

DEPARTMENT OF HIGHWAYS ONTARIO

MEMORANDUM

To: Mr. B. R. Davis,  
Bridge Engineer,  
Bridge Division.

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

Attention: Mr. S. McCombie

DATE: July 11, 1966.

OUR FILE REF.

IN REPLY TO

AUG 24 1966

SUBJECT:

FOUNDATION INVESTIGATION REPORT

For

Proposed C.N.R. Overhead at  
Fifty Rd., Township of Saltfleet,  
District #4 (Hamilton)  
W.J. 66-F-71 -- W.P. 217-63-2

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

We believe that the factual data and recommendations contained therein, will be adequate for your design requirements. Should additional information be required, please feel free to contact our Office.

AGS/tt

Attach.

cc: Messrs. B. R. Davis (2)  
H. A. Tregaskes  
D. W. Farren  
G. K. Hunter (2)  
H. Greenland  
W. S. Melinyshyn  
T. J. Kovich  
A. Watt

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

Foundations Office ✓  
Gen. Files

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# FOUNDATION INVESTIGATION REPORT

For

Proposed C.N.R. Overhead at  
Fifty Road, Township of Saltfleet,  
District #4 -- (Hamilton)

W.J.66-F-71 -- W.P. 217-63-2

## 1. INTRODUCTION:

A request to carry out a foundation investigation for the proposed structure at the crossing of the C.N.R. and Fifty Road was received from the Bridge Location section (memorandum from Mr. W. Melinyshyn, dated July 13, 1966). Subsequently, an investigation consisting of four sampled boreholes and five dynamic cone penetration tests, was carried out by the Foundation Section.

Presented in this report are the results of this investigation, together with our recommendations for the foundation design of the proposed structure and approaches.

The site is a portion of the Niagara Fruit Belt, lying between Niagara Escarpment and Lake Ontario, in the Township of Saltfleet. During the Pleistocene period the site was inundated by Lake Iroquois which carved the present relatively flat topography from the underlying shale bedrock.

## 2. SUBSOIL CONDITIONS:

Subsoil at the site consists of a shallow surface deposit of topsoil followed by shale bedrock. The contact with bedrock was established between elev. 286.5 and elev. 284.3. The upper 4 to 6 ft. has been subjected to extensive weathering. Sound bedrock was proved by drilling from 5 to 8.8 ft. of core in the boreholes. The boundaries between the weathered and the sound zone of the bedrock are given in the appended borelog sheets.

3. GROUNDWATER:

During the time of investigation, groundwater observations were carried out in the boreholes. These indicate that the groundwater level varies between elev. 279 and elev. 283 in the boreholes. The exact water levels are shown on the borelog sheets attached to this report.

4. DISCUSSION & RECOMMENDATIONS:

A three-span overhead structure (42'-70'-42') is proposed at the crossing of the Canadian National Railway and Fifty Road in the Township of Saltfleet.

Subsoil at the site consists of 0.5 to 2 ft. of topsoil followed by shale bedrock. The upper 4 to 6 ft. of shale bedrock has been subjected to extensive weathering.

It is recommended that the proposed structure be founded on sound shale bedrock with a safe bearing pressure of 10 t.s.f. If perched abutments are contemplated, they may be constructed within the approach fills and supported on end bearing piles driven to practical refusal to sound shale bedrock. Design loads to be used are dependent on the pile section selected and may be 80 tons per pile in the case of 12 BP 74 steel 'H' piles. Care should be taken to ensure that no bouldery fill is placed at locations through which piles have to be driven.

No major dewatering problems are anticipated during construction of footings.

cont'd. /3 ...

4. DISCUSSION & RECOMMENDATIONS: (cont'd.) ...

The proposed approach fills will be in the order of 30 ft. above the existing ground surface. No stability problems are anticipated for the standard 2:1 slopes.

5. MISCELLANEOUS:

The field work, performed during the period August 2 to 4, 1966, together with the preparation of this report, was undertaken by Mr. L. Palmer, Project Foundation Engineer. The investigation was carried out under the general supervision of Mr. M. Devata, Supervising Foundation Engineer, who reviewed this report.

Equipment used was owned and operated by Canadian Longyear Co. Ltd.

August 1966

APPENDIX I.

DEPARTMENT OF HIGHWAYS - ONTARIO

MATERIALS & TESTING DIVISION

# RECORD OF BOREHOLE NO. 1

FOUNDATION SECTION

JOB 66-F-71 LOCATION Fifty Road & C.N.R.; Sta. 44+49, 0/S 34' Lt. ORIGINATED BY L.P.  
W.P. 217-63-2 BORING DATE Aug. 2, 1966 COMPILED BY W.T.E.  
DATUM Geodetic BOREHOLE TYPE BX Casing; Dynamic Penetration CHECKED BY M.D.

