64-F-271 M

BRIDGE BR. 127

LOT. 18, CON II & III

LOGAN

TWP

B.A. 1961

25-125

MR. B. M. ROSS
CONSULTING ENGINEER
GODERICH ONTARIO

Report on

SOIL INVESTIGATION

for

BRIDGE BR 127

LOT 18, CONCESSIONS II & III

TOWNSHIP OF LOGAN

64-F-97,M

by

DOMINION SOIL INVESTIGATION LIMITED
363 Queens Avenue
LONDON ONTARIO

Reference No. 4-10-L7
November 9th, 1964

CONTENTS

ENCLOSURES

SUMMARY

The strata consist of very dense, cohesive glacial deposits.

It is recommended that the structure should be supported on spread footings designed for a maximum net soil pressure of 10,000 pounds per square foot. The resulting long-term settlement is not expected to exceed 0.5 inch.

No unusual construction problems are anticipated.

I INTRODUCTION

Verbal authorization was received from Mr. B. M. Ross's office on the 16th of October, 1964 to carry out a soil investigation at a site in the Township of Logan where it is proposed to replace an existing road bridge with a new structure.

The existing structure has a clear span of 77 feet. It is understood that the new bridge will probably be a concrete rigid frame of similar span and in the same position. The requirements of the project were discussed with Mr. K. G. Dunn 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 new foundations.

II FIELD WORK

The field work was done during the period 17th to 20th of October, 1964 and consisted of two boreholes at the locations shown on enclosure 2. The holes were advanced by washboring and lined with Bx casing. In borehole 2 the progress of the drilling was expedited by the use of diamond coring techniques to penetrate very dense glacial deposits below El. 1096.

Standard penetration tests were performed at frequent intervals of depth to determine the relative density or consistency of the soil and to recover representative samples. Dynamic cone penetration tests were performed adjacent to each borehole. Sections of core from boulders and cobbles were recovered during the process of diamond drilling described above.

The results of the field tests are recorded on enclosure 3. Elevations have been referred to the level of the existing bridge deck taken as El. 1114.93 feet.

III SUBSURFACE CONDITIONS

Details of the stratification at each borehole are shown on the data sheets and a general picture of the soil stratigraphy is given in the form of a subsurface profile on enclosure 2.

Boreholes 1 and 2 encountered 8.0 and 14.0 feet respectively of firm to stiff clayey silt fill which comprises the present road embankment. The material contains traces of gravel and organics.

In borehole 1 only, a hard grey silty clay was found between 8.0 and 11.5 feet. Its moisture content is close to the plastic limit. This is a glacial deposit possibly of the same origin as the underlying till. It differs in that it has a higher clay content and little granular material.

Both boreholes encountered a 6-inch seam of fine cohesionless sand at about El. 1098.

The borings were terminated in a very dense deposit of sandy clayey silt till. The moisture content of the matrix is below the plastic limit. It contains fine gravel and sand particles representing up to 20% of the total volume, but in general the permeability of the stratum is very low. In borehole 2, limestone, cobbles or boulders were encountered from which sections of core up to 6 inches in length were recovered.

The site is located in a wide shallow, glacial spillway now occupied by the North Branch of the River Thames. The soil deposits encountered in this investigation belong to the Stratford Till Plain.

IV GROUNDWATER CONDITIONS

Within the duration of the field work, the level of groundwater in the boreholes became established at an average elevation of 1102.3 feet. The level of water in the river at this time was El. 1102.1.

V DISCUSSION

It has been shown that the subsoil is a dense cohesive glacial deposit which is suitable for the support of the proposed rigid frame structure.

The bed of the river extends to El. 1099.9 and allowing for scour it is recommended that the footings should bear at El. 1095. This level lies within the very hard till stratum, and on the basis of the field tests a maximum net soil pressure of 10,000 pounds per square foot is recommended for the design of footings. It is estimated that the settlement due to consolidation of the soil below a footing 4 feet wide loaded to 10,000 pounds per square foot will not exceed 0.5 inch. In view of the very similar conditions at the two boreholes, no appreciable differential settlement is anticipated.

The coefficient of friction between the footings and the clay till should be taken as 0.35 and the factor of safety against horizontal sliding of the abutments should be at least 1.5. If this can not be achieved by friction alone, the footings should be lowered below the assumed level of maximum scour and the passive resistance of the soil can then be utilized. The coefficient of passive earth pressure should be taken as $K_p = 1 + 2c/\gamma H$ where c = 3000 pounds per square foot and γ = 70 pounds per cubic foot.

Excavations through the fill should be sloped at 1 to 1. It is anticipated that the sides of excavations through the natural soil will stand vertically without support. The volume of seepage through the till will be easily controlled by pumping.

