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ENTRANCE BRIDGE

JOB # 4/65

LOT 3, CON. IV

DELAWARE TWP.

BA 2299
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COUNTY BUILDINGS
LONDON ONTARIO

Report on
SOIL INVESTIGATION
for
ENTRANCE BRIDGE JOB #4/65
LOT 3, CONCESSION IV
TOWNSHIP OF DELAWARE

by
DOMINION SOIL INVESTIGATION LIMITED
369 Queens Avenue
LONDON ONTARIO

Reference No. 6-2-L9
March 14th, 1966

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SUMMARY

The natural soil consists of a dense to very dense fine sand stratum which was penetrated to a depth of 17 feet below the proposed creek bed.

It is recommended that the structure be supported on spread footing foundations using a maximum allowable soil pressure of 10,000 pounds per square foot. Total settlement is estimated to be less than 1/2 inch.

No unusual construction problems are anticipated.

I INTRODUCTION

In accordance with a letter of authorization, dated February 28, 1966, a soil investigation has been carried out in the Township of Delaware where it is proposed to construct an entrance bridge over a proposed stream diversion channel.

It is understood that the proposed structure is a rigid frame with about a 55 to 60 foot span. The bridge was located with the aid of a preliminary site plan supplied by the County of Middlesex and the boreholes were set out accordingly. The requirements of the project were discussed with Mr. J. P. McIntyre, P. Eng., who supplied the foregoing information.

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 bridge foundations.

II FIELD WORK

The field work, consisting of 2 boreholes, was carried out on March 3 and 4, 1966, at the locations shown on Enclosure 2. The holes were advanced by washboring methods, and were lined with Bx casing.

Standard Penetration Tests using a 2-inch outside diameter split-spoon sampler were performed at frequent intervals of depth, using a driving force of a 140 lb. hammer falling freely through 30-inches. 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 required to drive the sampler a further 12-inches was recorded as the standard penetration resistance (or 'N' value). This test determines the relative density of granular strata and gives an indication of the consistency of cohesive strata. It also enables samples to be obtained for classification purposes.

The results of the field tests are presented on the Geotechnical Data Sheets, Enclosures 3 and 4. Elevations were referred to a site benchmark which was indicated on the clients site plan B.M. No. 3, El. 50.15 feet.

III SUBSURFACE CONDITIONS

Detailed descriptions of the strata encountered in each borehole are given on the Geotechnical Data Sheets, comprising Enclosures 3 and 4, and a general picture of the soil stratigraphy is given in the form of a Subsurface Profile on Enclosure 2.

Both boreholes penetrated a stratum of generally uniform fine sand throughout their depth, although traces of fine gravel were found between El. 45 and El. 50. A layer of fine to medium sand was penetrated between El. 35 and El. 45 in borehole 1, and between El. 30 and El. 35 in borehole 2.

The relative density of the sand stratum generally increases with depth and is described as 'dense' to 'very dense' as estimated from standard penetration test results ranging from 33 blows per foot to refusal values of 100 blows for less than 1 foot penetration of the sampler.

IV GROUNDWATER CONDITIONS

The groundwater in the two boreholes reached equilibrium at an average level of El. 21.4, indicating that the water in the adjacent creek is flowing in a relatively impermeable channel.

V DISCUSSION

The creek bed level at the site of the proposed bridge will be at about El. 34, therefore allowing 4 feet depth of soil cover for frost protection, the footings will bear at or below El. 30. In order to determine the elevation at which the foundations must be located, the likely depth of scour in the stream bed must be determined. The hydraulics of the creek must be considered in estimating the depth of scour and such considerations do not fall within the scope of this report. However, the soil in which the creek bed will be founded is considered to be highly susceptible to erosion by the creek flow. This is because the soil is uncemented and is predominantly a fine sand gradation.

If normal spread footings are placed at or below El. 30, the maximum allowable soil pressure based on the 'very dense' relative density of the sand stratum will be 10,000 pounds per square foot. Total settlement of the foundations is estimated to be less than 1/2 inch, and a factor of safety of at least 3 against shear failure of the underlying soil is incorporated in the allowable soil pressure.

In considering the resistance of the foundations to horizontal forces, a force due to friction between the soil and the foundations equal to 45% of the vertical loading may be used and the factor of safety against sliding should be at least 1.5.

The water table is apparently well below the depth to which excavation will take place, therefore no unusual problems in construction are anticipated providing that the bridge foundation is constructed prior to excavation of the diversion channel. A similar water condition was encountered in the

boreholes made at the bridge immediately upstream from this site, therefore it must be assumed that the creek is flowing in an impervious channel and the water is in a 'perched' condition.



