

W.O. 70-F. 209M

BRIDGE # 394

STRUCTURE SITE

19-394

40113 - 28



DOMINION SOIL INVESTIGATION LIMITED
CONSULTING SOIL & FOUNDATION ENGINEERS

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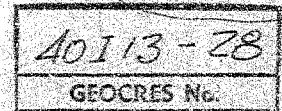
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ASSOCIATED COMPANY

SOIL TESTING AND ENGINEERING LTD.
39 BRENTFORD ROAD
KINGSTON 5, JAMAICA
WEST INDIES

J.P. MCINTYRE P.ENG.
CONSULTING ENGINEER
LONDON ONTARIO



STRUCTURE SITE No. 19-394

Report on
SOIL INVESTIGATION
for
BRIDGE NO. 394
EKFRID - METCALFE TOWNLINE
COUNTY OF MIDDLESEX

70-F-209M

by

DOMINION SOIL INVESTIGATION LIMITED
369 Queens Avenue
LONDON 14, ONTARIO

Our Reference: 70-2-L2
February 10th, 1970.

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E N C L O S U R E S

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SUMMARY

The natural subsoil below the creek bed consists of very stiff to hard silty clay till, which will provide adequate support for a concrete cast-in-place or pipe structure.

It is recommended that concrete footings be placed at about El.81, using a maximum allowable soil pressure of 6000 p.s.f. for the design. Total settlement is estimated to be 0.5 inch or less. A pipe structure should be back-filled with well-compacted granular material to provide adequate vertical and lateral support.

No construction problems are anticipated.

I INTRODUCTION

In accordance with a letter of authorization dated February 3, 1970, from J. P. McIntyre P.Eng., a soil investigation has been carried out on the Ekfrid - Metcalfe Townline, where it is proposed to replace an existing road bridge with a new structure.

The existing 20 foot span concrete structure is located on the road allowance between Lot 14 Concession 5 of Ekfrid Township, and Lot 14 Concession 14 of Metcalfe Township.

It is understood that the proposed structure is either a cast-in-place concrete culvert or a pipe culvert, and that it will be centred on the existing bridge.

The purpose of the investigation was to reveal the subsurface conditions at the site and to determine the relevant soil properties for the design and construction of the new foundations.

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II FIELD WORK

The field work, consisting of two boreholes and two dynamic cone penetration tests, was carried out on February 5 and 6, 1970, at the locations shown on Enclosure 1. The holes were advanced to the sampling depth by a continuous flight auger machine which was equipped for soil sampling.

Standard penetration tests were performed at frequent intervals of depth, as detailed in Appendix 'A', and the results are recorded on the borehole logs as 'N' values.

The dynamic cone penetration tests were performed adjacent to the borehole locations to obtain an indication of soil density and strata changes with depth.

The field work was supervised by a soils engineer, who also determined the ground surface elevations. These were referred to a nail in the north root of an 18-inch diameter Maple tree, 30 feet left of Sta. 12+47, which was taken as El. 100 feet.



III SUBSURFACE CONDITIONS

Detailed descriptions of the strata, which were encountered in each borehole, are given on the borehole logs comprising Enclosures 2 and 3, and a general picture of the soil stratigraphy is presented in the form of a Subsurface Profile on Enclosure 1. The following notes are intended only to amplify this data:-

Both boreholes penetrated a layer of silty clay fill which is associated with the construction of the approaches to the existing bridge. The natural subsoil consists of a glacial silty clay till stratum in which the boreholes were terminated at a depth of 26.5 feet.

Due to the clay content the till should be regarded as being a plastic and cohesive material, and the consistency is described as 'very stiff' to 'hard' based on 'N' values ranging from 24 to 55 blows per foot. Atterberg Limit tests were performed on two samples of the silty clay giving values of Liquid Limit of 35% and 43%, Plastic Limit of 18% and 19%, and Plasticity Index of 17% and 24%. The Liquidity Indices were 0.18 and 0.13, which



confirm the 'very stiff' consistency obtained by visual and tactile examination. The moisture content within the silty clay stratum ranges from 21% to 24%.

IV GROUNDWATER CONDITIONS

Due to the impermeable nature of the subsoil the boreholes remained dry throughout the boring operation, however the water level in the adjacent creek was observed at El.89.2. The lowest limit reached by the groundwater table is indicated by the change in colour of the silty clay from brown to grey at about El.84.

V DISCUSSION AND RECOMMENDATIONS

The natural subsoil consists of 'very stiff' to 'hard' silty clay till, which extends to a depth of at least 15 feet below the creek bed.



