

BRIDGE,

LOTS 20/21 CON. 2

GREY TWP.

40P14 - 11



DOMINION SOIL INVESTIGATION LIMITED

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B. M. ROSS AND ASSOCIATES LTD.,

CONSULTING ENGINEERS

GODERICH

ONTARIO.

40 P/4-11

GEOCREs No.

Report on
SOIL INVESTIGATION
for
BRIDGE BR-311
LOTS 20/21 CONCESSION 2
TOWNSHIP OF GREY.

by

DOMINION SOIL INVESTIGATION LIMITED,
1220 Trafalgar Street,
LONDON, ONTARIO.

Reference: 72-3-L8

JULY 1972



BRIDGE
SITE

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SUMMARY

The investigation has revealed that the natural soil profile at and below the footing grade consists of 'compact' to 'dense' sand strata, which contain silt and gravel sizes in different quantities at the two test locations.

It is recommended that spread footings be designed using a maximum allowable soil pressure of 5000 p.s.f., and total settlement of the structure is estimated to be 1-inch or less.

The use of driven wood or steel-tube piles is also discussed in the report as an alternative type of foundation.

I INTRODUCTION

In accordance with a letter of authorization dated March 24, 1972, from B. M. Ross & Associates Limited, Consulting Engineers, a soil investigation has been carried out in the Township of Grey, where it is proposed to replace an existing road bridge with a new structure.

The existing structure is located on the Lot 20/21 Sideroad in Concession 2 of the Township, where the road crosses a tributary of the Little Maitland River.

It is understood that the proposed structure is a 50 foot span concrete rigid frame bridge with the north abutment located approximately 75 feet to the north of the north abutment of the existing bridge. 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 site, and to determine the relevant soil properties for the design and construction of the new foundations.

II FIELD WORK

The field work, consisting of 2 boreholes accompanied by 2 dynamic cone penetration tests, was carried out on April 13, 1972, at the locations shown on Enclosure 1. The holes were advanced to the sampling depths by washboring methods, using Bx size casing to line the hole.

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 dynamic cone penetration tests were performed adjacent to the borehole locations to obtain an indication of soil density and strata changes with depth. The energy used to drive the cone was the same as was used for the standard penetration tests.

The field work was supervised by a soils engineer, who also determined the ground surface elevations. These were referred to the low steel of the existing bridge, which was taken as Geodetic El. 1125.63 feet.

III SUBSURFACE CONDITIONS

Detailed descriptions of the strata, which were encountered in each borehole, are given on the borehole logs comprising Enclosures 2 and 3, and a general picture of the soil stratigraphy is presented in the form of a Subsurface Profile on Enclosure 1. The following notes are intended only to amplify this data.

Both boreholes encountered surface layers of fill, which extend to a depth of 5.8 feet and consist of silty sand with some gravel and organics. The fill is associated with the construction of the approach to the existing bridge.

Immediately below the fill borehole 1 encountered wood, which extends to a depth of 8 feet.

The natural soil profile consists of sand deposits which took the form of silty fine to coarse sand with a trace of gravel at borehole 1 location, and silty fine sand at borehole 2 location. Both boreholes were terminated in the sand at a depth of 21.5 feet. The relative density of the sand is described as 'compact' to 'dense' based on 'N' values ranging from 15 to 38 blows per foot. Grading analyses of representative samples of the sand stratum are shown as grain size distribution curves on Enclosure No. 4.

IV GROUNDWATER CONDITIONS

Equilibrium water levels were observed at El. 1124.6 and El. 1124.5 in boreholes 1 and 2 respectively. The water level in the adjacent creek was at El. 1124.9 at the time the field work was carried out.

V DISCUSSION AND RECOMMENDATIONS

Spread Footing Foundations

The existing creek bed extends down to El. 1117.9, therefore normal spread footing foundations would require a founding level at or below El. 1114 to provide sufficient soil cover for protection against frost action.

On the basis of the borehole results a maximum allowable soil pressure of 5000 p.s.f. is appropriate for the design of footings at or below El. 1114, and this soil pressure incorporates a factor of safety of at least 3 against shear failure of the underlying soil.

