

#66-F-101

W.P. # 165-66

Hwy. # 41

CROSSING

BON ECHO

PROVINCIAL

PARK RD.

MEMORANDUM

To: Mr. B. R. Davis,
Bridge Engineer,
Bridge Division.
Attention: Mr. S. McCombie

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

DATE: December 7, 1966

IN REPLY TO:

DEC 21 1966

OUR FILE REF.

SUBJECT:

FOUNDATION INVESTIGATION REPORT

For

Prop. Crossing at Bon Echo Provincial
Park Road and King's Hwy. #41, Prop.
Rev'n. Line 'H', Twp. of Barrie, Co.
of Frontenac, District #10 (Bancroft).
W.J. 66-F-101 -- W.P. 165-66

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
design requirements. Should you require additional
information, please feel free to contact our Office.

AGS/MdeF
Attach.

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

cc: Messrs. B. R. Davis (2)
H. A. Tregaskes
D. W. Farren
S. J. Markiewicz
J. E. Callaghah
G. Scott
J. E. Gruspier
A. Watt

Foundations Office
Gen. Files ✓

TABLE OF CONTENTS

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

For

Prop. Crossing at Bon Echo Provincial
Park Road and King's Hwy. #41, Prop.
Rev'n. Line 'H', Twp. of Barrie, Co.
of Frontenac, District #10 (Bancroft).

W.J. 66-F-101 -- W.P. 165-66

1. INTRODUCTION:

A foundation investigation for the proposed crossing at Bon Echo Provincial Park and King's Hwy. #41, proposed Rev'n. Line 'H', was requested by Mr. G. Scott, Regional Bridge Location Engineer, in a memorandum dated October 19, 1966.

Following this request, a field investigation was carried out by the Foundation Section during the period November 25 to December 2, 1966.

Two boreholes were drilled to determine the subsoil conditions existing at the proposed bridge site. The locations and elevations of the borings are shown on Dwg. 66-F-101A, which forms part of this report.

2. SURSOIL CONDITIONS:

The subsoil conditions at the site were found to be uniform. The material encountered in the boreholes was found to consist of almost all ranges in grain size, from enormous boulders to silt, and to extend from ground level to the depth of exploration. The deposit may be described as gravelly sand with some silt and also frequent boulder concentrations. Boulders, recovered during the boring operation, were found to vary from 1 inch to 5 ft. in diameter. Due to the bouldery nature of the material, it was rather difficult to carry out a more detailed form of sampling, with the exception of a few standard penetration tests.

cont'd. /2 ...

2. SUBSOIL CONDITIONS: (cont'd.) ...

'N' values varied from 24 to 76 blows per foot, indicating a compact to very dense relative density. The moisture content, as determined in the laboratory, ranges from 8% to 13%.

3. RECOMMENDATIONS:

It is proposed to construct a single-span overpass at the crossing of Bon Echo Park Road and the new Hwy. #41. The height of the proposed approach fill is in the order of 20 ft.

The subsoil at the site was found to be suitable for spread footing type foundations. A safe pressure of 3.0 t.s.f. may be assumed for design purposes. The depth to the footings should be such that the backfill would provide sufficient frost protection.

The groundwater level was found to be at ground level. Due to the granular nature of the subsoil and the position of the groundwater, dewatering problems are anticipated. The presence of boulders and rock fragments, however, would not permit the driving of sheet piles.

No stability problems are anticipated for the proposed fill, provided 2:1 slopes are constructed.

The topsoil stripping should be in accordance with D.H.O. Standards.

4. MISCELLANEOUS:

Equipment used for the field investigation was owned by Wimpey Construction Co. Ltd. Supervision of the field work and the preparation of this report was undertaken by Mr. P. Payer, Project Foundation Engineer. The report was reviewed by Mr. K. G. Selby, Supervising Foundation Engineer.

December 1966

APPENDIX I

DEPARTMENT OF HIGHWAYS - ONTARIO

RECORD OF BOREHOLE NO. 1

FOUNDATION SECTION

MATERIALS & TESTING DIVISION

JOB 66-F-101

LOCATION Sta. 335 / 40: 19' Rt.

ORIGINATED BY P.P.

W. P. 165-66

BORING DATE November 28, 29 & 30, 1966

COMPILED BY P.P.

DATUM Geodetic

BOREHOLE TYPE

CHECKED BY

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. PLOT	NUMBER	TYPE	BLOWS / FOOT		SHEAR STRENGTH P.S.F.	WP		WL		
931.8	GROUND LEVEL											
0.0	Gravelly sand with some silt					930						
	Frequent Boulder concentrations		1	SS	76							
			2	SS	50/3"							
			3	SS	24							
	Compact to very dense.					920						
			4	SS	64/9"							
			5	SS	42/2"	910						
			6	SS	17/1"							
905.0												
26.8	End of Borehole					905						

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & TESTING DIVISION

RECORD OF BOREHOLE NO. 2

FOUNDATION SECTION

JOB 66-F-101 LOCATION Sta. 335 467; 21' Lt. ORIGINATED BY P.P.
W.P. 165-66 BORING DATE November 30 & December 1, 1966 COMPILED BY P.P.
DATUM Geodetic BOREHOLE TYPE _____ CHECKED BY AK

SOIL PROFILE			SAMPLES			DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT	Liquid Limit ——— w _L Plastic Limit ——— w _P Water Content ——— w	BULK DENSITY	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FOOT	SHEAR STRENGTH P.S.F.	w _p w _L	X P.C.F.	
932.0	GROUND LEVEL								
0.0	Gravelly sand with some silt					930			
	Frequent boulder concentrations.		1	SS	23/4"				
	Compact to very dense.		2	SS	24	920			
			3	SS	63				
						910			
907.1									
24.9	End of Borehole					900			

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

Q _u	UNCONFINED COMPRESSION	L.V	LABORATORY VANE
Q	UNDRAINED TRIAXIAL	F.V	FIELD VANE
Q _{cu}	CONSOLIDATED UNDRAINED TRIAXIAL	C	CONSOLIDATION
Q _d	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_r	SENSITIVITY

GENERAL

π	= 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
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

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

Materials and Testing Division

February 10, 1967

Mr. E. D. McCormick, P. Eng.,
McCormick & Rankin Limited,
Consulting Engineers,
8 Stavebank Road,
Port Credit, Ontario.