Concrete Culvert

The creek bed extends down to El.86.2, therefore normal spread footing foundations would be located at about El.81. On the basis of the borehole results a maximum allowable soil pressure of 6000 p.s.f. is appropriate for the design of footings at this level, and the recommended soil pressure incorporates a factor of safety of 3 against shear failure of the underlying soil.

It is estimated that total settlement of a 4 foot wide footing mobilizing the above soil pressure will be 0.5 inch or less, and in view of the similar soil conditions encountered in the two boreholes no appreciable differential settlement is anticipated.

The stiff cohesive subsoil will present no unusual construction problems. The sides of excavations will remain vertical for a short period of time, and seepage into excavations may be controlled by normal pumping procedures.

Pipe Culvert

The site is suitable for the use of a pipe culvert which is probably more economical than a concrete cast-in-place structure. It is recommended that a 12-inch thick mat of well-graded granular material be placed below the pipe to provide a uniform support along its entire length. The fill below and on the sides of the pipe should be compacted to at least 98% of the maximum standard Proctor dry density for the particular material used.

Yours very truly,

DOMINION SOIL INVESTIGATION LIMITED



E.J.W. Atkinson
C.J.W. Atkinson, M.Sc., P.Eng.,
Branch Manager

CJWA/jmc

APPENDIX 'A'.

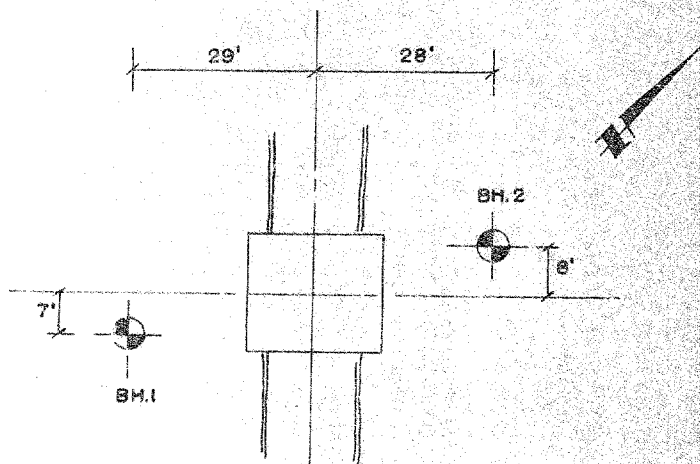
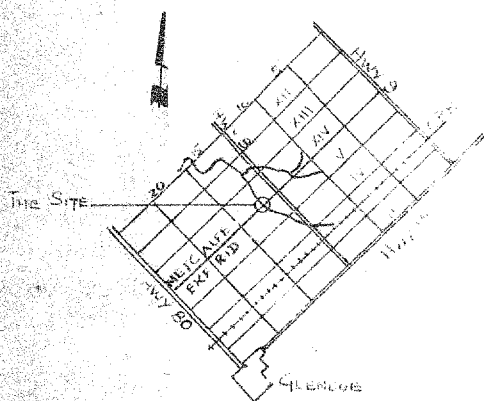
THE STANDARD PENETRATION TEST.

In order to determine the relative density of non-cohesive soils, such as sands and gravels, the standard penetration test has been adopted. The test also gives an indication of the consistency of cohesive soils.




A two inch external diameter thick-walled sample tube is driven into the ground at the bottom of the borehole by means of a 140 lb. hammer falling freely through 30-ins. The tube is first driven an initial 6-inches to allow for the presence of disturbed material at the bottom of the borehole. The number of standard blows (N) required to drive the sampler a further 12-in. is recorded. The sample tube is one originally developed by Raymond Concrete Pile Company in the United States, where a sufficient number of tests have been made in conjunction with field investigations to show that the results, although essentially empirical, may be applied to foundation design.

