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DIST. 3 REGION SOUTHWESTERN

W.P. No. _____

CONT. No. _____

W. O. No. _____

STR. SITE No. 12-146

HWY. No. _____

LOCATION PROP. NEW BRIDGE-361, CO. OF
HURON, GREY TWP, CON. 4, LOT 35

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OVERSIZE DRAWINGS TO BE INCLUDED WITH THIS REPORT. _____

REMARKS: DOCUMENTS TO BE UNFOLDED BEFORE
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40P11-14

ORDER No.

Report On
SOIL INVESTIGATION
for
PROPOSED NEW BRIDGE
LOT 35, CONCESSION 4
TOWNSHIP OF GREY
COUNTY OF HURON

STRUCTURE SITE No. 12-146

by

Dominion Soil Investigation Limited
164 Newbold Court
London Ontario

Ref: 75-7-L4
August 21, 1975

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I

INTRODUCTION

In accordance with a letter of authorization from B.M. Ross & Associates Limited, Consulting Engineers, a soil investigation has been carried out on the County line between Huron and Perth Counties, where it is proposed to replace an existing bridge with a new structure. The existing structure is located at Lot 35, Concession 4 of the Township of Grey in the County of Huron, and it consists of a concrete deck and steel truss construction.

It is understood that the proposed structure is a 70 foot span beam bridge with a new centre line approximately 87 feet to the north of the existing north abutment. The requirements of the project were discussed with Mr. K. G. Dunn, P.Eng., who supplied the foregoing information.

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

II

FIELD WORK

The field work, consisting of two boreholes, was carried out on July 15, 1975, at the locations shown on Enclosure 2. The holes were advanced to the sampling depths by a continuous flight power 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 split-spoon samples were stored in air-tight containers, which were transferred to our London laboratory for classification, testing and storage.

The field work was supervised by a soils technician, who also related the ground surface elevations to a local datum. The benchmark was taken as the low steel of the existing structure, and it was established by the client as having a Geodetic value El. 1174.30 feet.



III

SUBSURFACE CONDITIONS

Detailed descriptions of the strata, which were encountered in each borehole, are given on the borehole logs comprising Enclosures 3 and 4, and a general picture of the soil stratigraphy is presented in the form of a Subsurface Profile on Enclosure 2. The following notes are intended only to amplify this data.

Both boreholes encountered fill materials to depths of 7½ and 11 feet, which are associated with the construction of the existing road. The fill generally consists of granular materials grading from sand and gravel to silty fine sand.

The natural soil profile at the south abutment location consists of a layer of dense sandy silt overlying successive layers of glacial till which grade from sandy silt to silty clay. At the north abutment location the native subsoil consists of till materials from the bottom of the fill to the termination of the borehole at a depth of 31½ feet. The consistency of the cohesive clayey silt and silty clay tills is described as 'hard' based on 'N' values ranging from 48 to 119

blows per foot, which were confirmed by undrained shear strength values ranging from 3360 to 5000 p.s.f. The relative density of the sandy silt till is described as 'very dense' based on 'N' values ranging from 68 to 100 blows per foot. The natural moisture content of the sandy silt till was observed to range from 7.9 to 8.8%, the natural moisture content of the clayey silt till was observed to range from 8.4% to 10.1%, and the natural moisture content of the lower silty clay till stratum was observed to range from 16.2% to 28.6%.

IV

GROUNDWATER CONDITIONS

Water levels were observed at El. 1168.2 and El. 1168.8 in boreholes 1 and 2 respectively, and the water level in the adjacent stream was observed at El. 1166.3. For construction purposes it may be assumed that the water level adjacent to the site is closely related to the stream level at any particular time.

V

DISCUSSION AND RECOMMENDATIONS

The investigation has shown that the stream bed is located near the surface of the 'hard' clayey silt till layer, which is underlain by successive layers of 'very dense' sandy silt, 'hard' clayey silt and 'hard' silty clay. The site is therefore suitable for the support of normal spread footing foundations, which should be established at a minimum depth of 4 feet below the stream bed for protection against heave due to frost action. On the basis of the borehole results a maximum allowable soil pressure of 4 tons per square foot is appropriate for the design of footings located at or below El. 1160.

