

W.O. 70-F-212M

BRIDGE

LOTS 10411 CON 3

TWP. WESTMINSTER

40114-30

DOMINION SOIL INVESTIGATION LIMITED
CONSULTING SOIL & FOUNDATION ENGINEERS
104 CROCKFORD BLVD., SCARBOROUGH, ONT. (416) 751-2565 TELEX 02-21210 CABLES: DOMSOIL

STRUCTURE SITE No. 19-364

A.M. SPRIET AND ASSOCIATES LTD
CONSULTING ENGINEERS
LONDON ONTARIO

~~401-175~~

40114-30

GEOCREG No.

Report on
SOIL INVESTIGATION
for
PROPOSED BRIDGE
LOTS 10 & 11, CONCESSION 3
TOWNSHIP OF WESTMINSTER

by
DOMINION SOIL INVESTIGATION LIMITED
369 Queens Avenue
LONDON 14, ONTARIO

Our Reference: 70-2-L4
March 3rd, 1970.

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SUMMARY

The two boreholes have revealed a soil profile consisting of compact to very dense granular strata which extend to a depth of at least 20 feet below the creek bed.

If spread footings are used a maximum allowable soil pressure of 8000 p.s.f. is recommended in undisturbed soil conditions at or below El. 848. Problems concerning dewatering of excavations are discussed in the report.

The structure may also be supported on timber or concrete filled steel tube piles, which are anticipated to reach a satisfactory set when driven to El. 835.

INTRODUCTION

In accordance with authorization from A. M. Spriet & Associates Limited, Consulting Engineers, a soil investigation has been carried out in the Township of Westminster, 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 the Lot 10/11 Sideroad at Concession 3 of the Township, where the road crosses Dingman Creek.

It is understood that the proposed structure is a 45 foot span concrete rigid frame, and that it will be centred on the existing bridge. The requirements of the project were discussed with Mr . Kelley 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.

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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 10 and 19, 1970, at the locations shown on Enclosure 1. The holes were advanced to the sampling depths by washboring methods and were lined with 8x 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.

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 side of a tree stump at the south east corner of the road intersection. The benchmark was taken as Geodetic El. 863.40.

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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 surface layers of fill, which are associated with the construction of the approaches to the existing bridge. The natural subsoil at borehole 1 location consists of silt and fine sand in which the borehole was terminated at a depth of about 20 feet below the creek bed. The relative density of the silt and fine sand material is described as 'dense' to 'very dense' based on 'N' values ranging from 26 to 87 blows per foot.

Borehole 2 encountered a well-graded sand and fine gravel stratum which extends to a depth of about 15 feet below the creek bed. The relative density of the sand and gravel is described as 'compact' to 'very dense' based on 'N' values



ranging from 16 to 81 blows per foot. The borehole was terminated in a silty fine sand stratum, which has a 'very dense' relative density as indicated by an 'N' value of 82 blows per foot.

Grain size analyses of two typical samples of the sand and gravel, and silty fine sand strata are shown on Enclosure 4.

IV GROUNDWATER CONDITIONS

The groundwater levels in boreholes 1 and 2 reached equilibrium at El. 856.9 and El. 855.7 respectively. The ice level in the adjacent creek was at El. 855.5, at the time the field work was carried out.

V DISCUSSION AND RECOMMENDATIONS

The natural soil profile consists of 'compact' to 'very dense' granular strata, which are suitable for the support of normal spread footing foundations. A displacement pile foundation may be considered as an alternative.

Spread Footings

The creek bed extends down to El. 853.1, therefore normal spread footing foundations will be located at about El. 848 to provide sufficient protection against frost and scour. On the basis of the borehole results a maximum allowable soil pressure of 3000 p.s.f. is appropriate for the design of footings at or below El. 848, and this soil pressure incorporates a factor of safety of at least 3 against shear failure of the underlying soil.

Total settlement of footings mobilizing the above soil pressure is estimated to be 1-inch, and differential settlement between footings will be 0.75 inch or less. The greater part of the settlement will occur immediately as the load is applied.

The coefficient of friction between the footings and the underlying soil may be taken as 0.45, and the factor of safety against horizontal sliding of the abutments must be at least 1.5.

