

65-F-276 M

CHEESE FACTORY BRIDGE

WALLACE TWP

7558 /

BA 2054
25-19

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GODERICH ONTARIO

65-F-276 M

Report on
SOIL INVESTIGATION
for
CHEESE FACTORY BRIDGE
LOT 15, CONCESSIONS II & III
TOWNSHIP OF WALLACE

by
DOMINION SOIL INVESTIGATION LIMITED
369 Queens Avenue
LONDON ONTARIO
Reference No. 5-2-L7
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SUMMARY

The strata consist of road ballast and fill to a depth of about 9 feet, overlying variable glacial till which consists of clayey silt on the east side of the existing bridge and consecutive layers of sandy silt and silty fine sand on the west side of the existing bridge.

It is recommended that the structure should be supported on spread footings at or below El. 1260 using a maximum net soil pressure of 5000 pounds per square foot. The estimated total settlement is less than 1 inch.

Problems connected with excavation and dewatering are discussed.

I INTRODUCTION

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

The existing steel-beam structure, named Cheese Factory Bridge, is located on Lot 15, Concessions 2 and 3 of the Township and has a clear span of 28 feet. The road crosses the Maitland River on a skew of 30 degrees. It is understood that the new structure will be a 35 foot span rigid-frame barrel-arch centred on the existing bridge and the deck level will be raised by about 2 feet to clear the high water level. The requirements of the project were discussed with Mr. K.G. Dunn, 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 new foundations.

II FIELD WORK

Two boreholes were put down to a maximum depth of 22 feet 6 inches during the period March 8th and 9th, 1965, using a diamond drill machine equipped for soil sampling. The holes were advanced by dry boring methods and were lined with Bx casing.

Standard Penetration Tests using a 2" O.D. split-spoon sampler were performed at frequent intervals of depth to determine the relative density or consistency of the soil and to recover representative samples. The results are plotted as 'N' values on the Geotechnical Data Sheet for each borehole and are also given on the Subsurface Profile, Enclosure 2.

Dynamic Cone Penetration Tests were attempted adjacent to each borehole location and only limited penetration was possible due to the presence of boulders in the fill.

One in-situ vane shear test was performed in the clayey silt till stratum encountered in borehole 1. The result is plotted on the Geotechnical Data Sheet as a shear strength value, and is also given on the Subsurface Profile, Enclosure 2.

The locations of the boreholes are shown on the Site Plan, Enclosure 2, and elevations have been referred to a Bench Mark which was established by the client (Low steel of existing bridge, El. 1272.15 feet Geodetic).

III SUBSURFACE CONDITIONS

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

The boreholes revealed the following general ground succession:

	Thickness
(a) Road Ballast	1' - 6"
(b) Fill consisting of brown silty and clayey sand containing gravel and boulders.	7' - 6" to 8' - 6"
(c) Glacial till consisting of grey clayey silt containing embedded fine and medium gravel in borehole 1, and grey sandy silt containing layers or lenses of silty sand in borehole 2. The consistency of the cohesive clayey silt stratum is described as 'very stiff' as estimated from Standard Penetration Test Values ranging from 9 to 54 blows per foot and the relative density of the granular strata are described as 'compact' to 'dense' as estimated from Standard Penetration Test Values ranging from 15 to 35 blows per foot.	Penetrated 13' - 6" in borehole 2

IV GROUNDWATER CONDITIONS

The water levels recorded in the boreholes after the drilling was completed were at El. 1266.5 in borehole 1 and at El. 1268.4 in borehole 2. The river was frozen over at the time of the field work and the ice level was recorded at El. 1269.5. It can be assumed, therefore that the ground water table will follow the fluctuation of the water level in the river.

V

DISCUSSION

Natural ground was encountered at about El. 1264 in each borehole and the substrata consist of glacial till deposits of clayey silt and sandy silt containing layers or lenses of silty sand.

The bed of the river extends to El. 1265.4 and allowing for scour and future deepening of the river it is recommended that the footings should bear at or below El. 1260. This level lies within the stratum of very stiff clayey silt at borehole 1 location and in the stratum of dense sandy silt at borehole 2 location, and on the basis of the borehole results a maximum net soil pressure of 5000 pounds per square foot would be appropriate for the design of footings. It is estimated that total settlement will not exceed 1 inch and will occur shortly after application of the load. No appreciable differential settlement is anticipated and furthermore the footings will have a factor of safety of at least 3 against shear failure.

The adhesion between the footings and the clay at borehole 1 location can be assumed as being 2500 pounds per square foot and the coefficient of friction between the footings and the sandy silt at borehole 2 location may be taken as 0.35. The factor of safety against horizontal sliding of the abutments should be at least 1.5.

