#69-F-229 M

SITE 14-202

DAWN - ENNISKILLEN

TOWNLINE

LOT 3, CONCESSION 1

BRIDGE

B.A. 3163
Site 14-202

DOMINION SOIL INVESTIGATION LIMITED

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SARNIA ONTARIO.

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

Report on

SOIL INVESTIGATION

for

PROPOSED BRIDGE

DAWN - ENNISKILLEN TOWNLINE

LOT 3 CONCESSION 1

TOWNSHIP OF ENNISKILLEN

67 + 229 M

by

DOMINION SOIL INVESTIGATION LIMITED.
369 Queens Avenue
LONDON ONTARIO.

Ref.No. 9-5-L3.

CONTENTS.

ENCLOSURES.

SUMMARY.

The natural subsoil consists of stiff to very stiff silty clay till, which was penetrated to a depth of 27 feet below the creek bed.

It is recommended that the structure be supported on spread footing foundations at or below El.88.5, using a maximum net soil pressure of 5000 p.s.f. for the design. Total settlement is estimated to be 1-inch or less.

No unusual construction problems are anticipated.

1. INTRODUCTION.

In accordance with authorization from Nisbet Letham Limited, Consulting Engineers, a soil investigation has been carried out in the County of Lambton where it is proposed to replace an existing road bridge with a new structure.

The existing structure is located at Lot 3, Concession 1, of Enniskillen Township where the Townline crosses a small creek.

It is understood that the proposed structure is a single span bridge, and that it will be centered on the existing bridge. The requirements of the project were discussed with Mr. K.E. Stevens, who supplied the foregoing information.

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.

11. FIELD WORK.

The field work, consisting of 2 boreholes and 2 dynamic cone penetration tests, was carried out on May 29 & 30, 1969, at the locations shown on Enclosure 1. The holes were advanced by washboring methods and were lined with Bx size casing.

Standard penetration tests were performed at frequent intervals of depth, as detailed in Appendix 'A', to obtain disturbed samples of the subsoil for testing in the laboratory.

Insitu vane shear tests were performed in the cohesive subsoil to determine the undrained shear strength. The procedure followed in this test is outlined in Appendix 'B'.

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

Elevations were referred to the centre of the deck of the existing bridge, which was given the assumed value, El.100 feet.

111. SUBSURFACE CONDITIONS.

Detailed descriptions of the strata, which were encountered in each borehole are given on the borehole logs, comprising Enclosures 2 & 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.

Fill.

This material is associated with the construction of the approaches to the existing bridge, and was found to have a thickness of 5 and 4½ feet in boreholes 1 & 2 respectively.

Brown/grey silty clay, with a trace of gravel (Glacial Till).

The upper layers of this stratum are brown in colour, however with increasing depth the colour becomes grey and the change is characterized by a reduction in undrained shear strength.

Due to the clay content, the till should be regarded as being a plastic and cohesive material, and the consistency is described as 'stiff' to 'very stiff' based on insitu vane shear strengths ranging from 1800 to 3900 p.s.f. These results are confirmed by the 'N' values, which range from 12 to 41 blows per foot.

Atterberg Limit tests were performed on two samples of the clay till, giving values of Liquid Limit of 36% and 50%, Plastic Limit of 15% and 16%, and Plasticity Index of 20% and 35%. The natural moisture content was found to range from 19% to 27%, which is equivalent to a Liquidity Index range of 0.20 to 0.34.

IV. GROUNDWATER CONDITIONS.

The water levels in boreholes 1 and 2 after completion of the drilling were observed at El.94.7 and El.93.5 respectively.

V. DISCUSSION & RECOMMENDATIONS.

The natural subsoil below the creek bed consists of stiff to very stiff silty clay till, which is suitable for the support of normal spread footing foundations.

The bed of the creek extends down to El.88.4, therefore it is recommended that the footing grade be established at least 4 feet below this level to provide sufficient protection against frost action. A hydrological study should also be made to determine the depth of cover for scour protection.