The recommended soil pressure incorporates a factor of safety of 3 against shear failure of the underlying soil, and total settlement of footings 10 feet in width is estimated to be 0.5 inch or less. In view of the uniform soil conditions revealed by the boreholes, no appreciable differential settlement is anticipated.

The adhesion between the footings and the clayey silt till may be taken as 2000 p.s.f. or 35 % of the vertical load, whichever is the lower value, and the factor of safety against horizontal sliding of the abutments must be at least 1.5.

The native subsoil is unsuitable for use as backfill behind retaining walls therefore free-draining granular material will be required to comply with the requirements of the Ministry of Transportation and Communications. The bulk density of the granular fill may be assumed to be 130 p.c.f. and the coefficient of active earth pressure equal to 0.4.

Some seepage will be encountered from the upper layers of sand and gravel and silty fine sand fill, however it is anticipated that this will be controlled by pumping from sumps dug into the impervious clayey silt stratum. The footing grade should be protected from freezing or softening after it has been exposed, and the footing concrete should be poured as soon as possible after the excavation has been completed to minimize disturbance to the subgrade.



CJWA:eg

Yours very truly,

DOMINION SOIL INVESTIGATION LIMITED

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

DOMINION SOIL INVESTIGATION LIMITED

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

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
		COARSE	FINE	COARSE	MEDIUM	FINE						
> 8"		3"	3/4"	4.76mm	2.0	0.42	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	RC	Rock core	TP	Piston, thin walled tube sample
CS	Sample from casing	%	Recovery	TW	Open, thin walled tube sample
CHS	Chunk sample	SS	Split spoon sample	WS	Wash sample
SAMPLER ADVANCED BY		static weight :	w	OBSERVATIONS	Steady pressure
"		pressure :	p	MADE WHILE	No pressure
"		tapping :	t	CORING	

PENETRATION RESISTANCES.

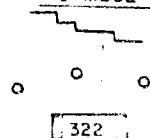
DYNAMIC PENETRATION RESISTANCE : to drive a 2", 60° cone attached to the end of the drilling rods into the ground, expressed in blows per foot

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

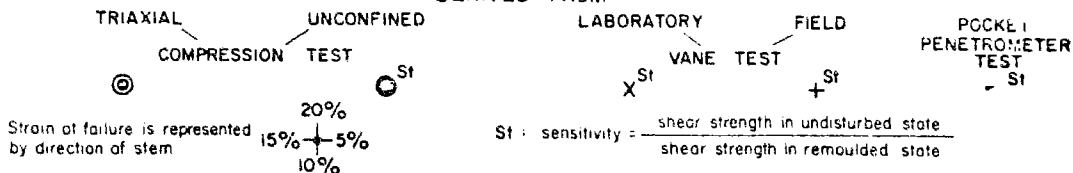


SOIL PROPERTIES.

W %	Water content	w	Natural bulk density (unit weight)	k	Coeff. of permeability	
LL %	Liquid limit	e	Void ratio	c	Shear strength	in terms of total stress
PL %	Plastic limit	R_D	Relative density	ϕ	Angle of int. friction	
PI %	Plasticity index	C_v	Coeff. of consolidation	c'	Cohesion	in terms of effective stress
LI	Liquidity index	m_v	Coeff. of volume compressibility	ϕ'	Angle of int. friction	

