#67-F-246 M

REYNOLDS CREEK BRIDGE (MILLS BRIDGE) LOT #2 CONC. #3 & #4

A.M. SPRIET & ASSOCIATES LTD.,
CONSULTING ENGINEERS
LONDON ONTARIO.

Report on

SOIL INVESTIGATION

for

REYNOLDS CREEK BRIDGE

(MILLS BRIDGE)

LOT 2 CONCESSIONS 3-4

TOWNSHIP OF N. DORCHESTER

by

DOMINION SOIL INVESTIGATION LIMITED
369 Queens Avenue
LONDON ONTARIO

Reference No 7-11-L11.

CONTENTS.

ENCLOSURES.

SUMMARY.

The two boreholes revealed the following general ground succession; clayey silt Fill (8 to 10 feet thick), compact silt (4 to 6 feet thick), firm to stiff silty clay (5 to 13 feet thick), and very stiff to hard silty clay till (maximum penetrated 13 feet)

It is recommended that the structure be supported on a timber pile foundation, and suitable working loads and pile penetration data are given in the report.

No unusual construction problems are anticipated.

1. INTRODUCTION.

In accordance with verbal authorization from A.M.Spriet and Associates Limited, Consulting Engineers, a soil investigation has been carried out in the Township of North Dorchester where it is proposed to replace an existing road bridge with a new structure.

The existing 45 foot span steel truss structure is located on Lot 2, Concessions 3-4 of the Township where the road crosses Reynolds Creek.

It is understood that the proposed structure will be on a skew, and that it will be centered on the existing bridge. The requirements of the project were discussed with Mr.A.M. Spriet, P.Eng., 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, was carried out on November 20 & 21, 1967, at the locations shown on Enclosure 1. The holes were advanced to the sampling depths 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', and the results are recorded on the borehole logs as 'N' values.

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

Elevations were referred to a nail driven into a 3-foot diameter Elm at the location indicated on Enclosure 1. The benchmark was given the assumed value El.100 feet.

111. SUBSURFACE CONDITIONS.

Detailed descriptions of the strata 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.

Brown clayey silt(Fill).

Both boreholes were put down from the existing road grade, therefore the fill material is associated with the construction of the approaches to the existing bridge.

Grey silt containing seams of silty clay.

The main body of this stratum exhibits no cohesion, however it was found to contain seams of silty clay several inches in thickness. The relative density of the stratum is described as 'compact' as estimated from 'N' values of 11 and 13 blows per foot.

Grey silty clay containing seams of silt.

Due to the clay content this material should be regarded as being cohesive and plastic, and the consistency is described as 'firm' to

'stiff' as indicated by undrained shear strength values of 720 and 1280 p.s.f.

Atterberg Limit tests were performed on one sample as a means of classification. The values of Liquid Limit and Plastic Limit obtained were 32% and 15% respectively, indicating that the clay has a medium plasticity and compressibility. The Liquidity Index which relates the natural moisture content to the Atterberg Limits was 0.5 confirming the 'firm' to 'stiff' consistency obtained from the vane shear test results.

Grey silty clay containing a trace of sand (Glacial Till).

This stratum was encountered at depths of 10 ane 14 feet below the creek bed in the two boreholes, and is known to extend to a condiserable depth.

The consistency of the stratum is described as 'very stiff' to 'hard' as indicated by 'N' values ranging from 25 to 79 blows per foot.

Atterberg Limit tests were performed on one sample as a means of classification, and the values of Liquid Limit and Plastic Limit obtained were 27% and 14% respectively. These indicate that the soil has a low plasticity and compressibility. The Liquidity Index was-0.1. confirming the 'very stiff' consistency obtained from visual and tactile examination.

IV. GROUNDWATER CONDITIONS.

Due to the impervious nature of the subsoil insufficient time was available during the boring operation to determine the equilibrium

ground water elevation. However for practical purposes, when considering seepage into excavations, it may be assumed that this will be controlled by normal pumping proceedures.

V. DISCUSSION AND RECOMMENDATIONS.

The natural soil profile consists of a firm to stiff silty clay stratum extending to a depth of 10 to 14 feet below the creek bed, overlying very stiff to hard silty clay till. The allowable net soil pressure which may be used for the design of spread footings in the firm to stiff clay is 1500 p.s.f. which is generally considered too low for this type of design. It is therefore recommended that the load from the structure be transferred to the hard silty clay till stratum by means of a friction pile foundation.

Piled Foundation.

