

DATE:

G. V. WISZKOVSKY FROM EWBANK & TUPPER

ASKED ABOUT PILE PREFERENCE

A.: THERE SHOULD BE NO DIFFICULTY OF DRIVING
TIMBER PILES THROUGH THE SAND GRAVEL LAYER
DOWN TO BEDROCK. HOWEVER, WHEN BEDROCK IS
REACHED TIMBER PILES CAN EASILY BE DAMAGED
DUE TO OVERDRIVING. IT IS THEREFORE SUGGESTED
THAT STEEL H-PILES BE USED PREFERABLY A
LIGHTER SECTION (10 BP 12) BECAUSE OF THE
SMALL LOADS

APRIL 16, 1964

ABSTERMAC

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

Foundation Section,
Room 107, Lab. Bldg.

Attention: Mr. A. Watt

February 21, 1964

Preliminary Plan D-5438-P,
W.P. 289-62, Mud Creek Bridge,
4.3 Miles North of North Gower,
Hwy. #16, District #8.

The designer appears to have complied with
the recommendations contained in the Foundation Report -
W.J. 63-F-124.

MD/MdeF

cc: Foundations Office ✓
Gen. Files

M. Devata
M. Devata,
SR. FOUNDATION ENGR.
For:
A. G. Stermac,
PRINCIPAL FOUNDATION ENGR.

MEMORANDUM

To: Mr. A. G. Stermac,
Principal Foundation Engineer,
Laboratory Building,
DOWNSVIEW, Ontario.

FROM: A. P. Watt.

DATE: February 11, 1964.

OUR FILE REF.

IN REPLY TO

SUBJECT: W.P. 289-62, Bridge Site 3-146,
Carsonby (Mud) Creek Bridge,
4.3 Miles North of North Gower,
Hwy. #16,
District #8.

Enclosed please find one copy of the preliminary plan D - 5438-P for the above noted structure.

The Hydrology Report has recommended that for scour protection that the bottom of the footings be placed at elevation 283.0 or lower.

Would you kindly review the bridge foundations proposed and inform me if they are satisfactory.



APW/lg.
c.c. J. Walter.

A. P. Watt.
Bridge Location Engineer.

MEMORANDUM

63-F-124

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

FROM: A. P. Watt

DATE: October 4, 1963.

OUR FILE REF.

IN REPLY TO

SUBJECT: W.P. 289-62 Bridge Site # 3-146
Carsonby Creek Bridge
4.3 miles North of North Gower
Hwy 16, District 9

Would you kindly arrange to have a foundation investigation conducted at the above location. I have enclosed one copy of the site plan number E-4223-1 with the probable footing locations marked in red.

Would you also have an additional boring made at the point indicated by the red circle in order that we might get some idea of the scour that might have taken place in the past.

APW/kd
c.c. N. D. Smith
R. Fitzgibbon

Apwatt
A. P. Watt,
Bridge Location Engineer.

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: December 11, 1963

OUR FILE REF.

IN REPLY TO

SUBJECT:

FOUNDATION INVESTIGATION REPORT

For

Proposed New Bridge at Hwy. #16 and
Mud Creek Crossing (Proposed Rev'n.
Line 'F'), Lot 9, Con. II, Twp. of
North Gower, County of Carleton,
District #9

W.J. 63-F-124 -- W. P. 289-623-64-357

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.

KYL/MdeF
Attach.

cc: Messrs. A. M. Toye (2)
H. A. Tregaskes
H. D. McMillan
J. Ford
L. E. Walker
J. E. Gruspier
A. Watt

Foundations Office -
Gen. Files

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

TABLE OF CONTENTS

1. INTRODUCTION.
 2. DESCRIPTION OF THE SITE.
 3. DESCRIPTION OF FIELD WORK.
 4. SUBSOIL CONDITIONS:
 - 4.1) General.
 - 4.2) Silty Clay to Clayey Silt with Occasional Layers of Silt.
 - 4.3) Silty Sand with Gravel.
 - 4.4) Limestone Bedrock.
 5. GROUND WATER CONDITIONS.
 6. DISCUSSIONS & RECOMMENDATIONS.
 7. SUMMARY.
 8. MISCELLANEOUS.
-

FOUNDATION INVESTIGATION REPORT

For

Proposed New Bridge at Hwy. #16 and
Mud Creek Crossing (Proposed Rev'n.
Line 'F'), Lot 9, Con. II, Twp. of
North Gower, County of Carleton,
District #9
W.J. 63-F-124 -- W. P. 289-62

1. INTRODUCTION:

A request for a foundation investigation at the site of the proposed Hwy. #16 and Mud Creek crossing was received from the Bridge Office in a memo dated October 4, 1963.

A field investigation was subsequently carried out by this Section to determine subsoil conditions at the site.

This report contains the field investigation results, together with foundation recommendations for the new proposed bridge.

2. DESCRIPTION OF THE SITE:

Mud Creek meanders in a flat farm country. During the time of the investigation, there was about one foot of stagnant water under the existing bridge while the adjacent sections of the creek were almost dry. The existing bridge is a single-span concrete structure with closed type abutments.

3. DESCRIPTION OF FIELD WORK:

The field investigations were carried out by means of a core drill machine adapted for soil sampling.

Three sampled boreholes were advanced to refusal at the bedrock. Adjacent to each borehole a dynamic cone penetration was

cont'd. /2 ...

3. DESCRIPTION OF FIELD WORK: (cont'd.) ...

also carried out. In the cohesive soils, 2" I.D. Shelby tube samples were taken. In granular soils, 2" O.D. split-spoon samples whose dimensions and energy used in driving, conform to the requirements of the Standard Penetration Test, were taken. The bedrock was proved by means of AXT diamond core barrels.