It is anticipated that seepage into the excavation from the clay silt stratum at borehole 1 location will easily be controlled by pumping, but at borehole 2 location it may be necessary to seal off the sand layers by means of close timber sheeting to prevent an excessive flow of water and soil into the excavation from these strata. Also to prevent 'boiling' in the bottom of the excavation due to the hydrostatic pressure in the underlying strata, the sheeting should be driven to a depth below the footing elevation equal to the head of water above the footing elevation. Should it prove too difficult to drive timber sheeting to the required depth, steel sheet piling should be employed.

Yours very truly,

DOMINION SOIL INVESTIGATION LIMITED



CA:sg

C.J.W. Atkinson

C.J.W. Atkinson, M. Sc., P. Eng.,
Project Engineer.

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						
0	> 8"	3"	3/4"	4.76mm	2.0	0.42	0.074	0.002	>
U.S. Standard Sieve Size:		No. 4		No. 10	No. 40	No. 200	NO SIZE LIMIT		

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.

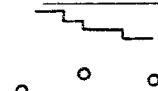
DYNAMIC PENETRATION RESISTANCE : to drive a 2" ϕ , 60° cone attached to the end of the drilling rods into the ground, expressed in blows per foot.

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
LL % Liquid limit
PL % Plastic limit
PI % Plasticity index
LI Liquidity index

γ Natural bulk density (unit weight)
e Void ratio
RD Relative density
C_v Coeff. of consolidation
m_v Coeff. of volume compressibility

k Coeff. of permeability
C Shear strength
 ϕ Angle of int. friction
C' Cohesion
 ϕ' Angle of int. friction

in terms of total stress
in terms of effective stress

UNDRAINED SHEAR STRENGTH.

- DERIVED FROM -

TRIAXIAL COMPRESSION TEST

LABORATORY

FIELD

POCKET PENETROMETER TEST

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 :

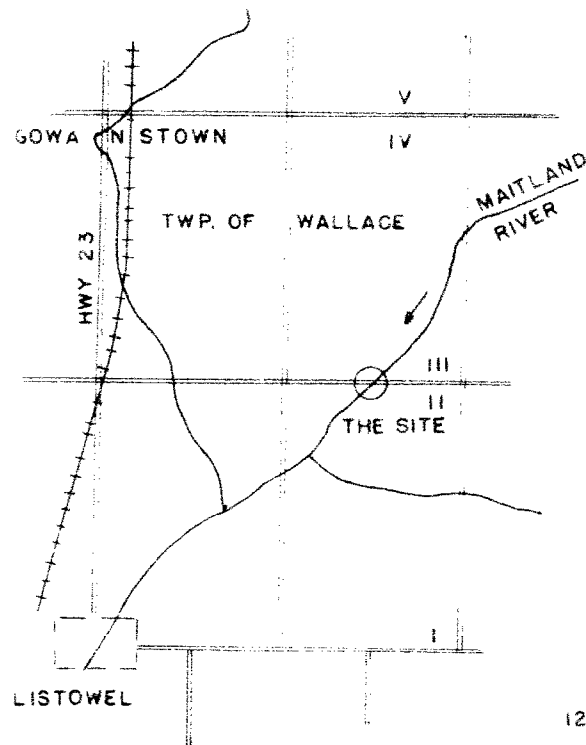
RD :

COHESIVE SOILS :

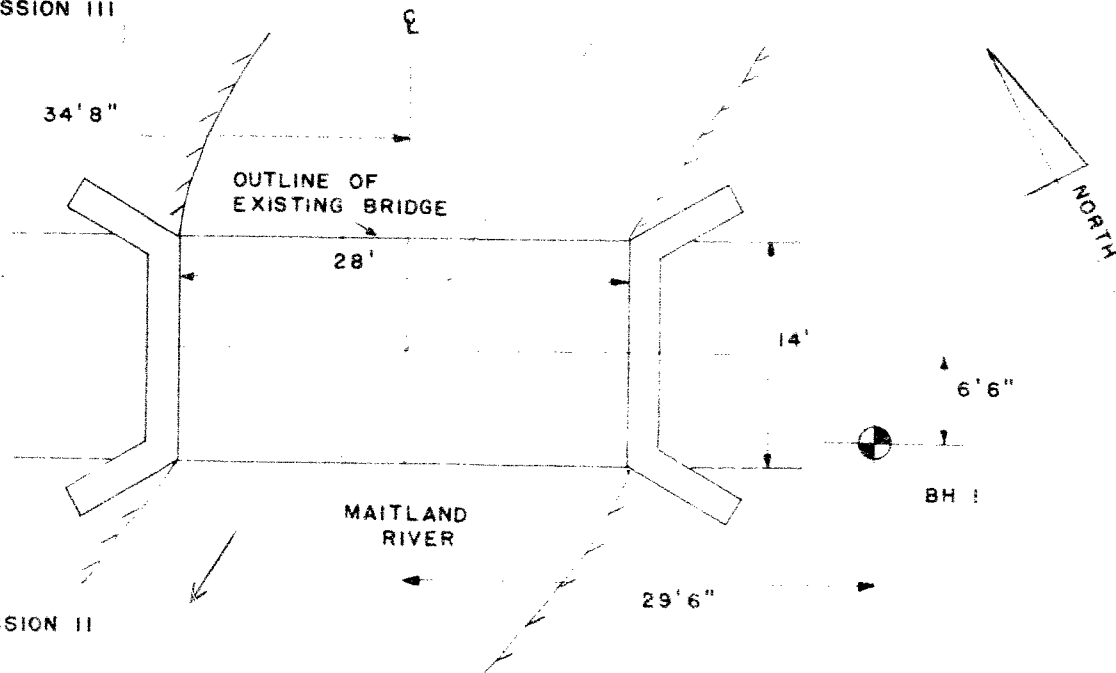
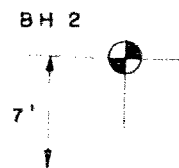
C lbs/sq.ft.