A major problem in the construction of footings below the water table will be to control the groundwater, and to prevent 'sloughing-in' of the sides and



'boiling' occurring in the bottom of excavations. This can be achieved by carrying out the excavation inside continuous sheeting which should be driven to a depth below the footing grade equal to the height of the groundwater table above the footing grade. Alternatively the groundwater table may be lowered below the footing grade during the construction period by the use of a well-point system.

Piled Foundation

An alternative to the use of spread footings with the associated groundwater problems would be the use of displacement piles, which could take the form of timber or concrete filled steel tubes. It is estimated that nominal 12-inch diameter timber and steel tube piles will develop a working load of 20 and 60 tons respectively if driven to El. 835.

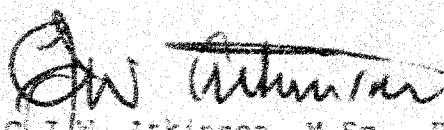


The foregoing estimate of length and bearing capacity of piles are only theoretical predictions based on the soil data. In practice, the piles should be driven to a satisfactory set in accordance with an accepted dynamic pile driving formula, irrespective of the elevation at which such a set is achieved.

Yours very truly,

DOMINION SOIL INVESTIGATION LIMITED




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.

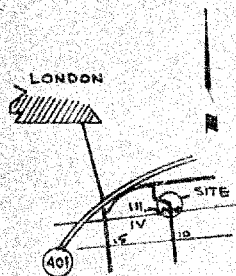
A two inch external diameter thick-walled sample tube is driven into the ground at the bottom of the borehole by means of a 140 lb. hammer falling freely through 30-ins. The tube is first driven an initial 6-inches to allow for the presence of disturbed material at the bottom of the borehole. The number 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:-

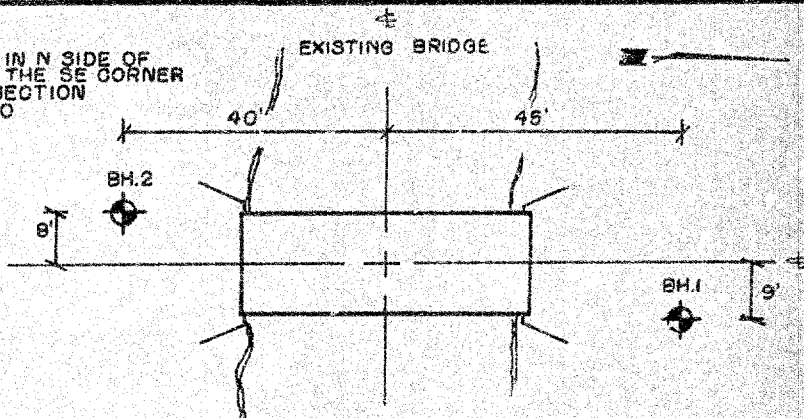
Values of 'N'.	Density.
Less than 10	Loose
Between 10 and 30	Compact
Between 30 and 50	Dense
Greater than 50	Very dense.