The samples were brought to the laboratory and tested for Atterberg limits, moisture content, density, shear strength and grain size distribution.

The locations and elevations of the boreholes are shown on Drawing 63-F-124A, attached at the end of this report.

4. SUBSOIL CONDITIONS:

4.1) General:

The following subsoil stratification was revealed by field investigation. The top clayey silt layer is underlain by a layer of silty sand with gravel which overlies the bedrock.

4.2) Silty Clay to Clayey Silt with Occasional Layers of Silt:

This layer extends down to about elevation 277.5 ft. in B.H. 1 and elevation 278.5 ft. in B.H. 2 & 3. The clayey silt material has a shear strength ranging from a high of 1030 p.s.f. near the surface and a low of 260 p.s.f. near the bottom. The laboratory test results show the following properties:

Plastic Limit	16% - 23%
Liquid Limit	26% - 51%
Moisture Content	..	8% - 45%
Density	117 - 122 p.c.f.

cont'd. /3 ...

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

4.3) Silty Sand with Gravel:

This layer extends from below the clayey silt stratum to elevation 269 ft. in B.H. 1 and elevation 270 ft. in B.H. 2 & 3. The deposit is generally loose in the upper portion and becomes compact to dense with depth. The standard penetration or 'N' values obtained in this material ranged from 4 to 36 blows/ft.

4.4) Limestone Bedrock:

In two boreholes (B.H. 1 & 3) the bedrock was drilled and core samples were obtained. The samples indicate that the bedrock is sound limestone.

The following are the bedrock elevations as observed in the boreholes:

B.H. No. 1	--	Elevation	-	269 ft.
B.H. No. 2	--	"	-	270 ft.
B.H. No. 3	--	"	-	270 ft.

5. GROUND WATER CONDITIONS:

The observed water levels in the boreholes were as follows:

B.H. No. 1	--	Elevation	-	292 ft.
B.H. No. 2	--	"	-	290.5 ft.
B.H. No. 3	--	"	-	289 ft.

The water level in the creek during the time of this investigation, was at elevation 288.5 ft.

cont'd. /4 ...

6. DISCUSSIONS & RECOMMENDATIONS:

It is proposed to construct a 30-ft. single-span structure where the relocated Hwy. #16 crosses Mud Creek. The existing structure is also a 30-ft. single-span structure and some 20 ft. wide. The new structure will be located approximately 25 ft. east of the existing one.

Subsoil at the site generally consists of soft to firm silty clay to clayey silt followed by loose to dense silty sand with gravel underlain by limestone bedrock.

Because of the presence of 12 to 15 ft. of soft to firm silty clay to clayey silt, adequate bearing capacity may not be achieved for the spread footing support to the structure. Therefore, the structure should be supported on end-bearing piles driven to bedrock. For example, #14 untreated timber piles (if pile caps are formed below the creek or ground water level) driven to the bedrock can support a safe design load of 25 tons. As an alternative, the structure may be supported on small displacement end-bearing piles. For example, a 12 BP 73 steel 'H' pile driven to bedrock can support a safe design load of 70 tons. However, the final choice of piles should depend upon economical considerations. The pile caps should be placed at a sufficient depth to ensure adequate frost protection and to conform to the hydrological requirements.

Approach Embankment:

According to the preliminary plans, the proposed grade line indicates about 9 ft. of approach fill on both sides.

cont'd. /5 ...

6. DISCUSSIONS & RECOMMENDATIONS: (cont'd.) ...

Approach Embankment: (cont'd.) ...

Stability analyses indicate that under the existing conditions, this amount of approach fill will not present any embankment stability problem for the standard 2:1 side slopes.

Because of the presence of a compressible layer of silty clay to clayey silt, some settlements may be anticipated. It would therefore, be preferable to postpone final paving operations for as long a period as possible after the completion of approach fills.

7. SUMMARY:

Subsoil at the site generally consists of soft to firm silty clay to clayey silt, followed by loose to dense silty sand with gravel underlain by limestone bedrock.

A single-span structure is proposed where relocated Hwy. #16 crosses Mud Creek.

The structure can be supported on end-bearing #14 untreated timber piles or steel H-piles driven to bedrock.

Approach fill stability problems are not anticipated for the standard 2:1 side slopes.

Because of the presence of a 12 to 15 ft. thick compressible layer, some settlements may be anticipated at the approach fill locations. In view of this, it is recommended that final paving operations should be delayed for as long a period as possible after the completion of the approach fills.

cont'd. /6 ...

8. MISCELLANEOUS:

The field work was carried out from October 25 to October 29, 1963, 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.

December 1963

APPENDIX I.

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & RESEARCH DIVISION

RECORD OF BOREHOLE NO. 1

FOUNDATION SECTION

JOB <u>63-F-124</u>	LOCATION <u>Hwy. 16 & Mud Crk. (535+70, 12' to Rt. of C)</u>	PREPARED BY <u>V.K.</u>
W.P. <u>289-62</u>	BORING DATE <u>Oct. 25, 1963.</u>	COMPILED BY <u>V.K.</u>
DATUM <u>Geodetic</u>	BORING TYPE <u>Wash boring using BX Casing.</u>	CHECKED BY <u>M.D.</u>

[illegible]

FOUNDATION SECTION

[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 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

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
$\log_e a$ 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

#63-F-124

W.P.#289-62

Hwy#16

MUD CREEK

BRIDGE

[illegible]