SOIL PROFILE			SAMPLES			DYNAMIC PENETRATION RESISTANCE					LIQUID LIMIT — WL PLASTIC LIMIT — WP WATER CONTENT — W		BULK DENSITY γ <sub>c</sub> C.C.F.	REMARKS
ELEV DEPTH	DESCRIPTION	STRAT. PLT	NUMBER	TYPE	BLOWS / FOOT	ELEV SCALE	20	40	60	80	100	Wp — W — WL WATER CONTENT %		
285.5	Groundlevel													
0.0 284.3	Topsoil													
1.2	Bedrock (Red & Grey Shale)													
			1	SS	74									
	(Extensively weathered)		2	SS	32/5"	280								
278.5														
7.0	(Sound)		3	RC	BXL 78% Rec									
			4	RC	BXL 96% Rec									
269.7						270								
15.8	End of borehole.													

El. 278.9  
▼ W.L.

DEPARTMENT OF HIGHWAYS - ONTARIO

MATERIALS & TESTING DIVISION

# RECORD OF BOREHOLE NO. 2

FOUNDATION SECTION

JOB 66-F-71 LOCATION Fifty Rd. & C.N.R.; Sta. 46/17, O/S 25.5' Rt. ORIGINATED BY L.F.  
W.P. 217-63-2 BORING DATE Aug. 3/66 COMPILED BY W.T.E.  
DATUM Geodetic BOREHOLE TYPE BX Casing, Dynamic Penetration CHECKED BY M.D.

SOIL PROFILE		SAMPLES			ELEV SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT					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		20	40	60	80	100	W <sub>P</sub>	W	W <sub>L</sub>		
287.0	Groundlevel														
0.0	Topsoil														
0.5	Bedrock														
	(Red Shale)		1	SS	20										
			2	SS	79										
282.0	(Weathered)														
5.0	(Sound)		3	RC	BXL 70% REC										
277.2															
9.8	End of borehole.														

110/9"

El. 279.3  
▼ W.L.



DEPARTMENT OF HIGHWAYS - ONTARIO

MATERIALS & TESTING DIVISION

# RECORD OF BOREHOLE NO. 3

FOUNDATION SECTION

JOB 66-F-71 LOCATION Fifty Rd. & C.N.R.; Sta. 45+73, O/S 38.5' Lt. ORIGINATED BY L.P.  
W.P. 217-63-2 BORING DATE Aug. 3, 1966 COMPILED BY W.T.E.  
DATUM Geodetic BOREHOLE TYPE BX Casing, Dynamic Penetration CHECKED BY M.D.

SOIL PROFILE		SAMPLES			ELEV SCALE	DYNAMIC PENETRATION RESISTANCE					LIQUID LIMIT ——— WL PLASTIC LIMIT ——— WP		BULK DENSITY P.C.F.	REMARKS
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE		BLOWS / FOOT	20	40	60	80	100	WATER CONTENT ——— W		
287.0	Groundlevel													
0.0	Topsoil													
284.7														
2.3	Bedrock (Red Shale)		1	SS	25									
			2	SS	53									
281.0	(Weathered)		3	SS	50/3"									
6.0	(Sound)													
			4	HC	91% Rec									
275.9														
11.1	End of Borehole.													

El. 283.4  
W.L.

65/6"

270

DEPARTMENT OF HIGHWAYS - ONTARIO

## MATERIALS &amp; TESTING DIVISION

## RECORD OF BOREHOLE NO. 4

FOUNDATION SECTION

JOB 66-F-71 LOCATION Fifty Rd. & C.N.R.; Sta. 44+94.5, O/S 43.5' Rt. ORIGINATED BY L.P.  
W P 217-63-2 BORING DATE Aug. 4, 1966 COMPILED BY W.T.E.  
DATUM Geodetic BOREHOLE TYPE BX Casing, Dynamic Penetration. 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		
							SHEAR STRENGTH P.S.F.	WATER CONTENT ——— w		
								wp ——— w ——— WL		
								WATER CONTENT %		
286.5	Groundlevel									
0.0	Topsoil	{ }							P.C.F.	
284.5		{ }								
2.0		{ }								
	Bedrock	{ } { } { }	1	SS	44					
	(Red & Grey Shale)	{ } { } { }	2	SS	94					
280.5	(Weathered)	{ } { } { }	3	RC	BXL 73% Rec	280				
6.0	(Sound)	{ } { } { }	4	RC	BXL 45% Rec					
		{ } { } { }	4	RC	BXL 91% Rec					
272.3										
14.2	End of borehole.					270				

CHECKED BY \_\_\_\_\_ M.D.

