

*Con. 23-46-296*

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July 22, 1963

D.H.O. FOUNDATION INVESTIGATION REPORT --  
Extension of an Underpass carrying Kipling Ave.,  
over Hwy. #401, Lots 22 & 23, Conc. A 'F.R.',  
County of York - District #6  
W.J. 63-F-68 - W.P. 250-61.

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

We believe that you will find the factual data  
and recommendations contained therein, adequate for your  
future design work.

Should you require further information, please  
feel free to contact our Office.

AGS/HdeF  
Attach.

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# FOUNDATION INVESTIGATION

For

Extension of an Underpass carrying Kipling Ave.,  
over Hwy. #401, Lots 22 & 23, Conc. A 'F. R.'  
County of York -- District #6  
W.J. 63-F-68 -- W.P. 250-61.

## 1. INTRODUCTION:

A foundation investigation for the proposed extension on either side of the existing underpass carrying Kipling Ave. over Hwy. 401 was requested by the Bridge Location Engineer (verbally Mr. J. Curtis) during May 1963. Subsequently an investigation was undertaken at the site of this structure on June 28, 1963.

This report contains the field and laboratory findings together with the recommendations for the foundations of the proposed extensions.

## 2. DESCRIPTION OF SITE:

The existing underpass is a two-span concrete structure (45'-45'), founded on spread footings. It appears to be in a stable condition. Kipling Avenue is a two-lane paved road. The area on either side of Kipling Avenue and Hwy. 401 is built with residential dwellings as well as factories. Utilities, underground as well as overhead, are present in the form of

cont'd. /2 ...

2. DESCRIPTION OF SITE: (Cont'd.)...

cables or pipes. The height of the approach fills is in the order of 20'±.

Physiographically the site is situated in the area known as Peel Plain. The underlying geological material of this plain is a dense till or boulder clay containing Palaeozoic shale and limestone.

3. DESCRIPTION OF FIELD AND LABORATORY WORK:

Field work consisted of four sampled boreholes and three dynamic cone penetration tests. Two dynamic cone penetration tests were carried out adjacent to boreholes 1 and 2 and the other one inside borehole 4. Boreholes 1 and 2 were drilled off the shoulder on Kipling Avenue and boreholes 3 and 4 were drilled near the toe of the slope, below Kipling Avenue. The locations of these boreholes were chosen from a drawing provided and were staked out by the District No. 6 personnel.

The exploration programme was carried out by a Standard core drill machine adapted for soil sampling. Conventional wash boring procedures were followed. Samples were recovered at required depths, by means of a 2-inch O.D. split spoon sampler. The dimension of this spoon sampler and the energy used in driving it, conform to the requirements of the Standard Penetration Test. Samples were visually examined and identified in the field before transportation to the laboratory. Tests were carried out in the laboratory on a selection of samples for

3. DESCRIPTION OF FIELD AND LABORATORY WORK: (Cont'd.)....  
determination of Atterberg limit, moisture content and grain size distribution.

Laboratory and field test results have been summarized and are included in this report under Appendix I.

4. SUBSOIL CONDITIONS:

4.1) General:

The investigation has shown that the subsoil stratification can be considered to be uniform. Apart from a layer of fill material, only one layer of glacial till was encountered.

A detailed description is as given below:

4.2) Fill:

In boreholes 1 and 2 which were drilled from the top of the approaches, a layer of cohesive fill material was encountered, down to an approximate elevation 504.0. It contains silty clay of medium to low plasticity with some sand and traces of fine gravel. It is in a stiff state of consistency with an average value of standard penetration test 'N' of 13 blows per foot. Organic silt and root matter was encountered in borehole 1, between elevations 504.5 and 505.0. The average values of Atterberg limit are 33.2% and 18.2% respectively, and moisture content averages 20%. The color of this material is predominantly brown.

cont'd. /4 ...

4. SUBSOIL CONDITIONS: (Cont'd.)...

4.3) Glacial Till:

This layer of till material was encountered in all the boreholes. It contains a heterogeneous mixture of silty clay, sand and gravel of low to medium plasticity.

The amount of the granular material increases with increasing depth. The maximum size of the gravel is in the order of 1.5" to 2.0". The compactness of this material, is in general, very dense with the value of Standard Penetration test 'N', in excess of 50 blows/foot. Where the material can be classified as cohesive, it is very stiff to hard. The average values of Atterberg limit on the cohesive binder are 26.3% and 16.5% respectively and the moisture content is 11.6%. On the average it contains 12% gravel, 38% sand and 50% silt and clay material. The color of the material is brown changing to grey around elevation 490.0 and lower.

