
367.7			7	SS	360						
75.0	Clayey silt with sand										
	gravel and boulders.										
	(Glacial Till)										
	Very dense.		8	RC							
341.7											
101.0	Weathered Bedrock.										
336.7											
106.0	Sound Bedrock.		9	RC							
331.5	(Grey Shale)										
111.2	End of borehole.				330						

 WL in casing  
 on 26/9/62

 426.7  
 16.0

 Gr. 7%  
 Sa. 30%  
 Si. 51%  
 Cl. 12%  
 Sa. 37%  
 Si. 56%  
 Cl. 7%



DEPARTMENT OF HIGHWAYS - ONTARIO  
MATERIALS & RESEARCH DIVISION

## RECORD OF BOREHOLE NO. 8

FOUNDATION SECTION

JOB 62-F-86 LOCATION Sta. 288+57 (139' Lt. of E. Hwy. #401) ORIGINATED BY H.S.  
W.P. 104-62 BORING DATE Oct. 4, 1962. COMPILED BY H.S.  
DATUM 440.1 BOREHOLE TYPE Washboring CHECKED BY B.K.

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE			LIQUID LIMIT — WL			BULK DENSITY	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FOOT		BLOWS / FOOT	SHEAR STRENGTH P.S.F.		PLASTIC LIMIT — WP	WATER CONTENT — W			
440.1	Groundlevel					440								
437.1	Sand (Fill Material)													
3.0	Desiccated zone - Hard to very stiff.													
426.1														
14.0														
			1	SS	29	410								
	Clayey silt with occasional gravel.													
	Firm to stiff.		2	SS	8									
			3	SS	9	380								
375.1														
65.0	Sandy silt with some gravel. Very dense.													
360.1			4	SS	>100	350								
80.0	Clayey silt with sand gravel and boulders. (Glacial Till)													
	Very dense.		5	RC	-									
342.1														
98.0	Weathered Bedrock.		6	RC	-									
333.6														
106.5	Sound Bedrock		7	RC	-									
329.9	(Grey Shale)													
110.2	End of borehole.					320								

WL in borehole on 11/10/62  
419.1  
21.0Sa. 1%  
Si. 83%  
Cl. 16%Sa. 4%  
Si. 73%  
Cl. 23%

Mr. B. R. Davis,  
Bridge Design Engineer,  
Bridge Division.

Attention: Mr. C. Bassi

Mr. A. G. Stermac,  
Principal Foundation Engr.,  
Foundation Section,  
Materials & Research Division.

July 10, 1963

D.H.O. FOUNDATION INVESTIGATION --  
Proposed Retaining Walls at Basket Weave Structure  
for South Service Road, Hwy. #401, Toronto By-Pass.  
W.J. 62-F-86B -- District #6 -- W.P. 104-62

Following your memo dated June 12, 1963, we have carried out four borings at the sites of the above-mentioned retaining walls. The borings revealed the presence of a stiff to very stiff deposit of clayey silt extending for at least 15 ft. below the proposed footing levels. In view of these facts, we believe that an allowable pressure of 2 tons per sq. ft. may be used for design purposes.

We are forwarding, for your information, the records of B.H.'s #9 - #12, inclusive. These, together with this memo, should be attached to Foundation Report #62-F-86B.

If you have any further queries in connection with this matter, please contact this Office.

KGS/MdeF  
Attach.

cc: Messrs. B. Davis (2)  
H. A. Tregaskes  
H. D. McMillan  
G. K. Hunter (2)  
C. Fraser  
T. J. Kovich  
A. Watt

*K. G. Selby*  
K. G. Selby,  
SENIOR FOUNDATION ENGR.  
For:  
A. G. Stermac,  
PRINCIPAL FOUNDATION ENGR.

Foundations Office  
Gen. Files



Mr. B. R. Davis,  
Bridge Design Engr.,  
Bridge Division.

