

MEMORANDUM

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

From: Foundation Section,
Materials & Testing Div.,
Room 107, Lab. Bldg.

Attention: Mr. S. McCombie

DATE: August 21, 1964

Our File Ref.

IN REPLY TO

SUBJECT:

FOUNDATION INVESTIGATION REPORT

For

Proposed New Structure at Q.E.W.
and Lincoln Co. Rd. No. 22, Twp.
of Louth, District No. 4, Hamilton

W.J. 64-F-70 -- W.P. 110-60

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 additional information be required, please do not hesitate to contact our Office.

AGS/MdeF
Attach.

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

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

Foundations Office
Gen. Files

TABLE OF CONTENTS

1. INTRODUCTION.
 2. SUBSOIL CONDITIONS.
 3. GROUND WATER CONDITIONS.
 4. RECOMMENDATIONS.
 5. MISCELLANEOUS.
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FOUNDATION INVESTIGATION REPORT

For

Proposed New Structure at Q.E.W.
and Lincoln Co. Rd. No. 22, Twp.
of Louth, District No. 4, Hamilton.

W.J. 64-F-70 -- W.P. 110-60

1. INTRODUCTION:

It has been decided to overpass Q.E.W. and new North-South service roads by constructing two new structures at the existing Lincoln Co. Rd. No. 22 crossing.

This proposal supersedes the earlier proposals where the crossing was indicated at a relocated Co. Rd. No. 22 line and Q.E.W. (See W.J. 60-F-62, and W.J. 63-F-116). Accordingly, additional subsoil investigations were carried out by driving four boreholes at the proposed location of the new structures.

2. SUBSOIL CONDITIONS:

The subsoil was found to be quite uniform throughout the entire area. The upper layer, of about 15 ft. thickness, is heterogeneous material made up of mainly clayey silt with traces of sand and gravel. The upper 8.5 ft. is brown, desiccated by oxidation while below that, it has retained its initial grey colour. The layer is stiff to very hard, having a range of 'N' values from 12 to over 100 blows per foot.

3. GROUND WATER CONDITIONS:

The ground water was encountered in borehole No. 1, only. It was first detected at about 8.5 ft. during boring and at the

cont'd. /2 ...

3. GROUND WATER CONDITIONS: (cont'd.) ...

completion of the borehole, it was measured at about 3 ft. below the ground level. No water was encountered in the other three boreholes during the drilling period.

4. RECOMMENDATIONS:

Because of the uniformity of the subsoil and its high bearing values, the use of spread footings to support the structures, seems to be technically and economically the best solution. An estimated 3 T.S.F. safe bearing value can be used.

No approach fill embankment stability problems are anticipated with the use of 2:1 standard slopes.

No dewatering problems are anticipated as the nature of the subsoil is relatively impermeable.

5. MISCELLANEOUS:

The field investigation was carried out during July 23 to July 24, 1964, under the supervision of Mr. V. Korlu, Project Foundation Engineer, who also wrote this report. The report was reviewed by Mr. M. Devata, Senior Foundation Engineer.

The drilling was carried out by means of a Penn. drill provided by Dominion Soil Investigation Limited of Toronto.

August 1964

APPENDIX I.

FOUNDATION SECTION

ORIGINATED BY V.K.

COMPILED BY V.K.

CHECKED BY M.D.

SOIL PROFILE			SAMPLES			ELEV SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT	LIQUID LIMIT ——— WL		BULK DENSITY	REMARKS
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FOOT		20 40 60 80 100	PLASTIC LIMIT ——— WP	WATER CONTENT ——— W		
							SHEAR STRENGTH P.S.F.	WP ——— W ——— WL			
								WATER CONTENT %			
276.0	Groundlevel										
0.0	<u>Brown</u>										
u.L.											
3.0											
	Clayey silt with		1	SS	25	270					
267.5											
8.5	<u>Grey</u> sand and gravel.		2	SS	12						
	(Glacial till)		3	SS	39						
	(Stiff to Hard)		4	SS	100 for 260						
256.5											
			5	SS	150 for 6"						
19.5	End of borehole.										
						250					

FOUNDATION SECTION

ORIGINATED BY V.K.

COMPILED BY V.K.

CHECKED BY M.D.