5. GROUNDWATER CONDITIONS:

Observation carried out during the field investigation indicate the water level to be at elevation 501.8 in borehole 1 and 491.9 in borehole 3. This water may be part of washing water, due to the low permeability of the subsoil. No attempt was made to establish an accurate groundwater level by means of piezometers.

cont'd. /5 ...

6. DISCUSSION AND RECOMMENDATIONS:

It has been proposed to extend the existing structure carrying Kipling Avenue over Hwy. 401, in order to facilitate the widening of Hwy. 401 to a maximum of twelve lanes. The present underpass is a two-span structure and allows for four lanes of Hwy. 401. Therefore, two additional spans are planned to be constructed on either side of the structure.

In the preceding paragraphs, the subsoil profile is described in detail. Considering the strength and compressibility characteristics of the glacial till layer, spread footings are feasible and recommended. A safe bearing load of up to 5 T.S.F. can be applied. Footings should be provided at least four feet below the original ground surface to provide for adequate frost protection.

As the proposed extensions are planned as separate structures from the original one, no differential settlements are anticipated. No groundwater problems are expected to be encountered. Underground utility cables and pipes should be taken care of before removing approach fills and starting construction work.

No slope stability problems are anticipated with the standard 2:1 slopes. All organic material should however be removed before placing the new fill.

7. CONCLUSIONS:

Subsoil conditions investigated at the site are uniform

cont'd. /6 ...

7. CONCLUSIONS: (Cont'd.)...

and found to contain a layer of very dense glacial till below cohesive fill material.

Exact ground water level could not be measured due to the low permeability of the subsoil.

Spread footings are recommended. A safe load of up to 5 T.S.F. can be applied. No settlement problems are anticipated.

No stability problems are expected to be encountered.

8. MISCELLANEOUS:

The field work was undertaken during the period from June 28, 1963 to July 5, 1963 by Mr. B. Ghadiali who also prepared this report, under the general supervision of Mr. K. G. Selby.

Equipment was owned and operated by Canadian Longyear Drilling Co. of Toronto.

July 1963.

APPENDIX I.

DEPARTMENT OF HIGHWAYS - ONTARIO  
MATERIALS & RESEARCH DIVISION

## RECORD OF BOREHOLE NO. 1

FOUNDATION SECTION

JOB 63-F-68 LOCATION Sta. 79+04 Hwy. 401 221' Rt. 2 ORIGINATED BY B.M.G.  
W.P. 250-61 BORING DATE June 28, 1963. COMPILED BY B.M.G.  
DATUM Geodetic BOREHOLE TYPE Washboring using BX casing. CHECKED BY K.G.S.

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	STRAT. PLOT	NUMBER	TYPE	BLOWS / FOOT		BLOWS / FOOT	20	40	60	80	100	WP	WL		
515.8	Groundlevel															
514.5	Granular road fill					515										
1.6	Silty clay-clayey silt-some sand and fine gravel. (Organics around El. 505.0)  (Fill Material) Stiff Brown		1	SS	14	510										
503.8			2	SS	13	505										
12.0	Clayey silt-sand and gravel. (Glacial till). V. dense. Brown and grey.		3	SS	48	500										
			4	SS	>100	495										
			5	SS	>100	490										
485			6	SS	>100	485										
30.9	End of borehole.															

W.L. at  
El. 501.8



DEPARTMENT OF HIGHWAYS - ONTARIO  
MATERIALS & RESEARCH DIVISION

## RECORD OF BOREHOLE NO. 3

FOUNDATION SECTION

JOB 63-F-68 LOCATION Sta. 8340 Hwy. 401 185' Lt. E ORIGINATED BY B.M.G.  
W.P. 250-61 BORING DATE July 3, 1963. COMPILED BY B.M.G.  
DATUM Geodetic BOREHOLE TYPE Washboring using BX casing. CHECKED BY K.G.S.

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE			LIQUID LIMIT ——— WL			BULK DENSITY	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLT	NUMBER	TYPE	BLOWS / FOOT		BLOWS / FOOT	SHEAR STRENGTH P.S.F.			PLASTIC LIMIT ——— WP	WATER CONTENT ——— W		
											WP	W	WL	
											WATER CONTENT %			
											15	30	45	
497.5	Groundlevel					500								
	Topsoil													
0.9						495								
	Clayey silt-some sand and gravel.		1	SS	25									
	(Glacial till).													
	Compact to v. dense.		2	SS	64	490								
	Brown and grey.		3	SS	81									
						485								
			4	SS	>100									
						480								
477.0			5	SS	60									
20.6	End of borehole.													