Total settlement of the footings is estimated to be 1-inch, and in view of the uniform soil density encountered in the two boreholes, no appreciable differential settlement is anticipated.

The coefficient of friction between the footings and the underlying sand material may be taken as 0.45, and the factor of safety against horizontal sliding of the abutment must be at least 1.5.

A major problem in the construction of the footings will be to control the groundwater and prevent sloughing-in of the sides of the excavations or disturbance of the sub-grade due to bottom heave. This can be achieved by carrying out the excavation inside rigid sheeting which should be driven to a depth below the bottom of the excavation equal to the height of the groundwater table above the footing grade. The sheeting may afterwards may be left in place as a positive means of scour protection. An alternative method of construction would be to use well-pointing to lower the groundwater table below the footing grade during the construction period.

Piled Foundations

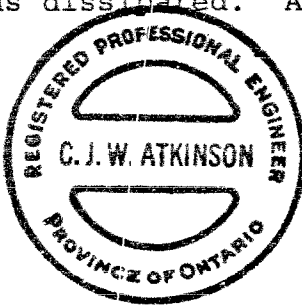
The pile foundation is an alternative to the use of spread footing foundations with the problem of minimising disturbance to the footing grade.

Driven wood or steel tube piles would appear to be the most suitable type to use and it is anticipated that adequate refusal would be

obtained if wood piles were driven to El. 1190 and steel-tube piles to El. 1180.


Nominal 12-inch diameter wood piles may be assumed to develop a working load of 20 tons and 10.75-inch diameter concrete-filled steel-tube piles would develop a working load of 40 tons.

The foregoing estimates of length and bearing capacity of piles are only theoretical predictions. In practice, when piles are driven through submerged sands there appears to be a decrease in resistance and sometimes driving appears to continue indefinitely without meeting adequate set. This is due to a temporary quick condition at the tip of the pile and pile lengths available may apparently be insufficient to reach satisfactory dynamic resistance. Actually there is no relation between driving resistance and static load in such soils, and if driving is stopped when adequate penetration is secured in the sand, computed from a static formula, the sand should settle into position around the pile as soon as the quick condition induced by the blows has dissipated. A load test is advisable to prove this condition.



Yours very truly,

DOMINION SOIL INVESTIGATION LIMITED,


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

CJWA:lg

APPENDIX 'A'

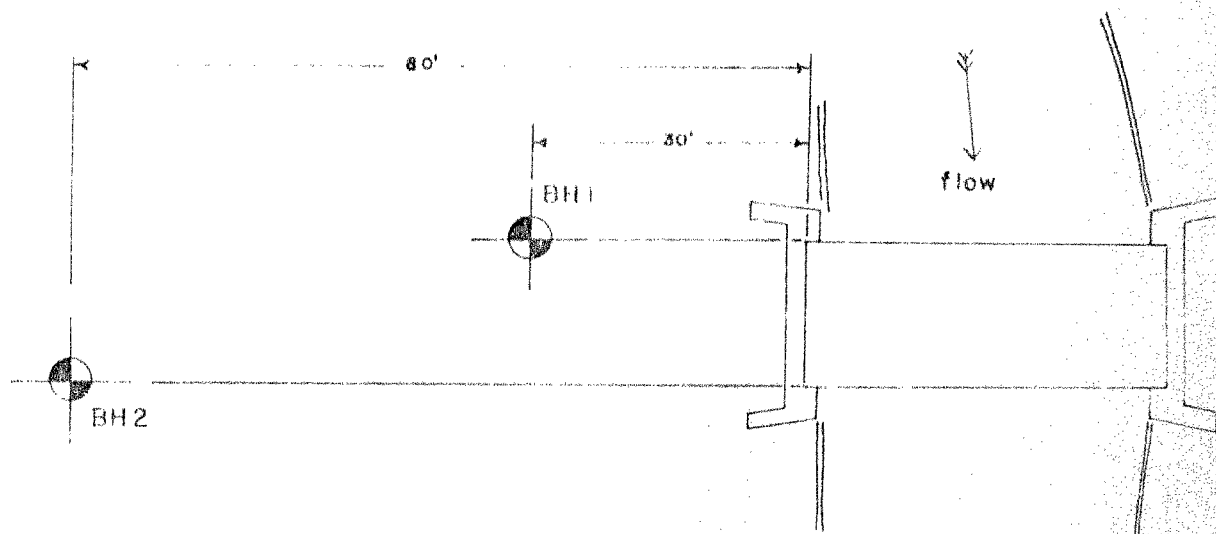
THE STANDARD PENETRATION TEST.

