

DEPARTMENT OF HIGHWAYS ONTARIO

MEMORANDUM

To: Mr. A. M. Toye,  
Bridge Engineer,  
Bridge Division.

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

Attention: Mr. S. McCombie

DATE: August 23, 1963

OUR FILE REF.

IN REPLY TO

SUBJECT:

FOUNDATION INVESTIGATION REPORT

For

Proposed Overpass at Dixon Road  
and Hwy. 401, Twp. of Etobicoke,  
District 6, Toronto

W.J. 63-F-92 -- W.P. 251-61

It is proposed to replace the existing overpass at Dixon Road and Hwy. 401, with a new structure of larger dimensions. A foundation investigation at this site was requested by the Bridge Location Engineer.

An investigation consisting of four sampled boreholes and dynamic cone penetration tests was undertaken on August 20, 1963, in order to determine the subsoil conditions and recommend the type and elevations of footings. Attached to this report is a drawing (63-F-92A), showing the locations and elevations of the boreholes, together with the inferred stratigraphy of the subsoil.

Subsoil conditions in the area are very uniform and favourable. Underlying a thin layer of topsoil, a deposit of glacial till consisting of clayey silt with some sand and gravel up to 3/4 inch in size, was encountered. This till material is in a hard state of

August 23, 1963

consistency and was found to extend to the investigated depth of 31 feet (elev. 503). Ground water level was observed between elevations 516 and 522. Exact water levels are marked on the attached borehole profiles.

Spread footings are recommended. A safe load of up to 4 T.S.F. can be applied. Footings should be placed below the finished level of Dixon Road to satisfy frost penetration requirements.

If found, organic compressible material should be removed below the footings. No dewatering problems are anticipated. No slope stability problems will be encountered if standard construction procedures are followed.

The field investigation was carried out during the period August 20 and 21, 1963, by Mr. B. M. Ghadiali, Project Foundation Engineer, who also compiled and interpreted the findings.

We trust that the given recommendations are sufficient for your future design work. However, if you have any questions you would like to discuss, please feel free to call on our Office.

AGS/MdeF  
Attach.

cc: Messrs.

A. M. Towe (2)  
H. A. Tregaskes  
H. D. McMillan  
G. K. Hunter (2)  
C. Fraser  
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*A. G. Stermac*  
A. G. Stermac,  
PRINCIPAL FOUNDATION ENGINEER

APPENDIX I.

DEPARTMENT OF HIGHWAYS - ONTARIO  
MATERIALS & RESEARCH DIVISION

# RECORD OF BOREHOLE NO. 1

FOUNDATION SECTION

JOB 63-F-9 LOCATION Stn. 119+00 and 11.0' to left of E. Hwy. 401 ORIGINATED BY B.M.G.  
W.P.                      BORING DATE August 20, 1963 COMPILED BY B.M.G.  
DATUM C.S.C. BOREHOLE TYPE Penn. Auger - 5 1/2" Ø CHECKED BY A.G.S.

SOIL PROFILE			SAMPLES			DYNAMIC PENETRATION RESISTANCE				LIQUID LIMIT — W <sub>L</sub> PLASTIC LIMIT — W <sub>P</sub> WATER CONTENT — W			BULK DENSITY P.C.F.	REMARKS	
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FOOT	ELEV. SCALE	BLOWS / FOOT 20    40    60    80    100				WATER CONTENT % 10    20    30				
							SHEAR STRENGTH P.S.F.				W <sub>P</sub> W    W <sub>L</sub>				
533.3	Groundlevel					535									
0.6	Topsoil														
	Clayey silt-some sand and fine gravel.		1	SS	29	530									
	(Glacial till)		2	SS	51										
	Brown changing to grey at elev. 517.5					525									
			3	SS	>100										
						520									
			4	SS	57										
						515									
			5	SS	38										
						510									
			6	SS	70										
						505									
502.5			7	SS	>100										
31.0	End of borehole.					500									

W.L.  
at elev.  
517.3

31.3  
517.3  
1.6

W.L.  
at elev.  
517.3

3'3.3  
517.3  
1.6

DEPARTMENT OF HIGHWAYS - ONTARIO  
MATERIALS & RESEARCH DIVISION

RECORD OF BOREHOLE NO. 2

FOUNDATION SECTION

JOB 63-F-92

LOCATION Stn. 118+58 and 105' to right of E. Hwy. 401

ORIGINATED BY B.M.G.

W. P.

BORING DATE August 20, 1963.

COMPILED BY B.M.G.

