

67-F-224 M

HORN BRIDGE

Lot 20, Con. 13 & 14

ELMA

DOMINION SOIL INVESTIGATION LIMITED
77 CROCKFORD BOULEVARD - SCARBOROUGH ONTARIO CANADA - TELEPHONE 421-2567

BRANCH
QUEENS AVENUE
LONDON, ONTARIO
TELEPHONE GE. 3-3881



FOUNDATION ENGINEERS

B.A. 2499
Site 25-73
ASSOCIATED COMPANY
SOIL TESTING AND ENGINEERING LTD.
24 BRENTFORD ROAD,
KINGSTON 5, JAMAICA, WEST INDIES
TELEPHONE: 68288

Letter from Mr. Dawson
1/11/67
London
January 31, 1967

Report
6-11-L22

67-F-224 M

Mr. R. M. Dawson,
Consulting Engineer,
258 William Street,
STRATFORD, Ontario.

Dear Sir:

Soil Investigation for Horn Bridge,
Lot 20, Concessions 13 and 14
Township of Elma.

40 P/H E.
HAD NO.

INTRODUCTION

In accordance with a letter of authorization dated November 21, 1966, a soil investigation has been carried out in the Township of Elma where it is proposed to replace an existing bridge with a new structure.

The existing concrete deck bridge is located on Lot 20, Concession XIII and XIV of Elma Township and is referred to as Horn Bridge. It is understood that the proposed structure will have the same centre line as the existing bridge.

The purpose of this 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.

FIELD WORK

The field work, consisting of one borehole, was carried out on January 4 and 5, 1967, at the location shown on Enclosure 2. The hole was advanced by washboring methods and was lined with Bx casing.

Standard Penetration tests were carried out at frequent intervals of depth, as detailed on Appendix A, and the results are recorded on the Geotechnical Data Sheet as 'N' values.

The results of the field tests are presented on the Geotechnical Data Sheet, Enclosure 3. Elevations were referred to the centre of the existing bridge deck, which was given the arbitrary value, El. 100 feet.

SUBSURFACE CONDITIONS

Detailed descriptions of the strata encountered in the borehole are given on the Geotechnical Data Sheet, comprising Enclosure 3, and a general picture of the soil stratigraphy in relation to the existing bridge is given in the form of a Subsurface Profile on Enclosure 2.

The borehole revealed the following general ground succession:-

	<u>Thickness</u>
(a) Road ballast	1' - 0"
(b) Loose brown sandy silt (Fill). This material is associated with the construction of the approaches to the existing fill.	4' - 6"
(c) Loose brown sandy silt and organics (Topsoil).	2' - 6"
(d) Brown silt containing a trace of fine sand. The relative density of this stratum is described as 'very dense' as indicated by standard pene- tration test results of 165 and 172 blows per foot.	6' - 6"

- (e) Grey silty clay containing a little gravel and sand. The consistency of this stratum is described as 'hard' as indicated by standard penetration test results ranging from 76 to 156 blows per foot.

Penetrated
7' - 0"

LABORATORY TESTS

Atterberg Limit and moisture content tests were carried out on a sample of the clay till stratum as a means of classification and as a guide to the probable behaviour of the soil. These gave a value of Liquid Limit of 19%; Plastic Limit of 10% and Plasticity Index of 9, indicating that the soil is a clay of low plasticity and compressibility. The Liquidity Index which relates the natural moisture content of the clay to the Atterberg Limits was 0.11 indicating a 'very stiff' consistency.

GROUNDWATER CONDITIONS

Groundwater was observed at El. 88.3 in the borehole, which was about 1 foot lower than the water level in the adjacent creek. For practical purposes however, when considering seepage into excavations, it can be assumed that the groundwater level corresponds to the water level in the creek at that particular time.