Yours very truly,

DOMINION SOIL INVESTIGATION LIMITED

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CJWA:js

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
		COARSE	FINE	COARSE	MEDIUM	FINE						
Ø	> 8"	3"	¾"	4 7/8mm	20	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		Washwater returns
"		pressure	p	MADE WHILE CORING		No pressure		Washwater lost
"		tapping	t			Intermittent pressure		

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



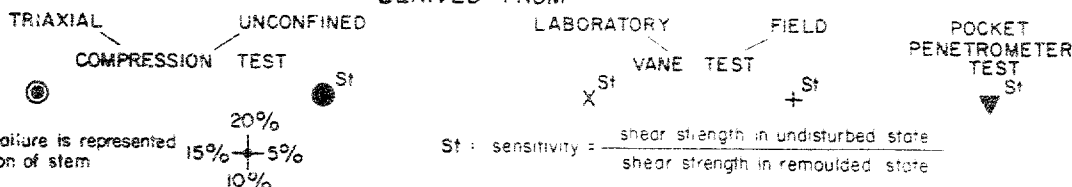
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SOIL PROPERTIES.

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

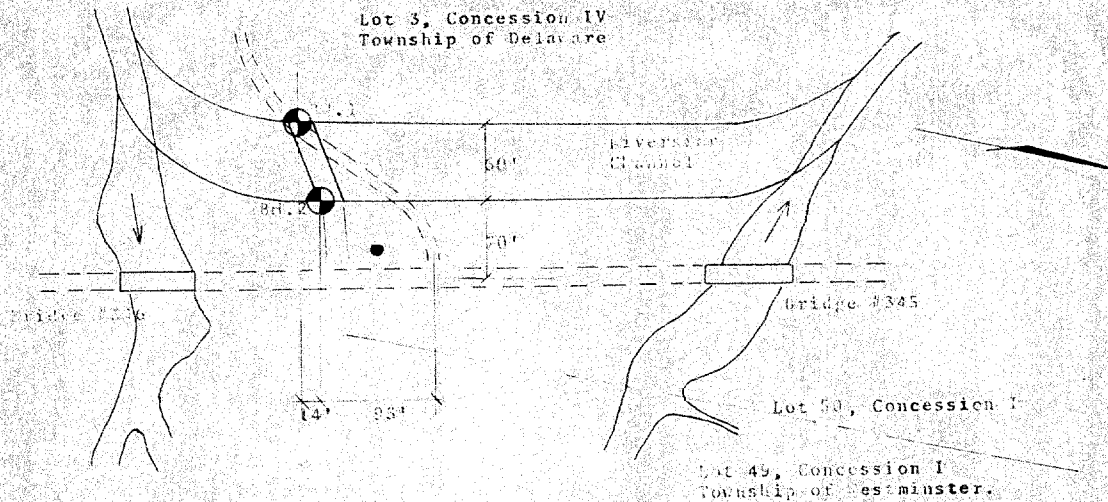
UNDRAINED SHEAR STRENGTH.