DATUM C.S.C.

BOREHOLE TYPE Penn. Auger - 5 1/2" Ø

CHECKED BY A.C.S.

SOIL PROFILE		SAMPLES			DYNAMIC PENETRATION RESISTANCE		LIQUID LIMIT — WL		BULK DENSITY P.C.F.	REMARKS		
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FOOT	ELEV. SCALE	BLOWS / FOOT				PLASTIC LIMIT — WP	
							20 40 60 80 100				WATER CONTENT — W	
							SHEAR STRENGTH P.S.F.				WATER CONTENT %	
											10 20 30	
534.5	Groundlevel					535						
0.6	Topsoil											
	Clayey silt-some sand and gravel. (organics to elev. 530.0) (Glacial till).		1	SS	14	530						
	V. stiff to hard.		2	SS	31							
	Brown changing to grey at elev. 518.2		3	SS	73	525						
			4	SS	>100							
			5	SS	>100	520						
			6	SS	49	515						
			7	SS	89	510						
503.2			8	SS	>100	505						
31.4	End of borehole.					500						

W.L.  
at elev.  
522.5

DEPARTMENT OF HIGHWAYS - ONTARIO MATERIALS & RESEARCH DIVISION		<b>RECORD OF BOREHOLE NO. 3</b>		FOUNDATION SECTION
JOB <u>63-F-92</u>	LOCATION <u>Stn. 120+79 and 105' to right of E. Hwy. 401</u>	ORIGINATED BY <u>B.M.C.</u>		
W.P. _____	BORING DATE <u>August 21, 1963.</u>	COMPILED BY <u>B.M.C.</u>		
DATUM <u>G.S.C.</u>	BOREHOLE TYPE <u>Penn. Auger - 5 1/2" Ø</u>	CHECKED BY <u>A.G.S.</u>		

SOIL PROFILE		SAMPLES		DYNAMIC PENETRATION RESISTANCE		LIQUID LIMIT — % PLASTIC LIMIT — % WATER CONTENT — %		BULK DENSITY P.C.F.	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT PLOT	NUMBER TYPE	BLOWS /FOOT	ELEV SCAL	SHEAR STRENGTH P.S.F.	WATER CONTENT %		
536.0	Groundlevel				540				
0.6	Clayey silt-some sand and gravel. (organics to 531.0).  (Glacial till)  Hard.  Brown changing to grey at elev. 512.2		1	SS 28	535				
			2	SS 67	530				
			3	SS 58	525				
			4	SS 97	520				
516.5					515				
21.6	End of borehole.								

▼ W.L.  
at elev.  
522.5

DEPARTMENT OF HIGHWAYS - ONTARIO  
MATERIALS & RESEARCH DIVISION

RECORD OF BOREHOLE NO. 4

FOUNDATION SECTION

JOB 63-F-92 LOCATION Stn. 117+01 and 107' to left of E. Hwy. 401 ORIGINATED BY B.M.G.  
W. P.                      BORING DATE August 21, 1963. COMPILED BY B.M.G.  
DATUM G.S.C. BOREHOLE TYPE Penn. Auger - 5 1/2" Ø CHECKED BY A.G.S.

SOIL PROFILE		SAMPLES			ELEV SCALE	DYNAMIC PENETRATION RESISTANCE					LIQUID LIMIT — %L PLASTIC LIMIT — %P WATER CONTENT — %W			BULK DENSITY P.C.F.	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE		BLOWS / FOOT	20	40	60	80	100	%P	%L		
530.5	Groundlevel				530										
0.6	Topsoil														
	Clayey silt-some sand and gravel. (Glacial till)														
	Hard.		1	SS	32	525									
	Brown changing to grey at elev. 510.0		2	SS	47	520									
			3	SS	>100	515									
509.0			4	SS	33	510									
21.6	End of borehole.														

WL  
at elev.  
516.0

## 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
$\phi'$	EFFECTIVE ANGLE OF SHEARING RESISTANCE, OR FRICTION
$c_u$	APPARENT COHESION
$\phi_u$	APPARENT ANGLE OF SHEARING RESISTANCE, OR FRICTION
$\mu$	COEFFICIENT OF FRICTION
$S_f$	SENSITIVITY

### GENERAL

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

### STRESS AND STRAIN

u	PORE PRESSURE
$\sigma$	NORMAL STRESS
$\bar{\sigma}$	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
$K_o$	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

#63-F-92

W.P. #251-61

HWY #401 &

OVERPASS AT

DIXON RD.