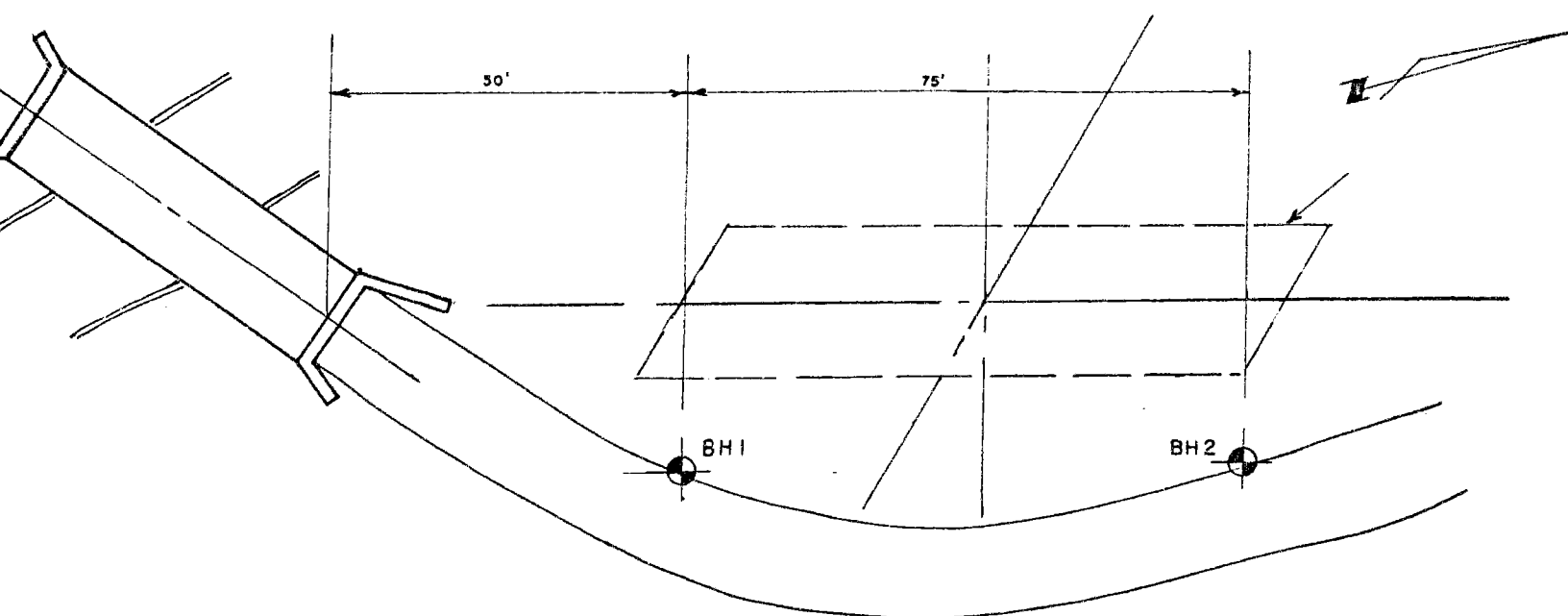
UNDRAINED SHEAR STRENGTH.