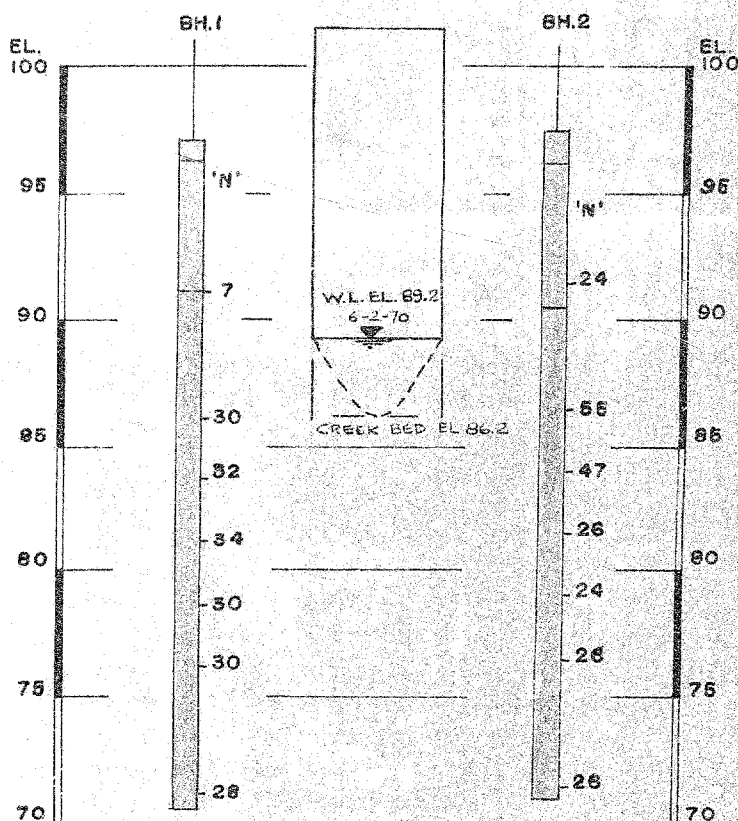
For Sands:-

Values of 'N'.	Density.
Less than 10	Loose
Between 10 and 30	Compact
Between 30 and 50	Dense
Greater than 50	Very dense.



LEGEND

-  SANDY GRAVEL
-  SILTY CLAY, FILL
-  VERY STIFF TO HARD SILTY CLAY, TILL



LOG OF BOREHOLE.....1.....

Our Reference No. 70-2-L2

Enclosure No.

CLIENT: J.P. McIntyre P.Eng.
PROJECT: Bridge No. 394,
LOCATION: Ekfrid - Metcalfe Townline
DATUM ELEVATION: nail in N root of tree, Sta 12+47,
El. 100 feet

DRILLING DATA

Method: Auger
Diameter: 4-inch
Date: February 5 & 6, 1970

SUBSURFACE PROFILE				SAMPLES			PENETRATION RESISTANCE					WATER CONTENT			REMARKS							
ELEVATION FL	DEPTH FL	DESCRIPTION	SYMBOL	GROUND WATER	NUMBER	TYPE	N' Blows / Foot	RESISTANCE					%									
								UNDRAINED SHEAR STRENGTH					PLASTIC LIMIT			NATURAL			LIQUID LIMIT			
								+ FIELD VANE TEST					lb/sq. ft.					W _p			W	
								20	40	60	80	100				10	20	30	4	50		
97.0	0.0	Ground Surface																				
	1.3	Sandy gravel	2.0	Dry																		
95		Silty clay (Fill)			1	SS	7															
90	7.0	Hard fissured brown silty clay			2	SS	30															
85		Very stiff to hard grey silty clay			3	SS	32															
80					4	SS	34															
75					5	SS	30															
70	26.5	End of Borehole			6	SS	30															
					7	SS	28															

VERTICAL SCALE: 1 inch to 5 feet

DOMINION SOIL INVESTIGATION LIMITED

MADE:

CHECKED:

LOG OF BOREHOLE...2.....

Our Reference No. 70-2-L2

Enclosure No. 3

CLIENT: J.P. McIntyre P.Eng.

PROJECT: Bridge No. 394,

LOCATION: Ekfrid - Metcalfe Townline

DATUM ELEVATION: nail in N root of tree at Sta. 12+47
El. 100 feet

DRILLING DATA

Method: Auger

Diameter: 4-inch

Date: February 6, 1970

SUBSURFACE PROFILE				SAMPLES			PENETRATION RESISTANCE				WATER CONTENT %			REMARKS															
ELEVATION ft.	DEPTH ft.	DESCRIPTION	SYMBOL	GROUND WATER	NUMBER	TYPE	N Blows / Foot	Stems / Foot				PLASTIC LIMIT W _p	NATURAL W		LIQUID LIMIT W _L														
								20	40	60	80					100													
								UNDRAINED SHEAR STRENGTH																					
+ FIELD VANE TEST					* COMPRESSION TEST					lbs/sq. ft.																			
					10					20					30					40					50				

97.5	0.0	Ground Surface																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																														</
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