DOMINION SOIL INVESTIGATION LIMITED

James Park

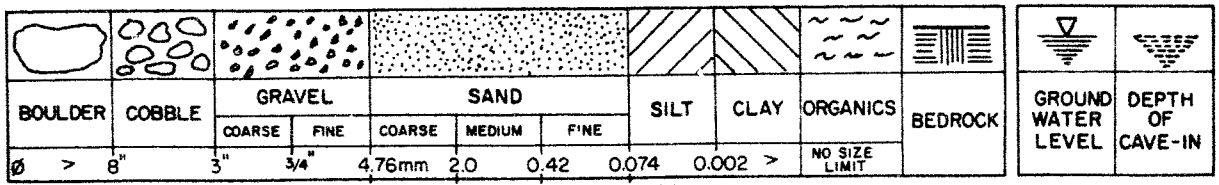
JP/mkf

James Park, M. Sc., P. Eng.

ENCLOSURES

LIST OF SYMBOLS, ABBREVIATIONS AND NOMENCLATURE.

SOIL COMPONENTS AND GROUND WATER CONDITIONS.



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
" pressure : p
" tapping : t

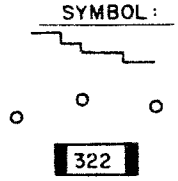
OBSERVATIONS MADE WHILE CORING: Steady pressure; No pressure; Intermittent pressure; Washwater returns; Washwater lost

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.

SYMBOL :



EXTRAPOLATED -N- VALUE

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

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 total stress
PL %	Plastic limit	RD	Relative density	ϕ	Angle of int. friction — in terms of total stress
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 — in terms of effective stress

UNDRAINED SHEAR STRENGTH.

— DERIVED FROM —

TRIAXIAL COMPRESSION — UNCONFINED TEST — St

LABORATORY VANE TEST — St

FIELD VANE TEST — St

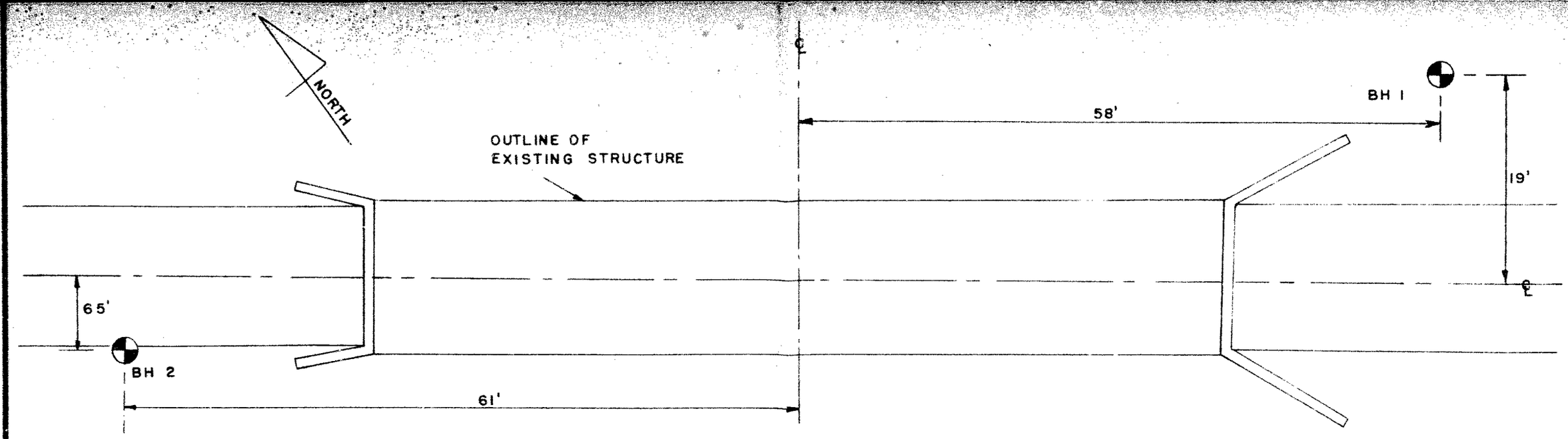
POCKET PENETROMETER TEST — St

Strain at failure is represented by direction of stem: 20%, 15%, 5%, 10%

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

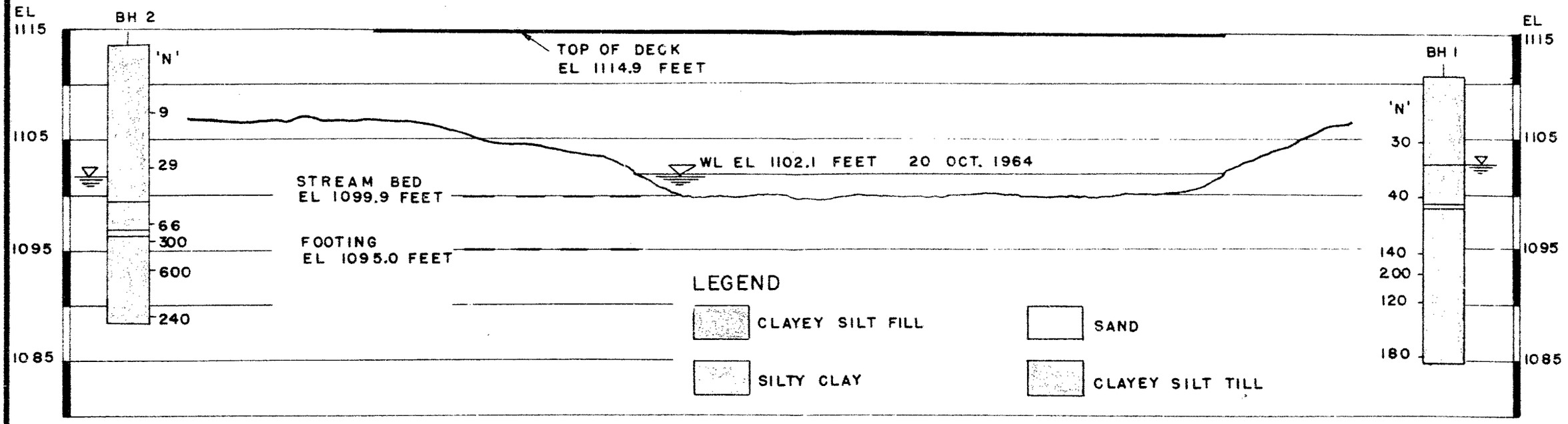
SOIL DESCRIPTION.