DISCUSSION AND RECOMMENDATIONS

The soil profile at the borehole location consists of surface layers of embankment fill and topsoil overlying very dense silt and hard clay till strata. The silt stratum is highly susceptible to scour, therefore it is recommended that the footings be supported in the clay till stratum at or below El. 84. In this

respect, careful inspection should be carried out during the excavation for the footings to confirm that the soil profile revealed by the borehole is representative of the whole site.

On the basis of the borehole results, a maximum net soil pressure of 10,000 pounds per square foot is appropriate for the design of footings at or below El. 84. This figure 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 less than 1/2 inch.

The adhesion between the footings and the clay till may be taken as 2000 p.s.f. and the factor of safety against sliding of the abutments should be at least 1.5.

Due to the relatively low permeability of the silt and clay strata, it is anticipated that seepage into excavations will be within the limits controllable by pumping from sumps or trenches.

However, due to the non-cohesive nature of the silt stratum, it will be necessary to provide lateral support for excavations below the water table in this stratum unless very flat side slopes are employed.



Yours very truly,

DOMINION SOIL INVESTIGATION LIMITED


Victor S. Chan, P. Eng.,
Project Engineer

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

Enclosures

LIST OF SYMBOLS, ABBREVIATIONS AND NOMENCLATURE.

SOIL COMPONENTS AND GROUND WATER CONDITIONS.

BOULDER	COBBLE	GRAVEL	SAND	SILT	CLAY	ORGANICS	BEDROCK	GROUND WATER LEVEL	DEPTH OF CAVE-IN
$\phi > 6"$	$3" - 3\frac{1}{4}"$	COARSE FINE	COARSE MEDIUM FINE	0.074	0.002	NO SIZE LIMIT			
U.S. Standard Sieve Size:		No. 4	No. 10	No. 40	No. 200				

SAMPLE TYPES.

AS Auger sample
CS Sample from casing
ChS Chunk sample

RC Rock core
% Recovery
SS Split spoon sample

TP Piston, thin walled tube sample
TW Open, thin walled tube sample
WS Wash sample

SAMPLER ADVANCED BY static weight : w
" pressure : p
" tapping : t

OBSERVATIONS
MADE WHILE
CORING

Steady pressure
No pressure
Intermittent pressure

Washwater returns
Washwater lost

PENETRATION RESISTANCES.

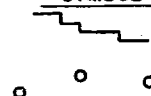
DYNAMIC PENETRATION RESISTANCE : to drive a 2" ϕ , 60° cone attached to the end of the drilling rods into the ground, expressed in blows per foot.

STANDARD PENETRATION RESISTANCE, -N- : to drive a 2" outside dia, split spoon sampler 1 foot into the ground, expressed in blows per foot.

EXTRAPOLATED -N- VALUE

The energy for the penetration resistances is supplied by a 140 lb. hammer falling 30 inches

SYMBOL :



322

SOIL PROPERTIES.

W %	Water content	γ	Natural bulk density (unit weight)	k	Coeff. of permeability
LL %	Liquid limit	e	Void ratio	C	Shear strength
PL %	Plastic limit	RD	Relative density	ϕ	Angle of int. friction
PI %	Plasticity index	C _v	Coeff. of consolidation	C'	Cohesion
LI	Liquidity index	m _v	Coeff. of volume compressibility	ϕ'	Angle of int. friction

UNDRAINED SHEAR STRENGTH.

- DERIVED FROM -

TRIAXIAL COMPRESSION TEST

UNCONFINED TEST

LABORATORY VANE TEST

FIELD

POCKET PENETROMETER TEST

Strain at failure is represented by direction of stem

St : sensitivity = $\frac{\text{shear strength in undisturbed state}}{\text{shear strength in remoulded state}}$

SOIL DESCRIPTION.

