

MEMORANDUM

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

FROM: Foundation Section,
Materials and Testing Div.,
Room 107, Lab. Bldg.

Attention: Mr. S. McCombie

DATE: August 20, 1964

OUR FILE REF.

IN REPLY TO

SUBJECT:

FOUNDATION INVESTIGATION REPORT

For

Proposed Retaining Wall on Belfield
Rd. Overpass (Ramp W.-E., Hwy. 401),
Twp. of Etobicoke, County of York,
District No. 6, Toronto
W.J. 64-F-75 -- W.P. 442-64-1

At the request of Mr. J. B. Curtis, Regional Bridge Location Engineer (memo dated August 6, 1964), a foundation investigation was carried out for the above proposed retaining wall in order to determine the subsoil conditions existing at the site.

This report contains the results of the investigation, together with our recommendations pertaining to the design of the foundations.

The field investigation consisted of four sampled boreholes. The locations and estimated elevations of the boreholes are shown on the attached Dwg. #64-F-75A.

Subsoil was found to consist of a deposit of glacial till consisting of clayey silt, sand and gravel. The consistency of the material is hard. The upper 13 ft. to 17 ft. of the deposit is oxidized and partially desiccated.

cont'd. /2 ...

The elevations of the water levels in the boreholes are shown on the borehole log sheets attached in the Appendix.

The proposed wall may be founded on spread footings with a safe bearing pressure of 3.0 T.S.F. A minimum of 5 ft. of cover for frost protection is recommended for the footings. Care should be taken to prevent softening of the foundation material by surface water during construction.

For calculating the resistance to sliding, a coefficient of friction of 0.5 may be assumed to apply between the subsoil and the footing bases.

No dewatering problems are anticipated with regard to the proposed footing excavations because the subsoil is relatively impermeable.

The field work was carried out during August 12 to August 13, 1964, under the supervision of Mr. T. Chan, Project Foundation Engineer, who also wrote this report. The investigation was carried out under the general supervision of Mr. M. Devata, Senior Foundation Engineer, who also reviewed this report.

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



for A. G. Stermac,
PRINCIPAL FOUNDATION ENGINEER

TC/MdeF
Attach.

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

Foundations Office
Gen. Files

APPENDIX I.

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & RESEARCH DIVISION

RECORD OF BOREHOLE NO. 1

FOUNDATION SECTION

JOB 64-F-75 LOCATION Ramp W-E (401), Sta. 558+32, 15' Rt. ORIGINATED BY H.T.C.
W.P. 442-64-1 BORING DATE August 13, 1964 COMPILED BY H.T.C.
DATUM G.S.C. BOREHOLE TYPE Penn. Type Auger - 3 1/2" Ø CHECKED BY M.D.

SOIL PROFILE		SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE		LIQUID LIMIT ——— W _L		BULK DENSITY	REMARKS
ELEV. DEPTH	DESCRIPTION	NUMBER	TYPE	BLOWS / FOOT		BLOWS / FOOT	SHEAR STRENGTH P.S.F.	PLASTIC LIMIT ——— W _P	WATER CONTENT ——— W		
511.0	Ground Level							W _P ——— W ——— W _L	WATER CONTENT %		
0.0	Heterogeneous Mixture of Clayey Silt with Sand & Occasional Gravel. (Glacial Till). Oxidized, brown, hard.	1	SS	42							
498.0		2	SS	62							
13.0	Changing to grey at elev. 498.0, approx.	3	SS	37							
		4	SS	59							
		5	SS	81/8"							
484.7		6	SS	102/8"							
26.3	End of Borehole										

509.3

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & RESEARCH DIVISION

RECORD OF BOREHOLE NO. 2

FOUNDATION SECTION

JOB 64-F-75 LOCATION Ramp W-E (401), Sta. 559+73, 34' Rt. ORIGINATED BY H.T.C.
W.P. 442-64-1 BORING DATE August 12, 1964 COMPILED BY H.T.C.
DATUM G.S.C. BOREHOLE TYPE Penn. Type Auger - 3 1/2" Ø CHECKED BY M.D.