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:-

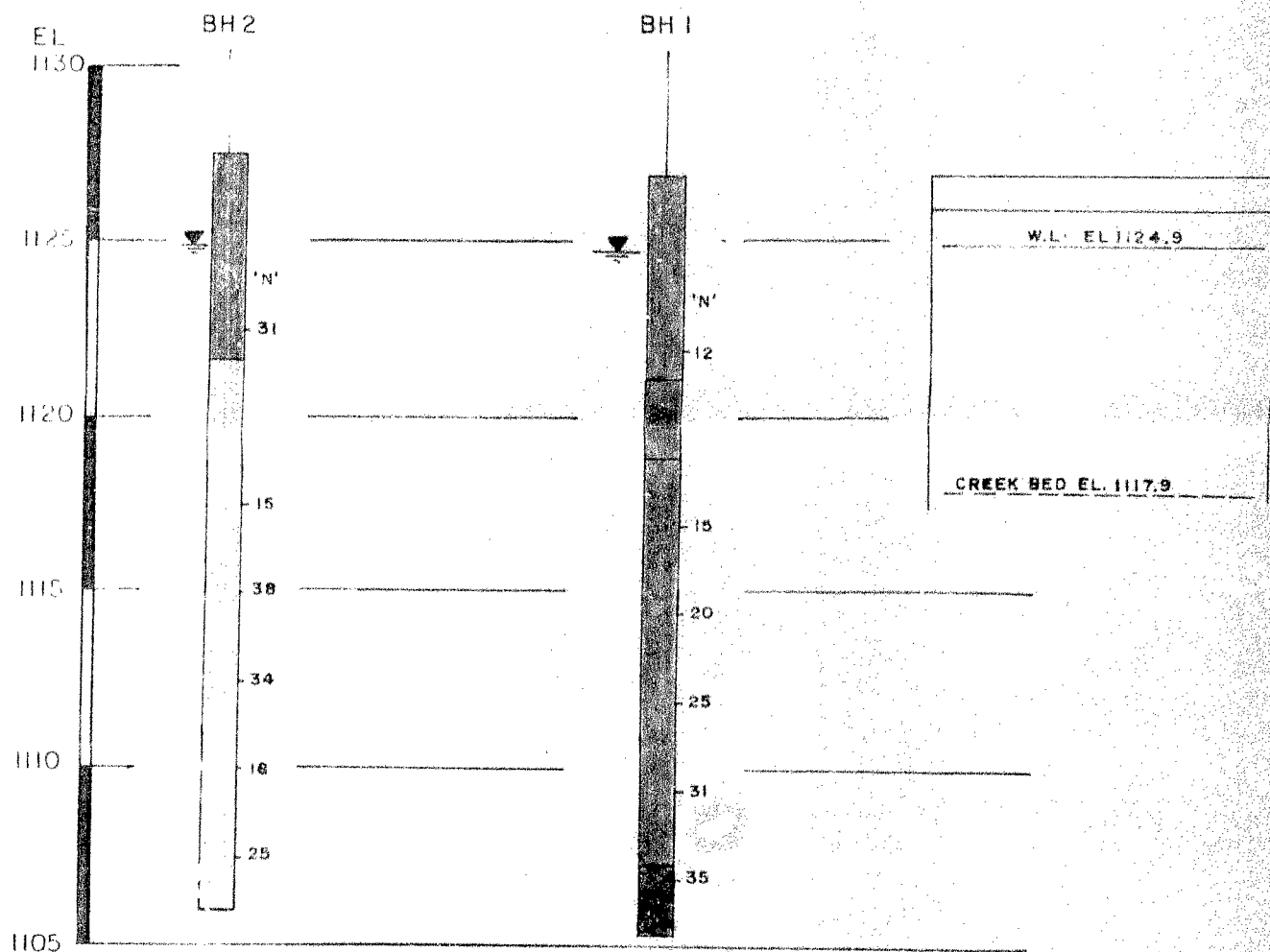
Values of 'N'	Density
Less than 10	Loose
Between 10 and 30	Compact
Between 30 and 50	Dense
Greater than 50	Very dense