Mr. A. G. Stermac,  
Principal Foundation Engr.,  
Foundation Section,  
Materials & Research Division.

Attention: Mr. C. Bazzi

June 20, 1963

Pile Loading Tests for Basket Weave Structures  
Between Jane St. and Keele St., Highway #401,  
Toronto By-Pass - Dist. #6 - Contract #IB-8-63.

We have recently completed two pile loading tests at the sites of the above-mentioned proposed structures, and are now in a position to make specific recommendations regarding the design loads and method of driving control for the piles to be used in the structure foundations. A complete report will be forwarded to you in the near future.

Tests were carried out on two 12 BP at 7 1/2 steel H-piles with standard reinforced tips. The tests showed that a design load of 120 tons per pile is within the requirements of the National Building Code of Canada. The maximum immediate settlement under such a loading is anticipated to be about 3/8".

In order that an adequate pile capacity is achieved in the field, the following method of control is recommended:

- (1) The piles should be driven by means of a DeLong D 22 Hammer.
- (2) Standard reinforcing should be provided for the pile tips.
- (3) The piles should be driven into the very dense sandy silt and gravel stratum, shown on Foundation Drawings 62-F-85B & 86B, for a distance of at least 3 feet so that the blows per foot of the pile driving hammer are in excess of 200.
- (4) The final 6 inches of driving should be such that the number of blows per inch are in excess of 20.
- (5) An ultimate capacity of at least 300 tons should be computed by means of the Hiley Formula, as shown on D.H.O. Standard DD 1219.

Mr. B. R. Davis,  
Attn: Mr. C. Bassi.

- 2 -

June 20, 1963

If the above recommendations are followed, we believe that a safe design of 120 tons per pile can be achieved, provided such a load is structurally acceptable for reasons other than soil capacity.

If you have any further queries in connection with this matter, please contact this Office.

KES/MdeF

cc: Foundations Office  
Gen. Files

*K. G. Selby*  
K. G. Selby,  
SENIOR FOUNDATION ENGR.  
For:  
A. G. Sternac,  
PRINCIPAL FOUNDATION ENGR.

MEMORANDUM

KEN 62-F-85A  
APRIL 29. 1963  
als

To: Mr. A. G. Stermac,  
Principal Foundation Engineer,  
Room 107, Lab. Building,  
DOWNSVIEW, Ontario.

FROM: B. Davis

DATE: April 25, 1963

OUR FILE REF.

IN REPLY TO

SUBJECT: East & Westbound Basketweave Bridges -  
Hwy. 401 between Keele St. & Jane St.  
Dist. #6, Toronto, W.P. 104-62 & 105-62.

The Foundation Investigation Reports for the above structures call for the abutments and piers to be supported on 12 BP 74 Steel "H" Piles driven to bedrock. Basing our design on the recommended design load of 70 tons per pile we find that we shall require approximately 8500 l.ft. of piles for each structure. As the piles are fairly long (100 ft. average) we feel that there would be a considerable saving if the design load per pile could be increased to say, even 100 tons. With this in view, would you please arrange to carry out a pile load test at each of the above mentioned structures.

Besides providing a basis for increasing the design load per pile, the pile load tests should also provide valuable information to the Contractors for bidding purposes.

\* NOTE : — PILE LOAD TEST REPORTED  
UNDER # 63-F-71  
(CONTRACT IB-8-63)

*B. Davis*

BD/rp

B. Davis,  
Bridge Design Engineer.

APPENDIX I

PILE LOADING TESTS AT SITE OF  
PROPOSED BASKET WEAVE STRUCTURES  
FOR NORTH AND SOUTH SERVICE ROADS  
BETWEEN KEELE AND JANE STREETS,  
HWY. #401, DISTRICT #6, TORONTO.