On the basis of the borehole results a maximum net soil pressure of 5000 p.s.f. is appropriate for the design of footings between El.88.5 and El.78, and this soil pressure incorporates a factor of safety of 3 against shear failure of the underlying soil.

It is estimated that the total settlement of a 5 foot wide footing mobilizing the above soil pressure will not exceed 1-inch, and due to the uniform moisture content encountered in the two boreholes, no differential settlement may be anticipated. In the calculation of consolidation settlement the coefficient of volume compressibility was taken as 0.012 square feet per ton. This value was obtained by relating the Atterberg Limits and natural moisture content values to the results of consolidation tests on similar material.

The adhesion between the footings and the clay till may be taken as 2000 p.s.f. or 35% of the normal load, whichever is

the lower value, and the factor of safety against horizontal sliding of the abutments must be at least 1.5.

The stiff cohesive till 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 pumping from sumps dug below the footing grade.

Yours very truly,

DOMINION SOIL INVESTIGATION LIMITED.

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

CJWA/jb.

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 diamter 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 empiric , 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.

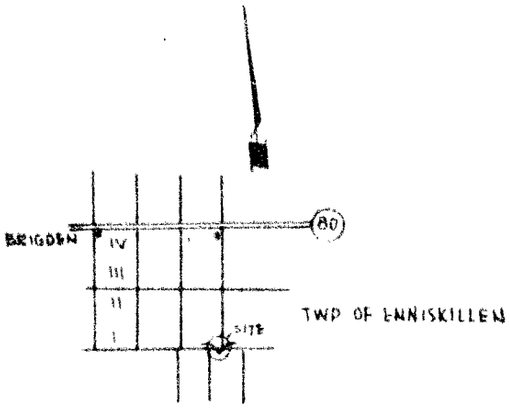
APPENDIX B

INSITU VANE SHEAR TEST

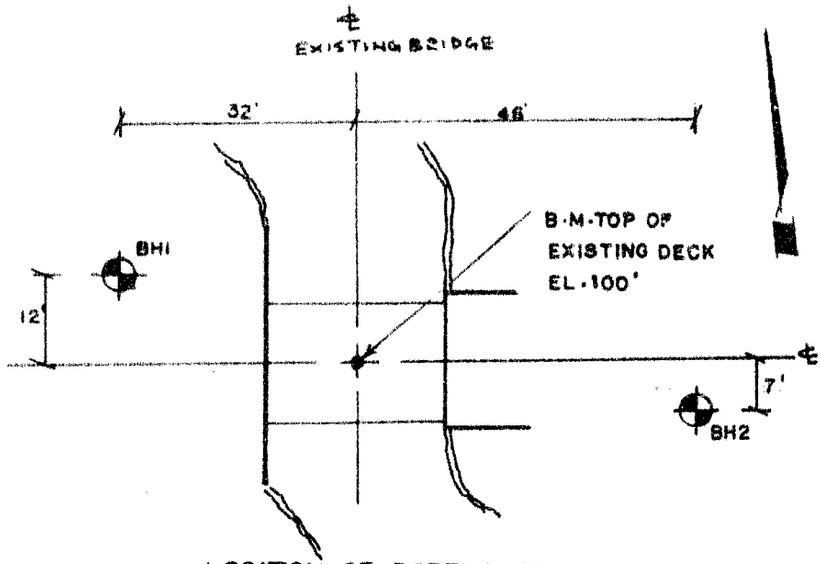
In soft to stiff clays, and particularly sensitive clay soils such as frequently occur in alluvial deposits, it is difficult to obtain reasonable undisturbed samples for the determination of the undrained shear strength. In order to overcome this difficulty, the vane test was developed as an in-situ method of measuring the shear strength.