SOIL PROFILE		STRAT PLOT	SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE		LIQUID LIMIT ——— WL		BULK DENSITY	REMARKS
ELEV. DEPTH	DESCRIPTION		NUMBER	TYPE	BLOWS / FOOT		BLOWS / FOOT	SHEAR STRENGTH P.S.F.	PLASTIC LIMIT ——— WP	WATER CONTENT ——— W		
513.0	Ground Level											
0.0	6" of Topsoil											
	Heterogeneous		1	SS	39	510						
	Mixture of Clayey		2	SS	42							
	Silt with Sand &		3	SS	53							
	Gravel. (Glacial		4	SS	49	500						
	Till).		5	SS	34							
	Oxidized, brown,											
	hard.											
496.0												
17.0	Changing to grey		6	SS	35	490						
	at elev. 496.0		7	SS	60							
	approx.		8	SS	75	480						
477.0			9	SS	57 1/2"							
36.0	End of Borehole											

506.2

OFFICE REPORT ON SOIL EXPLORATION

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & RESEARCH DIVISION

RECORD OF BOREHOLE NO. 4

FOUNDATION SECTION

JOB 64-F-75 LOCATION Ramp W-E (401), Sta. 561+93, 35' Rt. ORIGINATED BY H.T.C.
 W.P. 442-64-1 BORING DATE August 13, 1964 COMPILED BY H.T.C.
 DATUM G.S.C. BOREHOLE TYPE Penn. Type Auger - 3 1/2" Ø CHECKED BY M.D.

SOIL PROFILE		SAMPLES			ELEV SCALE	DYNAMIC PENETRATION RESISTANCE		LIQUID LIMIT ——— WL PLASTIC LIMIT ——— WP WATER CONTENT ——— W		BULK DENSITY P.C.F.	REMARKS
ELEV DEPTH	DESCRIPTION	NUMBER	TYPE	BLOWS / FOOT		SHEAR STRENGTH P.S.F.		WP	WL		
512.0	Ground Level										
0.0	Heterogeneous Mixture of Clayey Silt with Sand & Occasional Gravel (Glacial Till) Oxidized, brown, hard.	1	SS	22	510						509.1 ▽
		2	SS	31							
		3	SS	65							
497.0					500						
15.0	Changing to grey at elev. 497.0, 490.7 approx.	4	SS	38							
490.7		5	SS	85	485.5"						
21.3	End of Borehole				490						
					480						

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 1/2 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
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
$\log_e \sigma$ OR $\ln \sigma$	NATURAL LOGARITHM OF σ
$\log_{10} \sigma$ OR $\log \sigma$	LOGARITHM OF σ 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

64-F-75

W.P. # 442-64-1

Hwy. # 401

(RAMP W-E)

BELFIELD RD.

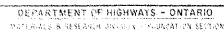
OVERPASS



- | NO. | ELEVATION | STATION
RAMP W-E | OFFSET |
|-----|-----------|---------------------|----------|
| 1 | 511.0 | 558.32 | 15' RY. |
| 7 | 518.0 | 559.78 | 34' RY. |
| 3 | 512.0 | 560.87 | 42' RT. |
| 4 | 512.0 | 561.03 | 35' R.T. |

- NOTE -

*No boundaries between soil strata have been established only at these hole locations. Between Bore Holes the boundaries are assumed from geological evidence and may be subject to considerable error.



PROPOSED RETAINING WALL
RAMP W-E (BELFIELD RD.)

KING'S HIGHWAY NO. 401 DIST NO. 6
CO. M. TORONTO METROPOLITAN TORONTO
TWP. ETOBICOKE LOT CON.

BORE HOLE LOCATIONS & SOIL STRATA

REVISED T.C.	CHECKED	WORK NO. 442-64-1	NBR DRAWING NO.
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FILED O. M. CHECKED ✓ J.R. 64-F-75 64-F-75

DATE: 23 AUG. 1964	SHEET NO.	WIRING DRAWING NO.
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NAME OF FIRM	DATE	
<i>J. J. McLaughlin</i>	<i>1907</i>	
LOCALITY	COUNTY	STATE
<i>St. Louis</i>	<i>Maryland</i>	<i>Missouri</i>

