

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 New Structure at
Keele Street and Hwy. 401, Toronto.
W.J. 63-F-87 -- W.F. 231-60
District 6

The present structure carrying Keele Street over Hwy. 401 is in good shape and no signs of deterioration that could be attributed to poor subsoil conditions, can be found.

It is intended to replace the present structure with a larger one in order to accommodate the widened Hwy. 401. Although it could have been assumed that the subsoil conditions are satisfactory, it was decided to carry out a limited investigation which would provide the necessary factual information.

In response to a request by the Bridge Planning Engineer, contained in his memorandum of June 22, 1963, the Foundation Section has put down two boreholes and two dynamic cone penetrations. The locations of these are shown on the attached Drawing No. D 5266-P2. Also attached, are the borehole logs that contain the results of a number of laboratory identification tests.

cont'd. /2

August 23, 1963

The investigation has confirmed that the subsoil conditions are very favourable. Under a thin layer of topsoil and/or road fill material, a layer of stiff to hard till was found. Its thickness at this location remains undetermined, the boreholes having been terminated at elev. 531.8 and 535.2, respectively.

Because of the relatively impervious nature of the till material, it was not possible to establish the exact ground water level and since no problems with ground water are anticipated, no effort was made to obtain this information.

It is recommended that for the new structure, spread footings with a safe load of 3.0 T/sq.ft. be used. The footings should be placed below ground level as to satisfy frost penetration requirements.

The investigation was carried out during the period August 13th and 14th, under the supervision of Mr. B. M. Ghadiali, Project Foundation Engineer.

If there are any queries, or further information is required, in connection with this project, please do not hesitate to contact our Office.

AGS/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

A. G. Stermac
A. G. Stermac,
PRINCIPAL FOUNDATION ENGINEER

APPENDIX I.

JOB 63-F-87

LOCATION Stn. 229+23 and 227' to rt. of E. Hwy. 401

ORIGINATED BY B.M.G.

W.P. 231-60

BORING DATE Aug. 13, 1963.

COMPILED BY B.M.G.

DATUM G.S.C.

BOREHOLE TYPE Pennsylvania Auger - 3 1/2" Ø

CHECKED BY A.G.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.				WP — WL	
											10 20 30	
586.7	Groundlevel					590						
0.6	Topsoil											
	Clayey silt-some sand and gravel. (Glacial till). V. stiff to hard. Brown changing to grey at Elev. 575.7		1	SS	43	580						
			2	SS	31							
			3	SS	26	570						
			4	SS	31							
			5	SS	29	560						
			6	SS	56							
			7	SS	33	550						
			8	SS	25							
			9	SS	35	540						
				10	SS	27						
535.2												
51.6	End of borehole.					530						

WE

Elev. 555.7

WE
Elev. 555.7

[illegible]

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 ROCS, 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>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

SS	SPLIT SPOON	TW	THINWALL OPEN
WS	WASHED SAMPLE	TP	THINWALL PISTON
SB	SCRAPER BUCKET SAMPLE	OS	OESTERBERG SAMPLE
AS	AUGER SAMPLE	FS	FOIL SAMPLE
CS	CHUNK SAMPLE	RC	ROCK CORE
ST	SLOTTED TUBE SAMPLE		
	FH	SAMPLE ADVANCED HYDRAULICALLY	
	FM	SAMPLE ADVANCED MANUALLY	

SOIL TESTS

CU	UNCONFINED COMPRESSION	L.V	LABORATORY VANE
Q	UNDRAINED TRIAXIAL	F.V	FIELD VANE
CU _o	CONSOLIDATED UNDRAINED TRIAXIAL	C	CONSOLIDATION
CD	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	SHEAR STRENGTH
c	EFFECTIVE COHESION
	INTERCEPT
ϕ'	EFFECTIVE ANGLE OF SHEARING RESISTANCE, OR FRICTION
	IN TERMS OF EFFECTIVE STRESS $\tau = c' + \sigma' \tan \phi'$
c_u	APPARENT COHESION
ϕ_u	APPARENT ANGLE OF SHEARING RESISTANCE, OR FRICTION
	IN TERMS OF TOTAL STRESS $\tau = c_u + \sigma \tan \phi$
μ	COEFFICIENT OF FRICTION
S_r	SENSITIVITY

GENERAL

π	$\pi = 3.1416$
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
σ	NORMAL STRESS
$\bar{\sigma}$	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

z	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

Mr. F. I. Hewson,
Bridge Consultant Liaison Engr.
Materials & Research Section.

May 4, 1960.

Re: W.P. 231-60,
Keele St. Interchange,
Hwy. 401 - District 6.

The requested comments on the proposed method of construction are as follows:-

1. At some time during construction, Stage 1, the sheet piles driven adjacent to the road (1/1) will be unsupported for a length of approx. 11 feet. It is possible, if this piling is not braced, that some damage may result to the road. It should be noted that a Bell Telephone cable is in the approximate location of this piling.
2. The abutments for the new structure, and the extension of the existing structure, will be supported by spread footings. If these footings are founded on original ground, there should be no problem. If fill material presently exists at the proposed abutment locations, some unpredicted settlements may result.

No other difficulties have been noted during our review of these drawings. Should any further queries arise, please contact the Foundation Section.

L. G. Soderman,
PRINCIPAL SOILS & FOUNDATIONS ENGR.
Per:

KP/MceF
Encls.

(K. Peaker,
FIELD FOUNDATION SUPERVISING ENGR.)

P.S.- Drawings returned herewith.

63-F-87

W.P. # 231-60

PROP. STRUCTURE

AT KEELE ST. &

HWY. # 401