66F-101

Re: Bon Echo Provincial Park Overpass,
Highway 41, District 10, Banaroft,
W.P. 165-66,
Your File No. 304-66

Dear Sir:

Thank you for your letter of February 9, 1967, regarding the above structure.

With respect to piles to be used for the support of open-type abutments, we would suggest 12 BP 53 steel H-piles with reinforced tips. Because of the very dense nature of the subsoil and the presence of boulders, we believe that not more, possibly less, than 10 feet of penetration will be achieved. The criterion for stopping the pile driving should be the encounter of practical refusal (15 blows/inch, using a D-22 hammer).

Should such refusal not be reached within the upper ten feet of original subsoil, we would suggest that the bearing capacity of the pile be assessed using the Hiley formula.

As an alternative, we would propose the use of 12-3/4" steel tube piles, 1/4" wall thickness. The final choice should be governed by economic considerations; otherwise, the same criterion for stopping the driving should apply to these piles as to the H-piles.

Yours very truly,

A. G. Stermac
A. G. Stermac

AGS/adeF

cc: Mr. W. A. McFarlane, P. Eng. Principal Foundation Engineer
Foundations Files
Gen. Files

**MCCORMICK & RANKIN
LIMITED**

CONSULTING ENGINEERS

PORT CREDIT

OTTAWA

8 STAVEBANK ROAD
PORT CREDIT, ONTARIO
TELEPHONE 274-3477

E. D. MCCORMICK, P. ENG.
G. A. RANKIN, P. ENG.
ASSOCIATES
C. MCCORMICK, P. ENG.
R. G. NAIRN, P. ENG.
J. F. BEATSON

February 9th, 1967.

Mr. A. G. Stermac, P. Eng.,
Principal Foundation Engineer,
Materials and Testing Division,
Department of Highways, Ontario,
Downsview, Ontario.

RE: Bon Echo Provincial Park Overpass
Highway 41, District 10, Bancroft
W. P. 165-66
Our File - 304-66.

Dear Sir:

We have been retained by the Department of Highways to prepare the design for the above-noted structure. In discussion with the Bridge Office it has been decided that the proposed structure shall be a three span continuous reinforced concrete slab with 26'-32'-32' spans. The piers shall be supported on spread footings with a design bearing pressure of 3.0 t.s.f. in accordance with the recommendations of Report BA 2474. It has been assumed that the open-type abutments shall be supported on piles.

We would appreciate your comments as to the type of piles to be used and the length required to develop a design load of 50 tons.

If there is any additional information that you may require please contact us.

Yours very truly,
MCCORMICK & RANKIN LIMITED



E. D. McCormick, P. Eng.,

EDM/gr

c. c. W. M. McFarlane, P. Eng.

MEMORANDUM

667-101

TO: Mr. A. Stermac,
Principal Foundation Engineer,
Administration Building,
DOWNSVIEW, Ontario.

FROM: Mr. G. Scott,
Regional Bridge Location Engineer,
KINGSTON, Ontario.

DATE: February 28, 1967

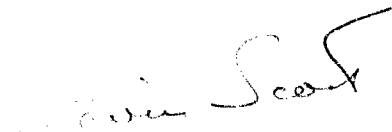
OUR FILE REF.

IN REPLY TO

SUBJECT:

W.P. 165-66, Site 7-98, Bon Echo Provincial
Park Overpass, Highway 41, District 10

Herewith please find print of Preliminary Plan
D-6142-Pl. May we have such comments as you wish
to make.



G. Scott
REGIONAL BRIDGE LOCATION ENG.

GS/hl

Enc.

acg

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

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

March 13, 1967

Don Echo Provincial Park Overpass
5.9 Miles North of Cloyne,
W.P. 165-66 -- Site 7-98,
Hwy. #41 -- District #10 (Bancroft).

W. F. 107

We have reviewed Preliminary Bridge Plan
#D 6142-P1 for the above mentioned structure.

The designer has complied with recommendations
contained in our Report 66-F-101, and in our memo of
February 10, 1967.

4/1. 1. 3-107

KCS/MdeF

K. G. Selby,
SUPERVISING FOUNDATION ENGR.
For:
A. G. Stermac,
PRINCIPAL FOUNDATION ENGR.

cc: Messrs. S. McCombie
G. Scott

Foundations Files
Gen. Files

Department of Highways Ontario

Copy for the information of

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

Mr. G. Scott,
Regional Bridge Location Engineer,
Kingston Regional Office

Bridge Division,
Downsview, Ontario

February 20, 1967

Bon Echo Prov. Park Overpass
5.9 Miles North of Cloyne
W.P. 105-66, Site 7-98
Highway 41, District No. 10

Attached herewith are prints of the Preliminary Bridge
Plan Drawing D6142-F1 for the above-mentioned structure.

The estimated cost of the proposed structure is \$55,000.
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
R. Forrest
E. Cross