W.L. at  
El. 491.9



## 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

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

$\gamma$	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
$\log_e a$ 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
$\sigma'$	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
$\rho$	ANGLE OF SLOPE TO HORIZONTAL

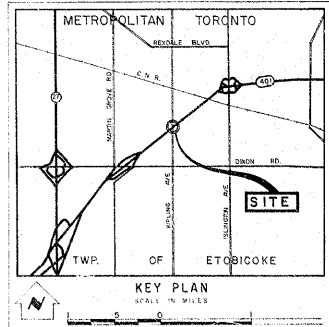
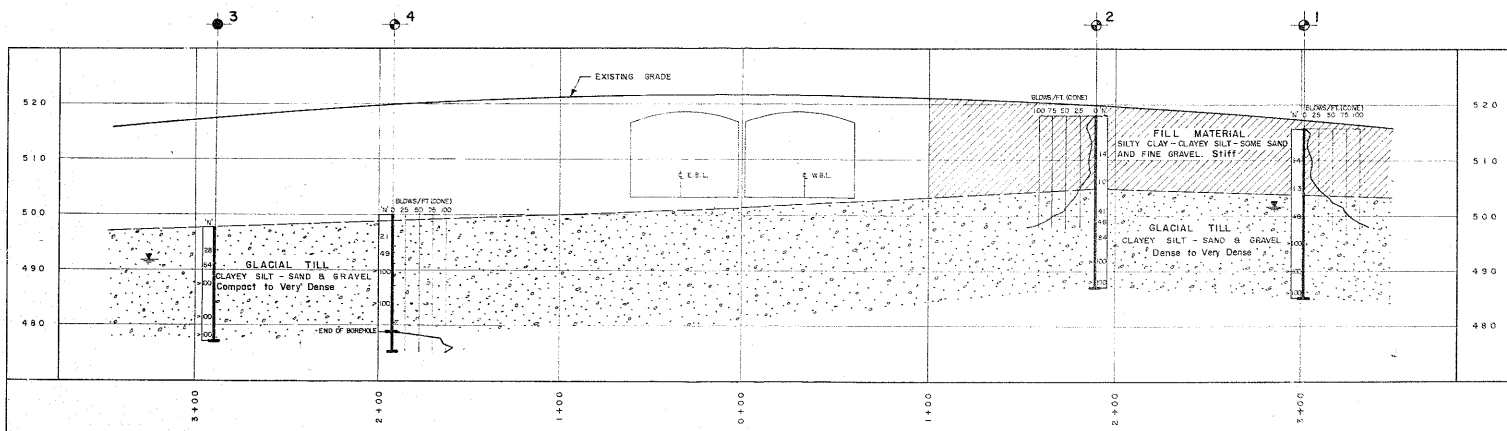
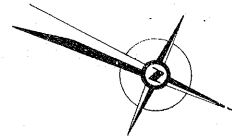
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W.P.#250-61

HWY.#401, KIPLING

AVE., UNDERPASS

LOTS #22 & 23



LEGEND			
	Flow Hole		
	Cone Penetration Hole		
	Rore B Cone Penetration Hole		
	Water Levels established at time of field investigation. (July 1963)		

NO.	ELEVATION	STATION	OFFSET
1	518.8	79+04	2.21' RT
2	518.0	80+09	1.63' RT
3	497.5	83+40	1.05' LT
4	500.0	81+82	1.89' 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 and may be subject to considerable error.

<b>REVISIONS</b>	<b>DATE</b>	<b>BY</b>	<b>DESCRIPTION</b>

DEPARTMENT OF HIGHWAYS - ONTARIO MATERIALS & RESEARCH DIVISION - FOUNDATION SECTION			
<h1>                     KIPLING AVENUE                 </h1>			
KING'S HIGHWAY NO. 401		DIST. NO. 6	
CO.		METROPOLITAN TORONTO	
TWP. ETOBICOKE		LOT CON.	
<h2>                     BORE HOLE LOCATIONS &amp; SOIL STRATA                 </h2>			
SURVEY D. G. CHRYAN D. G.	CHECKED (Signature)	REF. NO. 250-61 JOB NO. 63-F-68	DRAWING NO. <h1>                     63 - F - 68A                 </h1>
DATE 17 July 1968	SHEET NO.	BRIDGE DRAWING NO.	
APPROVED <i>(Signature)</i> (PRINT NO)			

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