B.M. NAIL IN N SIDE OF
STUMP AT THE SE CORNER
OF INTERSECTION
EL. 863.40

EXISTING BRIDGE



WESTMINSTER
TOWNSHIP

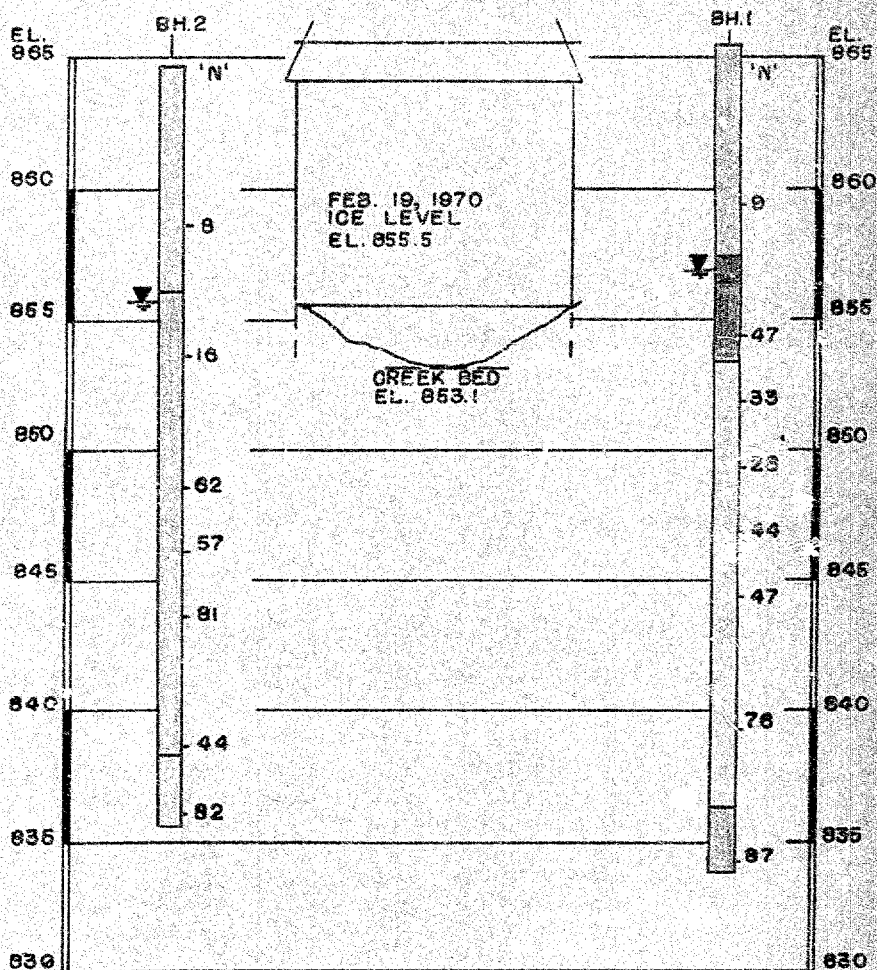


KEYPLAN

LOCATION OF BOREHOLES
SCALE 1" = 20'

LEGEND

- FILL
- TOPSOIL
- COMPACT TO VERY DENSE WELL-GRADED SAND & FINE GRAVEL
- DENSE SILT AND VERY FINE SAND
- DENSE TO VERY DENSE SILTY FINE SAND
- VERY DENSE SILT



SUBSURFACE PROFILE
VERT. SCALE 1" = 5'

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

Our Reference No. 79-2-L4

Enclosure No. 2

CLIENT: A.M. Spriet & Associates Ltd
 PROJECT: Proposed Bridge
 LOCATION: Hubrey Sideroad
 DATUM ELEVATION: Nail in tree stump, El. 863.40 feet

DRILLING DATA

Method: Washboring
 Diameter: 8x (3-inch)
 Date: February 10 & 19, 1970

SUBSURFACE PROFILE				SAMPLES				PENETRATION RESISTANCE					WATER CONTENT %			REMARKS
ELEVATION Ft.	DEPTH Ft.	DESCRIPTION	SYMBOL	GROUND WATER	NUMBER	TYPE	'N' Blows/Foot	20	40	60	80	100	PLASTIC LIMIT	NATURAL	LIQUID LIMIT	
								UNDRAINED SHEAR STRENGTH + FIELD VANE TEST								
863.4	0.0	Ground Surface														
		Brown														
		silty														
		fine														
860		sand			1	SS	9									
	8.0	(Fill)														
	9.0	Topsoil														
855		Dense grey														
	12.0	silt and			2	SS	47									
		very fine sand														
		Dense			3	SS	33									
850		to														
		very			4	SS	26									
		dense														
		grey silty			5	SS	44									
845		fine			6	SS	47									
		sand,														
840		trace														
		of			7	SS	76									
		clay														
835		Very dense														
		grey silt			8	SS	87									
831.5		End of Borehole														

VERTICAL SCALE: 1 inch to 5 feet

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MADE:

CHECKED:

LOG OF BOREHOLE 2

Our Reference No. 70-2-L4

Enclosure No. 3

CLIENT: A. M. Spriet & Associates Ltd

PROJECT: Proposed Bridge

LOCATION: Hubrey Sideroad

DATUM ELEVATION: Nail in tree stump, El. 863.40 feet

DRILLING DATA

Method: Washboring

Diameter: Bx (3-inch)