Synopsis:

It is proposed to carry out a pile load test at each of the sites of the proposed structures mentioned above. The purpose of these tests is to determine an appropriate design load for the piles to be used in the future structures and to obtain information on pile driving conditions. In both cases, the piles will be steel 'H' sections 12 BP at 74. At the north site, pile length will be about 120', and at the south site, about 110'. It is intended to test the piles up to a maximum of 300 tons. The procedure of the tests will be in general, in accordance with the National Building Code of Canada, but slight modifications to the latter will be made if the D.H.O. finds it necessary. The Contractor will be solely responsible for carrying out the following work at each site:

(1) Driving the pile vertically to an elevation which will be determined by the D.H.O., and as directed by the D.H.O. The hammer to be used for driving the pile should have an energy of not less than 37,000 ft.-lbs. per blow. A suitable anvil must be provided so as to afford maximum protection for the pile top.

(2) Splicing and cutting off the pile as necessary.

(3) Providing and erecting an adequate reaction in the form of a box loaded with sufficient material to provide the necessary load of 300 tons the resultant of which is vertically above the centre of the particular pile.

cont'd. /2 ...

(4) Providing and placing any material required to form a level base and working area for the above-mentioned loading box in (3).

(5) Providing and operating a jack with a minimum capacity of 300 tons as directed by the D.H.O.

(6) Providing and fixing two reference beams adjacent to the pile to be tested. The design and length of these beams must be such that no settlement due to the load of the box on the ground is caused at the reference beam supports. Provision must also be made to check the elevations of the reference beams to an accuracy of not less than 0.1" referred to a permanent bench mark, at times to be decided by the D.H.O.

(7) Provide 4 measuring gauges with a minimum accuracy of 0.001" per division, one to be attached to each corner of the pile in a manner approved by the D.H.O.

(8) Providing all necessary personnel to carry out the above work and for the recording of all data as directed by the D.H.O. General supervision at all times, and occasional direct supervision will be provided by the D.H.O. All recorded data will remain the property of the D.H.O.

(9) At completion of the work, the Contractor must cut off or extract the pile (decision to be made by the D.H.O.), and clear the site to the satisfaction of the D.H.O.

April 29/63

K. G. Selby  
SR. FOUNDATION ENGINEER



DEPARTMENT OF HIGHWAYS - ONTARIO  
MATERIALS & RESEARCH DIVISION

## RECORD OF BOREHOLE NO. 9

FOUNDATION SECTION

JOB 62-F-86B LOCATION 213.0' E. of S-Collector Rd. Centre Core (63.0' N) ORIGINATED BY B.K.  
 W. P. 104-62 BORING DATE June 19, 1963 COMPILED BY B.K.  
 DATUM 442.4' BOREHOLE TYPE Auger CHECKED BY K.S.

SOIL PROFILE		SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT		LIQUID LIMIT — WL PLASTIC LIMIT — WP WATER CONTENT — W		BULK DENSITY P.C.F.	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE		BLOWS / FOOT	SHEAR STRENGTH P.S.F.		WP — W — WL WATER CONTENT %		
42.4	Groundlevel										
0.0	Clayey silt.  Very stiff to stiff.				440						
			1	SS	9						
			2	SS	29						
			3	SS	40						
			4	SS	26	430					
			5	SS	30						
			6	SS	17						
21.5	End of borehole.				420						
											W.L. 426.5 15.9

 W.L.  
 426.5  
 15.9

DEPARTMENT OF HIGHWAYS - ONTARIO  
MATERIALS & RESEARCH DIVISION

## RECORD OF BOREHOLE NO. 10

FOUNDATION SECTION

JOB 62-F-86B LOCATION 160.0' E. of S-Collector Serv. Rd. Centre Core (43.0' N) ORIGINATED BY B.K.  
 W.P. 104-62 BORING DATE June 19, 1963. COMPILED BY B.K.  
 DATUM 442.4' BOREHOLE TYPE Auger CHECKED BY K.S.