COHESIONLESS SOILS :

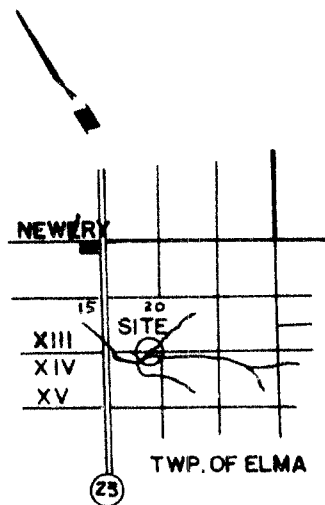
RD :

COHESIVE SOILS :

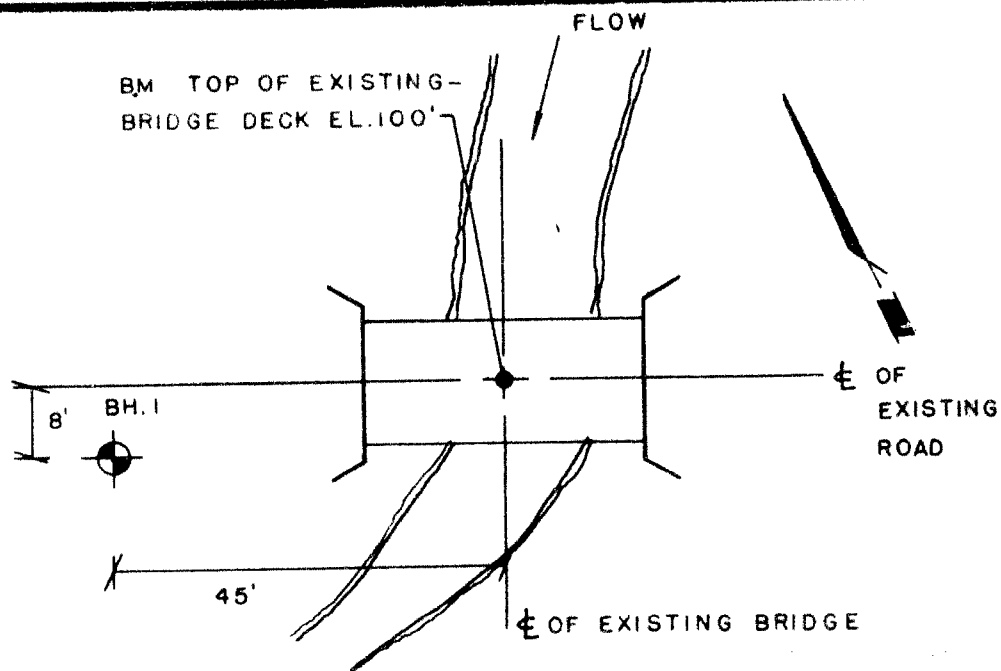
C lbs/sq.ft.

Very loose	0 - 15 %
Loose	15 - 35 %
Compact	35 - 65 %
Dense	65 - 85 %
Very dense	85 - 100 %

Very soft	less than 250
Soft	250 - 500
Firm	500 - 1000
Stiff	1000 - 2000
Very stiff	2000 - 4000
Hard	over 4000



KEY PLAN



LOCATION OF BOREHOLE
SCALE 1" = 20'