Date: February 19, 1970

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

864.60.0	Ground Surface																		
	Brown clayey silt (Fill)				1	SS	8												
	Compact to very dense well-graded sand and fine gravel, with a trace of silt				2	SS	10												
					3	SS	62												
					4	SS	57												
					5	SS	81												
					6	SS	44												
	Very dense grey silty fine sand				7	SS	82												
	End of Borehole																		

2-inch diameter cone

VERTICAL SCALE: 1 inch to 5 feet

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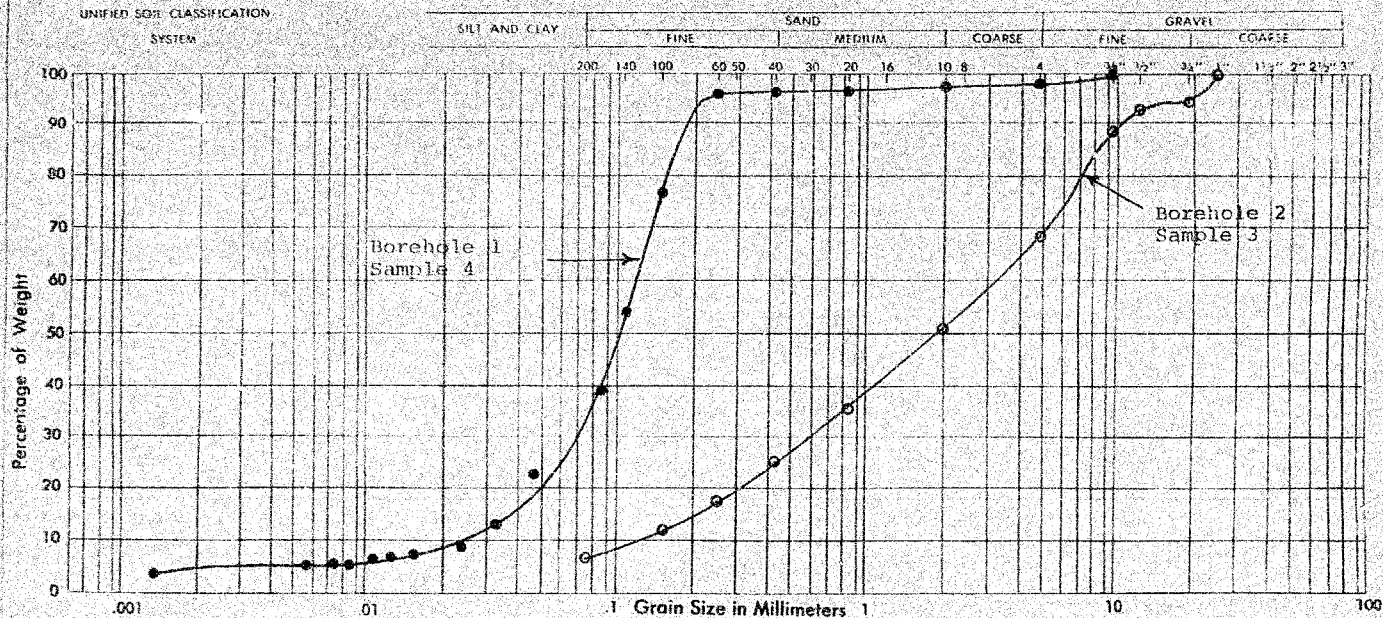
MADE:

CHECKED:

DOMINION SOIL INVESTIGATION LIMITED

GRAIN SIZE DISTRIBUTION

OUR REFERENCE NO. 70-2-L4



PROJECT: Proposed Bridge

LOCATION: Lots 10 & 11, Conc. 3,

BOREHOLE NO. Twp. of Westminster

SAMPLE NO. Borehole 1, Sample 4 &

DEPTH OF SAMPLE: " 2 " 3

ELEVATION OF SAMPLE:

COEFFICIENT OF UNIFORMITY

COEFFICIENT OF CURVATURE

Classification of Sample and Group Symbol:

1/4 SILTY FINE SAND

2/3 WELL-GRADED SAND & FINE GRAVEL,

TRACE OF SILT.

PLASTIC PROPERTIES:

LIQUID LIMIT % =

PLASTIC LIMIT % =

PLASTICITY INDEX % =

MOISTURE CONTENT % =

ACTIVITY =

Enclosure No. 4