The apparatus consists of a 4-inch long by 2-inch wide rectangular 4-bladed rotating vane attached to a thin rod, which is pushed into the undisturbed soil below the bottom of the borehole to the depth at which the test is to be made.

A torque is then applied to the vane and the maximum torque when failure occurs is recorded. The vane is then rotated 10 times to remould the soil and after one minute the torque test is repeated. The shear strength of the soil can then be calculated from the torque and the dimensions of the vane, and the sensitivity of the material estimated from the ratio of the original torque to the final torque after remoulding.



KEYPLAN

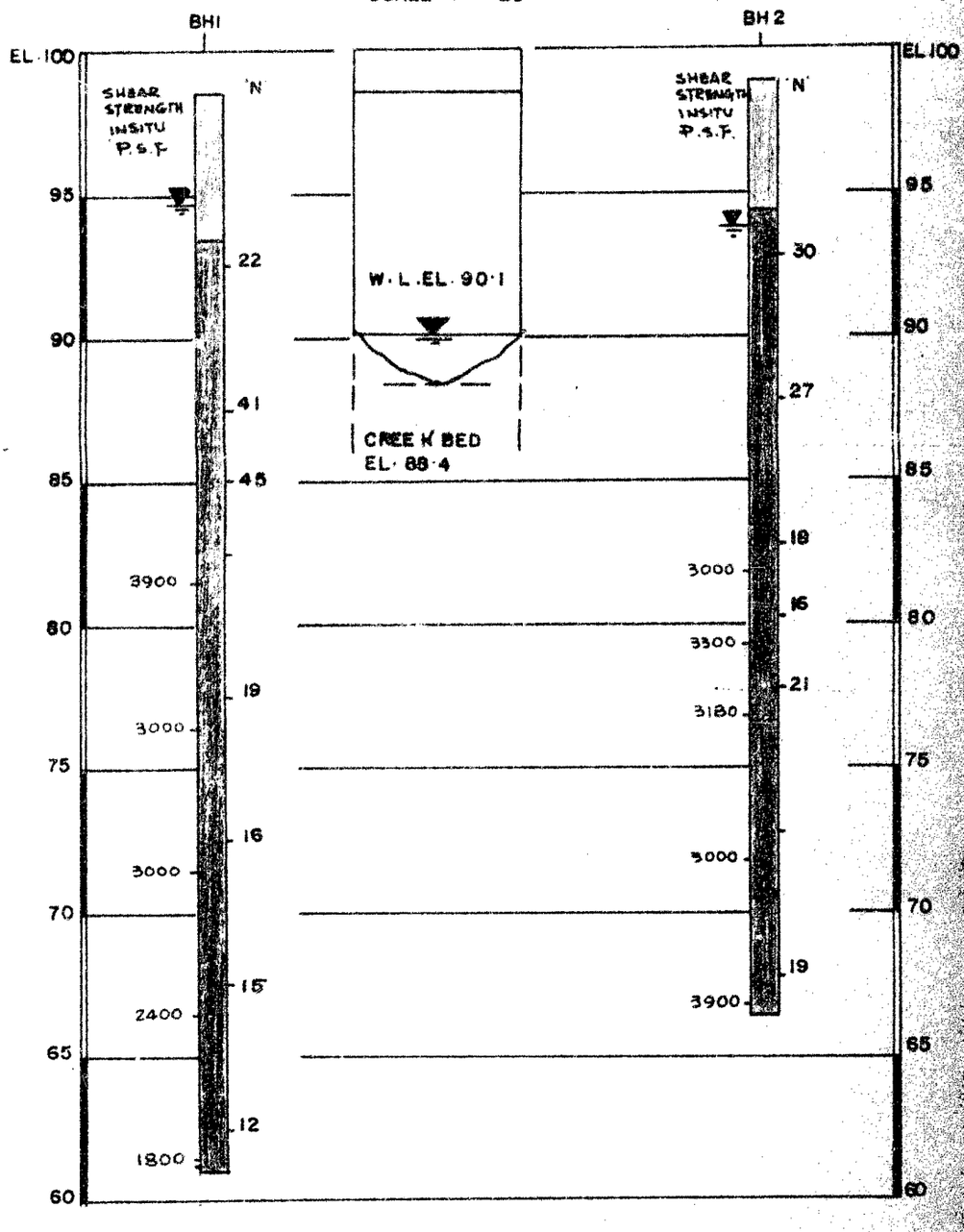


LOCATION OF BOREHOLES
SCALE 1" = 20'