— DERIVED FROM —

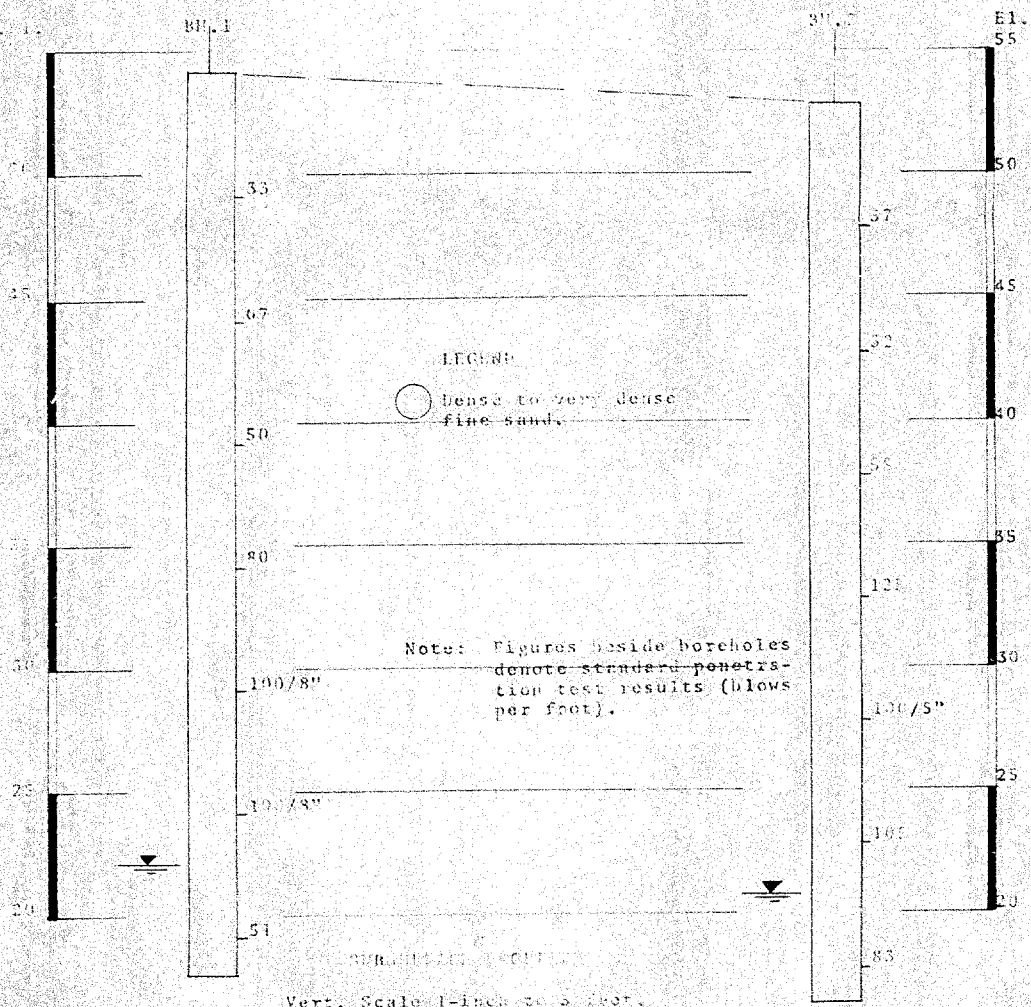


SOIL DESCRIPTION.

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-inch to 100 feet



GEOTECHNICAL DATA SHEET FOR BOREHOLE 11111

OUR REFERENCE NO. 6-2-19

CLIENT: County of Lincoln

PROJECT: Entrance to the 11111

LOCATION: Lot 11, Township 11N, Range 11E, S. 11

DATUM ELEVATION: 50.15 feet to 5.0 5.0

METHOD OF BORING: Wash boring

DIAMETER OF BOREHOLE: 5.0 (11111)

DATE: March 3, 1966

ENCLOSURE NO.

ELEVATION ft.	DEPTH ft.	STRATIFICATION DESCRIPTION	STRATIFICATION SYMBOL	SAMPLES			PENETRATION RESISTANCE blows per foot					CONSISTENCY water content %			REMARKS
				NUMBER	TYPE	N or Admixture of Samples	20	40	60	80	100	FL	W	LL	
54.1	0.0	Ground Surface													
50		Dense		1	SS	53									
		fine													
		gravel													
45		to		2	SS	67									
40		coarse		3	SS	50									
		sand													
35		dense		4	SS	60									
30		fine		5	SS	100.5"									
		brown													
		grey													
25				6	SS	100.5"									
20				7	SS	51									
15.5		End of Borehole													

VERTICAL SCALE: 1 IN. TO 5 FT.

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GEOTECHNICAL DATA SHEET FOR BOREHOLE 2

OUR REFERENCE NO. 1-2-13

CLIENT: County of Middlesex
PROJECT: Entrance Bridge Job #4/65
LOCATION: Lot 3, Concession 10, Twp. of Delaware
DATUM ELEVATION: 50.15 feet B.M. #3.

METHOD OF BORING: Wash boring
DIAMETER OF BOREHOLE: 8x (3-inch)
DATE: March 4, 1966

ENCLOSURE NO. 4

ELEVATION ft.	DEPTH ft.	STRATIFICATION DESCRIPTION	STRATIFICATION SYMBOL	SAMPLES			PENETRATION RESISTANCE blows per foot					CONSISTENCY water content %			REMARKS
				NUMBER	TYPE	Notes Advance Sample D	20	40	60	80	100	PL	W	LI	
52.80	0.0	Original surface													
50.0	2.8	Dense fine gravel	SS	1	SS	37									
45.0	7.8														
40.0	12.8	Very		2	SS	52									
35.0	17.8	Dense		3	SS	58									
30.0	22.8	medium sand		4	SS	125									
25.0	27.8	fine		5	SS	100/5"									
20.0	32.8	sand		6	SS	105									
15.0	37.8			7	SS	83									
10.0	42.8	End of Borehole													