Very loose 0 - 15 %
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



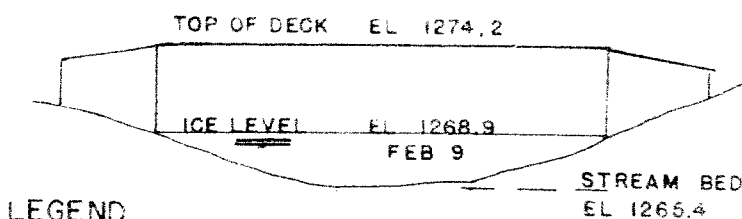
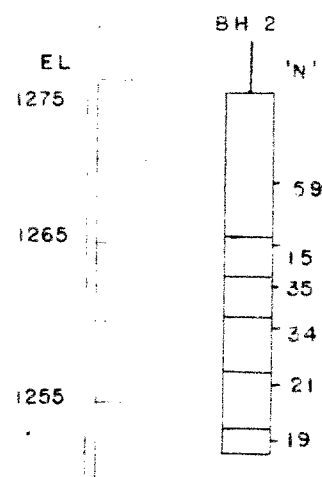
LOT 15 CONCESSION III



LOT 15 CONCESSION II

LOCATION OF BOREHOLES

SCALE: 1 INCH TO 10 FEET

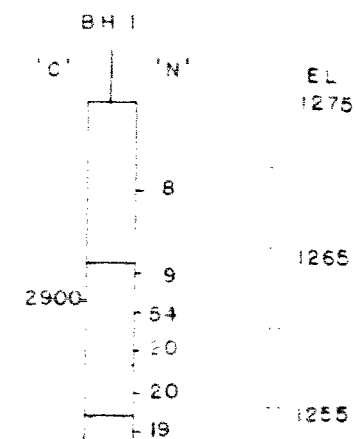


LEGEND

- CLAYEY AND SILTY SAND FILL
- CLAYEY SILT TILL
- SANDY SILT TILL
- SILTY FINE SAND

SUBSURFACE PROFILE

SCALE: 1 INCH TO 10 FEET



'N' DENOTES STANDARD PENETRATION TEST RESULTS (BLOWS/FOOT)

'C' DENOTES IN-SITU VANE SHEAR STRENGTHS (P.S.F.)

GEOTECHNICAL DATA SHEET FOR BOREHOLES 1 & 2

OUR REFERENCE NO 5-2-17

CLIENT: E.M. Ross
PROJECT: Proposed Bridge
LOCATION: Wallace Township, nr. Listowel
DATUM ELEVATION: 1272.15 feet Geodetic

METHOD OF BORING: Dry boring
DIAMETER OF BOREHOLE: 3x (3-inch)
DATE: March 8th & 9th, 1965

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 Advancement of Sampler	20	40	60	80	100	PL	W	LI	
1274.0	0.0	Ground Surface													
	1.5	Ballast													
70		Fill consisting of brown organic silty sand containing gravel and boulders		1	SS	8									
65															
10.0		Very stiff grey clayey silt with embedded fine and medium gravel (Till)		2	SS	9									
60				3	SS	54									
				4	SS	20									
55	19.5	Compact grey silty fine sand with fine gravel		5	SS	20									
21.5		End of Borehole		6	SS	19									
50															
1274.4	0.0	Ground Surface													
	1.5	Ballast													
70		Fill consisting of brown clayey sand containing gravel and boulders		1	SS	59									
65															
9.0		Compact grey sandy silt Till		2	SS	15									
60	14.0	Dense grey silty sand		3	SS	35									
		Dense grey sandy silt Till		4	SS	34									
55	17.5	Compact grey fine and medium sand		5	SS	21									
21.0		Sandy silt Till		6	SS	19									
22.5		End of Borehole													
50															

Borehole 1

W.L.
El. 1266.5
March 8th

St 4.0

Borehole 2

W.L.
El. 1268.4
March 9th