FOUNDATION SECTION

SOIL PROFILE			SAMPLES			ELEV SCALE	DYNAMIC PENETRATION RESISTANCE	LIQUID LIMIT ——— w <sub>L</sub>		BULK DENSITY	REMARKS
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FOOT		BLOWS / FOOT	PLASTIC LIMIT ——— w <sub>p</sub>	WATER CONTENT ——— w		
284.0	Groundlevel						SHEAR STRENGTH P.S.F.	WATER CONTENT % w <sub>p</sub> ——— w ——— w <sub>L</sub>		P.C.F.	
0.0											
280.0						280					
4.0	End of Penetration										
						270					
						260					

## 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
$\bar{\sigma}$	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
$K_0$	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
$\beta$	ANGLE OF SLOPE TO HORIZONTAL

Department of Highways Ontario

Copy for the information of

Mr. A. Stermac, Principal Foundation Engineer,  
Room 107, Lab. Building

Mr. W. Melinyshyn,  
Regional Bridge Location Engineer,  
Central Region,  
Administration Building

Bridge Division,  
Downsview, Ontario

March 1, 1967

C.N.R. Overhead on Fifty Road  
31.67 Mile Grimsby Subdivision  
W.P. 217-63-2, Site 36-217  
District No. 4

Attached herewith are prints of the Preliminary Bridge  
Plan Drawing D-6050-P1 for the above-mentioned structure.

The estimated cost of the proposed structure is \$86,400.  
This cost includes tender, materials, engineering and sundry  
construction.

Any comments or revisions you may have should be submitted  
within three weeks.

CSG:rd

C.S. Grebski,  
Bridge Design Engineer

Attach.

c.c. S. McCombie  
A. Stermac  
E. Cross  
R. Forrest

*ago*

Mr. C. S. Grebski,  
Bridge Design Engineer,  
Bridge Division,  
Admin. Bldg.

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

March 13, 1967

C.N.R. Overhead on Fifty Road,  
31.67 Miles - Grimsby Subdivision,  
W.P. 217-63-2, Site 36-217, W.J. 66-F-71,  
District #4 (Hamilton).

We have reviewed the Preliminary Bridge Plan  
Drawing D-6050-P1 for the above mentioned structure and  
submit the following comments:

The pier footings are located within the  
weathered shale. In such a case, a safe design load of  
5 t.s.f. should be used for design purposes instead of  
10 t.s.f. as indicated in the foundation report, for  
footings founded on sound shale bedrock.

AD/adeP

cc: Messrs. S. McCombie  
W. S. Melnyshyn

Foundations Files ✓  
Gen. Files

*J. Devata*  
J. Devata,  
SUPERVISING FOUNDATION ENGR.  
For:  
A. G. Sternac,  
PRINCIPAL FOUNDATION ENGR.

Hwy. 401 & Keele St.,  
Downsview, Ontario.

Tel. 248-3232

(Area Code 416)

Materials and Testing Division

July 25, 1967

Mr. J. W. Disher, P. Eng.,  
Manager, Highways Dept.,  
C. C. Parker and Associates Limited,  
Consulting Professional Engineers,  
688 Queensdale Ave. E.,  
Hamilton, Ontario.

Attention: Mr. J. T. Davis, Project Supervisor

Dear Sir:

Re: Fifty Road and C.N.R. Crossing - W.P. 217-63-2 ✓  
- W.J. 66-F-71  
Fruitland Road and C.N.R. Crossing - W.P. 209-63-2  
- W.J. 66-F-58

We have reviewed these reports, as requested in our recent telephone conversation, and wish to make the following comments as applied to proposed subway construction at the above sites.

1) Cuts should be constructed with 2:1 side slopes, both in the subsoil and in the shale bedrock.

2) Some water might be encountered in the weathered zone of the shale bedrock. A sump system will be necessary at both sites to accommodate surface runoff as well as intercepted groundwater.

3) Footings may be founded on sound shale where a safe load of 10 t.s.f. may be applied.

We trust that all your queries are answered above but, if not, please do not hesitate to call us.

Yours very truly,

*L. Palmer*

L. Palmer,  
PROJECT FOUNDATION ENGR.

For:

A. G. Stermac,  
PRINCIPAL FOUNDATION ENGR.

12/10/67

cc: Foundations Files (2)  
Gen. Files





C. C. PARKER AND ASSOCIATES LIMITED  
CONSULTING PROFESSIONAL ENGINEERS  
688 QUEENSDALE AVE. E., HAMILTON

July 21, 1967

Mr. M. Devata,  
Supervising Foundation Engineer,  
Foundation Section,  
Materials and Testing Division,  
Lab Building,  
Department of Highway, Ontario,  
Keele Street & Highway 401,  
Downsview, Ontario.

Attention: Mr. L. Palmer

Dear Sir:

Re: W.P. 209-63-2 and W.P. 217-63-2;  
Fruitland and Fifty Roads at the C.N.R.

I refer to our recent telephone conversation, regarding the Foundation Reports for the above-mentioned projects.

Would you please, as agreed, investigate the feasibility of subway construction and approaches for these railway grade separations.


The original planning had been to construct overheads, however recently we have been asked to do a feasibility study as to the possibility of constructing subways in order to reduce the excessive embankment requirements in the area.

Anything you might do to expedite this matter would be appreciated.

Yours truly,

C.C. PARKER AND ASSOCIATES LIMITED

JTD/hh

  
J. T. Davis, Project Supervisor  
For;  
J. W. Disher, P. Eng.,  
Manager, Highways, Dept.



# 66-F-71

W.P. # 217-63-2

FIFTY RD. &

C.N.R.

OVERHEAD