SOIL PROFILE			SAMPLES		DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT	LQUID LIMIT ——— WL	PLASTIC LIMIT ——— WP	WATER CONTENT —— W	BULK DENSITY	REMARKS	
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS /FOOT	ELEV SCALE					
							20	40	60	80	100
							SHEAR STRENGTH P.S.F.				
							WP W WL				
							WATER CONTENT %				
							P.C.F.				
276.0	Groundlevel										
0.0	Brown Clayey silt with		1	SS	24	270					
267.5			2	SS	55						
8.5	Grey sand and gravel (Glacial till)		3	SS	21						
	(Stiff to very hard)		4	SS	25						
256.5			5	SS	151for 9"	260					
19.5	End of borehole.		6		100for 6"						
						250					

JOB 64-F-70

LOCATION County Rd. No. 22 & J.E.W., Vineland.

ORIGINATED BY V.K.

W P 110-60

BORING DATE July 24, 1964.

COMPILED BY V.K.

DATUM Geodetic

BOREHOLE TYPE Penn. Drill

CHECKED BY M.D.

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 W WL				
								WATER CONTENT %								
276.0	Groundlevel															
0.0	Brown															
	clayey silt		1	SS	43											
	with		2	SS	64	270										
267.5			3	SS	17											
8.5	Grey sand and gravel		4	SS	32											
	(Glacial till)		5	SS	100	for 260										
	(Stiff to very hard)		6	SS	100	for										
256.5					5"											
19.5	End of borehole.				4"											
						250										

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & RESEARCH DIVISION

RECORD OF BOREHOLE NO. 4

FOUNDATION SECTION

JOB 64-F-70 LOCATION County Rd. No. 22 & Q.E.W., Vineland. ORIGINATED BY V.K.
W.P. 110-60 BORING DATE July 24, 1964. COMPILED BY V.K.
DATUM Geodetic BOREHOLE TYPE Penn Drill CHECKED BY M.D.

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. PLT	NUMBER	TYPE		SHEAR STRENGTH P.S.F.	W P ——— W ——— WL WATER CONTENT %		
276.0	Groundlevel								
0.0	<u>Brown</u> Clayey silt with		1	SS	14				
267.5			2	SS	40				
8.5	<u>Grey</u> sand and gravel. (Glacial till) (Stiff to very hard).		3	SS	32				
			4	SS	15				
			5	SS	14				
250.5			6	SS	100				
19.5	End of borehole.		for 5"						

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.	AUSER 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 INTERCEPT
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-70

Mr. W. S. Melinyshyn,
Regional Bridge Location Engr.,
Bridge Division.

Foundation Section,
Materials & Testing Div.,
Room 107, Lab. Bldg.

July 13, 1964

Your Memo - July 6/64

County Road #22 Underpass,
Hwy. Q.E.W. and Q.E.W. South Service Rd.
W.P. 110-60-1, W.P. 110-60-2,
District #4.

In reply to your request contained in your memo of July 6, 1964, and concerning the above-mentioned structure, we have reviewed our reports W.J. 60-F-62 and W.J. 63-F-116 and submit herewith, our comments for your consideration:

The subsoil in the area is generally dense glacial till. We feel that it is reasonable to assume that the subsoil at the new bridge location, which is some 200 feet west of the investigated site, is comparable in composition and properties. Therefore, the same recommendations should apply.

However, we would suggest that we carry out a check at the earliest time when our crew will be in the area. The check will consist of a number of shallow holes which should confirm the presence of the dense till layer.

AGS/MdeF

cc: Foundations Office ✓
Gen. Files

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

MEMORANDUM

To: Mr. A. Stermac,
Principal Foundation Engineer,
Room 107, Lab. Bldg.

FROM: Bridge Division,
Downsview, Ontario.

DATE: July 6, 1964.

OUR FILE REF.

IN REPLY TO

SUBJECT: County Road #22 Underpass
Hwy. Q.E.W. and Q.E.W. South Service Rd.
W.P. 110-60-1, W.P. 110-60-2
District #4

Enclosed please find a print showing the interchange and structures involved at the above site. Due to a redesigned intersection, (not shown) these three bridge locations are superseded and the footings for the two proposed structures are shown in red.

Would you be kind enough to advise us if a new foundation investigation will be required in view of the proximity of the new locations. If not required, would your recommendations as outlined in the original reports W.J. 60-F-62 and W.J. 63-F-116 be satisfactory for the design of the new structure?