COHESIONLESS SOILS :	RD :	COHESIVE SOILS :	C lbs/sq.ft.
Very loose	0 – 15 %	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 10 FEET



NOTE: FIGURES AT BOREHOLES DENOTE
STANDARD PENETRATION RESISTANCE

SUBSURFACE PROFILE
(LOOKING NORTH)

SCALE: 1 INCH TO 10 FEET

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ENCLOSURE No. 2

OUR REFERENCE NO. 4-10-L7

GEOTECHNICAL DATA SHEET FOR BOREHOLE 1

CLIENT: Mr. B. M. Ross
PROJECT: Bridge BR-127
LOCATION: Township of Logan
DATUM ELEVATION: Geodetic, 1114.9 feet

METHOD OF BORING: Washboring
DIAMETER OF BOREHOLE: Bx (3-inch)
DATE: October 17th - 19th, 1964

ENCLOSURE NO. 3

ELEVATION ft.	DEPTH ft.	STRATIFICATION DESCRIPTION	STRATIFICATION SYMBOL	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES N or Advancement of Sampler	PENETRATION RESISTANCE 20 blows per foot 40 60 80 100 / SHEAR STRENGTH lbs/sq ft	CONSISTENCY water content % PL W LL	REMARKS
	0.0	Ground surface							
1114.6	0.5	Topsoil							
		Dark brown damp, firm clayey silt fill		1	SS	30			
1110	8.0	Grey, damp, hard, silty clay		2	SS	40			
	11.5	sand seam							
	11.9	Grey, damp, hard sandy clayey silt (glacial till), some gravel		3	SS	140			
				4	SS	200			
1090				5	SS	120			
1085				6	SS	180			
	26.0	End of borehole							

2" dia. cone

WL El. 1102.6 20th Oct. 1964

Extrapolated 'N' values:
Sa.#3 28/6" 50/6" 30/2"
Sa.#4 52/6" 100/6"
Sa.#5 32/6" 60/6"
Sa.#6 50/6" 90/6"

VERTICAL SCALE: 1 IN. TO 5 FT.

DOMINION SOIL INVESTIGATION LIMITED

MADE: MKF CH'D: JP

OUR REFERENCE NO. 4-10-L7

GEOTECHNICAL DATA SHEET FOR BOREHOLE 2

CLIENT: Mr. B. M. Ross
PROJECT: Bridge BR-127
LOCATION: Township of Logan
DATUM ELEVATION: Geodetic, 1114.9 feet

METHOD OF BORING: Washboring
DIAMETER OF BOREHOLE: Bx (3-inch)
DATE: October 19th and 20th, 1964

ENCLOSURE NO. 4

ELEVATION ft.	DEPTH ft.	STRATIFICATION DESCRIPTION	STRATIFICATION SYMBOL	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES —N— or Advancement of Sampler	PENETRATION RESISTANCE blows per foot 20 40 60 80 100 / SHEAR STRENGTH lbs/sq ft	CONSISTENCY water content % PL W LL	REMARKS
1113.7	0.0	Ground surface							
	0.4	Gravelly sand road fill							
1110		Dark brown, damp, stiff clayey silt fill		1	SS	9			
1105				2	SS	29			
				3	CS				
1100	14.0								
	16.6	sand seam		4	SS	66			
	17.0			5	SS	300			
1095		Grey, damp, hard sandy clayey silt (glacial till), some gravel, cobbles and boulders		6	RC Bxt				
				7	SS		600		
				8	RC Bxt				
1090				9	SS	240			
	25.0	End of borehole							

2" dia. cone

WL
El. 1102.0
20th Oct. 1964

Extrapolated 'N' values:
Sa.#5 100/4"
Sa.#7 100/2"
Sa.#9 66/6"
120/6"

VERTICAL SCALE: 1 IN. TO 5 FT.

DOMINION SOIL INVESTIGATION LIMITED

MADE: MKF CH'D: JP