The length of pile required to penetrate the clay till stratum is relatively short therefore consideration should be given to the use of timber piles. Steel tube and H-piles of approximately the same size do not mobilize a higher load capacity than a timber pile of equivalent length when considering frictional resistance, therefore the timber pile usually proves to be the most economical type under these circumstances.

Nominal 12-inch diameter timber piles will achieve a suitable set corresponding to a safe working load of 20 tons per pile when driven 10 feet into the silty clay till stratum. The maximum penetration required will therefore be to El.65 resulting in a pile length of about 20 feet.

The above predictions of load capacity are based on a theoretical approach, and in practice the pile capacity should be determined in accordance with the Hiley formula. If the required set is not achieved at this level, the working load should be reduced and additional piles driven.

Consolidation settlement of the piled foundation is estimated to be less than 1/2-inch, and in view of the similar conditions encountered in the two boreholes no appreciable differential settlement is anticipated.

Yours very truly,

DOMINION SOIL INVESTIGATION LIMITED.

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

CJWA/jb

APPENDIX A

STANDARD PENETRATION TESTS

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 in. The tube is first driven an initial 6 in. 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 used is one originally developed by the 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

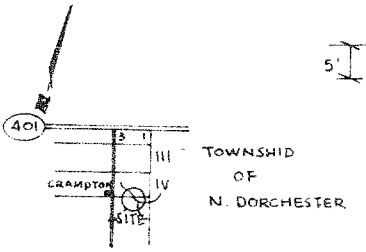
APPENDIX B

INSITU VANE SHEAR TEST

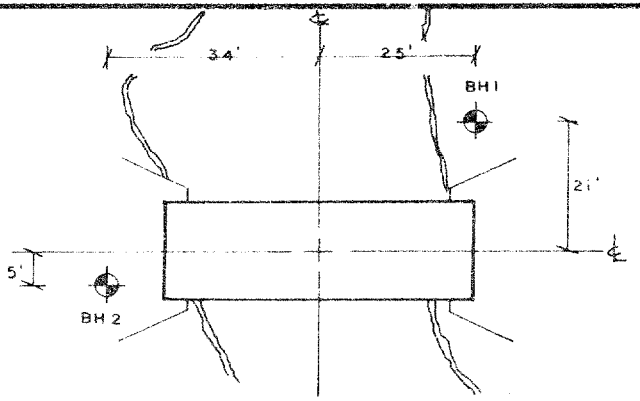
In soft to stiff clays, and particularly sensitive clay soils such as frequently occur in alluvial deposits, it is difficult to obtain reasonable undisturbed samples for the determination of the undrained shear strength. In order to overcome this difficulty, the vane test was developed as an in-situ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