LEGEND

SILTY CLAY FILL

STIFF TO
VERY STIFF
SILTY CLAY TILL.



SUBSURFACE PROFILE

LOG OF BOREHOLE 2

Our Reference Nº 9-3-13.

Enclosure Nº 3

CLIENT: Nisbet Letham Limited,
PROJECT: Proposed Bridge.
LOCATION: County of Lambton,
DATUM ELEVATION: top of existing deck, El.100 ft.

DRILLING DATA
Method: Washboring.
Diameter: BX (3-inch)
Date: May 30th, 1969.

ELEVATION Ft.	DEPTH Ft.	DESCRIPTION	SYMBOL	GROUND WATER	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES 'N' Blows / Foot
98.9	0.0	Ground Surface.					
		Brown silty clay (Fill).					
95	4.5				1	SS	30
		Very stiff grey silty clay, with a trace of gravel (Glacial Till).			2	SS	27
90					3	SS	18
					4	SS	16
85					5	SS	21
					6	TW	
80					7	SS	10
75							
70							
32.5		End of Borehole.					

PENETRATION RESISTANCE Blows / Foot
20 40 60 80 100

UNDRAINED SHEAR STRENGTH 100 lbs/sq ft
+ FIELD VANE TEST ● COMPRESSION TEST
10 20 30 40 50

WATER CONTENT %
PLASTIC LIMIT W_P NATURAL W LIQUID LIMIT W_L
10 20 30 40 50

REMARKS

2-inch diameter cone

St = 2.7
St = 2.2
St = 1.9
St = 1.7
St = 1.9

VERTICAL SCALE 1 inch to 5 feet

MADE CHECKED

DOMINION SOIL INVESTIGATION LIMITED

LOG OF BOREHOLE .....

Our Reference Nº 9-5-13. Enclosure Nº 2.

CLIENT: Nisbet Lethum Limited,
PROJECT: Proposed Bridge.
LOCATION: County of Lambton.
DATUM ELEVATION: top of existing deck, El.100 ft.

DRILLING DATA
Method: Washboring.
Diameter: BX(3-inch).
Date: May, 29&30.1969.

ELEVATION Ft.	DEPTH Ft.	DESCRIPTION	SYMBOL	GROUND WATER	SAMPLES NUMBER	TYPE	'N' Blows / Foot	REMARKS
98.5	0.0	Ground Surface.						
95	3.5	Brown silty clay (Fill).						
		Stiff to very stiff Brown silty clay, with a trace of gravel. (Glacial Till).	T		1	SS	22	
					2	SS	41	
					3	SS	45	
					4	SW		
					5	SS	19	
					6	SS	16	
					7	SS	12	
					8	SS	16	
37.5	61.0	End of Borehole.						

PENETRATION RESISTANCE Blows / Foot
20 40 60 80 100
UNDRAINED SHEAR STRENGTH 100 lbs/sq ft
+ FIELD VANE TEST @ COMPRESSION TEST
1.0 2.0 3.0 4.0 5.0

WATER CONTENT %
PLASTIC LIMIT W_p — NATURAL W — LIQUID LIMIT W_L
10 20 30 40 50

2-inch diameter cone.

VERTICAL SCALE: 1 inch to 5 feet

DOMINION SOIL INVESTIGATION LIMITED

MADE CHECKED