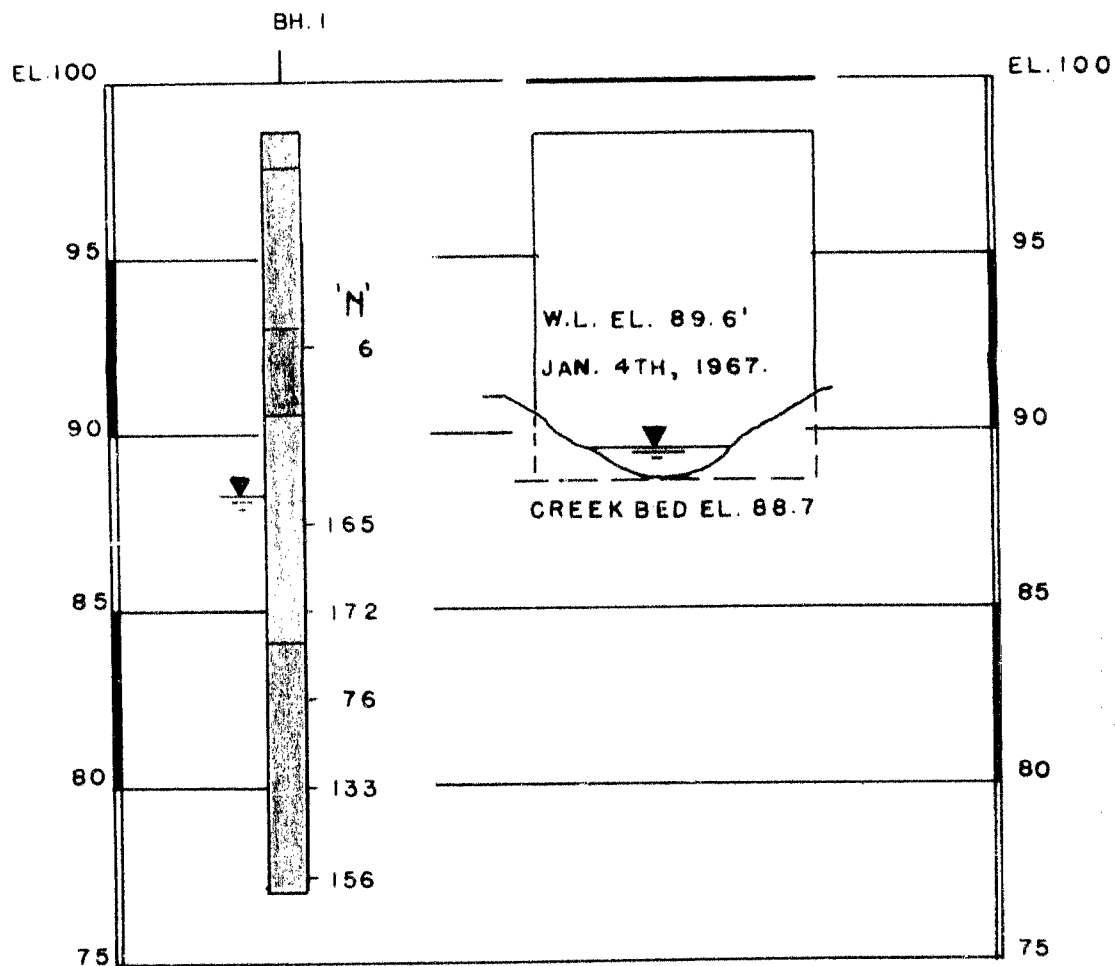
LEGEND

GENERAL FILL

TOPSOIL

VERY DENSE SILT

HARD SILTY CLAY
TILL



SUBSURFACE PROFILE
VERT. SCALE 1" = 5'

GEOTECHNICAL DATA SHEET FOR BOREHOLE 1. . . .

OUR REFERENCE NO. 6-11-L22

CLIENT: R. M. Dawson

PROJECT: Horn Bridge

LOCATION: Lot 20, Concs. 13 & 14, Twp. of Elma.

DATUM ELEVATION: 100 feet (See Enclosure 2)

METHOD OF BORING: Auger

DIAMETER OF BOREHOLE: 4-inch

DATE: January 4 & 5, 1967

ENCLOSURE NO. 3

ELEVATION ft	DEPTH ft	STRATIFICATION DESCRIPTION	STRATIFICATION SYMBOL	SAMPLES			PENETRATION RESISTANCE blows per foot					CONSISTENCY water content %				REMARKS
				NUMBER	TYPE	N or Advance- ment of Sampler	20	40	60	80	100	PI	W	LI		

▼ W. L.
El. 88.3
Jan 5, '67