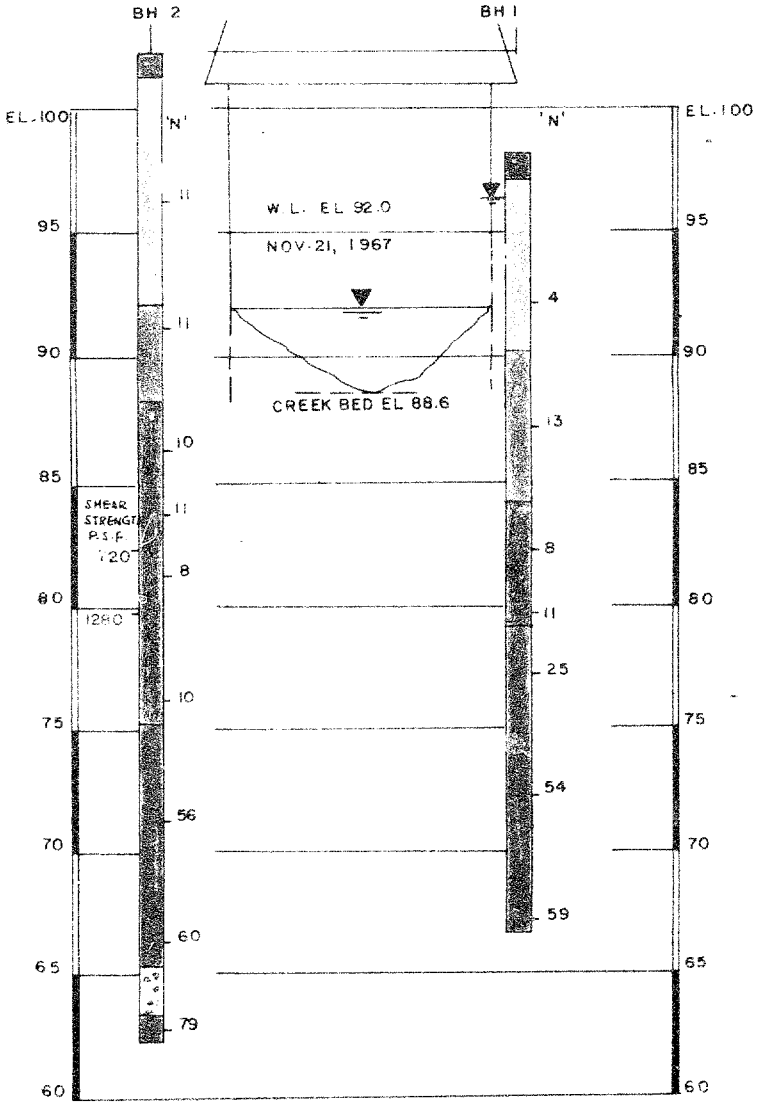
LOCATION OF BOREHOLES

SCALE 1"= 20'

● B.M. NAIL IN 3' ELM ABOUT 26' S. AND 63' E. OF THE CENTRE OF EXISTING BRIDGE

LEGEND

- TOPSOIL
- ROAD BALLAST
- CLAYEY SILT, FILL
- COMPACT SILT
- FIRM TO STIFF SILTY CLAY
- VERYSTIFF TO HARD SILTY CLAY, TILL



SUBSURFACE PROFILE

VERT SCALE 1" = 5'

OUR REF. No. 7-11-L11

DOMINION SOIL INVESTIGATION LIMITED

ENCLOSURE No. 1

LOG OF BOREHOLE 1

Our Reference No. 7-11-L11

Enclosure No. 2

CLIENT: A.M.Spriet & Assoc. Ltd.
PROJECT: Mills Bridge
LOCATION: Lot 2 Con 3-4, N. Dorchester Township
DATUM ELEVATION: 100 feet. (see Enclosure 1)

DRILLING DATA
Method: Washboring
Diameter: Bx(3-inch)
Date: November 20, 1967.

ELEVATION Ft.	DEPTH Ft.	DESCRIPTION	SYMBOL	GROUND WATER	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES 'N' Blows/Foot	REMARKS
98.3	0.0	Ground Surface						
	1.0	Topsoil						
95		Brown clayey silt			1	SS	4	
90	8.0	(Fill)						
		Compact grey silt, seams of silty clay			2	SS	13	
85	14.0							
		Stiff grey silty clay, seams of silt			3	SS	8	
80	19.0				4	SS	11	
		Very stiff to hard grey silty clay, trace of sand			5	SS	25	
75					6	SS	54	
70								
	31.5	(Glacial Till)			7	SS	59	
65		End of Borehole						

PENETRATION RESISTANCE Blows / Foot: 20 40 60 80 100
UNDRAINED SHEAR STRENGTH 100 lbs/sq.ft.
+ FIELD VANE TEST @ COMPRESSION TEST
5 10 15 20 25

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

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MADE: CHECKED:

LOG OF BOREHOLE 2

Our Reference No. 7-11-L11

Enclosure No. 3

CLIENT: A.M.Spriet & Assoc. Ltd.
PROJECT: Mills Bridge
LOCATION: Lot 2 Concessions 3-4, N. Dorchester Twp.
DATUM ELEVATION: 100 feet. (see Enclosure 1)

DRILLING DATA
Method: Washboring
Diameter: 3x(3-inch)
Date: November 21, 1967

ELEVATION Ft.	DEPTH Ft.	DESCRIPTION	SYMBOL	GROUND WATER	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES 'N' Blows / Foot	PENETRATION RESISTANCE Blows / Foot (20 40 60 80 100) / UNDRAINED SHEAR STRENGTH + FIELD VANE TEST or COMPRESSION TEST 100 lbs/sq.ft. (5 10 15 20 25)	WATER CONTENT % PLASTIC LIMIT W_P NATURAL W LIQUID LIMIT W_L (10 20 30 40 50)	REMARKS
102.3	0.0	Ground Surface								
	1.0	Road Ballast								
100		Brown clayey silt (Fill)			1	SS	11			2-inch diameter cone
95	10.0									
		Compact grey silt, seams of silty clay			2	SS	11			
90	14.0									
		Firm to stiff grey silty clay, seams of silt			3	SS	10			
85					4	SS	11			
					5	SS	8			
80										
					6	SS	10			
75	27.0									
		Very stiff to hard silty clay, trace gravel seam of sand			7	SS	56			
70										
					8	SS	60			
65										
					9	SS	79			
	40.0	End of Borehole								
60										

VERTICAL SCALE: 1 inch to 5 feet

MADE: CHECKED:

DOMINION SOIL INVESTIGATION LIMITED