- DERIVED FROM -

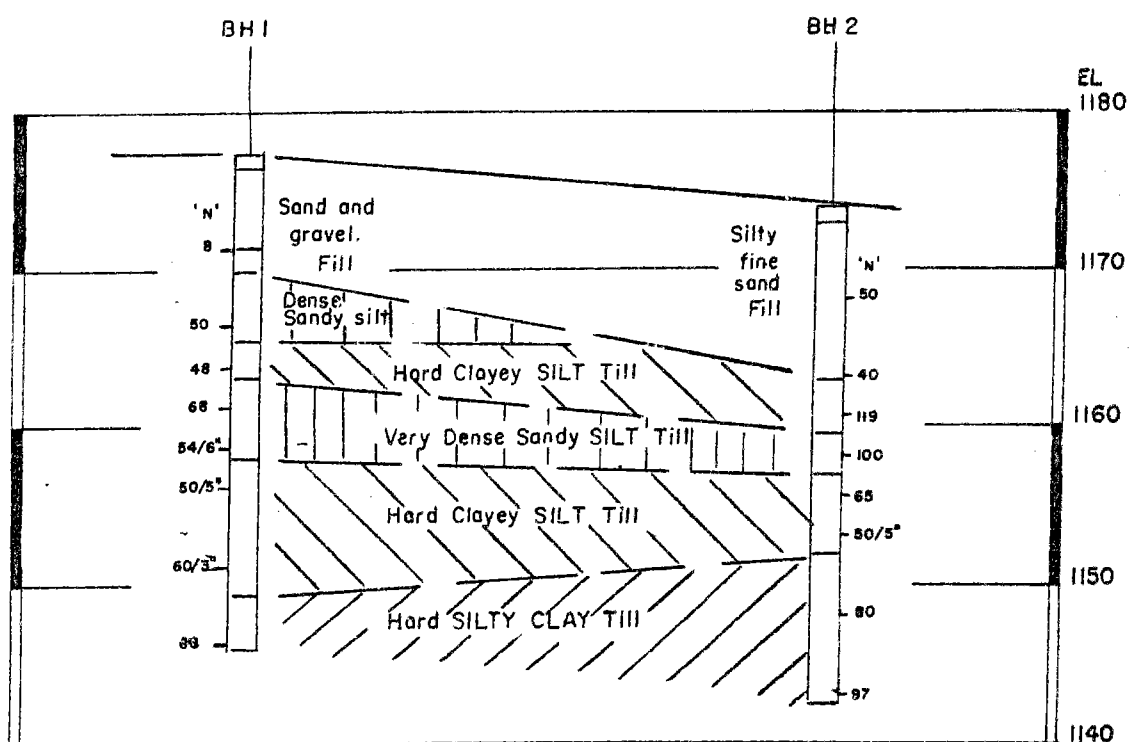


SOIL DESCRIPTION.

COHESIONLESS SOILS :		RD :	COHESIVE SOILS		C	lbs/sq ft
Very loose	0 - 15 %		Very soft			less than 250
Loose	15 - 35 %		Soft			250 - 500
Compact	35 - 65 %		Firm			500 - 1000
Dense	65 - 85 %		Stiff			1000 - 2000
Very dense	85 - 100 %		Very stiff			2000 - 4000
			Hard			over 4000



LOCATION OF BOREHOLES
Scale 1" = 20'



SUBSURFACE PROFILE
Hor Scale 1" = 20'
Vert Scale 1" = 10'

CLIENT: B.M. Ross & Associates Ltd.

PROJECT: Proposed Bridge BR-361

LOCATION: County of Huron,

DATUM ELEVATION: low steel, El.1174.3 feet.

DRILLING DATA

Method: Auger

Diameter: 4 1/2 inch

Date: July 15, 1975

Encl. 3

SUBSURFACE		PROFILE		SAMPLES			PENETRATION RESISTANCE					Blows / ft.				PLASTIC LIMIT %	NATURAL WATER %	LIQUID LIMIT %
ELEVATION Ft.	DEPTH Ft.	DESCRIPTION	SYMBOL	GROUND WATER	NUMBER	TYPE	'N'	Blows / Foot	20	40	60	80	100					
									Undrained Shear Strength 100 p.s.f. + Field vane test or Compression test									
									20	40	60	80	100					
1772.00		Ground Surface																
	1.0	Gravel																
75		Sand and gravel. Fill.																
	6.0	Sandy silt with topsoil Fill			1	SS	8	o								38.6		
70	7.5	Dense brown sandy silt																
					2	SS	50		o							9.4		
65	12.0	Hard grey clayey silt till			3	SS	48		o							8.7		
	14.5	Very dense grey sandy silt till.			4	SS	68									7.9		
60					5	SS	54/5"								o	8.4		
	19.5	Hard grey clayey silt till			6	SS	50/5"								→	10.1		
55																		
					7	SS	60/3"								→	8.4		
50	28.0	Hard grey silty clay till.																
	31.5				8	SS	68								o	28.6		
45		End of Borehole																

Vertical scale - Next to 5 feet