LOCATION OF BOREHOLES
SCALE 1 INCH = 20 FEET

LEGEND

- SILTY SAND FILL
- WOOD, SOME SAND
- COMPACT TO DENSE SILTY FINE SAND
- COMPACT TO DENSE SILTY SAND, TRACE OF GRAVEL
- DENSE FINE SAND, SOME GRAVEL, TRACE OF SILT



SUBSURFACE PROFILE
VERT. SCALE 1" = 5'

40 P14-11
GEOCRETS No.

LOG OF BOREHOLE.....1.....

Our Reference No. 72-3-L8

Enclosure No. 2

CLIENT: B.M. ROSS & ASSOCIATES LTD.,
PROJECT: PROPOSED BRIDGE, BR-311,
LOCATION: GREY TOWNSHIP.
DATUM ELEVATION: low steel, El. 1125.63 feet

DRILLING DATA

Method: Washboring
Diameter: 2½ inch
Date: April 13, 1972.

SUBSURFACE PROFILE				SAMPLES			PENETRATION RESISTANCE					WATER CONTENT %			REMARKS	
ELEVATION Ft.	DEPTH Ft.	DESCRIPTION	SYMBOL	GROUND WATER	NUMBER	TYPE	N' Blows / Foot	Blows / Foot					PLASTIC LIMIT	NATURAL		LIQUID LIMIT
								20	40	60	80	100				
								UNDRAINED SHEAR STRENGTH								
+ FIELD VANE TEST					• COMPRESSION TEST											
1126.8		Ground Surface														
1125	0.0	Brown silty sand some gravel & organics. (FILL)														
1120	5.8	Wood, some sand.			1	SS	12									
	8.0	Compact to dense grey silty sand, trace of gravel.			2	SS	15									
1115					3	SS	20									
1110					4	SS	25									
					5	SS	31									
1105	18.5	Dense grey fine sand, some gravel trace of silt. End of Borehole			6	SS	35									
1100	21.8															

VERTICAL SCALE: 1 inch to 5 feet

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MADE:

CHECKED:

LOG OF BOREHOLE2.....

Our Reference No. 72-3-L8

Enclosure No. 3

CLIENT: B.M. ROSS & ASSOCIATES LTD.,
PROJECT: PROPOSED BRIDGE, BR-311
LOCATION: GREY TOWNSHIP.
DATUM ELEVATION: low steel, El. 1125.63 feet.

DRILLING DATA

Method: Washboring
Diameter: 2½ inch
Date: April 13, 1972.

SUBSURFACE PROFILE				SAMPLES			PENETRATION RESISTANCE					WATER CONTENT %			REMARKS			
ELEVATION Ft.	DEPTH Ft.	DESCRIPTION	SYMBOL	GROUND WATER	NUMBER	TYPE	'N' Blows / Foot	Blows / Foot					PLASTIC LIMIT	NATURAL		LIQUID LIMIT		
								20	40	60	80	100	UNDRAINED SHEAR STRENGTH + FIELD VANE TEST	lb/s/sq. ft. COMPRESSION TEST		W _p	W	W _L
1127.2	0.0	GROUND SURFACE																
1125		Brown silty sand, some gravel & organics. (FILL)																
1120	5.8	Compact to dense brown silty fine sand.			1	SS	31											
1115					2	SS	15											
					3	SS	38											
1110					4	SS	34											
					5	SS	18											
1105	21.5				6	SS	25											
		End of Borehole																