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT			LIQUID LIMIT — WL PLASTIC LIMIT — WP WATER CONTENT — W			BULK DENSITY P.C.F.	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FOOT		SHEAR STRENGTH P.S.F.			W D — W — WL WATER CONTENT %				
442.7 0.0	Groundlevel					440								
	Clayey silt.  Very stiff to stiff.		1	SS	21									
			2	SS	23									
			3	SS	24									
			4	SS	18	430								
			5	SS	21									
421.2			6	SS	19									
21.5	End of borehole.					420								
														W.L. 425.3 17.4

W.L.  
425.3  
17.4

DEPARTMENT OF HIGHWAYS - ONTARIO  
MATERIALS & RESEARCH DIVISION

## RECORD OF BOREHOLE NO. #11

FOUNDATION SECTION

JOB 62-F-86B LOCATION 155.0' W of S-Serv Rd Center Core (40.0' South) ORIGINATED BY B.K.  
 W.P. 104-62 BORING DATE June 19, 1963. COMPILED BY B.K.  
 DATUM 440.6' BOREHOLE TYPE Auger CHECKED BY K.S.

SOIL PROFILE		SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT		LIQUID LIMIT — WL PLASTIC LIMIT — WP WATER CONTENT — W		BULK DENSITY P.C.F.	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE		BLOWS / FOOT	SHEAR STRENGTH P.S.F.		WATER CONTENT % wp — w — WL		
440.6	Groundlevel										
	Clayey silt.		1	SS	22						
	Very stiff to stiff.		2	SS	21						
			3	SS	24						
			4	SS	14						
			5	SS	17						
419.1			6	SS	23						
21.5	End of borehole.										

434.2  
3.5

DEPARTMENT OF HIGHWAYS - ONTARIO  
MATERIALS & RESEARCH DIVISION

## RECORD OF BOREHOLE NO. 12

FOUNDATION SECTION

JCB 62-F-86B

LOCATION 205.0' W of S-Serv Rd Center Core (63.0' South)

ORIGINATED BY B.K.

W P 104-62

SORING DATE June 19, 1963.

COMPILED BY E.K.

DATUM 437.6'

BOREHOLE TYPE Auger

CHECKED BY K.S.

SOIL PROFILE		SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT		LIQUID LIMIT ——— WL PLASTIC LIMIT ——— WP WATER CONTENT ——— W		BULK DENSITY P.C.F.	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE		BLOWS / FOOT	SHEAR STRENGTH P.S.F.	WP	WL		
437.6	Groundlevel										
	Clayey silt to silt- V. stiff to stiff.		1	SS	19						
			2	SS	23						
			3	SS	37						
			4	SS	36						
			5	SS	19						
			6	SS	23						
21.5	End of borehole.										