If, however, it is felt that an additional investigation is necessary, please advise us, and as site plans become available a foundation investigation request will be made.



WSM/es

W. S. Melinyshyn,
Regional Bridge Location Engineer.

cc. R. Fitzgibbon

3506

MEMORANDUM

To: Mr. A. Stermac,
Principal Foundation Engineer,
Room 107, Lab. Bldg.

FROM: Bridge Division,
Downsview, Ontario

DATE: November 30, 1964.

OUR FILE REF.

IN REPLY TO

SUBJECT: County Rd. No. 22 Underpasses
Hwy. QEW - W.P. 110-60-1
Hwy. QEW S. Service Rd. - W.P. 110-60-2
District 4

Enclosed please find prints of the Preliminary
Plans D-5546-1 and D-5547-1 for the proposed structures.

Would you please inform us if you have any com-
ments or let us have your approval if the plans are
satisfactory.

WSM/sp

W. S. Melinyshyn
W. S. Melinyshyn,
Regional Bridge Location Engineer.

Mr. S. McCombie,
Bridge Planning Engr.,
Bridge Division.

Foundation Section,
Materials & Testing Div.,
Lab. Bldg.

Attn: Mr. W. S. Melinyshyn
Regional Bridge Location Engr.

December 7, 1964.

County Road No. 22 Underpasses -
Hwy. Q.E.W. -- W.P. 110-60-1;
Hwy. Q.E.W., South Service Rd. -- W.P. 110-60-2.
District No. 4, Hamilton, Ont.

We have reviewed the preliminary drawings for the above-mentioned projects and submit the following comments:

County Rd. No. 22 and Hwy. Q.E.W. South Service Rd. Crossing --
W.P. 110-60-2:

The preliminary drawing indicates piled foundations for the abutments. The original ground surface is only 1 to 4 ft. below the abutment footings and the subsoil at this location generally consists of hard clayey silt with sand and gravel (glacial till). In view of this, it is our recommendation that the proposed abutments should be supported on spread footings placed within the approach fill. The fill material below the footings should consist of well compacted G.B.C. Class 'A' material and should extend for a horizontal distance of at least 10 ft. from the footing edges in the plane of the footing. This portion of the fill should be built with side slopes 2:1. The remainder of the fill should be completed to about profile grade for a distance of about 50 ft. behind the abutments before re-excavating for the abutment footings. A design load of 2 t.s.f. may be used for the abutment foundations.

County Rd. No. 22 and Q.E.W. -- W.P. 110-60-1:

The abutments may be constructed as outlined above. We have no other comments pertaining to the main structure foundations.

MD/MdeF

cc: Foundations Office. ✓
Gen. Files.

M. Devata
for A. G. Sternac,
PRINCIPAL FOUNDATION ENGINEER

Bridge Office etc
Attn: Mr. W.S. Mel'ingshyn
Regional Bridge Location Engineer.

Sub - County Rd No 22 Underpasses

Hwy G.E.W. W.P. 110-60-1

Hwy G.E.W. South Service Rd W.P. 110-60-2

Dist # 4

We have reviewed the Preliminary drawings for the above mentioned projects and submit the following comments:

County Rd #22 and Hwy G.E.W. South Service Rd crossing W.P. 110-60-2

The Preliminary drawing indicates pier foundation for the abutments.

The original ground surface is only 1 to 4 ft below the abutment footings and the subsoil at this location generally consists of hard clayey silt with sand and gravel (glacial till). In view of this it is our recommendation that the broabard abutments should be supported on spread footings placed within the approach fill. The fill material below ~~the top of~~ the footings should

consist of well compacted G.B.C. class A material and should extend for a horizontal distance of at least 10 ft from the footing edges in the plane of the footing ~~base~~. This portion of the fill should be built with side slopes 2:1. The remainder of the fill should be completed to above bridge grade for a distance of about 50 ft behind the abutments before excavating for the abutment footings. A design load of 2.5 ft may be used for the abutment foundations.

County Rd # 22 @ G.E.W. WP 110-60-1

The abutments may be constructed as outlined above. We have no other comments pertaining to the main structure foundations.

A. J. [Signature]

#64-F-70

W.P. #110-60

W.P. #110-60-1

W.P. #110-60-2

Q.E.W. & LINCOLN

CTY. RD. #22