VERTICAL SCALE: 1 inch to 5 feet

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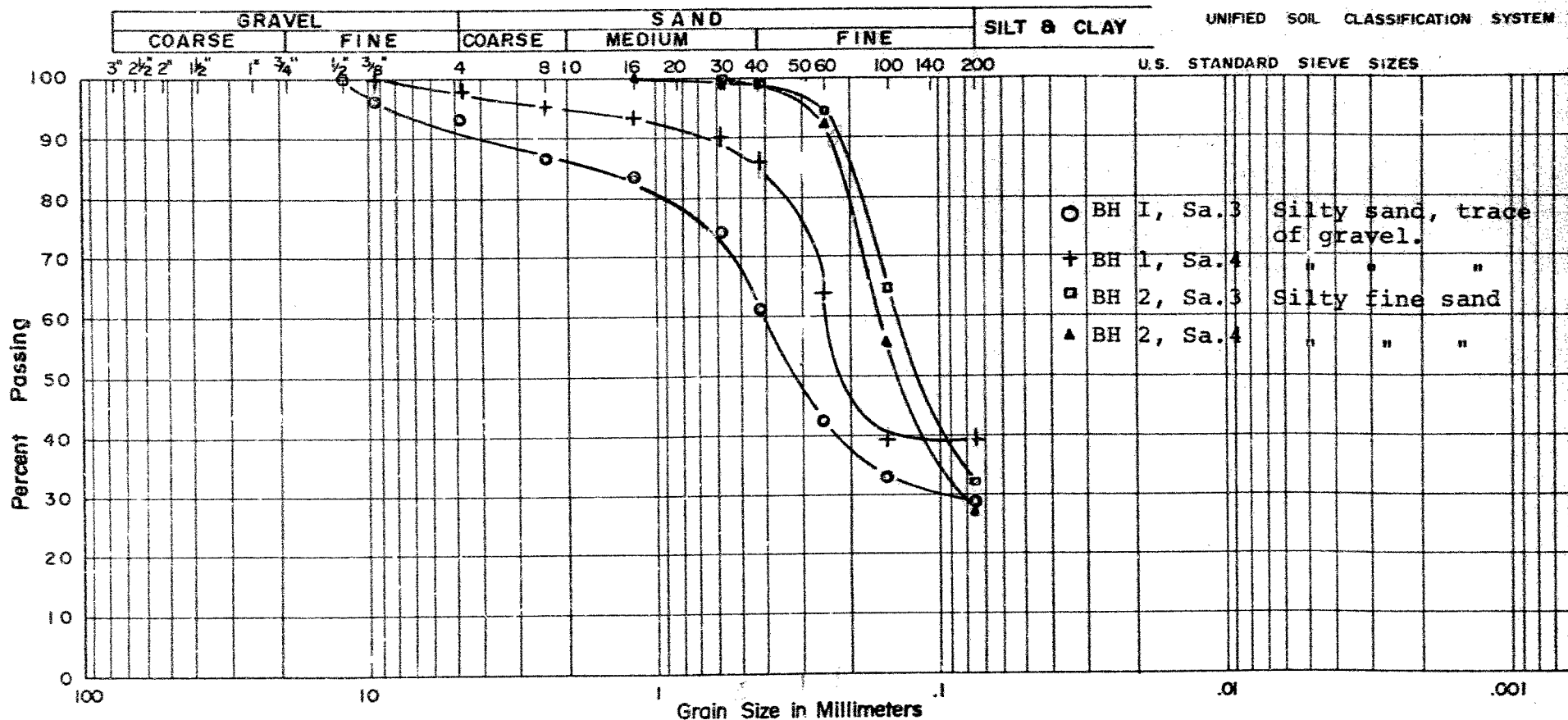
MADE:

CHECKED:

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GRAIN SIZE DISTRIBUTION

72-3-L8
OUR REFERENCE N^o _____



PROJECT: _____
 LOCATION: _____
 BOREHOLE N^o: _____
 SAMPLE N^o: _____
 DEPTH: _____
 ELEVATION: _____

COEFFICIENT OF UNIFORMITY: _____
 COEFFICIENT OF CURVATURE: _____

Classification of Sample and Group Symbol:

PLASTIC PROPERTIES

LIQUID LIMIT	% =
PLASTIC LIMIT	% =
PLASTICITY INDEX	% =
MOISTURE CONTENT	% =