W.L.  
 436.2  
 1.4

#

62-F-86 &

#

62-F-86 B

#

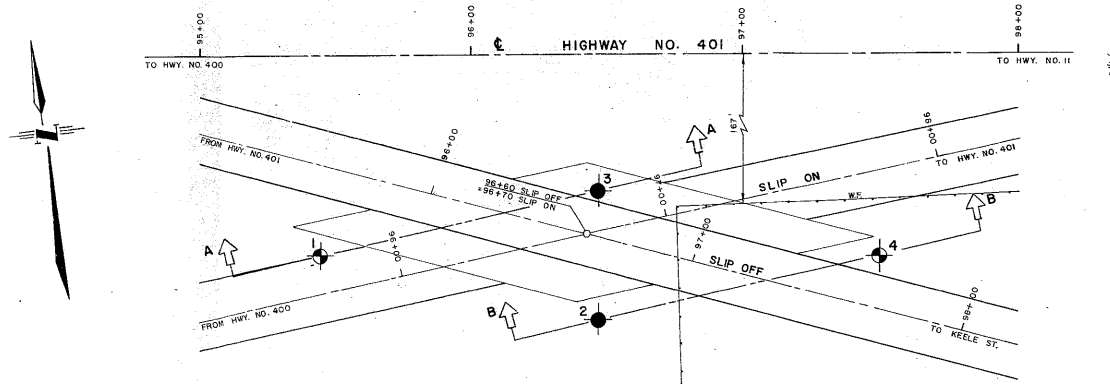
W.P. 104-62

#

HWY 401

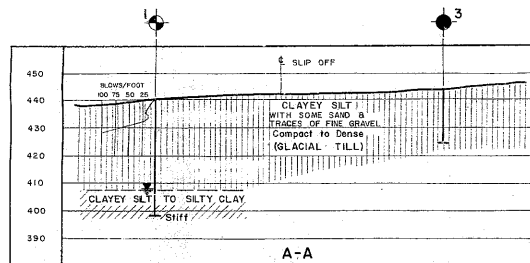
SOUTH SERVICE R

SHIP ON & SHIP OFF

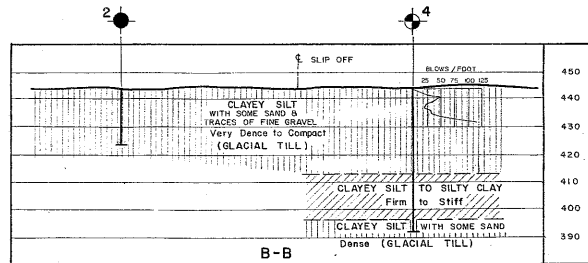


PLAN

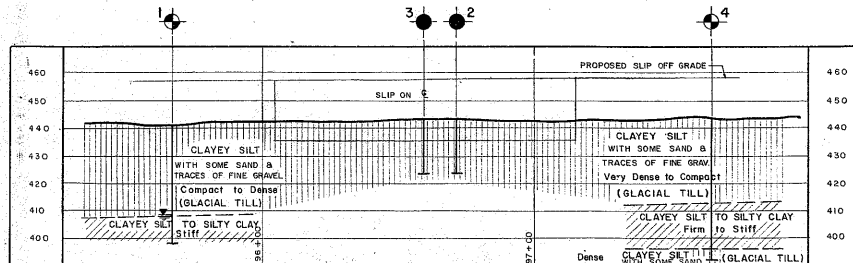
SCALE IN FEET  
20 10 0 20 40 60



A-A

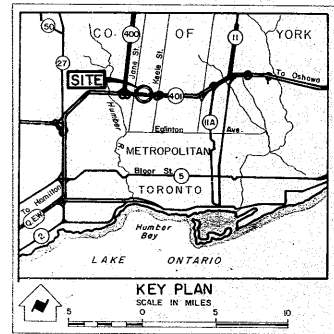


B-B



PROFILE OF SLIP OFF

SCALE IN FEET  
20 10 0 20 40 60



LEGEND

- Bore Hole
- ⊕ Cone Penetration Hole
- ⊕ Bore & Cone Penetration Hole
- Water Levels established at time of field investigation. July 10, 1962

NO.	ELEVATION	STATION	OFFSET
1	441.0	95+45	173' RT.
2	444.0	96+48	197' RT.
3	443.0	96+48	150' RT.
4	443.0	97+50	174' RT.

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.

DEPARTMENT OF HIGHWAYS - ONTARIO  
MATERIALS & RESEARCH SECTION

SLIP ON & SLIP OFF  
FOR  
SOUTH SERVICE ROAD & HIGHWAY NO. 401  
BETWEEN JANE ST. & KEELE ST.

DESIGNED BY	1. HOLUBEC	DISTRICT NO.	6	DATE	AUG. 9, 1962
DRAWN BY	F. CLARK	W. NO.	04-62	JOB NO.	62-F-86
CHECKED BY	CLARK	CONT. NO.		DRAWING NO.	
APPROVED BY	H. L. BULL				62-F-86A

